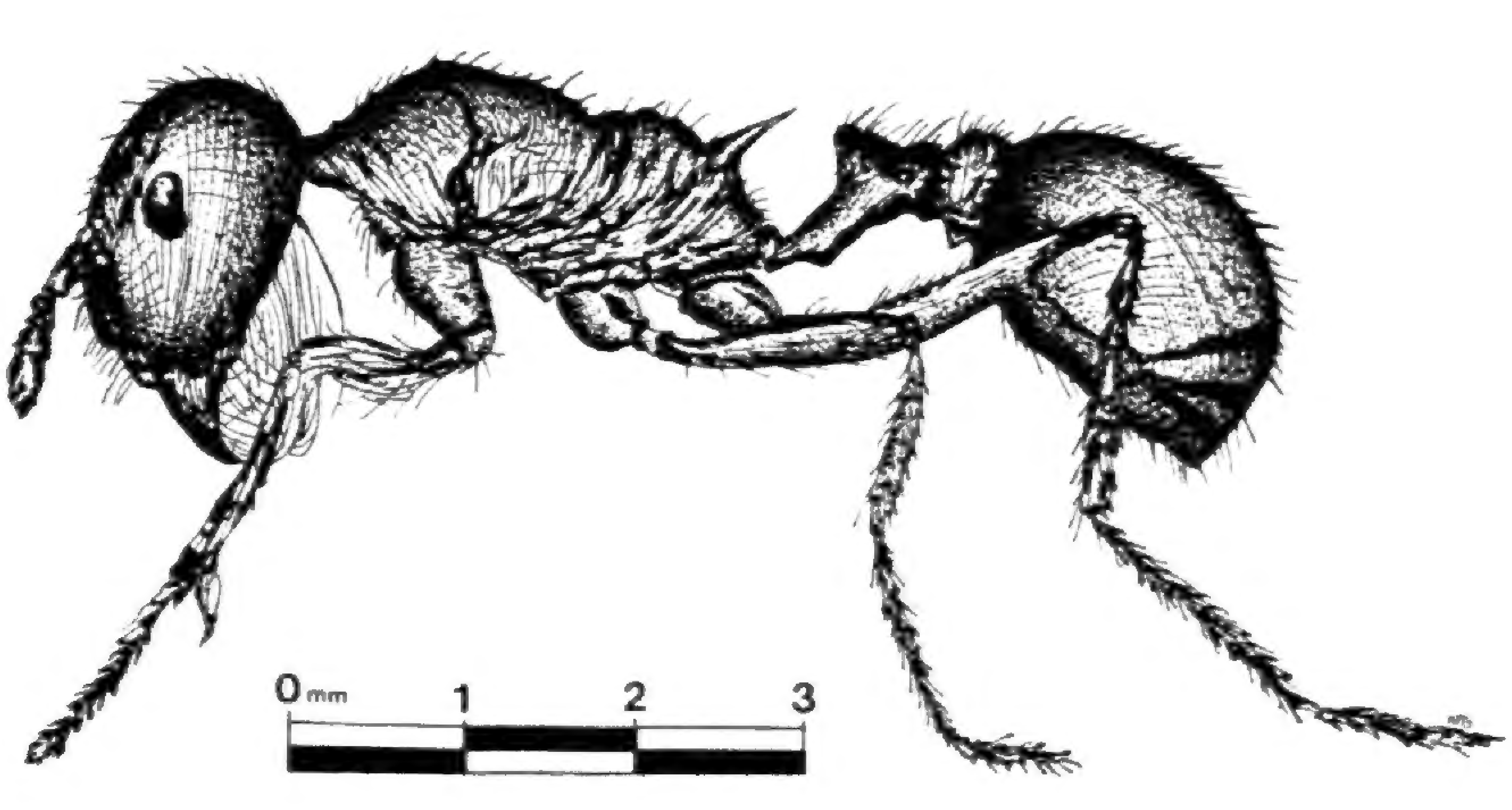
JOURNAL OF ETHNOBIOLOGY

Reconstructing Plateau Socioeconomies from Archaeological Data -Lepofsky *et al.*

Samburu Pastoralist Medicine and Healing -Fratkin

Non-Domesticated Foods in Thai Markets -Moreno-Black *et al.*

"Hallucinogenic" Ant Ingestion in Native California -Groark



Pogonomyrmex californicus

The *Journal of Ethnobiology* is published semi-annually. Manuscripts for publication, information for the "News and Comments" and book review sections should be sent to the appropriate editors as listed on the inside back cover of this issue.

ISSN 0278-0771

FRONT COVER The new *Journal of Ethnobiology* cover will feature a figure or photograph from one of the articles in that issue. The former cover piece will remain as the *Journal's* logo. It represents a split-twig figurine, made of squawbush (*Rhus trilobata*) or willow (*Salix*). Split-twig figurines appeared as a cultural trait in the American Southwest about 2000 B.C. among Archaic hunting and gathering populations in the Grand Canyon area of Arizona. They have also been found in Utah, Nevada, and California, and are thought to have had some magical/religious significance concerning hunting practices. For more information on these figurines see an *American Antiquity* article by Alan R. Schroedl (1977, Vol. 42(2):254-265). **COVER ILLUSTRATION:** *Pogonomyrmex californicus*, the venomous California harvester ant, ingested live by indigenous groups in southern and southcentral California to induce vision-producing altered states of consciousness.

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ETHNOBIOTICA

Time for some changes. The "new look" involves a brighter cover, glossy white with a touch of color, the traditional logo (see inside our front cover for the story behind it) is reduced to an icon freeing space to highlight the current contents, including a selected graphic image, a rather threatening and out-sized ant. See Groark's lead article for the ethnographic details. It's a fascinating story. Another new feature: a photo and bio section highlighting the authors published in the current issue. I'm trying to shake a bit of the dust off the Journal.

Volume 16 marks the mid-point of our second decade. I had hoped to have an index included but that must wait for the next issue. This index will bring us up to date since the last, which appeared in Volume 5, Number 2. I want to thank my editorial assistant, Jennifer Sepez for an excellent job (and the University of Washington for chipping in toward her wages). Jennifer will prepare the index on top of handling correspondence and general editorial housekeeping.

We have revised the "Guidelines for Authors," last printed in Volume 10, Number 1, in the era before computers and electronic mail had become commonplace. Note the new rules: send your manuscripts on diskette as well as hard copy. This will facilitate the review process, as I will be able to circulate drafts via e-mail in many cases.

The editorial board has been expanded and strengthened to better represent the range and complexity of topics we treat here. I would like to welcome **Scott Atran, Nina Etkin, Chris Healey, Brien Meilleur, and Gary Nabhan** to the board. I hope they will help me to speed the review process and assure the quality of the articles we publish.

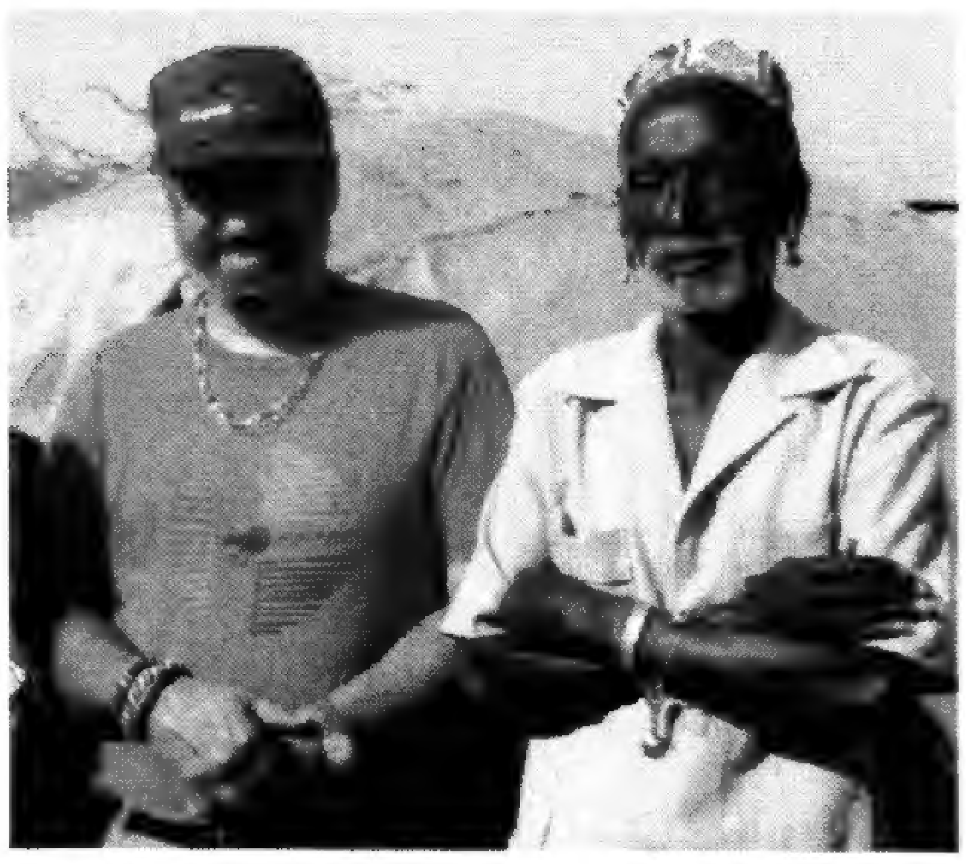
Once again our contents span the breadth of ethnobiology: hallucinogenic ants ingested by California Indians in a rite of passage; an analysis of macrobotanical remains from a prehistoric village in the Fraser Canyon of British Columbia; a comprehensive review of the medicinal ethnobotany of the Samburu, East African pastoralists; and a report on the role of wild plant and animal resources in northeastern Thai markets. "Notes and Comments" is back and Gary Martin, feature editor, urges you to consider contributing some newsworthy item or provocative comment.

Yours,

Eugene Hunn

From A. Miller, *The Wall Paintings of Teotihuacán* (1973). Drawing by Felipe Dávalos G.

AUTHORS IN THIS ISSUE



ELLIOT FRATKIN
Elliot Fratkin teaches anthropology at Smith College. He has written extensively about East African pastoralist peoples and is the author of *Surviving Drought and Development: Ariaal Rendille Pastoralists of Kenya* (Westview Press) and co-editor of *African Pastoralist Systems* (Lynne Rienner Press). Dr. Fratkin is currently researching health and nutrition effects of pastoral sedentarization with his physician partner Martha Nathan.

KEVIN P. GROARK
Kevin Groark is a doctoral candidate in sociocultural anthropology at the University of California, Los Angeles. He received his B.A. from UC Berkeley in 1992 and his M.A. from UCLA in 1996. His research interests focus on Mesoamerican and Amazonian ethnography, particularly medical ethnobotany and ethnomedicine. The present article derives from his ongoing research with J.P. Harrington's Kitanemuk fieldnotes, and is part of a book-length monograph on the ethnography of the Kitanemuk Indians of south-central California.

DANA LEPOFSKY, KARLA D. KUSMER, BRIAN HAYDEN, and KENNETH P. LERTZMAN
Dana Lepofsky is an Assistant Professor of Archaeology at Simon Fraser University. Her research in the Pacific Northwest and Polynesia examines the relationships of humans to their environments and the social relations of food production. Karla Kusmer is a consulting archaeologist specializing in zooarchaeology of the Pacific Northwest. Brian Hayden is a Professor of Archaeology at Simon Fraser University. His long-term research includes investigating prehistoric social and economic organization on the Plateau. Ken Lertzman is an Assistant Professor in the School of Resource and Environmental Management at Simon Fraser University. He is interested in forest ecosystem dynamics, landscape ecology, and conservation.

GERALDINE MORENO-BLACK, WATANA AKANAN, PRAPIMPORN SOMNASANG, SOMPONG THAMATHAWAN, AND PAUL BROZVOSKY

Geraldine Moreno-Black, Associate Professor of Anthropology of the University of Oregon, researches human nutrition and human ecology in Southeast Asia and Latin America. Her work in Thailand focused on the use of non-domesticated plants and animals in the diet and as a source of income. Her interests also include Community Supported Agriculture (CSA) as a social movement involving environmental activism and conservation; women's issues in nutrition and health, Latina health issues, and Pacific-Rim cuisine. **Prapimporn Somnasang**, Associate Professor in the department of Community Medicine at Khon Kaen University, is a nutritionist currently working on her doctorate in nutritional anthropology. She has done research on micronutrients, nutritional status of women and children in northeastern Thailand and the consumption of wild food. She is the recipient of the 1994 Margaret Macnamara Award. **Watana Akanan** (not pictured), at the time of the project, was on the faculty of the Mathayom Wapi Pathum School. **Paul Brozvovsky** (not pictured), Assistant Director of Institutional Research at Virginia Polytechnic Institute and State University, specializes in research design and analysis. **Sompong Thamathawan** (not pictured), Associate Professor in the School of Biology, Institute of Science at Suranaree University of Technology in Nakornajasima, Thailand is a systematic Botanist.

Journal of Ethnobiology 16(1):1–29 Summer 1996

RITUAL AND THERAPEUTIC USE OF "HALLUCINOGENIC" HARVESTER ANTS (*POGONOMYRMEX*) IN NATIVE SOUTH-CENTRAL CALIFORNIA

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ABSTRACT.—Red harvester ants of the genus *Pogonomyrmex* played a central role as vision-inducing agents in the religious and medical systems of many indigenous groups in southern and south-central California. The ants were ingested alive in massive quantities in order to induce prolonged catatonic states, during which hallucinogenic visions were reported to manifest. They also played an important role in both curative and preventative medicine, treating a diverse body of natural and supernatural ailments. In this article I present an ethnographic and toxicological overview of the ritual and therapeutic use of red ants, bringing together both published and unpublished accounts in an attempt to reconstruct this poorly-known facet of indigenous California culture. The data presented in this paper strongly suggest that, through either direct or indirect action on the central nervous system, massive quantities of *Pogonomyrmex* venom are capable of producing highly altered metabolic states during which hallucinatory visions are apt to manifest. This topic is of considerable interest, as it is the first well-documented ethnographic example of an hallucinogenic agent of insect origin.

RESUMEN.—Las hormigas granívoras rojas del género *Pogonomyrmex* jugaron un papel central como agentes para inducir visiones en los sistemas religiosos y médicos de varios grupos indígenas en el sur y centro-sur de California. Las hormigas vivas eran ingeridas en cantidades masivas para inducir estados catatónicos prolongados, durante los cuales se reportaba manifestarse visiones alucinógenas. Jugaban también un papel importante en la medicina curativa y preventiva, empleándose en el tratamiento de diversas aflicciones naturales y sobrenaturales. En este artículo presento una reseña etnográfica y toxicológica del uso ritual y terapéutico de las hormigas rojas, reuniendo informes publicados e inéditos en un intento de reconstruir esta faceta poco conocida de la cultura indígena de California. Los datos presentados en este trabajo sugieren fuertemente que las cantidades masivas de veneno de *Pogonomyrmex* son capaces de producir, por medio de su efecto directo o indirecto sobre el sistema nervioso central, estados metabólicos altamente alterados durante los cuales tienden a manifestarse visiones alucinatorias. Este tópico es de interés considerable, puesto que es el primer ejemplo etnográfico bien documentado de un agente alucinógeno derivado de un insecto.

RÉSUMÉ.—Les fourmis moissonneuses rousses du genre Pogonomyrmex ont joué un très grand rôle en tant qu'agents hallucinatoires dans la vie religieuse et la médecine de plusieurs groupes autochtones du Sud et du centre-Sud de la Californie. Les fourmis étaient ingérées vivantes en quantité considérable afin de provoquer des états prolongés de catatonie durant lesquels des visions hallucinatoires se seraient produites. Elles ont aussi joué un rôle dans les traitements curatifs et préventifs visant à soigner un ensemble de maux d'origine naturelle et surnaturelle. Dans cet article, je présente une vue d'ensemble ethnographique et toxicologique des usages rituels et thérapeutiques des fourmis rousses à partir de diverses descriptions, publiées et non publiées, dans une tentative de reconstruction de cet aspect mal connu de la culture autochtone de la Californie. Les données présentées dans cet article suggèrent fortement que par une action directe ou indirecte sur le système nerveux central, des doses massives de venin de Pogonomyrmex peuvent provoquer de très grands changements métaboliques créant des états propices à la production de visions hallucinatoires. L'intérêt de ce sujet est considérable car il s'agit là du premier exemple ethnographique bien documenté d'un agent hallucinatoire qui provient d'un insecte.

INTRODUCTION

Dosis sola facit venenum (Only the dose makes the poison)
—Paracelsus, 1564

The ethnographic literature on southern California contains many references to the central importance of hallucinogenic plants in curing, shamanism, and the acquisition of supernatural power. *Toloache* (*Datura wrightii* Regel) and tobacco (*Nicotiana attenuata* Torr., *N. bigelovii* (Torr.) Wats) have received the most attention in this regard, and are considered to have been the primary vehicles for establishing personal contact with the supernatural. Over the last few decades, several brief yet provocative mentions have been made regarding the ritual and medicinal use of "hallucinogenic" red ants in south-central California, but to date little has been written on the subject (cf. Blackburn 1976; Sutton 1988; Walker and Hudson 1993).

California anthropologists first became aware of the significance of red ants in the religious/visionary complex of south-central California with the publication of a brief report entitled, *A Query Regarding the Possible Hallucinogenic Effects of Ant Ingestion in South-Central California* (Blackburn 1976). In this article, a short account of Kitanemuk ant eating culled from the unpublished fieldnotes of John Peabody Harrington was presented along with a published Tubatulabal account, followed by a cursory examination of possible biochemical bases of psychoactivity. Few conclusions were reached, and even today the question of the hallucinogenic effects of red ant ingestion remains largely unexamined.

The author's recent analysis of John Peabody Harrington's 1916-1917 "Fort Tejón" Kitanemuk fieldnotes has brought to light the most detailed ethnographic account of medicinal and ritual red ant ingestion known. The discovery of this previously unpublished account prompted a review of the ethnographic literature on southern California, as well as a survey of relevant biological and toxicological literature in hopes of shedding more light on this wide-spread aboriginal tradition of "myrmecophagy."

In this article I present an overview of the ritual and therapeutic use of red ants in south-central California, bringing together both published and unpublished accounts in an attempt to reconstruct this poorly-known facet of indigenous California culture. A total of 17 indigenous Californian ethnic groups were found to have used red ants as a ritual intoxicant, as a medicine, or both. I balance the ethnographic overview with a detailed discussion of *Pogonomyrmex* biology and toxicology, suggesting possible empirical bases for the reported psychoactive effects generated by Harvester ant ingestion.

IDENTIFICATION, DISTRIBUTION, AND BIOCHEMISTRY

The taxonomic status of the red ant species used in aboriginal California is uncertain. All ethnographic accounts describe them merely as "large red ants"—the sole exception being a Tubatulabal account which refers to "yellow ants" (Voegelin 1938:60). The accounts uniformly emphasize their large size, the fact that they build mounded nests, and the excruciating pain of their sting. It has been suggested by several researchers that the species in question may have been the California harvester ant, *Pogonomyrmex californicus* (Hudson 1979:56; Walker and Hudson 1993:59), or the yellow honey ant, *Myrmecocystus testaceus* (Blackburn 1976:80). Unfortunately, no voucher specimens were collected when the ethnographic accounts were recorded, so the precise taxonomic identity of the ant species must therefore remain tentative. However, the taxonomic and toxicological literature strongly supports the assertion that a *Pogonomyrmex* species was indeed the red ant referred to in the ethnographic accounts. Of all the ant genera present in California and the Great Basin, *Pogonomyrmex* is distinguished by the large size, exceptionally painful sting, and highly biodynamic venom of its representative species.

Red harvester ants are common throughout south-central California and the Great Basin. While *Pogonomyrmex californicus* (Buckley), the California harvester ant, is the most common and conspicuous species, *P. subdentatus* Mayr, *P. salinus* Olsen, *P. brevispinosus* Cole, *P. subnitidus* Emery, and *P. rugosus* Emery also occur throughout the region (Cole 1968; J. O. Schmidt and R. Snelling, personal communications 1995).[1] In keeping with the ethnographic descriptions, these ants are large—the workers of most species average about 5-7 mm in length, while those of *P. rugosus* are larger in size, averaging about 10 mm (Essig 1958:861-862). Many Harvester ant species build conspicuous mounds (10 to 30 cm high) around the entrance to their nests, and live in colonies numbering in the thousands. *Pogonomyrmex* stings are exceptionally intense and piercing—often maintaining this high level for up to several hours—and have been characterized as approximating "ripping muscles or tendons" or "turning a screw in the flesh around the sting site" (Schmidt 1986:487). The venom is also reported to cause a nervous, chilling sensation to sweep upward from the sting site (Schmidt 1986:488).

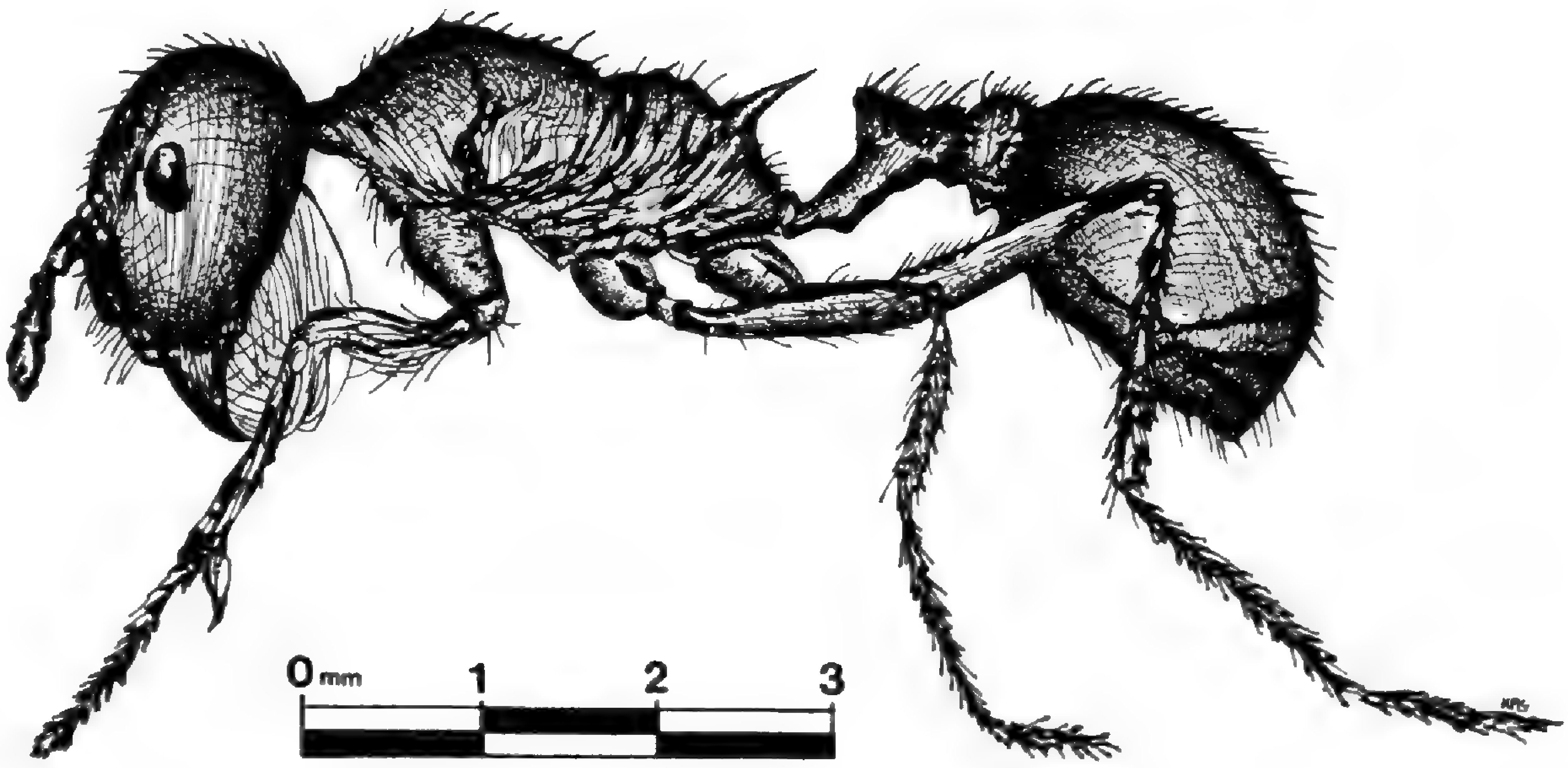

FIGURE 1.—*Pogonomyrmex californicus*, the California harvester ant (after original line drawing by J. Young)

The genus *Pogonomyrmex* belongs to the subfamily Myrmicinae (Hymenoptera: Formicidae, Myrmicinae), along with other strongly biochemically active genera, including *Aphaenogaster* and *Myrmica*. Myrmicinae is the most derived subfamily of stinging ants, characterized by highly complex and potent venoms (Schmidt 1986:430). In fact, *Pogonomyrmex maricopa* possesses the most toxic insect venom recorded to date—five stings can kill a two pound mammal (J. O. Schmidt, personal communications 1995). Unfortunately, the chemistry of ant venoms is still poorly understood, largely due to the difficulties of collecting the significant quantities of highly purified venom needed for toxicological analysis. However, one thing has become clear over the past few years—the ant's venom gland represents the pinnacle of venom development among the social insects. It is capable of synthesizing extremely complex and potent chemical compounds, many of which are highly pharmacologically active, and were previously thought to occur only in higher plant taxa (Schmidt and Blum 1978a; Wheeler *et al.* 1981; Schmidt 1986).

The morphological, behavioral, and biochemical characteristics of the genus strongly suggest that the red ant species reported ethnographically was a *Pogonomyrmex* species—probably *P. californicus* (see Figure 1). No other genus matches the ethnographic descriptions as closely as *Pogonomyrmex* in terms of size, mound characteristics, and the potency of the sting. Most importantly, it appears that *Pogonomyrmex* is the only ant genus toxic enough to induce the altered physiological states described in the ethnographic record—*P. subnitidus*, the least toxic *Pogonomyrmex* species in California, is 7 times more lethal than *Manica bradleyi*, the next most toxic stinging ant (and *P. californicus* is almost 15 times as lethal) (seeTable 1 for comparison of mammalian lethality). The implications of these data will be discussed in a later section.

TABLE 1.—Venom quantity, lethality, lethal capacity, and number of stings for an LD_{50}/kg for *Pogonomyrmex* harvester ants compared to other California stinging ant genera.

Species	µg venom/ ant	LD_{50} iv (mg/kg)	Lethal Capacity (g mammal/sting)	# stings for LD_{50}/kg
P. maricopa	27	.13	208	4.8
P. rugosus	31	.80	39	26
P. californicus	21	.60	35	29
P. brevispinosus	17	.70	24	41
P. montanus	14	.60	23	43
P. subdentatus	22	1.1	20	50
P. subnitidus	18	1.1	16	61
Manica bradleyi	14	6	2.3	430
Odontomachus sp.	65	~30	2.2	460
Pseudomyrmex gracilis	16	8	2	500

f J. O. Schmidt, unpublished data

RED ANTS IN THE ETHNOGRAPHIC RECORD

Along with *toloache* (*Datura wrightii*) and tobacco (*Nicotiana* spp.), red ants completed the sacred trinity of powerful ritual medicines used in native California, possessing both therapeutic and mind-altering properties. Despite their significance, the use of red ants in either ritual or medicinal contexts is poorly represented in the published anthropological literature on native California, and is discussed only briefly—if at all—in most recent syntheses of California Indian shamanism and ethnomedicine (cf. Bean 1975, 1992a,b; Bean and Vane 1978; Applegate 1978; Walker and Hudson 1993). One reason for the paucity of data is that many of the societies which used red ants were extinct or no longer fully functioning by the time ethnographers arrived in the first quarter of this century. This fact alone makes any precise delineation of the use of red ants exceedingly difficult.

Brief mentions of red ant swallowing appear irregularly in the ethnographic records of several groups, but the data are often vague, confusing, or incomplete. The most complete descriptions come from the unpublished ethnographic fieldnotes of the late John Peabody Harrington, a prolific ethnographer and gifted linguist from the Bureau of American Ethnology who conducted salvage ethnographic research in Southern California during the first quarter of this century. Even at this late date, he was able to locate several individuals who had themselves taken red ants, and were therefore able to provide detailed first-hand accounts of their experiences.

These ethnographic accounts indicate that large quantities of live red ants were swallowed in order to induce visions and thereby acquire supernatural power in the form of a "dream helper." They were also administered both internally and externally in the treatment of particular physical ailments, such as rheumatism, heavy colds, paralysis, body pain, stomach aches, and various gynecological disorders. For purposes of clarity, I have chosen to treat the two facets of use separately, structuring each discussion around representative ethnographic accounts.[2]

RITUAL SWALLOWING OF RED ANTS

The use of red ants as a ritual intoxicant has a far more limited distribution than their use in medicinal contexts. Of the 17 indigenous southern and south-central California ethnic groups known to have utilized red ants medicinally, 7 were reported to swallow them in order to induce visions and acquire supernatural power in the form of dream helpers.

The ritual use of red ants appears to have been strongest among the Shoshonean groups along the southeastern edge of the south-central area—the Kitanemuk (Harrington 1986b:rl.98, frs.449-450), Kawaiisu (Zigmond 1977:62, 1986:405), Tubatulabal (Voegelin 1938:5, 46, 67-68), and the various Hokan-speaking Chumash groups, particularly the Interior Chumash (Harrington 1986b:rl.98, frs.608-609, 648-652). Some of the neighboring Southern Valley Yokuts (particularly the Yawelmani) and Southern and Central Foothill Yokuts (Wikchamni, Yawdanchi, Bokninwad, Yokod, and Palewyami) also swallowed ants in order to gain dream helpers and shamanic power (Harrington 1986a:rl.94, fr.387; Driver 1937:99), but the practice among these latter groups appears in a somewhat attenuated form and was likely spread to them by the core groups. The Northern Miwok are also reported to have ingested ants "for vision or power" (Aginsky 1943:440). Although the Miwok lived far to the north, they appear to have shared in many of the cosmological beliefs and religious practices typical of the south-central region (Levy 1978:412).

The presence of this practice among groups to the south is less well established. It is based largely on the testimony of one of J. P. Harrington's Kitanemuk consultants, who indicated that ritual ant swallowing was present among groups to the southeast—probably the Gabrielino and Luiseño-Juaneño—and was integrated into the protohistoric Chingichngish Cult—"that religion [in which] you take ants or *toloache* and they counsel you and teach you everything" (Harrington 1986b:rl.98, fr.443). If visionary ant swallowing did indeed form part of the ritual repertoire of the Chingichngish Cult, it seems odd that the practice is not mentioned in the ethnographic accounts of the Gabrielino (Harrington 1933; Johnston 1962) or the Luiseño-Juaneño (Du Bois 1908; Sparkman 1908).

Exactly where this tradition originated is uncertain. All extant ethnographic accounts were collected from the south-central and coastal core groups mentioned above, among whom ritual ant swallowing was highly elaborated. This distribution suggest that these practices were developed among Shoshonean speakers living in and around the Tehachapi Mountains and southern Sierra Nevada, then passed on to interior Chumash speakers to the west, and then to various Yokuts groups in the southern half of the San Joaquin Valley. Interestingly, the distribution of this tradition is largely coextensive with the Toloache-Dream Helper Complex, a generalized, egalitarian religion that stressed individual contact with the supernatural and the acquisition of one or more dream helpers through ecstatic trance and the use of the hallucinogenic plant *Datura wrightii* (cf. Gayton 1928; Applegate 1975, 1978; Bean and Vane 1978).

A survey of the ethnographic literature has revealed striking commonalities in the ritual use of red ants, and although there are some discrepancies in detail, the general features of this use complex are quite clear. I have chosen to organize the following discussion of ritual red ant ingestion around a previously unpublished Interior Chumash (or possibly Kitanemuk) account collected at Tejón Ranch in 1916 by John P. Harrington and his wife, Carobeth.[3] This account is the most detailed description of ritual ant ingestion known, and appears to be representative of patterns of use for neighboring southern and south-central groups.

Purpose of administration.—Throughout the southern half of California, the possession of a "dream helper" was considered to be a prerequisite for a long and healthy life. These dream helpers were frequently sought through a "vision quest," usually mediated by the ingestion of the hallucinogenic plant *Datura wrightii* (*toloache* or jimsonweed), which induces vivid visual, auditory, and tactile hallucinations. If the vision quest was successful, the aspirant saw an animal spirit, a personified natural force, or the spirit of a dead relative who then acted as a life-long spiritual helper and protector (Applegate 1978).

Red ants, like *Datura*, were used by individuals seeking to acquire supernatural power in the form of a dream helper. Quite apart from any "virtues" or specific skills they might confer, dream helpers (and the power they embody) were critically important in leading a safe, healthy, and prosperous life. Possession of a dream helper represented a direct connection with supernatural power—a source of security in an otherwise unpredictable environment. One of J. P. Harrington's Kitanemuk consultants emphasized the importance of supernatural aid in the precolonial world of native California, saying, "[We] gave the boys red ants to eat. [We] did this to save them from getting killed... for long ago there used to be lots of fighting..." (Harrington 1986b:rl.98, fr.449). In a very real sense, the acquisition of a dream helper was viewed as a basic form of preventative medicine.

Those men who sought shamanic power would ingest red ants or *toloache* repeatedly over a period of months or years. If they were fortunate, they gradually acquired multiple or specialized dream helpers who bestowed shamanic skills upon them. Most native southern Californians consulted by early anthropologists were quite explicit about the association between red ant ingestion and the acquisition of shamanic powers, as illustrated by J. P. Harrington's Interior Chumash/ Kitanemuk consultant, José Juan Olivas:

> [These] are the ants that you take if you wish to become an *hechicero* [curing or bewitching shaman]... You take ants again the following summer and so on every summer till they tell you [that you've had] enough... They give you power to injure or cure people and help you to escape when in peril—you always have these powers if you take the ants successfully. *Toloache* also gives you the power of escaping from danger, but only 2 or 3 times,

> and *pespibata* [green tobacco powder] gives it only once... [Harrington 1986b:rl.98, frs.595, 608].

The decision to take red ants was never made in haste, for these creatures were regarded as potent manifestations of supernatural power. While providing the above information, José Juan cautioned, "If [you] are going to take red ants, [you] have to keep your promise. You can't fool this animal. The ant knows you have said it. If you do not fulfill [your promise], you will die soon" (Harrington 1986b:rl.98, fr.489).

Administration and the "Coming of the Animals".—The ritual ingestion of red ants, whether aimed at establishing a relationship with a dream helper or gaining more specialized shamanistic power, was always an individual and voluntary matter. Unlike *toloache* use, it was not tied to boys' puberty ceremonies, and no change of social status occurred. The ants were taken anytime after puberty—usually during the winter months—and the experience could be repeated as often as desired. Since red ants were considered to be more powerful than *toloache*, their ritual use was limited to boys and men.

An elderly post-menopausal woman or old man served as the "ant doctor," and was in charge of the administration. For three days prior to administration the aspirant (and often the ant doctor) observed a regimen of fasting and nightly vomiting to purify the body. Avoidance of meat, grease, blood, and salt was stringently observed, as it was felt that these substances diminished the likelihood that a dream helper would appear. These restrictions suggest that red ants, like all representatives of supernatural power, were believed to be "hostile to blood" and would visit harm upon individuals who had consumed flesh or come into contact with blood or sexual fluids prior to ingestion (cf. Applegate 1975:9). This careful avoidance of "contaminating" substances—particularly blood—may explain the universal exclusion of pre-menopausal women from all facets of ritual ant use and vision seeking.

The actual ingestion took place during the daytime at an isolated location, away from the village and fully exposed to the elements. After collecting the ants from a nearby anthill, the ant doctor would lay the aspirant down on his back and quasi force-feed him large quantities of live red ants collected on balls of moist eagle down. She regulated the dose by watching the boy's appearance and behavior closely—when his eyes turned red and he began to experience lassitude she knew that he had ingested enough (Voegelin 1938:67).[4] The general characteristics of administration are exemplified in the following Interior Chumash or Kitanemuk account provided by José Juan Olivas:

> An old woman who no longer has monthlies cares for the eater in the hills... an old man can give them if there is no old woman, but an old woman is preferred because she can pound and prepare his food. The old woman wets something—the down-feather of an eagle is good to use—and sticks it into a vessel containing the ants and 4 or 5 ants cling to it and form a ball. She puts the ball in your mouth and you draw your breath in sharply and thus suck the ball down your throat, swallowing both ants and feather. Then the old woman gives you another and another and another—she goes on

counting until you have taken 50, 60, 80, or 90 balls—just as many as you can stand. Every little while she pauses and asks, "Do you want more?" and if you are brave you say, "Yes, give me more." As you swallow you have a very painful burning sensation in your throat and when you can stand it no longer you say, "That's enough," and she stops giving them to you...

While you are sitting quietly after taking the ants, the old woman who gave them to you says, "Sit here quietly a little while, I am going to get something." You sit perfectly still with drooping shoulders and hanging head, arms hanging loosely at [your] sides... But she does not have to get anything—just says this to fool you. Then she slips up behind you and grabs you, or rather pokes you with both hands, on ribs at sides, just back of upper arms, crying out or grunting as she does so. She does this to startle you. It is necessary to do this because until you are startled in this way the ants do not bite—they are simply clinging together in balls inside of you. When the old woman startles you the ants all bite all at once and immediately you fall as dead. Then she takes you and puts you in the shade so that you lie face down (informant at first said face-down very positively but later said either face-up or face-down). Then she retires some little distance (about 200 ft. or more) and watches you.

If you take the ants in the morning (about 9:00 am) you will come to about noon. When the old woman sees that you are sitting up she comes and asks how you feel and you tell her "all right," and then she asks if you want more. If you have courage you say yes, and take more, perhaps as many as you did the first time, just as many as you can stand. When you have finished, the old woman startles you again and you fall in a faint and lie until sundown, when you revive. Then she asks you how you feel, and if you say you feel all right she knows you mean to take more tomorrow. At sundown she comes nearer so that she can watch you better during the night. The next day if you are brave you take ants in the morning and at noon, as on the previous day. And so on for 2, 3, or 4 days... The ants do not kill you, they give you force to go without food 5 or 6 days... [Harrington 1986b:rl.98, frs.608-609, 648-651].

The focal event in all accounts of ritual red ant use is the dramatic loss of consciousness following ingestion. This deep, death-like sleep was characteristic of all drug-induced visionary experiences in south-central California, and held great symbolic significance. Death, dreaming, and the experiencing of supernatural visions seem to have constituted a single conceptual domain in native Californian thought, and the three experiences were sometimes glossed under a single term.[5] The catatonic, near-death state was essential to shamanic and visionary practice, and was understood as a sort of small death in which the aspirant was "killed" by the supernatural agents which he sought to contact. It was during this liminal death-like state that supernatural visions manifested and a dream helper "chose" the boy, conferring his virtue upon him. J. P. Harrington provides us with a detailed description of the "coming of the animals" and the powers they confer:

> If you have enough courage you take ants until the ants run out of your mouth as soon as they are swallowed. This gives you a lot of power if you can do it. When this happens the ants speak to you and tell you [that] you have taken enough... The ants talk to you and ask what you want—[they] give [you] any *virtud* [virtue] that you want.
>
> Then come the animals...The lion can give you *virtud*. Or bear. The coyote, the *gavilan* [sparrow-hawk]. Each can give their *virtud*—all of these, even the rattlesnake, can come and talk to you. Rattlesnake says, "they are going to bite you." That night the rattlesnakes come [and bite you], and you open your eyes and you are well. Also the [ghost] gives his *virtud*, which is that you can become invisible, yell to people who follow to kill you, from [the] distance [issue] challenge and disappear again. The [mountain] lion—very strong, bullets go aside. *Gavilan*—[gives you the ability to] shoot 2 arrows [at once]. Arrows shot at you go aside. Spit on hawk claw and touch it to bowstring as you shoot when in a hurry. A hawk comes and circles, and if enemy does not kill him when he shoots at you, you are o.k. Bullets go aside. The coyote also [gives the ability] to shoot 2 [arrows]. The bear [makes bullets and arrows go] aside. The horse—wear belt of the mane—jump on horse when in hurry and escape. The dog—dog comes and barks when you are in a hurry, and if [they] don't kill [the] dog you are o.k... If ants say you will live, you will live 100 years. They give you *espiritu* [spirit, strength, fortitude]... These are the *virtudes* [virtues] the ants give you [Harrington 1986b:rl.98, fr.649, 651-2].

While most of the virtues conferred by the dream helpers in this account are purely utilitarian, other reports indicate that they were just as likely to be highly specialized shamanic powers that enabled the recipient to cure, bewitch, make rain, or transform into an animal. Such specialized powers were often conferred by poisonous or dangerous creatures, such as Rattlesnake or Black Widow, who bit the vision seeker and transferred their power to him through the medium of their venom. The relationship between poison, power, and medicine will be explored further in a later section.

Although not mentioned in this account, the aspirant always drank hot water after regaining consciousness in order to induce vomiting. The regurgitated ants reportedly came out alive, still clinging together in little balls. It is likely that some form of vision interpretation took place between the ant doctor and the aspirant after he had recovered from this ordeal. Such a practice was reported for the Tubatulabal (Voegelin 1938:68) and Kitanemuk (Harrington 1986b:rl.98, fr.450), and was common following *toloache* ceremonies, in which an analysis of the aspirant's visions served to reinterpret idiosyncratic psychic experiences in terms of widely held public beliefs and local cosmology. After coming to mutual agreement on the significance, meaning, and success of the vision experience, the ant doctor would have given the boy instructions for cementing his relationship with the dream helper, which usually included a series of prayers and offerings of seeds, shell beads, tobacco, and eagle down.

Post-ingestion observances.—For a period of time following the ant eating ritual, the aspirant observed a number of dietary and behavioral restrictions. These restrictions were designed to ensure that the bonds forged between the individual and his dream helper were not broken. The length and severity of the proscriptions corresponded with the degree and type of power sought—men seeking certain highly-specialized shamanic skills underwent lengthier and more rigorous restrictions than those who took ants in order to establish a relationship with a single dream helper or to cure themselves. After this period had passed, a small ceremony was held to formally mark the end of the fast and to reintegrate the individual with his family and community:

> [You] must stay alone without speaking to anyone—[the] person who is taking care of you does not talk [for] 4 days... When you take ants for to cure you, you diet 12 days—when you [take them in order to] become [a] medicine man, one month... [You stay for] one month in hills, then [there is a] *fiesta*. The person who administered [the ants] tells the captain that the month is up, and the captain tells the *payaso* [ritual announcer] to cry announcing a *fiesta* [for the next day]. Eater comes in from hills with his head covered and man pays many beadstrings to people—[the ant eater's] relatives pay this for permission [for him] to eat meat again. A ceremony is then held in which [the aspirant] eats a small piece of meat [the size of] last joint of finger. Then [he drinks] warm water—eaglefeather—vomits. That night he eats meat [Harrington 1986b:rl.98, fr.650].

Overall, the ritual use of red ants reported ethnographically exhibits great homogeneity among culturally and linguistically distinct ethnic groups. However, several minor variations should be noted. The emphasis in this account on multiple administrations over a period of several days appears to be atypical, and may reflect attempts to gain specialized or multiple dream helpers. Among all other groups the aspirant is reported to have taken the ants only once, usually in the morning, then lapsed into an unconscious state from which he recovered later the same day. In addition, Tubatulabal youths are reported to have ingested the ants inside of a sweathouse under the supervision of their grandfather in order to "gain power" (Voegelin 1938:67), while among the Kitanemuk a man who "knew how to pray" administered red ants to the boys either individually or in small groups out in the hills (Blackburn 1976:78).

THE THERAPEUTIC USE OF RED ANTS

Reported medicinal use of red ants is more widespread than ritual use. While all groups that used red ants in the acquisition of dream helpers also used them as medicines, the majority employed them only in therapeutic contexts. However, inasmuch as indigenous California medicine was integrally connected with religious beliefs and practices, any sharp separation of the two is necessarily artificial. As we will see below, the relationship between ritual vision induction and therapeutic vision seeking is quite complex, and distinctions between the two rapidly begin to blur.

The Kawaiisu believe that red ants were one of the four medicines given to people at the beginning of time, along with tobacco, nettles, and *toloache* (Zigmond 1981:23). When evaluating the efficacy of traditional remedies, J. P. Harrington's Chumash consultants often declared red ants to be one of the three finest medicines: José Juan Olivas felt them to be the most powerful medicine in terms of the supernatural powers they conferred, followed by *toloache* and tobacco (Harrington 1986b:rl.98, fr.608), while Fernando Librado Kitsepawit ranked them third, surpassed only by *toloache* and sea water (Hudson 1979:56).

Most of the groups occupying south-central California were reported to use ants both internally and externally in the treatment of unspecified illnesses, including: the Kitanemuk (Harrington 1986b:rl.98, frs.124, 384, 415), Kawaiisu (Zigmond 1977:77-78, 1981:23, 1986:405), Tubatulabal (Voegelin 1938:5, 60, 73), Chumash (Hudson 1979:73; Walker and Hudson 1993:60, 89-90), Monache (Wobonuch), Southern Valley Yokuts (Nutúnutu and Yawelmani), Southern and Central Foothill Yokuts (Palewyami, Wikchamni, Yawdanchi, Bokninwad, Yokod)(Driver 1937:99), and Northern Miwok (Aginsky 1943:440). The Owens Valley Paiute and the Entimbich band of the Monache limited the therapeutic use of red ants to external application, while the Wikchamni band of the Central Foothill Yokuts took them only internally (Driver 1937:99).

Unfortunately, most ethnographic accounts regarding the therapeutic use of red ants are disappointingly brief, and frequently neglect to specify the conditions that were treated. Despite these lacunae, a survey of the extant literature reveals that they were employed in the treatment of a diverse inventory of conditions, including: paralysis, gastrointestinal ailments, severe colds, pain, arthritis, and gynecological disorders. Red ants were also widely used throughout south-central California as a general tonic. The ants were either swallowed alive (as in ritual use) or applied in great numbers to the exterior of the body, then aroused to anger so they would sting freely. Many groups practiced both forms of administration, choosing between them depending on the condition being treated and the preferences of the individual. Unlike ritual use, both men and women were allowed to use ants for medicinal purposes.

The internal administration of red ants for explicitly therapeutic ends appears to be closely related to their use in visionary contexts. The form of administration is identical, involving various pre- and post-ingestion food proscriptions. Although visions were sometimes sought during medicinal ant ingestion, there was no attempt to gain a dream helper or shamanic powers. Frances Philips, an elderly Tubatulabal woman, has left a record of her experience with therapeutic ant ingestion, which took place between 1875-1885 at the village of ***uupulap*** on the South Fork Kern River. This account provides a typical example of the therapeutic use of red ants, and highlights the structural similarity between ritual and medicinal uses:

> I became sick at ***uupulap***; my arm was bent and I couldn't straighten it. So I didn't eat meat for a month, then my aunt gave me red ants. She gave me half a baking-powder can full of little balls of cotton with live red ants

wrapped up inside them. I hadn't eaten anything the day before my aunt gave me those ants... I took the ants in the morning and slept all day; then I woke up and everything was clear and bright. The red ants that are all around here now are the ones I took. I didn't eat any meat for a month; if I had, then when I took the ants they would have killed me.

Those ants are good to take for a bad cold too, wrapped up in eagle down. When you take them you burn inside your stomach, just like fire; you get hot inside; they bite you there, I guess. I slept all day the time I took ants; I was unconscious and I slept outside on the ground and rolled over and over in the dirt. My hair got full of dirt; I didn't know anything. They gave me warm water to drink when I woke up that evening; then I vomited, but nothing came up except water. The cotton and the ants had disappeared. I could straighten out my arm again. After that I just ate acorn gravy and a little bread; no meat or grease for a month [Voegelin 1938: 73].

From this and other accounts, Voegelin was able to reconstruct a normative description of therapeutic red ant ingestion among the Tubatulabal. The similarities between the following account and José Juan Olivas' account of ritual ingestion are striking:

For heavy colds, paralysis, 4-5 yellow ants [or] large red ants [were] wrapped together in eagle down; 15-20 of these balls swallowed with sips of water, one ball at a time, by man, woman who had abstained from meat for month, fasted for 2-3 days and vomited each morning during fast, previous to taking ants. After swallowing the balls [the] patient [was] frightened, "so the ants would break out of the balls and sting patient"; later remained in stupor 24 hrs., at end of this time given warm water to induce vomiting...If all ants came up alive, patient would recover completely, if half of them were dead he "wouldn't live long," and if all dead he would die shortly... After taking ants patient ate only a little acorn mush for 2-3 days, no meat, grease for month. Live ants also put on sick person's abdomen, "if patient didn't want to drink them" [Voegelin 1938:60].

These accounts illustrate several typical features of therapeutic ant swallowing, including pre- and post-ingestion food avoidances, a regimen of purging and fasting for both patient and doctor, the characteristic death-like stupor, and forced post-ingestion vomiting. In the treatment of less serious conditions fewer ants were ingested and no loss of consciousness occurred. A particularly unusual feature of therapeutic ant ingestion is the divinatory or prognostic role accorded to the ants after they have been regurgitated. This trait is also reported for the Kawaiisu (Driver 1937:99) and the Northern Paiute (Steward 1941:331; in Sutton 1988:65).

While visions are not reported in either of these accounts, we know that they played a central role in many therapeutic contexts—especially when supernatural etiology was suspected. The Kawaiisu swallowed red ants in order to ward off supernatural threats. After witnessing a bad omen, both men and women would take red ants in an attempt to counteract the impending misfortune:

When you are out and see something you haven't seen before—a big

> rattlesnake or other big animal—it is a bad sign. You will die in two or three days. He will eat you... But if you eat or drink nothing after seeing him and you take red ants the next morning, you will live...[you] swallow red ants in order to be well. After swallowing the ants, you fall into a deep sleep at once like being drunk. The [creature] comes to you in your dream and says, "you will not die" [Zigmond 1977:77-78].

The importance of the manifestation of visions suggests that direct contact with supernatural power was considered necessary in the treatment of particularly tenacious, serious, or unusual conditions. J. P. Harrington reports that one of his Central Foothill Yokuts (Wikchamni-Yawdanchi) consultants, Juan Dionisio, "has taken *estafiate* [*Artemisia douglasiana* Bess. in Hook.] and also red ants—his child was sick and [Dionisio] took red ants but he did not succeed in dreaming anything, and for this reason the child died" (Harrington 1986a: rl.94, fr.382). Apparently, failure to "dream"—to contact dream helpers in a visionary trance—precluded access to the inherently curative powers that reside in the realm of the supernatural, rendering a successful outcome highly unlikely. This account also illustrates the common practice of curing by proxy, in which a parent ingests red ants on behalf of a sick child. This form of therapy was particularly common among the various Yokuts and Monache groups (Driver 1937:99), and has also been recorded for the Northern Miwok (Aginsky 1943:440).

Among the Yokuts, Monache, and Miwok there existed a widespread belief that the ants would "crawl through to the surface of the body" after being swallowed in therapeutic contexts (Driver 1937:99; Aginsky 1943:440). This seemingly odd statement may reflect the Yokuts belief that illnesses became visible when diagnosed under the influence of hallucinogenic agents, manifesting physically as "swarms of insects" or "microcosms" that covered the victim's body (Gayton 1948:119). These pathogenic microcosms were immediately brushed off into a fire, and the patient was invariably cured. If this interpretation is correct, it would suggest that these groups may have taken red ants in order to induce a visionary state in which the same ants were seen to "crawl through" to the surface of the body, presumably carrying the illness from the interior to the exterior of the body, where it was then disposed of.

Localized external application of live red ants was common in the treatment of many simple ailments, and appears to have been based on the principle of counter-irritation. The Kitanemuk treated painful or arthritic joints by applying large numbers of red ants to the affected area, then inducing them to sting in the belief that they would "take out all the badness" (Harrington 1986b:rl.98, fr.415).[6] The Gabrielino, Luiseño, Serrano, Cupeño, and Mountain and Western Diegueño followed a similar procedure to alleviate body pains (Drucker 1937:43; Johnston 1962:66), and the Central Miwok are reported to have treated infants "born with disease" by preparing a mash of red ants and applying the resulting paste to the child's body (Aginsky 1943:440).

The external administration of large numbers of red ants is a typical feature of native California "ant ordeals." During these painful physical ordeals, a boy was forced to stand or lie in a newly disturbed ant nest and allow the ants to sting his naked body repeatedly, usually until he lost consciousness. While these ant ordeals were not directly therapeutic, they were viewed as a form of general preventative medicine which imparted strength, fortitude, and endurance—traits necessary for a long and healthy life. The practice was common among the Chumash, and appears to have been integrated into the ritual repertoire of the Toloache Complex among the Tubatulabal (Driver 1937:98) and possibly the Monache (Driver 1937:99). The Northern Miwok also employed an ant ordeal to "test strength"—four or five men would lay down in a disturbed ant nest, and the one who endured the longest was given an award by the chief (Aginsky 1943:440).

Fernando Librado Kitsepawit, J. P. Harrington's principal Chumash consultant, related the ant ordeal he underwent as an adolescent. This event took place while constructing an irrigation canal somewhere near Mission San Buenaventura before the secularization of the mission system in 1836:

> There was a time when I had the red-ant treatment... While [my mother and maternal grandfather] were digging they cut through an ant nest, and a multitude of ants came out and my mother said that if I was going to die [someday], she wanted me to live to a ripe old age. I was naked. My mother stood me right in the midst of the red ants, and they crawled all over me and bit me, after which I fainted. Thereupon...my grandfather came with a lot of green sycamore leaves, and rubbed me all over freely with the leaves. He then chewed some tobacco and rubbed this over my body too. I came to and never suffered any ill effects after that [Hudson 1979:73].

As a rule, no visions were reported, and there was no ritual dimension to the ant ordeal. It was usually supervised by relatives, and as indicated in the previous narrative, the event was often quite informal and spontaneous. No change of status occurred, except among the Mountain Cahuilla who integrated a collective ant-ordeal into clan initiation rites (Strong 1929:176), the Luiseño-Juaneño, and Cupeño, who closed their *Datura* ritual with an ant ordeal (Du Bois 1908:91-92; Strong 1929:317, 339), and the Gabrielino, who "tested and hardened" their youths by subjecting them to an ant ordeal involving both internal and external administration in the final stages of the puberty observance (Heizer 1968:36; Johnston 1962:60-61).

In the treatment of particularly serious or tenacious conditions, ants were often swallowed then simultaneously applied to the exterior of the body (usually the abdomen, chest, and/or back). A particularly dramatic example of this dual administration was provided to Carobeth Tucker Harrington by Angela Montes, a Kitanemuk woman who had been given red ants in the treatment of post-partum "cold" (probably referring to uterine hemorrhage, dysmenorrhea, or a similar gynecological disorder):

> After Vicente was born, I took cold or for some other reason became very sick. I was suffering great pain in my belly (gesture with both hands to sides of upper part of belly below ribs...). They gave me red ants as a medicine, both externally and internally. First, they put them all over my belly, from navel down...so you could not see my skin for the ants. It is no trouble to get them to stay on, as they begin to bite and hang on very tightly the minute they touch your skin. The pain was intense. At the same time that

> the external treatment was applied, I also had to swallow a great many live red ants—I don't not know how many, a lot. They of their own accord cling together in balls and it is these balls of ants that you swallow. This was also very painful. They must surely have bitten me inside, as I felt like something was pricking me between my shoulders. Some days after taking the red ant treatment, a flow of blood came freely from my uterus, and I got well [Harrington 1986b:rl.98, frs.384, 415].

As we have seen, the therapeutic use of red ants appears to have been more widespread and culturally variable than their use in ritual contexts. The few specific accounts we have indicate that red ants were administered internally and/or externally in the treatment of diverse conditions ranging from simple aches and pains to gynecological and obstetric disorders. In addition to these seemingly straightforward, "empirical" therapies, native Californians utilized the visionary potential of red ants in order to harness the power of the supernatural and direct it towards therapeutic ends. These practices reflect a sophisticated understanding of the nature of venom: namely, that poison can often act as a medicine or an hallucinogen, depending on the dose. This quasi-Paracelsan observation largely elides the distinctions between the three concepts, inseparably linking them together under the overarching rubric of supernatural power.

POISON AS POWER, POISON AS MEDICINE

One of the central conceptual tenets underlying red ant ingestion appears to be the equivalence drawn by native Californians between poison, power, medicine, and hallucinogen. In native Californian thought, poison (or venom) was understood to be a sign of potent supernatural power. A defining feature of both poison and power was their dangerously amoral character—poison was power first and foremost, only secondarily was it put to use for either malevolent or beneficial ends (Applegate 1978). Accordingly, many venomous creatures were esteemed as powerful supernatural allies who possessed the ability to confer shamanic powers during the vision quest.

Among the Tachi Yokuts, Black Widow was the supreme dream helper of powerful shamans. The association between the two was so strong that black widows and shamans were called by the same name, ***métsa***, meaning "true, real, big, and powerful" (Gayton 1948:24). Among the Kitanemuk the equivalence of these concepts is even more apparent. The word for poison or venom is ***pahaviit***—this same term is also used to refer to specialized shaman's dream helpers such as Bear and Rattlesnake (Anderton 1988:452). Given the extraordinary toxicity of *Pogonomyrmex* venom, and a cultural predisposition to equate poison with supernatural power, it comes as no surprise that this species would become identified as ritually and therapeutically valuable based on the potency of its sting. Voegelin's (1938:60) Tubatulabal consultants cited the fact that they "could sting hardest and had medicine" as the primary indicator of therapeutic and supernatural efficacy—less potent varieties were thought to be ineffective.

It is interesting to note that the three "sacred medicines" used in native California—tobacco, *toloache*, and red ants—are all extremely toxic. The cultural history of these hallucinogenic agents is very old, and it was only through long-term experimentation and use that these potentially deadly substances could be manipulated with impunity for therapeutic or visionary ends.

Although not a "true" hallucinogen, tobacco (*Nicotiana* spp.) is highly psychoactive and is used throughout the Americas in the induction of narcosis and ecstatic trance, usually in shamanic or curing contexts (cf. Wilbert 1987, 1991). Nicotine, the principal alkaloid in tobacco, is highly toxic. The amount of nicotine contained in an ordinary cigar—if it were extracted and injected internally—would kill a man twice over (Larson *et al.* 1961). Visionary trance is induced by carefully managing the toxic effects of the nicotine alkaloid, pushing the aspirant very close to death then bringing him safely back as the toxic tobacco alkaloids are metabolized (Wilbert 1987:157).

Toloache (*Datura wrightii*) provides another interesting illustration. This solanaceous plant owes its psychoactive properties to a group of neurotoxic tropane alkaloids (including atropine, hyoscyamine, and scopolamine) which acts directly upon the central nervous system. In addition to being highly toxic, these alkaloids are true hallucinogens. Unfortunately, tapping into the plant's visionary powers is risky—by the time hallucinations manifest, the alkaloids are often at near-fatal levels, making poisoning or death a distinct possibility (Levy and Primack 1984:36; Blackwell 1990:36). The Chumash recognized that the visionary substances in *Datura* were also potent poisons—in fact, it was commonly held that rattlesnakes derived their venom by sinking their fangs into a *toloache* root and sucking up the poison before biting a human (Applegate 1975:11)

In recent years, toxicologists and phytochemists have shown that the venoms and assorted toxins found in insects, reptiles, and plants are actually complex secondary defensive compounds that have evolved in order to protect the organism from predation. At certain non-lethal dosages, many of these toxins produce "side effects" which can be therapeutic and/or psychotropic in humans (and often, in other mammals as well). As Schultes and Hofmann (1992 [1979]) have pointed out, natural substances are useful in medicinal and/or visionary contexts precisely because they are toxic. The difference between a poison, a medicine, and an hallucinogen is often merely one of dosage.

HALLUCINOGENIC RED ANTS: POSSIBLE BASES OF PSYCHOACTIVITY

The ethnographic record is unequivocal—in native south-central California Harvester ants were used to induce altered physiological states during which visions manifested. The question remains—to what do these ants owe their vision producing potential? In this section I examine the ethnographic accounts in light of general pharmacology and toxicology, and propose two possible explanations for the reported psychoactivity. First, I consider the possibility that the ants are "true" hallucinogens, containing endogenously-produced, directly hallucinogenic chemicals. Second, I examine the possibility that the psychoactivity is a toxic "side effect" of massive envenomation combined with non-venom factors such as physiological stress and cultural preconditioning. I present data which suggest that certain venom constituents (possibly kinin-like agonists) could interact with neurotransmitters to trigger a cascade of psychophysiological events, including endogenously-produced hallucinations.

Previous reports of extra-botanical hallucinogens.—The most obvious explanation of *Pogonomyrmex* psychoactivity would be to postulate the presence of true chemical hallucinogens as metabolites or venom components. The occurrence of such endogenously-produced psychoactive compounds outside of the plant kingdom is rare, but not unheard of. The only animal with clinically demonstrated hallucinogenic potency is the Sonoran Desert toad (*Bufo alvarius*), whose venom contains an unusual enzyme, *O*-methyl transferase, which converts bufotenine (5-OH-DMT) to the potent hallucinogen 5-methoxy-*N,N*-dimethyltryptamine (5-MeO-DMT). The activity of this enzyme leads to the production and accumulation of prodigious quantities of 5-MeO-DMT in the toad's cutaneous, tibial, and parotoid glands (Deulofeu and Rúveda 1971; Weil and Davis 1994). Remains of this toad have been found in archaeological contexts at Olmec and Maya sites in Mesoamerica, as well as Moche sites in northern coastal Perú, suggesting that these societies may have recognized the unique nature of *Bufo* secretions and exploited them for visionary purposes (Weil and Davis 1994).

Similarly, cutaneous toxins from the skins of neotropical frogs (mostly *Phyllobates*, *Phyllomedusa*, and *Dendrobates*) are reported to produce psychoactive effects when rubbed into self-inflicted burns by the Amahuaca and Matsés Indians of the Peruvian Amazon (Carneiro 1970). Analysis of skin secretions from these frogs has revealed the presence of a number of vasoactive and neuroactive peptides (Daly *et al.* 1992; Erspamer *et al.* 1993). Interestingly, recent research indicates that a majority of the cutaneous alkaloids found in *Dendrobates auratus* are not endogenously produced, but are captured from dietary sources, which include alkaloid-rich myrmicine ant species (Daly 1994; Daly *et al.* 1994).[7]

In addition to these well-documented examples, there have been occasional but unsubstantiated reports of an "hallucinogenic" moth (*Myelobia smerintha* Huebner) that induces "marvellous dreams" when eaten in the larval stage (Britton 1984), several related fish species known as the Norfolk Island "dream fish" and the Hawaiian "nightmare ***weke***" reputed to possess dream-inducing properties (Ott 1993:410), and a black and red bird called ***oconenetl*** from Tlaxcala, México, whose flesh was reportedly eaten for hallucinogenic effect by the Aztecs (La Barre 1981; Ott 1993:416).[8]

To date, no directly hallucinogenic constituents have been isolated from any arthropod. However, several pharmacologically interesting compounds have been isolated from the venoms of myrmicine ants. Anabasine, a toxic tobacco alkaloid, was isolated from the venom of *Aphaenogaster fulva*. Although anabasine is a minor alkaloid in tobacco, this marks the first time it has been found in an insect (Wheeler *et al.* 1981). Other alkaloids have been isolated from the poison glands of myrmicine ants, including: dialkylpiperidines, pyrrolidines, dialkylpyrrolidines, and an indolizine (Wheeler *et al.* 1981). Three lactones related to nepetalactone (the principal active agent in catnip, and a possible hallucinogen in humans), and several coniine-related alkaloids have also been reported (Jackson and Reed 1969; Pavan 1959: cited in Blackburn 1976:80).[9] Although none of these alkaloids is known to be directly hallucinogenic in humans, their presence is provocative and underscores the need for further toxicological research. Given the extreme plasticity of the ant's venom gland and the preliminary state of our knowledge concerning the chemicals it synthesizes, the possibility remains that a directly psychoactive compound awaits our discovery.

Venom and visions: A possible toxicological basis.—While direct psychoactivity on the part of Harvester ants remains a possibility, I would like to suggest an alternate toxicological explanation of the practices described in this paper. It is possible that the visionary experiences reported ethnographically are not due to direct biochemically-based psychoactivity on the part of the ants, but rather represent an endogenously-produced physiological response to intentional massive envenomation—in short, ant poisoning. There is ample evidence that experiences very similar to hallucinations may be induced by the ingestion of toxic substances which upset the normal metabolism, causing abnormal mental states to develop. Such altered states of consciousness may also be induced without ingesting toxins—long periods of drumming, dancing, fasting, self-induced physical pain, and high fevers have been known to alter normal metabolic functions to such a degree that visions manifest (Schultes and Hofmann 1992 [1979]).

The pre-ingestion practices recorded in the ethnographic accounts indicate that native Californians knew how to carefully manipulate diet and behavior in ways that altered basic metabolic processes and rendered the human body maximally susceptible to altered mental states. The three days of fasting and forced purging that preceded ant ingestion would have produced stress on blood physiology, generating low glucose levels (thereby stressing the brain), and significantly altering the digestive function. Under starvation, the production of digestive enzymes decreases significantly, and the avoidance of meat and grease particularly helps decrease degradative enzyme production. This regimen of dieting and purging would set up a benign microenvironment in the stomach, protecting the ants and their venom from digestive degradation. The synergism of these non-venom factors would certainly potentiate the action of venom constituents, and when combined in a ritual setting, may have predisposed the individual to visionary experiences.

The ethnographic record stresses the fact that the ants were always swallowed alive and unmasticated. This mode of administration risks not only ant bites, but also envenomation from the sting apparatus left in the skin, mouth, and stomach, as *Pogonomyrmex* exhibits sting autonomy (Hermann 1971). In fact, many native consultants were aware that the ants "bit the lining of the stomach," and some reported burning or prickling sensations in the throat and/or upper body, and an intense, fire-like burning in the stomach.

This form of live oral ingestion relies on a direct gastrointestinal route of administration and on enteric envenomation from the buccal cavity, the laryngeal tract and the stomach, and possibly the large and small intestines. The buccal cavity is the most propitious site for venom absorption, with a thin epithelium and a rich blood supply. Once the venom is injected, it is not diminished by passage through the liver, but gains access directly to the heart and general circulation.

The stomach and small intestine also represent favorable sites for rapid absorption, and stings in either location would introduce toxic venom components directly into the bloodstream. In addition, *Pogonomyrmex* venom contains potent pro-inflammatory agents that speed absorption by increasing vascular dilation and capillary permeability. The fact that ant ingestion (as well as tobacco and *toloache* use) occurred on an intentionally purged and dieted stomach may have furthered the rapid progress of ants into the small intestine where they could sting the intestine wall, potentially inducing toxic reactions.

Recent toxicological research has shown Harvester ants of the genus *Pogonomyrmex* to possess the most toxic insect venom recorded to date. Their venom has the highest known mammalian lethality of any arthropod (LD_{50} = 0.1-1.1 µg venom/g mouse, n = 15 species of *Pogonomyrmex*), and proved to be 5 times more toxic than the venom of the Oriental hornet and 8-10 times more toxic than that reported for honeybee venom. These two venoms are the most toxic venoms reported from insects outside the genus *Pogonomyrmex* (Schmidt and Blum 1978a,b,c; Schmidt *et al.* 1989).

This extreme toxicity is derived from the presence of rich quantities of direct hemolysins and assorted enzymes (including hyaluronidase, phospholipase A_2 and B, lipase, acid phosphotase, and esterases), some of which promote the internal spreading of venom components by opening passages through host tissue matrix (Schmidt 1986:475). In addition, *Pogonomyrmex* is one of the few genera for which the presence of neurotoxins has been physiologically demonstrated (Schmidt and Blum 1978b; Piek *et al.* 1989; Piek 1991). These peptidal compounds appear to have evolved as deterrents against vertebrate predators, and produce a marked reaction in the mammalian central and peripheral nervous systems.

Harrington's account of Chumash ant ingestion states that as many as 90 eagle down balls (each holding 4-5 ants) were ingested in a single session. Assuming this information is accurate, an individual might swallow as many as 450 ants per day for the duration of the ritual. The venom delivered from this number of *Pogonomyrmex* stings (assuming total venom delivery) represents approximately 35% of a lethal dose (LD_{50}) of *P. californicus* venom in an individual with a 100 lb. (45.5 kg) body weight (see Table 1 for precise data on venom quantity and lethality for *Pogonomyrmex* species ants). Such massive sub-lethal doses are clearly in the range of pharmacological activity, and would likely generate a variety of neurological and physiological effects. Unfortunately, there are no clinical data on the reactions of human subjects to massive quantities of hymenoptera venom, and the specific nature of the resulting physiological reactions is therefore uncertain.[10]

It is possible that the visions and catatonia reported ethnographically may be triggered by venom constituents that alter the relative levels of endogenous neurotransmitters such as serotonin, norepinephrine, and dopamine in the brain. These synaptic transmitters and their metabolites are present throughout the brain at low baseline levels, and even small fluctuations in relative quantity can lead to pronounced physical and psychic effects similar to those induced by tranquilizing or hallucinogenic drugs. Interestingly, these neurotransmitters are structurally similar to plant hallucinogens: norepinephrine is chemically related to the hallucinogen mescaline, while serotonin is closely related the hallucinogenic indolealkylamines psilocin, DMT, and LSD (Schultes and Hofmann 1992 [1979]; Ott 1993:195).

Recent studies have shown *Pogonomyrmex* venom to be a veritable chemical cocktail, containing many strongly bioactive compounds (presumably peptides and alkaloids). While most of these constituents remain unidentified, the presence of kinin-like agonists has been established (Piek *et al.* 1989; Piek 1991). Kinins are endogenously-produced nonapeptides that appear to have potent and profound actions in the mammalian nervous system. They are implicated in pain production, and are produced by the body in response to trauma or noxious stimuli. Exposure to exogenously-produced kinins (such as those found in ant venom) can also trigger a kinin-producing response in the body (Moniuszko-Jakoniuk *et al.* 1976). The presence of kinins in both frog skin and the venoms of at least nine species of ants and social wasps suggests a toxicological effect in vertebrates, since both groups of animals must defend themselves against vertebrate predators.

Although their actions in the mammalian central nervous system are still poorly understood, it appears that kinins can function as neuromodulators, altering the uptake and release of neurotransmitters and producing marked behavioral changes. Moniuszko-Jakoniuk *et al.* (1976) demonstrated that exposure to bradykinin leads to decreased levels of norepinephrine and dopamine in corpus striatum, an increased level of serotonin in corpus striatum and cerebellum, and a higher level of 5-hydroxyindoloacetic acid in corpus striatum and hippocampus. In mammals, these changes in neurotransmission evoke the following behavioral responses: an initial short period (2-5 min.) of excitation, followed by a pronounced depression of activity, shallow respiration, cognitive slowing, the appearance of deep catatonic sedation, paralysis, occasional convulsions, and an eventual return to normal functioning (Capek 1962; Moniuszko-Jakoniuk and Wisniewski 1974; Moniuszko-Jakoniuk *et al.* 1976; Yazaki 1989).[11]

The critical question remains—do hallucinations accompany these pathophysiological responses? Unfortunately, no definitive answer is currently possible. We are only beginning to appreciate the complex role of neurotransmission in altered states of consciousness, hallucinogenic experiences, psychiatric disorders, and delusional conditions such as schizophrenia (cf. Bird 1990; Pearson 1990; Price *et al.* 1990). However, the toxicological explanation outlined above is at least as plausible as that of direct psychoactivity. We know that certain non-hallucinogenic toxins (such as the nicotine alkaloid), when taken in sufficiently large doses, interact with neurotransmitter systems to produce a cascade of psychophysiological responses that often includes anxiety, agitation, hypotension, stupor, delirium, and hallucinations (Pearson 1990:316; Wilbert 1987).[12]

It is unlikely that the actions of kinins alone can explain the suite of psychophysiological effects generated by red ant ingestion. The more likely explanation is that kinins are but one of the strongly bioactive compounds that produces the altered states recorded in the ethnographic record. Kinins are known to cause lasting disruption of the blood-brain barrier (Walker *et al.* 1995), and may potentiate altered mental and physical states by facilitating access to the brain not only of themselves, but also of all other venom constituents (which may include as-yet unidentified hallucinogenic chemicals). Interestingly, a recent pharmacological study of ritual intoxication induced through the administration of poison frog skin secretions concluded that kinins, along with other bioactive peptides, were implicated in the resulting intoxication (Erspamer *et al.* 1993).

The purpose of this discussion has been to explore possible bases of psychoactivity for Harvester ants, and thereby stimulate further research into the chemistry of *Pogonomyrmex* venom and its roles in human pathophysiological and visionary states. It is now clear that the ant's venom gland is capable of synthesizing peptides and complex alkaloids, some of which may ultimately prove to be directly psychoactive. Recent toxicological research has also demonstrated that *Pogonomyrmex* species possess a highly toxic venom capable of acting on the mammalian central nervous system and triggering a wide range of psychophysiological reactions. Whether the visionary states reported in the ethnographic record are generated by directly psychoactive compounds or complex toxic reactions is a question that will only be answered through future pharmacological and toxicological research. Whatever the final conclusions, the ritual ingestion of Harvester ants in aboriginal south-central California represents the first well-documented case of the widespread use of an insect as an hallucinogenic agent.

SUMMARY AND CONCLUSIONS

In this paper I have outlined the distribution and major features of the ritual and therapeutic use of red ants in south-central California. There remains no doubt that red ants (almost certainly a *Pogonomyrmex* species) played a central role as vision-inducing agents in the ritual, religious, and medical life of Southern California Indians. These "virtuous" creatures were universally esteemed for their ability to put human beings in direct contact supernatural power, and paralleled tobacco and *toloache* in terms of their social and religious significance. They were used to induce catatonic, death-like states, during which vivid visions of the supernatural realm manifested. They also played an important role in both curative and preventative medicine, treating a diverse body of ailments. It appears that these red ants were recognized as therapeutically valuable (and therefore, biochemically active) based on the potency of their painful stings. This empirical quality dovetailed with native ideological constructs which equated poison with both curative and supernatural power, potentiating their use in therapeutic and visionary contexts.

Both published and unpublished ethnographic accounts have been examined in light of general biology, pharmacology, and toxicology in order to assess the pharmacological wisdom that informs this exotic and seemingly bizarre practice. The extant ethnographic sources cited in this paper strongly suggest that, through either direct or indirect action on the central nervous system, massive quantities of *Pogonomyrmex* venom are capable of producing highly altered metabolic states during which hallucinatory visions are apt to manifest. While it is possible that kinin-like compounds are implicated, the non-specific nature of the ethnographic accounts, combined with the preliminary state of our knowledge concerning ant venom chemistry makes it impossible to identify a specific pharmacological agent or definite mechanism of action.

NOTES

[1] Justin O. Schmidt generously provided taxonomic and toxicological data based on his *Pogonomyrmex* collections from southern and south-central California. He may be contacted at the following address: Justin O. Schmidt, Research Entomologist/United States Department of Agriculture/Agricultural Research Service/Carl Hayden Bee Research Center/ 2000 East Allen Road/Tucson, AZ 85719-1596. Roy Snelling also provided valuable information on the current nomenclature of *Pogonomyrmex* species, their distribution, and size. He may be reached at the following address: Roy Snelling/Los Angeles County Museum of Natural History/900 Exposition Blvd./Los Angeles, CA 90007.

[2] Due to Harrington's non-directive interviewing technique, data on a single subject are often scattered across many pages. In preparing Olivas' account of ritual ant ingestion, several descriptions of the same event (from the same informant) were synthesized to increase clarity. The most complete description was used as the basic structure, and details contained on other pages were inserted where appropriate. Some passages have been lightly edited in order to clarify meaning and to read with more fluidity.

[3] John P. Harrington was accompanied to Ft. Tejón in 1916 by his wife, Carobeth, who carried out some ethnographic interviewing among the Kitanemuk and Interior Chumash. Although her notes have been thoroughly mixed with her husband's (and often attributed to him), they are written in a distinctive hand and are easily distinguished.

José Juan Olivas was one of the Harringtons' principal Kitanemuk and Interior Chumash consultants on the Tejón. Although he was born at Saticoy (and was therefore Castac or "Inland" Chumash by both ancestry and language), Olivas came to Tejón Ranch at age twelve and spent most of his life living among the largely Kitanemuk amalgamation of people at Tejón, where he became very familiar with many Kitanemuk cultural practices (Mills and Brickfield 1986:60). In Harrington's notes it is often impossible to determine whether the data provided by Olivas describes a Kitanemuk or an Interior Chumash practice, so the precise attribution of the ant account must therefore remain uncertain.

[4] Interestingly, exopthalmia (protruding eyes) is characteristic of *Pogonomyrmex* poisoning, and appears to be related to changes in blood pressure behind the eyes (Schmidt 1986:481). The "bloodshot" eyes reported ethnographically might similarly reflect early stages of *Pogonomyrmex* intoxication.

[5] Evidence of the conceptual similarities between these three states is provided by the semantic domain encompassed by the Kitanemuk verb ***-muk***. This intransitive verb can be variously glossed as, "to die, to be intoxicated, to dream of something, to see visions of something." In fact, the incorporated form ***manimuk*** "to be drunk with toloache" might also be translated as "to die from toloache." (c.f. Anderton 1988:411)

[6] This practice has received support from Western biomedicine, in which Hymenoptera are being used in experimental treatments for degenerative joint disease. The venom of *Pseudomyrmex* has been utilized as an efficacious treatment for chronic rheumatoid arthritis (Schultz and Arnold 1978; Schultz et al. 1978), and there is evidence that a component in honey-bee venom alleviates arthritic pain and associated symptoms (Roy Snelling, personal communication 1995)

[7] This observation suggests the intriguing possibility that harvester ants, like *Dendrobates*, may be able to sequester psychoactive compounds from dietary sources such as plants.

Although there is no direct evidence in support of this hypothesis, it would not be unusual. Many insects are known to sequester chemicals derived from dietary sources—the moth *Eloria noyesi* feeds on the leaves of *Erythroxylon coca* and sequesters cocaine (J. Ott, written communication 1995), and certain bees have been known to produce intoxicating honeys after sequestering alkaloids from the nectar of hallucinogenic plants such as *Virola surinamensis* and *Atropa belladonna* (J. Wilbert, personal communication 1995; Ott 1993:404).

[8] Both the moth larvae and the Tlaxcala bird examples are based strictly on hearsay—no voucher specimens were collected, the identity of the animals has not been firmly established, and they were never observed in use. The "dream fish" examples appear to relate to a fairly common phenomenon known as ichthyoallyeinotoxism, accidental hallucinogenic fish poisoning (Weil and Davis 1994:2). The resulting symptoms are often impossible to distinguish from poisoning, and the seasonality of the phenomenon suggests that toxicity may be related to unknown environmental factors. Ott (1993:414) classifies most of these examples as "oneirogenic" or dream-inducing substances, and not as true hallucinogens.

[9] Blackburn (1976) suggests that the possible presence of nepetalactone-like compounds may provide the key to unraveling Harvester ant psychoactivity. Nepetalactone is the principal active agent in catnip, and appears to be psychoactive in felines. Although catnip has been reported to be psychoactive in humans following smoking of the dried leaves (Jackson and Reed 1969), it is uncertain whether the cat-active lactones are implicated, as cats are normally affected by the mere aroma of the plant (the active compounds being volatile) (Ott 1993:415). Respiratory administration by smoking may involve an altogether different mechanism of action.

[10] Although there are no clinical data on the reactions of human subjects to massive quantities of ant venom, there have been several studies (Brown and Bernton 1970; Chipps et al. 1980; Grant et al. 1983) focusing on systemic reactions of hypersensitive individuals to various Hymenoptera stings (ants, wasps, and social bees). While the physiological mechanisms mediating an allergic reaction are different from those which govern a "normal" reaction to large doses of Hymenoptera venom, the symptoms reported in these studies bear a striking resemblance to the physiological effects generated through ritual ant ingestion, namely: lassitude, dizziness, fainting, unconsciousness, and sometimes vomiting.

[11] Although the kinins present in Hymenoptera venom appear to be closely related to bradykinin—the most potent kinin in mammals—even slight structural differences may cause significant changes in activity. In addition, ant venoms contain a variety of unidentified agonists that may alter (or even negate) the effects of kinins. There is very little information on the function and mode of action of whole ant venom—let alone these kinin-like constituents—in the mammalian central nervous system, so this discussion must be viewed as highly speculative. Since most of these experimental results were obtained through direct intracerebral administration of enormous quantities of bradykinin (4 μg/rat), their relevance to human pathophysiological events is uncertain. However, the similarities between the effects generated by kinins in laboratory settings and those reported ethnographically for red ant ingestion are striking and extremely provocative, and warrant further investigation.

[12] A potential argument against this "toxic side-effects" explanation is the observation that toxins often produce a range of severe primary effects (e.g., memory loss, cognitive slowing, convulsions, etc.) that could preclude or overwhelm the hallucinogenic "side effects."

In addition, certain toxins (as well as certain psychoactive compounds) tend to induce hallucinations that are chaotic, disjointed, and poorly remembered upon awakening. One could argue that such substances are not likely to be used in shamanic or visionary practice because the visions they generate do not lend themselves to meaningful interpretation—therefore, the experience would not likely be repeated, and would certainly not be instituted as a widespread ritual practice.

However, the ethnographic facts do not entirely support such observations. Certain substances (such as tobacco), are useful as visionary agents precisely because of their toxic constituents, and severe physiological "primary effects" are considered part and parcel of the "hallucinogenic" shamanic experience generated by these substances (c.f. Wilbert 1987, 1991). Also, it should be remembered that—in addition to the use of red ants—aboriginal southern and south-central California shamanism was based upon the use of two exceedingly toxic substances: tobacco (*Nicotiana* spp.), and the highly toxic hallucinogen *toloache* (*Datura wrightii*).

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BOOK REVIEW

Histoire Illustrée du Caoutchouc. J. B. Serier, A. Diez, and A. Van Dyck. Montpellier, France (Cirad-CP, BP5035, 34032 Montpellier Cedex 1): Editiones Desjonquères, 1993. Pp. 96. (Price and ISBN not found).

A most remarkable book has appeared: a pictorial history of rubber. It will be of interest to specialists in the production of this most important economic plant, to teachers, to students and, in fact to the general reader.

The illustrated history begins with the dinosaur age. It then proceeds to: the Aztec use of rubber and the European encounter with the product; the 18th century with the uses in Europe of this new substance; the early French interest in rubber; the Humboldt and Bonpland period, followed by the discovery by Goodyear of vulcanization; the ensuing proliferation of commercial and industrial uses; the effect of rubber on bicycle and motor car transport; the rubber boom and mistreatment of rubber tappers in Africa and South America; the several attempts to procure seed to domesticate Hevea; and many later commercial and scientific events, including such historically significant aspects as the influence on the British and Dutch plantations of Asia from the Japanese occupation in 1945, plus an innumerable series of exceedingly interesting and important aspects of the history of rubber.

As a botanist who has devoted nearly half a century in field work on rubber in the Amazon (taxonomic studies of the sources of rubber) and has published many scientific papers on Hevea rubber, I applaud the authors of this unusual way of presenting the full history of rubber-producing plants and their effect on the creation of our modern world. It is with great pleasure that I recommend this contribution with no reservations as a major step in explaining the history of rubber to a wide audience without recourse to many books, most of them unavailable in many libraries.

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The Diversity and Evolution of Plants. Lorentz C. Pearson. Boca Raton, Florida: CRC Press. 1995. Pp. viii; 646. $59.95 (Outside United States, $72.00 U.S.). ISBN 0-8493-2483-1.

There can be no other word to describe this book than the term "encyclopaedic ." Its 640 pages, 86 tables and 182 well chosen illustrations provide a veritable mine of information and from an interdisciplinary point of view. It can, without any reservation, be recommended for its unexcelled presentation of material valuable for environmental conservation specialists even though it is basically a textbook for advanced students in its method of presentation of the technical contents. Each part contains suggested readings, student exercises, special interest essays and often other topics for student guidance. It is much more than a student guide however, and it can be used as an excellent source of easily obtainable information.

The author, Lorenz C. Pearson, is Professor of Botany and Curator of the Cryptogamic Herbarium at Ricks College, Roxbury, Idaho, and Adjunct Associate Professor in Brigham Young University, Provo, Utah, and has written several other books and more than 40 technical articles.

The Diversity and Evolution of Plants is divided into four parts: I. Introduction. II. The Red Line. Prokaryotes, Red Seaweeds; Terrestrial Fungi (Molds and Mushrooms); Lichens and other Symbiotic Plants); III. The Brown Line. Fire Plants and *Cryptophytes;* Slime Molds; The Ubiquitous Algae (Diatoms and other *Chrysophytes*); Flagellated Fungi; Kelps and other Brown Seaweeds. IV. The Green Line. Euglenids; The Pond "Mosses" (Siphonophytes and Stoneworts); Mosses and Liverworts; Fern Allies and Origin of Vascular Plants; Ferns; Gymnosperms, and Flowering Plants.

There follow: a Glossary of 319 technical terms, 19 pages of very useful bibliographic entries, and a most exhaustive index occupying 39 pages.

The author rightly said: "Knowledge about plant diversity is important to everyone, not only to an ecologist-geneticist like me or to the tropical taxonomist, daily awed by how meagre our knowledge of diversity really is, but to every soul who eats and breathes... Human life, and indeed all life, is unthinkable without the food and oxygen which only green plants can produce." He has done a masterful job in presenting the significance of this diversity.

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RECONSTRUCTING PREHISTORIC SOCIOECONOMIES FROM PALEOETHNOBOTANICAL AND ZOOARCHAEOLOGICAL DATA: AN EXAMPLE FROM THE BRITISH COLUMBIA PLATEAU

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ABSTRACT.—The Keatley Creek site, located on the British Columbia Plateau, is composed of 119 house depressions. In order to investigate the position of residential structures of different sizes in the socioeconomy at Keatley Creek, we compare the density, diversity, and distribution of the plant and animal remains recovered from the living floors of a small, medium-sized, and large housepit. In particular, we investigate whether differences in these residential structures correlate with differences in housepit socioeconomic status, and whether the larger housepits show evidence of distinct domestic subgroups, which themselves differ in socioeconomic status. This requires a number of methodological approaches that are not commonly used. The results of both the faunal and floral analyses indicate that density and diversity of remains do vary with housepit size. Taxonomic richness of both plants and animals suggest that more diverse activities took place in the largest structure. The faunal remains, but not the floral remains, support the hypothesis that the large housepit was divided into distinct domestic subgroups, possibly of unequal socioeconomic status. The distribution of floral and faunal remains from the medium-sized and small houses suggests that internal domestic subgroups were less pronounced and activities were undertaken more communally. A larger, more diverse sample is needed before we can make more definitive statements about the prehistoric socioeconomy at Keatley Creek, but this study demonstrates the value of combining paleoethnobotanical and zooarchaeological analyses in studies of prehistoric social and economic organization.

RESUMEN.—El sitio arqueológico de Keatley Creek, ubicado en la región de la Meseta en Columbia Británica, Canadá, está compuesto de 119 depresiones habitacionales. Con el fin de investigar la posición de estructuras residenciales de diferente tamaño en la socioeconomía de Keatley Creek, comparamos la densidad, diversidad y distribución de los restos de plantas y animales recuperados de los pisos de una vivienda pequeña, una mediana y una grande. En particular, investigamos si las diferencias en estas estructuras residenciales se correlacionan con diferencias en estatus socioeconómico, y si los fosos habitacionales mayores muestran evidencia de subgrupos domésticos distintos que difieran entre sí en estatus socioeconómico. Esto requiere de un número de aproximaciones metodológicas que no son comunmente empleadas. Los resultados tanto de los análisis faunísticos como florísticos indican que la densidad y la diversidad de los restos sí varían en relación al tamaño del foso habitacional. La riqueza taxonómica de ambos, plantas y animales, sugiere que en la estructura mayor se llevaban a cabo actividades más diversas. Los restos de animales, mas no de plantas, apoyan la hipótesis de que el foso habitacional más grande estaba dividido en subgrupos socioeconómicos distintos, posiblemente de estatus socioeconómico desigual. La distribución de los restos florísticos y faunísticos de las viviendas medianas y pequeñas sugiere que los subgrupos domésticos internos eran menos pronunciados y que las actividades eran emprendidas en forma más comunitaria. Se requiere de una muestra mayor y más diversa antes de que podamos hacer declaraciones más definitivas acerca de la socioeconomía prehistórica en Keatley Creek, pero este trabajo demuestra el valor de combinar los análisis paleoetnobotánicos y zooarqueológicos en los estudios de la organización social y económica prehistórica.

RÉSUMÉ.—Le site de Keatly Creek, situé sur le Plateau de la Colombie britannique, est composé de vestiges de 119 maisons. Pour connaître le rôle de chacune des différentes structures résidentielles dans la vie économique et sociale de Keatly Creek, nous avons comparé la quantité, la diversité et la répartition des débris d'espèces végétales et animales trouvés dans les parties habitées d'une petite, d'une moyenne et d'une grande maison. Plus spécifiquement, nous avons cherché à savoir s'il y avait une relation entre la quantité, la diversité et la répartition de ces débris dans les différentes maisons et les différents statuts sociaux et économiques des occupants des maisons excavées et, dans le cas des grandes maisons, si des sous-groupes domestiques distincts avec des statuts sociaux et économiques différents ont pu coexister. Une telle recherche a nécessité l'emploi de plusieurs méthodes généralement peu utilisées. Les résultats des analyses des débris d'espèces végétales et animales montrent que la quantité et la diversité des mêmes débris varient effectivement en fonction de la taille des maisons. L'abondance taxinomique des débris à la fois floraux et fauniques suggère qu'il se tenait plus d'activités variées dans la grande maison. L'analyse des débris d'espèces animales, ce qui n'est pas corroboré par celle des débris d'espèces végétales, vient étayer l'hypothèse de la présence de sous-groupes domestiques distincts, à statuts sociaux et économiques probablement inégaux, dans la grande maison. La répartition des débris floraux et fauniques dans les deux autres maisons porte à croire que la différenciation des sous-groupes domestiques y était moins prononcée et que les activités qui s'y tenaient étaient plus communautaires. Il faudra examiner un échantillon plus important et diversifié avant de se prononcer de façon définitive sur la vie économique et sociale préhistorique de Keatley Creek. Toutefois, la présente étude montre l'intérêt d'utiliser ensemble des méthodes d'analyse paléoethnobotaniques et zooarchéologiques dans l'étude de l'organisation de la vie sociale et économique des sociétés préhistoriques.

INTRODUCTION

Differential access and control over resources are fundamental charactersitics of complex societies which are reflected in the archaeological record. To examine the archaeological correlates of socioeconomic complexity, we focus on the remains of a large winter village located along the Fraser River in southwestern British Columbia (Figure 1). Ethnographic and archaeological evidence suggests that the hunter-gatherer subgroups occupying these pithouse villages were socially and economically complex (Hayden and Ryder 1991; Hayden and Spafford 1993; Hayden *et al.* 1985). The wide variation in size and apparent complexity of the pithouses led us to develop hypotheses about social and economic differences both among and within pithouses, and to postulate that these differences would be reflected in the organic remains within the houses.

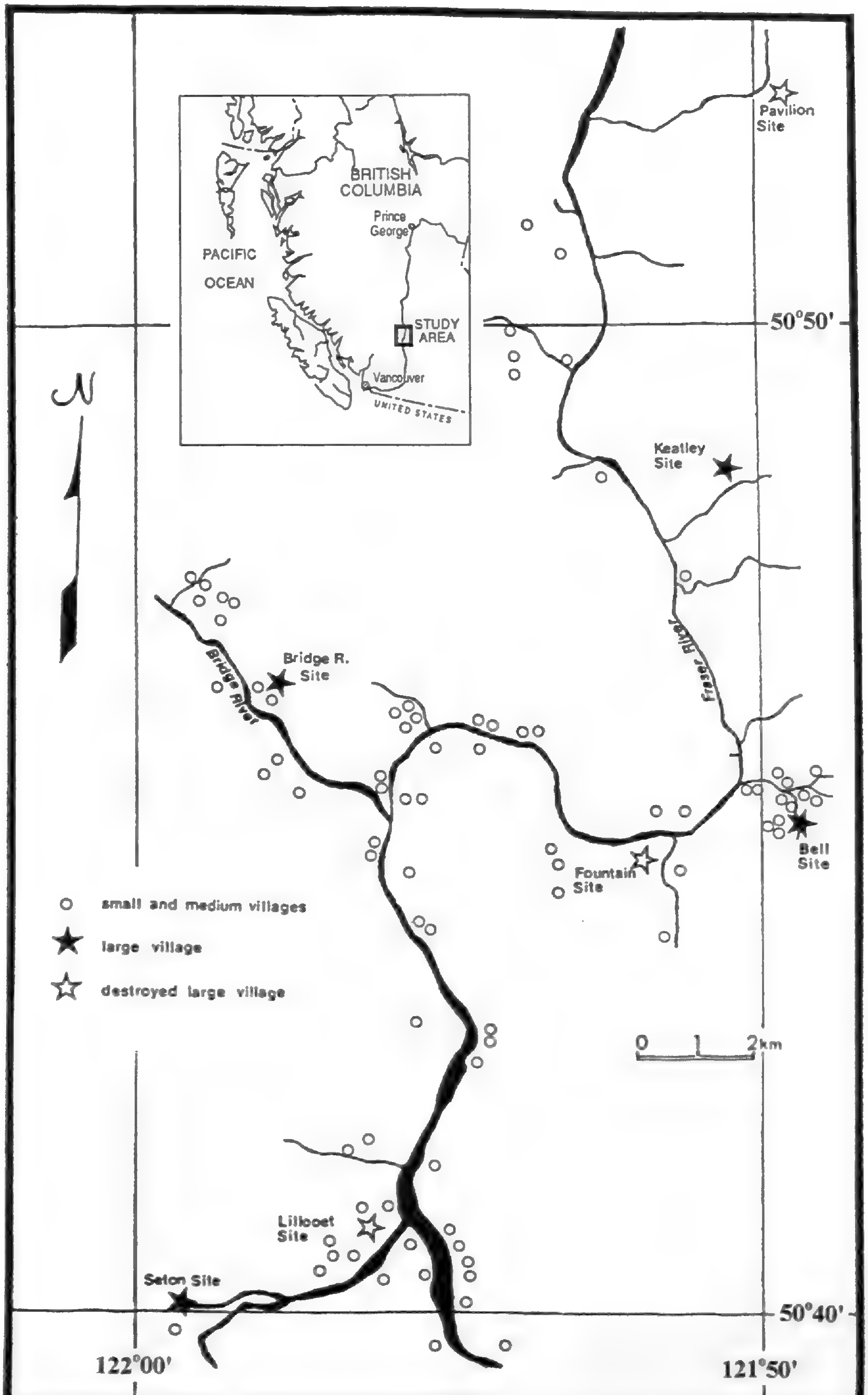
In 1986, an excavation program began at the Keatley Creek site, the largest remaining pithouse village in the region, to reconstruct the prehistoric social and economic organization at the site, and in particular to investigate the position of the vastly different sized residential structures in the socioeconomy. There are a total of 119 house depressions at the site, ranging in size from 5-21 meters in diameter measured from rim crest to rim crest. In order to understand the nature of the different sized structures, a detailed comparison of the economic and social organization of various sized residences was undertaken. In this paper we discuss the socioeconomy of the Keatley Creek site as reflected in species composition, species richness, and spatial distributions of paleoethnobotanical and zooarchaeological remains recovered from the living floors of a small, medium-sized, and large housepit.[1]

In developing the overall goal of the project, Hayden *et al.* (1985) hypothesized that the housepit village at Keatley Creek was occupied by residential corporate groups of differing economic and social status. They posited that differences in housepit size were dependent upon socioeconomic differentiation and control. The larger houses, they predicted, housed groups of relatively greater wealth and status, and should exhibit greater internal socioeconomic differentiation than smaller structures.

These hypotheses generate the following predictions:

1) *Differences in residence structure size generally correlate with differences in socioeconomic status*, such that the largest houses contained the most privileged individuals, and the proportionally smaller structures the less privileged ones. Assuming that more affluent groups produce more refuse in a greater variety of con-

FIGURE 1.—Location of Keatley Creek site and other housepit village sites in the study area.



texts, the larger housepits should contain the greatest density and diversity of remains (after sample size has been taken into account), and the greatest number of special or restricted items. The pattern should hold despite the fact that the ethnographies suggest that smaller houses contained a higher density of people than larger structures, and therefore are more likely to produce more remains, all other things being equal (Hayden et al. 1992). The pattern will not apply to special, nonresidence structures, such as feasting or sweat lodges.

2) *The larger residence housepits should exhibit greater internal differentiation than the smaller structures*, indicating the relatively more varied socioeconomy within those structures. The larger, more privileged residential groups will tend to have a wider range of individuals and domestic subgroups with differing wealth, occupation, and status. This would be expressed in two ways: a) by the delineation of the housepit floor space into areas used by distinct domestic subgroups; and b) by differences in status, wealth and/or occupation between these distinct domestic subgroups.

A "domestic subgroup" may be composed of a single nuclear family, an extended family, or several unrelated individuals or families. The delineation of distinct domestic subgroups is distinguished archaeologically by the regular, repeated patterning of food processing and consumption remains across the floor, with each set of remains being associated with a different subgroup. Differences in status, wealth, and/or occupation among domestic subgroups would be expressed by the presence of special or restricted items associated with only some of the distinct domestic subgroups. The absence of regular, repeated patterning of all remains would suggest that internal domestic subgroups were less pronounced and that housepit activities were undertaken more communally.

Initially, 24 housepits were tested to determine their suitability for more extensive excavation and to test these hypotheses. Because of the goals of the project, all large and many small housepits were tested, particularly those in areas less likely to have undergone disturbance by subsequent building events. Almost all of the large and medium-sized housepits tested were first occupied during the Shuswap horizon (3,500–2,400 b.p.), continued to be used during the Plateau horizon (2,400–1,200 b.p.), and were abandoned at the beginning of the Kamloops horizon (1,200–200 b.p.). Refuse inside the house was periodically gathered together and dumped outside at the base of the roof forming stratified rim middens surrounding the house depressions. Houses had to be re-roofed periodically, probably every 1-3 years.[2] It appears that all the accumulated living floor debris and sediment were removed, and a clean till floor re-established with each re-roofing event. In most houses tested, there was no remaining evidence of multiple house floors. Thus the floor sediments that we excavated represent the accumulated debris of the residents from the last re-roofing event until final abandonment of the house.

We completely excavated the floors of a small (HP 12), medium-sized (HP 3), and large housepit (HP 7). These housepits were chosen because of the ease of defining their floor deposits and because the floor deposits in these housepits were approximately contemporaneous. Clearly defined floor and roof deposits were identified in the selected small, medium-sized, and large housepits on the basis of field criteria such as charcoal remains of roofs, color changes, textual changes, and artifact orientations. The botanical and faunal material comprising the analyses reported here resulted from these excavations. The specific goals of the analyses were to delineate patterning of remains across the floors of the three houses, and to make comparisons between the structures which could provide insights into socioeconomic differences.

The three housepits are ideally suited for such a study. All three houses were clearly residences rather than special function structures. This is most strongly indicated by the lithic assemblages in all three strucutres which displays a basic underlying similarity including artifacts likely to have been used by both women (hide scrapers, abrading stones, fire-cracked rocks) and men (projectile points, bifaces; Spafford 1991). The large and medium-sized housepit floors (HPs 7 and 3) yielded radiocarbon dates that were indistinguishable (c. 1100 bp). The smaller housepit appears to have been occupied a few hundred years earlier, but we feel it is representative of the social and economic organization of smaller housepits.[3]

The persistent association of a *different* type of lithic material with each major housepit from Shuswap times until final abandonment indicates that a single corporate group retained ownership of each large house site over this time period (Hayden 1996). Presumably, each large residential corporate group controlled a separate hunting and gathering area in the mountains and different types of chert were located in these different resource areas. Each corporate group brought back their distinctive chert type to their winter residence. The persistant association of a given lithic type with a particular house implies that the large and medium-sized housepits were continuously occupied over more than 1,000 years by a single, identifiable social group with periodic re-roofing and excavation of prior living floor accumulations. During this time, the larger structures do not appear to have changed fundamentally in size or internal organization based on the relatively close clustering of main post holes and the constant position of storage pits in relation to the edge of the floors.

All houses seem to have been systematically abandoned, with no useful or valuable material being left on the floors. Roofs in all three structures were burned soon after abandonment, thereby sealing the floor deposits from subsequent disturbance and providing a charcoal layer useful in distinguishing the floor from the roof deposits. The burning of all three structures after abandonment resulted in the preservation of a wide variety of floral remains.

The non-random distributions of botanical, faunal, and lithic remains associated with hearths and walls suggest little disturbance or mixing of floor sediments. Further, there is little evidence for contamination or confounding taphonomic factors, such as carnivore damage (Kusmer 1993a; Lepofsky 1993a). The discrete distributions of seeds and fish remains, in particular, are convincing since small remains appear to be those most likely to reflect original primary refuse patterns (Bartram *et al.* 1991; Gifford 1980; Miksicek 1987; O'Connell 1987; Stahl and Zeidler 1990). Nor was there any accumulation of refuse in the center of any of the housepits as one might expect from post abandonment dumping. Moreover, the depositional environment of the three housepits seem to have been similar, suggesting that differences in the preservation of organic remains should be largely due to cultural rather than environmental factors. The Keatley Creek remains, then, are ideal for examining the archaeological correlates of socioeconomic behavior in the pithouses.

The usable floor of the largest excavated housepit (HP 7), which covered an area approximately 113 m^2 (not including wall slopes), had a series of well developed fire-reddened areas close to the west perimeter of the floor (Figure 2). These were associated with large storage pits, concentrations of fire-cracked rock, tools, debitage, abrading stones, and anvil stones. The eastern part of the floor had a number of less well defined hearths associated with fire-cracked rock, anvils, tools, debitage, and abrading stones, but no large storage pits, and a narrow earthen bench or shelf along the perimeter. Based on lithic analyses, the fire-reddened areas appear to correspond to individual domestic subgroups within this large house (Spafford 1991). We are interested in determining whether the distribution of organic remains supports this supposition.

The floor plans of the medium-sized and small housepits are less complex than the large structure (Figures 3 and 4). The medium-sized housepit (HP 3) covered approximately 78 m^2 in area. A wooden bench is suggested by carbonized planks remains recovered along the eastern and northeastern walls. One large storage pit in the northwest floor and three additional more shallow depressions are located on the floor of the medium-sized structure. There are also three fire-reddened areas on this floor. The small housepit (HP 12), which covers only 38 m^2 in area, had only one fire-reddened area and several shallow depressions.

It is difficult to determine whether floors in the three structures were occupied for the same length of time. However, the debris and discoloration on each of the floors were substantial enough to indicate that all had been used for a number of years. We do not expect any of the floor accumulations to represent more than 60 (and probably far fewer) consecutive years since the last re-roofing event of the structure. The smaller housepit does not appear to have been occupied long enough for a significant amount of debris to have accumulated on the housepit rim. In the other housepits, the rim debris deposits are very thick and begin their depositional sequences prior to 2400 bp.

ENVIRONMENTAL SETTING

The Keatley Creek site is situated about 25 km upstream along the Fraser River from the modern community of Lillooet, British Columbia. The village site is located on a terrace of morainal origin, about 370 m above and 1.5 km distant from the Fraser River. The vegetation on the site today is characteristic of disturbed grasslands in the region and is dominated by various grasses and big sagebrush (*Artemisia tridentata*). Forested slopes rise steeply to the east of the village and, near the site, are dominated by ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*). These forests extend from the site up to where they grade into sub-alpine meadows. They represent a characteristic elevational sequence of biogeoclimatic zones from the Ponderosa Pine zone, through the Interior Douglas-Fir zone, to a mix of montane and subalpine forest types (Meidinger and Pojar 1991).

The location of the Keatley Creek site on benchlands above the Fraser River gorge allowed access to a variety of animal and plant resources due to the range of biotic zones available within a short distance of the site. Principal food species

FIGURE 2.—Maps showing features and distribution of floral and faunal remains on floor of large housepit (HP 7). Boxes on floral maps indicate 50 x 50 cm sampling subsquares for flotation.

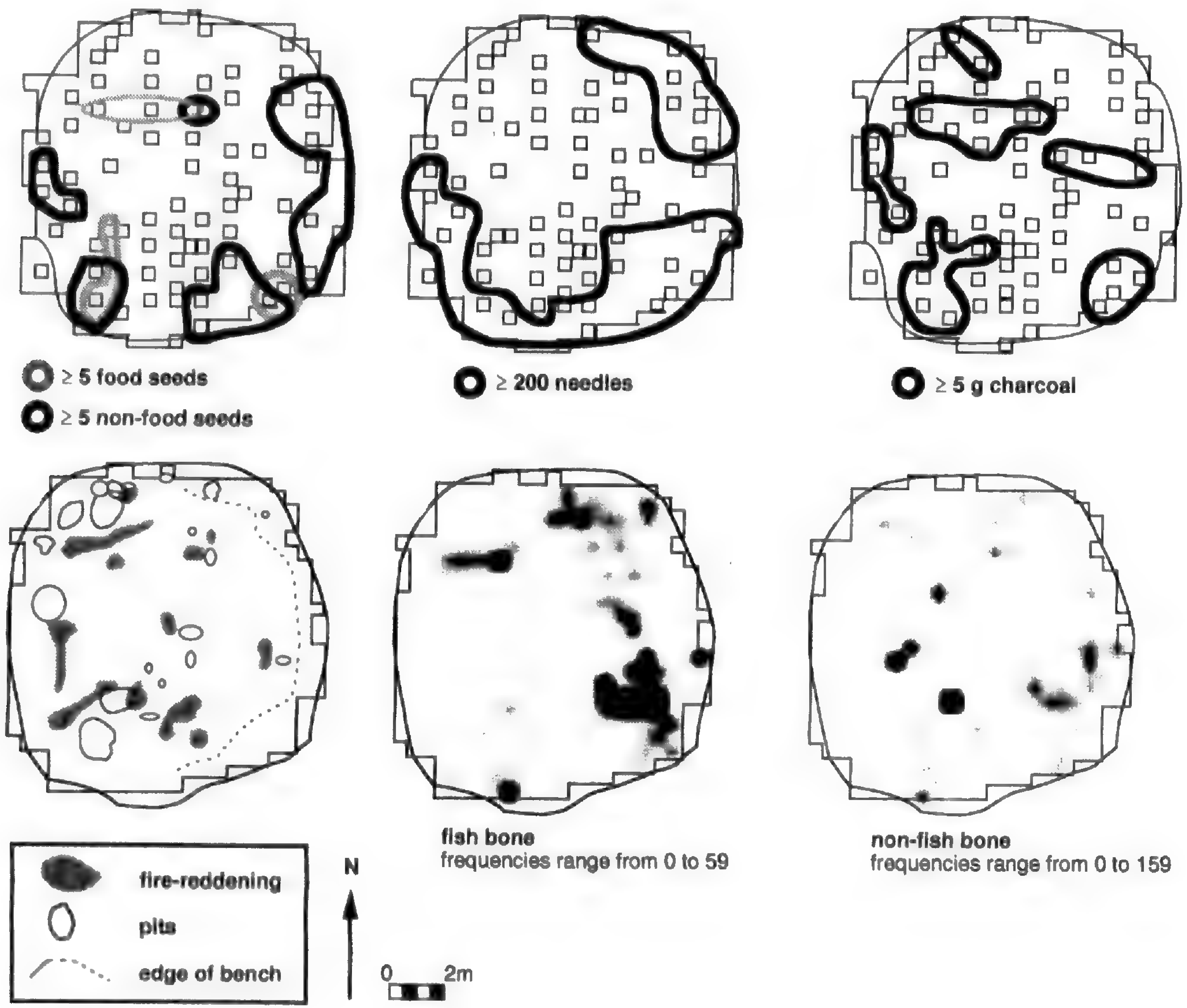
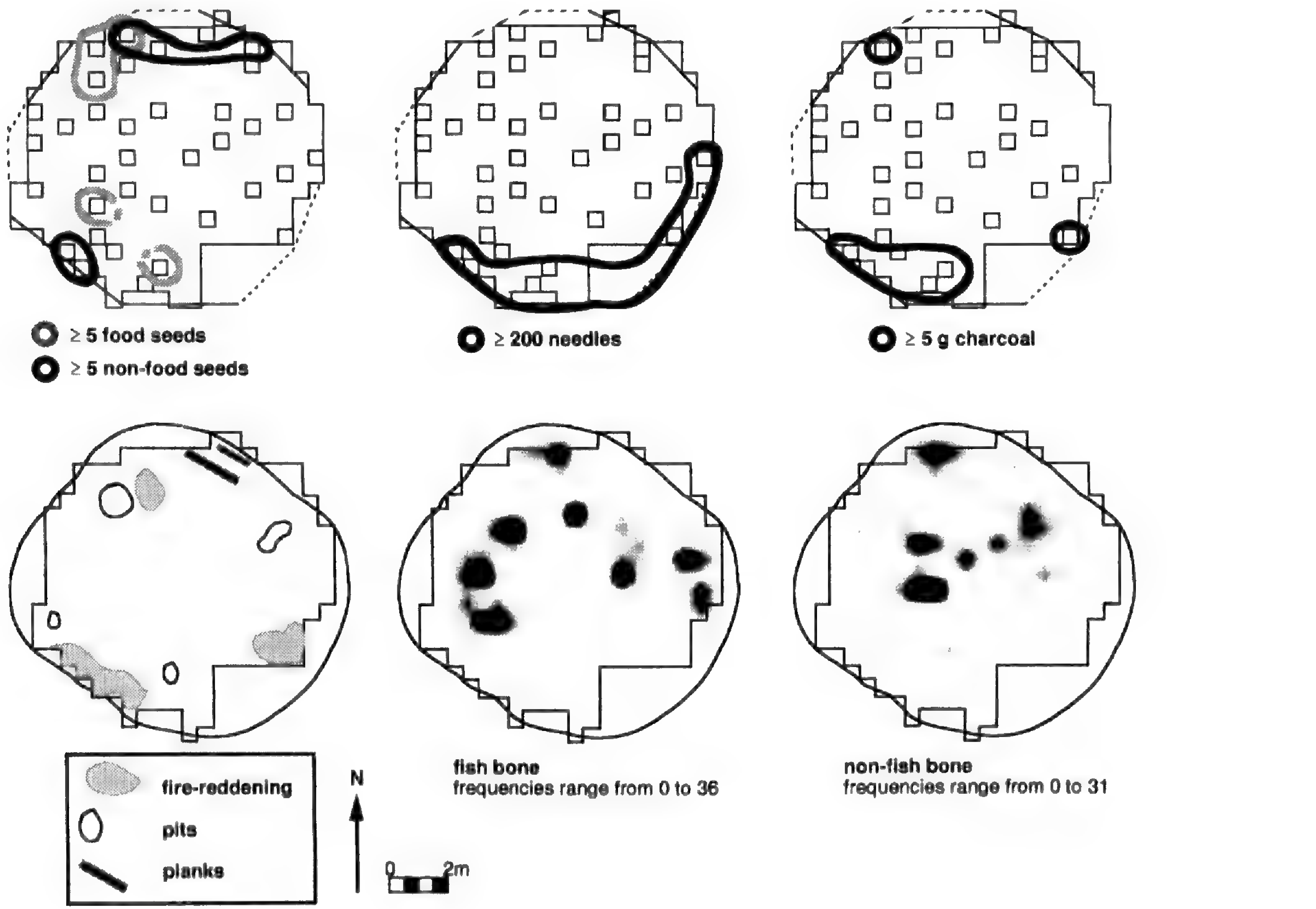


FIGURE 3.—Maps showing features and distribution of floral and faunal remains on floor of medium-sized housepit (HP 3). Boxes on floral maps indicate 50 x 50 cm sampling subsquares for flotation.



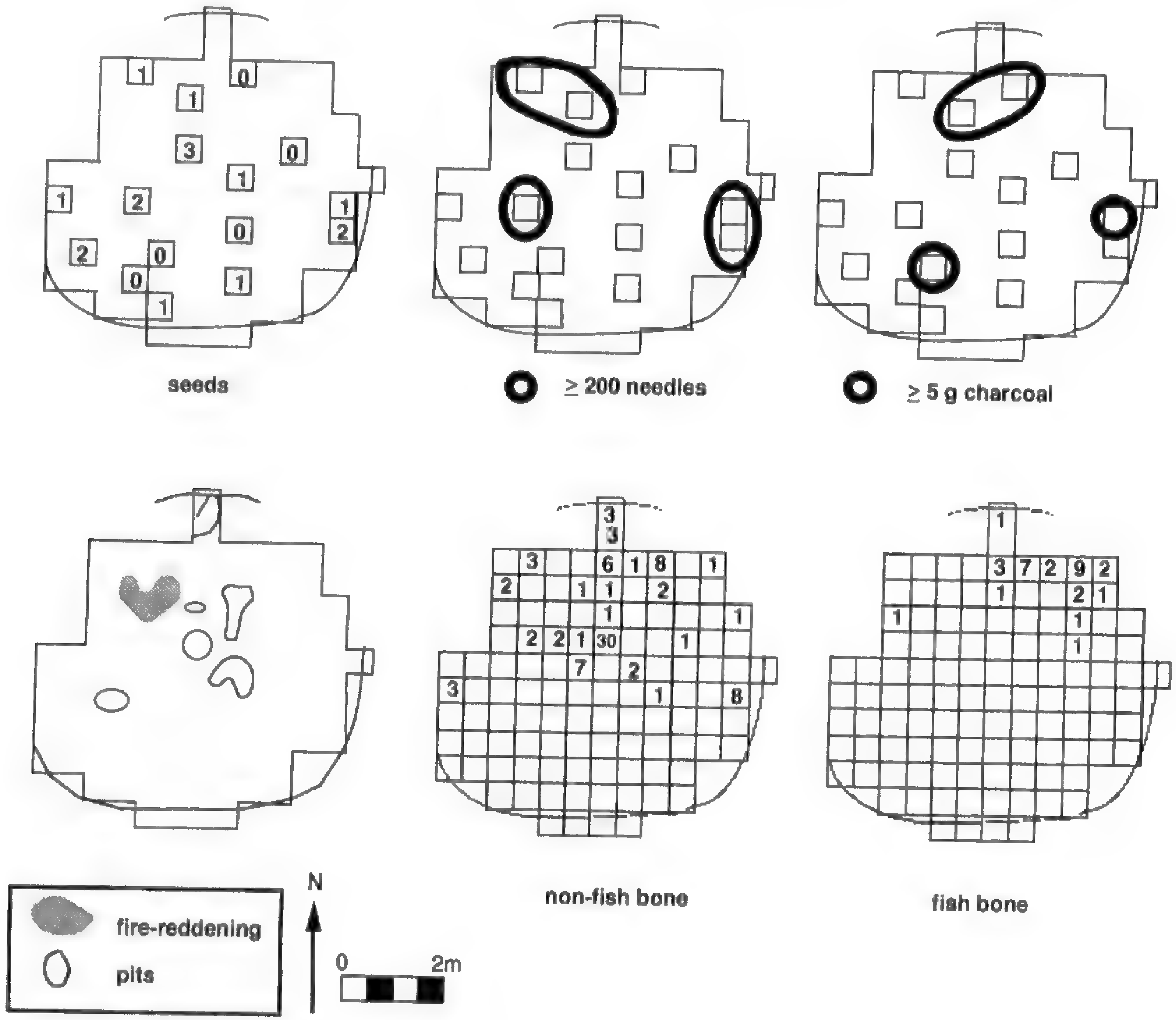


FIGURE 4.—Maps showing features and distribution of floral and faunal remains on floor of small housepit (HP 12). Boxes indicate 50 x 50 cm sampling subsquares. Numbers in the subsquares are the total numbers of seeds or bones recovered from each subsquare.

include anadromous salmon (*Oncorhynchus* spp.), deer (*Odocoileus* spp.), bighorn sheep (*Ovis canadensis*), a variety of berry crops such as rosehips (*Rosa* spp.), currants (*Ribes* spp.) and saskatoons (*Amelanchier alnifolia*), and several edible "roots" including balsamroot (*Balsamorhiza sagittata*), various members of the lily family, and several *Lomatium* species. See Alexander (1992) for a more detailed discussion of fauna available in the various vegetation zones around the site and Turner (1992) for a detailed ethnobotanical discussion of plant use by the St'at'imc (Upper Lillooet) of the Keatley Creek area.

METHODS

Excavators collected bulk flotation samples for the paleoethnobotanical analysis from designated 50 x 50 cm sampling subsquares (Figures 2-4). All samples were measured to a standardized volume of one liter and then floated using the "garbage can" technique (Watson 1976). The bucket mesh was 1.0 mm and the scoop mesh was 0.45mm. The light fraction provided the material for the paleoethnobotanical analysis (Lepofsky 1993a, 1993b) and the heavy fraction the material for the microfaunal and microdebitage analyses (Handley 1990; Kusmer 1993a, 1993b). The heavy fraction was also checked for charred botanical remains.

A total of 123 flotation samples from pithouse floor contexts was examined for archaeobotanical remains, which was comprised of 69 samples from the large housepit (HP 7), 38 from the medium-sized housepit (HP 3), and 16 from the small structure (HP 12). In the large and medium-sized housepits roughly 15% of the floor subsquares were examined for archaeobotanical remains; approximately 12% of the floor subsquares of the small housepit were examined.

Faunal remains were recovered from 6.35 mm mesh dry screening of the excavated floor deposits and from the heavy fraction of flotation samples, which allowed recovery of bones down to 1 mm in size. All the faunal remains recovered from the 6.35 mm screens from the three housepit floor deposits were examined. In the large and medium-sized housepits faunal remains from flotation samples were examined from ca. 25% of the floor subsquares, while ca. 16% of the remains from the small housepit were examined. Faunal remains from the examined flotation samples consist of salmon fragments and tiny, unidentifiable mammal fragments. These data largely proved to be redundant with data from the larger mesh screens; the few exceptions are discussed below. Our analyses and discussion of relative frequencies of taxa, taxonomic richness, and eveness are based on data from the 6.35 mm screens.

RESULTS

The results of the paleoethnobotanical and zooarchaeological analyses for the large, medium-sized, and small housepits are discussed in turn below, followed by comparisons of remains among the three structures. The frequency and distribution of archaeobotanical and zooarchaeological remains across the floors of the housepits are represented in Figures 2-4. High concentrations of archaeobotanical and zooarchaeological remains are distinguished on the maps. Lists of the plant and animal taxa recovered, their frequencies, and uses are presented in Tables 1 and 2.

TABLE 1.—Archaeobotanical remains recovered from the floor of the three housepits.*

Scientific Name (common name)	Part found†	Frequency			Primary Use‡
		Large HP (HP 7)	Medium HP (HP 3)	Small HP (HP 12)	
Alnus cf. *sinuata* (alder)	C	5			T
Amelanchier alnifolia (saskatoon)	S	40	27	2	F
Arctostaphylos uva-ursi (kinnikinnik)	S	9	11		F
Betula papyrifera (paper birch)	C	1			T
?Boraginaceae (Borage Family)	S	1			?
Carex sp. (sedge)	S		1		T
Chenopodium sp. (chenopod)**	S	148	36	10	?
Cornus sericea (red-osier dogwood)	S	3			F
Ericaceae (Heather Family)	S	62	44	2	?F
Graminae (grass) **	S	77	9		T
——	O	79	115		T
Opuntia sp. (prickly pear)	S	2	12		F
Phacelia sp. (phacelia)	S	20	7		O
Pinus ponderosa (ponderosa pine)	N	10078	7521		T
——	C	67	25		T
Populus sp. (cottonwood)	C	44	20		T
Prunus sp. (cherry)	S	4			F
Pseudotsuga menziesii (Douglas-fir)	N	18129	835		T
——	C	218	88		T
——	S		5		?
Rosa cf. *woodsii* (rose)	S	9	1		F
Scirpus sp. (rush)S	1			T	
Silene sp.	S		1		O
Smilacina stellata (Solomon's seal)	2			F	
Unidentified	C	14	7		—
Unidentified	S	94	16	2	—
	(HP 7)	(HP 3)	(HP 12)		
Total N††	C	349	140	—	—
Total N	S	472	172	16	—

*Miscellaneous plant parts, such as buds, bark, and other plant tissues are not included here. See Lepofsky (1993a) for complete presentation of data.

†C = charcoal; S = seed; N = needle; O = other

‡F = Food; T = technology; O = other; see Lepofsky (1993a) for more detailed ethnobotanical descriptions.

**There is no ethnobotanical or paleoethnobotanical evidence that either chenopods or grass seeds were ever eaten in the Interior Plateau.

†† Charcoal from only a small number of the total flotation samples were identified. No charcoal specimens from HP 12 were identified.

TABLE 2.—Faunal remains recovered from the three housepits floors.

Scientific Name (common name)	**Frequency**			**Primary Use‡**
	Large HP (HP 7)	**Medium HP (HP 3)**	**Small HP (HP 12)**	
Uniden. freshwater shellfish	5	2		T
Dentalium sp. (dentalium)	3			T
Hinnites giganteus (purple-hinged rock scallop)	1			T
Margaritifera falcata (freshwater shellfish)	2	-		T
Nucella sp. (dogwinkle)	1			T
Oncorhynchus sp. (salmon)	1344	314	31	F
Accipiter sp. (hawk)	2			T
Tetraoninae (grouse)	4			F
Bird	1			
Lepus americanus (snowshoe hare)	19			F,T
Castor canadensis (beaver)	16	4	3	F,T
Peromyscus sp. (deermouse)	1			
Microtus sp. (vole)	9			
Canis familiaris (domestic dog)	1	41 (MNI = 1)		
Vulpes vulpes (red fox)	1			T
Ursus arctos (grizzly)	1			T
Artiodactyl	27	12	3	F,T
Cervus elaphus (elk)			2	F,T
Odocoileus sp. (deer)	42	5	1	F,T
Ovis canadensis (bighorn sheep)	1			F,T
Unidentified large mammal	176	35	10	
Unidentified mammal	751	147	71	
Total NISP	**2407**	**561**	**121**	

‡ F = Food; T = Technology; see Kusmer 1993a for more detailed accounts of taxa.

The paleoethnobotanical remains were divided into the three major plant categories recovered on the floor: charcoal, needles, and seeds. Seeds were divided further in the large (HP 7) and medium-sized (HP 3) structures into food seeds, non-food seeds, and unidentified seeds (see Table 1 and Lepofsky 1993a for ethnobotanical descriptions). The category "unidentified seeds" is largely composed of single specimens of each unidentified taxon. In each of the housepits, floral remains were quantified by determining the number of specimens per one liter flotation sample collected from each sampling subsquare. These numbers were used to determine the concentrations of remains on the floors.

Distinguishing archaeobotanical patterning across the floor of the small housepit is somewhat more problematic than in the two larger housepits. Because the small housepit has such limited floor space, clusters of remains may be more spatially restricted than in the other housepits. Thus, although roughly the same percent of surface area in the three structures has been analyzed for archaeobotanical remains, we may be missing relatively more information in the unsampled subsquares of the small structure. Given the nature of the paleoethnobotanical sampling strategy in the small housepit, any concentration of remains is likely to be defined by very few subsquares.

The zooarchaeological analysis was divided into fish and non-fish (mammal, bird, and shellfish) remains. Within the mammal category, it is difficult to interpret activities with respect to artiodactyls because of the nature of the bone fragments. The high degree of bone fragmentation and loss due to marrow extraction, burning, tool making, the clearing of the floor of large debris, and trampling, resulted in few identifiable fragments. Because of the low numbers, it is difficult to compare identifiable elements on a hearth to hearth basis, but it is useful to compare frequencies of unidentifiable bones. The identifiable fragments reflect most clearly their resistance to the above processes and their relative identifiability as small fragments. The rather extensive bone and antler tool industry reflected in the bone artifacts would also have affected the presence/absence of specific elements of artiodactyls.

The large housepit.—Archaeobotany. Charcoal, needles, and seeds are distributed non-randomly on the floor of the large housepit (Figure 2). Relatively denser concentrations of charcoal fragments are located in six discrete clusters on the floor of the large structure. The charcoal clusters correspond well with the hearths on the western perimeter of the floor. On the eastern side, charcoal concentrations and the less well defined fire-reddened areas do not correspond. This may be due to the fact that the eastern hearths were not used frequently enough to have accumulated or retained large amounts of charcoal debris. Conversely, the presence of charcoal and no hearths may be contamination from the burnt roof.

Conifer needles in the large housepit are clustered along much of the periphery of the floor, and are almost entirely absent from the center of the structure. The concentration of conifer needles around the periphery of the floor likely indicates the deliberate covering of the floor and sleeping platform with boughs for bedding or floor covering, as was documented in ethnographic times (Teit 1900:199). This in turn implies that there were sleeping or domestic areas behind the hearths around most or all of the house perimeter.

There are three discrete concentrations of food seeds across the large housepit floor, all of which correspond closely to charcoal concentrations. The area in and around the hearth in the north-central area is the largest cluster. If the unidentified seeds are included (each representing a single taxon; see fn. 8), this area of the floor also contains the greatest diversity of taxa. The extent and diversity of seeds in and around this hearth suggests that the hearth was repeatedly used for plant processing, or (less likely) was the regular discard area for all plant foods used in the pithouse. This hearth area is therefore a good candidate for a special activity area.

The other two clusters are considerably smaller in extent and diversity of seeds than the large concentration. Their limited occurrence suggests that they were either more minor plant processing areas, or accidental, or unique events. The analysis of additional subsquares in the large housepit adjacent to these smaller food seed clusters would help to better define their nature. Plant processing which did not involve fire (and the accidental charring of plants) may have occurred elsewhere on the floor, but the residues from these events are not likely to show up in the archaeobotanical record.

Non-food seeds occur in clusters in five discrete areas on the floor of the large housepit. Although we have separated the concentrations on the periphery of the floor into four discrete clusters, we suspect that the gaps between the clusters have more to do with gaps in our sampling than actual breaks in the distribution. The concentration of non-food seeds along the south and east periphery of the pithouse corresponds well with the zone of highest needle concentration. The non-food seed category is predominantly composed of charred chenopod and grass seeds. The grass and needles are likely the remains of a covering for bedding or floor covering composed of grass stems and conifer boughs. Why the charred chenopods are also associated is not clear, but they may have been accidentally collected along with the grasses. A pollen study (Vance n.d. in Lepofsky 1993a) indicates that chenopods were a major component of the local prehistoric flora at Keatley Creek.

Zooarchaeology. Approximately 2400 bones were recovered from floor deposits of the large housepit (Figure 2). About 60% of these are fish bones, about 5% are identifiable mammal bones (primarily artiodactyl/deer), and about 35% are small, unidentifiable mammal bone fragments (probably mostly deer).[4] The distribution of different size categories of bones, with larger bones occurring primarily towards the periphery of the floor, suggests that housecleaning activities kept the activity areas clear of large debris. Burned bone fragments are scattered in low amounts over the floor, with concentrations associated with hearths and fire-reddened areas. The percentage of burned mammal bones is higher in the west and south (73%) than in the east (44%), suggesting differential use of fire and mammal bone processing or consumption practices between the west and east.

Four areas on the floor contain high frequencies of fish, along with less distinct concentrations of mammal bone (primarily artiodactyl). These fish concentrations are also well represented in the flotation samples. The only difference is a cluster of fish bones along the wall in the southwest which shows up in the flotation sample, but not the larger bone sample. This area also had many tiny, unidentifiable fragments and may have been an area of heavy trampling or extreme bone reduction.

Fish bone concentrations in the northwest, southeast, and south/southwest are associated with hearths and storage pits. In the south/southwest there is also a concentration of mammal remains. In the northwest, in addition to the fish and artiodactyl, are the remains of grizzly bear, red fox, and bighorn sheep, found only in this area. Also, the large pits in this area contain unusual remains such as a dog burial, hawk wing bones, and trade shells (dentalium and dogwinkle).

In the southeast, the artiodactyl concentration is relatively high, as is the fish density. Hare and grouse are limited to this area of the floor. The presence of more types of artiodactyl skeletal elements here than on the rest of the floor suggests this may have been an important area for reduction of large artiodactyl parts prior to cooking. The relatively high frequency of small bone fragments here compared to other areas of the floor further suggests processing for marrow and grease extraction in this area.

Scattered fish are present in the northeast and artiodactyl bones here are near a small hearth. An abundance of beaver incisors also in the northeast may indicate a locus for woodworking.

Each of these four areas, in the northwest, northeast, southeast, and south/southwest, likely represents a discrete activity area for animal consumption and/or processing. This repeated patterning of remains also suggests the presence of independent domestic subgroups within this structure. Based on the presence of rare faunal remains and major storage pits and hearths, the group occupying the northwest may have held relatively higher status.

The medium-sized housepit.—Archaeobotany. Charcoal, needles, and seeds are distributed non-randomly across the floor of the medium-sized housepit (Figure 3). There are three distinct charcoal concentrations on the floor of the medium-sized housepit. There is generally a close relationship between fire-reddened areas and charcoal frequencies. The concentration of needles along the southern periphery of the floor likely distinguished this area for sleeping or sitting, as in the largest structure. As in the large house, this implies the use of most or all of the periphery of the house as domestic or sleeping areas.

There are three concentrations of food seeds on the floor of the medium-sized housepit: one large and two smaller clusters. Each of the three clusters is associated with charcoal concentrations and nearby fire-reddened areas and likely functioned for food plant processing. The extent and number of plant remains in the large concentration in the northwest of the floor suggests that this area was used repeatedly for plant processing. The two small concentrations may represent single events.

As in the large housepit, the non-food seed clusters on the floor of the medium-sized housepit are located along the periphery of the structure. In each case, the bulk of the non-food seeds are comprised of charred chenopods. This differs from the large housepit where the category was comprised primarily of chenopod and grass seeds. Without the presence of grass seeds, we cannot think of a parsimonious cultural explanation for the chenopods along the periphery of the floor of the medium-sized housepit. We cannot rule out the possibility that the distribution of charred chenopods along the periphery of the structure may be due to post-occupation depositional processes, but this does not account for their concentration only around the peripheral areas under the deepest accumulations of collapsed roof deposits (Lepofsky 1993a). There is no recorded evidence that chenopods were eaten ethnographically, and their absence from hearth areas makes it unlikely that they were used as food prehistorically.

Zooarchaeology. Approximately 560 bones were recovered from floor deposits in the medium-sized housepit. Fifty-six percent of these are fish bones, 32% are unidentifiable mammal, and 12% are identifiable mammal (Figure 3). As in the large housepit, most of the remains on the floor are small, suggesting the inhabitants of the medium-sized structure were keeping the activity areas clear of larger debris. The largest bones occur most often near the periphery, except for an immature, largely articulated post-cranial canid skeleton found on the floor in the west-center area.

Fish bones occur around the perimeter of the floor, except for the southeast. Articulated salmon remains occur near the walls in the east and in the north, suggesting these were areas of little trampling, perhaps under benches. This distribution is similar to the fish distribution from the flotation samples, except that more fish were recovered from the flotation samples in the northeast. The presence of tiny fish fragments here may be due to heavy trampling. Fish concentrations in the north and in the southwest are associated with fire-reddened areas.

The two largest non-fish concentrations near the west/center are portions of the immature canid skeleton. Other non-fish bones (primarily artiodactyl) are found in the highest frequencies in the north and east/center of the floor, with lightly scattered remains across much of the floor. The concentration of artiodactyl (and fish) in the east is associated with a small storage pit and fire-cracked rock and may be a food processing area. The concentration of bones in the north is associated with a storage pit and fire-reddened areas and may also represent a food processing area. However, a number of bones in this area, including artiodactyl bones, are larger than other floor bones. Their size and location against the house wall suggests these bones may represent debris from housecleaning activities placed in a "provisional discard" location (Hayden and Cannon 1983). Surprisingly, there are few faunal remains near the large hearth in the southeast.

The patterning of faunal remains across the floor of the medium-sized house is more indicative of communal food preparation, rather than of distinct social subgroups performing the same animal food-related activities. The fish concentrations associated with fire reddened areas may represent two discrete fish consumption/processing areas in the north and southwest.

The small housepit.—Archaeobotany. Concentrations of charcoal and needles, but not seeds, can be distinguished on the floor of the small housepit (Figure 4). The three charcoal concentrations roughly correspond to the concentrations of needles. The charcoal and needle concentrations in the north correspond to the fire-reddened area.

Seed densities are strikingly low in all areas across the floor of the small housepit, and no area appears to have a greater or lesser concentration than another. Even the areas which have a concentration of both charcoal and needles, have almost no seeds. Indeed, only 16 seeds were found across the floor, representing only 5 taxa. The most ubiquitous seed remains are chenopods, which are of uncertain ethnobotanical significance, and even its total number is low.

Zooarchaeology. About 120 bones were recovered from floor deposits in the small housepit (Figure 4). Twenty-six percent of the floor bones are fish and these are clustered in the northeast corner of the floor. The majority of the remaining floor bones are small, unidentifiable fragments. They are found primarily in the north half of the floor near a fire-reddened area. The presence of a single concentration of faunal remains on the floor, corresponding to a hearth and fire-cracked rock concentration, suggests animal food processing activities took place communally in this small house.

Comparisons between housepits.—Archaeobotany. A common pattern displayed in all three structures is the relative absence of all three categories of archaeobotanical remains in the center of the floors. This pattern, however, is less marked in the small housepit than in the medium-sized and large housepits, probably owing to greater constraints on the use of space. Since charcoal can be easily displaced and is difficult to remove, it seems clear that considerable care was taken to keep housepit centers clear of debris. The center may have been a communal use area for the inhabitants of each structure.[5]

TABLE 3. Abundance of charcoal, needles, and seeds recovered from the three housepit floors.*

	Large HP (HP 7)	**Medium HP (HP 3)**	**Small HP (HP 12)**
Charcoal			
total (g)	4.4 ± 3.9	2.8 ± 2.0	2.9 ± 2.8
Douglas-fir (N)	62.5 ± 20.3	62.5 ± 21.6	—
Ponderosa pine (N)	18.0 ± 13.7	19.3 ± 20.6	—
Populus (N)	14.5 ± 19.7	14.7 ± 7.1	—
Needles			
total (N)	444.7 ± 971.8	235.5 ± 463.2	278.1 ± 536.6
Seeds			
total (N)	6.8 ± 9.2	4.7 ± 5.0	1.0 ± 0.9

* Means and standard deviations, calculated per 1 liter flotation sample.*

The average amounts of charcoal recovered per liter flotation sample can be compared for the three housepit floors (Table 3). Charcoal abundances on the three floors are statistically different from one another (ANOVA, $p = 0.04$), but in a post hoc 2-way comparison only the large and the medium-sized floor charcoal are significantly different (Tukey HSD, $p = 0.07$).[6] Thus, the large structure has significantly more charcoal on the floor than the medium-sized structure, but not more than the small structure. From this, we can conclude that on average more fires may have been burned in the large than medium-sized structure, but there was no difference in fire intensity in the large structure versus the small one, nor in the medium-sized housepit versus the small housepit.[7]

In terms of species, on average, the three most common wood species (Douglas-fir, pine, *Populus*) are found in almost exactly the same proportions on the floor of the large and medium-sized housepits (Table 3; D-fir: Mann Whitney U test, $p = 0.92$; Pine: Mann Whitney U test, $p = 0.80$; Pop: Mann Whitney U test, $p = 0.16$). In fact, these taxa have almost identical abundances and standard deviations across the two housepit floors. Identifications of charcoal from the small housepit were not carried out.

We can conclude from this that the same kinds of fuel wood were generally burned in the large and medium-sized structures, but that more fires were burned on average in the largest structure than the medium-sized structure. This result is supported by a greater degree of fire-reddening underlying the hearths of the large structure compared to the medium-sized structure. Whether the burning of more fires has more to do with differential access to fuel, the intensity which the large housepit as a whole was used, or perhaps length of use of the last floor, cannot be determined at present.

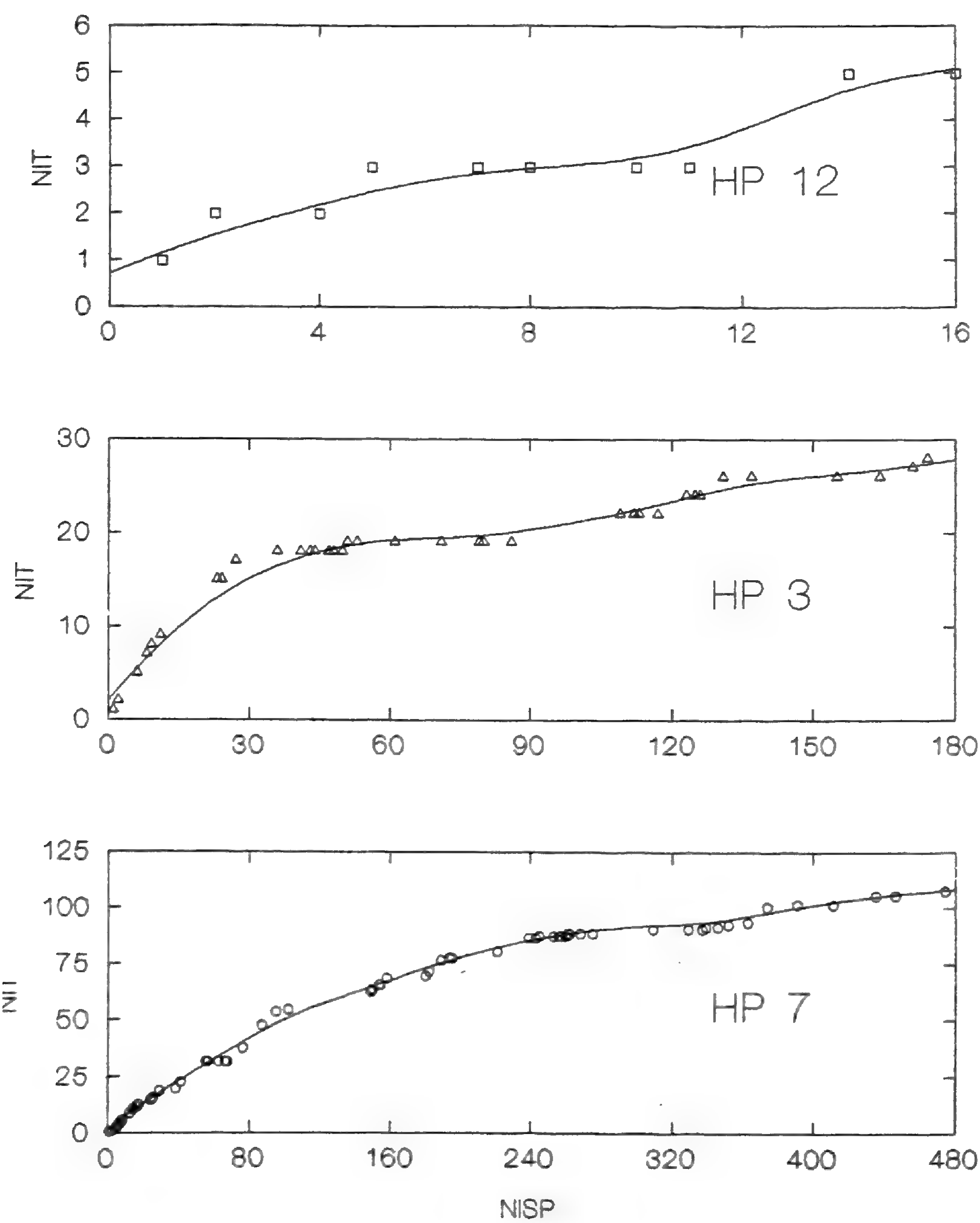
Although the three structures do not differ from one another in average needle abundance per liter flotation sample (ANOVA, $p = 0.2$), the distributions of needles on the three floors are quite distinct. The nearly continuous peripheral concentrations in the large and medium-sized structures but not the small housepit indicate that the needles may have been used differently in the latter structure. The concentration of conifer needles around the periphery of the larger two housepit floors likely indicates the deliberate covering of pole or plank platforms with boughs for bedding or floor covering. While these platforms are described and illustrated ethnographically, they are more difficult to identify archaeologically. Only the presence of small post holes near the wall of the large house, an earthen bench along the wall of the same structure, and a fortuitously preserved bench plank along one wall of the medium-sized house, indicate use of sleeping platforms at Keatley Creek. The inhabitants of the small housepit slept either directly on the pithouse floor or on mats that were not preserved. The source of the sporadic high concentrations of needles on the floor of the small housepit cannot be determined at this point.

The three housepits differ from one another in the average number of seeds recovered per liter flotation sample (Table 3; ANOVA, $p = 0.005$). In a post hoc 2-way comparison the large structure is significantly different from the small housepit (Tukey HSD, $p = 0.003$), and the medium-sized housepit significantly differs from the small structure (Tukey HSD, $p = 0.04$). If seed density can be taken to represent intensity of use, these results suggest more intensive use of seed plants in the large and medium-sized housepits than in the small. The medium-sized and large housepits cannot be distinguished statistically.

Differences in species richness in the housepits can be evaluated by comparing the number of seed taxa on the floors of the three structures. Richness is the number of species present in a given assemblage. Although we were only able to identify a limited number of taxa, far more taxa are represented by the unidentified category. When number of taxa represented in the unidentified category are taken into account, it is clear that the floor of the large housepit has far more *taxa* represented by seeds than either of the other two housepits (Table 1; HP 7 = 108, HP 3 = 28, HP 12 = 5).[8]

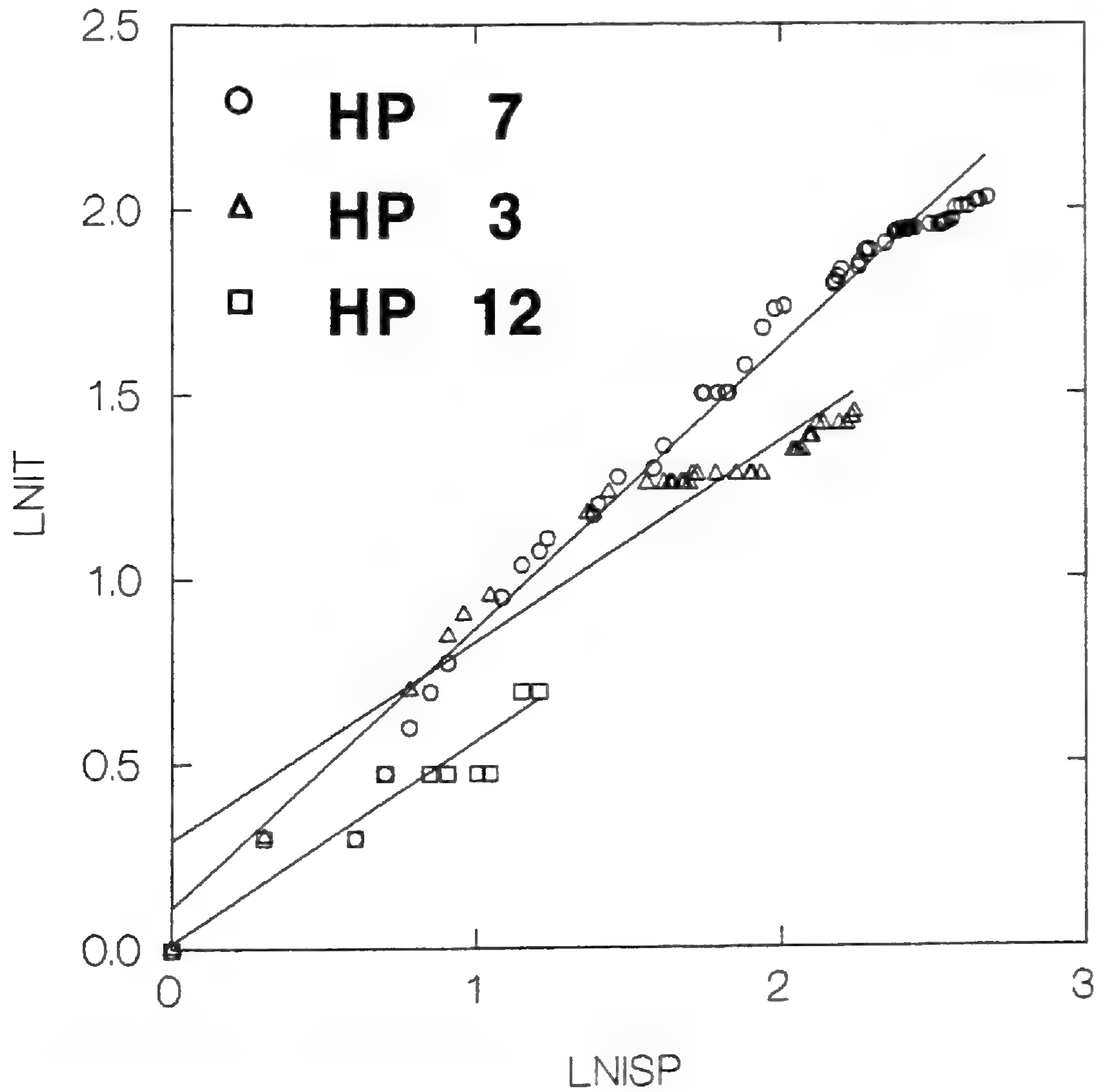
In order to assess these differences in richness, we need to consider the effect of sample size. When the logarithm of the total number of seed is plotted against the logarithm of the number of specimens (not shown) in the three housepits, the three structures fall on the same line, indicating that total number of taxa can be accounted for by sample size. However, a plot of the number of taxa against number of specimens recovered (Figure 5) illustrates that the slope is beginning to level off in the two larger structures and that the number of taxa is approaching the true maximum number of taxa. From this we can conclude that these housepits have been adequately sampled to assess relative richness, and that the differences in species richness may represent real behavioral differences between the structures.

FIGURE 5.—Number of identifiable taxa (NIT) of seeds plotted against number of identifiable specimens (NISP) recovered from three housepit floors. The lines are distance weighted least squares smoothings (DWLS; Wilkinson *et al.* 1992).



Although we have no basis to argue that the number of taxa represented in the small structure approaches its true maximum number of species, there appear to be real differences in taxon abundance in the three structures. The larger structures have already accumulated more taxa than the small house when we compare them at the point they have each accumulated a number of identifiable specimens equal to the total accumulated in the small structure (i.e., at NISP = 16, HP 7 = 12 taxa, HP 3 = 13 taxa [interpolated], HP 12 = 5 taxa). This indicates that the patterns observed in the small house are not merely an artifact of sample size.

FIGURE 6.—Log number of identifiable taxa (LNIT) of seeds plotted against log number of identifiable specimens (LNISP) recovered from three housepit floors, illustrating accumulation rates of seed taxa per specimens.



To further examine the differences in species diversity, we compare the rate of accumulation of species relative to the addition of new specimens (Figure 6). In biological samples, the number of species observed characteristically increases with the size of the sample, the area sampled, or the number of specimens examined (Krebs 1989; Magurran 1988). The rate at which species accumulate with sample size, as well as the eventual asymptote of species richness, can both be used to characterize an ecological community. We take the logarithm of the number of seed taxa and of the number of seed specimens and fit regression lines to characterize their relationship within each housepit. When the slopes of the three lines are compared, the large housepit is significantly different than the medium-sized and small housepits (ANOVA f-test for homogeneity of slope; $p < 0.0001$ in both cases), but the medium-sized and small housepits are statistically similar ($p = 0.89$). From this we can conclude that the large housepit is accumulating number of species/specimens at a significantly higher rate than in the other two housepits.

Finally, we compare the three housepits in terms of species evenness. Evenness is a measure of the equability of the relative abundances of the species in an assemblage. For example, an assemblage with low evenness would be dominated by many individuals of a few taxa, with other taxa poorly represented. The small housepit appears to have the least even distribution of species (Figure 7) and the medium-sized and large structures appear similar in evenness. However, the shapes of the frequency distributions in Figure 7 cannot be distinguished statistically (Kolmogorov-Smirnov test, HP 7 and 3: $p = 0.70$; HP 7 and 12: $p = 0.37$; HP 3 and 12: $p = 0.43$).

There are some notable differences in the seed species composition of each of the houses, especially among the less common species. The three most abundant species in the medium-sized and large structures (not including the unidentifieds) make up approximately 65% and 60%, respectively, of the entire distribution. In the case of the large housepit, the total includes chenopods, grasses, and Ericaceae. In the medium-sized structure the three most common taxa are Ericaceae, chenopods, and saskatoons. Of the seven most rare species in each distribution, only two are shared between the two structures. This may be a result of sample size or may represent actual differences in species use in the two housepits. Chenopods dominate the small housepit assemblage.

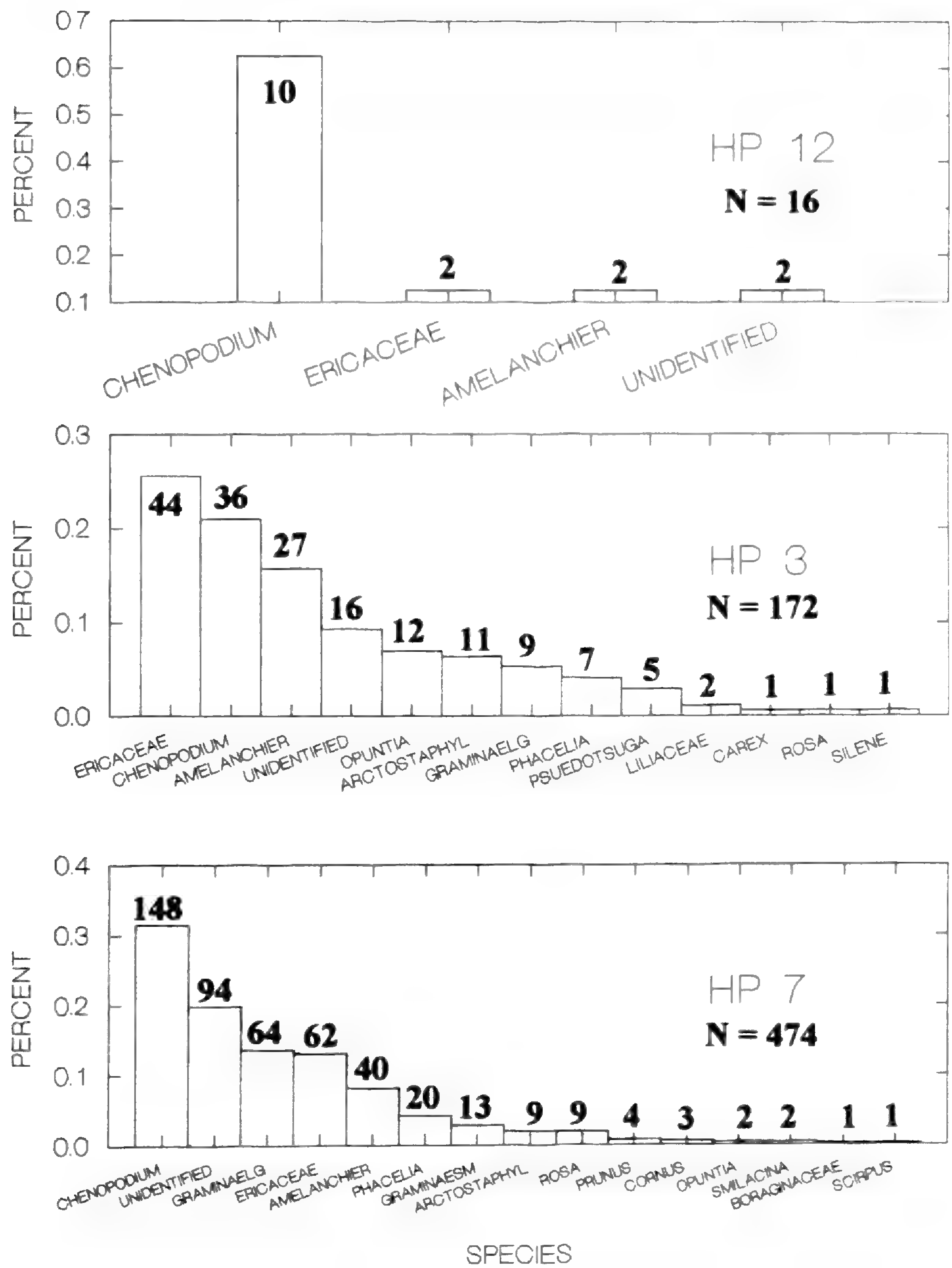
TABLE 4. Relative frequencies of select faunal taxa from the three housepit floors.

	Large HP (HP 7)	**Medium HP (HP 3)**	**Small HP (HP 12)**
Total (N)	2,401	561	121
Fish	.56	.56	.26
Canid	<.01	<.01	.00
Artiodactyl*	.03	.03	.05
Large mammal	.07	.06	.06
Other	.33	.34	.63

* "Artiodactyl" includes deer, sheep, elk, and unidentified artiodactyl remains.*

Zooarchaeology. The relative frequencies of important taxa from the three housepits are listed in Table 4. The large (HP 7) and medium-sized (HP 3) housepits contain similar proportions of fish, canids, artiodactyls, and large mammal bones on the floor, while the small housepit contains less fish. In terms of average abundance per square meter of floor, the three housepits are significantly different in total number of bones, number of fish bones, and number of mammal bones

FIGURE 7.—Abundance of seed taxa recovered from three housepit floors.



(ANOVA, $p < 0.0001$ in all cases; Table 5). However, in post–hoc 2-way comparisons the only significant differences are between the large housepit and the other two (Tukey HSD, $p < 0.01$). The large housepit has significantly greater density of animal remains than the medium and small structures, but the medium and small structures do not differ in terms of average density of remains.

TABLE 5. Abundance of selected faunal taxa on the three housepit floors.*

	Large HP (HP 7)	**Medium HP (HP 3)**	**Small HP (HP 12)**
Fish	12.1 ± 23.2	4.9 ± 10.0	1.1 ± 3.1
Mammal	9.5 ± 16.4	3.6 ± 8.5	3.1 ± 6.1
Total bones	21.6 ± 28.3	8.5 ± 15.8	4.1 ± 7.2

Means and standard deviations, calculated per square meter of floor. Numbers are based on numbers of identified specimens.

Differences in the species of salmon present between the large housepit and the medium and small housepits imply differential access to salmon resources (Berry 1992). All of the fish in the small housepit and over 90% in the medium-sized housepit were found to be pink salmon (*Oncorhynchus gorbuscha*), while in the large housepit, a broader range of age-categories of salmon, including mostly pink salmon, but also three year-old salmon and a few four and five year-olds were present. The three year-olds probably represent sockeye salmon (*O. nerka*), although the possibility that some of them may be spring salmon ("Chinook salmon" or "king salmon"; *O. tshawytscha*) cannot be ruled out (Berry 1992).

When species richness between the three structures is examined (using taxa from floor and non-floor deposits), the large housepit has far more taxa than the medium-sized or small structures (HP 7 = 18, HP 3 = 6, HP 12 = 3; Table 2 and Figure 8).[9] As with the floral data, the logarithm of the total number of specimens (LNISP) plotted against that for each housepit (not shown) falls on the same line, indicating a correlation between assemblage size and number of taxa. While a larger number of rare faunal items is found in the large housepit, we expect more taxa simply because of the relative size of the assemblage. However, since the faunal assemblages from these houses are virtually 100% samples of identifiable remains, sample size is not a major issue (Plog and Hegmon 1993:490). Thus the presence of more taxa in the large house probably is due to the more diverse activities involving animal remains of its inhabitants (i.e., hunting, trade, ritual) compared to the smaller houses.

As with the plant data, it is informative to compare the rates at which animal taxa are added per specimens in each housepit (Figure 9). Comparing the slopes of the three lines in Figure 9 we see that the medium-sized housepit differs significantly from the other two (ANOVA f-test for homogeneity of slope; $p < 0.0001$), but the large and small houses have similar slopes (ANOVA f-test for homogeneity of slope; $p = 0.374$). Based on the steepness of the slope, we conclude that the small and large housepits are accumulating species/specimens at a significantly

FIGURE 8.—Abundance of faunal taxa recovered from three housepits. "Artiodactyl" includes deer, sheep, elk, and unidentified artiodactyl remains.

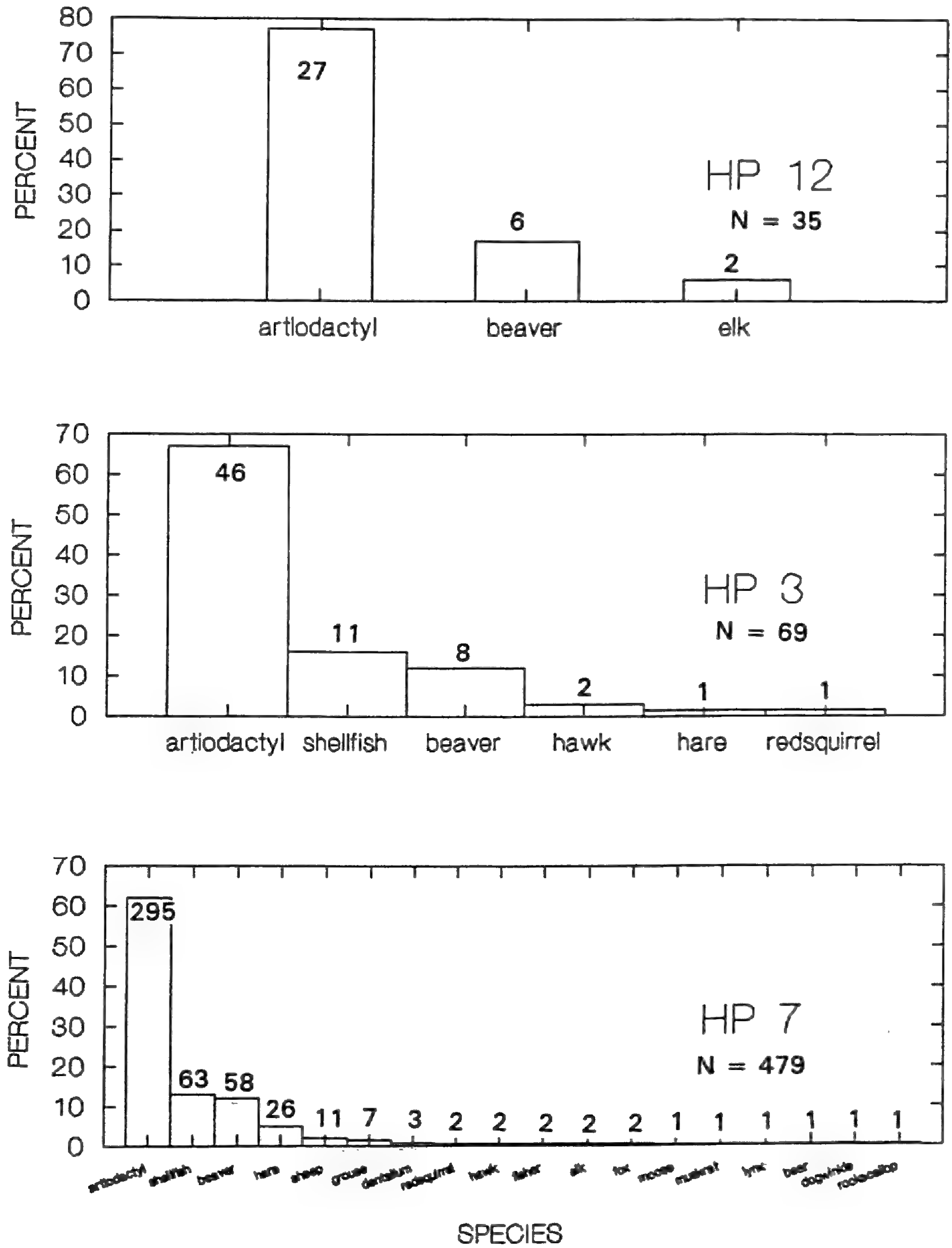
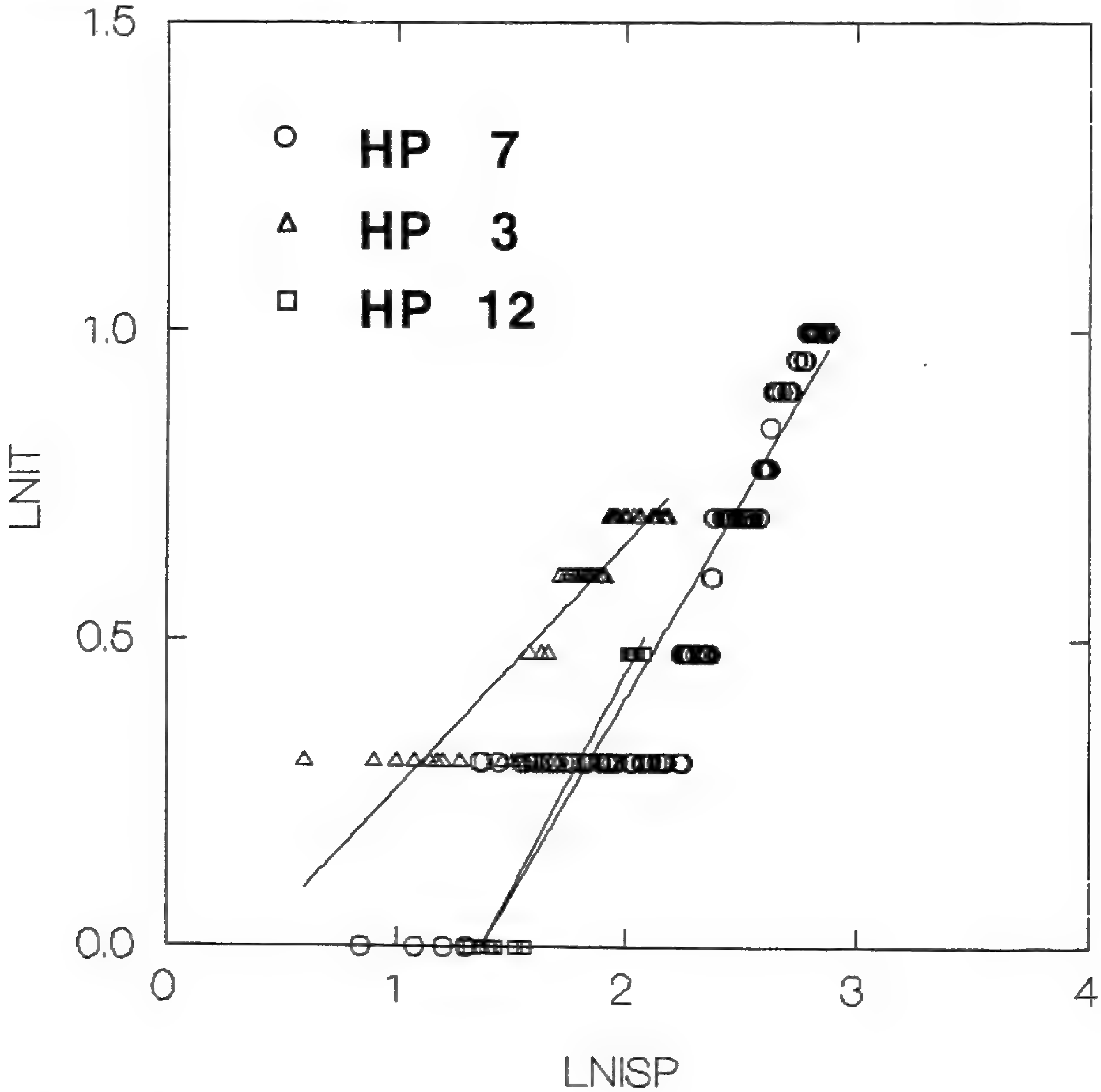


FIGURE 9.—Log number of identifiable faunal taxa (LNIT) plotted against log number of identifiable specimens (LNISP) recovered from three housepits, illustrating accumulation rates of animal taxa per specimens.



higher rate than the medium-sized housepit.

In terms of species evenness, the three housepits have similar distributions (Figure 8), and the shapes of the slopes of the three housepits cannot be distinguished statistically (Kolmogorov-Smirnov test, all *P* values approaching 1.0). The relatively high frequencies of artiodactyl and beaver in the three housepits is notable, as is the absence of shellfish and relative abundance of elk in the small housepit. With the exception of hare, sheep and grouse in the large housepit, the large and medium-sized housepits have similar distributions of remains.

DISCUSSION

Archaeobotany.—The results of the archaeobotanical analyses indicate that intensity of plant use is correlated with housepit size. The large structure stands out clearly as having the greatest density of remains, the greatest number of taxa relative to the density of remains, and the most rapid accumulation of taxa relative to the number of specimens. Conversely, the small housepit has few remains, few taxa, and low accumulation rates of species. The medium-sized housepit is intermediate in species density, richness, and species accumulation rate. These archaeobotanical data support our first hypothesis that differences in the size of residence structures should correlate with differences in socioeconomic status, as indicated by greater density and diversity of remains.

Our second hypothesis asserts that larger residences should exhibit greater internal differentiation than smaller structures, corresponding to distinct domestic subgroups with differential socioeconomic status. This hypothesis would be supported by the presence of regular, repeated patterning of remains and the presence of special or restricted items associated with some of these patterned remains. We examined three sources of archaeobotanical evidence which could support or reject this hypothesis: the distribution of food-plant processing areas, the distribution of the remains of non-food plants, and the pattern of areas with no plant remains.

Distinct plant food processing areas can be identified on the floors of the large and medium-sized housepits, but not the small one. In the large housepit, we identified one primary food plant processing area, associated with a hearth, and two additional minor processing areas. In the medium-sized housepit, one primary and two smaller plant food concentrations, each associated with hearth areas, were also identified. The spatial extent and species diversity of the larger concentrations suggest that these areas were used repeatedly for plant processing. The smaller concentrations may have been unique events.

Similarly, the distribution of non-food plant remains indicates that the floors in the large and medium-sized housepits were partitioned in a similar manner, and were distinct from the small housepit. The placement of floor or bench coverings along the edge of the large and medium-sized housepits delineates the periphery of those structures from the remainder of the housepit. The remains of conifer boughs (and grass in the large housepit) distinguish the peripheral areas as places where people regularly sat and/or lay down. No such area was identified in the small structure.

The only archaeobotanical pattern which is consistent among all three housepits is the relative paucity of remains in the center of the floors. The center of each structure may have been used equally by all members of each pithouse for communal events or activities. Given that the clear space is only about three m^2 in the small structure, these activities—at least in the case of the smaller structure—could not have required much room.

Thus, in contrast to the predictions of our second hypothesis, there is no evidence of regular, repeated patterning of archaeobotanical remains which would indicate distinct domestic subgroups in any of the housepits. The presence of only one major plant processing area in the large and medium-sized structures suggests that plant processing may have been a communal activity. Further, the relatively continuous distribution of needles around the peripheries of the larger houses does not support the presence of distinct domestic subgroups. The archaeobotanical remains in the small structure indicate limited plant processing and suggest that plant processing activities there were communal.

Zooarchaeology.—Consistent with our conclusions from the archaeobotanical remains, and in support of our first hypothesis, the density and diversity of faunal remains correlate well with housepit size. The largest structure has the greatest density of faunal remains, followed by the medium-sized housepit. Similarly, faunal species richness was correlated with structure size. However, rates of species accumulation provided ambiguous results with regard to the first hypothesis, with the large and small housepits having higher rates than the medium-sized housepit. Notably, a number of special types of faunal remains were found only in the large housepit. For example, fox, grizzly, bighorn sheep, and rock scallop (a trade item) were found on the floor, while hawk wing bones, dentalium, dogwinkle, and rock scallop (trade items) were found in the storage pits.

In support of the second hypothesis, and in contrast to the evidence from the archaeobotanical remains, the largest house exhibits regular, repeated patterning of faunal remains. Faunal remains in the large housepit are associated with a number of storage pits and fire-reddened areas, and artiodactyls and fish seem to have been processed and consumed in four distinct areas of the house. In contrast, faunal remains in the medium-sized structure are less discrete, although concentrations of fish associated with fire-reddened areas and storage pits suggest two animal consumption/processing areas within the house. This suggests that activities related to the processing and consumption of animals were more communal than in the large house. The small housepit has the simplest patterning, with a single, diffuse concentration of remains, suggesting that animal processing activities were communal in this structure as well.

Based on the predictions of our second hypothesis, the four distinct consumption/processing areas associated with storage pits and hearths indicate the presence of four domestic subgroups in the large housepit. These faunal consumption/processing areas are distinguished from each other by the presence of special faunal items or evidence for distinct types of activities, such as woodworking. This suggests socioeconomic differences among the four domestic subgroups in the large house.

CONCLUSIONS

Together, the paleoethnobotanical and zooarchaeological analyses offer some support for the hypothesis that housepit size correlates with socioeconomic status. Based on the density and diversity of both the plant and animal remains, the large housepit was used more intensively and was the site of more diverse activities than the smaller housepits. The presence of rare faunal items in the large housepit also sets it apart from the other structures. However, whether this patterning of plant and animal remains can ultimately be related to status differences, to a larger work force having access to a more diverse resource base, or to differences in the length of use of the floor before abandonment cannot be answered with the present data alone.

The zooarchaeological analyses alone support the hypothesis that larger residential housepits exhibit greater internal socioeconomic differentiation than smaller structures. The regular, repeated patterning of faunal remains in the large housepit indicates that the large structure was divided into distinct domestic subgroups which may have been of unequal socioeconomic status. The presence of a number of distinct domestic subgroups in the large structure is further supported by the repeated occurrence of hearths around the perimeter of the house, and by storage pits, clusters of fire-cracked rocks, debitage, stone tools, anvils, and abrading stones associated with those hearths.

How do we reconcile the varying pictures that emerge from the faunal versus botanical data concerning internal socioeconomic differentiation within the housepits? The patterning of plant remains suggests that internal domestic subgroups within the three structures were not distinct and that housepit activities involving plants were undertaken communally. However, it may be that the presence of a single, major plant processing area in the largest structure represents the specialized use of plants by one domestic subgroup within that house, rather than communal use by all inhabitants. This plant processing area is associated with a domestic subgroup which, based on the faunal data, appears to have held relatively high status. Future research should test hypotheses which distinguish between these scenarios.

The distributions of both plant and animal remains among the houses suggest that internal domestic subgroups were less pronounced and activities were undertaken more communally in the smaller structures. Finally, the absence of both plant and animal remains in the centers of all three housepit floors suggests that the center of each structure was used equally by all members of each pithouse for various communal events or activities.

In this study we examined not only overall species richness from our samples, but the pattern of accumulation of species with sample size. This allowed us to make inferences regarding taxonomic diversity in each housepit beyond simply estimating the total number of species present. Our analyses support the conclusions of Plog and Hegmon (1993) that species richness in archaeological samples should not be treated merely as an artifact of sample size, but as a consequence of the combined effects of behavioral processes and sample size. By examining in detail the relationship between number of taxa and number of specimens, we are able to evaluate better the effects of sample size on our data. Despite the differences in sample size among the housepits, we are able to draw conclusions regarding the role of behavior in generating patterns of species diversity.

This study demonstrates a useful role for combined paleoethnobotanical and zooarchaeological analyses in studies of prehistoric social and economic organization. Separately, the analyses provide independent lines of evidence which can be used to test our hypotheses. Combining the two sets of data allows us to reevaluate and modify our original conclusions. Our analyses of both plant and animal remains support the notion that Keatley Creek was occupied by residential corporate groups of differing economic and social status. However, the three housepits examined here represent less than 3% of the housepits in the village of Keatley Creek. A much larger sample of housepits, representative of the range of housepit sizes, is needed before we can draw more definitive conclusions about the prehistoric socioeconomy at Keatley Creek.

NOTES

[1] Analyses of organic remains from housepit rim and roof deposits, details of faunal and floral taphonomy and site formation processes, and a discussion of plant and animal use at Keatley Creek as a whole are presented elsewhere (Kusmer 1993a, 1993b; Lepofsky 1993a, 1993b). Refer to these studies for detailed presentations of the raw data.

[2] Based on modern observations of wood decay.

[3] Based on modern observations of wood decay and ethnographic statements (Wilson 1934:372; McGuire and Schiffer 1983:291; Condrashoff 1980:5).

[4] All identified fish remains at the site are salmon (*Oncorhynchus* spp.), thus all fish in all analyses are assumed to be salmon.

[5] This is supported by Hastorf's (1991) observation that charred seeds in houses are less dense in areas where many activities occur.

[6] All data for archaeobotanical and zooarchaeological ANOVAs were transformed before analysis using square root transformation for normalizing poisson distributed data. Zooarchaeological data for the small and medium housepit remained skewed even after transformation.

[7] We recognize that density is a complex issue and may be related to other factors (e.g. length of occupation, differential discard patterns) in addition to intensity of use. Despite this, it can be a useful measure of difference between the structures.

[8] The number of taxa in the large (HP 7) and medium housepit (HP 3) are inflated because we are unable to go back to many of the original samples and group the unidentifiable seeds into like taxa. Since the majority of taxa are represented by only a single specimen, this will not significantly alter the analysis. Any biases that are introduced should be parallel in both housepits.

[9] Since we feel the analyzed faunal remains represent well the actual distribution of remains, we do not need to graphically examine the distribution of bones as we did for the plants in Figure 5. Further, the plots in Figure 5 are not well suited to the faunal data. The faunal data are represented by many more specimens than taxa, whereas the situation is reversed with the floral data. Because of this, the faunal data displays a step function distribution when NISP are plotted against NIT. The step function makes it considerably more difficult to determine when the graph has leveled off.

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TRADITIONAL MEDICINE AND CONCEPTS OF HEALING AMONG SAMBURU PASTORALISTS OF KENYA

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ABSTRACT.—Samburu pastoralists of Kenya, who are closely related to Maasai, attribute many illnesses to polluting influences that block internal digestion and blood circulation. These pollutants include eating the "wrong" foods, the introduction of contagious substances from ill people, and the action of sorcery attacks. Treatment of these health problems is aimed at relieving blockages through herbal purgatives and laxatives or, in the case of sorcery, consulting diviners (***loibonok***) who dispense ritually protective medicines. In addition to purgatives and ritual medicines, Samburu also use herbal preparations to treat wounds and burns, relieve aches, and kill parasites. Samburu treatment of illnesses is pluralistic. An individual and his or her family may seek the services of herbalists, diviners, or Western health care providers, depending on proximity, costs, and beliefs in causation of the health problem. This article describes Samburu concepts of illness, the practices of healing specialists including ***laibon*** ritual curers, herbalists, and midwives, and lists Samburu medicinal plants and their uses.

RESUMEN.—Los grupos pastoriles samburu y maasai de Kenia atribuyen muchas enfermedades a influencias contaminantes que obstruyen internamente la digestión y la circulación de la sangre. Estos contaminantes incluyen el comer alimentos "indebidos," la introducción de sustancias contagiosas de personas enfermas, y la acción de ataques de brujería. El tratamiento de estos problemas de salud está dirigido a remediar las obstrucciones mediante purgantes y laxantes vegetales, o, en el caso de brujería, mediante la consulta de adivinos (***loibonok***) quienes administran medicinas ritualmente protectoras. Además de los purgantes y las medicinas rituales, los samburu usan también preparaciones de plantas para tratar heridas y quemaduras, aliviar dolores y matar parásitos. El tratamiento samburu de las enfermedades es pluralista, donde un individuo y su familia puedan buscar los servicios de especialistas en herbolaria, adivinos, o proveedores de cuidado médico woccidental, dependiendo de la proximidad, los costos, y las creencias acerca de la causa del problema de salud. Este artículo describe los conceptos samburus de la enfermadad, las prácticas de los especialistas en curación incluyendo los curanderos rituales ***laibon***, los herbolarios y las parteras, y lista las plantas medicinales samburus y sus usos.

RÉSUMÉ.—Les Samburu et les Masaï, peuples pasteurs du Kenya, attribuent plusieurs maladies à des influences polluantes qui viennent bloquer la digestion interne et la circulation sanguine. Ces agents pollueurs comprennent l'ingestion de « mauvais » aliments, l'introduction de substances contaminées provenant de personnes malades et les actions maléfiques des sorciers. Les traitements de ces problèmes de santé visent à dégager les obstructions à l'aide de médicaments laxatifs et purgatifs à base d'herbes ou, dans les cas de sorcellerie, en consultant les devins (***libonok***) qui dispensent les médicaments rituels protecteurs. En plus de médicaments purgatifs et rituels, les Samburu utilisent aussi des préparations d'herbes pour soigner les blessures et les brûlures, pour soulager la douleur et tuer les parasites. Le traitement samburu des maladies est pluraliste dans la mesure où un individu et sa famille peuvent recourir aux services d'herboristes, et de devins autant que de dispensateurs de soins de santé occidentaux, selon la distance à parcourir pour obtenir les services, les coûts et les croyances concernant la cause de la maladie. Dans cet article, nous décrivons les concepts samburu relatifs aux maladies et les pratiques des spécialistes thérapeutes y compris les guérisseurs rituels ***laibon***, les herboristes et les sages-femmes. Une liste des plantes médicinales samburu avec leurs usages complète cet article.

INTRODUCTION

The Samburu are livestock-keeping pastoralists of northern Kenya related to both Maasai (Nilotic-speakers of the Sudanic language family) and Rendille (Cushitic-speakers of the Afro-Asiatic family). The Samburu share with the Maasai a healing tradition that combines knowledge of herbal medicines (***ol-chani; il-keek***, "trees" in Maa) which are used as purgatives, emetics, analgesics, and salves. They also share with the Maasai beliefs and practices in ritual medicines (***entasim; intasimi*** in Maa) which are prepared and dispensed by diviner-prophets known as ***laibons*** (***ol-oiboni, il-oibonok***).

In a recent treatment of Maasai conceptions of health and illness, Westerlund (1989:179) argues that there is no sharp distinction in African healing between religious beliefs and empirical knowledge, and that most curing activities operate along a continuum distinguishing "natural" from "supernatural" causation, combining naturalistic healing with ritual activities. In this same volume, Arhem (1989:75) argues that Maasai make no conceptual difference between "supernatural" and "natural" illnesses, as both "tree medicine" and ritual medicine "derive their power from God." However, Samburu, as well as Maasai, do distinguish those illnesses caused "by God alone" (***nkai openy***) from those due to the malicious forces of sorcery sent by a human enemy (***nkuruporen*** in Samburu; ***esayet*** in Maasai), a distinction George Foster (1976) contrasted as "naturalistic" versus "personalistic" etiology of illness. Determination of an illness' origin is essential to prescribe the most appropriate treatment. If an illness is thought to derive from "God alone," one seeks treatment from local herbalists or Western health clinics. If an illness or misfortune is believed to result from sorcery—infertility, insanity, or death by unusual causes—Samburu will consult a ***laibon*** diviner/healer to protect themselves with ritual medicines.

The spread of Western health care has not greatly affected traditional beliefs about illness among Samburu. While the government of Kenya has expanded medical services including vaccination programs and the use of anti-malarials and antibiotics, many rural and pastoralist regions remain underserved. The seeking of health care by Samburu remains pluralistic, where health providers are selected based on availability, location, cost, and beliefs in the effectiveness of treatments.

I have studied Samburu and Samburu-speaking Ariaal Rendille pastoralists since 1975 mainly exploring topics of ecology and economy (e.g. Fratkin 1986, 1991a, Fratkin and Roth 1990; Fratkin and Smith 1994, 1995). During my earlier fieldwork, I collected and identified Samburu herbal medicines (Fratkin 1975), and developed friendships with several Samburu healers including the ***laibon*** Lekati Leaduma who adopted me into his family (Fratkin 1979, 1991b). This paper is an opportunity to discuss Samburu traditional medicine as a whole, integrating a discussion of Samburu concepts of health and illness with a description of their indigenous practices and medical knowledge.

Recently there have appeared important discussions of Maasai identity (Galaty 1982; Spear and Waller 1993; Spencer 1988) as well as studies of Maasai beliefs about pollution, healing, and divination (Arhem 1989; Berntsen 1979; Galaty 1979; Hurskainen 1989; Spencer 1991). Moreover, there are now published inventories of Samburu plants (Heine *et al.* 1988) building on the earlier work of colonial ethnographers (Hollis 1905; Merker 1910) who collected and discussed Maasai uses of shrubs and trees.

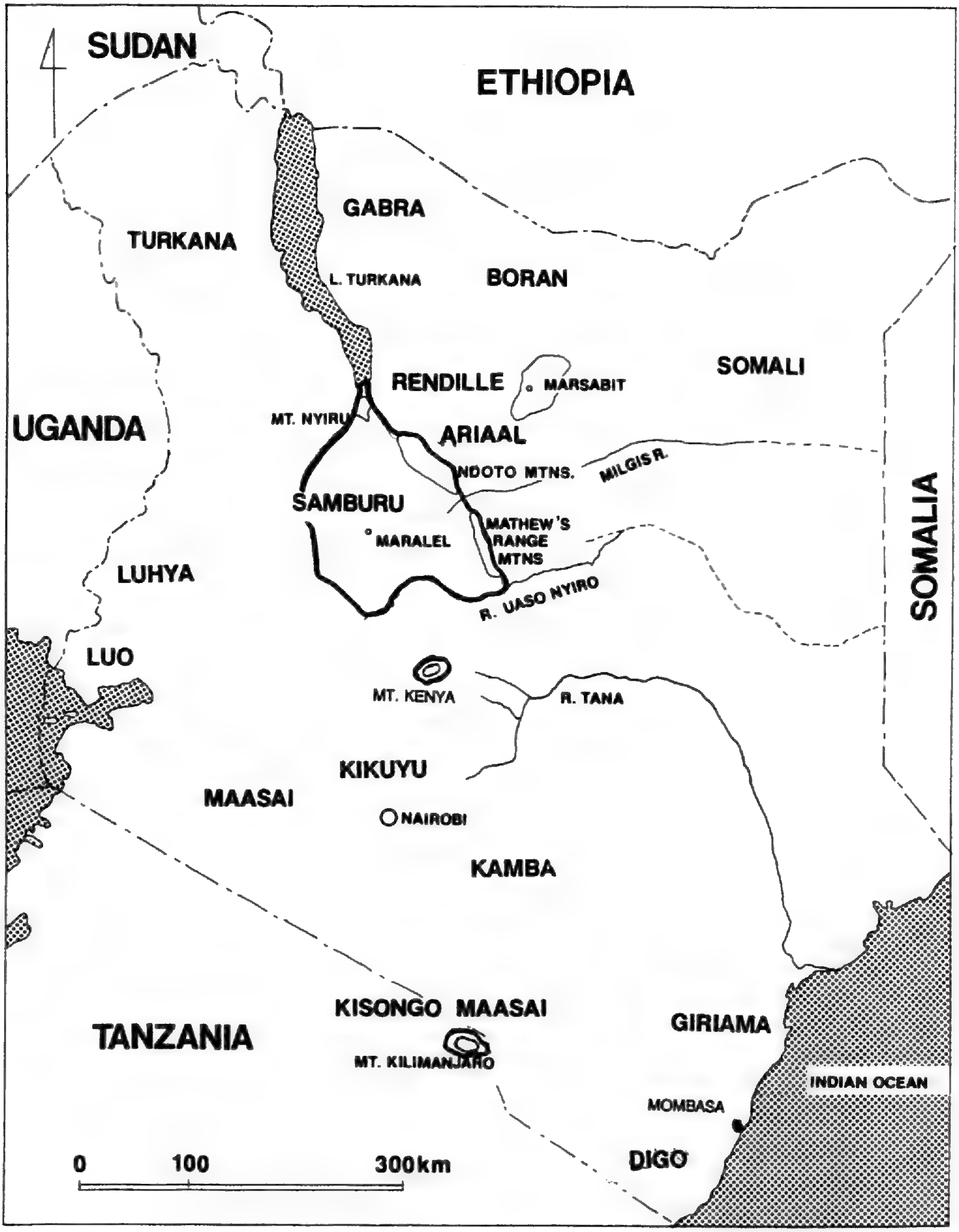
Following a brief description of health problems experienced by the Samburu, I discuss Samburu concepts of health and illness, traditional cures employing "tree medicine" and ritual medicine, and the role of the traditional healers: the herbalist, midwife, and ***laibon***. A concluding discussion places Samburu medical beliefs and practices in the wider context of African systems of healing.

HEALTH AND ILLNESS IN SAMBURU

Most of northern Kenya is too dry for extensive agriculture, and the majority of its small populations subsist as pastoralists on the milk, meat, blood, and trade of their domestic cattle, camels, goats and sheep. The Samburu (population 80,000), who live in the arid plains and highlands of Samburu District, keep mainly cattle and small stock (goats and sheep), while their allies and neighbors the Rendille (pop. 20,000), keep camels and small stock in the arid lowlands of Marsabit District (see Figure 1). The Ariaal Rendille (population 7000), with whom I lived for most of my fieldwork, are a mixed group of Samburu and Rendille living along the Ndoto Mountains separating Marsabit and Samburu Districts and on Mt. Marsabit in Marsabit District. The Ariaal are bilingual in both Samburu and Rendille but are incorporated in the Samburu age-set and descent-group systems. Although they follow certain Rendille customs associated with camel production, they hold many Samburu and Maasai beliefs including beliefs in the ***laibon*** diviners and shared knowledge of plant medicines.

Closely related to Maasai pastoralists of southern Kenya and Tanzania (population 500,000), Samburu speak a northern dialect of Maa and follow Maasai customs of named age-set organization (with distinct age-grades of boys, warriors, and male elders), marriage practices (including female circumcision, polygyny, and levirate inheritance of widows), acephalous and autonomous village structure, and shared religious beliefs which includes a distant creator god (***en'gai*** in

FIGURE 1.— Location of Samburu in Kenya.



Maasai; ***nkai*** in Samburu) without defined ancestors or spirits. However Samburu do have strong beliefs in the power of living elders' curses, as well as traditions of divination, prophesy, and beliefs in sorcery (Spencer 1965, 1973, 1988).

Samburu, Maasai, Rendille, and other pastoralist groups, do not share the ***ngoma*** healing tradition widespread among Bantu-speaking farmers (e.g. Kongo, BaGanda, Zulu), in which illnesses are believed to result from the punishing powers of deceased ancestors and in which cures are effected through human spirit mediums (***m'ganga, wa'ganga***) who combine herbal medicines with songs, drumming, and dance performances (Janzen 1992).

However, Samburu and Maasai possess an elaborate healing tradition based on the use of herbal medicines. Among Samburu, over one hundred and twenty species of trees and shrubs are employed as purgatives, emetics, analgesics, poultices, and salves (see Table 1). Many plants used by the Samburu are toxic and are used as emetics and diarrhetics, as Samburu medicinal cures are aimed at cleansing the body of polluting influences.

Access to Western health care is not widely available in the underpopulated regions of northern Kenya where the Samburu live. The government maintains a hospital in the capital of Maralal, and the Catholic Diocese a hospital in Wamba, while most towns have small clinics maintained by Catholic and Protestant missions which are staffed by missionary and local nurses. Because the majority of Samburu live in semi-nomadic settlements distant from these towns, visits to clinics and hospitals are rare and usually only for serious and life threatening illnesses (Nathan *et al.* 1996).

The major health problems experienced by Samburu, as with most rural African populations, are infectious diseases including malaria, pneumonia, gastroenteritis, diarrhea, measles, and whooping cough. Gonorrhea and other sexually transmitted diseases are widespread. While the incidence of HIV infection and AIDS have not been reported, they are known to exist in Samburu and Marsabit Districts. Samburu also carry a specific health burden associated with the hazards of livestock herding. Internal and external parasites (mites, ticks, scabies), fungal skin rashes, eye and ear infections, anthrax and brucellosis combine with frequent accidents including lacerations, burns, embedded thorns, animal and snake bites, fractures and dislocations (Nathan *et al.* 1996). The health problems of Samburu are compounded by nutritional stresses, particularly during periods of extensive droughts when milk supplies are low and animals are too emaciated or decimated to trade for grains (Galvin *et al.* 1994). Milk is the main food in both Samburu and Rendille diets, providing 70% of the daily calories in the wet season. In the dry seasons people rely on meat, blood, and grains, with tea and sugar acquired from trading livestock. Poor families are the most vulnerable to prolonged drought and may move (temporarily or permanently) to towns to receive famine-relief foods. Settled pastoralists face increased malnutrition due to the reduced consumption of milk, meat and blood and reliance on maize meal as the only food source. While medical care is improving, particularly with immunization campaigns against measles, polio, and diphtheria-pertussis-tetanus (DPT), these services are still irregular and distantly based in the rural pastoral regions. For many ailments, rural Samburu depend on their local healers and traditional medicines (see Table 2).

TABLE 1.–Samburu Medicinal Plants and Their Uses.

Samburu Name	Scientific Name and Identification	Scientific Family	Specimen Numbers	Medicinal Uses
l-aarami	*Cistanche tubulosa* (Schenk.) Hook.	OROBANCHACEAE	KNMUS/H250/59:133	childbirth
l-abaai	*Psiadia arabica* Jaub. and Spach	COMPOSITAE	KNMUS/H133/75:39	burns, ticks
l-aishimi	*Commiphora africana* (A. Rich) Engl.	BURSERACEAE	Heine *et al.* 1988:55	diarrhea
l-aimuronyai	*Maytenus senegalensis* (Lam.) Exell	CELASTRACEAE	Heine *et al.* 1988:56	arthritis
l-akirding'ai	*Croton dichogamus* Pax	EUPHORBIACEAE	KNMUS/H133/75:25	malaria, chest, stomach
l-amai	*Ximenia caffra* Sond.	OLEACEAE	KNMUS/H250/59:47	stomach
l-ampurrorri	*Commiphora* sp.	BURSERACEAE	KNMUS/H250/59:1[1]	liver, stomach
l-amuriei	*Carissa edulis* (Forsk.) Vahl	APOCYNACEAE	KNMUS/H133/75:37	polio, gonorrhea
l-aramirami	*Senecio petitianus* A. Rich	COMPOSITAE	KNMUS/H250/59:152	strength for baby
larasoro	*Cadaba farinosa* Forsk.	CAPPARIDACEAE	KNMUS/H133/75:72	fever, ritual
l-asaremai	*Harrisonia abyssinica*	SIMAROUBACEAE	KNMUS/H133/75:46	gonorrhea, malaria, chest congestion
l-aturdei	*Capparis elaegnoides* (Gilg.) de Wolf	CAPPARIDACEAE	KNMUS/H133/75:32	wounds, burns
lauragi	*Sansevieria* sp.	AGAVACEAE	KNMUS/H250/59:53	gonorrhea
l-bolan	*Plectranthus forskholii* (Poir.) Briq.	LABIATAE	Heine *et al.* 1988:68	childbirth
l-bukoi	*Momordica spinosa* (Gilg) Chiov.	CUCURBITACEAE	KNMUS/H250/59:168	headaches, hepatitis
l-cheni ng'iro	*Commiphora africana* (A. Rich.) Engl.	BURSERACEAE	KNMUS/H250/59:122	diarrhea, stomach
l-ching'ei	*Euclea divinorum* Hiern.	EBENACEAE	KNMUS/H133/75:36	diarrhea, stomach
l-dalampoi	*Entada leptostachya* Harms	MIMOSACEAE	KNMUS/H250/59:34	polio, back pain

Samburu Name	Scientific Name and Identification	Scientific Family	Specimen Numbers	Medicinal Uses
l-dawa lenkop	*Melhania ovata* (cav.) Spreng.	STERCULIACEAE	KNMUS/H250/59:114	wounds, burns
l-depe	*Acacia nubica* Benth.	MIMOSACEAE	KNMUS/H133/75:58	women's stomach pain, hepatitis, fever, gonorrhea
l-dupai	*Sansevieria robusta* N.E. Br.	AGAVACEAE	Heine *et al.* 1988:75	gonorrhea, arthritis
lekule	*Euphorbia systyloides* Pax.	EUPHORBIACEAE	KNMUS/H250/59:163	wounds
lekuru	*Withania somnifera* (L.) Dunal	SOLANACEAE	Heine *et al.* 1988:81	eyes, burns, wounds
leminshiria	*Combretum aculeatum* Vent.	COMBRETACEAE	KNMUS/H304/74 & 56/75-4	malaria, gonorrhea, stomach, back pains
lepurana	*Jatropha dictar* Macbr.	EUPHORBIACEAE	KNMUS/H133/75:41	stomach, chest
lerai	*Acacia hockii* de Wild.	MIMOSACEAE	KNMUS/H133/75:43	stomach, childbirth
lesayyet	*Withania somnifera* (L.) Dunal	SOLANACEAE	KNMUS/H250/59:27	ritual fires
letuala	*Crotalaria incana* L.	PAPILIONACEAE	KNMUS/H250/59:105	chest, coughs
l-gweita	*Cordia sinensis* Lam.	BORAGINACEAE	KNMUS/H304/74 & 56/75-2	fractures, ritual
l-jipilikua	*Strychnos* sp.	LOGANIACEAE	KNMUS/H250/59:38	malaria, wounds
l-karasha	*Stericulia africana* (Lour.) Fiori	STERCULIACEAE	KNMUS/H250/59:66	children's stomach
l-kaukawa	*Oxyanthus speciosus* DC.	RUBIACEAE	Heine *et al.* 1988:96	sore throat
l-kelelit	*Euphorbia heterochroma* Pax	EUPHORBIACEAE	KNMUS/H250/59:138	malaria, gonorrhea
l-kerdeedi (l-terikesi)	*Acacia senegal* (L.) Willd.	MIMOSACEAE	KNMUS/H250/59:169	abortion, stomach
l-kiloriti	*Acacia nilotica* (L.) Del.	MIMOSACEAE	KNMUS/H133/75:64	stomach
l-kimanshoi	*Hibiscus greenwayi* Bak. f.	MALVACEAE	KNMUS/H250/59:2	colds
l-kinoi	*Lannea alota* (Engl.) Engl.	ANACARDIACEAE	KNMUS/H250/59:115	wounds, burns, stomach

Samburu Name	Scientific Name and Identification	Scientific Family	Specimen Numbers	Medicinal Uses
l-kinyil	*Rhamnus prinoides* L'Herit.	RHAMNACEAE	KNMUS/H250/59:224	fever, malaria, snakebites
l-kiriantus	*Plumbago zeylanica* L.	PLUMBAGINACEAE	KNMUS/H133/75:69	stomach, malaria
l-kitalaswa	*Myrica salicifolia* A. Rich.	MYRICACEAE	KNMUS/H250/59:207	strength
l-kukulai	*Rhamnus staddo* A. Rich.	RHAMNACEAE	KNMUS/H133/75:49	polio, gonorrhea, malaria, colds, ritual protection
l-maim	*Commiphora* sp.	BURSERACEAE	KNU/H200/83:585	polio, gonorrhea, arthritis
l-makutukuti	*Clerodendrum myricoides*	VERBENACEAE	KNMUS/H133/75:44	gonorrhea, malaria, polio, abortions, colds, headache
l-mang'wei	*Sclerocarya birrea* (A. Rich.) Hochst.	ANACARDIACEAE	Heine *et al.* 1988:113	stomach, colds
l-marag	*Blepharis lineariifolia* Pers.	ACANTHACEAE	KNMUS/H250/59:141	malaria
l-margweet	*Croton megalocarpus* Hutch.	EUPHORBIACEAE	KNMUS/H133/75:25	stomach, malaria, fever, chest
l-masikirai	*Heliotropium steudneri* Vatke	BORAGINACEAE	KNMUS/H304/74 & 56/75:5	fleas
mira'a	*Catha edulis* (Vahl) Endl.	CELASTRACEAE	Heine *et al.* 1988:118	stimulant
l-miskiyei	*Rhus natalensis* Krauss	ANACARDIACEAE	KNMUS/H133/75:38	children's stomach
l-momoi	*Kigelia aethiopica* Decne	BIGNONIACEAE	KNMUS/H250/59:81	stomach
l-morijioi	*Acokanthera longiflora* Stapf.	APOCYNACEAE	KNMUS/H133/75:65	arrow poison
l-mugutan	*Albizia anthelmintica* Brongn.	MIMOSACEAE	KNMUS/H250/59:5	malaria, tapeworms, gonorrhea, stomach
l-murgusyan	*Gardenia jovis-tonantis* (Welw.) Hiern	RUBIACEAE	KNMUS/H250/59:107	malaria
l-ng'alayoi	Possibly *Cissus* sp.*	VITACEAE	KNMUS/H250/59:89	strength, gonorrhea, cough, headache
l-ng'erriyei	*Olea africana* Mill.	OLEACEAE	Heine *et al.* 1988:123	tapeworms
l-ng'iriai	*Lawsonia inermis* L.	LYTHRACEAE	KNMUS/H133/75:60	stomach

Samburu Name	Scientific Name and Identification	Scientific Family	Specimen Numbers	Medicinal Uses
loduaporoo	*Commicarpus plumbagineus* (Cav.) Standl.	NYCTAGINACEAE	Heine *et al.* 1988:127	malaria, earache, headache
loimugi	*Newtonia hildebrandtii* Vatke.	COMPOSITAE	KNMUS/H250/59:42	stomach
loisugi	*Fagara chalybea* (Engl.) Engl.	RUTACEAE	KNMUS/H250/59:67	chest congestion, sore throat
loitaakine	*Maerua triphylla* A. Rich.	CAPPARIDACEAE	KNMUS/H133/75:34	wounds, burns
loitokutok	*Commiphora* sp.	BURSERACEAE	KNMUS/H250/59:120	hepatitis, fractures
lokildia	*Tinnea aethiopica* Kotschy & Peyr.	LABIATAE	KNMUS/H133/75:28	ritual
lokii	*Lycium europaeum* L.	SOLANACEAE	KNMUS/H250/59:4	malaria, rheumatism, swelling of breast
lokumaati	*Vernonia brachycalyx* O. Hoffm.	COMPOSITAE	KNMUS/H133/75:68	eye infections
lokiteng'i	*Ipomoea spathulata* Hall f.	CONVOLVULACEAE	KNMUS/H133/75:33	eyes
loliontoi	*Olea hochstetteri* Baker	OLEACEAE	Heine *et al.* 1988:141	tapeworms, stomach
lolsesyai	*Osyris abyssinica* A. Rich.	SANTALACEAE	Heine *et al.* 1988:154	pregnancy, swollen breasts
lororai	*Boscia angustifolia* A. Rich.	CAPPARIDACEAE	KNMUS/H304/74 & 56/75:16	malaria
lordo	*Cyphostemma adenocaule* (A.Rich.) Willd. & Drum.	VITACEAE	KNMUS/H133/75:47	tuberculosis, arthritis
lowwai	*Balanites aegyptiaca* (L.) Del.	BALANITACEAE	KNU/H200/83:873	wounds, burns, eyes, ribs, chest
l-paraa	*Euphorbia* sp.	EUPHORBIACEAE	KNMUS/H250/59:55	wounds, burns, malaria
l-perentai	*Adenium obesum* (Forsk.) Roem & Schult	APOCYNACEAE	KNMUS/H304/74 & 56/75:9	poison
l-paramunyo	*Toddalia asiatica* (L.) Lam.	RUTACEAE	KNMUS/H133/75:50	strength, ritual ntasim
l-tarakwai	*Juniperus procera* Hochst. ex Endl.	CUPRESSACEAE	KNMUS/H250/59:156	sore throat

* Heine *et al.* (1988:122) identify this as *Cucumis* sp. (CUCURBITACEAE).

Samburu Name	Scientific Name and Identification	Scientific Family	Specimen Numbers	Medicinal Uses
l-tepes	*Acacia tortilis* (Forsk.) Hayne	MIMOSACEAE	KNMUS/H304/74 & 56/75:18	malaria, fever, polio, colds
l-terikesi (l-kerdedi)	*Acacia senegal* (L.) Willd.	MIMOSACEAE	Heine *et al.* 1988:123	stomach
l-teroi	*Commiphora* sp.	BURSERACEAE	Heine *et al.* 1988:167	polio, rheumatism
l-tigomi	*Cardiospermum corindum* L.	SAPINDACEAE	KNMUS/H133/75:62	malaria, polio, snakebites
l-tulelei	*Solanum incanum* L.	SOLANACEAE	KNMUS/H304/74 & 56/75:6	sore throat, polio, fever, wounds
l-turkan	*Sericocompsis pallida* (S. Moore) Schinz	AMARANTHACEAE	KNMUS/H133/75:42	malaria
n-aiba layyok	*Solanum renschii* Vatke.	SOLANACEAE	Heine *et al.* 1988:180	stomach
n-dupai	*Sansevieria robusta* N.E. Br.	AGAVACEAE	KNMUS/H250/59:92	gonorrhea, rheumatism
	Euphorbia uhligiana Pax	EUPHORBIACEAE	KNMUS/H250/59:94	malaria, chest colds, stomach
ng'aing'aipiapi	(unidentified)			warrior's strength ***nemunyi***
ng'elai orok	*Vepris eugenifolia* (Engl.) Verdoorn	RUTACEAE	KNMUS/H133/75:70	hepatitis
n-kaiteteyyai	*Commelina imberbis*	COMMELINACEAE	KNMUS/H250/59:57	children's coughs
n-keju nkitejo	*Portulaca* sp.	PORTULACACEAE	KNMUS/H250/59:117	burns
ng'ilai orok	*Vepris eugeniifolia* (Engl.) Verdoorn	RUTACEAE	KNMUS/H250/59:84	sore throat, hepatitis
n-kilenyei	*Syzgium cordatum* Hochst.	MYRTACEAE	Heine *et al.* 1988:195	strength
n-kunee	*Cissus* sp.	VITACEAE	Heine *et al.* 1988:198	eyes, arthritis
nyiriman	*Hildebrantia sepalosa*	CONVOLVULACEAE	Heine *et al.* 1988:201	stomach
raraiti	*Kalanchoe diesiflorum* Rolfe.	CRASSULACEAE	KNMUS/H250/59:25	wounds, stomach
reteti	*Ficus wakefieldii* Hutch.	MORACEAE	KNMUS/H133/75:29	ritual, women's ntasim
sakurdumi	*Kedrostis gijef* (J.F.Gmel) C. Jeffrey	CUCURBITACEAE	KNMUS/H133/75:61	malaria, stomach

Samburu Name	Scientific Name and Identification	Scientific Family	Specimen Numbers	Medicinal Uses
sarai	*Balanites* sp.	BALANITACEAE	KNMUS/H250/59:131	eyes, stomach
seketeti	*Myrsine africana* L.	MYRSINACEAE	KNMUS/H250/59:153	tapeworms, malaria, tuberculosis
senatoi	*Cassia longiracemosa* Vatke.	CAESALPINIACEAE	KNMUS/H304/74 & 56/75:12	malaria, stomach, headache
serai	*Euphorbia candelabrum* Kotschy	EUPHORBIACEAE	KNMUS/H250/59:75	chest, bronchitis, headache, barrenness
serijioi	*Boscia coriacea* Pax	CAPPARIDACEAE	Heine *et al.* 1988:215	malaria, burns
silalei	*Boswellia hildebrandtii* Engl.	BURSERACEAE	KNMUS/H250/59:127	chest, headache, ribs, diarrhea
silipani	*Cordia sinensis* Lam.	BORAGINACEAE	Heine *et al.* 1988:219	chest, pneumonia
simalelei	unidentified			women's stomach
sinandei	*Cassia longiracemosa* Vatke.	CAESALPINIACEAE	Heine *et al.* 1988:220	malaria
siteti	*Grewia bicolor* A. Juss.	TILIACEAE	KNMUS/H304/74 & 56/75:22	coughs, soreness after childbirth
sokoltei	*Phytolacca dodecandra* L'Herit.	PHYTOLACCACEAE	KNMUS/H250/59:157	stomach, childbirth
sokotei	*Salvadora persica* L.	SALVADORACEAE	KNMUS/H250/59:100	malaria, fever, abortion, childbirth
sokoni	*Warburgia ugandensis* Sprague	CANELLACEAE	KNMUS/H223/75:6	stomach, diarrhea, tuberculosis, chest
sucha	*Barleria spinisepala* E.A. Bruce	ACANTHACEAE	KNMUS/H133/75:40	polio, fever, ritual ntasim
sukoroi	*Aloe secundiflora* Engl.	LILIACEAE	KNMUS/H133/75:30	eyes, tuberculosis
sukurtuti	*Cissus quadrangularis* L.	VITACEAE	KNMUS/H250/59:51	malaria, stomach, tuberculosis
sunoni	*Lippia ukambensis* Vatke	VERBENACEAE	KNMUS/H133/75:26	measles, malaria, smallpox, strength

TABLE 2. SAMBURU MEDICINAL CURES BY LOCATION OF SYMPTOMS

Location/ Symptoms	Herbal Medicine	Preparation
The chest ***(l-go'o)***		
Cough, colds ***(l-chema)***		
	l-margweet *(Croton megalocarpus)*	boil bark as tea
	l-kimanshoi *(Hibiscus greenwayi)*	chew bark
	letuala *(Crotalaria incana)*	chew outer layer of root
	curry powder or red pepper	add to tea
Bronchitis and pneumonia ***(nkanyaragi)***		
	sokoni *(Warburgia ugandensis)*	boil bark and root
	nemunyi *(Euphorbia sp.)*	boil bark in soup
	silalei *(Boswellia hildebrandtii)*	chew bark
	silipani *(Cordia sinensis)*	boil gum in water, add milk
	lowwai *(Balanites* sp.*)*	boil gum in water, add milk
Chest congestion believed due to poisonous substances		
	l-asaremai *(Harrisonia abyssinica)*	boil roots, stems as soup
	l-makutukuti *(Clerodendrum myricoides)*	boil roots, add milk, sugar
	l-ng'alayoi *(Cissus* sp.*)*	boil roots, add fat as soup
	loisugi *(Fagara chalybea)*	boil tuber roots in milk and drink
	l-akirding'ai *(Croton dichogamus)*	boil roots in water, prepare as tea
	lepurana *(Jatropha dictar)*	boil roots as tea
	sukurtuti *(Cissus quadrangularis)*	stew root
Children's coughs (treated with milder purgatives)		
	n-kaiteteyyai *(Commelina imberbis)*	pound stalk, boil and add milk
Tuberculosis ***(shurr)***		
	seketeti *(Myrsine africana)*	crush berries or seeds, boil in water or soak and drink cold
	sukoroi *(Aloe secundiflora)*	stew roots, take as enema
	sokoni *(Warburgia ugandensis)*	soak bark and roots, boil as tea
Pneumonia (***l-marei*** or "ribs")		
	silalei (Boswellia hildebrandtii)	mix resin with ***silipani*** *(Cordia sinensis)* bar, add pepper and soda ash
	lordo *(Cyphostemma adenocaule)*	Mix with blood and stalks of ***nkunee*** *(Cissus* sp.*)* as soup
	lepurana *(Jatropha dictar)*	boil roots with ***sokoni*** (*Warburgia ugandensis)* roots and bark
The stomach ***(Ngosheke)***		
Upset stomach		
	l-kiloriti *(Acacia nilotica)*	boil bark as soup
	sakurdumi *(Kedrostis gijef)*	boil roots, mix with ***l-ng'iriai*** *(Lawsonia inermis)* leaves, as enema or tea

Location/ Symptoms	Herbal Medicine	Preparation
	l-kukulai *(Rhamnus staddo)*	boil root and drink
	l-amai *(Ximenia caffra)*	boil bark add milk
	l-akirding'ai *(Croton dichogamus)*	boil roots add tea
	l-ampurrorri *(Commiphora* sp.*)*	soak bark in cold water and drink
	lepurana *(Jatropha dictar)*	boil roots, drink
	lerai *(Acacia hockii)*	boil roots as tea
	leminshiria *(Combretum aculeatum)*	soak roots in water
	loimugi *(Newtonia hildebrandtii)*	boil bark and drink
	l-mang'wei *(Sclerocarya birrea)*	stew bark in water, add milk or boil
	l-mugutan *(Albizia anthelmintica)*	boil bark, wood, or root and add milk
	l-momoi *(Kigelia aethiopica)*	soak bark, drink cold
	raraiti *(Kalanchoe diesiflorum)*	stew root, drink cold
	sokoltei *(Phytolacca dodecandra)*	stew root, drink cold
	sokotei *(Salvadora persica)*	boil roots and drink
	l-terikesi *(Acacia senegal)*	boil bark and drink
	l-turkan *(Sericocompsis pallida)*	boil roots and drink
Congested blood vessels around the stomach (***ng'ony***)		
	ching'ei *(Euclea divinorum)*	boil roots and drink
	l-kiriantus *(Plumbago zeylanica)*	boil roots as tea
Nausea		
	l-kiloriti *(Acacia nilotica)*	soak bark in water and drink cold
	l-mang'wei *(Sclerocarya birrea)*	boil bark in tea
Menstruation, "women's stomach"		
	nyeriman *(Hildebrantia sepalosa)*	stew roots as soup
	simalelei (unidentified)	boil tuberous roots, add milk
	l-depe *(Acacia nubica)*	soak bark in water 12 hours and drink
Diarrhea, "children's stomach" (***airi***)		
	l-cheni ng'iro *(Commiphora africana)*	soak bark in tea
	l-aishimi *(Commiphora africana*	soak bark in tea
	l-miskiyei *(Rhus natalensis)*	soak leaves, roots in water, drink cold
	l-karasha *(Stericulia africana)*	boil roots
Intestinal worms		
	l-mugutan *(Albizia anthelmintica)*	boil bark, roots, and wood, add milk
	l-ng'erriyei *(Olea africana)*	soak bark in water 30 minutes, boil, let sit 12 hours, drink cold

Location/ Symptoms	Herbal Medicine	Preparation
	seketeti *(Myrsine africana)*	crush berries, drink with milk
The Head (***nkue***)		
Headache		
	l-ng'alayoi *(Cissus* sp.*)*	soak bark several days, ingest through nose
	l-makutukuti *(Clerodendrum myricoides)*	grind roots and sniff through nose
	silalei *(Boswellia hildebrandtii)*	place resinous gum near fire, inhale fumes through nose
	l-bukoi *(Momordia spinosa)*	peel bark, add to sheep brain soup
Sinus congestion (***lchema lenkue***)		
	sokoni *(Warburgia ugandensis)*	boil roots and bark as tea
	mira'a *(Catha edulis)*	chew bark
Sore throat (***lgoso***)		
	l-kaukawa *(Oxyanthus speciosus)*	soak bark in cold water and drink
	ng'elai orok *(Vepris eugenifolia)*	chew leaves
	l-tulelei *(Solanum incanum)*	peel root, stew and gargle, or chew peeled root
	l-tarakwai *(Juniperus procera)*	soak bark in cold water and drink
Eyes (***nkonjek***)		
	l-ng'alayoi *(Cissus* sp.*)*	grind roots and soak in water, snuff through nose
	sukoroi *(Aloe secundiflora)*	place drops of sap in eyes, later wash
	lokiteng'i *(Ipomoea spathulata)*	wash eyes with leaves soaked in water
	lokumaati	soak leaves in water, wash eyes
	lowwai (*Balanites* sp.)	place resinous gum in eyes, wash out
The Liver (***eminyua***)		
	l-depe *(Acacia nubica)*	peel bark, soak in water, drink as tea
	sukurtuti *(Cissus quadrangularis)*	stew root in water and drink cold; avoid sheep meat
Hepatitis (***ndis***)		
	l-depe *(Acacia nubica)*	soak bark in water over night, heat and drink cold
	ng'elai orok *(Vepris eugenifolia)*	soak leaves, mix with bark and tea
	l-kiloriti *(Acacia nilotica)*	boil bark as soup
	loitokutok *(Commiphora* sp.*)*	boil bark as tea
	l-bukoi *(Momordica spinosa)*	boil bark as tea, fat, and liver
Fractures and dislocations		
Limbs are set using branches of		
	l-gweita *(Cordia sinensis)*	held together by the resinous gum of ***l-tepes*** (*Acacia tortilis*), ***lowwai*** (*Balanites* sp.) and ***loitokutok*** (*Commiphora* sp.)
	seketeti *(Myrsine africana)*	crush berries or seed, drink as tea for "strength"

Location/ Symptoms	Herbal Medicine	Preparation
Wounds and burns		
	l-jipilikua *(Strychnos* sp.)	dry and grind root, place on cut to dry
	l-kinoi *(Lannea alota)*	apply red surface of roots
	l-aturdei *(Capparis elaegnoides)*	grind outer root, apply to cuts
	loitaakine *(Maerua triphylla)*	chew leaves, place on wound
	lowwai (*Balanites* sp.)	heat gum and place on wound
	l-paraa (*Euphorbia* sp.)	place sap on wound
Burns		
	l-kiloriti *(Acacia nilotica)*	boil bark or chew leaves and apply to burn
	l-dawa lenkop *(Melhania ovata)*	grind leaf into paste with water, or chew leaf and apply to burn
	n-keju nkitejo (*Portulaca* sp.)	chew leaf and place on burn
	l-abaai *(Psiadia arabica)*	burn leaves, sprinkle ash on burns
	lekuru *(Withania somnifera)*	dry root and grind, sprinkle on burn
Skin rashes		
	l-tulelei *(Solanum incanum)*	boil peeled root and place on skin
Muscular-skeletal aches (***l-bai***)		
	l-dalampoi *(Entada leptostachya)*	soak root in water, soup, or tea
	l-depe *(Acacia nubica)*	soak bark overnight and drink
	l-dupai *(Sansevieria robusta)*	warm leaves, squeeze and drink juice
	l-aimuronyai *(Maytenus senegalensis)*	boil roots in soup and drink
	lauragi (*Sansevieria* sp.)	boil root, add milk
	leminshiria *(Combretum aculeatum)*	soak roots overnight, add milk
	l-makutukuti *(Clerodendrum myricoides)*	soak roots and drink
To relieve swelling		
	lokii *(Lycium europaeum)*	boil root, let sit and drink cold
	l-teroi (*Commiphora* sp.)	boil bark and stew leaves, add milk
	lordo *(Cyphostemma adenocaule)*	boil leaves with ***n-kunee*** (*Cissus* sp.), mix with blood, eat
Malaria (***nkirewa***)		
	l-ching'ei *(Euclea divinorum)*	soak roots with ***sunoni*** *(Lippia ukambensis)* twigs and goat's meat and drink; or boil stems and leaves, add milk
	l-asaremai *(Harrisonia abyssinica)*	boil roots as soup
	loduaporoo *(Commicarpus plumbagineus)*	boil roots as tea
	lowwai (*Balanites* sp.)	boil bark as tea
	l-makutukuti *(Clerodendrum myricoides)*	boil roots as tea

Location/ Symptoms	Herbal Medicine	Preparation
	l-marag *(Blepharis lineariifolia)*	stew whole plant in water, add milk
	l-mugutan *(Albizia anthelmintica)*	boil roots and bark in tea
	l-murgusyan *(Gardenia jovis-tonantis)*	boil fruit and drink cold
	nyeriman *(Hildebrantia sepalosa)*	stew roots
	l-paraa (*Euphorbia* sp.)	stew leaves
	sinandei *(Cassia longiracemosa)*	stew leaves
	serijioi *(Boscia coriacea)*	boil roots, add milk
	l-turkan *(Sericocompsis pallida)*	boil roots
Measles (***l-tipu***)		
	sunoni *(Lippia ukambensis)*	boil leaves, stem, drink milk, butter, and animal fat
Smallpox (***l-pepedo***)		
	rub skin with fat from the monitor lizard	
Polio (***nkurotet***)		
	l-kukulai *(Rhamnus staddo)*	boil root
	lamuriei *(Carissa edulis)*	boil root, add milk
	l-makutukuti *(Clerodendrum myricoides)*	boil roots
	sucha *(Barleria spinisepala)*	boil whole plant
	l-dalampoi *(Entada leptostachya)*	soak root in water, soup, or tea
	l-depe *(Acacia nubica)*	soak bark in water
	l-maim (*Commiphora* sp.)	boil bark in water
	leminshiria *(Combretum aculeatum)*	boil roots
	l-tepes *(Acacia tortilis)*	boil bark
	l-teroi (*Commiphora* sp.)	stew leaves, boil bark
Gonorrhea (***kisunono***)		
	l-mugutan *(Albizia anthelmintica)*	boil root, bark, leaves, mix with sheep fat as enema
	l-dupai *(Sansevieria robusta)*	enema, as above
	l-makutukuti *(Clerodendrum myricoides)*	enema, as above
	l-depe *(Acacia nubica)*	soak bark in water 12 hours
	l-kelelit *(Euphorbia heterochroma)*	burn stems in fire to remove white gum, prepare in fat soup
	l-kukulai *(Rhamnus staddo)*	boil root
	l-amuriei *(Carissa edulis)*	boil root, add milk
	leminshiria *(Combretum aculeatum)*	soak roots in water, add milk
	l-asaremai *(Harrisonia abyssinica)*	boil branches and roots as tea
	l-makutukuti *(Clerodendrum myricoides)*	boil roots
	l-mugutan *(Albizia*	

Location/ Symptoms	Herbal Medicine	Preparation
	anthelmintica)	boil bark and roots, add milk
For difficulties in passing urine		
	lauragi (*Sansevieria* sp.)	boil root, add milk
	l-dupai *(Sansevieria robusta)*	boil roots and inner stem in sheep's fat as enemaFor women
	l-makutukuti *(Clerodendrum myricoides)*	boil roots as enema, add above
Pregnancy and childbirth		
Upset stomach		
	l-miskiyei *(Rhus natalensis)*	soak leaves and roots in water, drink
	nyeriman *(Hildebrantia sepalosa)*	boil roots in soup and drink
Soreness after delivery		
	siteti *(Grewia bicolor)*	boil berries in water five hours, add milk and drink
Swelling in the breasts		
	lokii *(Lycium europaeum)*	mix leaves and stem, boil roots, let sit and drink cold
	lolsesyai *(Osyris abyssinica)*	burn wood, hold smoking ember near breasts rubbed with goat's fat
Problems urinating		
	l-aarami *(Cistanche tubulosa)*	boil root in water, add milk and drink
Strength for mother		
	l-bolan *(Plectranthus forskholii)*	mix leaves and stem with blood and drink
Strength for baby		
	l-aramirami *(Senecio petitianus)*	mother chews roots and gives pulp to baby mouth to mouth
Abortion (***airony***) or retained placenta (***mudong***)		
	makutikuti *(Clerodendrum myricoides)*	boil roots, mix with sheep's urine, as enema or orally
	l-terikesi *(Acacia senegal)*	boil bark in water and drink
	sokotei *(Salvadora persica)*	boil root and mix with sheep urine and dung, drink, massage abdomen
For soreness following abortion		
	l-terikesi *(Acacia senegal)*	boil bark and drink
	siteti *(Grewia bicolor)*	boil bark and drink
Barrenness: usually treated by ***loibon*** ritual specialists, but also by		
	simalelei (unidentified)	boil roots in water, add milk and drink
	serai *(Euphorbia candelabrum)*	tap trunk for latex, mix with water and ox-meat boiled in an ox bladder; drink soup and vomit 3 to 5 times a day
Stimulants		
	l-kambau *(chewing tobacco)*	chew, for men

Location/ Symptoms	Herbal Medicine	Preparation
	naisuki *(snuffing tobacco)*	grind tobacco and mix with soda ash, for women
	mira'a *(Catha edulis)*	boil roots in soup, chew bark and sugar
For strength (**ngolon**)		
	n-aiba layyok *(Solanum renschii)*	boil roots in tea or sour milk
	l-ng'alayoi (*Cissus* sp.)	boil root and drink
	siteti *(Grewia bicolor)*	boil berries, add milk
For warrior's stength (results in "shaking" [***aduku***] or "trembling" [***nkirakirr***])		
	l-kinyil *(Rhamnus prinoides)*	boil roots and drink
	l-kitalaswa *(Myrica salicifolia)*	boil roots in soup
	lolsesyai *(Osyris abyssinica)*	boil roots in soup
	ng'aing'aipiapi (unidentified)	boil roots in tea or soup
	n-kilenyei *(Syzgium cordatum)*	boil roots in tea
	seketeti *(Myrsine africana)*	boil roots in soup
Poisons		
	l-morijioi *(Acokanthera longiflora)*	as arrow poison, boil wood, roots, bark
	l-perentai *(Adenium obesum)*	boil bark, to kill lions
	laturdei *(Capparis elaegnoides)*	grind roots and boil
Snakebite		
	l-tigomi *(Cardiospermum corindum)*	soak roots in water 2 hours, drink to vomit
	l-kinyil *(Rhamnus prinoides)*	boil roots in soup
Ritual cures: medicines of ***loibonok*** diviners		
	l-paramunyo *(Toddalia asiatica)*	grind outer bark of root, for madness, fits, epilepsy
	l-kukulai *(Rhamnus staddo)*	grind outer bark of root, mix with ***l-paramunyo*** *(Toddalia asiatica)* root
	reteti *(Ficus wakefieldii)*	scrape inside of bark, for barrenness in women
	l-kiloriti *(Acacia nilotica)*	burn roots
	lokildia *(Tinnea aethiopica)*	burn roots
Livestock diseases		
Trypanosomiasis (***saar***)		
	l-depe *(Acacia nubica)*	soak bark and bathe
Foot and mouth disease (***l-kulup***)		ritual blessings by ***L-Toiyo*** clan
Tick fever (***l-merimer***)		
	l-abaai *(Psidadia arabica)*	boil leaves, bathe
"Lungs," i.e., bovine or carpine pleuro-pneumonia (***l-kipei***)		no local cure
Sheep disease, possibly glanders (***l-pus, nadol manyeta***)		no local cure except solutions of tea, milk, tobacco
Anthrax (***lokochum***)		no local cure; Samburu believe it is caused by poison blown in the grass by toads (***ntua'an***)

Location/ Symptoms	Herbal Medicine	Preparation
Camel "glands," viz., lymphatic swellings, diarrhea (***ng'aring'ari***)		no cure
Swollen udder		
	lolsesyai *(Osyris abyssinica)*	burn plant, hold smoking embers near udder greased in fat
Fleas		
	l-abaai *(Psiadia arabica)*	boil leaves
	l-masikirai *(Heliotropium steudneri)*	boil leaves
Worms		
	loliontoi *(Olea hochstetteri)*	soak in water 12 hours, ingest
	l-mugutan *(Albizia anthelmintica)*	boil bark, wood, and root
	l-ng'erriyei *(Olea africana)*	soak bark in water 30 minutes, ingest
	seketeti *(Myrsine africana)*	soak seeds in water
Infected eyes		
	sarai (*Balanites* sp.)	grind leaves and place in eyes
Retained placenta		
	sokotei *(Salvadora persica)*	burn roots and grind, pour powder in a shed snake skin stuffed with grass, force feed to cow
Swollen liver		
	sukurtuti *(Cissus quadrangularis)*	pound wood until soft, feed to cow

SAMBURU CONCEPTS OF HEALTH AND ILLNESS

Samburu cognitively distinguish health problems by causality, distinguishing those illnesses which result from "natural" or expected events from those unusual occurrences believed to result from "mystical" causes such as the curse of one's kinsmen or the immoral attacks of sorcery directed by known or unknown enemies. In this discussion, illness refers to Samburu notions of physical disability and poor health, while disease refers to Western medical categories, particularly infectious disease. Samburu treat "naturalistic" illnesses with medicines derived from trees and shrubs (***dawa lo l-chani***, combining Swahili ***dawa*** or "medicine" with Samburu "tree") or increasingly, Western medicines, and sorcery illness with ritual medicines known as ***ntasim*** (spelled ***entasim*** in Maasai) prepared by ***laibon*** ritual curers and which protect against attacks of sorcery and witchcraft.

Infectious diseases, wounds, fractures, and burns are accepted as everyday events and are treated by traditional specialists knowledgeable in tree medicines, bone-setting or massage, or by Western medicine if available. Unusual events such as drowning, attacks by wild animals, snakebites, and problems of infertility and recurrent infant deaths are often attributed to mystical causes, and can only be treated by the interventions of ***laibon*** diviners and healers or, in the case of infertility, by blacksmiths whose iron flakes from their hearths (***l-kunee***) are believed to act as powerful ***ntasim*** medicines.

Diet, anatomy, and pollution.—As cattle pastoralists Samburu and Maasai believe God gave them cattle and small stock to provide them with milk, meat, and blood (see Figure 2). To eat animal foods from outside this domain risks both natural and mystical misfortune. "Unclean" foods include most wild animals - fish, birds, eggs, reptiles, and non-ruminant mammals including pigs, carnivores, and rodents. Only those wild animals that resemble domestic livestock in their diet and behavior such as giraffe (considered an archaic "camel"), antelope ("small stock") and eland ("cattle") are considered edible, and they are only eaten during periods of severe shortages and famine.

FIGURE 2.— Samburu warrior herding cattle.

Distinctions of "clean" from "unclean" foods mirror social categories within Samburu society. Sexually mature women are considered by men to be unclean, particularly during menstrual or child birth periods, and are excluded from male-dominated rituals. Women are "made clean" at their wedding ceremonies by female circumcision (clitoridectomy), which ensures the culturally approved reproduction and birth of children. Men refrain from sexual relations during female menstruation, lest "polluting" menstrual blood enter their bodies.

Samburu believe many health problems are caused by the presence of "unclean" substances which block vital internal systems such as blood circulation or food digestion. Notions of illness resulting from blocked internal circulations has been described for other African societies, as in Taylor's (1992) discussion of Rwandan medicine. Samburu believe these blockages may result from food congestion, caused by eating the wrong foods or fatty foods, or from invisible substances which enter the body from insect bites or contact with other humans. These substances are thought to "turn blood from red to black," obstruct circulation, stiffen the limbs, and lead to fevers and headaches. Samburu worry about constipation (which is probably common due to little roughage and much animal protein in their diet), and seek herbal medicines to relieve it.

According to Lemeriwas the herbalist, food enters the mouth (***nkutuk, nkutkui***) and proceeds to the stomach (***ngoshoke, ngoshuaa***), which separates waste (***ng'ik***, or excrement) and conveys the nourishment through surrounding fatty tissue (***emanyit, imanyit***) directly to the kidneys (***lare, larie***). The kidneys extract urine (***nkulak***) and pass the remaining food to the liver (***emwinyua, imwinyuashi***) via blood vessels (***ng'onyo, ng'ony***). The liver is considered the most vital organ next to the heart (***l-tau, l-tauja***) as it converts food into blood (***mpuro***). The blood is conveyed directly to the heart, which "breathes" blood into the rest of the body through blood vessels.

Rich red blood is the final product of food, it brings life to all parts of the body. If blood is contaminated by the "wrong" foods or other pollutants, the blood turns black and hard and poisons the body. Meat is considered the best food for blood production although animal blood is also good as it "strengthens the system." Milk, while not directly contributing to blood production, is thought valuable for growth in muscles and bones. The eating of crops such as maize or potatoes is not prohibited but they are not considered to be strength-building foods. The gall bladder (***lodua, loduan***, or the "bitter one"), helps to filter out poisons, but bile (also ***lodua***) is considered poisonous and Samburu believe that humans need to urinate regularly to remove the bile.

A serious illness caused by undigested foods is ***ng'ony***, the congestion and swelling of the blood vessels in the abdomen region believed to convey food from the stomach to the liver. The uncirculated blood is believed to turn "black and hard", blocking digestion and blood flow and poisoning the entire system. ***Ng'ony*** is thought to result from mixing the wrong types of food (meat and milk, or porridge and meat), or may result from illnesses such as liver disease or hepatitis (***ndis***). It is believed that one who suffers ***ng'ony*** feels nauseated, and blood may be seen in the stool. Cures for ***ng'ony*** include massaging the stomach and consuming a variety of herbal purgatives, listed in Table 2.

Whereas stomach disorders are usually associated with eating the wrong foods, illnesses of the "whole body" (***sisen po'oke***) including malaria, measles, or tuberculosis, are thought to derive from invisible poisons that enter the body. While Samburu today attribute malaria to mosquito bites, it is not clear that they conceptualized this prior to European contact in the late nineteenth century. Samburu nevertheless attribute malaria to a foreign poison which results in blood loss by the liver and spleen giving rise to headaches and fever. Lemeriwas, the herbalist explained:

> If a person doesn't remove the poison from the body by vomiting and

> diarrhea, he's in trouble. The longer the poison stays in the body, the worse it becomes. It turns into ***l-tikana loibor*** (the white illness), where the blood turns white, the stomach and liver swell, the person becomes weaker and weaker. Usually people will eat anything, even porridge and blood, that just entraps the poison in the system even more, so the person becomes stiff and ultimately lame.

"Liver illness" (***ndis***) is commonly associated with malaria, although people use the term to complain of pains in either the right side or left side of the abdomen (i.e. liver or spleen area). The term ***ndis*** may refer to different health problems, however, including liver disease, urinary tract infections, and ulcers. It is also believed that drinking too much alchohol will damage the liver and contribute to ***ndis***. Polio (***nkurotet***) is also thought to be caused by poison which is believed to lodge in the legs, arms and backs, causing swelling, pain and paralysis.

Samburu recognize several infectious diseases including measles (***ntipu***), smallpox (***l-pepedo***), whooping cough (***l-muruti***), tuberculosis (***tibi*** or ***shurr***), and gonorrhea (***kisunono*** in Swahili). It is not clear to what degree Samburu attribute these infectious diseases to human contagion. Epidemics such as measles and, previously, smallpox, are believed to result from curses and sorcery attacks. Samburu are aware of the Western medical explanations for sexually transmitted diseases, but men have asserted, for example, that gonorrhea can appear spontaneously, "when a man wants a woman too much, and can't relieve himself." AIDS, like other terminal illnesses, is viewed fatalistically, and few men I interviewed believed that it was sexually transmitted and they saw little use in protecting themselves or their partners with condoms. I often heard the comment, "If God wants me to die, then I will die; if He wants me to live, I will live."

Herbal medicines as purgatives.— Samburu have a detailed knowledge of their grazing environment and recognize many of the plant species within the varied montane, savanna, desert, and riverine resources. Samburu identify over 300 species of plants, categorized as useful "trees" (***l-chani*** sing., ***l-keek*** pl.), "grasses" (***nkujit, nkujita***) as well as "weeds" or "useless" plants (***nyeerte***) (Heine *et al.* 1988). Heine found that where the largest category of useful plants are grasses and shrubs used to feed livestock, the second largest category is medicinal plants from which Samburu employ bark, roots, leaves, and woody parts of 122 species (42% of the total), mainly trees and shrubs.

Samburu herbal medicines are not placebos whose value is mainly symbolic, but effective purgatives, astringents, and analgesics based on their particular chemical constitutents. I was not able to analyze the specific compositions of my Samburu plant samples, but many of the species used by Samburu are referred to in other sources on African plants. For example, the poisonous qualities of alkaloids are thought to be responsible for the purging qualities of ***l-kiloriti*** (*Acacia nilotica* [L.] Del.), ***l-karasha*** (*Stericulia africana* [Lour.] Fiori), ***l-bukoi*** (*Momordia spinosa* [Gilg] Chiov.), and ***sinandei*** (*Cassia longiracemosa* Vatke.). In addition, plants containing saponins induce nausea and vomiting when added to water and contribute to the purging uses of ***leminciria*** (*Combretum aculeatum* Vent.), ***sokoltei*** (*Phytolacca dodecandra* L'Herit.), and the snakebite cure ***tigomi*** (*Cardiospermum corindum* L.)

(Verdcourt and Trump 1969:120, Watt and Breyer-Brandwijk 1962:257, 927, 158).

Samburu medicines also include plants such as tannin rich ***lesayyet*** (*Withania somnifera* L. Dunal) which have astringent qualities that dry wounds and burns (Watt and Breyer-Brandwijk 1962:927). Other plants used to quell a cough and relieve chest congestion such as ***sokoni*** (*Warburgia ugandensis*) and ***margweet*** (*Croton megalocarpus* Hutch.) contain amorphous resinous substances which irritate mucus membranes and act as expectorants (Watt and Breyer-Brandwijk 1962:158). The anti-malarial effect of a ***Cassia*** species known in Samburu as ***senetoi*** derives from its anthraquinone cathartics. This plant is used widely throughout southern and East Africa to reduce malarial fevers (Watt and Breyer-Brandwijk 1962:568).

Samburu descriptions of illnesses.—Individuals in Samburu usually describe ailments by the location of their symptoms, such as the chest, stomach, or head. If they are suffering a known disease such as malaria, they will name the illness and add the description "I am sick in my whole body." This section discusses briefly the specific health problems named by Samburu. Herbal cures and their preparations are listed in Table 2.

The "chest" (***l-go'o***). ***L-go'o*** includes chest pains and congestion, and covers a variety of illnesses of the repiratory tract: upper respiratory illnesses, bronchitis, pneumonia (all referred to as ***l-chema***). The word ***l-chema*** also refers to mucus congestion in the lungs (sometimes called ***nkanyaragi***) or mucus congestion in the nose and sinuses (***l-chema lenkue*** or head). Tuberculosis is recognized and called by a distinct name (***tibi***, derived from English, or ***shurr***, origin unknown), suggesting it has become a recognized disease only recently.

Chest pain or pleurisy associated with lung infection is described as "ribs" (***l-marei***) and is treated with teas prepared from pepper, "magadi" soda (calcium carbonate, as found in Lake Magadi in southern Kenya), resin from ***silalei*** (*Boswellia hildebrandtii* Engl.), and bark from ***silipani*** (*Cordia sinensis* Lam.). In addition, a soup prepared from blood, the leaves of the ***lordo*** (*Cyphostemma adenocaule* [A.Rich.] Willd. & Drum.), and stalks of ***nkunee*** (*Cissus* sp.) add relief.

The "stomach" (***ngosheke***). A "sick stomach" (***ngoshoke kemoi***) refers to all abdominal symptoms and is associated with food digestion. It includes cramps, constipation, diarrhea, and "women's stomach," i.e., menstrual cramps. Many "stomach" problems are thought due to congestion of undigested food and "old blood," which is treated by both massage and purgatives. Abdominal problems are a common complaint, and are treated by over twenty herbal preparations (Table 2). The illness ***ng'ony*** ("congested blood vessels around the stomach") is considered a grave condition (the category may include appendicitis), and is treated with powerful purgatives including ***ching'ei*** (*Euclea divinorum* Hiern.), ***l-kiriantus*** (*Plumbago zeylanica* L.), ***l-kiloriti*** (*Acacia nilotica*), and ***l-mang'wei*** (*Sclerocarya birrea* [A. Rich.] Hochst.).

While many Samburu cures induce diarrhea (***airi***) to relieve constipation, excessive diarrhea is considered dangerous. Nevertheless, the cures used by Samburu to treat diarrhea are themselves purgatives. They are not ingested to prevent diarrhea as much as to cleanse the body of polluting substances.

Among digestive problems, Samburu specifically recognize parasitic worms, usually tapeworm and ascaris, which they treat with several widely known anthelmintics, including ***l-mugutan*** (*Albizia anthelmintica* Brong.), ***l-ng'erriyei*** (*Olea africana* Mill.), and ***seketeti*** (*Myrsine africana* L.) which is known widely in East Africa.

The head and throat. ***Nkue*** (the head) specifically refers to headaches, but also includes problems of the throat (***l-goso***) and sinus congestion around the eyes (***l-chema lenkue***). Headaches are relieved by drinking or inhaling the vapors of several herbal cures prepared from ***l-ng'alayoi*** (*Cissus* sp.), ***l-makutukuti*** (*Clerodendrum myricoides* [Hochst.] R.Br.), and ***silalei*** (*Boswellia hildebrandtii*), whose resinous gum is burned and inhaled.

Sore throats (***l-goso***) are treated by boiling the bark of several highland trees including ***l-kawa*** (*Oxyanthus speciosus* DC., ***ng'elai orok*** (*Vepris eugenifolia* [Engl.]), and the juniper ***l-tarakwai*** (*Juniperus procera* Hochst. ex Endl.).

Eyes (***nkonjek***). Eyes frequently become irritated or infected by dust. Eye problems examined at local dispensaries include infections, conjunctivitis, cornea opacity, and trachoma. Some eye problems are thought (not incorrectly) to result from waste matter left by flies. Treatment includes applying substances that make the eyes tear, including ***l-ng'alayoi*** (*Cissus* sp.), and the aloe plant ***sukoroi*** (*Aloe secundiflora* Engl.).

The liver (***eminyua***) and spleen (***ntanu***). Illnesses of the liver and spleen are distinguished from other stomach problems. Liver and spleen are thought to swell as the result of malaria, hepatitis, and polio. Liver pains are relieved by purgatives mixed with milk, particularly from the bark of the acacia tree ***l-depe*** (*Acacia nubica* Benth.). Additional cures include eating roasted goat's liver and avoiding the meat, fat, and liver of sheep, which are thought to be more fatty and congesting.

Samburu, Maasai, and Rendille will also treat swollen spleens by making small cuts on the abdomen with a razor blade or knife. They do this to bleed the area, which is believed to prevent ***ng'ony*** (congestion and hardening of the blood), and to reduce the pressure and reduce the swelling.

Systemic illnesses. These refer to those health problems affecting the entire body such as malaria, measles, and polio. Often systemic illness are thought to be due to poisons that obstruct circulation of blood and digestion of food. Cures usually involve ingestion of purgatives as well as treatments for specific pains and discomfort.

Malaria (***nkirewa***, "hot" or "fever") is believed to result from poison introduced by mosquito bites, which are thought to inhibit blood circulation and destroy the liver, heart, and ultimately the entire body. Treatment is by expurgation (vomiting and diarrhea) brought about by strong purgatives taken orally and anally. Belief in disease transmission by mosquitoes is probably recent. It is not noted in earlier accounts of Maasai healing (Merker 1910, Thomson 1885).

Hepatitis (***ndis***), "the yellow illness," causes fever, swollen liver, jaundice, and yellow eyes. It is also thought to be conveyed by the mosquito, which lodges a poison that is trapped in the liver. Cures, as with malaria, include expurgation. Polio (***nkurotet***) is also believed to be caused by the mosquito - the poison is believed to spread throughout the body via the blood. A person afflicted with polio will take as many purgatives as possible, although people say there is little one can do once the weakness and muscle loss sets in.

Measles (***l-tipu***) is recognized by its rash; its fevers are known to kill people. Unlike malaria, measles is not attributed to congestion. Ill people are encouraged to drink milk and eat butter and animal fat (of both sheep and goat).

Smallpox (***l-pepedo***) is remembered from the 1890s, when a large segment of the Samburu and Rendille populations succumbed (Sobania 1988). It is said that the intense itching of the pox can be relieved by rubbing the skin with fat from the monitor lizard. No other treatments are known.

Injuries, accidents, and snakebite. In addition to these major ailments, Samburu use a variety of herbal preparations to deal with injuries. Bone fractures and dislocations are set by specialists, usually older men. When a bone is fractured, the limb is pulled forward and down from the body, and set in a straight cast made from the long branches of ***l-gweita*** (*Cordia sinensis* Lam.) or ***l-tepes*** (*Acacia tortilis* [Forsk.] Hayne), held together by the resinous gum of ***lowwai*** (*Balanites* sp.) or ***loitokutok*** (*Commiphora* sp.). The patient should drink tea made from ***seketeti*** (*Myrsine africana*) for "strength" and avoid fat, meat, and posho for several weeks. Depending on the fracture, the patient will wear the cast from two to six months.

Wounds and burns are common occurrences that often lead to infection. Wounds may be caused by thorns, steel weapons, or falls from rocks. They are treated by a variety of drying substances including ***l-jipilikua*** (*Strychnos* sp.), ***l-kiloriti*** (*Acacia nilotica*), and ***loitaakine*** (*Maerua triphylla* A. Rich.). Burns occur most frequently among small children who are apt to fall into the open cooking hearths. Burns are washed and treated with astrigent leaves of ***l-dawa lenkop*** (*Melhania ovata* [Cav.] Spreng.) and ***nkeju nkitejo*** (*Portulaca* sp.), the leaves of which are chewed and placed on the burn.

Stimulants. Samburu use a variety of herbal stimulants to give them "strength," but also for relaxation. Tobacco (***l-kambau***) is chewed by married elders or ground and mixed with soda ash (***magadi***) as snuff (***naisuki***) that is consumed by married women, single girls, and single men. The cocaine-like stimulant *Catha edulis* (Vahl) Endl. (***mira'a*** or ***khat*** in Somali) is popular among men; it is grown in the highlands of Mt. Meru or Mt. Marsabit, and bought from sellers in towns.

Members of the warrior age-grade consume a variety of "strength-producing" soups, some of which are said to cause "shaking" (***aduku***) or "trembling" (***nkirakirr***), pronounced muscular spasms characteristic of Maa-speaking warriors during intense social situations including ceremonies and warfare. These plants include ***l-kinyil*** (*Rhamnus prinoides* L'Herit.), ***l-kitalaswa*** (*Myrica salicifolia* A. Rich.), and ***n-kilenyei*** (*Syzgium cordatum* Hochst.) (Spencer 1959).

Mental health. Insanity (***l-madai***, or "foolishness") is said to result from certain illnesses (measles, malaria, or other high fevers) or from misfortune brought about by sorcery or a curse. Several forms of madness are distinguished, including depression (***l-tung'ani erobi*** or the "cold person"), epilepsy (***lakirikirr***), and psychological trauma following an attack by a wild animal or human enemy, which is manifested in shaking fits and nightmares. Treatment for insanity brought about by physical illness includes taking purgatives. Treatment for madness attributed to sorcery must be sought from a ***laibon*** ritual specialist.

Livestock diseases. In addition to human illness, Samburu have a wide knowledge of illness and health problems affecting their livestock, specific to the different types of animals they keep (cattle, camels, goats, sheep, and donkeys). The most serious cattle diseases are trypanosomiasis (***saar***, or "the fly disease"), foot and mouth disease (***lkulup***), anthrax (***lokochum***), and rinderpest (***lodua***, or "the bitter disease"), an epidemic which decimated African livestock at the end of the 19th century. Ticks (***l-merimer***) affect all livestock, leading to both allergic responses and the transmission of microbial infections. Ticks are controlled by bathing the animals with boiled leaves from ***l-abaai*** (*Psiadia arabica* Jaub. and Spach). Further descriptions of the treatments for these diseases are listed in Table 2.

SAMBURU HEALERS—HERBALISTS, MIDWIVES, AND LAIBONS

Not everyone is equally knowledgeable in the preparation and dispensation of herbal medicines. Individuals caring for ill relatives will try to obtain the services of specialists including herbalists, bone setters, masseurs, and midwives, known generally as ***l-kursan***. More often than not, ***l-kursan*** are poor and rely on the few shillings they receive from dispensing treatments to earn a living. This contrasts sharply to ***laibons***, who have an especially high status and who receive large payments for their treatments of sorcery. This section describes three Samburu healers living near the town of Ngurunit, along the Samburu/Marsabit District line: the herbalist Lemeriwas, the midwife Lenkuye, and the ***laibon*** Leaduma.

Lemeriwas the herbalist.—Lemeriwas was, in 1976, a fifty year old male healer from the Masala section of Samburu who lived in a Dorrobo community in the Ndoto Mountains near Ngurunit town. Dorrobo is a Maasai term meaning "poor," without cattle. It also refers to foraging populations, some of which prey upon pastoralists. Other Dorrobo groups have established interdependent relations with pastoralists including trade in honey (Galaty 1982; Kratz 1980). They may also provide services as herbalists based on their knowledge of "tree medicines."

Lemeriwas made a meager living visiting various Samburu and Rendille villages, selling his services as an herbalist, masseur and bone setter. He carried a large goat-skin bag containing rare highland plants including ***sokoni*** (*Warburgia ugandensis* Sprague) to treat chest pains, ***makutikuti*** (*Clerodendrum myricoides* [Hochst.] R.Br.) to treat gonorrhea, and powerful emetics such as ***l-gilai orok*** (*Vepris eugenifolia* [Engl.] Verdoorn) to treat hepatitis and stomach and uterine disorders.

Lemeriwas was outgoing and funny, telling stories about others, perhaps to avoid being mocked himself as a poor Dorrobo from the forest. His knowledge of plant medicines was widely appreciated, however, and his patients told me only Lemeriwas knew both the highland and lowland species of plants. He was my principal informant and helped me collect over 125 tree specimens for which he described particular properties and preparations. Lemeriwas also had an extraordinary knowledge of the habits of animals (insects, snakes, birds, and mammals); he could imitate large predators, and delighted in scaring me with a leopard's cough or lion's roar (see Figure 3).

FIGURE 3: Lemeriwas digs for *Larosoro* root (*Cadaba farinosa* Forsk.)

Lemeriwas' treatments were usually private and held in the house of the sick person. They consisted of preparation and dispensation of herbal soups, teas and enemas, invariably delivered with animated commentary on the nature of the particular illness and its cure. In one healing episode I observed, Lemeriwas treated a patient suffering from ***ng'ony*** (congested blood vessels around the abdomen). While massaging the man's abdomen, Lemeriwas said, "I feel something here I felt in other people before. Do you feel this lump? This is swollen blood vessels that have gone bad. What have you recently eaten?" The patient replies, "I drank some blood mixed with goat's milk. But it was new milk. Now my stomach hurts when I eat porridge or fat." Lemeriwas says, "You should only drink sour milk for a while. You stomach is bad in this area, the blood is the same color as cooked blood [i.e., dark]. If we don't fix it, blood will come out in your feces. I can hear the blood gurgle, because it is trapped. First it was trapped near the liver, which is very dangerous, but I've pushed it down [toward the intestines]."

Lemeriwas had the patient drink tea containing the bitter ***kerdeedi*** bark (*Acacia senegal* [L.] Willd.) and roots from the ***ching'ei*** tree (*Euclea divinorum*), two of the strongest purgatives known to Samburu. Lemeriwas also had the man lie down and raise his rear end while he administered the same herbal tea by enema through a hollow goat's horn. This caused immediate diarrhea, which was coupled with vomiting from the tea. The ordeal was so excruciating that the patient fainted. Lemeriwas lifted his head and gave him a calabash of milk to drink. He repeated this ordeal five more times.

Where the patient was exhausted after the treatment, Lemeriwas was ecstatic. After cleaning the body and the area soiled by the treatment, Lemeriwas hugged the man and told him, "Tomorrow you'll look like a warrior. Your blood will change and you'll be able to eat anything without trouble." Indeed the next day the man did look better, bright-eyed and active. I was amazed the man was alive.

Lenguye, the midwife specialist.—Most African communities have women skilled in child delivery who act as midwives and advisers during pregnancy and delivery. In Samburu, these women are skilled herbalists as well, knowledgeable in the preparation of medicines used to relieve menstrual pains, aid difficult pregnancies, treat venereal diseases such as gonorrhea, or abort unwanted pregnancies. Midwives also perform female circumcision (clitoridectomy) on Samburu women as part of the marriage ritual. Lenguye is a widowed Samburu woman now (1995) in her late 70s living in the town of Ngurunit in eastern Samburu District.

Lenguye described how she became a midwife:

> I am originally from the mountains near Maralal, far from this hot place. When my husband and I moved out here, I was living alone, not mixing with people. I believed I could do everything myself, I didn't want anybody disturbing me. I did not fear anybody, I always had my *panga* (blade) in my hand, whenever I was grazing, whenever I was going for firewood. At that time, I was very healthy, very tough, very young.
>
> After we had some children, we moved in with other people, with Lukumai clan. I looked at the women when they're delivering children, and I see that I am not afraid of their pain and yells. So I used my courage to do these things (to deliver their babies). I have this courage because I was used to living alone. I see I have this courage, and that's how I started midwifing.
>
> I learned about tree medicine from my grandmother when I used to live in the mountains by Maralal. I knew about many plants, and I learned more when I moved down here. Now every one comes to me when they are sick, not just women. I do them all.

Pregnancy and childbirth are periods of great danger to both the mother and child. Cautions are taken to protect the mother and child from conception to weaning, and there are several ritual prohibitions associated with diet and behavior during this period. During pregnancy (***katonute***) a woman will cease sexual relations with her husband. Delivery (***aisho***) is performed in the woman's house by the midwife and other female assistants. The mother may lie on her side, or more often squat while holding on to the house's center post. If the birth canal is too small, as often happens with first deliveries due in part to scar tissue from the female circumcision, the midwife may perform an episiotomy using a razor blade or the steel circumcision knife. Although I never witnessed a delivery, Lenkuye told me that there is a modest degree of cleanliness in childbirth including using boiled water to bathe the mother and the area she inhabits before the birth and the baby shortly after he or she is born. However, Samburu custom calls for the umbilical cord to be cut on the sole of the father's sandal, a situation that undoubtedly raises the risk of infection. Ritual also demands that the afterbirth be buried in the calves' enclosure following a prayer and blessing, to protect the child from sorcerers or malevolence.

Four days following childbirth, a small animal (called the ***morr***) is killed (a goat for a son, a sheep for a daughter) and consumed by the midwife and women attending the mother; the mother is encouraged to drink boiled blood and soup prepared with the roots of ***sokoltei*** (*Phytolacca dodecandra* L.Herit) to encourage the mother to vomit and "clean the stomach," ensuring the complete removal of the afterbirth.

Unsuccessful pregnancies and miscarriages are attributed to mystical causes, although physical stress and natural illness are also held responsible for miscarriage. ***Ng'ony***, the "congested blood vessels" of the abdomen described earlier, is thought to kill the child with too much accumulated blood. Hepatitis is thought to cause the unborn child to turn yellow and die, and if a mother drinks milk from an animal infected with hoof and mouth disease (***l-kulup***), it is thought she will pass the disease directly to the child. In all cases of miscarriages, the midwife will offer medicinal purgatives to the woman to clean out any residue, thought to be decaying material which must be removed.

Abortion (***airony***) is rare but will be performed on unmarried girls by older women. It is carried out away from the village in the bush. Methods include the ingestion of several strong purgatives (including a solution made from the roots of the "toothbrush" tree ***sokotei*** (*Salvadora persica* L.) mixed with sheep's urine and dung), accompanied by hard massaging and rope tightening about the girl's abdomen. In addition, Western pharmaceuticals such as chloroquine may be ingested in large quantities. If the abortion is successful, the girl drinks tea made with ***l-terikesi*** (*Acacia senegal* L. Wild.) and ***siteti*** (*Grewia bicolor* A. Juss), boiling the bark until it turns red, symbolic of women's reproductive powers.

Leaduma, the ***Laibon*** *ritual curer.*—In addition to treatments for natural illnesses, Samburu share with the Maasai beliefs in the ability of ***laibon*** ritual curers to treat afflictions believed to be caused by sorcery. ***Laibons*** (***ol-oiboni***; ***il-oibonok*** in Maasai), from the verb ***a-ibon***, "predict" or "prophesize") are male diviners, healers, and prophets descended from certain Maasai families. In the past they took the role of war leaders during the internecine Maasai wars of the 19th century (Berntsen 1979; Fratkin 1979). ***Laibons*** are said to inherit a mystical ability to "see" past, present, or future events hidden to ordinary people, achieved either in dreams or by the use of divination objects known as the ***nkidong*** (from "container," usually a gourd or cow's horn from which the divination objects are thrown). In addition to their ability to divine, ***laibons*** possess the ability to manufacture mystically powerful medicines (***entasim***; ***intasimi*** in Maasai; ***ntasim, ntasimi*** in Samburu) that, when worn as amulets, protect individuals and their livestock from dangers of human enemies, wild animals, or supernatural attacks (see Figure 4). ***Laibons*** are also suspected of preparing sorcery poisons which they sell secretly to clients. As I have described their ritual behavior in detail elsewhere (Fratkin 1991b), let me describe briefly their role in maintaining health in the Samburu community.

FIGURE 4: The ***laibon*** Leaduma applies ***ntasim*** medicine to warrior's forehead.

Lekati Leaduma was a ***laibon*** from Lorokushu clan of Samburu who practiced among Samburu and Ariaal Rendille until his death in 1987. Leaduma treated a variety of problems including human infertility, livestock losses, and unusual illnesses. He also offered ***ntasim*** protective medicines to warriors at their age-set rituals and when preparing for raids. Once during my stay with him, he dreamed of a measles epidemic sweeping through the country, and he instructed the two hundred and fifty residents of the village to come to his house to receive ritual protection in the form of tying a string dipped in ***ntasim*** medicines about their torsos.

In one particular treatment I witnessed during a drought period (February 1976), a family asked Leaduma to treat their daughter of about ten years who had been listless, uncommunicative, and refused to eat. Previously, the herbalist Lemeriwas had proclaimed that the girl was suffering from measles. The pox had not broken out on the skin, his purgative treatments were not effective, and the girl's condition worsened.

In a public performance outside the women's house (some divinations are private, particularly those where families wish to protect secrets from neighbors), the ***laibon*** performed a divination by throwing "stones" consisting of seeds, marbles, and metal pieces from a gourd. This revealed that the family of the girl had been ensorceled long ago. Initially the mother had threatened the girl both verbally and physically for not eating; now she moved a protective arm around her daughter's shoulders, as the problem was revealed to belong to all the family and not to the girl alone. Leaduma prepared a yellow ***ntasim*** powder which he marked on the forehead and the tongue of each family member. Within a few days, the girl had recovered, showing both a lively disposition and a healthy appetite.

The ***laibon***'s curative procedure resemble those of other African traditional healers, such as the Ndembu doctor of Zambia described by Victor Turner (1967). The curative ceremony becomes a ritualized "family therapy" where tensions are revealed and blame is shifted outside the immediate group to the sorcerous acts of unnamed individuals (often thought to be jealous family or neighbors). Unlike herbal cures, the efficacy of the ***ntasim*** medicines is not based on observable physiological change, but on the belief in their power.

SUMMARY AND DISCUSSION

Samburu attribute many illnesses to spiritual or physical pollution leading to internal blockage and congestion that impedes digestion and blood circulation. Treatment of many common illnesses, including stomach aches, fevers, snakebites, and arthritis, is aimed at relieving this suspected blockage by having the patient consume purging soups and teas prepared from the roots, bark, and leaves of over 120 trees and shrubs. Many of these cures do cause vomiting and diarrhea, but others are effective in drying wounds, treating burns, and combating infection. Healing specialists, including herbalists, midwives, and bone-setters, are called upon to treat "naturalistic" infectious diseases, parasites, wounds, and fractures. Samburu also believe that certain illnesses are supernaturally caused, including problems of mental illness, infertility, or unusual accidents caused by floods, fire, or attacks by wild animals. These misfortunes are most often attributed to sorcery, and are treated by the ***ntasim*** medicines of ***loibon*** ritual diviners and healers.

There are several points that emerge in a discussion of Samburu medicine:

1) Samburu have an extensive practical knowledge of illnesses and possess a large pharmacopoeia to treat them. Samburu concepts of illness, particularly views about digestion and blood circulation, are based in large part on their familiarity with raising and butchering livestock. In addition, Samburu have a practical knowledge about the vegetal resources of their pastoral environment, including riverine, montane, and desert species of plants.

Many of the plants used in Samburu medicine have direct effects as emetics or purgatives, and many contain a variety of poisonous or irritating substances that cause vomiting or diarrhea. Samburu take these medicines to "clean" the body of impure elements, as they believe that many illnesses are caused by polluting substances that block digestion and the circulation of blood.

2) Although much of Samburu medicine is based on a practical knowledge of anatomy and plant behavior, it would be wrong to imply that Samburu healing is simply empirical or pragmatic and thus categorically distinct from religious beliefs and ritual practices. Although many of their healing techniques have visible effects, Samburu healing is predicated on the belief that many illnesses—including those brought about "by God alone" or due to the immoral actions of sorcerers—lead to internal pollution and decay, a belief that is ultimately spiritual.

3) Although Samburu traditional medicine shares features with other African societies, there are several distinctions between the beliefs and practices of Nilotic-speaking pastoralists and Bantu-speaking agriculturalists, with some borrowing

between these two large traditions. Nilotic pastoralists including Samburu do not have strong beliefs in ancestor spirits, unlike Bantu-speakers who share the ***ngoma*** healing tradition described by Janzen (1992). Many pastoral groups have strong beliefs in divination and prophesy, as among Nilotic Maasai (Berntsen 1979), Atuot and Nuer (Burton 1991), Samburu (Fratkin 1991b), Turkana (Lamphear 1992), and the Cushitic-speaking Boran and Somali (Dahl 1989, Lewis 1966).

Samburu believe in sorcery activities of human enemies, but this feature may be more widespread among Bantu farmers than Nilotic herders. Edgerton (1966) found that where Bantu-speaking Kamba and Hehe attributed most mental illness to sorcery, the Nilotic-speaking Pokot and Sebei very rarely did so, attributing mental disturbances to "God alone" or natural causes. Moreover, where the Bantu-speakers had elaborate treatments for insanity through ritual curing, the Nilotes rarely attempted treatment and were more likely to kill the person if he/she became violent.

Samburu and Maasai, with their unique (for Nilotes) institution of the ***laibon*** diviner-healers are an exception to this, perhaps because of their adoption of the prophet-diviner-sorcerer tradition from neighboring Kikuyu and Meru who are Bantu-speaking agriculturalists (Berntsen 1979). Maasai and Samburu thus represent an important fusion of Nilotic and Bantu, as well as Cushitic, healing traditions.

4) Social and economic changes influence Samburu medical beliefs and practices, particularly as Western values and medical knowledge filter into local groups via schools, commerce, and health services. Today, Samburu attribute malaria to mosquitos and measles to human contagion, but it is not certain they did so two generations ago. There also exist syncretic borrowing between the two traditions, where for example Samburu readily seek injections as more powerful than pills because the medicine goes directly into the body (and presumably the blood) where, one believes, it can effectively break apart internal congestions.

Samburu medicine is highly pluralistic. It is not unusual to simultaneously consult different types of healing specialists including herbalists, ***laibons***, and Western health clinics. When vaccination teams from the African Inland Church came to the ***laibon*** Leaduma's settlement, he encouraged all mothers to bring their children and assisted the nurses by lining up people. However, determining the cause of an illness is essential to treating it, and several Samburu have remarked that if an illness is due to sorcery, only a ***laibon's ntasim*** will save that person.

Western health care workers periodically complain about the widespread use of herbal medicines among Africans, showing particular concern about dehydration and possibly mortality resulting from the strong purgatives. Clinicians complain that herbal dosages are not regulated, and that people suffering from serious medical problems who first attempt herbal cures delay coming to the clinics until it is too late to save them. Certainly the description of Lemeriwas' treatment for ***ng'ony*** blood congestion could be interpreted this way.

However, because local healers are the first line of treatment for many rural people, Western health care providers would do well to work more closely with them. This is happening to some degree in northern Kenya where health personnel distribute sterilized razors to male circumcisers and to midwives in attempts to combat the spread of AIDS. Hopefully, this paper will be of use to health care providers in rural Africa who are attempting to integrate African and Western medical knowledge.

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BOOK REVIEW

Plant Intoxicants. A Classic Text on the Use of Mind-Altering Plants. Baron Ernst von Bibra. [Translated by Hedwig Schleiffer; Forward by Martin Hasenrier; technical notes by Jonathan Ott]. Rochester, Vermont: Healing Arts Press, and Inner Traditions International. 1995. $16.95 (paperbound). ISBN 089281-498-5.

This translation of the famous German book *Die Narkotischen Genussmittel und der Mench* has been beautifully published. It is a joy to read.

The original German volume was the first book published for an interdisciplinary, non-technical audience that could bring to the public the story of the use of narcotic and hallucinatory plants in an ethnobotanical and international point of view. But since it was published in German and was a rather rare book, its influence was rather restricted. It pre-dated by five years the English popular book by Mordecai C. Cooke *The Seven Sisters of Sleep*, which similarly considered a number of narcotics and intoxicants then employed in various parts of the world.

Von Bibra's book, now in English, has long been an extremely rare item–and only available in German. Dr. Schleiffer's expert translation and Jonathan Ott's technical notes make this publication a must for any English-speaking reader interested in the sociological and historical importance in the last century of the use of narcotics and stimulants. It is truly, as indicated in a description on the back cover, "...a pioneer study of psychoactive plants and their role in society." It is also, as stated on the cover of the book, "a classic text on the use of mind-altering plants." I recommend it highly to readers who will find this English translation a welcome addition to our fund of excellent books on mind-altering drugs employed in various parts of the world.

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La Guía de Incafo de las Plantas Útiles y venenosas de la Peninsula Ibérica y Baleares (Excluidas Medicinales). Diego Rivera Núñez and Concepción Obón. Incafo., Castello 59,28001, Madrid.

This handy-sized (4" x 8") book of 1257 pages and 386 excellent color illustrations is a model for geographically localized floras. Each entry has the common name under the Latin binomial—always in Spanish and (when the plant grows in the non-Spanish speaking areas of Spain) in Catalan and Euskara. Vernacular names are often given in Portuguese, French, English, and German as well. Interesting etymological analyses of the Latin names are frequently given. A description of the plant is followed by notes on the habitat, flowering period, and uses (if any). There is an excellent bibliography of 21 pages followed by a page of clever symbols signifying uses. This is supported by a very complete page index of the uses of plants. The index is extremely detailed, occupying 80 pages.

It is not usual to find such a local economic botanical book with so much information so easily available.

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NON-DOMESTICATED FOOD RESOURCES IN THE MARKETPLACE AND MARKETING SYSTEM OF NORTHEASTERN THAILAND

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ABSTRACT.—Non-domesticated and semi-domesticated food resources are an important part of the traditional lifestyle in northeastern Thailand. These plants and animals, gathered for a wide variety of purposes, are increasingly being sold in the local markets and becoming a part of the commercial exchange system. Early morning markets in this region were surveyed throughout the year in order to: 1) document the prevalence and seasonal variation of non-domesticated food resources; 2) determine which non-domesticated food resources are important sources of income for the local people; and 3) identify factors that impact the marketing of these items. We found that a wide variety of non-domesticates were sold at the markets including plants, mushrooms, algae, fish, insects, birds, mammals, reptiles, amphibians, and crustaceans. Seasonal variation in availability and diversity was found. Plants, insects, amphibians, and crustaceans were most common and diverse during the hot season, while fish diversity and abundance was highest during the rainy season. Very few species were found to predominate and market variability was high. Cultural and social changes that are related to the use of non-domesticates as sources of income are also discussed.

RESUMEN.— Los recursos alimenticios no domesticados y semidomesticados son parte importante de la vida tradicional en el noreste de Tailandia. Estas plantas y animales, recolectados para una amplia variedad de propósitos, están siendo puestos en venta con creciente frecuencia en los mercados locales y están convirtiéndose en parte del sistema de intercambio comercial. Los mercados que operan temprano en la mañana en esta región fueron estudiados a lo largo del año con el fin de: 1) documentar la frequencia y variación estacional de recursos alimenticios no domesticados; 2) determinar cuáles recursos alimenticios no domesticados son fuente important de ingresos para la poblacion local; y 3) identificar factores que tienen un impacto sobre el mercadeo de estos artículos. Encontramos que una amplia variedad de recursos no domesticados eran vendidos en los mercados, incluyendo plantas, hongos, algas, peces, insectos, aves, mamíferos, reptiles, anfibios y crustáceos. Se encontró variación estacional en la disponsibilidad y diversidad. Las plantas, insectos, anfibios y crustáceos fueron más comunes y diversos durante la temporada de calor, mientras que la diversidad y abundancia de peces fue mayor durante la época de lluvias. Se encontraron muy pocas especies que predominaran y la variabilidad en el mercado fue alta. Los cambios culturales y sociales que están relacionados con el uso de los recursos no domesticados como fuente de ingreso son también abordados.

RÉSUMÉ.—Les ressources alimentaires sauvages et à demi sauvages jouent un rôle important dans la vie traditionnelle du Nord-Est de la Thaïlande. Ces plantes et ces animaux, récoltés pour de multiples raisons, sont de plus en plus vendus sur les marchés locaux et sont en train de devenir partie intégrante du système d'échange commercial. Nous avons étudié pendant une année les marchés du matin dans cette région afin de 1) faire l'inventaire des ressources alimentaires sauvages en tenant compte des variations saisonnières, 2) déterminer quels produits alimentaires sauvages pouvaient constituer une source de revenu importante pour les communautés locales, et 3) identifier les facteurs qui pouvaient influencer le mise en vente des mêmes produits. Nous avons ainsi constaté qu'une grande variété de produits sauvages étaient vendus sur les marchés dont des plantes, des champignons, des algues, des poissons, des insectes, des oiseaux, des mammifères, des reptiles, des batraciens et des crustacés. La disponibilité et la diversité des produits variaient également selon les saisons. Les plantes, les insectes, les batraciens et les crustacés étaient plus communs et diversifiés durant la saison sèche tandis que les poissons étaient plus abondants et diversifiés durant la saison des pluies. Malgré la diversité des produits vendus, il y avait très peu d'espèces prédominantes et la variabilité était très grande sur les marchés. Les changements culturels et sociaux liés à l'utilisation des produits sauvages en tant que source de revenu sont aussi commentés.

INTRODUCTION

Non-domesticated[1] plants and animals have significant cultural, biological, and economic value at local, regional, and national levels. People who utilize non-domesticated resources to meet these needs often rely on organized exchange systems to obtain them (Dhanamitta *et al.* 1988; De Beer and McDermott 1989; Moreno-Black 1991, 1994; Moreno-Black and Price 1993; Ngamsomsuke *et al.* 1987; Ngarmsak 1987; Scoones *et al.* 1992). An important aspect of recent ethnobiological studies has been the focus on how resources are defined, appropriated, and distributed.

Most subsistence-based communities are linked to larger economic and political systems through markets. Consequently, markets are a valuable arena for gathering information on people-resource relationships. Recent marketplace studies have shown the importance of this domain for monitoring changing selection pressures on specific resources, i.e., selection by people because of culturally defined qualities of the items (Bye and Linares 1983, 1990; Jacquat 1990; Johnson and Johnson 1976; Pei 1987, 1988; Schlage 1969; Scoones *et al.* 1992; Wester and Chuensanguansat 1994; Wanatabe and Satrawaha 1984; Whitaker and Cutler 1966). The sale of non-domesticated resources in the market can lead to more intensified interactions with the environment, modification of habitats, selection and maintenance of certain plants, and changes in how individuals exert control over each other for the use of these resource areas.

This paper is based on research conducted in northeastern Thailand from 1990 through 1992. We examined the occurrence of non-domesticated plants and animals in a group of markets in northeastern Thailand as part of a larger investigation of the use of non-domesticated food resources. We aim to contextualize how non-domesticated resources are utilized on the local level. We are particularly interested in the process of transformation by which biological resources used for home consumption become tradeable commodities.

Our specific objectives in surveying the markets were as follows: 1) document the prevalence of non-domesticated foods in the marketplace; 2) evaluate variation in the availability of these items; 3) determine the types of non-domesticated foods that are important income generators for the people of northeastern Thailand, and 4) identify factors that lead to these resources being selected for market sale as well as home consumption. In this selection process we see some of the cultural and social factors involved in this transformation.

Northeast Thailand: Its environment, people, and markets.—The northeastern part of Thailand, called Isan, is the largest of the country's four major geographic regions. Isan is characterized by a distinctive language and culture similar to those of neighboring Laos. It contains one third of the nation's population and is usually considered the poorest and least economically developed region of the country. This region has been inhabited for a long time. Archaeological sites with some of the earliest evidence in Asia of agriculture, pottery, and bronze work are located in the Northeast (Higham 1982; Solheim 1986).

Isan is characterized by a gently sloping plateau of undulating mini-watersheds and flood plains, but also includes a zone of hills and upland areas in the west and the south (Hafner 1990). These hills—which and extract moisture from airstreams during monsoon periods—are most pronounced in the western and southern part of the region. While contributing to the biodiversity of the region, they also create a rain-shadow, making the area more susceptible to droughts. The climate is usually differentiated into three seasons: 1) the "cool" season from November to February, 2) the "hot" season from March to mid-May, and 3) the "wet" season from mid-May to October.

The semi-arid environment greatly influenced the traditional subsistence system and other adaptations to the habitat. Traditionally, the people in the Northeast adjusted to variability in these habitat factors through the development of a combined subsistence system, in which they complemented their reliance on the staple rice and other subsistence crops with a large input from wild food (Moreno-Black 1991, 1994; Pradipasen *et al.* 1985; Somnasang *et al.* 1988; Tontisirin *et al.* 1986).

The rich flora and fauna in the Northeast provide an array of edible and useful plants and animals that are gathered for a wide variety of purposes, including foods, building materials, crafts, medicinal uses, and religious activities. These indigenous practices and the knowledge that they represent have been developed over many generations and are deeply ingrained in regional Thai culture (Phithakpol 1990). The diet—characterized by a staple core of glutinous rice, fish, and fish products—is embellished with a variety of local wild and semi-domesticated plants and animals (Moreno-Black 1991, 1994; Ngamsomsuke *et al.* 1987; Ngarmsak 1987; Pradipasen *et al.* 1985; Somnasang *et al.* 1988). These important items—collected from forests, upland fields, rice paddies, gardens, house areas, canals, ponds, swamps, rivers, and dam areas—contribute valuable nutrients. Coupled with a variety of cooking methods, they add diversity to an otherwise monotonous diet (Moreno-Black 1991; Somnasang *et al.* 1988).

These food items have more recently become an important source of income for Isan villagers. In the early 1960s life in Isan changed considerably. This marked the beginning of the government's focus on development, introduced with the first "National Economic Development Plan." National government involvement in the local market system began in the early 1950s with the keeping of official records. Government involvement in the markets increased with construction of permanent structures and other physical improvements and maintenance of these facilities. Today markets are maintained through users' fees collected daily by a government office or a private company on contract to the government.

Road development also greatly influenced the Northeast in the 1960s. Roads provided easy access to nearby towns, and local markets flourished as they were more closely integrated into the wider market system. As large numbers of villagers in the Northeast for the first time entered the market-oriented economic system, items traditionally collected for local consumption from local forests, rivers, and other resource areas, as well as village agricultural products, were rapidly incorporated into the growing economic system. Today it is increasingly common to find gathered, non-domesticated, and semi-domesticated plants and animals being sold in the local market system (Jacquat 1990; Levin 1992; Wester and Chuensanguansat 1994). These markets now represent a place of intense interaction between people and their food resources (Pei 1988).

METHODS

The market system in northeastern Thailand includes several types of markets. First are the early-morning markets, primarily active between four a.m. and eight or nine a.m. Second are the all-day markets, where activity may begin as early as six a.m. and continue throughout the day. Third are the late afternoon or early evening markets. Fourth are the night markets, predominantly oriented to the selling of cooked food. Our study was conducted only at the early morning markets since these are the predominant locus of market activity for rural village farmers. The sample included markets located in rural areas as well as near and within cities (Figure 1). Market size varied with location and season (Table 1). The smallest, and most rural, varied from 93 vendors in the hot season to 68 in the cool. The largest market, centrally located near three towns and a large rural population varied from 312 vendors in the cool season and 353 in the rainy season. We consulted with district offices and found their records of market size and variation, based on daily fee collection, to be similar to ours.

TABLE 1.—Number of vendors per market by season.

Markets	KM	CP	HP	WP	Bor	TK	TN	BF	SEL	RE	CY	Total
Hot	218	226	146	211	183	216	216	92	347	221	163	2,239
Rainy	119	124	140	145	98	120	238	93	353	174	135	1,739
Cool	178	151	179	102	167	162	277	68	312	225	110	1,931
Total	515	501	465	458	448	498	731	253	1012	620	408	5,909

*Legend for Markets***

KM	=	Kamalasai (Pu)	TN	=	Tuenj-Nathorn (T)
CP	=	Chaturaphak Phiman (Pu)	BF	=	Ban Fang (R)
HP	=	Hui Phung (R)	Sel	=	Selaphum (R)
WP	=	Wapi Pathum (T)	RE	=	Roi Et (T)
Bor	=	Borabu (T)	CY	=	Chiang Yun (Pu)
TK	=	Talaat Kaset (T)			

*Species diversity was greatest during the hot season ($F = 32.89$, $df = 20, 2$; $p < .001$)
**Pu = Peri-urban, T = Town, R = Rural

We surveyed 11 markets during the annual climatic cycle, characterized by cool, hot, and wet seasons. Within the markets information was obtained both through surveying the market and interviewing vendors. In addition we obtained information concerning marketing practices and resource utilization in one village over a two-year period.

The market survey.—At each market we utilized a "continuous survey method." We worked in pairs. Walking through a designated section of the market, we recorded all of the items being sold by each vendor, the gender of the vendor, and the number of vendors per "stall." When we were unfamiliar with particular items, we briefly questioned the vendors about the item.[2]

The vendor survey.—Vendors at each of the markets were interviewed to obtain information about items they were selling, their gathering practices, and their marketing habits.[3] We chose vendors for the interview based on the items they were selling. We gave first priority to interviewing vendors who were selling items that had not previously been recorded. The open-ended interview included 1) brief

FIGURE 1.—Map of northeastern Thailand with the location of the eleven markets.

Figure 1. Location of study sites

demographic information on the vendor; 2) item name; 3) price per unit of purchase; 4) collection site and resource-area status (e.g., public or private); 5) collection methods, including whether permission was needed to collect the item and whether this differed when gathering for home consumption or for selling; 6) management and propagation practices; 7) uses; and 8) methods of cooking or preparation.

The samples.—Raw plant and animal samples were purchased, usually in the units in which they were sold. Color slide photographs were taken of most of the items that were the focus of the interviews. The photographs were used for identification purposes as well as in the focus village to confirm or expand the survey information. Plant specimens appropriate for preservation or propagation were collected and deposited with the Herbarium at Khon Kaen University.

Ethnographic data—During the course of the market survey, we collected data in one village in Kalasin Province. We participated in gathering activities and interviewed villagers using both semi-structured and focus-group interviews. The interview questionnaire included topics concerning gathering practices and knowledge of wild foods and their habitats, use of gathered foods, and women's plant-management practices. The focus-group interviews centered on gathering and marketing practices and use of non-domesticated food.

RESULTS

How prevalent are non-domesticated resources in the marketplace and which resources are being utilized as income generators?—One of our original objectives was to evaluate the prevalence of non-domesticated resources in the marketplace and to identify which species are becoming important sources of income. We believed that documenting these resources would provide baseline data, since little information currently exists on the extent to which these resources are being utilized to generate cash. As is common in any marketplace, a wide array of items were sold at the 11 markets in the survey. We observed raw food; cooked foods, which included snacks as well as composite dishes to be purchased and eaten later at home; clothing; dry goods; cutlery; firewood; charcoal; and numerous other items. Although no large domesticated animals such as pigs, cattle, or buffalo were ever observed for sale, occasionally a vendor did have live chickens.

During the course of the survey of the 11 markets, we recorded a total of 15,789 items being sold by 5,909 vendors (Table 1). We found that of the 5,909 vendors we recorded, 94% were women, 4% were men, and 2% were men and women working together. The number and percent of the different types of domestic and non-domestic raw foods recorded at the markets are shown in Table 2. Plants represented the largest category, and a total of 110 non-domesticated and 130 domesticated plant food items were identified in the 11 markets. For the whole survey period, the total number of non-domesticated plant items per market ranged from 26 to 64. We recorded 19 different kinds of mushrooms during the survey. A variety of non-domesticated animals were recorded at the markets and represented 13% of the items sold during the survey. Fish were the most common animals seen at the markets, with a total of 46 varieties observed. Fifteen different insects were

TABLE 2.–Number and percent of times raw food items were recorded at the markets by category and type.

Category	Plant	Fungi	Amphibian	Insect	Crustacean	Reptile	Mammal	Bird	Fish	Total
Non-domestic:										
Number of observances	3022	114	178	268	437	21	3	5	998	5042
% of all observations	19.10%	0.70%	1.10%	1.70%	2.80%	0.10%	0%	0%	6.30%	32%
Domestic:										
Number of observations	10,122	2	37	0	0	0	197	310		10,743
% of all observations	64%	0%	0.20%	0%	0%	0%	1.20%	2.00%	0.50%	68%
Total observations	13,144	116	215	268	437	21	200	315	1073	15,789
Total %	83%	0.70%	1.30%	1.70%	2.80%	0.10%	1.30%	2.00%	6.80%	100%

observed during the survey.

How variable are non-domesticated resources in the marketplace in terms of their diversity and availability?—We were interested in evaluating the variation in the occurrence of non-domesticated resources in the marketplace. We thought this information would provide insight into some of the factors affecting the changing patterns of resource use. In particular, we were interested in determining if there were different seasons in which non-domesticated foods predominated and which species were commonly utilized throughout the region.

In terms of overall market activity, we found the hot season (March through June) to be the most active period at the markets; 36% of the vendors worked during this time period. The markets were slightly less active during the cool (34%) and rainy seasons (30%). Seasonal variation in species diversity at the markets was significant, with the greatest diversity of items occurring in the hot season (Table 3). However, fish were found to be more plentiful and sold in greater variety during the rainy season. Few fish species are "reared" or "stocked," so most are dependent on rainfall. Plants, insects, amphibians, and crustaceans were most abundant and diverse during the hot season, also the period of the most active markets. The hot season (February–May) is considered the season of most frequent food shortage. April, normally the hottest month of the year, was consistently identified as the most difficult time. Non-domesticated foods are also scarcest during the hot season and few are found in the paddy fields then. In this season ponds that retain water and irrigation ditches assume special importance as resource areas. Villagers utilize a wide variety of resources during the hot season, including crabs, snails, fish, amphibians, reptiles, birds, and insects. Rats (***noo puk***) are eaten more often during this time than at any other season of the year.

TABLE 3.—Number of different non-domesticated plants recorded at each market (11 market sample).

Market		KM	CP	HP	WP	Bor	TK	TN	BF	SEL	RE	CY	Total
Season													
Hot*	$\overline{X} = 29.4$	31	35	26	40	33	14	34	18	38	34	20	323
Rainy	$\overline{X} = 20.8$	14	21	7	35	20	15	30	15	27	31	14	229
Cool	$\overline{X} = 18.4$	17	14	14	20	24	7	21	13	23	33	16	202
Total	$\overline{X} = 46.6$	40	48	34	62	50	26	62	38	60	58	35	513

*Legend for Markets***

KM	=	Kamalasai (Pu)	TN	=	Tuenj-Nathorn (T)
CP	=	Chaturaphak Phiman (Pu)	BF	=	Ban Fang (R)
HP	=	Hui Phung (R)	Sel	=	Selaphum (R)
WP	=	Wapi Pathum (T)	RE	=	Roi Et (T)
Bor	=	Borabu (T)	CY	=	Chiang Yun (Pu)
TK	=	Talaat Kaset (T)			

*Species diversity was greatest during the hot season ($F = 32.89$, $df = 20, 2$; $p < .001$)
**Pu=Peri-urban, T=Town, R= Rural

Since the least amount of agricultural activity occurs in the hot season, many individuals turn to off-farm activities and wage labor to earn cash. Despite the difficulty of obtaining non-domesticated items in the hot season, marketing them becomes a viable economic activity, especially for women who have limited access to other cash-generating activities. At this season market activity provides important food and cash inputs. Most villagers indicated that if they bought non-domesticated foods at all, they did so most often in the hot season when resources were scarce and difficult to obtain.

We were interested in determining which species were most commonly utilized for income generation, because these species might be under increased selective pressure locally. We were also interested in patterns of species diversity within and among the markets, as these patterns might indicate the impact of local traditions and habitats on item selection. Habitat degradation in Isan has significantly reduced the biodiversity of the region. Changing human use patterns may be contributing to the pressure on the flora and fauna.

There was considerable variety in the non-domesticated plants sold at the markets (Tables 3, 4, 5); only six were found at all 11 markets. Nineteen species of mushrooms were observed being sold 99 times over all seasons. There was considerable variation in the species of mushrooms seen at the different markets (Tables 5, 6, 7); no species was found at all the markets. Sixteen mushroom species were observed in the rainy season, eleven during the hot season, and three in the cool season.

TABLE 4.—Number of different non-domesticated plants which were recorded occurring in one or more markets of a total of 110 different plants recorded at all markets.

25	***plants were found at just***	***1***	***market***
19	plants were found at	2	markets
11	plants were found at	3	markets
14	plants were found at	4	markets
7	plants were found at	5	markets
6	plants were found at	6	markets
3	plants were found at	7	markets
4	plants were found at	8	markets
10	plants were found at	9	markets
5	plants were found at	10	markets
6	plants were found at	11	markets

TABLE 6.—Occurrences of mushrooms recorded in the 11 market sample.

Season	Number of Species	Number of Occurrences	Number of Markets
Hot	11	34	8
Rainy	16	38	10
Cool	3	22	8
Total	19	99	11

TABLE 5.–Market and seasonal variation in the most common non-domesticatedfood items

Scientific Name (Family)	Local Name	Common Name	Season*	Number of Markets	Number of Vendors
Plants					
Ipomoea aquatica (Convolvulaceae)	***Pak bung Thai***	Water spinach	HRC	11	223
Tiliacora triandra (Menispermaceae)	***Bai yaanang***	–	HRC	11	159
Limnocharis flava (Limnocharitaceae)	***Pak karnjong***	Yellow velvet	C	11	170
Spondias pinnata (Anacardiaceae)	***Makok***	Hog plum	HRC	11	144
Glinus spp. (Aïzoaceae)	***Pak gen khom***	–	HRC	11	44
Carya herbacea (Lycythidaceae)	***Pak kradon pa***	–	HRC	10	69
Limophila aromatica (Scrophulariaceae)	***Pak Kra yaeng***	–	HRC	10	55
Neptunia oleracea (Leguminosae)	***Pak kraced naam***	Water mimosa	HRC	10	44
Centella asiatica (Umbelliferae)	***Bai Bua bok***	Aquatic pennywort	HRC	9	60
Marsilea crenata (Marsileaceae)	***Pak waen***	Water clover	HRC	9	26
Bambusa spp. (Gramineae)	***Naw mai pai pa***	–	HR	9	51
Amorphophallus brevispathus (Araceae)	***Pak-e-rok***	–	HC	9	39
Piper sarmentosum (Piperaceae)	***Pak-e-lert pa***	–	HRC	9	39
Crotoxylon formosum (Guttiferae)	***Pak tiew/tuew***	–	HR	8	38
Melientha suavis (Opiliaceae)	***Pak waan***	–	C	8	24
unk. (Polygonaceae)	***Pak paew***	–	HRC	7	15
Barringtonia racemosa (Barringtoniaceae)	***Pak jik***	–	HR	7	14
unk.	***Nak ngaen***	–	H	6	6
unk.	***Pak linpii***	–	RC	6	12
Terminalia chibulaletz (Combretacene)	***Sa-mor***	Chebulic myrabolan	C	6	6
	Mushrooms				
Lentinus praerigidus (Pleurotaceae)	***Hed gkra-dang***	Oyster mushroom	HRC	10	57
Heimiella retispora	***Hed Phueng***	–	HRC	4	10
Russula violeipais (Russulaceae)	***Hed na lae***	–	HR	3	4
Russula spp. (Russulaceae)	***Hed Khai***	–	HR	3	4

Scientific Name (Family)	Local Name	Common Name	Season*	Number of Markets	Number of Vendors
Insects					
Oecophylla smaragdina (Formicidae)	***Mod daeng***	Red ant egg	HR	8	102
Catharsius spp. (Scarabaeidae)	***Maeng Kutgee***	Dung beetle	HR	7	14
Lethocerus indicus (Belostomidae)	***Maeng Da na***	Giant water bug	HRC	7	24
Microtricia spp. (Scarabaeidae)	***Maeng Kinoon***	June beetle	HC	7	4
Gryllotalpa africana (Gryllidae)	***Maeng gra chon***	Mole cricket	HC	5	6
	Fish				
Anabas testudineus (Anabantidae)	***Pla moa/mor***	Climbing perch	HRC	9	52
Ophicephalus striatus	***Pla chon***	Snakehead fish	HRC	11	226
Clarias spp.	***Pla duk***	Catfish	HRC	11	171
Puntius gonionti	***Pla ta pean***	Carp	HRC	9	52
	Mollusks and Crustaceans				
Somannia thelpusa	***Poo***	Crab	HRC	11	97
unk.	***Hoi khoang***	Snail	HRC	11	54
Sinotaia ingallsiana	***Hoi joob***	Pond snail	HR	11	99
Macrobrachium lanchosteri	***Kung***	Fresh water shrimp	HRC	11	37

* H = Hot Season, R = Rainy Season, C = Cool Season

TABLE 7.—Number of different mushroom species recorded at one or more markets of a total of 19 species recorded at all markets.

10	***mushroom species were found at just***	***1***	***market***
5	mushrooms species were found at	2	markets
2	mushrooms species were found at	3	markets
1	mushrooms species was found at	4	markets
1	mushrooms species was found at	10	markets

TABLE 8.—The number of nondomesticated animal species recorded in the eleven markets.

Season	Fish	Insect	Amphibian	Crustacean	Reptile	Bird	Mammal	Total
Hot	26	15*	7*	9*	1	0	0	58
Rainy	35	9	4	4	2	2	0	56
Cool	32	7	3	5	1	1	1	50
Total	**46**	**15**	**7**	**9**	**2**	**2**	**1**	**82**

* Statistically significant differences ($F = 17.51$, $df = 12, 2$; $p < .001$)

Insects, amphibians, and crustaceans were sold most often and in greatest variety in the hot season (Tables 5 and 8). Mammals, birds, and reptiles were rare throughout the survey. The low numbers of the latter is most likely related to the extensive deforestation of northeastern Thailand in the recent past. Fish were most available during the rainy and the cool seasons. As with plants, notable differences were found among the markets in terms of the species of fish offered for sale. Three species of fish were found at all markets and two species at nine markets. These fish occur naturally and are also either commonly stocked or reared (Table 5). Fish are among the most important foods gathered from natural sources and are considered staples. Fish are significant sources of protein, fat, and other nutrients. Wet rice agriculture and seasonal bouts of rainfall have led to the development of various stocking and management techniques. These, coupled with traditional methods of preservation, enable local people to utilize fish products throughout the year. Both traditional customs and government-sponsored programs have encouraged fish stocking and rearing practices.

None of the insects occurred at all markets. Seven species occurred at five or more markets. Two species were found in only one market. Red ants (*Oecophylla smaragdina*)—both eggs and eggs mixed with adults—were observed 102 times, the most frequently observed of all the insects. These are often eaten raw with sour vegetables or ***jaew*** (side dish used for dipping, often fish sauce based), fried with eggs or pork or mixed in fish ***gaeng*** (Thai curry). The giant water bug, ***maeng da na*** (*Lethocerus indicus*), was the second most common insect food, observed 24 times. This very popular insect is commonly used to make ***jeaw***, grilled or eaten in ***pon pla***, a steamed fish dish.

Four of the nine crustacean species occurred at all eleven markets (Table 5).

Frogs (*Rana* spp.) were found at ten markets; the other six amphibians were found at four or fewer markets. These included a variety of "toads" (e.g., ***kee-at e-***

moo, kee-at ta-na). Two types of reptiles were found at the markets: ground lizards, ***yae*** (*Lioalepis* spp.), were recorded nine times at four markets, and turtles were seen four times at two markets. Field rats were the main wild mammals seen at the markets. We recorded them twice, both times in the cool season. Two different types of birds were also observed, but we did not collect specimens and did not obtain scientific identifications for them. The birds, like the mammals and reptiles, were quite rare, having been recorded only four times in two different markets.

What factors are important in the choice of non-domesticated resources for sale in the marketplace?—To understand the reasons why non-domesticated food resources were chosen for sale in the marketplace, we interviewed 349 vendors selling non-domesticated food at the markets and obtained information in one focus village during the year. The age of the vendors ranged from seven to 76 years, with a mean of 42 years (sd=15 years).

All of the vendors spoke of the need to earn money. Income earned from the sale of these items was important to the vendors. Although they were not able to support their families from their market activities alone, they indicated that the cash they earned was used for basic household needs, such as food, clothing, and utility bills, and for school fees, religious purposes, and savings. The vendors sold at these markets an average of four days per week (sd = 2; range = 1-7 days/week).

The 183 different non-domesticated items sold by these vendors included plants, algae, mushrooms, fish, crustaceans, reptiles, birds, mammals, insects, and amphibians. The plant resources sold by these vendors fell into different categories of leafy greens (70%), fruits (10%), algae (2%), mushrooms (6%), bamboo (4%), roots and tubers (4%), and flowers (3%). The leafy greens—the most common item in these markets—commanded the lowest prices, often selling for one Bhat (U.S. $0.04) per unit. Fruits, mushrooms, and bamboo, rarer and more seasonal in their occurrence, were considered especially delicious and commanded a higher price, three to ten Bhat (U.S. $0.10-0.40) per unit.

Many food plants are considered to have health-promoting or medicinal qualities. Thus the domains of food and medicine overlap considerably. Food preferences are guided by qualities of taste, smell, and texture, which also influence health-promoting choices. Many local people expressed concern about the high levels of pesticides used in the region. Nevertheless, some villagers believe that these non-agricultural items are healthier than domesticated plant foods, despite the fact that many are obtained from paddy fields and other habitats located near agricultural plots where pesticides, herbicides, and chemical fertilizers are used.

Non-domesticated plants provide a wide variety of tastes and textures that greatly embellish the diet. Both the vendors and the people in the focus village discussed the taste qualities of the non-domesticated food items. They consistently judged that the non-domesticated foods were "more delicious" or "smelled good" compared to domesticated food. The qualities of these food add to the taste of the whole meal, which is judged best when it includes hot, sour, and salty flavors. Taste was an important factor affecting the choice of items for sale, as was the price of the item.

Fish, amphibians, and certain insects are especially favored items in the diet. Compared to plants they often commanded a high price. The vendors were aware of the popularity of these items and specifically sought to obtain them for sale, especially during seasons when they were not abundant. Taste as well as nutritional value and health/medicinal-related factors also influenced the popularity of the animal resources. Some live animals, such as turtles, birds, and even frogs or toads, may be purchased to be liberated as a form of merit-making.

Are there practices or behaviors that change when items are used for income rather than solely for home consumption?—Finally, we were interested in identifying cultural and social changes related to the increased use of wild and semi-domesticated resources as sources of income. We were specifically interested in management activities, as for example, transplanting vegetation into intensively utilized or occupied areas involves a process of management and manipulation with long-term effects on human-plant relationships.

Plant and mushroom food resources were obtained from a number of different resource areas: forests (28%); paddies (23%); gardens (23%); water sources such as ponds, canals, and swamps (22%); and other areas, such as the house compound and upland garden areas (4%). A significant proportion of vendors indicated that the plant items they sold could be transplanted to make them more accessible and to conserve them, since much of the area is being rapidly deforested. Plant vendors were knowledgeable about a wide variety of management practices for the nurturance and maintenance of plants that were transplanted (Moreno-Black 1991; Moreno-Black *et al.* 1994).

Twenty-two percent of the animal vendors indicated that they knew how to manage the animals they harvested, most referring to fish. A small proportion of the vendors also mentioned that they "raised" snails, insects, rats, amphibians, and/or reptiles. Fish, snails, and amphibians were "raised" by releasing them in privately owned ponds, but only fish were specifically fed and protected. Vendors and villagers also discussed capturing live rats and maintaining and feeding them until they were an appropriate size for sale. No one discussed breeding any animals except frogs.

Sixty-two percent of all animals were collected from public resource areas (e.g., rivers, irrigation canals, forests), 22% from privately owned areas. Among the vendors of animal food items, a difference of opinion existed concerning collecting from other people's property for selling and for eating. Thirty-nine percent of the vendors indicated it was unacceptable to collect from another's resource area when collecting for selling, while only 16% said it was unacceptable when collecting for domestic consumption. Eighty-nine percent of the plant vendors indicated they felt it was acceptable to collect food from resource areas other than their own if they were collecting for their own consumption, but only 50% of the vendors felt it was acceptable to collect items for sale from resource areas that belonged to other individuals. (Forty percent indicated that this practice was not appropriate, while eight percent said it was acceptable under certain conditions.)

Information obtained from both the vendors and the villagers showed a shift in personal relationships with a decrease in sharing of resources through time. They spoke of how in the past there were many more plants and animals. It had been easy to obtain food. But now some items were difficult to find. They said they often transplanted items to their house gardens because they were afraid the plants were going extinct, or that the areas where they grew naturally had been cut down. A variety of animals were also being raised or cared for, and information about the possibility of extending this practice to other species was spreading among individuals. The movement of these food items to privately owned locales, such as the area around a house, marks a change in the relationship between people and resources. Once re-located in the personal compounds of a family, plants become part of an area considered to be privately owned and the availability of these items to the village as a whole is therefore limited.

CONCLUSIONS

Non-domesticated and semi-domesticated foods in the market system in northeastern Thailand fill an important niche. These items, a vital part of the traditional lifestyle, are now a significant part of the commercial exchange system. These resources contribute to individual, household, and community welfare in a complex manner. While the supplier population is primarily rural, the consumer population is comprised of both rural and urban individuals. As villagers continue to seek wage employment, they experience a decrease in the time available for collecting their own food and turn increasingly to purchased foods in the villages and local markets. Demands for these items also increase as they become more valued as luxury or "exotic" foods for urban populations attempting to retain their traditional dietary patterns.

In the expanding cash economy of the region, the ability to obtain and control earnings can empower individuals; thus the motivation for obtaining cash increases. In northeastern Thailand the sale of non-domesticated foods provides a valuable and important source of income. This cash is used to meet household needs and financial obligations. The avenues for obtaining cash continue to be limited, especially for women, and consequently marketing has flourished as both a temporary and permanent means of economic employment.

The striking variability in non-domesticated food resources in the markets emphasizes the urgency for researchers to document the wide range of resources. Similarly, changes in environmental-use patterns—for example, increased relocation of resources into paddy and garden areas, increased management of resources, and increased privatization—suggest the need for continued documentation of these dynamic processes.

Food, food procurement, and food distribution practices transform many aspects of life; they influence social relationships and social control, affect economic practices, instill power or prestige, and alter human-environment relationships and the rules governing these connections (Fajans 1988; Moreno-Black 1991; Moreno-Black *et al.* 1994). Through gathering and marketing activities, an intensive interaction results in the selection, consumption, and exchange of forest products and other gathered items. The growth in the popularity of marketing non-domesticated resources is changing the patterns of resource exploitation. The increased demand for these items will inevitably put additional strains on the resource base, especially those food items that are considered to have high market value because of inherent qualities of taste and ease of collection. On the other hand, as certain items become more in demand, the push to cultivate them may increase; these items will consequently be afforded some protection from extinction, although they will be changed somewhat in the transformation.

Finally, as the use of local non-domesticated and semi-domesticated resources as cash generators increases, we anticipate that cultural practices concerning the management and gathering of these resources will continue to evolve. Pressure from commercialization of these resources is altering the traditional system. This system emphasized sharing and encouraged reliance on a wide resource base distributed across a variety of habitats as a hedge against the drought and flood conditions that characterized the region. These changing use patterns are also liable to have significant consequences for the ethnobiological knowledge base, since that knowledge is greatly shaped by experience. The changes in the variety of items selected for use coupled with the diminished availability of resources may lead to a constriction of the traditional knowledge system. We need to better understand how the commercialization of resources is affecting their availability. This contextualization of differential use patterns is essential for understanding cultural and environmental change in the region.

NOTES

[1] Plant resources often exist on a continuum from truly wild through semi-domesticated to domesticated. Active or incipient manipulation of resources and habitats can also occur on a continuum from selective harvesting through propagation and selective breeding. Various terms have been utilized to describe these different types of resources. In this article we use the term non-domesticated to indicate any resource that is not actively managed and propagated to the extent that it would be altered genetically.

[2] This system allowed us to obtain an overview of all the items sold during one continuous period. Once an aisle was recorded, we did not return to that aisle; nor did we record information from individuals who set up after we had already surveyed an aisle. Although this method caused us to lose some data, we felt that it ensured the best "moment in time" picture of the marketplace and enabled us to avoid recording some stalls more than once.

[3] All interviews were conducted at the market, during market hours, while the vendors were selling their items. Interviewing was interrupted to allow vendors to conduct transactions. Every effort was made to sit with the vendor, behind the items, so as not to block the items from view or to impede traffic in the narrow, busy aisles.

ACKNOWLEDGEMENTS

This study was part of a larger project focusing on the marketing and use of non-domesticated, indigenous plants and animals in the northeastern part of Thailand. The project was supported by grants from The Wenner Gren Foundation for Anthropological Research, The National Geographic Society, and a Fulbright Hayes Southeast Asian Regional Research Award. We would like to thank the staff of the National Research Council of

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NEWS AND COMMENTS

THE 5TH INTERNATIONAL CONGRESS OF ETHNOBIOLOGY

The 5th International Congress of Ethnobiology will take place in Nairobi, Kenya, September 2-6, 1996. The Congress has occurred every two years since 1988 and is held under the auspices of the International Society for Ethnobiology. The 5th Congress has the theme "Ethnobiology and conservation of cultural and biological diversity." For more information contact Christine H.S. Kabuye, National Museums of Kenya, P.O. Box 40658, Nairobi, KENYA, Telephone: 254-2-742131/4 or 254-2-743513, Fax: 254-2-741424. E-mail: Kenrik@tt.sasa.unep.no or Kenrik@tt.gn.apc.org

THE 20TH ANNUAL SOCIETY OF ETHNOBIOLGY MEETING

The Society of Ethnobiology will hold its 20th anniversary meeting March 26-29, 1997 at the University of Georgia, Athens, GA. Our host will be the Department of Anthropology. Abstracts are due January 15, 1997. Contact Bryan LaBau for information or to submit an abstract:

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A NEW ELECTRONIC FORUM

Dr. Dana Lepofsky, Department of Anthropology, Simon Fraser University, Vancouver, B.C. has set up an e-mail bulletin board at the address

ethno-bio@sfu.ca

If you would like to participate you may subscribe by sending the following message (don't include quotation marks) to the list processor at Simon Fraser University

majordomo@sfu.ca
"subscribe ethno-bio end"

Use this service to engage in exchanges of information and to debate issues of interest. Remember to observe the customary etiquette. This is a public forum.

MEDICINAL PLANT SPECIALIST GROUP

A new IUCN SSC Specialist Group is in place.—In May 1994, the SSC Plant Conservation Subcommittee recommended that a Medicinal Plant Specialist Group (MPSG) should be formed in response to rising concerns from many independent experts about plant conservation issues relating to medicinal plants. Following this meeting, Tony Cunningham and Uwe Schippmann were appointed co-chairs of the MPSG. Since then, more than 30 members have been invited to join the group and membership is still growing. Members were selected on the basis of strategic geographic location, professional interest, and their role as people who could network within regions.

The group is still in its formative stage. A draft concept and working program was prepared in May 1994 and sent out to all prospective members. A first meeting of the MPSG is planned for late 1995 or early 1996. Details about the group and developments in medicinal plant conservation will be made available through the MPSG Newsletter which will be published on a regular basis. The first issue is in preparation and will serve to keep members of the group, as well as a much broader interest group, informed about the issues relating to the conservation of medicinal plants.

The Problem.—Herbal medicines are used by a high proportion of rural and urban people in developing countries for their symbolic and medical value. There is also a renewed interest in industrialized countries in traditional medicinal plants as a source of chemical leads for new pharmaceuticals. Harvesting of medicinal plants, whether for export, sale, or local use is highly species specific. Species loss through this process has global implications. Its most immediate and earliest effect is the loss of self-sufficiency of the rural people using these species.

Despite immense public interest in medicinal plants and development of guidelines for conservation of medicinal plants (WHO et al. 1993; Heywood et al. 1991), coordinated international action for conservation and sustainable harvesting programs for medicinal plants has been limited.

The Focus.—The MPSG will be concentrating its efforts on vulnerable species for which demand exceeds supply from wild populations. Here, the greatest conservation threat is faced by high demand for slow growing, slow reproducing, habitat specific species. At the same time the MPSG will promote the need to deal with threats to medicinal plants at an early stage rather than focusing purely on taxa that are already in decline.

The biodiversity prospecting debate needs to be recognized by the MPSG as an issue in which conservation aspects need to be further developed (Cunningham 1993). This includes the important issue of benefit sharing through commercialization of natural resources as an incentive for habitat conservation infrastructure in order to protect medicinal plant populations in source countries.

The major task for the MPSG will be to make a general assessment of the situation, define objectives, set priorities of medicinal plant conservation, and draw up an Action Plan with both taxonomic and geographic focus. The Action Plan will review the conservation needs of taxa and recommend conservation action sufficient to ensure the long-term survival of these species. Action planning is the best means for the MPSG to play its role as advisory and catalytic committee for other bodies. As a first step, it is proposed to draw up national reports which review existing information on medicinal plants in local, regional, and international trade and short-list species for special attention.

Any material and news on the conservation of medicinal plants would be gratefully received. Contact address: Dr. Uwe Schippmann, Co-Chair, Medicinal Plant Specialist Group, Bundesamt für Naturschutz, Konstantinstrasse 110, D-53179 Bonn, Germany.

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THE AKHA MEDICINE PLANT PROJECT

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As many ethnobiologists are aware, traditional knowledge of indigenous peoples is being replaced by information and practices from external industrial urban-based megacultures. While not all changes are negative, the loss of traditional environmental knowledge, cultural values, and language is tragic. Frequently occurring with loss of traditional culture is environmental degradation, which generally accompanies large-scale commodity production. These are among the greatest misfortunes facing humans today, and are certainly among the hardest to overcome.

Among the many important initiatives to reverse these trends is the Akha Medicine Plant Project. The Akha are one of several distinct cultural and linguistic groups living in the forested mountainous region of northern Thailand. Emerging as a distinct group more than 3,000 years ago near what is now Tibet, they migrated to and settled in southern Yunnan, in what is now southern China, and neighboring areas. War and pressure from Thai and Chinese lowland peoples have increasingly forced them into the mountains of Burma, Laos, and Thailand. They have been established in northern Thailand for about 100 years (Von Geusau 1982). Increasingly, the lifestyles of the Akha are threatened by urban development, deforestation, encroachment of outsiders, forced resettlement, and lack of official recognition of land rights. Logging and reforestation with pine and eucalyptus trees have dramatically affected water courses and levels in the mountains.

The Akha have a rich tradition of using herbal medicines from the forests, fields, and gardens of their home regions. A preliminary study showed that about 90% of plants collected around villages were used by Akha villagers. These include medicines for over 60 types of illnesses and afflictions, ranging from broken bones and sprains to insect bites, diarrhea, jaundice, and childbirth problems. Plants are also used, alone or in various combinations, for medicinal tonics to maintain health and strength (Bragg 1989).

As Akha children become exposed to outside influences through education and the search for employment, they lose important links to their traditional language and culture. They are no longer taught traditional skills people would have absorbed readily in times past, such as the gathering and preparation of medicines (Ajopho 1989, Von Geusau 1989). The people are caught in a dilemma. How can they maintain their cultural integrity? How can they give their children the education and skills needed to survive in an international commercial economy while instilling in them a sense of the importance of their cultural heritage and the value, both philosophical and practical, of the traditional knowledge of their elders?

A counter movement, started by Akha headmen in the late 1970's, has tried to keep Akha culture and traditional knowledge alive as part of education and development (Von Geusau 1992). The Akha Medicine Plant Project, a part of this movement, aims to:

- record as much as possible the knowledge of the elders — especially the elderly women — of several Akha villages in Chiang Rai Province;
- document the plants used and teach the younger people in the community — particularly university students in Chiang Mai — the procedures for documenting plant medicines;
- encourage the continued practice and the use of traditional medicines in primary health care in the communities;
- demonstrate the importance of community forests (and also customary laws that promote conservation) to the survival of the Akha people, through their continuing provision of plant medicines, food, and materials needed for living;
- employ traditional knowledge and use of plants, linked with the mapping of ancestral lands by the villagers, to enhance and restore forests and fields as a vital part of the Akha environment and economy.

The news of this Akha Medicine Plant Project has attracted the attention of Hani/Akha people in Yunnan and Burma, who are planning to follow this model. It will also be an important item on the agenda of the Second International Hani/Akha Culture Study Conference in May 1996.

In May 1995 Nancy Turner was invited, together with elder teachers, to give a three-day workshop with Akha students, staff, and researchers on documenting traditional knowledge and collecting plant vouchers. Specimens were made of 67 species of plant medicines identified by women elders of Saen Chaeron village (Figures 1 & 2). A low-cost, illustrated book on traditional medicines available to

Akha people will be one of the outcomes of the project. Following the documentation of medicinal plants, there will be a study of the contribution of traditional foods, condiments, and beverages to Akha diet and nutrition. Other types of traditional knowledge, including forest, land, and water management, also need further research. Members of the Society of Ethnobiology interested in learning more about these activities may contact SEAMP-CD-RDI (South-East Asian Mountain Peoples—Thailand Culture and Development, Research, Documentation and Information Programs) at the address listed above for Leo A. Von Geusau and Aphi Deuleu (AvGeusau) Majeu. As the value of medicinal plants and other non-timber forest products is recognized, projects such as the Akha Medicine Plant Project can serve as models for cultural and environmental sustainability; they deserve strong support from all of us.

Figure 1.—Aphi Deu Dzoebaw collecting and teaching about Akha medicine plants.

Figure 2.—Aphi Deu Dzoebaw (left) and Aphi Ku Majeu discuss the medicinal uses of a wild ginger with Leo A. Von Geusau.

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GUIDELINES FOR AUTHORS

GENERAL INFORMATION

The *Journal of Ethnobiology* invites manuscripts based on original research in any area of ethnobiology (ethnobotany, ethnozoology) including, but not limited to: folk biological classification and nomenclature, traditional environmental knowledge, ethnoecology, indigenous natural resource management, plant and animal domestication, zooarchaeology, archaeological botany, medical and nutritional ethnobiology, and the roles of plants and animals in the intellectual, aesthetic, and spiritual lives of the world's peoples. In the material that follows, we give instructions and suggestions for manuscript preparation.

Typing and printing the manuscript.—Manuscripts should be submitted both as hardcopy and in digital form on a computer diskette. Hardcopy should be printed on an inkjet or laser printer. Typewritten manuscripts will be accepted if the author(s) do not have access to computers. The text should be double spaced throughout (including abstracts, text, literature cited, legends, and notes) on 21.5 x 28 cm (8.5 x 11 in) paper with at least 2.5 cm (one inch) margin on all sides.

Illustrations.—The ratio of tables and figures to text pages should not exceed 1:2. All illustrations, including maps, are figures and should be numbered in the sequence in which they should appear in the text. Illustrations should be submitted reduced to a size which can be published within a *Journal* page without further reduction. Photographs should be black-and-white glossy prints of good contrast and sharpness with metric scales included when appropriate. All illustrations should have the author's name(s) on the back along with the figure number and a designation for the top of the figure. Legends for figures should be printed on a separate sheet at the end of the manuscript.

Tables.—Tables should complement the text. Tabular material should be relevant to the appropriate section of text but not simply repetitive of textual material. Tables should be prepared in either spreadsheet format (e.g., Excel®) or using the table functions of your word processor program. Rows and columns of information must be clearly demarcated and labeled. Use portrait or landscape orientation as needed. Adjust column widths to conserve space without loss of clarity. Each table should be printed on a separate page (or pages) and appended to the manuscript. Tables must include brief, self-explanatory titles. The image area on a *Journal* page measures approximately 20 x 12.5 cm (5 x 8 in). Take this into account in preparing tables.

Scientific names and voucher specimens.—All generic and subgeneric names must be *italicized* (underlined in typescript). Authors of all but the most familiar species of plants and animals should be cited the first time each is mentioned in the text. The locations where voucher specimens have been deposited for curation should be noted. The rationale for these requirements can be found in:

BYE, ROBERT A., JR. 1986. Voucher specimens in ethnobiological studies and publications. Journal of Ethnobiology 6:1-8.
REA, AMADEO M. 1986. Verification and reverification. Problems in archaeofaunal studies. Journal of Ethnobiology 6:9-18.
KUHNLEIN, HARRIET V. 1986. Food sample collection for nutrient analysis in ethnobiological studies. Journal of Ethnobiology 6:19-25.
HUNN, EUGENE S. 1992. The use of sound recordings as voucher specimens and stimulus materials in ethnozoological research. Journal of Ethnobiology 12:187-198.

Native language terminology.—If native terminology is used as data, a consistent phonemic orthography or practical alphabet should be employed. A brief characterization of the orthographic conventions used should be given in an endnote at the first occurrence in the text. To increase readability native terms should be indicated by ***bold-face italics*** (underlined in typescript) to contrast with normal use of *italic type* for foreign terms and Latin binomials. The distinction between lexical glosses, i.e., English (or Spanish) language approximations of a term's referential meaning, and precise English (or Spanish) equivalents or definitions should be indicated by enclosing glosses in single quotation marks.

Miscellaneous.—Use metric units for all measurements; English units may be added in parentheses. Do not place footnotes at the bottom of text pages; list these in order on a separate page at the end of the manuscript under the first-order heading "NOTES."

Submitting the manuscript.—Submit all English language manuscripts to the *Journal* Editor. All Spanish language manuscripts should be submitted to the Spanish language Associate Editor. Authors must submit two hardcopies of their manuscript plus a digital copy on a 3.5-inch computer diskette prepared in a standard word processing format. Camera-ready figures should also be included. Copies of illustrations must be clear and suitable for review.

ORGANIZATION

Title page.—The title page is primarily for the convenience of the editorial staff. Center the title of the manuscript in capital letters. Lower on the page center the name and affiliation and address of the first named author, then any of the co-authors. On the lower third of the page, give telephone numbers for at least the first-named author. Below this, give information relating to any temporary addresses (e.g. summer address, field address). The title and name(s), affiliation(s) and address(es) of the author(s) are to be repeated on the first page of the actual manuscript as you would like them to appear in the *Journal*.

Abstract.—With rare exceptions (e.g., a position paper) each manuscript must include an informative one paragraph abstract which briefly (i.e., in less than 200 words) summarizes the information presented in the text. The format for the abstract differs from that of the rest of the text in that the heading "ABSTRACT" is placed on a separate line flush with the left margin and is capitalized; the first line of the abstract is not indented. The abstract in English is to be followed by one in

Spanish (RESUMEN) and in French (RÉSUMÉ). Spanish and French abstracts will be edited by our editorial consultants. Examples can be found in recent volumes of the *Journal*. Please list as well *five key words* that characterize the content of your manuscript for indexing purposes.

Headings.—Center first-order headings on a separate line, separated from the previous paragraph by two carriage returns. Headings are written in capital letters. The heading "GENERAL INFORMATION" in this "Guidelines for Authors" is a first-order heading. Second-order headings are place flush with the left margin, written in capital and lower case letters, *italicized* (underlined in typescript), followed by a period and a long dash ("em dash") and are separated by two double spaces from the preceding paragraph (as in the present paragraph). If third-order headings are necessary, they are written in capital and lower case letters, indented as in a normal paragraph, and followed by a period. Text immediately follows a third-order heading. There are examples of third-order headings in this "Guidelines for Authors" under "Citations," below. Do not use more than three orders of headings.

Citations.—*Italicize* (underline in typescript) titles of books and journals that appear in the text of your manuscript. For example, "Schultes and Raffauf (1990) in their book *The Healing Forest: Medicinal and Toxic Plants of the Northwest Amazon* report that..." This style is permitted occasionally for variety. Generally, titles of published works do not appear in the text. Follow examples below to cite previously published articles, books, and materials. Note that commas separate multiple works by a single author, semicolons separate works by different authors.

Single reference. Gade (1985) or (Gade 1985).

Multiple references. Posey (1984, 1986) or (Posey 1984, 1986). Posey (1986) and Balee (1989), (Posey 1986; Balee 1989), or (Posey 1984, 1986; Balee 1989).

Multiple authors. Farrington and Urry (1985) or (Farrington and Urry 1985). For more than two authors: Klippel *et al.* (1987) or (Klippel *et al.* 1987).

Unpublished sources. We discourage the use of unpublished sources. It is difficult, often impossible, for the reader to verify or check the interpretation of material cited in this way. If it is absolutely necessary to use an unpublished source, please aid the reader by providing additional information as a note, e.g., the name and address of the person being quoted or paraphrased or the name and address of the person and/or institution where the information is on file or on deposit. Because of the detailed information to be placed in the "NOTES" section, unpublished sources do not appear in the "LITERATURE CITED" section. Follow these examples for citations.

Joe E. Doe (personal communication 1989)[1], or John E. Doe (written communication 1989).[1] Also: Jane E. Doe (report in the files of... 1989)[1], or Jane E. Doe (manuscript in the files of...1989)[1], or John E. Doe (data on specimen label... 1959)[1].

Notes.—Footnotes are not permitted at the bottom of pages. Notes, if any, appear at the end of the manuscript, immediately before the Literature Cited section. Consult recent volumes for examples.

Acknowledgements.—Although acknowledgements are commonly given, they are optional. If you have such a section, place it at the end of the text of the manuscript, i.e., after "Notes" (if any) and before "Literature Cited." See examples in recent volumes.

LITERATURE CITED

Note in the examples below that authors of the works cited in the text of the manuscript are to be given here as they were in the original publication, i.e., with fully written names, with first names and an initial, or with initials only as in the original article. The works cited in the text of the manuscript are arranged alphabetically by author with the names of authors and co-authors in capital letters. Also note in these examples that the titles of book chapters and journal articles are not capitalized, except for proper nouns, place names, and names of persons. However, the books and journals in which these appear are capitalized fully, as indicated below. Write out the names of book and journal titles completely; do not abbreviate, as the space saved is not worth the information lost. Do not list works which are not cited in the text of the manuscript. In addition to those given below, consult examples in recent volumes of the *Journal*.

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BOOK REVIEWS

Eat Not This Flesh: Food Avoidances from Prehistory to the Present. Frederick J. Simoons. (2nd edition, revised and enlarged). Madison, Wisconsin: University of Wisconsin Press. 1994. Pp. xiv; 550. $22.95. ISBN 0-299-14254-X (paperbound).

The original edition of this work, published in 1961, became a classic—the standard work on flesh food taboos and avoidances in the Old World. Simoons provided data on religious and cultural bans against pork, beef, chicken, fish, horse, camel, and dog meat. It was praised and it was attacked, but it was not ignored. A modest essay of 241 pages, it argued the primacy of cultural and religious factors in taboos, in opposition to the view that taboos initially came about for nutritional, medical or ecological reasons.

More than 30 years have passed, and the book has more than doubled in size. It has become a far more formidable work. The scholarship is better, the argument tighter. In the years between editions, we have seen the rise and fall of what Marshall Sahlins called "practical reason"—particularly dogmatic and extreme forms of the models that ascribe taboos to narrowly physical causes. Sahlins himself, in Culture and Practical Reason (University of Chicago Press, 1976), sharply questioned the "practical reason" view. Now Simoons has not simply questioned it; he has destroyed it.

Simoons brings to bear on the question a lifetime of scholarship. The bibliography of this edition is 80 pages of fine print. History, geography, religious studies, anthropology, biology, medical science, and other fields are drawn on for evidence. From medieval explorers' accounts to modern parasitological literature, all bodies of documentation yield up their due. He considers a vast range of possible reasons for taboos. For the pig alone, these include explanations based on ecological insuitability, habitat change, political economy, trichinosis transmission, other health considerations, unclean feeding, anomalous classificatory status, religious rivalry, religious change, and ethnic identity maintenance. All these he subjects to a fair reading and a judicious evaluation.

The results of the survey are a pattern that fits with no ecological or medical reality. Taboos, and populations of tabooed animals, wax and wane with the ebb and flow of religion. Pigs, said by the ecological determinists to be ill-suited to the Near East, were widely raised there until the area became over-whelmingly Muslim. Similarly, neighboring peoples, in identical environments, have quite different patterns of avoidance; some African groups eat fish or chicken while their neighbors do not. The crazyquilt pattern of chicken and egg avoidance in Africa is particularly hard to fit with any ecological reality. The taboo on killing and eating cows has spread across India. It has trickled down the social order, from priests to caste Hindus and, increasingly, outcaste groups.

This is not to say that there is no eco-logic to food taboos. The cow is indeed useful in India, and certainly some part of the veneration of the cow is due to its utility, as the Arab traveler al-Biruni pointed out centuries ago (Simoons, p. 143 and elsewhere). But the cow did not suddenly become more useful in Southeast and East Asia when Buddhism and Hinduism brought beef avoidance there. The avoidance spread quite apart from the utility.

What, then, explains these taboos? A wide range of factors. Most common is avoidance of filthy feeders: pigs, chickens, dogs. Structural concerns are important, as Mary Douglas pointed out; animals that do not fit standard and obvious categories are shunned. Humans also love to make animals the symbols of political constructs (including religious and ethnic groups), and then one political group's sacred symbol is their enemy's hated foe. Thus, the dog, unclean throughout Islam, is especially loathed by some Iranian Muslims because dogs are revered by the rival Zoroastrians. The Zoroastrians—like Westerners—avoid dogflesh for the opposite reason: dogs (and cats, and horses) are shunned as food where they are most appreciated as companions. Simoons avoids the easy traps of ascribing taboos to vague and general factors such as "meaning" or "identity."

Though this book establishes its case, it is not perfect. Its greatest weakness is an entailed corollary of its greatest strength, its comprehensive coverage. Today, the literature of social science is flooded (almost, indeed, washed away) by specialized and detailed interpretation. Eat Not This Flesh is in an older scholarly tradition–the tradition of the vast survey, covering a huge amount of ground, but not going into depth. Simoons simply cannot go into full detail on the place of food taboos in every society; that would require countless volumes. Thus, experts in each area will no doubt complain about the neglect of the rich texture of detail–the local variations, the historical shifts, the subtle feelings of the participants. Very well; let the experts follow Simoons, and elaborate on his points.

One important source missed by Simoons is Eugene Hunn's definitive artcle ("The Abominations of Leviticus Revisited," 1979) on the taboos in Leviticus and Deuteronomy. Hunn showed that the tabooed birds (and most other tabooed creatures) are those that are predatory or carrion-feeding, and thus become contaminated by blood. This is, of course, consistent with the veneration of blood and the absolute Biblical rule against contact with blood not ritually shed. Pigs, of course, are notoriously omnivorous—eating live or dead animals when they can get them. The Biblical taboos also cover some vegetarian animals, notably herbivores that "divideth not the hoof" such as donkeys, but the vast majority of taboos follow simply from the blood-contamination rule. Hunn's article—unfortunately published in an obscure collection—strengthens Simoons' case.

Ethnobiologists should read this book, and keep it at their fingertips for reference. It is a corrective for the idea (perhaps more often felt, at gut level, than stated) that people use plants and animals solely according to "practical reason." People are creatures of practical reason, to be sure, but they are also creatures of emotion, and of symbolic communication.

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Earth's Insights: A Multicultural Survey of Ecological Ethics from the Mediterranean Basin to the Australian Outback. J. Baird Callicott. Foreword by Tom Hayden. Berkeley: University of California Press, 1994. Pp. xxiv, 285. $35.00. ISBN 0-520-08559-0 (hardcover).

There is currently an active controversy in environmentalist circles over the degree to which traditional peoples valued conservation and environmental protection. A wide spectrum of views exists, ranging from one extreme (the Noble Savage in harmony with nature) to the other (the impulsive savage destroying wantonly). To this controversy, Baird Callicott's book is a valuable addition. It should—but, alas, probably will not—deal a final deathblow to the extreme positions, and bring debate back to a sensible middle ground.

Callicott, who is Professor of Philosophy and Natural Resources at the University of Wisconsin-Stevens Point, provides a quick survey of environmental ethics around the world. He is among the rare scholars who can write a brief overview that is not superficial. By choosing references and points of emphasis with extreme care, and by knowing his ground very well indeed, he avoids much of the shallowness that inevitably creeps into a book that goes round the world in 285 pages. One wishes, of course, for more detail on everything, and some areas are not well covered due to sheer lack of available material. Africa is one of these; Callicott reports a lack of known environmental ethics; I suspect the ethnographic literature, not the Africans, to be the source of this deficiency.

The book covers philosophy, not practice. Some of the areas in question (China, for instance) have bleak records in their treatment of the environment, yet have produced great writings on environmental ethics. Indeed, sometimes the wreakage prompted the great writings. People do learn—often, alas, too late.

On areas well known to me, Callicott does a good job. North America is excellently covered; no one will ever be able to maintain seriously, again, that Native Americans had no conservation ethnic. China (my main research area) is somewhat less well done. Callicott worked with Roger Ames, a leading authority on Chinese philosophy, and thus has the classic book-learning right. The problem is that no one in the world really lives by classics alone. Chinese environmental values grow from farmers' and gatherers' daily experiences with the land and water, just as ordinary social ethics grow from daily experiences with people. The philosophers who write the books, in turn, get their environmental ethics from a thoughtful consideration of and dialogue with such folk knowledge. One can literally see this happening in some of the Han Dynasty texts (apparently unknown to Callicott) in which court debates on such matters are recorded.

One result of focus on books is that Callicott somewhat misunderstands and overvalues the role of Taoism. This is important, because he finds Taoism perhaps the most environmentalist of all traditional philosophies. He gives its mystical and quietistic side an important place. In fact, Taoist practice has been less concerned with mystical withdrawal and nature contemplation than the West has been led to believe, and much of "Taoist" love of nature is simply Chinese folk values asserting themselves.

Here and elsewhere, however, we must remember that the religious and philosophical classics really are important. They are what we read and what inspires us in developing new ethics. Recognizing that no tradition has solved all the problems—there never were those all-harmonious Noble Savages–Callicott advocates learning all we can from everyone, and creating new and more profound environmental ethics on the basis of our reasoned reflection on others' experiences. Sympathetic with Deep Ecology and other radical new trends, he wishes to inform them through study of all that the human species has learned, and thought, in its long and not-too-successful attempt to deal with Planet Earth.

I fear that, as I wax old and cynical, I am far less sanguine than Callicott about the prospects of his agenda. Not only are most humans still all too prone to view the environment as nothing but a source of food and fibre, but also the radical ecologists are often too dogmatic and hidebound to open their minds to the ways of other peoples. Callicott's faith in both traditional peoples and modern environmentalists seems a bit naive to an aging veteran.

For the above reasons, ethnobiologists will find this book most useful as a "finder" for further reading, and as a general introduction to the philosophical aspects of ethnobiology. They will wish to check carefully with the primary sources before using this book as an authoritative voice on any particular area

However, I found Callicott's book inspiring. It revived what hopes I have. In any case, everyone concerned with the environment should read this book.

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Progress in Old World Palaeoethnobotany: A Retrospective View on the Occasion of 20 Years of the International Work Group for Palaeoethnobotany. van Zeist, Willem, Wasylikowa, Krystyna, and Karl-Ernst Behre, Eds., with the assistance of G. Entjes-Nieborg. Rotterdam, Netherlands and Brookfield, Vermont: A.A. Balkema, 1991. $60.00 (hardcover). Pp. ix; 350. ISBN 9061918812.

The International Work Group for Palaeoethnobotany (IWGP) was founded at Kacina Castle, near Prague in October,1968, with the aim of promoting collaboration between European researchers involved in the study of plant remains from archaeological sites. The Group, which has considerably expanded in recent years, has organized nine meetings in different East and West European countries resulting in some invaluable collected volumes (e.g. van Zeist and Casparie 1983; Renfrew 1991). This book celebrates the Group's 20th anniversary and aims to review the developments in the field since its foundation. Its geographical scope covers Europe and the Middle East (the research area of the Group), and it summarizes results based mainly on plant macrofossils other than wood and charcoal.

The book is divided into two parts. The first part is thematic, covering mostly methodological issues, and the second consists of separate regional surveys of archaeobotanical research. The thematic part deals with the basic analytical steps in archaeobotanical work such as identification (U. Korber-Grohne), sampling (M.K. Jones) and numerical analysis (G.E.M. Jones), with the taphonomic factors affecting the preservation and representation of plant remains (U. Willerding), and with issues of interpretation such as environmental reconstruction (K-E. Behre and S. Jacomet) and procurement, management and trade and exchange of plant resources (W. van Zeist). Regional surveys cover the Middle East (N.F. Miller), Southeast Europe (H. Kroll), Central Europe south of the Danube (H. Kuster), Germany north of the Danube (K-E Knorzer), East-Central Europe (K. Wasylikowa, M. Carciumaru, E. Hajnalova, B.P. Hartyanyi, G. A. Pashkevich and Z. Y. Yanushevich), South and Southeast Europe (M. Hopf), Western and Continental Europe (C.C. Bakels), the British Isles (J.R.A. Greig) and the Nordic countries (H.A. Jensen). Four chapters are in German (but with long summaries in English) and the rest in English. There are five pages with good-quality black and white photographs, and many drawings and graphs. The absence of an index is a drawback, but, in general, the volume was produced with great editorial care.

The thematic part as a whole provides a very useful collection of papers which will be of interest to archaeobotanists irrespective of their geographical specialization. As with the rest of the book, the diverse epistemological backgrounds of the authors has resulted in an extreme heterogeneity in the approach adopted. In general, methodological aspects (mainly the analytical procedures) received a more thorough coverage, whereas discussion on the interpretative models involving human relations has been kept to a minimum. The book would have been greatly benefited if, for example, preceding the discussion on the field's methodological procedures, the preface had been expanded to become a separate chapter dealing with the nature of the discipline today (given the recent debates in archaeology) and its research agenda.

The part with the regional surveys provides a summary of a huge quantity of material from such a wide geographical area. It is based on an enormous and diverse body of literature written in many languages, many of them inaccessible to the majority of western researchers. Some areas received more detailed coverage than others as a result of the variable volume of the archaeobotanical work undertaken. For example, the chapter dealing with the work on Germany north of Danube summarizes over 400 publications from more than 300 countries whereas the chapter dealing with the Nordic countries (Sweden, Norway, Finland and Denmark) present data from 84 sites altogether. Most of the chapters begin with a short historical overview of the wok undertaken to date. In nearly all of them (with the exception of the chapter on the Near East) the data are presented in chronological order (employing rather broad divisions) followed by a subdivision into plant categories. Material is very conveniently summarized in tables and distribution maps. The chapter on the Near East is an exception in explicitly focusing on specific archaeological problems, rather than listing finds and discussing some of their implications. It devotes most of its part on the origins of agriculture (an issue far from being resolved according to Miller) but it also discusses other issues such as fuelburning as an agent in the formation of archaeobotanical record, and the assessment of the human impact on the land. This last attempt to situate archaeobotanical finds within a general archaeological context and within a framework of archaeological research questions is sadly missing from the majority of regional contributions.

In conclusion this book, produced by a group of leading world authorities in the field, will be of interest to archaeologists in general and archaeobotanists in particular, ethnobotanists, agriculturalists and plant ecologists; it is highly recommended as it can serve as a very good reference guide, an invaluable source of often inaccessible information, for both methodological issues and regional studies. Moreover, it can be viewed as a mirror of the state of the discipline today, revealing both its advances and its weaknesses: the expansion and intensification of the archaeobotanical research both geographically and chronologically and the methodological developments especially in recovery, sampling, taphonomy and ecological interpretations, and its serious difficulties in fully integrating itself within the archaeological framework, in developing theoretically informed models of human-plant relationships, and in understanding that "people don't eat species, they eat meals" (Sherratt 1991:221).

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Phytolith Systematics. Emerging Issues. George Rapp, Jr. and Susan Mulholland (Eds.) New York: Plenum Press (233 Spring St. New York, NY 10013),1992. $49.50 (hardcover). Pp. xxiv; 350. ISBN 0-306-44208-6.

This volume is the first in the Advances in Archaeological and Museum Science series sponsored by the Society for Archaeological Sciences. The purpose of this series, which has been launched as biennial, is to provide summaries of advances in closely defined topics in archaeometry, archaeological science, environmental archaeology, preservation technology and museum conservation.

Phytoliths are defined as microscopic mineral deposits in plants, that form in and between plant cells. The reviewed book adopts the restrictive approach for the phytolith concept: Calcium and opal phytoliths from vascular plants are reviewed while cysts from one celled organisms (diatoms, and other algae) are not considered. The latter materials seem also pertinent for the archaeological science and palaeoenvironmental studies, and, presumably, are worthy of another issue in this series. Not only calcium oxalate but also calcium phosphate, calcium carbonate and opaline silica may be deposited in determined parts of the plant. These crystalline or amorphous mineral deposits may become botanical microfossils, and can provide relevant archaeobotanical and palaeoenvironmental information.

The contributors are outstanding archaeologists, anthropologists, palaeoresearchers and promising students in these fields. The fourteen chapters cover a wide range of subjects in the field of phytolith systematics, which vary from general systematics, to specialized regional studies or taxonomic monographs. The first group of chapters is based on papers presented at The Third Phytolith Research Workshop, which was held on January 23-24,1988 in Columbia, Missouri. An interesting annotated bibliography of Phytolith Systematics, by S. Mulholland, E. Lawlor and I. Rowner, is provided in the last chapter (pp. 277-322). General and Plant Name Indexes (pp. 323-346) are given which made this book easy to consult. Figures are abundant (over a hundred). Scanning electron micrographs, optical micrographs and line drawings are used for illustrating the phytolith morphology, with unequal efficacy because some of the optical micrographs are scarcely recogniable. Two introductory chapters (by Mulholland and Rapp, pp. 1-14, and Powers, pp. 15-36, respectively), throw light upon the lesser known history of phytolith analysis and systematics.

Several approaches to phytolith systematics are presented by Pearsall and Dinan (all phytoliths) (pp. 37-64); Mulholland and Rapp (grass silica-bodies) (pp. 65-90); Ollendorf (sedge phytoliths) (pp. 91-112); Kaplan, Smith and Sneddon (cereal grain phytoliths) (pp. 149-174); Scott Cummings (Assorted Food Plants phytoliths) (pp. 175-192); Bozarth (selected dicotyledon phytoliths of the Great Plains) (pp. 193-214); and Jones and Bryant (Texas cacti phytoliths) (pp. 215-238). Arlene Miller's chapter on silica skeletons from Near Eastern archaeological sites (pp. 129-148) explores a promising field which merits further research.

Silica deposition in roots and rhizomes is discussed by Sangster and Hodson (pp. 239-252) making evident the lack of a thorough systematic survey of this field, which is still in its infancy.

Twiss (pp. 113-128) presents phytolith analysis as a potential alternative for paleoenvironmental research in conditions where pollen analysis is neither practicable nor suitable. Twiss discusses the shapes of individual phytoliths from grasses, by underlining their potentialities as indicators of the C3 and G photosynthethic pathways. Using ratios of pooid, panicoid and chloridoid phytoliths is proposed as a tool to reconstruct the Cenozoic environment of a site or region.

The archaeological substance of the matter is scarcely represented in the book, which is, according with the title, mainly focused on systematics and based in fresh materials. Archaeological possibilities of phytolith analysis are underlined by most of the authors, but a few examples are fully developed through the whole work.

Rovner and Russ, in their chapter on Darwin and Design in Phytolith Systematics (pp. 253-276), propose the use of computer-assisted feature measurements and statistical analysis for obtaining the assurance of consistency and replication of phytolith analysis. They conclude this is the ideal basis upon which to develop effective, consistent and reproducible phytolith classification. Without this assurance of consistency and replication, results of phytolith analysis will remain suspect, and phytolith analysis itself will be unable to gain the same validity as palynological analysis.

This book brings together much dispersed information on phytolith systematics and phytolith analysis. The text is easily readable for a nonspecialist public and could be an useful introductory reading for palaeoresearchers, archaeologists, and plant taxonomists, both professionals and students.

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Ethnobotany of the California Indians. Volume 1. A Bibliography and Index. Beatrice M. Beck. **Volume 2. Aboriginal Uses of California's Indigeneous Plants.** Sandra S. Strike. Illustrated by Emily D. Roeder. Champaign, Illinois: Koeltz Scientific Books USA/Germany, 1994. $80.00 (two volume paperback set). Volume 1. Pp. iv; 165. ISBN 1-878762-50-8 (USA), 3-87429-353-X (Germany). Volume 2. Pp. ii; 210. ISBN 1-878762-51-6 (USA), 3-87429-354-8 (Germany).

California has a rich aboriginal past. When the first Europeans arrived in the sixteenth century there were 135 linguistically-distinct groups in an area blessed with a diversity of floristic and ecological zones. A compilation from the ethnobotanical literature is certainly welcome.

Volume 1 is a bibliography of over 2500 journal articles, monographs, dissertations, films videos, audio recordings, catalogues, unpublished reports and articles from the popular press. While much of the material is specific to California, the general material is annotated to indicate mentions of Californian plant species or native groups, or to indicate accounts of aboriginal activities relevant to California Indians such as fire-making, basketry, acorn-leaching and stick-throwing (a game of strategy). The bibliography is indexed by the key words of both titles and annotations. There are, however, annoying errors in the index. A random check revealed that *Larrea tridentata*, the creosote bush, is listed in the index as appearing on page 18 but instead appears on page 19. Similarly, *Proboscidea*, appears on pages 6 and 22, each being one page past those listed in the index. Systemic errors like these erode the reader's confidence and diminish the usefulness of the work. This reviewer wonders whether bibliographic works are better (and more economically) supplied in digital format on a computer diskette. Using simple search tools found in computer word processing programs a digital bibliography would permit researchers to compile references in different ways; for example, all the citations of one author can easily be assembled regardless of the author's rank.

Volume 2 is a compendium of ethnobotanical notes arranged alphabetically by genus on plants indigenous to California. For each plant, notes are categorized as 'food,' 'medicine,' 'basketry,' 'dye,' and 'other.' Plant parts used, method of preparation, and aboriginal group utilizing each plant, are described. Frequently, plants are identified only to the genus level, a minor annoyance. Few aboriginal names appear in an otherwise useful index of mostly English and Spanish folkloric names.

No details are given on how this work was compiled. None of the notes in the main section issupported by specific citations, although a bibliography of 174 references is provided. The author acknowledges three native informants and several workshops given by various specialists but there is no way of determining which of the notes are the author's own observations and which are derived from the references cited.

Comparing the two volumes, it appears that the research methods of the two authors differed somewhat. Volume 1 lists only five references to *Artemisia* spp., a surprisingly low number given the importance of *Artemisia* species in American Indian medicine. Volume 2, however, gives 141 lines of notes on various *Artemisia* spp. induding sagebrushes, mugwort and wormwood. The two volumes are more in agreement on other plants. For example, the creosote bush, *Larrea tridentata*, has 18 references in Volume 1 and 38 lines of notes in Volume 2. Similarly, for the unicorn plant, *Proboscidea* spp., there are nine references in Volume 1 and only eleven lines of notes in Volume 2.

Complaints aside, the two volumes of Ethnobotany of the California Indians will be useful reference books for specialists interested in native American ethnobotany. Archaeologists, medical anthropologists and ethnopharmacologists will find much material to explore here.

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Forestry and Food Security. Rome, Italy: Food and Agriculture Organization of the United Nations. (FAO Forestry Paper Number 90), 1989.Pp. vii; 130. $12.00 (paperbound). ISBN 92-5-1028478.

This publication has been prepared by FAO in view of the widely recognized fact that, as the introduction states: "Food security is a fundamental problem facing the world today. Despite substantial increases in food production in many countries, over 800 million people still suffer from malnutrition."

This problem is thoroughly analyzed in the 130 pages. Following the Foreword, the contents are arranged in five chapters: I) Overview, with eight sections; II) Environmental Links between Forestry and Food Security, with 25 sections; III) Forestry and Food Production, with 19 sections; IV) The Socio-economic Aspects of Forestry and Food Security, with 22 sections; and V) Opportunities for Action, with 16 sections.

There follow Background Documents presented at the Expert Consultation on Forestry and Food Production/Security, Trivandrum and Bangalore, India; and the Documents Presented number 19, by 15 experts. The Bibliography is extraordinarily inclusive with a total of 215 items.

It seems certain that such a thoroughly complete coverage of the relationship between forestry and food security has never before been published. This, in addition to the high quality and practical approaches, make this FAO Forestry Paper a unique analysis of the problems considered and what can be done to utilize our knowledge of forestry in many ways to increase food security.

I applaud the sincerity that pervades the book, a recognition that there are no easy solutions. The words introducing the fifth chapter, Opportunities for Action: "There are no simple prescriptions to follow on how to integrate food security objectives into forestry activities. Experience is still limited and there are few examples of forestry initiatives...designed with food security as a specific target. Nonetheless, there are many opportunities for action..."

This modest publication should be made easily available to academic, commercial and governmental agencies of the many individuals who are working actively on methods to feed the world's growing population and of individuals who are looking for novel approaches to increase food supplies.

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Forest, Trees and Food. R. Clarke. Rome: Food and Agriculture Organization (Accompanies FAO Forestry Paper Number 90), 1989. (No price given). ISBN not given.

This brief paperbacked booklet, written in language for the non-technical audience that it wants to meet, is a masterpiece in bringing to the general public an appreciation of the importance of food supplies, possible new food plants in the future, the value of forests and their products and numerous other practical aspects of food and their sources.

The words of Edouard Saouma, Director-General of the U.S. Food and Agriculture Organzation, in the foreword, resound with encouraging optimism: "The ways in which the rural poor in developing countries benefit from forests and farm trees have rarely been spelt out in detail. Yet research shows that those without access to forests and to trees growing on common land…I commend this publication for drawing attention to an underdeveloped natural resource which can make a bigger contribution to the fight against malnutrition."

The booklet is divided into four major parts: I. *Food and Nutrition*—Food from the forest, foods from cultivated trees, food for livestodk, nutrition and health. II. *Income*—Income from the forest, Income from tree cultivation. III. *Agriculture*—Soil erosion, Improving soil quality, Improving water supplies, Trees and Climate. IV. *Strategies for Improvement*—Adapting forestry policy and legislation, Adapting forestry institutions, Research, Designing projects to meet local needs, Conclusion. There follows a section of sources with 25 citations.

This publication is highly recommended, especially for high school and preparatory classes in sociological courses designed to improve nutrition and health of the general populations of both developed and developing nations.

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Stressed Ecosystems and Sustainable Agriculture. S.M. Virmani, J.C. Katyal, H. Eswaran, and I.P. Abrol (editors). Lebanon, New Hampshire: Science Publishers, 1995. Pp. xi; 441. $80.00 (hardcover). ISBN 1886106142.

One of the most inclusive, comprehensive and practical contributions to environmental conservation and its relation to agriculture has appeared. It has been needed for a long time, especially since unfortunately too often even experts in environmental conservation fail to realize how much of the world's environment is human-created–agricultural environments.

The foreward has a statement of a rarely recognized aspect of real conservation efforts: "…there are many indigenous systems, particularly in India, when sustainable agriculture is traditionally and historically practiced. We have much to learn from this indigenous knowledge." This theme runs throughout the book.

The volume is introduced by a 15-page chapter entitled I. Synthesis, introducing the readers in brief discussions of the technical chapters that follow. This Synthesis is followed by six chapters of 34 invited papers: 1) Issues, Challenges and Role of Institutions; 2) Sustainability and Resource Utilization; 3) Resource Base and Stresses; 4) Resource Management; 5) Technology for Mitigating Stresses; and 6) Supporting Papers. There is an Appendix comprising a list of 130 contributions and participants from five countries with a heavy representation by authors from India. The nine-page Subject Index is especially useful in locating unusual minor topics.

This most valuable volume resulted from a meeting of eminent scientists meeting in 1993 in Hyderabad, India "to devise alternate systems of land management that would restore degraded land back to productivity, optimize natural resource uses and stabilize dry land production."

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Eating on the Wild Side. Nina L. Etkin (editor). Tucson: University of Arizona Press, 1994. Pp. viii; 305. $37.50 (clothbound). ISBN 0-8165-1369-4.

In the plethora of books on "eating native," it is heartening to see published one that is truly interdisciplinary in scope and scientific in its outlook and organization: Eating on the Wild Side. The long subtitle of the book gives the potential reader a better idea of the breadth of the contents: "The Pharmacologic, Ecologic and Social Implications of Using Non-Cultigens."

While the list of contributors is made up mainly of outstanding anthropologists, it also includes experts in medicine, surgery, gastroenterology, environmental conservation and botany; consequently there are many and often varied outlooks amongst the contributors. But, since the topic is interdisciplinary, the selection of contributors is well chosen.

There is little that one reviewer can handle in such an interdisciplinary contribution. Even though it reviews primarily the nutritional aspects of wild foods, the book contains much of an insight into the nutrition of aboriginal peoples from the point of view of health, and many tangential methods of living and feeding.

The first chapter defines the expectations of the reader into "The Cull of the Wild", divided into several sections: Definition: Are Weeds Politically Incorrect? with a well-chosen bibliography of 89 references. The succeeding collections follow with five sections, each fully provided with a specialized bibliography: Selection; Physiologic Implications of Wild Plant Consumption; Wild Plants in Prehistory; Plants and non-human Primates; Epilogue.

Any person—especially economicbotany or ethnobotany specialists—will appreciate the interdisciplinary and geographically widespread aspect of the numerous contributions to the book. The reader will likewise thank the editor for the extensive chapter-by-chapter complete bibliography annotations, the list of the 20 contributors to the volume with their official university connections and the excellent botanical and topic indices.

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Murder, Magic and Medicine. John Mann. Oxford, United Kingdom: Oxford University Press, 1992. Pp. 232. $14.95 (paperbound), $29.95 (hardcover). ISBN 0198558546 (paperbound), 019855561x (hardcover).

The literature has been surfeited in the last quarter century with books on psychoactive, medicinal or otherwise bioactive books—some excellent, many leaving much to be desired. John Mann, in this relatively small book, has treated medicine, the use of hallucinogens and other psychoactive plants in a novel way—a breath of new reading in the plethora of material that the past few decades have offered the interested audience—some of them outstanding, some mediocre.

Mann has presented much new material on toxic, narcotic and medicinal plants and very frequently in a novel intrepretation. I do not hesitate to recommend his book without reserve for good reading, accurately presented technical material and, especially, its historical treatment of many of the bioactive plants, particularly those which, in past times, held great importance especially in magic. The reader will enjoy throughout the volume its philosophical tone.

The book is organized in very logical and usable ways. It has an Introduction; followed by three sections: Murder, Magic, Medicine; a Bibliography, an Index of Scientific Names and a Subject Index. The Bibliography, one might expect, could have been expanded somewhat but the items listed do provide a wide range of pertinent topics for those who want to read further. For the non-technical audience, there is a useful Index of 71 Scientific Names which will be helpful.

I am certain that *Murder, Magic and Medicine* will be widely accepted and appreciated, and I congratulate John for writing it and Oxford Press for so attractively publishing this new contribution.

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Ethnobotany: A Methods Manual. Gary J. Martin. London: Chapman & Hall, 1995. $29.95 (softcover). Pp. 268. ISBN 0412 48370 X.

Techniques and Methods of Ethnobotany. David R. Given and Warwick Harris. London, The Commonwealth Secretariat, 1994. £9.50 (softcover). Pp. 148. ISBN 085092 405 7. (Available from Commonwealth Secretariat Publications, Marlborough House, London, SWIY 5HX, United Kingdom).

Ethnobotany's profile has risen dramatically as the global community has acknowledged the imperative need for environmental conservation. With this recognition comes high expectations and as a discipline ethnobotany has been seriously challenged to provide approaches appropriate for the crucial tasks of simultaneously addressing both human needs and conserving plant biodiversity. Until recently books on ethnobotany have been more concerned with defining what this diverse field encompasses rather than refining the methods that it uses. At the same time as ethnobotany has struggled to find its identity it has been held back by the lack of scientific legitimacy conferred by a valid methodology.

The recent appearance of two methods manuals on ethnobotany is therefore both timely and welcome. However this event and the books themselves should be assessed within the current context. Both books very consciously place ethnobotany within the conservation agenda and in doing so tend to define ethnobotany specifically along the lines from which the global recognition is coming. In examining the books we should be wary that the field not be narrowly defined at the exclusion of the breadth that has enriched it as it has developed over the past one hundred years. As well the books should be evaluated for the degree to which they use the current spotlight on ethnobotany to strengthen the push for more rigorous methodologies in ethnobotany.

These two books differ greatly in the degree to which they are successful in accomplishing these two objectives. *Ethnobotany: A Methods Manual* by Gary J. Martin is a landmark book in ethnobiology. It is faithful to the multidisciplinary nature of ethnobotany and Martin is extraordinarily skillful at integrating both the bio- logical and anthropological traditions of the field. As well as having a sense of history he is very conversant with activities that are at the forefront of ethnobotanical research and in this regard is particularly attentive to including in the book examples of innovative methodologies. In addition to being a practical introduction to ethnobotany for those seeking to undertake conservation-oriented projects, the volume is of a high scholarly standard. It is essential reading for anyone embarking on graduate studies in ethnobiology.

The same cannot be said for *Techniques and Methods of Ethnobotany* by David R. Given and Warwick Harris. While this book contains a good deal of useful information for someone being introduced to ethnobotany, it is difficult to figure who is its target audience. Certain aspects of the book such as the glossary are rather elementary and appear directed at persons without higher education. On the other hand detailed advice is given for western scientists working in foreign countries.

The book is focused on methods that are exclusively biological in orientation. Moreover, few methods are described in sufficient detail for an uninitiated person to carry them out. Symptomatic of the deficiencies of the book is the statement in the section on plant collection techniques that "a number of widely available books deal with the details of collection techniques and the brief notes below supplement these references." However, no references to more detailed works are cited in the text and the section of Bibliography and Further Reading contains no titles that obviously encompass collection techniques. Further indication of the unscholarly nature of this book are numerous grammatical and typographical faults.

Without knowing better I conclude that the latter volume was written not for researchers but for policy makers. The current attention on ethnobotany and much of the current funding for research in this area comes from government agencies and international bodies whose primary agendas are economic, conservation, social and/or political, not scientific. These are legitimate organizations to provide direction for addressing global environmental problems and they are the institutions which have made the appearance of these two books possible. However, the two books illustrate poignantly the importance for policy making and funding to be coupled with the best of science and of academic scholarship, the former by demonstrating what happens when the link is made, and the latter when it is not.

Neither of these books is a definitive statement on ethnobotanical methods; indeed they are welcome in the first instance for drawing attention to the issue. Ethnobotany will continue to thrive as it maintains its broad integrative perspective. The attention coming from the conservation focus provides an opportunity for rising as well as established ethnobotanists to incorporate the best scientific methodologies from all of the sub-disciplines of the field. This will greatly enrich the field and I hope that in a few years the authors of these volumes will be recognized as true pioneers toward this end.

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Amazonian Indians From Prehistory to the Present: Anthropological Perspectives. Anna Roosevelt (Editor). Tucson: The University of Arizona Press, 1994. Pp. xviii; 420. $60.00 (hardcover). ISBN 0-8165-1436-4.

"Amazonia is one of the world's foremost ethnographic laboratories," so asserts Stephen Beckerman, a contributor to this edited volume. Most ethnologists and ethnobiologists would agree. Pioneering researchers, from Holmberg and Steward who worked 50 years ago, to recent investigators, such as Vickers and Balee, have contributed to our knowledge of cultural ecology based on their Amazonian studies. Despite its fragility, much remains to be discovered in this living laboratory.

To many, the Amazon Basin appears as an invariable landscape draped in green, yet it is far from homogenous. Montane forests bathed by clouds form its western boundary. Open-canopied forests and islands of xerophytic savanna veg- etation occur in the East. Fish forage on fruits in the flooded forests of the Amazon and its tributaries. The rainy season may be continuous or it may be interrupted by a distinct dry period. This varied landscape supports an abundant biota and an equally impressive cultural diversity.

Amazonian Indians examines this cultural diversity in 17 chapters by many prominent Amazonian anthropologists, including researchers from Venezuela and Brazil. In chapter 1, Anna Roosevelt, who also edited the book, argues that Amazonian floodplain societies were more complex than previously thought. These cultures attained a degree of specialization more similar to highland and Meso-American cultures than to extant, acephalous horticultural bands. Roosevelt begins with a description of the Amazonian physical environment and then examines pre-historic cultures from early foragers to horticulturalists and finally to the chiefdom societies.

A major thesis of Amazonian Indians is that surviving cultures differ significantly from pre-contact ones. Darrell Posey, in his usual candid and refreshing manner, states the theme clearly when he writes, "Modern indigenous societies probably bear little resemblance to their pre-contact antecedents." (p. 271) Examples supporting this thesis occur throughout the text. Today, manioc and plantains are the dominant starches in the region but Roosevelt claims their importance is a post-contact phenomenon. Plantains, introduced from the Old World, replaced other staples but even manioc may be more widely cultivated than during the pre-contact period. Neil Whitehead develops this idea further in the second chapter, noting that the use of seed and tuber crops, other than manioc, was far more common than modern ethnographic data suggests. In chapter 8, Beckerman echoes the same sentiments, claiming that Amazonians have switched from animal to vegetable and back to animals as prime protein sources, during the past 2,000 years. These arguments refute the purely adaptational view of Amazonian societies. As Roosevelt notes, "the present-day Indians' cultural and ecological patterns cannot be explained as simply adaptations to the environment. Their changing interactions with other societies must also be taken into account." (p. 9)

Adelia De Oliveira (chapter 5) describes deculturation and destabilization in the Brazilian Amazon, noting the following changes for Amazonian peoples: 1) loss of territories, 2) destabilization and deculturation, 3) demographic decline, 4) substitution of tribal rule by secular rule, and 5) biological maintenance assumed by colonists. The latter is particular interest to ethnobiologists. Do colonists recognize crop genetic diversity developed by indigenous people and are they effective at maintaining this biological richness?

In chapter 6, Warren Hern argues against the universality of one of De Oliveira's principles. He writes, "at least some Amazonian populations are experiencing high fertility and rapid population growth, whereas others have become extinct or nearly so." (p. 131) This is certainly true in Ecuador. Populations of several indigenous cultures hover around 1,000 while the Shuar and lowland Quichua speakers have a combined population of nearly 100,000

Darna Dufour (chapter 7) discusses diet and nutrition of several indigenous groups and notes that non-domesticated food plants are not well-studied. Her observations suggests the need for further collaboration between ethnobiologists and medical anthropologists. Native South Americans societies recognize hundreds of non-domesticated food plants but the caloric and nutritional contribution of these wild plants is virtually unknown.

Just as the flora and fauna varies throughout the Amazon basin, so do the cultures. Philippe Descola (chapter 9) and Pita Kelekna (chapter 10) argue that the Achuar of Ecuador, in contrast to the floodplain societies, have experienced little cultural change in the past 500 years. This contrasts strongly to the closely-related, parapatric Shuar. Kelekna asserts that Achuar warfare and dispersed settlement are pre-contact in origin. Descola also warns of the disruptiveness of market economies which have changed the Shuar and now threaten the Achuar.

In chapter 12, Posey examines pre- and post-contact Kayapó resource utilization. He notes that following European colonization, the Kayapó depended more on semi-domesticates. These species, found in war gardens, forest fields, trail-side gardens and apàte escaped notice of most investigators, as they represented novel forms of resource management. William Balée and Denny Moore (chapter 16), shift the focus when they discuss Tupí-Guaraní taxonomy. They show that the retention of a plant name is affected more by the name's type and cultural practices associated with the plant than by the plant's cultural importance. All those who have read Berlin's (1992) seminal treatise on ethnobiological classification should examine this chapter. It is an important contribution to the literature on folk taxonomy.

Amazonian Indians contains some minor errors or misleading statements. The Ecuadorian Amazon is not "blanketed with soils developed from nutrient-rich volcanic ash" as claimed by Roosevelt (p. 2). Soils are richer than in most parts of Amazonia. Hidrandepts (volcanic soils) occur along the Andes but acidic dystropepts occur in the west. Figure 1.1, which lists lowland groups in South America, is incomplete. The Awá, Chocó and Emberá from western Colombia are not shown nor are the Shuar and Kofán from Amazonian Ecuador. The preferred self-designation term is provided for some cultures (e.g., Runa and Waorani) but not for others (Cayapa who call themselves Chachi and Colorado who call themselves Tsatchila). Hern states that the Jívaro use sacha mangue as an abortifacient but does not cite the source of this data. Sacha mangue is a Quichua name for Grias peruviana. The Jivaroan name is apai (Bennett in press). Some information is contradictory. Did humans first enter the Amazon 10,000 (p. 124),11,000 (p. 3),12,000 (p. 1) or 14,000 years ago (p. 97)? Is the current indigenous population of Brazil 160,000 (p. 102) or 200,000 (p. 114)?

Although its title may imply otherwise. Amazonian Indians is not a handbook of Amazonian indigenous people but it is an important treatise that clearly shows existing cultures do not necessarily represent their pre-contact predecessors. All anthropologists and ethnobiologists with interest in the Amazon will enjoy this book.

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NOTICE TO AUTHORS

The *Journal of Ethnobiology*'s revised "Guidelines for Authors" appears in this issue on pp. 124. If you need a copy of these Guidelines you may request a copy from the Editor. Careful scrutiny of recent issues of the *Journal* should provide appropriate stylistic models for any manuscript you may wish to submit.

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JOURNAL OF ETHNOBIOLOGY

Mimbres Trapper

Volume 16, Number 2 Winter 1996

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ISSN 0278-0771

FRONT COVER The new *Journal of Ethnobiology* cover will feature a figure or photograph from one of the articles in that issue. The former cover piece will remain as the *Journal's* logo. It represents a split-twig figurine, made of squawbush (*Rhus trilobata*) or willow (*Salix*). Split-twig figurines appeared as a cultural trait in the American Southwest about 2000 B.C. among Archaic hunting and gathering populations in the Grand Canyon area of Arizona. They have also been found in Utah, Nevada, and California, and are thought to have had some magical/religious significance concerning hunting practices. For more information on these figurines see an *American Antiquity* article by Alan R. Schroedl (1977, Vol. 42(2):254-265). **COVER ILLUSTRATION:** Eleventh century Mimbres pottery motif depicting a man trapping birds, redrawn by Shaffer *et al.* from Fewkes (1989) and Brody 1977.

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CONTENTS

ETHNOBIOTICA

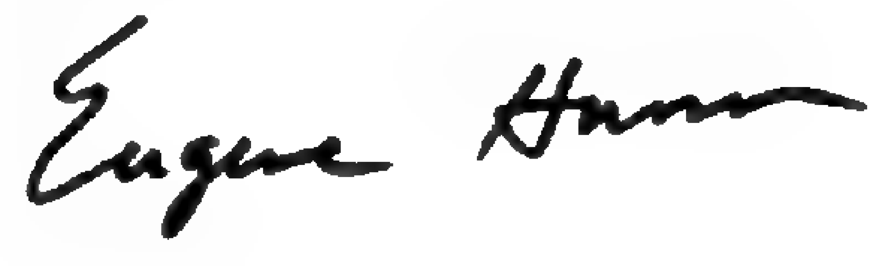
This issue is later than I would have wished due to the added complexities of putting it together at a distance, as I'm in Oaxaca, Mexico, in the midst of field work while my office is in Seattle, Washington. Special thanks are due my editorial assistant Jennifer Sepez for keeping things more or less on track during my sabbatical. She is also responsible for the ten-year index that appears in this issue. Thanks also to Tom Murphy and Brian Van Hoy who helped Jennifer with this issue. Brian will be taking over much of the work of coordinating my office as Jennifer dedicates herself to her dissertation research on Native American whaling, funded by a generous award from the E.P.A.

I'm six months into my two-year Zapotec ethnobiology project in San Juan and San Pedro Mixtepec, Oaxaca. I'm struggling to get the hang of a new language, Mixtepec Zapotec, which distinguishes more than 100 vowel phonemes, if one counts all the permutations of six vowel positions, four tones, simple and glottalized variants, and glides. My entry point into the language has been the local environmental vocabulary. To date I have recorded over 600 distinctly named plant categories and some 300 for animals, and there's surely more to come. The challenge is to position myself between Western biologists who "know" a particular species and local Zapotec biologists who know the same species, juxtaposing their perspectives, their particular ways of knowing that species. Of course, neither Western nor local biologists agree entirely among themselves, so one must carefully sort out the variant classificatory perspectives and nomenclatural preferences in current fashion in both cultures. This exercize will be repeated thousands of times in the course of this project, using living organisms *in situ*, prepared voucher specimens, photos, video clips, and verbal descriptions in Zapotec, Spanish, and English. I'm putting together a multidimensional jigsaw puzzle, and it has the same obsessive fascination as that task. It can be very hard to put the puzzle aside long enough to get caught up with my editorial duties.

What has most impressed me so far in this work is the extraordinary persistence of this local Zapotec environmental knowledge passed down through nearly five centuries of Spanish and Mexican colonial and national experience. For example, in the Cruz Hernandez family of San Juan Mixtepec, the mother, grandmother, five daughters (ages 10–27), and two granddaughters (ages four and five) live and work together tending their milpa and their domestic animals, while the father is frequently away on trading trips to the coast. All speak fluent Zapotec and all but the mother and grandmother are also fluent in Spanish. The four youngest attend school but help out afternoons and weekends. Justina, the 15-year-old daughter, collects plants for my project. I am constantly amazed as they review their most recent collections with me: 10-year-old Mari Elena is likely the first to name the plant and eagerly demonstrates how to apply a particular leaf to remedy some particular ailment. Five-year-old Lilia knows many of the names as well. Occasionally, Justina will send her niece to the kitchen to seek confirmation of a particular name or use from her mother. They all show the same alert fascination for the insect specimens we bring by for naming.

I am grateful for these opportunities to share my own fascination with the diversity of nature with that of the Cruz Hernandez family. Nurturing the human capacity to appreciate biodiversity, so evident in this Zapotec family, is ultimately what the Society of Ethnobiology is all about: E. O. Wilson calls it *biophilia*.

Yours,



From A. Miller, *The Wall Paintings of Teotihuacán* (1973).
Drawing by Felipe Dávalos G.

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Leslie A. Brownrigg is a Social Science Analyst with the Department of Commerce. A Columbia University Ph.D. Anthropologist, Dr. Brownrigg applies ethnographic methods to censuses for the Statistical Research Division and the International Programs Center. Through long term field work and designing rural development projects, Dr. Brownrigg has researched and advocated the knowledge and management of living resources held traditional among native Andean and tropical forest cultural communities in Peru, Ecuador, Bolivia, Colombia, and Belize.

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CAROL VENTURA

Carol Ventura was a Peace Corps volunteer in Jacaltenango, Guatemala from 1976–80. She returned again in 1986 for her doctoral research. Carol earned a Ph.D. in Art at the University of Georgia in 1989. Her dissertation was recently published under the title *Mayan Hairsashes Backstrap Woven in Jacaltenango*, Guatemala, by Yax Te' Press of Ranchos Palos Verdes, California. It focuses on Jacaltec Maya backstrap woven hair sashes, their theory and symbolism. Carol currently teaches Art History and Art Appreciation at Tennessee Technological University.

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PREHISTORIC SMALL GAME SNARE TRAP TECHNOLOGY, DEPLOYMENT STRATEGY, AND TRAPPER GENDER DEPICTED IN MIMBRES POTTERY

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ABSTRACT.—Small game traps have been recovered from throughout much of the American Southwest and Great Basin, primarily from cave contexts where they were stored. Since these traps have not been recovered *in situ* from locations of use, no direct archaeological information has been obtained on prehistoric deployment strategies. Archaeologists have drawn from historic and ethnographic analogy to explain small trap use in prehistoric times. Prehistoric pictorial evidence of trapping technology and strategy, however, was documented in pottery motifs by the American Southwest's Mimbres culture in the eleventh century. These motifs portray the deployment of multiple snare traps to procure multiple game by male trappers. Additionally, trapping activities were probably conducted in conjunction with other hunting activities.

RESUMEN.—Se han encontrado trampas para caza menor en buena parte de Suroeste y la Gran Cuenca de los Estados Unidos de Norteamérica, principalmente en cuevas donde fueron almacenadas. Puesto que estas trampas no han sido halladas *in situ* en localidades donde estaban siendo usadas, no se ha obtenido información arqueológica directa sobre las estrategias prehistóricas de colocación de las mismas. Por ello, los arqueólogos se han basado en analogías históricas y ethnográficas para explicar el uso de trampas pequeñas en tiempos prehistóricos. Sin embargo, los diseños en cerámica de la cultura Mimbres de Suroeste de los Estados Unidos en el siglo onceavo documentan evidencia pictórica de la tecnología y la estrategia de la caza con trampas. Estos diseños muestran la colocación de múltiples trampas con señuelo por parte de hombres tramperos para cazar presas múltiples. Además, las actividades de los tramperos probablemente tomaban lugar en conjunción con otras actividades de caza.

RÉSUMÉ.— L'exploration d'une grande partie du Sud-Ouest et du Grand Bassin américain a permis la mise à jour de pièges à petit gibier provenant principalement de cavernes où ils étaient remisés. Ces pièges n'ont pas été retirés *in situ* de leurs lieux d'usage et, par conséquent, nous n'avons aucune information archéologique directe sur les stratégies préhistoriques d'utilisation. Ainsi, les archéologues ont dû travailler à partir d'analogies historiques et ethnographiques pour expliquer l'usage des petits pièges durant la préhistoire. Toutefois des témoignages picturaux sur la technologie et les stratégies de piégeage nous sont parvenus sous la forme de motifs de poterie. La poterie du 11e siècle provient de la culture mimbres du Sud-Ouest américain. Les motifs montrent des trappeurs mâles déployant de nombreux pièges à lacets dans le but de prendre plusieurs sortes de gibiers. Il semble également que les activités de piégeage aient été menées conjointement avec d'autres activités de chasse.

INTRODUCTION

Trap use has been documented historically and ethnographically as an effective technique for procuring animals of varying sizes (Anell 1960, 1969; Coon 1971; Hudson 1991; Oswalt 1976). This was especially true in the American Southwest and Great Basin, where much of the human-exploited animal biomass consisted of small game. For small game, traps often provided a more effective means of procurement than other hunting methods, such as the use of bows and arrows.

While small game trap use was documented in historic times in western North America (e.g., Beaglehole 1936; Beals 1933, 1943; Bennett and Zingg 1935; Cushing 1920; Kelly 1932; Loeb 1932, 1933; Pennington 1963; Radin 1923; Reagan 1919-1921; Spier 1955; Stephen 1936; Steward 1933), prehistoric use of traps for small game is not as well documented. Most prehistoric Native American traps, such as snares, were made out of perishable materials (hair, plant fibers, or wood) and are rarely preserved intact, unless recovered from dry cave contexts (e.g., Aikens 1993; Cosgrove 1947; Echlin et al. 1981; Elston 1986; Fowler 1963; Guernsey and Kidder 1921; Gunnerson 1959; Janetski 1979, 1980; Kidder and Guernsey 1919; Lambert and Ambler 1961; Loud and Harrington 1929; Morris 1980; Schellbach 1927). Studies such as these provide a range of data about traps, including the types of traps, their antiquity, materials, methods of construction, methods of repair, and storage or caching in caves. When recovered archaeologically, these traps closely resemble those described ethnographically for the procurement of smaller game such as birds, rodents, rabbits, and small carnivores (Beals 1933:349, 1943:16; Bennett and Zingg 1935:117; Fowler 1986:82; Gilmore 1953:153; McKennan 1935:64; Pennington 1963:91-92). Unfortunately, because the traps were recovered from places of storage, little direct contextual information has been ascertained about prehistoric trap use or deployment.

Two studies discussing prehistoric trapping from the West and Southwest inferred that prehistoric trappers probably did not just set individual traps, but also set series of traps in "trap lines" (Echlin *et al.* 1981:65; Janetski 1979:312). This trapping strategy was inferred on the basis of the recovery of numerous bundles of multiple snares from caches in dry caves. The numbers of snares was analogous to ethnographic sources that described using multiple snares in trap lines. New insight into prehistoric trapping comes from southwestern New Mexico in the form of pictorial evidence painted on the interior of Classic Mimbres bowls. These motifs match ethnographic data for trap line use and positively identify the use of trap lines in prehistory.

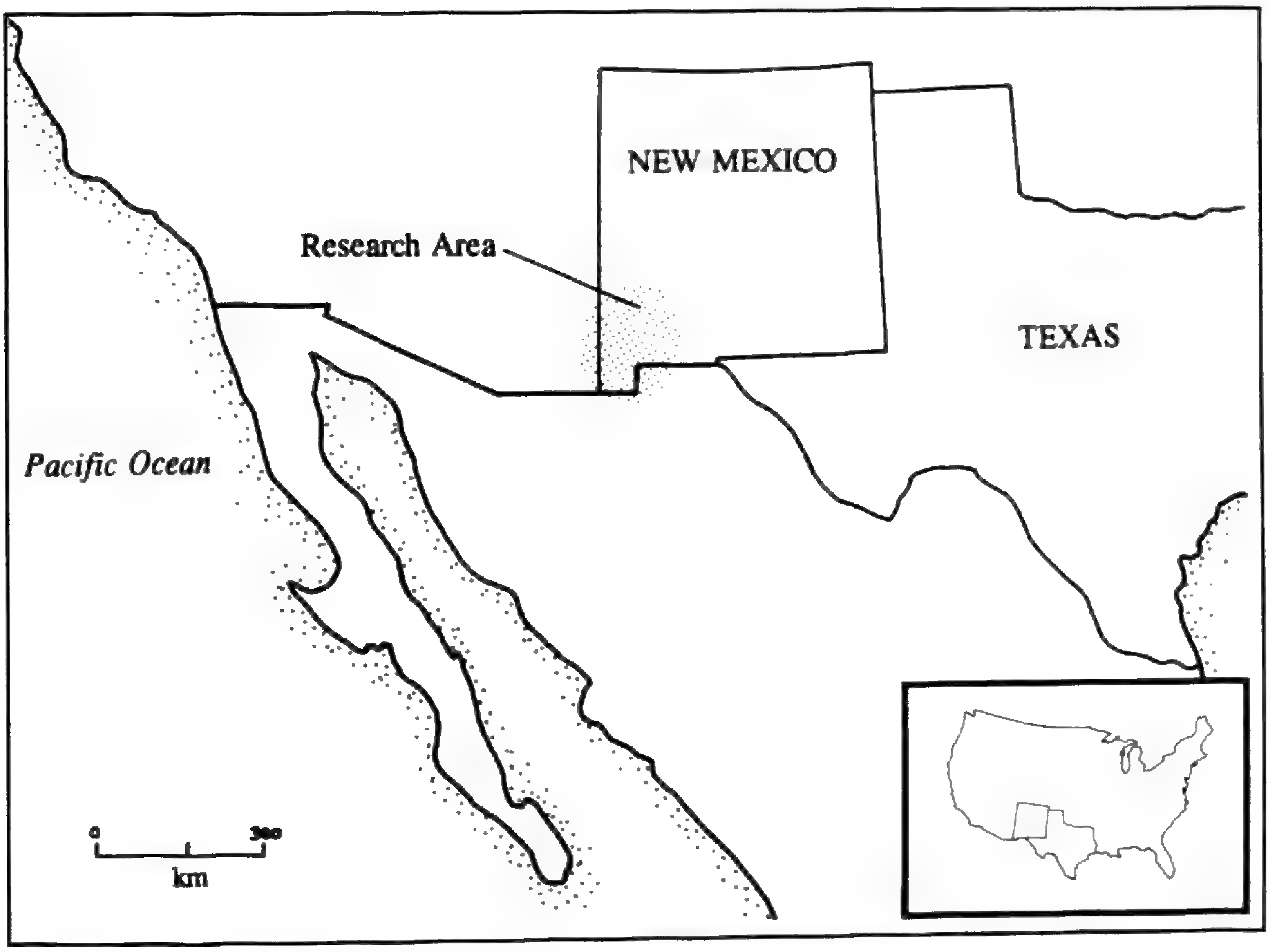

FIGURE 1.—Map of Mimbres region.

MIMBRES OVERVIEW

The Mimbres (A.D. 200 - 1150) were a regional group of the Mogollon, with most of their sites concentrated in the Mimbres River Valley of southwestern New Mexico (Figure 1). During the Classic Period (A.D. 1000-1150), the Mimbres people lived in above-ground pueblo structures and produced much of the pottery for which they are known. By A.D. 1150 the core area of the Mimbres was abandoned and the pottery was no longer produced (Anyon *et al.* 1981; Anyon and LeBlanc 1980; Gilman 1987; LeBlanc 1983a, 1983b:23-33; Shafer 1982a, 1982b; Shafer and Brewington 1995; Shafer and Taylor 1986).

The Mimbres people are known for their elaborate pottery that was painted and decorated with geometric and naturalistic motifs on the inside of ceramic bowls. The naturalistic motifs are often quite explicit, detailed, and provide useful information about prehistoric lifeways by portraying specific tools, activities, ceremonies, and often the sex of the persons portrayed. Many of the motifs compare closely with ethnographically documented daily, seasonal, and ceremonial activities for Puebloan and other Native American peoples (Brody 1977:203-207, 1983:123; Carr 1979:4; Fewkes 1989a [1914], 1989b [1923], 1989c [1924]; Kabotie 1982; LeBlanc 1983a:120-137; Moulard 1984:xxiv-xxv; Shaffer and Gardner 1995a, 1995b; Shaffer *et al.* 1995; Snodgrass 1973:11). The link between the motifs and the ethnographic record is important since many of the motifs portray intangible technology, behavior, and artifactual technologies that either cannot, or did not survive otherwise in an empirically recognizable manner in the Mimbres archaeological record (Shaffer and Gardner 1995a, 1995b; Shaffer *et al.* 1995).

DESCRIPTION OF MIMBRES SNARE TRAP MOTIFS

No Mimbres artifacts have been identified and reported as traps, although most Mimbres sites abound with remains of smaller animals that zooarchaeologists assumed were procured, in part, by trapping (Olsen and Olsen 1996; Powell 1977; Shaffer 1991). Two Classic Mimbres bowls and one sherd (Figures 2-4) depict the use of traps (snares) for the procurement of small game. While Figures 2 and 3 have been previously identified as trapping scenes (Brody 1977, Figure 167; 1983, Figure 98; Crimmins 1930, Plate 22; Fewkes 1989b [1923:7-8], Figure 1), none of the motifs have been synthesized in relation to ethnographic data. Furthermore, not only is information provided about Mimbres snaring technology, these motifs provide insight as to the strategy of deployment, sex of the trappers, and related activities combined with trapping.

FIGURE 2.—Trappers setting snares (redrawn from Brody 1983, Figure 98).

FIGURE 3.—Male trapper, unset, and sprung snares (redrawn from Fewkes (1989, [1923:7-8, Figure1]) and Brody (1977, Figure 167).

Images of traps and trap technology are rare on Mimbres pottery. Figures 2-4 represent the only reported examples from published Mimbres literature or documented among the 5288 Mimbres vessel record cards curated in the Mimbres Archives in the Maxwell Museum of Anthropology at the University of New Mexico. While an uncommon motif, the drawing of all three snare motifs is uniform. For example, all unsprung snares are drawn as a loop on a straight line. All set snares were deployed in "V"-shaped gaps in the vertical lines, possibly representing grass or other wild plants, crops, or fences. The fact that each design motif was drawn similarly in each figure indicates that a common practice and technology are portrayed.

Depicted in Figure 2 are two people who are setting snare traps. Both people appear to be sitting or kneeling and bent over while setting the snares. In the hands of the person at the top of the motif is an unset snare. To the front of this person one snare has already been set (in the "V"-shaped gap in the vertical lines) and behind this person are three unset snares. The vertical lines into which the snares are placed may represent tall grass or other wild vegetation, crop rows (for garden hunting), or possibly a fence to guide animals to the snares (e.g., Crimmins 1930; Oswalt 1976:135; Spier 1955:4).

The person setting the snare at the bottom of Figure 2 appears to be a male. This assessment is made based on the presence of an apparent phallus, and the presence of a hair knot or bun on the back of his head, frequently portrayed on anatomically explicit males in Mimbres pottery. The sex of the person at the top of Figure 2 is not recognizable from the image depicted. By contrast to the male at the bottom of the figure (shown with anatomically and culturally male traits), the person at the top is not shown with such sex or gender traits and therefore could be a female, adolescent, or another male depicted without detail. For example, females in Mimbres pottery motifs are usually depicted with anatomical traits such as breasts or being pregnant, and cultural traits such as string apron sashes (LeBlanc 1983a), baskets, or hair whorls.

Additional implements are present on the right side of Figure 2. At the top right are a bow, two arrows, and an unidentified bilobate object. The bilobate object may be representative of bundled snares which have been recovered throughout the West and Southwest (Echlin *et al.* 1981; Janetski 1979, 1980), or could be a bilobed gourd with a carrying strap. At the bottom right are two more objects, one of which is a sword or staff motif, while the other is an unknown object. The triangular shape in the middle of the bowl in the top row of vertical lines is part of a "kill" hole in the center of the bowl. "Kill" holes may indicate that the bowl was ritually punctured before interment with a human burial (Brody 1977:51-52; LeBlanc 1983a:64; Snodgrass 1973:10). Most of the broken pottery from the "kill" hole was recovered and reconstructed except for the missing triangle.

The result of successful trapping is presented in Figure 3. Brody (1977:203-204) described Figure 3 as a man trapping birds in a garden, although Brody felt the motif may also depict a mythical story. Crimmins (1930:74) identified this motif as a trapper with snares set in the openings along a constructed wattle fence. At the top of Figure 3, a male trapper holds an unidentified object, possibly a feather, in one hand and three snares in the other. At the bottom of the bowl's design are four traps that have been set in the gaps of vertical lines. Three traps are sprung and contain captured birds. A fourth trap remains unsprung. The "X" marks under the snared birds possibly indicate the footprints of the birds.

The group of objects at the top left of Figure 3 includes several items. The two birds depicted may be escaping the snares or may represent dead birds harvested from the snares. The footprints under these two birds appear to belong to the trapper and not the birds. Near these two birds are three additional vertical lines and a bilobate object that was similar to the object described in Figure 2. The circular shape below the trapper is a "kill" hole.

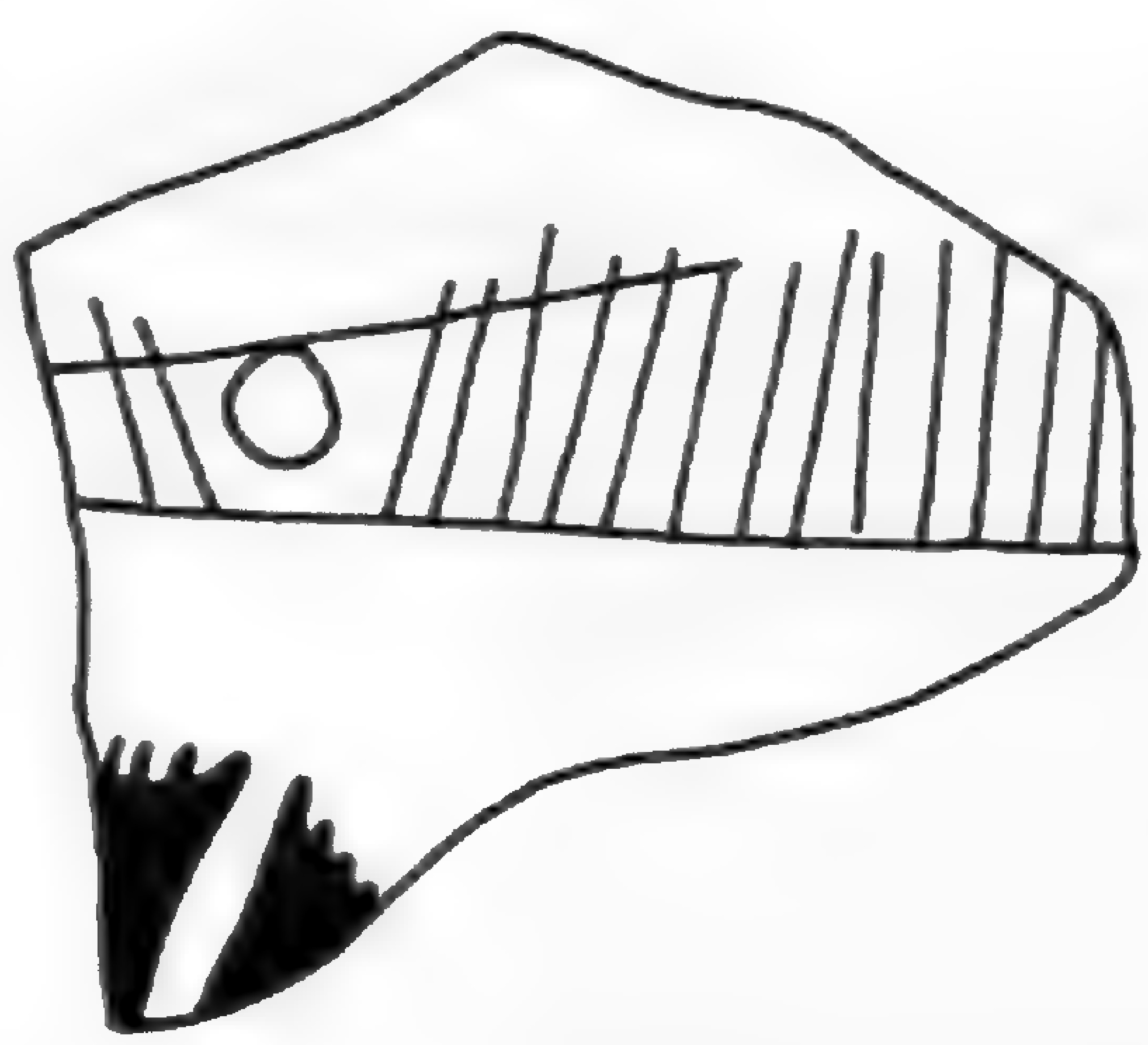

FIGURE 4.—A set snare motif painted on a ceramic sherd recovered from Swarts Ruin (redrawn from Cosgrove and Cosgrove 1932, Plate 232g).

Figure 4 consists of a sherd recovered from Swarts Ruin (Cosgrove and Cosgrove 1932, Plate 232 g). Similar to Figures 2 and 3, Figure 4 shows the vertical lines with a "V"-shaped gap, and a snare placed in the gap. Also shown at the bottom left are two shapes with jagged edges. These may represent human feet and toes, although they could also represent bird tail feathers.

DISCUSSION

In western North America, trapping was documented as a male dominated activity, where multiple traps were set to increase the chances of success (Beaglehole 1936:17, 1937:18; Beals 1933:349; Du Bois 1935:13; Kelly 1932:88; Spier 1928:113; Underhill 1991:63-64; White 1962:301-302), as seen in both Figures 2 and 3. In Figure 2 one male is setting multiple traps with another person (sex and gender undetermined), and in Figure 3 a man is depicted holding three traps in association with four other deployed traps. These graphical Mimbres representations substantiate Janetski's (1979:312) and Echlin *et al.'s* (1981) inferences that prehistoric peoples set multiple traps simultaneously, as has been described historically.

Deployment of trap lines represents a form of sequential multiple predation (Steele and Baker 1993), where the trappers attempt to increase their success and to maximize their bounty by using multiple traps during a single trapping episode. The use of these traps reflects a nonselective hunting strategy where the trapper does not choose the target prey individually in terms of age or sex (Hudson 1991), but apparently is selective in terms of the targeted prey species (in this case, birds). The presence of the bow and arrows in Figure 2 would indicate that snaring was probably combined with other animal procurement activities, such as either selective or opportunistic hunting. Thus, Figure 2 depicts a possible multi-task procurement strategy of both snaring and hunting, as has been documented historically (e.g., Wheat 1967:69-73). If the vertical lines are indeed crop vegetation, then the repeated depiction of snares placed in crop fields would be indicative of garden hunting (Linares 1976; Peterson 1982). Hence, the Mimbres could have exploited game attracted to the fields, thereby protecting the crops while snaring invading animals for food or other uses.

More information can be ascertained regarding trap use and implementation strategies for snaring of animals by the Mimbres from these motifs than if the actual artifacts themselves were recovered. This is because the scenes depicted provide a context of use by humans. While large numbers of traps have been recovered from throughout the southwestern and western United States (noted above), none have been reported from a context of use. As such, the Mimbres motifs provide a unique perspective on these artifacts and their implementation.

There is no way to know if Figures 2-4 are representative of actual events or mythical stories, are sympathetic magic, or have symbolic meanings beyond the empirical imagery. Whichever may be correct, the Mimbres artisan(s) conveyed their message using images of trapping technology. As such, these images allow archaeologists to identify behaviors and technologies of past lifeways that may not have been preserved otherwise. Even so, the symbolism beyond the empirical aspects that was intended by the painters may never be known (Brody 1977:200-210).

SUMMARY

The technology and use of traps to capture small game is well documented historically in North America. Numerous prehistoric examples of traps have been recovered from cave or rockshelter contexts. Little direct information, however, regarding trap deployment strategies has been ascertained from these finds. Three Classic Mimbres painted bowl motifs provide prehistoric confirmation of these trapping strategies and, in one case, additional subsistence information.

Mimbres snare trap motifs depict the simultaneous use of several traps to capture multiple game. This trapping strategy has been described ethnographically and is supported indirectly in prehistory through the archaeological recovery of stored snare bundles suggestive of trap lines. In addition, two of the depicted trappers are identifiable as male. This matches ethnographic accounts and provides the prehistoric documentation of the trappers' gender that has not been substantiated through other archaeological work.

The motifs described here also provide insight into trapping technology, selective and nonselective hunting, and illustrate a method of animal procurement used by the Mimbres. Using archaeological evidence, it would have been difficult to positively identify trap line deployment strategy, the gender of the trappers, or other archaeologically obscure facets of trapping had it not been for the graphic depiction of the events by the Mimbres pottery painters.

ACKNOWLEDGEMENTS

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BOOK REVIEW

Environmental Values in American Culture. Willett Kempton, James S. Boster and Jennifer A. Hartley. Cambridge, Massachusetts and London, England: The MIT Press, 1995. $39.95(hardcover). Pp. xiii; 320. ISBN 0-262-11191-8.

This carefully executed, clearly presented and reasoned study by three anthropologists explores an important domain: shared cultural understandings, or cultural models, related to global warming and other environmental changes in the United States. Attention to the conceptual underpinning of popular American thinking about the environment is critical "as the cultural framework shapes the issues people see as important and affects the way they act upon those issues" (p. 1). Surprisingly, given the participation of members of groups that might be expected to hold divergent views about the environment, the researchers discover that environmental beliefs are broadly shared in American culture. This is true even for those whose livelihoods had been negatively impacted by environmental legislation. Yet, in spite of the overall consensus, when drawn upon existing cultural models, like pollution for example, to make sense of a new, and quite different problems, like global warming, this cognitive strategy has the potential of leading to ineffective policy and actions.

In nine chapters, the authors present the study's rationale and distinctive features of its design; review the survey evidence for increasing environmental concerns in the United States; relate the cultural models for nature, weather and the atmosphere and show how these cultural models contrast with scientific and specialist models; examine fundamental environmental values and their links to other core American values; explore the relationship of cultural models to policy reasoning; present case studies of influential specialists highlighting how individuals shape and remember information to be consistent with their interests; analyze patterns of agreement and disagreement; and address the implications of their findings. The four appendices contain: details on data collection and analysis; background information on informant demographics; the full protocols for the two interview formats used; and case studies of several citizens (which complement those of specialists in the main text).

This book builds upon the previous insightful and meticulous empirical studies of the first two authors and contributes to the anthropological literature in at least four areas: 1) representing the cultural models and values which underlie American environmentalism, a domain hitherto receiving relatively little information from anthropologists; 2) presenting a careful exploration of the extent of intracultural variation by interviewing and comparing groups of people likely to differ, as well as a sample drawn from the general public; 3) understanding cognitive processes and their relation to individual and cultural knowledge; and 4) providing a valuable and detailed methodological exposition of the characteristics and strengths of the research design and analysis.

Decisions made in regard to sample selection may raise questions about the generalizability of the study's findings, given that the choice process contributed to the preponderance of white and middle class participants. However, by juxtaposing findings from more broadly based surveys on environmental issues, the authors provide additional support for their findings while pointing to the underlying differences between their methods and survey methodology.

As the authors address policy issues and articulate the policy implications of their research, this book is relevant to a much broader audience than many anthropological texts. And while the authors adopt a methodologically sophisticated design and approach, both the procedures and anthropological concepts are clearly explained, making the book accessible to anthropologists and non-anthropologists alike.

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ETHNOICHTHYOLOGY OF GAMBOA FISHERMEN OF SEPETIBA BAY, BRAZIL

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ABSTRACT.—We describe aspects of the ethnoichthyology of fishermen from Gamboa, Itacuruçá Island, Sepetiba Bay, State of Rio de Janeiro, Brazil. Ethnobiology includes the study of the folk classification of organisms; thus ethnoichthyology subsumes the folk classification of fish. Fishermen from Gamboa categorize fish by reference to morphological and ecological criteria. We observed an hierarchical system of classification, with fish grouped in ethnofamilies. Following Berlin's framework, the folk taxonomy of Gamboa's fishermen includes fish as a life-form and ethnofamilies as intermediate taxa. The knowledge fishermen have about the ecology and behavior of fish is, for the most part, in concordance with the scientific literature. This important result reinforces the current ethnobiological consensus and may justify the inclusion of local fishermen in management decisions in this priority conservation area, the Atlantic Forest coast of Brazil.

RESUMO.—Este é um estudo sobre a etnoictiologia dos pescadores de Gamboa, Ilha de Itacuruçá, Baía de Sepetiba, Estado do Rio de Janeiro, Brasil. Etnobiologia é o estudo da classificação popular dos organismos e etnoictiologia inclui o conhecimento popular sobre os peixes. Os pescadores de Gamboa identificam os peixes baseando-se em critérios morfológicos e ecológicos. Um sistema de classificação hierárquico, incluindo os peixes agrupados em etnofamílias, foi observado. Segundo a terminologia de Berlin, a taxonomia popular dos pescadores de Gamboa inclui os peixes como "life-form" que inclui etnofamilias como "intermediate taxa." O conhecimento dos pescadores sobre a ecologia e comportamento dos peixes está, em grande parte, em concordância com a literatura científica. Estes resultados são importantes pois reforçam a literatura a literatura corrente em etnobiologia e podem contribuir para a inclusão dos pescadores em decisões de manejo para uma área prioritária para conservação, como é a costa da Mata Atlântica.

RÉSUMÉ.—Cette étude porte sur certains aspects de l'ethnoichtyologie des pêcheurs de Gamboa, Île d'Itacuruçá, Baie de Sepetiba, État de Rio de Janeiro, Brésil. L'ethnobiologie inclut l'étude de la classification populaire des organismes et, par conséquent, l'ethnoichtyologie subsume la classification populaire des poissons. Les pêcheurs de Gamboa classent les poissons à partir de critères morphologiques et écologiques. Un système hiérarchique de classification comprenant des poissons classés en ethnofamilles a été observé. Suivant la terminologie de B. Berlin, la taxinomie populaire des pêcheurs de Gamboa comporte une 'forme de vie' poisson qui comprend elle-même des ethnofamilles comme 'taxons intermédiaires'. La connaisssance que les pêcheurs ont de l'écologie et des mœurs des poissons correspond, en grande partie, à celle des scientifiques occidentaux. Il s'agit là d'un résultat important qui renforce le consensus ethnobiologique actuel et qui peut justifier la participation des pêcheurs locaux aux prises de décisions administratives dans des régions de conservation prioritaire comme la forêt atlantique côtière du Brésil.

INTRODUCTION

Ethnoscience includes the study of the perceptions, knowledge, and classification of the world by different cultures. Most ethnoscience research has dealt with specific domains, such as folk medicine, color categories, and plant classification (Garbarino 1977). Ethnobiology refers to the study of the perceptions that different peoples have of living organisms, in particular, how they classify those organisms. According to Simpson (1962), systematics is the scientific study of the morphology, diversity, and relations among organisms and includes their assemblages or groups and related nomenclature. The analytical part of systematics is called taxonomy (Vanzolini 1992). Berlin (1992) proposed about a dozen general principles for folk biosystematics, which include the proposal that categories of organisms will be of varying degrees of inclusiveness and that these ethnobiological categories may be assigned to one of Berlin's universal folk taxonomic ranks, that is, unique beginner, life-form, intermediate, generic, specific, or varietal.

Different groups or communities may classify organisms using different criteria, but apparently there are some universal aspects in the classification processes. Organisms may be grouped according to habitat, such as among the Menináku Indians (Costa 1988), or according to their occurrence and feeding behavior (Silva 1988), in addition to their morphology. Classificatory systems may include more than one system, as shown by Marques (1991), which identified hierarchical (with inclusive categories), sequential (with serial orders following some criteria), concentric (including focal species), and cyclic (based on different stages of development) systems of fish classification among fishermen from the state of Alagoas, Brazil. These classificatory patterns were used together as coexisting systems.

In Brazil, pioneering ethnobiological studies were carried out by Posey (1981, 1983, 1986) on the ethnoecology and ethnoentomology of the Kayapó Indians (in the north of Brazil). Studies of Brazilian ethnoichthyology include riverine fishing communities (Begossi and Garavello 1990) and maritime communities (Begossi 1989; Begossi and Figueiredo 1995; Marques 1991, 1994). These studies have shown the deep knowledge fishers have about the taxonomic relations, ecology, and behavior of fish species. Marques (1991), in particular, documents a very detailed Brazilian ethnoichthyological system.

In this study we describe aspects of the folk taxonomy of fishermen from Gamboa, including attributes used in classification of ethnoichthyological families and the feeding behavior and habitat preferences of fish species. Nine ethnofamilies of common occurrence—which were mentioned by most or all fishermen interviewed—are analyzed. At Gamboa "fish" is a life-form which includes ethnofamilies as intermediate taxa, following Berlin (1992).

THE COMMUNITY OF GAMBOA

Gamboa is a community of 26 related nuclear families that live on Itacuruçá Island, Sepetiba Bay, State of Rio de Janeiro. The importance of Gamboa is both ecological and cultural, as it is the last fishing community remaining on this coastal island of 8.3 km^2 (see Figures 1 and 2).

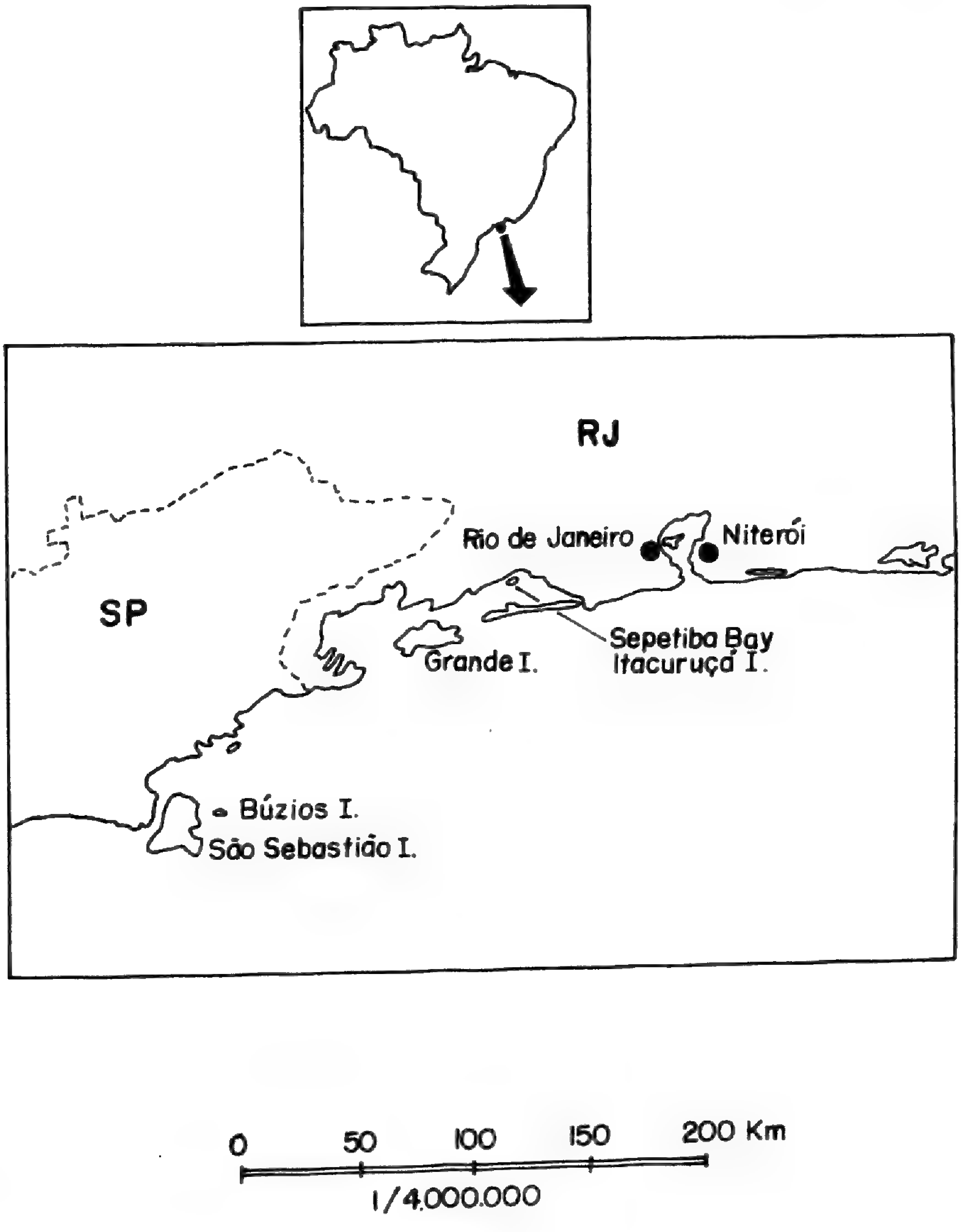

FIGURE 1.—Map of the region within Brazil.

On Itacuruçá Island, as in other major islands of Sepetiba Bay, there are many houses owned by non-residents such as tourists and high income families from the city of Rio de Janeiro. Tourism is vigorously promoted. There are many tourist hotels on the so-called Green Coast ("Costa Verde"), which includes areas of the Atlantic Forest as well as islands in the bay.

FIGURE 2.—Itacuruçá Island.

Itacuruçá Island includes about 50 fishermen's houses, representing 21% of all the houses (Hoefle 1989). Temporary residents own the majority of the island's houses. Gamboa has survived as an artisanal fishing community on Itacuruçá probably because of its location next to a mangrove forest, an area usually avoided by tourists. Most Gamboa residents (33 out of 45) were born here. Illiteracy (including functional illiteracy) is relatively low (26%) compared to other communities and to other Brazilian rural areas (Begossi 1992a). Illiteracy is in general lower in the more developed southeast of Brazil than in other Brazilian regions. Gamboa literacy rates are high compared to those of more isolated communities of the Atlantic Forest coast, such as Búzios Island, where 53% are illiterate (Begossi 1996). Economic activities at Gamboa are essentially fishing, tourism, and some agriculture.

Fishing is performed in paddled or motorized canoes, often using small encircling nets with 30 mm mesh for shrimp and fish (see Figure 3). Marine animals commonly consumed or sold by families are shrimp (*Pennaeus schmitti*), *corvina* (*Micropogonias furnieri*), *pescada* (*Cynoscion* spp., among others) and *paratí* (*Mugil curema*). Marine animals are very important in the diet of families from Gamboa, representing about 67% of the meat consumed.

PROCEDURES

This study is part of a larger study conducted from 1989 to 1991 on fishing and fishermen of Sepetiba Bay, including fishing strategies and fishing techniques, diet, and information on ethnobotany (Begossi 1991, 1992a; Figueiredo *et al.* 1993). In this previous fieldwork, 66 fish species (corresponding to 73 "folk species" or ter-

FIGURE 3.—Gamboa fisherman.

minal folk taxa) were collected from fishermen during fishing trips (Begossi and Figueiredo 1995). This fish collection is just a partial representation of the diversity of fish in the region. Fish were identified based on keys by Figueiredo (1977), Figueiredo and Menezes (1978, 1980), and Menezes and Figueiredo (1980, 1985). The ethnoichthyological aspects of this study were recorded primarily from subsequent interviews with local community members, since most fish had been collected and identified earlier in the study (Begossi and Figueiredo 1995).

After interviewing all adult members of the community and collecting data on diet and fishing, we focused interviews on specific ethnoichthyological topics. These were completed during several visits in 1990 and 1991. For these interviews we initially included all 11 full-time fishermen of Gamboa. During the study the sample was reduced to 8 fishermen, because some of them subsequently shifted their economic activities from fishing.

Interviews were based on questionnaires that included such general questions as: "How did you learn about fish names?" "What are the relations among fish species (if any)?" "How are they assembled in groups?" We included as well questions on fish diet and habitat. Interviews were conducted at fishermen's houses while fishermen were doing daily tasks, such as cleaning, sewing, or manufacturing nylon nets (see Figure 4).

FIGURE 4.—Gamboa fisherman manufacturing a nylon net.

A second type of interview was performed with 58 cards, each one illustrated with a fish drawing from Suzuki (1986). The cards were organized using random numbers. Fishermen were asked to assemble sets of fish they believe were related, or, according to their own way of speaking, fish of the same "family." We encountered some difficulties employing this method. Fishermen sometimes had difficulty recognizing the fish species illustrated. We attribute this to two factors. First of all, fishermen were not accustomed to fish in just two dimensions. Secondly, there were imperfections or errors in the descriptions of species in the drawings on the cards. The cards used included drawings with insufficient detail and faithfulness. Unfortunately, we recognized these problems only at the end of work, with the help of the Brazilian fish taxonomist J. L. Figueiredo, who critically evaluated the cards used.

FISHERMEN'S KNOWLEDGE: ETHNOTAXONOMY AND ETHNOECOLOGY

Fishermen learned about fish from their parents or from other "old," i.e., experienced, fishermen, as is typical of "vertical" cultural transmission (Cavalli-Sforza and Feldman 1981). Morphological features seemed the most important in characterizing fish, but ecological features were also important. Fish are recognized as such because they have scales, gills, do not have hair, and live, breathe, and reproduce in the water.

The life-form "fish" includes a variety of aquatic organisms, including turtles but excluding moray eels. Moray eels were not considered to be fish by most (nine of 11) fishermen because they are snake-shaped and aggressive, biting like a snake. Since the moray eel ethnofamily is considered more similar in shape to land animals, it is separated from the fish life-form. This supports Randall and Hunn (1984), who noted that the fish life-form may or may not include precisely what biologists consider to be "fish"; that the category is often extended to include cetaceans (see Table 1) and other aquatic animal groups.

Gamboa fishermen utilize an hierarchical classification, including ethnospecies (Berlin's terminal taxa) within ethnofamilies (Berlin's polytypic folk generic and intermediate taxa) and these in the life-form fish. Ethnofamilies are characterized by a variety of criteria, but the most important are morphological, followed by criteria such as the quality of the flesh (e.g., tasteful, strong, white), monetary value (e.g., cheap or expensive), and ecological relations (e.g., schooling behavior, diet, habitat).

Ethnofamilies.—This category was suggested by Marques (1991) when studying fishermen from the State of Alagoas, Brazil. He found, for example, that the family Mugilidae was considered by fishermen to constitute two distinct ethnofamilies (*família da tainha* and *família do curimã*). Silva (1988) also observed that fishermen from Piratininga, State of Rio de Janeiro, were assembling fish into "families." At Gamboa, ethnofamilies are also typically given a name consisting of *família do/da* followed by X, the name of a generic level taxon within the family. Examples include the *família do cação* (shark family) and *família da arraia* (ray family). Berlin (1992) observed that the terms "relative of" or "companion of" were used by Tzetal Maya of Mexico for similar species and that these were called "brothers" or "members of the same family" by the Aguaruna and Jívaro of Peru.

Table 1.—Ethnofamilies of fishermen from Gamboa, Sepetiba Bay, Rio de Janeiro, Brazil, and associated information.

Ethno-family	Ethnospecies	Species Collected[1]	Cards Used in Sorting Task	Ethnohabitat (pg. 166)	Ethnodiet (pg. 166)
Arraia (rays)					
	Arraia pinima	*Gymnura altavela*	*Gymnura*	open sea[2], coast	fish, crust.*
	A. morcego	*Gymnura altavela*	*Gymnura*	open sea, coast	fish, crust.
	A. lixa	*Dasyatis guttata*	*Dasyatis, Raja*	mud, sand	fish, crust.
	A. chita	*Dasyatis guttata*	*Dasyatis, Raja*	mud, sand	fish, crust.
	A. jereba	*Dasyatis guttata*	*Dasyatis, Raja*	mud, sand	fish, crust.
	A. manteiga	*Dasyatis guttata*	*Dasyatis, Raja*	mud, sand	fish, crust.
	A. cabocla	*Rhinoptera bonasus*	card not used	mud, sand	fish, crust.
	A. moitão	*Rhinoptera bonasus*	card not used	mud, sand	fish, crust.
Cação (sharks)					
	Cação viola	*Rhinobatos horkelii*	*Rhinobatos*	open sea	fish
	Cação viola	*R. percellens*	*Rhinobatos*	open sea	fish
	C. aniqui	not collected	*Galeocerdo, Mustelus, Carcharhinus*	open sea	fish
	C. tintureira	not collected	*Galeocerdo, Mustelus, Carcharhinus*	open sea	fish
	Tintureira verdadeira	not collected	*Galeocerdo, Mustelus, Carcharhinus*	open sea	fish
	Tubarão	not collected	*Galeocerdo, Mustelus, Carcharhinus*	open sea	fish
	C. babaqueira	*Rhizoprionondon lalandei*	card not used	open sea	fish
	C. baniquinha	*Rhizoprionondon lalandei*	card not used	open sea	fish
	C. leitão	*Rhizoprionondon lalandei*	card not used	open sea	fish
	Boto[3]	not collected	card not used	open sea	fish
	C. campeba	*Sphyrna tiburo*	*Sphyrna*	open sea	fish
Cobra do mar/ Moréia (eels/ moray)					
	Cobra verdadeira	not collected	*Conger*	mud	fish
	Moréia	*Gymnothorax ocelatus*	*Gymnothorax, Muraena, Ophichtus*	rocky shores	fish
	Caramburú	*Gymnothorax ocelatus*		rocky shores	fish
	Camburupí	*Gymnothorax ocelatus*		rocky shores	fish
	Muçum	not collected	card not used	rocky shores	fish
	Vira-vira	not collected	card not used	rocky shores	fish
Galo (moonfish)					
	Galo	*Selene vomer*	*Selene*	open sea, rocky substrate	fish, crust.
Peixe-porco (filefish)					
	Peixe-porco	*Stephanolepis hispidus*	*Stephanolepis Aluterus*	rocky shores, open sea	algae, crust.
Sororoca/ Cavala (mackerels) (Scombridae)					
	Sororoca	*Scomberomorus brasiliensis*	*Scomberomorus,*	open sea	fish
	Cavala	not collected	*Scomberomorus, Scomber*	open sea	fish

Table 1.—Continued

Ethno-family	Ethnospecies	Species Collected	Cards	Ethnohabitat	Ethnodiet
Badejo/ Garoupa / Mira (Serranidae)					
	Badejo	not collected	*Mycteroperca*	rocky substrate	fish
	Mira	*Mycteroperca acutirostris*	*Mycteroperca*	rocky substrate	fish
	Cherne	*Epinephelus niveatus*	*Epinephelus*	rocky substrate	fish
	Mero	not collected	*Epinephelus*	rocky substrate	fish
Xaréu/ Carapau (Carangidae)					
	Xaréu	*Caranx hippos*	*Caranx*	open sea, coast shores	fish, crust.
	Olhudo	*C. latus*	*Caranx*	open sea, coast shores	fish, crust.
	Xarelete	*C. latus*	*Caranx*	open sea, coast shores	fish, crust.
	Carapau	*C. latus*	*Caranx*	open sea, coast shores	fish, crust.
	Palombeta	*Chloroscombrus chrysurus*	*Chloroscombrus Tachinotus*	coast shores	crustacea
Linguado (flounders)					
	Linguado	*Citharichthys spilopterus*	*Paralichthys*	mud, sand	fish, crust., detritus

*crust.=crustacea.

[1] Begossi and Figueiredo (1995).
[2] Called "*mar grosso*" or "*mar aberto.*"
[3] Boto is a dolphin (Cetacea).

Nine ethnofamilies were readily recognized by all or most Gamboa fishermen (see Table 1). Other ethnofamilies were mentioned by a few fishermen, such as the families of snook, bluefish, and species of *Cynoscion* (Sciaenidae), also economically important groups. Due to the small sample size and limited period of the investigation, we decided to analyze only the ethnofamilies mentioned by most or all fishermen. These were, besides the sharks and rays mentioned, *sororoca/cavala* (mackerels), *galo* (moonfish), *mira/garoupa/badejo* (groupers), *peixe-porco* (filefish), *linguado* (flounders), *xaréu/carapau* (jacks), and *cobra/moréia* (eel/moray). These ethnofamilies are important for fishermen either because they are caught, eaten, and sold (mackerels, groupers, flounders, filefish, and jacks), or because they may be dangerous (rays, sharks, and morays). These results show the importance of utilitarian purposes in terms of the folk classification, as noted by Hunn (1982). Begossi and Garavello (1990) also observed that fishermen from the Tocantins River region of Brazil have a detailed taxonomy based on how fish are used.

Morphological criteria are very important in order to characterize both ethnospecies and ethnofamilies. Presence or absence of scales (*peixe de couro* or *de pele*, meaning "scales absent"), of spines, and the fish shapes are important attributes. For example, the ethnofamily of groupers have spines and scales; absence of scales is noticed for filefish, eel or moray, and rays; while flounders have an unusual shape. Criteria based on taste are exemplified by the strong-tasting flesh of rays and the white flesh of *cavala* (mackerel), groupers, and *galo* (moonfish). In another study nearby on Búzios Island (Begossi 1992b), strong-tasting flesh was linked to fish prohibitions or food taboos, for example, of rays. At Gamboa, rays were mentioned by 78% of 40 adults interviewed as a tabooed food.

Market value, such as the high price of flounders, groupers, and mackerel-like fishes (compared to inexpensive fish, such as rays) were also noted in differentiating fish. Other criteria used are those based on ecological features, such as the observations that mackerels school and have low rates of reproduction; that eels live in the mud; that groupers do not school and live among rocks (*peixes de pedra*); that sharks live in the open sea (*mar grosso*); that moonfish live near the surface while mackerels prefer waters of medium depth. Fish with medicinal (filefish) or ornamental (pufferfish) value were also mentioned. Multiple criteria occur in the folk taxonomy of Gamboa fishermen, as in other Brazilian fishing communities (Marques 1991). Other ethnofamilies were distinguished by reference to fishing practices, as for example: shrimp lures are used for groupers; nets as well as lures are used for sharks; the high speed of moonfish make them difficult to capture; while mackerels show jumping behavior. Besides form and edibility, capture methods were also observed to affect the folk taxonomy of fish among southern Philippine Sinama (Randall and Hunn 1984).

The ethnofamily of morays includes several Western scientific families, such as the Muraenidae, Congridae, and Ophichthidae (see Table 1), all of which are of the order Anguilliformes. Similar results were found by Marques (1991) among fishermen from the State of Alagoas: in that case the ethnofamily was called *mororó* and included the Muraenidae, Ophichthidae, and Gobiidae. Their snake-like shapes seem the primary factor for grouping these species in both communities.

The ethnofamily *xaréu/carapau* includes ethnospecies that are subdivided into named size classes. *Xaréu* are big, *xerelete* medium-sized, and *olhudo* small. However, they are considered to be a single ethnospecies, with different names labeling forms differing only based on size, perhaps interpreted as phases of life-cycle development. In terms of the Western scientific taxonomy, we may be dealing with different species (*Caranx hippos* and *C. latus*). Another example of name differentiation based on size or on developmental stage is for the Mugilidae. *Virote* and *tainha* are also forms of the same ethnospecies: the first is the young and the second the adult of *Mugil platanus*. Marques (1991) also observed, among another group of Brazilian fishermen, systems of classification based on life-cycle development.

Moonfish, a member of the Carangidae, were considered by fishermen from Gamboa to represent a different ethnofamily from the other Carangidae (see Table 1). This monotypical ethnofamily may be attributed to the unusual morphology typical of moonfish.

Some fish were well known to fishermen, but were not classified in any ethnofamily. These were *Hipocampus puntulatus* (*cavalo do mar*, sea horse), *Euthynnus alleteratus* (bonito) and *Oligoplites saliens* (*guaivira*, another jack). These may be cases of "unaffiliated generics" (Berlin 1992). Some ethnofamilies closely correspond to Western scientific families. According to Berlin (1992), intermediate taxa often group folk generics in ways that make good biological sense or correspond to Western scientific families.

Begossi and Figueiredo (1995) reported that at Sepetiba Bay about 20% of the ethnospecies were labeled with binomials. If these correspond to Berlin's folk generics (1992), a low degree of polytypy (11%) was observed, compared to cases cited by Berlin (1992). However, we believe that this original total was an underestimate. We later recognized at least 11 polytypic genera, compared to just six cited by Begossi and Figueiredo (1995): *arraia, bagre, baiacú, budião, cação, cara, corcoroca, garoupa, pescada, paratí,* and *sardinha.*

Ethnohabitat and Ethnodiet.—Fishermen showed a detailed knowledge of fish habitat and diet (see Table 1). Comparing their folk knowledge with the scientific data (Figueiredo 1977; Figueiredo and Menezes 1978, 1980; Menezes and Figueiredo 1980; Moyle and Cech 1982), we observe that local accounts of habitat preferences and feeding behavior of rays, sharks, filefish, mackerels, groupers, and flounders correspond very closely to what is reported in this literature. Filefish were considered by fishermen to live in the open sea or in shallow waters close to rocky shores. Ichthyologists also report that filefish may be found in diverse habitats, from shallow waters to locations far from shore. Local fishermen report that algae (*limo*), mollusks, and crustacea constitute the diet of filefish, which corresponds well with current ichthyological opinion. Other information shows less certain correspondence with the scientific literature. For example, while local reports of the feeding habits of the Carangidae correspond to this literature, reports of habitat preferences do not: Gamboa fishermen consider Carangidae to be open-sea fish, whereas they are reported in the ichthyological literature to inhabit shallow estuarine or coastal waters (with the exception of *Caranx lugubris*, which is found in the open sea, according to Menezes and Figueiredo 1980).

CONCLUSIONS

Some ethnofamilies are considered to be important by Gamboa fishermen because of their economic value, such as the highly priced flounders and mackerels, others because they have medicinal uses, such as filefish (used for bronchitis), and still others because of their common occurrence, such as Carangidae and Serranidae. These observations reinforce a practical view, in a sense that people tend to perceive more detail for the most useful organisms (which might mean those that are consumed, sold, or perceived as dangerous).

In terms of the folk categories mentioned by Berlin (1973, 1992), the folk taxonomy of Gamboa's fishermen includes fish as a life-form that includes ethnofamilies ("intermediate taxa" and/or polytypic folk genera) given the same name as one (or more) ethnospecies included in each family. The grouping of fish in families may be a more general folk classificatory strategy than previously considered, as shown by other studies on Brazilian fishermen (e.g., Marques 1991).

The importance of comparing folk knowledge with Western scientific knowledge is obvious. It is another way of improving that knowledge, as some folk classifications have provided the basis for new scientific discoveries. Marques (1991) noted some examples, such as a catfish (*Arius herzbergii*) called *bagre marruá* from the Lagoa Manguaba, Alagoas, that included mayflies (*Campsurus* sp., Ephemeroptera, "*maripôsas*") in its diet.

A large part of the Brazilian coast includes remnants of the Atlantic Forest which are included in the Man in the Biosphere Program (MAB/UNESCO). The importance of fishermen's biological knowledge should not be underestimated, because it may be valuable for resource management in the region. It has been shown that in adopting certain innovations, local fishermen are aware of both ecological and economic costs and benefits of new technologies, and that this awareness is closely tied to their biological knowledge (Begossi and Richerson 1991). Brazilian fishermen also employ traditional technologies based on their knowledge of organisms, such as the *caiçara* technique (brush parks) by which fish are attracted selectively using branches and leaves of different tree species, a form of native aquaculture (Marques 1991).

Questions that our preliminary results have not yet resolved include the basis for recognition of relations among fish species, defined by local fishermen as fish that are similar to each other but differing in features such as size or taste. The place of the moray eel ethnofamily is also an aspect that needs to be better understood. Morays and other snake-shaped animals were grouped in an ethnofamily separate from the fish life-form.

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THE SYMBOLISM OF JAKALTEK MAYA TREE GOURD VESSELS AND CORN DRINKS IN GUATEMALA

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ABSTRACT.—In both prehistoric and historic America, gourds and corn have often been associated with fertility. This association persists in the highland Guatemalan town of Jacaltenango, where a traditional corn beverage is drunk from a tree gourd (*Crescentia cujete*) vessel. The breast-like shape of the tree gourd vessel symbolizes the breast of Mother Earth, who sustains Jakalteks with her corn milk. This paper documents the tree gourd vessel and corn drink in Jacaltenango and explores Mayan gourd and corn traditions.

RESUMEN.—En América, tanto en la prehistoria como durante el período histórico, las jícaras y el maíz se han asociado frecuentemente a la fertilidad. Esta asociación perdura en el pueblo de Jacaltenango en la zona alta de Guatemala, donde se bebe en una jícara de árbol *(Crescentia cujete)* una bebida tradicional de maíz. La forma de seno de la jícara simboliza el pecho de la Madre Tierra, quien sostiene a los jacaltecos con su leche de maíz. Este trabajo documenta el recipiente y la bebida de maíz en Jacaltenango y explora las tradiciones mayas acerca de la jícara y el maíz.

RÉSUMÉ.—En Amérique, la gourde et le maïs ont souvent été associés aux rites de fertilité. Cette association, qui remonte aux temps préhistoriques, persiste aujourd'hui à Jacaltenango, un village de montagne du Guatemala, où l'on boit une boisson traditionnelle de maïs dans un récipient formé par une gourde (*Crescentia cujete*). Le récipient constitué par la gourde est en forme de sein et symbolise le sein de la terre mère qui soutient les Jacaltèques de son lait de maïs. Le présent travail vise à documenter le récipient formé par une gourde et la boisson de maïs de Jacaltenango et à examiner les traditions relatives à la gourde et au maïs chez les Mayas.

INTRODUCTION

In many parts of the Americas, gourds grow on both vines and trees. The two types of gourds are easily distinguishable because the rind of the tree gourd (*Crescentia cujete*) is much thinner and tougher than that of the bottle gourd (*Lagenaria siceraria*)(Ford 1985:341; Heiser 1979:17, 72; King 1985:76, 77). The bottle gourd is one of the few plants that was known to both the Old and New Worlds prior to the arrival of Columbus and is found in pre-Columbian graves wherever the climate is sufficiently dry or the specimens are charred enough to allow for preservation.

Present archaeological evidence suggests that bottle gourds were cultivated since 7,000 BC, even before the Mesoamerican staples of corn and beans (McClung de Tapia 1992:154; Menzie 1976:9). Since gourds form natural containers with little processing, they were especially important before the invention of pottery. They were also highly prized items of ritual significance, appearing in pre-Conquest tribute lists (Biart 1887:193; Ross 1984:55), and still occupy a prominent position in many native cultures.

Before the Spanish conquest Mexicans received the blood of their sacrificial victims in gourds, Mayas drank from painted gourds similar to ones still made today, and the Indians of Costa Rica and Panama adorned tree gourds with gold. Colonial Spaniards of the sixteenth century trimmed some of their gourds with silver (Heiser 1979:172-174; Menzie 1976:41). Both types of gourds are still popular in many parts of the Americas.

Tree gourds and corn drinks caught my attention when I worked as a Peace Corps volunteer in Jacaltenango from 1976-1980 and again when I returned in the summer of 1986 to do my doctoral research on Jakaltek backstrap weaving. This report is based on my research in Jacaltenango and a literature review.

I will show that the association of tree gourd vessels and corn has religious significance that dates to pre-Columbian times and that this association survives today. Although strong outside forces have tried to erase their culture, the Maya tenaciously cling to their ethnicity. One of the ways that Jakaltek Maya celebrate their heritage today is by consuming traditional drinks from tree gourd vessels.

Jacaltenango.—The Jakalteks have lived in the foothills of the Cuchumatan Mountains in northwest Guatemala since pre-Columbian times (Casaverde 1976:33; Cox Collins 1980:21; LaFarge and Byers 1931:7, 199), occupying an area centered on the town of Jacaltenango. Built on a bedrock plateau overlooking Mexican territory, the town of Jacaltenango is 1437 m above sea level, and has 11 surrounding villages and 31 hamlets located at both higher and lower elevations (Merida Vasquez 1984:276-277). Its advantageous ecological position allows access to a wide variety of highland and lowland products. The principle crops are corn, beans, coffee, sugar cane, oranges, and bananas (Merida Vasquez 1984:277). It is a governmental, religious, and market center and according to the latest available figures, had a municipal population of 18,012, of which 4,967 lived in Jacaltenango itself (Guatemala 1984).

The town's modern name, Jacaltenango, literally means "place of the grass covered huts" (Cox de Collins 1970:133-134). According to my Jakaltek language instructor, José Luis Hernández, the town is referred to as **Xajlah**, or "place of the white rock slabs," in Jakaltek (Popti').[1]

For many years, this area was both physically and culturally among the most remote from Spanish centers in the country (Dieterich *et al.* 1979:25). The 72 km trip from Huehuetenango, the departmental capital, was a rugged two-day excursion through Chiantla, Todos Santos, San Martín, and Concepción (LaFarge and Byers 1931:9-21). In 1974 an unpaved road was built, allowing for bus transportation. I lived in Jacaltenango for 3 years before electricity was brought into town, in 1979.

Because of its relative isolation, many pre-Columbian traditions survived in Jacaltenango. Some of these ancient traditions attracted Oliver LaFarge and Douglas Byers in 1929. Their book (1931), *The Year Bearer's People,* documented the traditional culture of the Jakalteks. According to several of my informants, since that time, Catholic missionaries moved into town and in the 1940s one of the priests tried to purge traditional Mayan religious practices, which forced surviving traditions into hiding.

Gourds in Jacaltenango.—Both vine and tree gourds are cultivated in Jacaltenango. The bottle gourd (*Lagenaria siceraria*) (**tzuh** in Jakaltek and *tecomate* or *calabaza* in Spanish) grows between rows of corn surrounding the lowland villages of Jacaltenango. The vines discourage weeds by providing ground cover and sometimes use the mature corn stalks for support. The Jakalteks harvest the bottle gourds when the vines dry out. The gourds are placed on ceiling rafters over cooking fires until the rinds have completely dried. The smoke from the cooking fires rises and deposits soot on the gourds, which keeps mold from growing on the exterior of the gourds as they dry. After the gourd has completely dried out, the exterior is washed and the rind is cut. The seeds are removed and the inside is scraped clean. The shape of the gourd determines its use. Large round bottle gourds are processed for storing tortillas, long ones for carrying water, and hourglass shaped gourds for canteens. Gourd canteens have a corncob stopper and are carried by looping a cord around their narrow center. Jakalteks say that water stays cooler and tastes better in a bottle gourd than in a plastic canteen. Although in some parts of the Americas bottle gourds are carved or painted, in Jacaltenango they are left plain.

Two types of tree gourds grow in the Americas: *Crescentia alata* and *Crescentia cujete*, both of the Bignoniaceae family (Figure 1).[2]

Only *Crescentia cujete* (**tzima** in Jakaltek and *jícara*[3] in Spanish) grows in the lowland villages of Jacaltenango, near the tree owner's house (Figures 2 and 3). Tree gourds are harvested in Jacaltenango when they are dark green. Sometimes a heavy wind blows them off the tree before they are fully mature. Simple processing transforms the green fruits into drinking cups, dippers, bowls, kitchen utensils, scales (Figure 4), and containers. In some parts of Mesoamerica, tree gourds are ornamented by carving and/or painting.[4] In Jacaltenango, tree gourds are decorated in a style unique to the area; a dark band encircles the middle (Figure 5).

To decorate a gourd in this manner, a rag is tied around the middle of the gourd; the gourd is dipped into boiling water, first one half, then the other. When the rag is removed, a colored band (the original green color of the gourd) is revealed against a darker background. The next day the gourd is cut with a machete, and the inside is cleaned out with a stick (Figures 6, 7, and 8). The gourd is then left to dry for three days. When completely dry, the green stripe turns dark brown while the upper and lower portions of the gourd turn beige. Since gourd products are in demand and few people own gourd trees, the vessels are an economic commodity and are sold locally.

FIGURE 1.—*Crescentia cujete:* A. a branch with leaves; B. the flower; C. the fruit; D. the leaf of *Crescentia alata*. This illustration is by Sylvia Garcia, from *Árboles Tropicales de México,* by T. D. Pennington and Jose Sarukhan, 1968. Courtesy of the Food and Agriculture Organization of the United Nations and the Instituto Nacional de Investigaciones Forestales.

FIGURE 2.—A *Crescentia cujete* gourd tree in a lowland village of Jacaltenango, Guatemala.

FIGURE 3.—A mature 14 cm *Crescentia cujete* gourd.

SYMBOLISM OF THE GOURD IN NATIVE AMERICA

Both bottle and tree gourds play an important role in Native American mythology. Gourds are hiding places for gods and traps for birds. They are used as body coverings and as special containers (Recinos *et al.* 1950:194, 201, 203, 209; Recinos and Goetz 1953:67, 70). Gourd basins are used to bathe kings, and in some myths names like "house of the gourd trees" describe locations (Recinos and Goetz 1953:78, 83).

The tree gourd may be associated with the human skull. In the *Popul Vuh* (Tedlock 1985), a Quiché Maya sacred book, the hero twins Hun-Hunahpu' and Vucub-Hunahpu' crossed a river which flowed among thorny gourd trees. In the underworld, Hun-Hunahpu' was decapitated. At the moment that his head was put in a tree, the tree instantly became covered with gourds. No one was allowed to pick the fruit or go near the tree. A girl, however, disobeyed and went near the tree. The skull of Hun-Hunahpu', which was among the branches, told her that the fruits were skulls and then proceeded to impregnate her by spitting on her hand. Because she was pregnant, she was ordered to be sacrificed and her heart carried in a gourd container.

FIGURE 4.—A Jakaltek woman weighs peanuts with a scale made from two halves of an undecorated tree gourd. She sells these peanuts to passersby from her door step.

FIGURE 5.—Three Jakaltek gourds decorated with a band around the middle with six **chuc'ul** mixing sticks. These mixing sticks consist of a long handle with several prongs on the mixing end.

In a Mayan myth of the Corozal District in Belize, a gourd vessel full of corn drink was set out for divination purposes and a magical gourd tree seed was given to a boy. The seed grew into a gourd tree as soon as the boy threw it down. The tree later helped the boy escape his enemies (Thompson 1930:174-5).

Some Maya believe that Chacs (rain deities) ride across the sky sprinkling rain from a gourd with one hand while holding machete-like lightning in the other hand (Thompson 1970:253-54).

The Aztecs also associated gourds with skulls. According to Lucien Biart (1887), some Aztec rulers fasted and prayed at Quauxicalco ("place of the tree gourds"), a temple filled with skulls (Biart 1887:146).

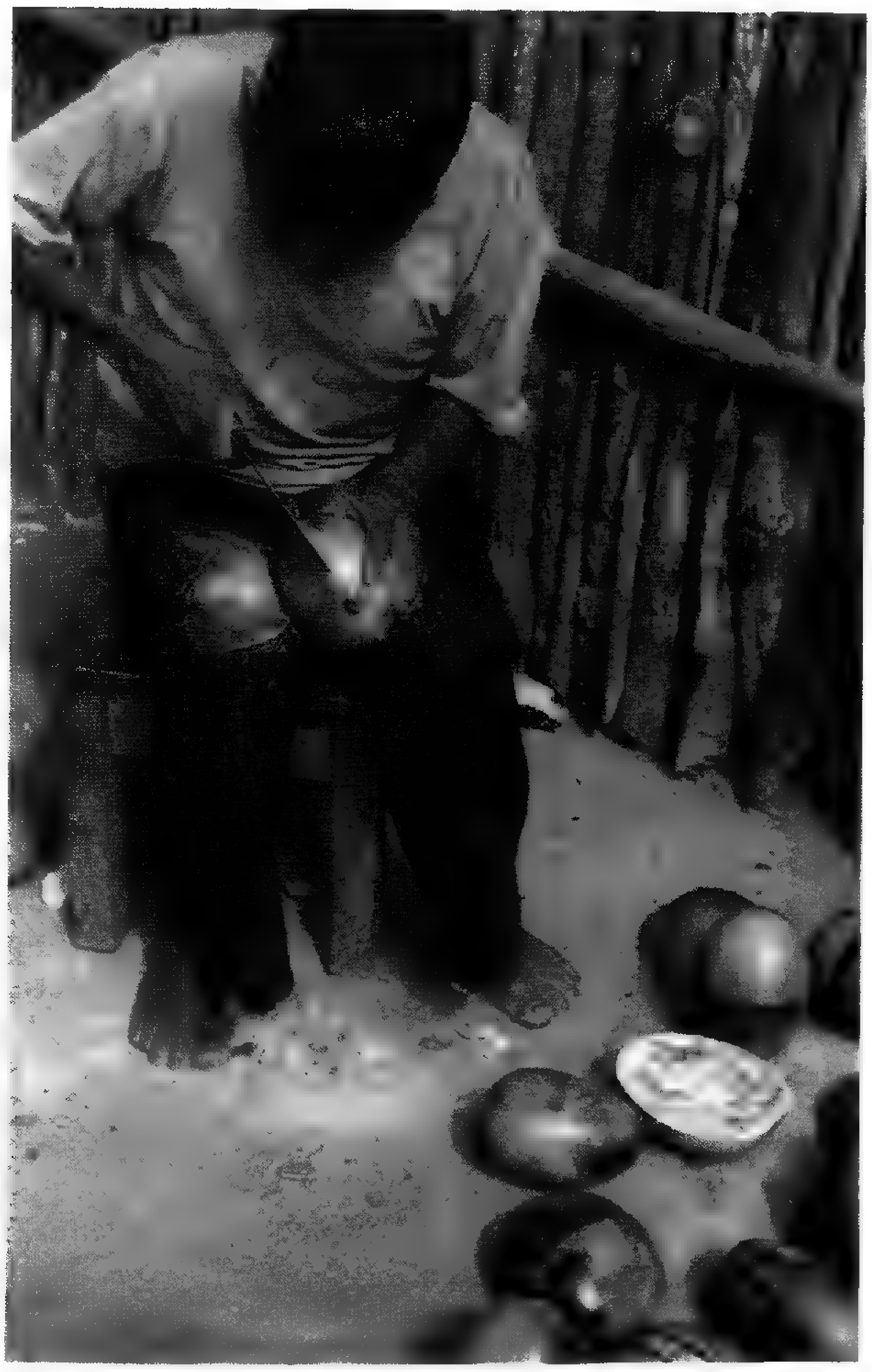

FIGURE 6.—A spherical gourd is cut across the middle with a machete to make two bowls (called *guacales;* Recinos *et al.* 1950:114) while an oblong gourd is cut across the top to create a drinking vessel. Some have been decorated with a band across the middle.

FIGURE 7.—This Jakaltek man uses a stick to scrape the insides and break up the pulp in the gourd. Other decorated and undecorated gourds lie at his feet, in various stages of processing.

FIGURE 8.—As their children observe, this Jakaltek husband and wife team clean the white pulp from tree gourds, some of which have been decorated with a band around the middle.

SYMBOLISM OF CORN IN NATIVE AMERICA

Cultivated corn, which constitutes seventy percent or more of the Mayan diet, springs to life only when man plants it.[5] Corn and man are interdependent since man has to pray for rain and protect it from weeds, wild animals, and insects. Corn is essential to the survival of many Native Americans, so it is not surprising that it plays a prominent role in American mythology and ritual.

The Quiché Maya believe that the first modern man was created from corn. According to the *Popul Vuh,* four attempts were made to create the Quiché. The first Quiché were created from mud. They were fed wood and leaves, but were limp and could not move their heads. They spoke but had no mind, disintegrated in water, and could not stand. The second generation was created without souls or minds. They were made of wood but they did not remember their creators, and walked aimlessly on all fours. Their feet and hands had no strength, they had no blood or substance, and their flesh was dry and yellow. Some were destroyed by a flood and others turned into monkeys. The third generation of Quiché men, according to the *Popul Vuh,* were made of bright red beans, **tzité**[6] (*Erythrina* sp.; Recinos *et al.* 1950:88), and women were made from cattail rushes (*Typha* sp.). Since these men did not think or speak with their Creator, they were killed by a heavy resin that fell from the sky. The fourth and last generation of Quiché, the ancestors of the present Quiché, were created of corn. According to the *Popul Vuh,* the goddess **Xmucané** made nine drinks by grinding yellow corn and white corn, and from this food came man's strength and blood. His arms and legs were made of corn dough. These men talked, saw, heard, walked, grasped things, and were wise (Recinos *et al.* 1950:62, 86, 88-92, 166-169; Tedlock 1985:79, 83-86, 163-167; Thompson 1970:333-334).

A seventeenth century Pocomam Maya birthing ceremony illustrates how a newborn child was psychically united to corn, with one being the counterpart of the other. While praying for his well-being, the child's umbilical cord was cut over a multicolored ear of corn with a new obsidian knife. The knife was thrown in the river after the ceremony. The blood-stained ear was smoke cured and the grain was removed and sown with the utmost care in the name of the child. The yield was harvested and resowed, and the increased yield eaten after a share had been given to the temple priest to maintain the boy until he was old enough to sow his own corn. It was said that thereby he not only ate of the sweat of his brow, but of his own "blood" (Thompson 1970:283-4).

Fray Bartolomé de Las Casas detailed a similar colonial rite which differed in only two respects. The first food the child ate was a gruel made from the first harvest, and some seed was kept so the boy could plant it himself when he was old enough. He then sacrificed the harvest to the gods (Thompson 1970:283).

Thompson (1970) documented this practice among the Tzotzil Maya, where the blood-spattered grains from the ear on which the umbilical cord was cut were sown by the father in a tiny corn field called "the child's blood." The growth of the little crop was carefully watched because it foretold the child's future. The eating of the "blood crop" by all members of the family linked the child to the family. In Yucatec Maya, a youth of marriageable age was known as "corn plant coming into flower" (Thompson 1970:283-284).

The 16th century Cakchiquel Maya believed that people were created of tapir and serpent blood kneaded together with corn (Recinos and Goetz 1953:47).

The corn spirit is feminine. The Kanjobal Maya of San Miguel Acatan call corn the moon and the earth our mother and the three become identified in speech and thought (Siegel 1941:66).

Corn not only influences a child's life, it guards it. Among the Bachajon Tzeltal Maya of Mexico, it is customary to leave an ear of yellow corn with a baby which has to be left unattended so that the child's soul will not be stolen (Blom and LaFarge 1926:360). In Jacaltenango in the 1930s, if a child was left for any reason, an ear of corn of any color was usually placed on each side of it (LaFarge and Byers 1931:80). I was told by local informants that this tradition still persisted in some parts of Jacaltenango in the 1980s

The Jakaltek image of the cosmos envisions levels similar to those reported for other cultures. For example, the Chamulas (and Tzotzil Maya) of Chiapas, Mexico, conceptualize the universe in three levels (Gossen 1974:23, 34). Thompson wrote of the Yucatec Maya that:

> At the four points of the compass or at the angles between stood the four **Bacab** deities who, with upraised arms, supported the skies . . . There were thirteen "layers" of heaven and nine of the underworld . . . a giant ceiba tree, the sacred tree of the Maya, the **yaxche**, "first" or "green" tree, stands at the exact center of the earth. Its roots penetrate the underworld; its trunk and branches pierce the various layers of the skies. Some Maya groups hold that by its roots their ancestors ascended into the world, and by its trunk and branches the dead climb to the highest sky . . . the sky is male, the earth female, and this intercourse mystically brings life to the world. Similarly, light is male, and darkness female (Thompson 1970:195, 196).

Some Nahuas of Mexico also associate corn with blood. They say that people sprout from the earth like young corn plants and conversely, the corn plant is seen as a human body. The roots are its feet and the tassel its hair. Corn is their blood (Sandstrom 1991:240, 241, 255). Among the Cora of west central Mexico, the moon goddess, who is also called "our mother," is goddess of the earth and corn and the sun's wife (Thompson 1970:246).

Examples from outside Mesoamerica.—Native Mesoamericans were not the only Americans to associate corn with the body. Traditional Hopis see the earth as a living entity like themselves. She is their mother; they are made from her flesh and suckled at her breast. Her milk is the grass upon which all animals graze and the corn that has been created for man. The corn plant is also a living entity with a body similar to man's, and the people build its flesh into their own, so corn is also their mother. Their mother appears in two aspects which are often synonymous, as Mother Earth and as the Corn Mother (Waters 1964:7).

Corn is the metaphorical milk for the Hopi and unites the two principles of creation, male and female. Frank Waters (1964) noted that when the plant begins to grow, the leaf curves back towards the ground like the arm of a child groping for its mother's breast. As the stalk grows upward in a spiral the male tassel appears, then the female ear of corn shows herself, at the point corresponding to the halfway span of man's life. The female ear is now ready to be fertilized by the male tassel. The silk subsequently appears and pollen is dropped on the "life line" to mature and season to its fullest expression. When the tassel finally begins to turn brown and bend downward, male and female have reached their old age and the end of their reproductive power (Waters 1964:135-136). They say, "Because we build its flesh into our own, corn is also our body. Hence, when we offer cornmeal with our prayers we are offering a part of our body. But corn is also spirit, for it was divinely created, so we are also offering spiritual thanks to the creator." When a child was born, an ear of corn, his Corn Mother, was placed beside him, where it was kept for twenty days (Waters 1964:8, 135-136).

For some of the Zuni, corn is the severed flesh of seven immortal maidens. Each of the varieties sprouted from one of the maidens: yellow, blue, red, white, speckled, black, and sweet corn (Cushing 1974:36, 42).

Corn drinks and gourd vessels.—Corn preparation in Mesoamerica has changed little since pre-Columbian times. Fray Diego de Landa wrote in 1566 that corn was soaked over night in lime and water, cooked in the morning, then coarsely ground on stones and made into balls and stored. When needed, it was dissolved in a cup made from a tree gourd and drunk. Another drink was made with toasted corn that was ground and mixed with water and chile pepper or cacao. The cacao drink was popular at festivals. Many pre-Columbian paintings and carvings show deities and officials holding carved gourds filled with chocolate, "the drink of the gods" (Osborne 1965:322). Another drink was made of 415 grains of toasted corn (de Landa 1978:34, 63). Although the number of grains in the preparation of pre-Columbian corn drinks was a consideration in de Landa's colonial account, today the quantity is dependent on the consumers' appetite. Sahagún noted similar customs in colonial Mexico (Kiddle 1948:129). Probably because of their connection with Mayan beliefs, in 1552, the Royal Audencia of Guatemala ordered the prohibition of ancient drinks and that the utensils and cups be burned (de Landa 1978:158).

Corn and chocolate drinks became popular with colonial Spaniards, and Mexico and Guatemala were noted for the handsomely designed tree gourd vessels from which the beverages were drunk. The phrase *sacar la jícara* (get out the tree gourd) means "to welcome, or flatter" in Guatemala and Costa Rica. It refers to the indigenous custom of welcoming visitors with a chocolate drink served in a gourd cup (Kiddle 1948:140). These cups were rounded at the bottom. To support them when set down, either a stand especially made for the purpose or a twist of cloth or cotton was used (Standley and Williams 1974:188).

The "drink of the gods" chocolate and corn beverage that was in pre-Columbian times a privilege of the elite, is today enjoyed by all Jakalteks. Besides its popularity at religious festivals, it is consumed routinely by those who can afford the luxury. Every morning, cooked and ground balls of corn mixed with chocolate are peddled door to door. At weddings, engagements, christenings, funerals, and other ceremonies, Christian and non-Christian, gourds are still used to serve ceremonial food and drink, here and in many parts of Mesoamerica (Osborne 1965:322), sustaining and renewing one both spiritually and physically. This custom of drinking beverages in gourd cups is not just ideological, but practical, because it is widely believed that beverages taste better when consumed from tree gourd vessels. The drinks include *bebida* or **pozol** of coarsely ground corn dough mixed with water; **atole** of water mixed with cooked corn dough; *bebida* drunk during fiestas of water mixed with toasted and ground peanuts and cacao with corn dough; a beverage of water mixed with corn and chile; and *batido* of water mixed with corn and cacao (Recinos *et al.* 1950:211).

Along with their corn tortillas, Jakaltek farmers carry a ball of ground corn wrapped in a cloth to the fields. When they need a break, they put the corn in their tree gourd, add water from a gourd or plastic jug, mix the drink with a **chuc'ul** stick (Figure 5), then rotate it to keep the corn suspended in the water.

The ancient association of corn drinks with gourds is documented in a Jakaltek myth: "Their thick necked gourds were empty, and without water they couldn't beat their delicious corn and chocolate drink in their gourd cups" (Montejo *et al.*1984:40). In Jacaltenango, some of the dead are buried with tortillas, an ear of corn, and a gourd full of **pozol** to serve as food for the journey to the underworld. Thompson noticed the same custom among the Maya he studied in Belize (1970:310).

Another Jakaltek Maya myth metaphorically connects the gourd to a woman's breast. To quote: "And our great coin, the cacao, whose nut we ground and took in delicious drinks served in long and bright gourds resembling our woman's breasts" (Montejo *et al.* 1984:8). The breast is that of Mother Earth, who sustains her children with corn milk *bebida* or **atole** drinks. The corn drink is mixed in the tree gourd with a three to five pronged **chuc'ul** stick (Figure 5), then right before drinking, the gourd is rotated in a motion reminiscent of the massaging action that a mother gives her breast before nursing her baby.

Some Mexican people conceptualize the earth as a turtle and according to Recinos *et al.*(1950:222), the Aztec word **ayotl** means both turtle and gourd. In the Quiche Maya book, the *Popol Vuh* the sky was referred to as the "Green Gourd" or the "Blue Bowl" (Recinos *et al.* 1950:78).

South American examples.—The tree gourd also has ritual significance in northern South America, where a Barasana shaman wraps a special tree gourd, that has lumps of bees wax and coca powder inside, in brown bark cloth. Tree gourds are cultivated by men and are their exclusive property. Besides being used as containers for coca, snuff, and beeswax, they are also made into maracas for dancing and the uses are always associated with ritual activities. Bottle gourds are the property of Barasana women and are used in the preparation and consumption of food and drink, both secular activities. In general, Barasana plant products cultivated and owned by men come from above the ground (leaves and bark) and the useful parts of the plants cultivated and owned by women tend to come from below the ground (roots and tubers). This same contrast is found in these two kinds of gourds: men's gourds come from trees while women's gourds come from the vines that trail on the ground (Hugh-Jones 1979b:163-164).

For the Barasana, the gourd is also the Sun, the father of the earth. It is kept wrapped in bark cloth because, as would the sun, it could hurt one's eyes to look at it. The gourd is the sun's head with a feather crown, eyes, eyebrows, a tongue, and a mouth and is kept on a stand because it must never touch the ground. The wax is the shadow of prenatal children and the gourd is the womb (Hugh-Jones 1979b:165-6).

The South American Pira-Paraná also conceive of a three layered universe; a great spherical gourd with the arch as a central horizontal plane (Hugh-Jones 1979a:258). The South American Barasana also compare the sky to a gourd (Hugh-Jones 1979b:167).

The fact that similar beliefs are found scattered throughout Native groups of North, Central, and South America that have little or no contact with one another suggests that this concept is very old.

CONCLUSION

Jakalteks I spoke with preferred the tree gourd decorated with a band rather than plain, but most could give no other reason than, "It is our tradition." A few traditional Jakalteks, however, suggested that the gourd could have religious significance. Most Jakalteks today speak Jakaltek Maya as their primary language and most Jakaltek women wear traditional clothing. The banded tree gourd might simply be an ethnic marker reinforcing distinctions of speech and dress.

One highly educated Jakaltek man suggested the local decoration of the tree gourd symbolized the three levels of the cosmos. This is possible since the gourd is often associated with the earth and the cosmos is divided into three regions by both Christian and non-Christian Native Americas. The three levels of the Mayan cosmos may be graphically represented on the Jakaltek tree gourd; a dark female band running through the middle of a light male sky and underworld. Even the **chuc'ul** mixing stick is symbolic; its three, four, or five points representing the three levels, the four directions, or the four directions with a balanced center, all important Maya religious concepts.

Although clay, plastic and metal cups have replaced the tree gourd in much of America, the strength of tradition and its practical value should assure its survival in Jacaltenango.

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I would like to thank Padre Arnulfo Delgado Montejo, a native Jakaltek, for his linguistic and cosmological insights. This paper developed from a conversation we had in 1986 about the symbolism of the stripe around the Jakaltek tree gourd vessel. His insight encouraged me to organize information that I had gathered during my four year residence in Jacaltenango and to review the literature in both Guatemala and the United States on the symbolism and cultural importance of gourds and corn.

NOTES

[1] Jakaltek is one of 25 Mayan languages spoken today. It is a member of the Kanjobalan branch of Mayan (Day 1973:98). The Jakaltek Maya and their language are now called

Popti' by the Academia de las Lenguas Mayas de Guatemala.

[2] *Crescentia cujete* is a 7-10 m high tree. It has a trunk of up to 20 cm in diameter, long drooping branches, spatula shaped leaves 15-30 cm long, and oval or round fruits 15-30 cm long. *Crescentia alata* is 3-12 m high, has a trunk of up to 50 cm in diameter, thick and sometimes interlaced branches, scaly light brown bark, narrow trifoliate 2-9 cm leaves that form a cross, and round or oval fruit that are 10-15 cm long. Both species are common at altitudes from sea level to 1,200 meters. On some Pacific coast sites of Central America, there are extensive stands of *Crescentia cujete* trees, forming a distinct and characteristic plant association. Although sometimes very large, the fruits are not heavy. The tube shaped flowers bloom only one night and are pollinated by bats (Pennington and Sarukhan 1968: 374-375; Siebert 1940:383-384; Standley and Williams 1974:183-189). This tree was sacred to the Maya because of the cross-shaped leaves. Also, the thorns of the tree were used to draw blood for sacrificial purposes (Thompson 1930:190).

[3] *Jícara* might come from the Nahuatl word, **xicalli. Sik-tli** means navel (Karttunen 1983:323) and **ka'-li** means house or receptacle; the compound translates to "a receptacle having a navel" (Kiddle 1948:123-124; Morales 1978:3).

[4] A negative painting technique is employed in San Bernardino, Guatemala. The gourd is painted with wax (a sun and branch motif is popular), dyed, and then the wax is removed (Morales 1978:4). In Rabinal, Guatemala, gourds are cleaned and dyed with soot and insect wax by women and carved with a pointed tool by men. Others are cleaned and painted with red, yellow, or black oil paints (Morales 1982:3, 4; Osborne 1965:326-331).

[5] I was told by several Jakaltek farmers that uncultivated corn still grows in some areas of Jacaltenango. Although I did not see a specimen, according to its description, the uncultivated corn might be teosinte (*Z. mexicana*)(Galinat 1985:247; McClung de Tapia 1992:148).

[6] Like their cousins, the Quiché (see Recinos *et al.* 1950:88), Jakalteks use **tzité** beans for divination.

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BOOK REVIEWS

Economic Botany Data Collection Standard. Frances E.M. Cook. Kew: Royal Botanic Gardens, 1995. **£15.00** (paper). Pp. 146. ISBN 0-947643-71-0.

Ethnobotanical literature, especially older publications, is rife with vague, uninformative statements like "This plant is used for fever," with no additional information given. Any newcomer to the field must be taught to gather more detailed and precise data. This book, published by the Royal Botanic Gardens, represents a call for standardizing information on the uses of plants, animals, fungi, and other organisms for a wide variety of purposes. Included are extensive tables listing the possible organisms, parts of organisms, materials, products, disease, poisons, etc. An example is included showing how one would report the uses of a particular organism using the standardized format suggested.

I applaud the call for more detailed information in the ethnobiological literature, and the discussion of what types of information are useful. However, the system suggested seems geared toward facilitation of entry of information into a computerized database for purposes of mass-screening. This is a laudable goal as far as it goes, but it is too rigid to allow recording of all pertinent information. The most interesting stories in the literature are instances which do not correspond to any standardized categories. Uses can cut across categories, or represent an anomalous use peculiar to one particular situation. The format in this book contains no information on processing techniques, nor on organisms used in combination with other species, nor on specific ecological factors affecting physiological effects (such as soil type influencing a plant's chemical makeup).

The book's value appears to be in bridging the gap between fieldworkers and those performing mass-screenings. Fieldworkers need to know what types of information would be useful to their laboratory colleagues, and make efforts to ensure that their field data include this information. Screeners can then standardize the data, keeping mind that some of the information will inevitably be lost in the process.

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CATEGORIES OF FAUNAL AND FLORAL ECONOMIC RESOURCES OF THE NATIVE COMMUNITIES OF THE PERUVIAN AMAZON IN 1993

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ABSTRACT.—Categories derived from names for fauna and flora reported on the First Census of the Indigenous Communities of the Peruvian Amazon in 1993 are discussed. Sources of variance and ambiguities, decisions made to prepare coding categories for tabulation and statistical data, and methods used to reference local names for life forms to Latin binomial names are detailed. The words originating in respondents' languages actually reported, the raw frequencies of reports for these terms, and their probable biological references are presented. Some alternative methods are recommended which may permit collection and processing of precise information by overcoming cultural and linguistic differences between local respondents and Western sciences.

RESUMEN.—Se discuten las categorías derivadas de los nombres para la fauna y la flora reportados en el Primer Censo de las Comunidades Indígenas del Amazonas Peruano en 1993. Se detallan las ambigüedades y fuentes de variación, las decisiones tomadas para preparar categorías de codificación para los datos estadísticos y la tabulación, y los métodos empleados para referir los nombres locales de formas de vida a nombres binarios en latín. Se presentan las palabras que fueron reportadas en las lenguas de las personas censadas, las frecuencias crudas de reportes de estos términos, y sus probables referente biológicos. Se recomiendan algunos métodos alternativos que pueden permitir la recopilación y procesamiento de imformación precisa superando las diferencias culturales y lingüísticas entre las poblaciones locales censadas y las ciencias occidentales.

RÉSUMÉ.—Dans cette étude, nous examinons les catégories associées aux noms de plantes et d'animaux rapportés dans le Premier Recensement des Communautés indigènes de l'Amazonie péruvienne de 1993. Nous décrivons les sources de variation et d'ambiguité, les décisions prises relatives à la création des catégories utilisées dans les tableaux et le traitement des données statistiques, ainsi que les méthodes suivies pour établir les relations entre les noms vernaculaires des entités biologiques et les binômes latins. Nous présentons les mots tels que rapportés dans les langues des répondants, la fréquence de ces mots et leurs référents biologiques probables. Nous proposons enfin des méthodes alternatives qui devraient permettre d'améliorer la cueillette et le traitement de l'information en surmontant les différences culturelles et linguistiques entre les répondants locaux et les sciences occidentales.

INTRODUCTION

The First Census of the Indigenous Communities of the Peruvian Amazon collected word lists of faunal and floral resources used in the economic activities of native communities located in the South American tropical lowlands. I report methodological steps, some results, and issues related to defining census categories from answers to questions that elicited word lists from over a thousand linguistically and culturally diverse respondents. The census section on economic characteristics of the native community began with the general question, What activities do the families in the community pursue? ("*¿ Cuales son las actividades a que se dedican las familias de la comunidad?*") Seven types of economic activity were pre-coded as the answers to this question: Agriculture, Fishing, Raising Livestock, Extraction, Gathering, Handicrafts, and Other (See Table 1). If Agriculture, "Collecting," or Hunting were reported then the respondent was asked to specify. The census form had answer lines for up to seven agricultural crops and, for each crop specified, asked whether it was for subsistence, cash sale, or both subsistence and sale. The form had lines for up to five answers for items "collected" and for animals hunted.

Two additional questions, similarly open-ended, collected types of timber and construction material. The question, What varieties of timber are extracted in the community? ("*¿Que variedades de madera extraen en la comunidad?*") requested the respondent to name up to twenty. Another question asked respondents to indicate what type of wood or other material was predominant in the key components of their houses–beams, walls, roof, floor, and so on—and how long the wood or other material lasts. ("*¿En la construcción de viviendas de la comunidad, indique el tipo de madera o material predominante y el tiempo de duración de vigas o largueros? ¿ tijerales ? ¿ cumbreras ? ¿ horcones ? ¿ piso ? ...*")

FIRST CENSUS OF INDIGENOUS COMMUNITIES OF THE PERUVIAN AMAZON

The First Census of the Indigenous Communities was conducted in July 1993 during the enumeration of Peru's Ninth Census of Population and Fourth Census of Housing by the National Institute of Statistics and Information (*Instituto Nacional de Estadística e Informática,* abbreviated as INEI). The Peruvian Amazon was defined geographically by selected rural provinces and districts located in seven regions of Peru (Loreto, Andes Avelino Caceres, Ucayali, Inca, Los Liberatores Wari, Nor Oriente del Marañon, and San Martin). The area defined descends west to east from Andean high cloud forest and grasslands to the Amazon floor. This first community-level census enumerated named settlements legally recognized or eligible for recognition as native communities (*Comunidad Nativas,* abbreviated as CCNN) under Peruvian laws D.L. 20653 and D.L. 22175.

Native communities are corporations of members who belong to one of the 64 Amazonian Indian "ethnic groups" (*etnías*) acknowledged by the Peruvian state. Native communities may own or claim land. Of the native communities enumerated in this first census, about 64% reported they held land titles and another 26% were petitioning for titles to their land. A quarter of the communities reported holding between one and 999 hectares and 17% reported they have no common territory. The mean size of land base reported was 5,267 hectares; holdings ranged from no land to a territory of over 100,000 hectares claimed by one untitled community. The population size of settlements INEI coded as native communities in the simultaneous Ninth Census of Population and Housing ranged from nine persons to 998 (INEI 1993). INEI's preliminary estimate of the total population residing in enumerated native communities was 192,295 persons (INEI 1993). This figure, while interesting, should not be considered as the total population of Amazonian native peoples in Peru in 1993. Since this was a census, INEI sought to interview in all the native communities, however more native communities exist in the Peruvian Amazon than were enumerated and native Amazonians live in other types of rural and urban settlements.

This first census of native Amazonian communities faced cultural and language barriers between the respondents and census enumerators, between respondents and statisticians, and between statisticians and the primary customers for information which were the native communities themselves. The designated respondent for the community report was the recognized political authority who reported for the families of the settlement as a whole. The communities enumerated included speakers of at least 40 highly differentiated languages in the Arawak, Caribe (Peba-Yaguan), Harakmbet, Jivaroan, Panoan, Quechua, Tacaman, Tucanoan, and Wititoan families of languages. The census form was in Spanish. INEI's field staff and native Amazonian witnesses whom I interviewed agreed that most of the census takers were hired in district capitals and conducted interviews in Spanish, using translators if necessary. Although Amazonian ethnolinguistic groups in Peru use Spanish as a general language to interact with those who do not speak their language and about half the native communities reported their members spoke some Spanish, half reported that their members did not speak any Spanish. The native communities that reported their members spoke some Spanish included 37% where Spanish was the second language spoken, 2.5% where it was spoken in combination with two Amazonian languages, and just under 10%, mainly Cocama-Cocamilla or lowland Quichua communities, where Spanish was the first language. Most words transcribed on the forms were in the lexicon of the local Spanish which incorporates words and roots derived from Quechua and other New World native languages into its standard vocabulary.

INEI collected 1,298 original community census reports from 1,175 unique native communities and 123 district neighborhoods of larger, more dispersed native communities. Despite incomplete coverage of native communities, this census provides recent and comprehensive information about rural native Amazonian Indians in Peru. INEI is publishing results from this census in a series entitled *Colección comunidades nativas*. Numbers published by INEI will differ from the frequencies and percentages reported here from the preliminary data set. The tables published by INEI eliminate names of biological resources reported by a minority of the communities and group types of resources. I believe the biological resources reported in the "raw" information collected on census forms are intrinsically interesting for ethnobiology and ecological anthropology.

METHODOLOGICAL CONSIDERATIONS

Censuses and surveys apply methods to gather information from a large number of respondents on the egalitarian assumption that any respondent can answer the questions posed. Respondents' answers are filtered and structured by questionnaire designers, interviewers, interviewer-respondent interaction, and data processing. Census methodologists strive to use terms in questions that elicit defined, precise responses appropriate for the statistical tables and analyses planned. The census method values brief, unambiguous responses from many people on the same subject matter. Statistical categories are routinely defined before census data are collected, often by "pre-coded" answers to "closed" questions developed through research in ethnosemantics (*cf.*, Custred 1980). Information collected in a census (or sample survey) can be validated and analyzed by statistical tests. In the case of a census or a large, randomly selected survey sample universe, a great number of statistical tests can be applied. Patterns can be mapped geographically and documented statistically by tests of significance of cross-tabulations, correlation, regression, trend, and probability analyses.

Table 1.—Number of Native Communities Reporting the Economic Activities and Combinations with or without Agriculture.

Economic Activities	CCNN Reporting Activity Agriculture	Combined Activity with	Not Combined With Agriculture	Without this Activity
Agriculture	1281	NA	NA	17
Fishing	1137	1129	8	161
Livestock	1127	1122	5	171
Hunting	979	972	7	319
Artisanal production	849	845	4	449
Extraction [Timber]	800 [711]	799	1	498
Collecting	547	542	5	751
Other	208	207	1	1090

Notes: CCNN stands for *Comunidades Nativas*. This table shows for each economic activity, how many of the 1,298 communities reported engaging in the activity or did not report the activity.

Optimally, how what respondents say will be translated by coders, editors, and computer programmers into machine-language data sets is tested before the census or survey begins. Well established census methods require time, funding, and expertise that statistical agencies in developing countries lack. In the case of this census, INEI responded to scarcity with creativity. The data in Table 1, for example, is based on a question which defined seven economic activities that INEI designers predicted would be important among the families of native communities and elicited specification of one "other" economic activity. INEI census methodologists conservatively allowed respondents to specify "other" answers to additional questions along with defined categories. INEI left some questions in this first census completely "open-ended" if INEI had no precedent for what answers might be given. These questionnaire design decisions shifted the task of defining statistical categories to INEI's processing and computer center staff after the completed forms were received.

From the point of view of data processing design and statistical methodology, the open-ended and multiple choice questions in this census posed a series of problems, especially considering the relatively small universe of cases. The primary customers for this census were its subjects: the Amazonian native communities. Their associations asked INEI to produce information useful for the native communities themselves. INEI requested help from the U.S. Census Bureau to design the processing and publication tables for this first census of native communities. I was selected to provide INEI with technical assistance. In Lima, I worked with INEI's staff to solve processing problems and simultaneously train and advise INEI colleagues in methodological procedures. In the course of my technical assistance mission, I had the opportunity to examine the original forms and analyze the preliminary data set. I report as a participant interventionist in the creation of statistical categories from the words recorded on census forms that listed faunal and floral economic resources of native Amazonian communities.

Manual coding.—Master coding lists were compiled from the answers to the open ended instructions, "—specify". The lists of agricultural crops, items collected, animals hunted, commercial timbers, materials used in house construction, and others not discussed here, remained open until clerks had hand-coded the forms and keying began. If clerks found a new word written on forms, it was brought to the attention of their supervisor. If the supervisor or INEI's Amazonian consultant recognized the word as a synonym of another already on the master list, the supervisor updated the definition of a data element. If the word was found on only one or two forms, it was assigned to a data element group for "other." If the word was found on several forms, it was assigned a numeric code and added to updated editions of the master code lists issued to clerks.

The master list of biological resources for each economic activity eventually contained between 44 and 86 data elements. Each data element was a numeric key code defined by a single word or a set of words that coders regarded as synonyms. Tables 2-6 show the name or set of names that defined the more frequently reported data elements and percentage of cases respectively reporting each. Clerks wrote the numeric codes on the census forms and these codes were keyed.

The number codes keyed reflected only the order in which new names appeared in the pile of census forms. Definitions existed on in-house data dictionaries annotated by hand and nowhere else. By contrast, for settlements, INEI used a hierarchial code which embedded the region, province, district, and name of each place, and for occupations, used a code issued by the United Nations. INEI's use of standardized codes for geography and occupation permitted data from this first census of native communities to be linked with Peru's 1993 census of population and housing.

INEI required technical assistance to group data elements into a set of progressively inclusive statistical categories consistent with its observations from the Peruvian Amazon and its plan to publish tables. No Peruvian or international standard hierarchial numeric code for biological resources exists, although standard industrial codes in other countries refer to some products of agriculture, hunting, and forestry. Constructing a coding scheme was necessary to design processing and develop tables.

Coding Responses into Statistical Categories.—The steps taken to reduce the number of answers to meaningfully defined statistical categories were to 1) count which data elements were more frequently named, 2) recognize and equate synonyms in different Amazonian languages and in Spanish, and 3) associate vernacular terms with biological references in order to group the biological resources along the lines of scientific taxonomy. I convened a team within INEI to make decisions about the evolving coding and processing design. The team included the supervisor of manual coding, the assigned computer programmer, an Amazonian consultant, a census methodologist detailed to the Computing Center, and myself. Other INEI staff and guest consultants occasionally sat in on discussions of the emerging statistical categories and of test runs using the categories developed. Outside INEI, the Amazonian consultant, an INEI senior manager, and I recruited and met with an advisory panel from several different ethnolinguistic groups studying in Lima.

The task of grouping raw data elements into more inclusive statistical categories began after the manually coded forms had all been keyed. The number of answer categories had to be reduced in order to cross-tabulate by provinces and, separately, by ethnic groups, by river basin, and so on, without an excess of empty cells. Three criteria were progressively applied to construct statistical categories from the data elements that had resulted from manually coding the words actually written on census forms.

Table 2.—Agricultural crops ranked by percent of enumerated native communities reporting agriculture (N=1281) and ranked as first crop mentioned, second crop mentioned, and first and second combined.

Rank by percent	Percent	Local name reported, Associated English Name, Associated Latin Genus and Species	1st Named Rank	2nd Named Rank	1 & 2 Combined
1	88.7	*yuca* cassava or manioc *Manihot esculenta*	1	2	1
2	81.4	*plátanos, paranta, banano, guineo, seda* plantains & bananas *Musa* spp.	2	1	2
3	67.1	*maíz* corn *Zea mays*	5	3	4
4	47.5	*arroz* rice *Oryza sativa*	3	4	3
5	21.1	*maní* peanuts *Arachis hypogaea*	9	-	-
6	17.3	*frijol, ucayali, porotos* **chongo** "beans" *Phaseolus vulgaris* or *P. lunatus* or *P. mungo*	7	-	-
7	14.3	*café* coffee *Coffea arabica*	4	-	5
8	9.5	*cacao* chocolate *Theobroma cacao*	6	-	6
9	7.6	*camote* sweet potato *Ipomea batatas*	NA	-	NA
10	7.5	**sachapapa** yam *Dioscorea* spp.	10	NA	NA
11	7.2	*azucar* sugar *Saccharum officinarum*	NA	-	NA
12	5.8	*piña* pineapple *Ananas comosus*	NA	-	NA
13	5.2	*papaya* papaya *Carica papaya, C. stipulata, C. monoica, C. boliviana*	NA	-	NA

The first criterion was frequency: a computerized count of native communities which had reported each data element using the original keyed data set. Unique data elements specified by at least five communities were preserved for a research data set and those noted by fewer than five communities were targeted for collapse. Some of those frequencies are reported here in tables.

The second criterion was to eliminate remaining synonyms and/or gather infrequently reported names into some logical yet more general categories. Unique terms from Quechua and several different native Amazonian languages augmented what statisticians call respondent variance. The processing team within INEI spoke Spanish and two of us knew highland Quechua, which is related to languages spoken in seven percent of the native communities enumerated, and the Amazonian consultant was a native speaker of the Panoan language, Shipibo-Conibo, which was spoken in 11.2% of the communities enumerated. To determine the meaning of those words for biological resources that no one at INEI understood, I sought advice from experts field biologists and native Amazonians. The Amazonian native people who volunteered their assistance included 10 speakers of the Arahuan (or "Arawak") language, Ashaninka (formerly called "Campa"), which was spoken in 25% of the native communities enumerated; speakers of Jivaroan languages, seven of Aguaruna (spoken in 17.4%) and three of Achual (3.5%); four speakers of Peruvian lowland Quechuas, three additional Conibo-Shipibo, and one speaker of the Harakmbut language, Amarakaeri (spoken in .01% of the communities). The native Amazonians recognized additional synonyms and cognates.

By the time I began meeting with the Amazonian volunteer consultants, I had associated a Latin binomial species name or higher order taxonomic group with most of the vernacular names to design test categories based on biological distributions and ethnographic reports (Brownrigg 1986, Emmons 1990, Encarnación 1983, Soukup 1988, Vasquez 1989, and Vallarejo). These associations were reviewed and expanded in consultations with Peruvian field biologists (see Acknowledgements) and in panel discussions about what fauna or flora each word named among native speakers of different Amazonian languages. They helped clarify what animal or plant the common names referenced, by supplying synonyms, answering questions I structured to eliminate some tentative identifications, elaborating descriptions, and matching names to plates and sketches shown to them.

The third criterion set five percent of the enumerated communities as the minimum threshold for statistical categories to use in testing tabulation. Terms reported by fewer than five percent of the communities, while preserved on intermediate data sets, were grouped into some category where this minimum percentage of cases could be achieved. INEI adopted my suggestion to collect less frequently reported names into more general groupings based on biological similarities.

FAUNAL AND FLORAL RESOURCES REPORTED

Tables 2, 4, and 5 display the percent of native communities that specified the more frequently named fauna or flora. In headings of columns displaying percentages, I state the denominator used. Denominators are either the preliminary universe of 1,298 forms or an eligible population from that universe, that is, the

Table 3.—Rank of varieties of woods by frequency reported used in house construction and rank by frequency reported as commerically exploited.

Local Name Reported, Associated Latin Genus and Species	Rank for House Construction	Rank for Timber Exploitation
pona (*Socratea exorrhiza*)	1	10
huacapú (*Minguartia punctata*)	2	15
despintana (*Xylopia* sp. or *Duguettia* sp.)—Annonaceae	3	18
capirona (*Capirona decorticans*)	4	12
yarina	5	NA
quinilla (*Pouteria* sp.)	6	21
cedro cedar (*Cedrela odorata*)	50	1
moena, moenilla, muenilla (laurel *Ocotea* sp. or *Nectandra* sp.)— Lauraceae	45	2
tornillo (*Cedrelinga catenaeformis*)	47	3
caoba mahogany (*Swientenia macrophylla*) or *aguano* (*Huberodendron* sp.)	NA	4
cumula (*Virola* sp.)	82	5

TABLE 4.—Items collected by percent of communities reporting collecting (N=547), and by percent of enumerated communities (N=1298).

Rank	Local Name Reported	Percent of CCNN Reporting Collecting (N=547)	Percent of CCNN Enumerated (N=1298)	Associated English Name, Latin Genus and Species
1	*aguaje*	41.3	17.4	burutí or mauritia palm *Mauritia flexuosa* or *M. vinifera*
2	*unguravi*	26.1	11	*Jessenia* bataua or *J. weberbaueri*
3	*motelo* ***ñesa/ñusa*** *tortuga de la tierra*	15	6.3	yellow-footed tortoise *Geochelone denticulata* or red-footed tortoise *G. carbonaria*
4	*frutas en general*	12	5	"fruits in general"
5	*pijuajo*	11.2	4.6	peach palm *Guilielma*(or *Bactris*) *gasipaes* or *G. utilis*
6	*chonta*	10	4.2	a palm *Bactris* sp.? *Euterpe* sp.? *Wettinia qunaria*?
7	**suri**	9.6	4	"grub"—see discussion
8	*chapaja*	7.7	-	palm leaves (Arecaceae) *Scheelea cephalotes*
9	*caimito*	6.0	-	star apple *Chrysophyllum cainito*

TABLE 5.—Game specified by 5 percent or more of the communities reporting hunting (N=979) ranked by the percent of hunting communities reporting the game.

Rank by Percent	Percent (N=979)	Local Names Reported	Associated English Name, Latin Genus and Species
1	56%	*sajino, saíno, cerdo,* ***kitaykiri***	collared peccary *Tayassu tajacu*
2	48%	*venado,* ***siwayro***	deer *Mazama americana*
3	47%	*majaz, majas picuno*	paca ***Agouti*** *paca*
4	33%	*añuje,* ***cutpe***	agouti *Dasyprocta fuliginosa* or *D. variegata*
5	29%	***sachavaca****, tapiro*	tapir *Tapirus terretris*
6	23%	***huangana***	white-lipped peccary *Tayassu pecari*
7	19%	*mono negro*	brown capuchin monkey *Cebus apella*
8	15%	*armadillo, carachupi,* ***kirquinco***	nine-banded armadillo *Dasypus novencinctus* giant armadillo *Priodontes maximus*
9	9%	*pava de monte,* ***paujil***	guan (bush or wild turkey *Penelope purpurascen* and/or curassow *Crax mitu* or *Mitu salvini*
10	7%	*perdiz*	"dove" or tinamous *Timamus tao* and others

TABLE 6.—Number of Native Communities Reported Selected Types of Livestock Raised and Animals Hunted.

Livestock Raised	CCNN Reporting	Animals Hunted	CCNN Reporting
Cattle	230	Deer and "***Sachavaca***" (Tapir)	801
Pigs	446	Both Peccaries	779
Turkeys	180	"Pava de monte" (Guans)	91
Chickens	1060	All other reports of birds	161
Other livestock	242	All other reports of prey	1162

number of native communities which, having reported a particular activity, were asked to specify resource details. Tables 2 through 5 show the rank of each of the more frequently reported biological resources by these percentages.

Tables 2 through 6 associate the vernacular names of the more frequently reported fauna and flora written on census forms with probable English common names and Latin names; associations for less frequently reported biological taxa appear in the text. Associating a vernacular name with a Latin binomial for a particular species was not always possible. Words reported for faunal and floral economic resources in this census were taken out of the context of respondents' and enumerators' respective folk classifications. The local Spanish and the several native Amazonian languages each have underlying "ethnotaxonomies" which classify biological taxa differently than do formal scientific systematics. Some terms reported for faunal or floral resources in this census refer to several different species, varying by region. Some names are of intermediate or life form taxonomic rank (Berlin 1992:52-101, 135-139) referring to groups of animal or plant life forms which are formally classified in different orders, classes, genera, or species. These more inclusive terms cannot be associated with a single species. Some terms refer to one species in one part of the Peruvian Amazon and another species in other areas. I omit reference to voucher specimen or authorities because biological taxa were not conventionally identified—no specimens were collected or observed. After the fact, it was not possible to determine what animal or plant the Amazonian respondents and Peruvian census-takers had in mind when the verbal reports were recorded.

Proxies for Importance.—Because each respondent named a limited number of biological resources for each economic activity to characterize a whole community, any biological resource named should be considered important for at least one community. The census did not ask respondents to specify the crops, commercial timbers, items collected, or animals hunted by any criteria, except that census takers did request the most predominant material for house construction. I suggest that rank by the frequency and percent of native communities reporting each biological resource can be interpreted as a proxy indicating its relative economic importance or use in this universe—cautioning, however, possible biases were introduced by cultural preferences or seasonal effects. Cultural preferences could account for the higher frequency rank of prized hunting prey over more quotidian fare. The seasonal effect may favor those economic biological resources salient in July 1993 rather than of other months or other years. "Seasonal effects" are a source of error well documented in consumer expenditure, business, and recreational survey research (Silberstein and Stuart 1991, 1992; Kemsley, Redpath, and Holmes 1980). Ethnographic studies report that particular Amazonian communities cultivate, gather, fish, and hunt different living resources at different seasons following an annual round. (See Meggers 1971:47-49, 58-62, 69-72, 79-81, 89-92, and 101-102 and Lévi-Strauss 1973; among others.) Long term studies of the hunting practices of particular Amazonian native communities reveal variations by season and from year to year as the societies respond to fluctuations in the availability of game by redirecting hunting to other species or other areas (see Vickers 1991; Hames and Vickers 1983; Meggers 1971, Mashinkash Chinkias and Awak Tentets 1986; among others).

Another proxy for relative importance is the order in which respondents spontaneously specified their biological resources. I tested the cumulative number of communities reporting each named biological resource in any order and the number of communities that reported it first, second, or first or second combined and found highly significant correlations. For example, correlations for wood varieties were at .8843 for woods reported first and at .9564 for woods reported second.

Agriculture.—Agriculture was reported by 98% of the enumerated communities (N=1281/1298) which also designated it their important economic activity. Over 60% of the agricultural communities combined agriculture with raising livestock such as cattle, pigs, turkeys, and chickens, and/or with fishing, and/or with the production of artisanal goods. Fewer communities combined agriculture with collecting or hunting or extraction, or "other activities" such as operating river boats, making canoes, and milling rice. Table 1 reports these activities. Less than one percent of the communities reported their members worked in day labor for surrounding colonists. Subsistence activities dominated, although over half of the Amazonian native communities reported cash crop agriculture or commercial timber sales in their mix of economic activities.

Crops. The 1,281 native communities that reported agriculture collectively named crops that were identified as 44 initial data elements. Table 2 lists leading crops ranked by the percentage of communities practicing agriculture and ranked according to the number of communities which named the crop first, named it second, and named it first or second.

It was no surprise to find *yuca* or cassava (*Manihot esculenta*) ranked first, plantains and bananas (*Musa x paradisiaca* and other *Musaceae*) ranked second, and maize (*Zea mays*) ranked third in a census of native communities or that these crops were primarily grown for subsistence. The agricultural crops listed on Table 2 are familiar from previous ethnographic and agricultural studies from the Peruvian Amazon. Yuca, maize, peanuts (*Arachis hypogaea*), and "beans" (mainly *Phaseolus vulgaris*) have been subsistence staples of Amazonian agriculture for thousands of years as have plantains and bananas since their introduction.

The rank of rice (*Oryza sativa*) confirms its contemporary importance and departs from earlier ethnographic and agronomic observations in native communities. Rice was fourth most often reported by the native communities practicing agriculture and third most often mentioned first. Several factors propelled a rapid expansion of rice production among native communities. Several Amazonian native groups adapted rice into their traditional inventory of floodplain (*playa*) crops (Eakin *et al.* 1980; Tournon 1988; Bergman 1990:97; among others); others adopted upland rice cultivation techniques introduced by the riziculture colonists who have been migrating from the Peruvian Pacific coast since the 1960s The rank of rice in relation to traditional Amazonian crops may index native communities' participation in the modern agricultural cash economy; most communities grew rice for subsistence and for sale.

Two crops grown almost exclusively for cash, *café* (*Coffea arabica*) and *cacao*, the chocolate bean (*Theobroma cacao*), ranked seventh and eighth. Coffee ranked fourth as the crop that communities mentioned first, following yuca, plantains, and rice, and ranked fifth as the crop communities mentioned first or second. *Cacao*, a pre-Columbian domesticate and trade good, ranked sixth by the measure of the order it was mentioned and eighth by frequency.

Two traditional subsistence root crop staples, camotes (sweet potatoes, *Impomea batatas*) and ***sachapapas*** ranked ninth and tenth respectively according to the count of communities reporting these crops. No community spontaneously mentioned the sweet potato first and ***sachapapas*** ranked tenth among the crops mentioned first. The term ***sachapapa*** means wild or fake potato in Quechua. The term ***sachapapa*** or "pseudo-potato" is used in the Amazon region to refer to the regional cultivated and wild potatoes and to other non-potato crops. Hawkes (1990) describes 'candidate' cultivated and wild potato species that grow in the Peruvian montaña and Amazon floor. The best known 'wet and hot' potato species, *Solanum hygrotermicum* Ochoa, is named ***moiske*** or ***moshaki*** by the Ashanika or Campa. The name ***sachapapa*** can gloss Amazonian root crops such as *yuca*, however, ***sachapapa*** usually refers a yam in the genus *Dioscorea*, such as *D. trifida* (*ñame*). Sweet potatoes and yams have little market value and ranked below crops primarily grown for sale. Other names for root crops reported were ***uncucha*** (a name for the cocoyam or yautia, *Xanthosoma* sp.), *papa morada* (purple potato = *Solanum* sp.), and ***kuikui*** which may be a cognate of either ***kui*** (*Arracia xanthorrhiza*) or ***kurahiji***, another name for the tropical potato. Altogether, less than one percent of native communities enumerated specified these less frequently reported minor root and tuber crops.

Among the crops reported by five percent or more of native communities are three others that served as a source either for cash or for subsistence food. Only one community reported pineapple first, one other reported papaya first, and no community reported sugar first.

Fruit trees stood out among the 31 additional crops reported by fewer than five percent of the agricultural communities (one to 60 communities). *Naranjo*, Spanish for sweet orange (*Citrus sinensis*) trees, were reported by two percent; *palto*, the avocado or alligator pear (*Persea america* or *gratissuma*), and *pitayo* or *pijuajo*—peach palm—were each reported by 1.9%. *Mandarinas*, which is usually identified with the tangerine (*Citrus reticulata* or a *Citrus* hybrid) were reported by one percent. Fruit trees reported by less than 1% of the communities included *limón* (lemon, *Citrus lemon*), *toronja* (grapefruit, *Citrus paradisi*), ***maracuyá*** (*Passiflora quadrangularis*), *cocos* (coconut, *Cocos nucifera*) and ***anowa, anona***, or *chirimoya*: three names for the fruit, cherimoya (*Annona cherimola* or *A. diversifolia*).

Achiote or *bija*, which is the red colorant dye and food flavoring, *Bixa orellana*, was reported by three percent of the communities. Combining achiote with the fruit trees listed above created an inclusive statistical category that totaled 12% of the agricultural communities.

Other crops reported by less than one percent of the communities were the condiments *aji* or chile pepper (*Capsicum* sp.) and *culandro* or coriander (*Coriandrum sativum*) and the annual field vegetables including *zapallo* squash (probably *Cucurbita maxima* or *Cucurbita moschata*), *pallares* and *habas* (Lima beans, *Phaseolus lunatus*), *sandía* (melon, *Citrullus vulgaris*), and *pepino* (see below). About three percent of the communities said one of their agricultural crops was *vitucos*, which is a general name for a side dish with a variety of ingredients or *hortalizas*, Spanish for salad greens or green vegetables generally. Non-food crops reported included *algodon* (cotton, *Gossypium barbadensis*), tobacco (*Nicotiana tabacum*) and *barbasco* fish poison (*Lonchocarpus nincou*). One community reported coca leaf (*Erythroxylum coca*).

Crop identifications. In the discussions held at INEI, the agricultural crops reported by five percent or more of the native communities were consensually associated with Spanish names that designate a botanical species or genus. The statistical staff (urban consumers) and the Amazonian native consultants (rural producers) shared a core vocabulary for food crops. Differences in the appearance, agronomic or cooking characteristics, or taste of agricultural crops inspire a profusion of primary terms for varieties in Peru, as elsewhere. The manual coding staff had grouped names for bananas (*banano, guineo, seda*) and plantains (*plátanos, paranta*) into a single data element which can be considered as crops in the *Musa* genus. Similarly, the clerks had coded as *frijoles* the regional names *ucayali, porotos*, and *chongo* which may be varieties of the common bean or introduced mung beans (*Phaseolus mungo*) or a *Vigna* species. Additional names for "beans" recognized during the recoding were ***chivango, chuvi***, and ***hundia***. These may be popping beans or ***ñunas*** (*Phaseolus chuvis*—see National Research Council 1989), rather than common beans or mung beans. Additional names for beans and reports of Lima beans were gathered into a single coding category, which is best interpreted as "beans" of some *Phaseolus* species.

The botanic species of the more common, commercial food crops of Peru are known, well researched, and deposited in germ plasm banks (See on-line Harvard University's Gray Herbarium Index of New World Plants or Purdue University's New Crops at the World Wide Web site, http://newcrop.hort.perdue.edu). Several of the crops reported less frequently in this census are not well researched or are not firmly identified botanically. Three crops reported by less than one percent of the communities were not identified—***humbilla***, *tongarina*, and *cantrini*. Botanical associations for three other crop names, each also reported by less than one percent of the communities, are tentative. Is ***huistina*** *Sechium edule*? Is *cocona Solanum topiro*? Is *pepino* the melon pear, *Solanum muricatum* (syn. *Solanum variegatum* and *Solanum guatemalenses*), or the sweet cucumber, *Cucumis sativus* or *Cyclanthera pedada*? These elusive crops reported by very few communities were relegated to an amorphous "other" category.

Timber and house materials.—A total of 711 native communities specified they exploit at least one kind of timber and 888 communities indicated the materials they use to construct houses. A total of 52% of the communities named at least one type of wood used as a house material or exploited commercially. A single code list was compiled from responses to the requests to specify that gave respondents up to 27 chances to name timber. Consequently, 86 terms for varieties of wood exploited commercially or house construction materials were compiled from respondents, a longer list of biological resources than for the more prevalent economic activities.

Cedar (*cedro*), laurel (*tornillo*), and the mahoganies (*caoba* and *aguano*) are sold as logs for export and used to manufacture fine furniture (*Perú. Ministerio de Agricultura*, 1992). According to this first census, these highest value woods of the Peruvian lumber industry are the focus of commercial lumbering activities in native Amazonian communities.

The rank order of commercially exploited varieties of wood had little relationship to the rank order of woods specified as materials used in the construction of native housing. The cases of *cedro* (*Cedrela odorata*) and ***pona*** (*Socratea exorrhiza*) illustrate this point. Cedar ranked first among varieties of wood exploited as timber. Of the 711 communities engaged in commercial lumbering, 585 (82%) reported they exploit cedar. Cedar was the variety of wood named first by 292 of these communities and cedar was nearly five times more often mentioned first than any other type of wood. This indicates either cedar's importance for commercial exploitation or its prestige and value, yet, cedar was reported as a material for any house component by less than one percent of the communities.

Pona (or ***cashapona***) was specified by 85 or about 12% of the 711 communities as a variety of wood they exploit commercially. This placed ***pona*** in tenth place among varieties of timber exploited. ***Pona*** is a wild palm with a thick, dense, woody pith. Only three communities mentioned ***pona*** first and three others mentioned it second when they listed varieties of commercial timbers. However, of the 888 communities which specified the material most predominant used to construct house walls, 593 communities (or 66%) named ***pona***. Of the 709 communities which specified a flooring material, 579 or 81% named ***pona***. ***Pona*** therefore ranked overall as the most predominant wood in native house construction and was the only wood used for construction which ranked among those top 12 commercial varieties which five percent or more of the communities enumerated had specified.

The varieties of wood that ranked highest as house construction materials generally had low ranks as commercial timber. Table 3 displays the inverse relationship between the percentage of wood materials used in house construction compared to timbers exploited commercially. For house construction, plant resources other than timber are important, including materials such as palm fronds or leaves, *caña brava* (which usually refers to one of the false bamboos), and *shapajo* (see Collecting, below). Of the 1032 communities which specified the material predominant in the roofs of houses, 38% reported palm fronds, 11% reported *shapajo*, and 7.5% reported leaves in general. ***Shapajo*** (variant names: ***shapaja, chapaja***) is *Scheelea cephalotes* in the palm family.

Identification of timber woods and building materials. Finding an English common name, Latin name, or a plant family to associate with the vernacular names reported for timber woods and building materials was more difficult than associating the crops and hunting prey. Neither INEI staff nor the native language consultants could identify many of the timber names. I consulted experts who suggested Latin names usually associated with vernacular names for the most commercially important woods. The professional foresters, forestry officials, and field botanists whom I consulted associated less than half the woods reported used in house beams or struts with scientifically known family, genus, or species. Forestry officials expressed interest in what tropical hardwoods, unknown to them, the communities reported endured for decades.

Many more names for timber turned out to be highly generalized folk taxa covering a large number (100s) of species in one or two families than the relatively more particular names for living resources of the other economic activities. For example, *moena* and its cognates, *moenilla* and *muenilla* refer to laurels. The published literature equating vernacular names for South American woody plants with Latin binomials is often contradictory, or perhaps accurate for usage in one location but not elsewhere. (Compare Mahecha-Vega and Echeverri-Restrepo 1983 for Colombia, Acosta-Solis 1971 for Ecuador, and Gentry 1988 or *Instituto Geográfico Nacional* 1989:312-314.)

Collecting.—Respondents from 42.3% (547) of the enumerated native communities reported that "collecting" (*recolección*) is an economic activity; all but five of these communities also reported agriculture. Over half the native communities (57.7%)

did not collect and did not report any items collected. I translate "*recolección*" here as "collecting" to avoid the connotations of "gathering" and "foraging" (Hutterer 1982) as a serendipitous search for food among wild life forms. Judging from the evidence of their replies, native Amazonian respondents interpreted the activity of *recolección* to mean harvesting or picking. More types and cases of items harvested from orchards or cultivated mixed gardens were reported than items culled from the forest or at river banks. Almost every item named under "*recolección*" is "picked" or captured by hand.

The coding clerks compiled names for 49 collected items and applied a catch-all code, *frutas en general* ("fruits in general"), for additional names they recognized as fruits that were found on one or two forms. "Fruits in general" and three single items were reported by five percent or more of the enumerated native communities: *aguaje, unguravi,* and *motelo.* Ten categories of collected items were reported by at least five percent of the communities that reported collecting. The leading items collected are shown ranked on Table 4.

Harvested food plants. Aguaje is known in English as burutí or mauritia palm. *Aguaje* fruit figures as a leading non-timber forest product exported from the Peruvian Amazon, especially from Loreto and San Martin (*Ministerio de Agricultura* 1992:49, Table No. 30). *Aguaje* was reported as an item collected by 41.3% of the communities that reported collecting. *Unguravi* was reported collected by 26.1% of the communities. The pulp and oil pressed from *unguravi* fruit are foods.

Harvested plant products collected by more than five percent of the communities that collected, but less than five percent of the universe of enumerated communities were *pijuajo, chonta, chapaja, caimito, and uvillas. Pijuajo* was reported "collected" by 11.2% of the communities that collected. *Pijuajo* is the Peruvian name for the peach palm, *Guilielma* (or *Bactris*) *gasipaes* or *Guilielma utilis.* What 10% of collecting communities intended by *chonta* is not clear. In the Peruvian Amazon, meanings for *chonta* include a dense woody material and the fruits and edible heart of palms in the Bactris/Guilielma or Euterpe genera, *Wettinia qunaria,* and several other trees. In the northwest Amazon, the peach palm is occasionally called *chonta duro* (Shultes and Raffauf 1990:351) and *Guilielma chontaduro* is an alternative name for the peach palm (National Academy of Sciences 1975:73).

Pijuajo (peach palm) was reported collected by 61 communities and as an agricultural crop by 15 others. Ten other plant products were reported "collected" from species that are considered domesticated or cultivated in various sources and situations. These include *pan de árbol* or *pandisho*—in English, breadfruit *Artocarpus altilis; mango* (*Mangifera indica*); *sapota,* the white sapote or mamey zapote (*Calocarpum sapota or Matisia* sp.?); *uvos* or *taperiba,* the mombin fruit (*Spondias mombin* or possibly *Spondias cytherea*); *uvillas,* which may be either "grapes" *Pourouma cecropiaefolia* or the goldenberry *Physalis peruviana; caimito* (the star apple, *Chrysophyllum cainito*); and *almendras* (almonds, *Caryocar* sp.). The names *guaba, guava,* and *guayaba* are usually regarded as synonyms for *Psidium guajava,* however *guaba* or *guava* names the pod fruit of some *Mimosacae* in the *Inga* genus, usually *Inga feuillei* or *Inga edulis,* which is called the ice cream bean in English (National Research Council 1989). ***Dale*** (*Calathea allouia*), called dali or leren in English, was reported collected in the Peruvian Amazon although it is a crop in the Caribbean (see Leren, http://newcrops.hort.perdue.edu/).

The names supplied for "collected" products spontaneously listed items of diverse status, some clearly "wild" like crabs and some clearly domesticated like the breadfruit and mango trees. Tree products are collected in the Peruvian Amazon from a number of different species, some domesticated, some only "cultivated" or "protected," and some, definitely wild. (Cf., Berlin 1976:392). Plants that yield functionally equivalent food or other economically useful material may have the same name, their common use justifying the label. The name *almendra* (almonds) applies to nuts from wild and cultivated *Caryocar* species in the Peruvian Amazon (Patiño 1971; National Academy of Sciences 1975:100-103; Prance and da Silva 1973). The name *almendra* is commonly used in Peru for the nut elsewhere called "*castaña*" or Brazil nut. The three communities in Madre de Dios that reported collecting "*almendra*" may harvest the wild *Bertholletia excelsa* that grows in that area.

The dual reporting of *pijuano* and other domesticated trees as agricultural crops and as collected items prompts the comment that domesticated trees (and other cultivars) may be erroneously classified as "wild" in ethnographic and/or botanic sources because of assumptions made about the status of these crops from the nature of their harvesting. The domesticated status of many Neotropical tree crops has been further clouded by their capacity to survive in feral form and "seed" the forest fallow at sites where a village and gardens were abandoned (Denevan 1974:105; Brownrigg 1986:77-84, 110-114; among others). I hope that botanical research on the hypothesis of the "anthropogenic forest" (or "semi-silvaculture", Brownrigg 1986: 113-114) will clarify which domesticated tree crops can survive as feral in the Amazon region and which domesticated trees are planted for harvesting long after gardens are otherwise in forest fallow. In the meantime, the assumption that "gathered" items are "wild" or "feral" should be suspended.

Non-food plant products collected were leaves in general, ***chapaja*** or ***shapaja***, and chonta. ***Shapaja*** was reported as a material used in housing construction: this palm's fronds are widely used to thatch roofs and make walls. *Chonta*, as noted above, may refer to the woody palm piths or tropical hardwoods that are used to make lances, arrow shafts, bows, and other hand-made artifacts.

Animals and animal products collected. The tortoise and "grubs" were the leading animals reported collected. A total of 15% of the 547 collecting communities reported the land tortoise, naming it in Spanish as *motelo* (which means "motel" and is a joke name) and *tortuga de la tierra* (land turtle) and as *ñesa* and *ñusa*. The land tortoise was concurrently named as game by about three percent of the communities reporting hunting (see below). Totaling together reports it was collected and hunted, 8.8% of the native communities enumerated reported this biological resource, which in the Peruvian Amazon is either the yellow-footed tortoise, *Geochelone denticulata*, or the closely related red-footed tortoise, *Geochelone carbonaria* (Alderton 1988). Five times more communities characterized acquiring tortoises as "collecting" than hunting. This may reflect a perception that catching this slow moving animal is not as purposeful as hunting and may signal a distinction between "collecting" and hunting activities. A distinction might be based on age or gender of participants or the stated objectives of forays. Tortoises may be captured during forays primarily intended for collecting leaves or fruits or during organized hunting expeditions. Strikingly similar ethnographic accounts describe how Shipibo, Sharanahua, and Siona-Secoya, and elsewhere in the Amazon, Kayapo, hunters capture and carry home alive tortoises they happen to find, disable their leg tendons, and keep tortoises alive to stock house pantries (Bergman 1990:139; Siskind 1973; Vickers 1991:74; Meggers 1971:72).

Among the fauna and faunal products less frequently collected were turtles or their eggs: 20 communities reported they collect ***taricaya***, the yellow-spotted Amazon river turtle *Podocnemnis unifilis*) or *huevos de* ***taricaya***, its eggs; five communities reported collecting *huevos* **chorapa** (the eggs of the Arrau river turtle, *Podocnemis expansa*, or another of the Pelomedusidae family of Amazonian river turtles) and one community collected the **mata mata** (*Chelys fimbriatus*) turtle.

The item ***suri*** which was reported by 9.6% of the communities reporting collecting or about four percent of the enumerated native communities illustrates the problem of vernacular names. Based on advice from INEI's native Amazonian consultant, INEI coders defined ***suri*** as *"gusano"* which means larval worm or grub in Spanish and suggests insect larvae. Ethnographic reports on insects consumed by Amazonian native groups are scattered and brief, as is the case for tropical forest peoples generally (Hutterer 1982). Descriptions note Peruvian Amazonian groups collect, tend, and cull preferred larvae, activities which could be viewed as microlivestock production with protected wild species. The "Jivaro" regard the larvae of the *chonta* palm beetle as a delicacy; its flavor "has been compared to pork sausage spiced with nutmeg" (Meggers 1971:61). Achual spot and cut down diseased palms, haul sections with larval nests to housesites, and scoop grubs from the felled trunks to provide a rich, valued, and convenient source of protein meat. Ashaninka raised larvae of a maize pest in cribs on shucked corn cobs (Denevan in:Lyons 1974:105).

I reserve doubt that ***suri*** is insect larvae. It was described as aquatic. The Ecuadorian Shuar group characins, minnows, catfish, and their relatives into the ethnozoological "order" ***tsarar***, one variety of which is called ***tsuri*** in Shuar, the Jivaroan language that commingles and adjoins the Achual speakers of Peru. Ecuadorian Shuar authors Mashinkiash Chinkias and Awak Tentets (1986) describe the "order" ***tsarar*** with the Quechua word, ***caracha***. The Quechua word ***caracha*** is applied to crust, scab, itch, mange, even llama lice (Fernandez de Cordova 1982). During the prime fishing season, when the forest flowers and the headwaters rivers are full, ***carachas*** are "found in great numbers, up to 20-30 on one rock...and are picked up by hand" [they are smaller fish (*"sardina"* in Spanish) that]... "live in rivers attached to rocks by a sucker in its mouth" (Mashinkash Chinkias and Awak Tentets 1986). This description fits the *Loricariidae* order of catfish, which have plate-like suctorial lips located under their heads (Herald 1961:122-123). The fish (*Ancistrus* sp.), named *"raspa balsa"* in Spanish for its characteristic behavior of adhering to logs floating in rivers as well as to rocks (Patzelt 1979), is an example of this order. A small fish caught by hand fits the profile of items collected and descriptions, however, ***suri*** might also be leeches, snails, egg cases, or eggs of waterbirds. In Quechua, ***suri*** names the South American ostrich or rhea *(Pterocnemia pennata)* found in the Peruvian high altitude (Parker *et al.* 1982:29) to about 3000 meters above sea level but not in the Peruvian Amazon (Gentry 1990:252-269,

Appendix 14.1.). In versions of South American myths, the duck is interchanged with the ostrich as a story character (See Lévi-Strauss 1973). Although a duck, heron, or another water bird would be an odd item to collect, the item actually collected might be the bird's eggs, as seen in the communities that reported eggs of turtles by the name of the turtles.

Other animals or animal products reported collected by fewer than four percent of the communities are non-vertebrates. Names for the microfauna reported collected are so generalized as to refer to phyla and, at our present stage of knowledge, are difficult to associate with a species, genus, or order. The non-vertebrates include terrestrial or freshwater snails, mollusks, and bi-valves (*congompe, caracoles,* and *churos*), crabs, and honey. The name "shell" (*caracol*) may refer to shell material used to manufacture ornaments and tools or to the many terrestrial and freshwater snails and mollusks consumed as food. *Churos* is a general Peruvian name for bivalve mollusks of a certain shape, applied to different species according to regional Spanish dialect. The name also applies to a particular oversized snail and a grape-like fruit. Despite the mythical importance of honey in Amazonian cultures, only one community enumerated reported collecting honey. This may be a "seasonal effect" because honey is ritually reserved for collection during or prior to the time for certain ceremonies (Lévi-Strauss 1973:32, 75-76).

A sufficiently large and representative portion of the universe of this census reported collecting non-vertebrates to warrant closer examination of their status in the diet of Amazonian Peruvian communities. If reports of ***suri*** are defined as insect larvae and included, a total of 21.7% of the collecting communities reported some non-vertebrates or non-vertebrate products; if reports of ***suri*** are excluded, then 12% of the collecting communities reported some non-vertebrate or non-vertebrate product. Although the consumption of insects and non-vertebrates not regarded as "food" in Western cultures has been characterized as an adaptive responses to (macro) game depletion (Gross 1975; Hames and Vickers 1983; among others), insects and non-vertebrates constitute a large gross biomass and are an excellent source of protein available in abundant variety in the Amazon basin and in tropical forests generally (Hutterer 1982). Native Amazonian peoples' regard for non-vertebrate micro-game was apparent in the frequency of reports in this census.

Fishing.—This census did not request communities to specify what kind of fish they caught although 88% of the communities reported they fished. This omission of detail about fish leaves a major gap in the inventory of biological resources used by native Amazonian communities compiled in this census. Nonetheless, among fauna reported hunted, communities reported the large fish, *zungaro* (*Trychomiterus* sp.), which is speared and is the prey of organized expeditions.

Hunting.—Nine hundred and seventy nine (979) native communities hunted, which is 74% of the universe enumerated; seven of the hunting communities did not practice agriculture. The names of 59 animals hunted and a 60th "other" category were compiled during manual coding. After clarification of synonyms and association with biological taxa, the list was found to refer to 54 species or groups of macrofauna. Names for the wild macrofauna can be fairly confidently associated with one species if there is only one species in its genus or class in the Peruvian Amazon. This is true for the capybara, *ronsoco*. More usually, there are two or more species which share one or more common names, discussed below.

Ten game animals were specified by five percent or more of the communities that hunted. In descending order by the number of communities reporting, these were the collared peccary (*Tayassu tajacu*), deer (*Mazama americana*), paca (*Agouti paca*), agouti (*Dasyprocta fuliginosa* or *D. variegata*), tapir (*Tapirus terrestris*), white-lipped peccary (*Tayassu peccari*), "black monkey", armadillo (*Dasyprus novemcinctus*), the "bush turkey," and the "dove," (See Table 5). Eight of the ten are larger mammals.

Mammals. Collared peccary was prey reported by 56% of the communities that reported hunting (which is 42% of the communities enumerated) with the Spanish word *sajíno* or *saíno*, which means wild boar, and a Spanish word for pig, *cerdo*. The term ***kitaykiri,*** reported by one community, may be a mistranscription of the Ashaninka name for collared peccary, ***kitáiriki*** (Weiss 1969:605). 48% of the hunting communities reported hunting deer, primarily using the Spanish name, *venado*.

The large rodents, pacas and agoutis, were respectively the third and fourth most frequently specified game. According to Emmons, pacas are "the most prized Neotropical game animal for their tender, veal-like meat" (1990:205). The names used to report the paca in the Peruvian Amazon were *majaz* or *majas* and *picuro*. None of the volunteer Amazonian native language consultants recognized the term paca and they identified photographs of both pacas and pacarinas (literally "little paca" which usually refers to juvenile pacas which have a distinctive spotted fawn and white pelage and are highly prized for their meat), as ***majaz***. A third of the hunting communities reported agouti game using either the name ***añuje*** or ***cutpe***. Of the hunting communities, 23% specified *huangana*: the consistent and exclusive name used to report the white-lipped peccary, *Tayassu pecari*.

The "black monkey" (*mono negro*) was reported as game by 19% of the communities that hunt. The native Amazonians I consulted identified photographs of the brown capuchin or cebus monkey as what they call the "black monkey." Alternative candidates include the woolly monkey and the black howler, which are larger and darker in pelage and have been ethnographically reported as preferred primate game, but are increasingly rare. The 189 reports were sufficient to preserve "black monkey" as a separate category in the data.

"*Mono*" is a Spanish general name for Neotropical primates, Cebidae and Callithricidae, and for some animals in different orders. By analogy to monkeys' appearance and habits, names for monkeys are extended to "monkey-like" arboreal mammals. The speakers of Shipibo and Aguaruna I consulted provided the Spanish term "*monos*" (monkeys) to identify primates and also several marsupials, edentates, and procyonids that spend a lot of time in trees. For Aguaruna mammal taxonomy, Berlin and Patton (1979) suggested a higher order taxon of arboreal mammals includes primates and "similar" mammals. Their insight for Aguaruna could be tested in local Spanish.

The kinkajou (*Potus flavus*) is an example of a non-primate called a monkey. The kinkajou was reported hunted by 23 communities in this first census by the names ***chosna, cuzumbo, cusumbo,*** and ***cusumbi***—and there may be kinkajous in the count of monkeys, too. The panel of native Amazonians agreed with each other that the kinkajou is a "*mono*" (monkey). Their classification mirrors the ethnozoological taxonomy of the Aguaruna (Berlin 1976 and Berlin and Patton 1979)—one of the ethnolinguistic groups censused and represented in the panel discussion—in grouping animals with distant biological relationships but similar traits. The kinkajou has the distinguishing sharp teeth of Carnivora and Procyonidae. However, the kinkajou lives in trees, is the size of several common South American monkeys, and has a long prehensile tail. Apparently these are sufficient similarities to assign the kinkajou to the folk classification of monkey.

About 17% of the hunting communities reported names associated with at least one additional primate and these reports were grouped. Twenty communities reported hunting ***choro*** (the common woolly monkey, *Lagothrix lagothricha*); 15, *coto* (the howler monkey, *Alouatta seniculus* or *A. villosa*); 14 reported *mono blanco* (the white-fronted Capuchin monkey, *Cebus albifrons*, or the white-faced monkey, *Cebus capucinus*), 34 reported *samari* and six, ***huasa***—two names that may refer to the squirrel monkey, *Saimiri sciureus*; 14 reported ***maquisapa*** or ***maquizapa***, a name associated with the white-bellied spider monkey, *Ateles belzebuth*, or black spider monkey, *Ateles paniscus*, and four reported ***pichico***, a name applied to tamarins in the Callithricidae family.

Armadillo was reported by 15% of the hunting communities. The term *armadillo* in Spanish (and English) and its synonyms *carachupi* ("sucking face") and ***kirquinco*** refer generally to the armadillo and to particular local armadillo species, depending on the group and regional usage. The nine-banded or common long-nosed armadillo (*Dasypus novemcinctus*) has the widest distribution in the Peruvian Amazon.

Additional mammals hunted by less than five percent of the hunting communities are in order of frequency the capybara (40 reports of *ronsoco* = *Hydrochaeris capibara*), the kinkajou (23) and *achuni* (11), the South American coati (*Nasua nasua*); seven reports of *liebre* or *conejo de monte*, the hare or rabbit (*Sylvilagus brasiliensis*); five of the *ardilla*, the Northern Amazonian red squirrel (*Sciurus igniventris*) or Southern Amazonian red squirrel (*S. spadiceus*); "bear" and "fox" (see below); and the Amazonian manatee (*Manati amazonica* or *Trichechus inunguis*).

Five communities reported they hunted bears ("*osos*"). Strictly speaking, the only possible bear is the spectacled bear, found in the high jungle but rarely in the low. Several other mammals have Spanish names composed with the term *oso*. Anteaters (*Myrmecophaga tridactyla* and other species) are called *oso hormiguero* or ant bear. The tamandua (*Tamandua tetradactyla*) is called *oso colmenero*. Two names for the South American racoon (*Procyon cancrivorus*) are *oso lavador* (the bathing bear) and *osito lavador* (little bathing bear). The Amazonian language consultants knew of communities that hunt "bears" and indicated the large size "*osos*" attain, the length of their claws, and how dangerous they are to hunters. Though which "*oso*" was slow to clarify, participation in the animated discussion in Spanish about hunting bears by Shipibo-Conibo from the low jungle well beyond the range of the spectacled bear served to rule it out in favor of the larger of the ant bears. *Zorro* (fox) presents the same difficulty of glosses. The tayra (*Eira barbara*) is sometimes known as a *zorro negro* or black fox; the *zarigueya* (*Didelphis marsupialis*) is known as *zorrillo*–the little fox. *Zorrillo* is one name for the elusive wild dog, *Speothos venaticus*, usually called the *perro de monte* or *perro selvático* (Emmons 1990). Even though which *oso* and which *zorro* remained ambiguous, they were definitely mammals and it was legitimate to collapse these few cases into a statistical category for "other" mammals.

Birds. Paujil and *pava de monte* and *panguana* and *perdiz* were the game birds most frequently specified as hunting prey. The *paujil* and the "bush turkey" in the Peruvian Amazon region refer to the guan (*Penelope purpurascens*), Salvin's curassow (*Crax* [*Mitu*] *salvini*), or another of the large birds (15-20 kilograms) in the Cracidae family of guans, currassows, or chachalacas. Studies of subsistence hunting throughout the Amazon concur that this family of birds contributes "the most avian biomass extracted by hunters in the Neotropics" (Silva and Strahl 1991:37). The 65 reports of *paujil*, 22 of *pava de monte*, four of *pucacunga* (Spix's guan, *Penelope jacquacu*) and of *manacaraco* (the variable chachalaca, *Ortlalis motmot*) were merged into a single category.

The *panguana*, reported by nine communities, refers to one of the tinamous (Tinamidae, including *Crypturellus undulatus* and 10 other Peruvian species called tinamous in English). *"Perdiz,"* reported hunted by 59 communities, refers to terrestrial birds of several common species, most prominently *Tinamus tao* and other tinamous. Pigeons (*Columba* spp.) and true doves (*Columbina* spp.) fly under the vernacular name *perdiz* as well. *"Perdiz"* are hunted casually by children with slingshots and during organized hunts.

A quarter of the communities that hunt reported at least one game bird other than the larger Cracidae or "doves." Among the water game birds reported hunted by five percent or more communities were ducks and geese (Anatidae)—*pato del monte* and *pato silvestre*, herons (Ardeidae)—*garza blanca* (the white heron, *Casmerodius albus*) and *garza cuca* (the grey or white-necked heron, *Ardea cocoi*). Feral—or stray—domesticated Muscovy or tree ducks (*Cairina moschata*) were reported hunted as were wild whistling ducks (*Dendrocygna bicolor, D. viduata, D. autumnalis*), the masked duck (*Oxyura dominica*), teals and pintails (*Anas* sp.). The Neotropical cormorant (*Phalacrocorax olivaceus*) and Brazilian cormorant (*Phalacrocorax brasilensis*) are associated with the vernacular names ***cushiri*** or ***qushuri*** and ***chiwia*** reported as prey. Names for land game birds included "parrots," from one of the 14 genera of Psittacidae of the Peruvian Amazon, *guacamayo, macaw, loro* and others. The American darter (*Anhinga anhinga*) is likely the *sharara* that 10 communities reported hunting. Game birds reported by the general Spanish name *trompedero* or by Achual communities as ***chiwia*** are most likely birds in the family Psophiidae. The names of 44 additional birds reported hunted were collapsed in the data element *aves en general* "birds in general."

Reptiles. Reptiles were reported by about 14 percent of the communities that hunted. With the exception of *lagarto blanco* (the smaller caiman, *Caiman sclerops*), reptiles were reported using a local Spanish term for the order, *kiloneos*, or the names of the particular tortoise or turtle, as discussed above.

Mishasho was reported hunted by 15 communities. In Quechua, this word has several meanings, including "rotten" and a talisman found inside animals and may refer to carrion left by felines. No names for sloths, snakes or felines were identified. Sloths are prohibited as food among the "Jivaro" (Meggers 1971) and Secoya (Vickers 1991:71) and the Achual and Shuar Jivaroan speakers prohibit snakes as food. In the final data set, which can be ordered from INEI, it will be possible to review faunal prey by particular ethnolinguistic groups and test ethnographic descriptions of food prohibitions (cf., Kensinger and Kracke 1981; Ross 1978), resource inventories, and other theories.

The mammals most frequently specified hunted are larger macrofauna. According to Emmons (1990), a full grown Brazilian tapir weighs 227-250 kg, each deer weighs 24-48kg, an adult collared peccary weighs 17-30 kg, and an adult ***huangana*** or white-lipped peccary weighs 25-40 kg. The collared peccary (ranked first), and the ***huangana*** or white-lipped peccary (ranked 6th) run in herds. A hunting expedition that encounters a herd of peccaries can yield meat on a par with or better than kills of larger, solitary animals like the tapir. For example, a Shipibo hunting party reported by Bergman killed 22 white-lipped peccaries in a larger herd in 105 minutes and produced 472 kg of meat (1990:118-119). The giant armadillo weighs up to 30 kg and the common, or nine-ringed, armadillo weighs 2.7 to 6.3 kg. The paca weighs five to 13 kg. The adult agouti reaches 3.5 kg and the brown capuchin monkey weighs 1.7 to 4.5 kg. The agouti is smaller than other mammals hunted by five percent or more of enumerated communities, but because it forages in groups and invades gardens, it is hunted efficiently.

Table 6 suggests the relative contribution and variety of mammal and bird meat obtained by hunting compared to raising livestock. More native communities reported they raised livestock than reported hunting (See Table 1). About half the communities that raised cattle, raised pigs, or raised both were concentrated among the "Campa" (Ashanika) who have been raising European livestock since colonial times. Only 230 Amazonian native communities reported they raise cattle while 801 reported they hunted the two largest game animals, deer, and/or tapir (" the wild cow"). The 446 native communities that reported raising domestic pigs can be contrasted with the 779 that reported hunting one or both peccaries–the wild *cerdo* pig and ***huangana***. However, almost twice as many communities (180) reported they raise turkeys than the 91 that reported hunting a wild avian counterpart in the *Cracidae*. More than seven times as many communities (1060) raised chickens than the 161 which reported hunting game birds other than Cracidae. Less than a fifth of the stock-rearing communities reported any domesticated animals other than chickens, turkeys, pigs, cattle, or pigs, and these were mainly ducks, while the 979 hunting communities gave 1,162 reports of prey other than the most frequently hunted game: deer, tapir, peccaries, guans, and birds.

SUMMARY

The 44 agricultural crops, 10 harvested cultivars, and five types of livestock specified is an impressive list of domesticated biological resources, however, the Amazonian native communities specified overall far more categories of wild biological resources than domesticated. The word lists collected in this census documented native knowledge of economic resources naturally occurring in their environment that are unknown, unrecognized, or unsuspected by other Peruvians, especially in the profusion of names for lumber and housing timbers.

The large number of biological resources named in this census corroborates ethnographic descriptions of how particular settlements and cultural groups of native peoples in the Peruvian Amazon secure their subsistence. Ethnographers have observed native Amazonians operate a subsistence strategy based on light, occasional use of individual domesticated, cultivated, and wild species for food and other necessities from a large inventory, rather than specializing, super-exploiting, or relying on a limited spectrum of living resources. This species and space extensive strategy can be contrasted with a set of equally indigenous, intensive strategies which concentrate domesticated or wild biological resources in built environments (Brownrigg 1986:93-130, 203-236). The strategy of light use from a large inventory of living resources found over a large territory through activities variously called foraging, hunting, or gathering is by no means universal among native Amazonians, nor is it the exclusive economic strategy of any Peruvian Amazonian native community reporting in this first census. The option to exercise the extensive strategy of light use of a large inventory of biological resource is increasingly constrained as native settlements and their growing populations become more sedentary to take advantage of new infrastructure and services, as national colonists and corporate extraction industries withdraw resource areas from use and access by native Amazonians, and as the habitat of the biological resources is destroyed.

RECOMMENDATIONS

For the short term, it would be useful to validate the names which the native people of the Peruvian Amazonian specified as the biological resources in their agricultural, collecting, hunting, commercial lumbering, and house construction activities in other research, surveys, and censuses in the region. From the perspective of census and survey methods, a universe of over a thousand respondents providing answers to open-ended questions is sufficiently large to establish response variations. Salient biological resources were identified by principal and variant names among culturally diverse native peoples. The more frequently reported names are useful for designing answer values and for writing questions likely to be understood. The less frequently reported names can serve to formulate probes or explanations for respondents and enumerators. By applying the same categories developed for this first census to pre-code answers in future censuses, surveys, and other research in the Peruvian Amazon, the importance and use of these categories can be tested. Use of the names and categories from this census in research in a settlement or ethnolinguistic group would permit researchers to compare local resources with native communities throughout the Peruvian Amazon region. Use of the same categories in later censuses would allow comparison to the baseline of information about the living economic resources of native communities built in this 1993 census. Use of the vocabulary and categories in systematic surveys of households or communities would allow for collection of the same or even more detailed information. In ethnobiological research, the species or set of species to which the local names refer could be detailed in particular ethnolinguistic and geographical contexts and positively identified with species.

Over the long term, I recommend departing from verbal reports to research and test standardized methods to collect and process information about biological resources from local people and scientific field observers alike. Research and development of 1) pre-coded visual aides illustrating pre-identified species and 2) standardized statistical categories for the economically important biological species address methodological problems which this census confronted. The same problems affect biological and ethnobiological research field surveys that attempt to quantify observations yet do not produce data sets suitable for sophisticated statistical analyses.

Visual aides.—Visual aides could provide respondents or local experts the same common reference. Some accurate and recognizable illustration of the taxa that are the topic of the research could help overcome the problems of synonyms, ambiguous associations between vernacular names and Linnean taxa, subjective or idiosyncratic identifications, ad-hoc coding schemes (see Heyer *et al.* 1994; Scott 1994), and communication with those respondents who are not familiar with the Spanish language yet know a great deal about indigenous biological resources. Two recent experiments tested promising methods (Phillips and Gentry 1993; Benz *et al.* 1994). Benz and his colleagues showed their informants plants in freshly pressed state. Displaying the same plant specimen to several informants served to "pre-code" and pre-identify botanical names. Fresh pressed plants, however, are too expensive and fragile to use in national censuses or random surveys of enough people to produce statistically reliable conclusions concerning distributions in populations. The native language consultants who contributed to this research could supply at least one name for accurate sketches and photographs of the Neotropical animals I showed them. This experience suggests that it may be possible to develop inexpensive, printed visual aides with biologically accurate and cognitively recognizable line drawings. Eliciting local names to identify images and descriptions issued by herbaria is another prospect, given resources increasingly available on CD-ROM and on line.

Standardized categories for biological resources.—In order to pre-define the information to be collected from local respondents and to conduct statistical analyses, standardized codes for biological resources must be developed. Codes are required for ethnobiological and scientific knowledge of the living resources to maximize computer tools and progress beyond inventory (cf., Scott 1994) and highly localized studies of populations. Variables that are precise, standardized, well defined, and documented are needed to build information systems capable of demonstrating distributions and testing effects (cf., Heyer *et al.* 1994). At a minimum, a standardized code to substitute for and reference species names is required. Latin binomial names, as alphanumeric strings, can be stored in computer data bases with other texts and images, but must be truncated to serve as variable names or values. Consistent eight place codes for species with initial digits reserved for class and order would meet common requirements for machine languages and programs. These codes could provide links—currently missing—between qualitative and descriptive information about biological resources already residing in electronic data bases and texts with new quantitative information from censuses and surveys.

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SHORT COMMUNICATION

AUSTRALIAN ABORIGINAL BURNING, MISHAPS AND CONFLICT: IMPLICATIONS FOR ETHNOBIOLOGY

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INTRODUCTION

Aboriginal burning and its long-term effects on Australian vegetation and ecosystems have been hotly debated. Jones (1969) characterizes Aborigines as 'fire-stick farmers' who deliberately manipulated fire regimes and resources bringing about significant changes to the Australian biota. Horton (1982), on the other hand, suggests that climate and soil are determinants of vegetation with human ignition being relatively insignificant.[1] Today, ecologists and land managers are grappling with the decline of many fire-sensitive species, such as the cypress pine *Callitris intratropica,* which has been severely impacted by altered fire regimes following the settlement of the northern Australian savanna (Bowman 1995a, 1995b; Bowman *et al.* 1988, 1993; Haynes 1985, 1991). Land use has changed, and feral animals and plants now add further ecological complexity (Bowman 1991; Latz 1995a). Across much of northern and central Australia there remains considerable scope for collaborative research involving Aborigines, anthropologists and ecologists with respect to the ecology of Aboriginal burning.

Aboriginal society has also been significantly transformed. Alienation from the land and economic impoverishment have occurred in many regions, while some groups continue to occupy traditional lands and now engage in new forms of economic endeavor such as ecotourism or beef cattle production. Aboriginal burning continues, albeit with many contemporary adaptations, and this practice attracts the scrutiny of policy analysts (Hughes 1995) and scientists (Braithwaite 1995; Press 1995) who, despite differing land management priorities, recognize the practical significance of understanding Aboriginal fire use. Anthropologists and ethnobiologists should contribute to this discussion, although with the exception of Lewis (1982, 1985, 1989, 1991, 1992, 1994) and more recently Bradley (1995), few substantial accounts have been offered. Lewis (1982), in particular, has firmly set Australian Aboriginal burning in the broad context of hunter-gatherer studies with his discussion of deliberate environmental manipulation and resource domestication.

In this paper, I sketch the pragmatic and esoteric aspects of Aboriginal burning, drawing together the fragments of existing anthropological research within an ethnobiological and ecological framework. But my concerns are also with broader issues of relevance to ethnobiology and themes in human-environment relationships. Fire, even when used by experienced practitioners, whether rangers, pastoralists or Aborigines, is a volatile and easily mis-managed tool.[2] Sources of conflict and resolution processes have been a major analytical focus for anthropologists (Gluckman 1965; Hallpike 1977; Hiatt 1965; Meyers 1986). While conflict in Aboriginal communities is mostly generated by causes other than fire, I argue that social tension arising from fire-related problems is not uncommon and offers an opportunity for a profitable marriage of political anthropology and ethnobiology (see Healey 1994 for a similar orientation). To set the stage for this theoretical convergence, I begin with an outline of fire in Aboriginal practice and thought.

ABORIGINAL FIRE USE, KNOWLEDGE AND CHANGE

Aboriginal cosmology and natural history concepts are well documented (e.g. Rose 1992). Narrative traditions record the eventful journeys of creative ancestors who sculpted landforms and introduced all natural phenomena, including people. Rules for the ritual maintenance of country, including the proper use of fire, were established to ensure that the social and natural order would prevail. Of course, the use of fire has numerous practical applications as well. Campsites are cleared of grass and snakes, signals transmitted between distant parties and game driven to strategic places for harvesting. However, even in hunting, burning is not haphazard and the supernatural dimension is ever-present. Chaloupka and Giuliani (1984) detail strategies for various hunting scenarios used by the Mayali people of the Kakadu region. These maneuvers take account of the prey, season, time of day, topography, wind dynamics, and the number of available hunters. Wallaroo[3] hunting at night is described as particularly hazardous, with malevolent spirits attempting to deceive the hunters.

Systems of classification are also keys to understanding Aboriginal fire knowledge. Beyond biological taxonomies which recognize discontinuities in nature and assemble named and covert clusters of folk taxa (Hunn 1977; Waddy 1988), social classification schemes integrate the natural world into the social and cosmic order. While humans have individual membership in a social class, such as a semi-moiety, each species is systematically assigned to the same categories in ways which may have implications for the ethnography of burning. For example, Chaloupka and Giuliani (1984) have shown that the allocation by the Mayali people, of certain grasses (Poaceae) to the semi-moiety associated with fire, is dependent on the species' flammability. Those species which readily and fiercely combust are included in the same semi-moiety as fire, while less flammable grasses are assigned to another social category.

Totemic classification and fire ecology are also linked. Totemism and species selection have been of enduring concern to anthropologists (Bulmer 1978, 1979; Elkin 1933; Levi-Strauss 1966), and Waddy (1988) demonstrates that the distribution and sharing of totems among Groote Eylandt clans is not random. Waddy finds that totemic classification is based on associations in nature as well as myth, not hierarchical conceptual thought as with biological taxonomies. Sentimental attachment to locality is also important in totemic beliefs, and Peterson (1972) has shown that totemism has an adaptive significance in the spatial arrangement of groups and territories. As emblematic indicators of the relationships between humans, natural entities and places, totems are integral to Aboriginal burning. Strategies for elicitation must be carefully considered to access environmental knowledge encoded in social phenomena.

In Waddy's (1988) account of totemic classification, the cypress pine *Callitris intratropica* and other related totems are shared by a number of clans, influencing the distribution of clan territories and sites. This tree is fire-sensitive and requires careful management (Bowman 1995a, 1995b; Bowman *et al.* 1988, 1993; Haynes 1985, 1991), and Bowman (1995b) suggests that the survival and characteristics of stands in some environments can only be attributed to skilled burning by Aboriginal people. On Maria Island in the Limmen Bight of the Gulf of Carpentaria, a particular cypress pine is regarded as potentially harmful if disturbed, and knowledge of the poisonous nature of the tree and fear of sickness are widespread (Bradley 1988; McLaughlin 1978/79). The sap, which is used in sorcery, can only be collected by persons in a prescribed custodial role. In the mythology of the local Mara people, the Plains Kangaroo deliberately left this cypress on the island rather than the mainland to reduce the likelihood of damage to the tree and the risk of social harm (Bradley 1988). It is probable that local fire regimes have evolved to minimize impact on the cypress habitat. Similar examples of fire protection at totemic places are given by Haynes (1985), Jones (1980) and Lewis (1985, 1989, 1992). Careful planning to reduce scorch height and to protect tree-dwelling fauna may have a similar motivation.

Exclusion of fire from places of importance is not always desirable. Bradley (1984, 1995) describes burning to cleanse country of the spirit of the recently deceased. This common purifying ritual is necessary before general use of the area can be resumed. Some potentially harmful totemic sites can be calmed with fire and smoke. One place discussed by Haynes (1991) can only be approached by people with appropriate affiliations who must sing particular songs and carefully ignite the grass on the designated access route. Such activity must only be undertaken when wind conditions are favorable for directing the smoke. Obviously, great care is needed with fire as well as substantial environmental knowledge.

While I have so far furnished an account of burning in its traditional context, the picture is far from complete. The movement of people across the landscape is now influenced by land title and legislation (Hughes 1995), access restrictions, residence, vehicles, roads and fencelines. Matches are now the norm for ignition. Waddy (1988) describes burning as a random activity carried out as roads become passable after the monsoonal wet season. Head and Fullagar (1991) provide a more detailed description of vehicle-based burning in a region where extensive pastoral activities dominate land use. Two points are significant here. First, the use of new technology does not necessarily mean a discontinuity in cultural knowledge with regard to fire. Lewis (1992) is correct in chiding anthropologists for equating technology with material culture and failing to consider underlying ecological knowledge. The second point I wish to make is that ethnobiological studies, including resource management and fire use, must account for specific regional environmental and socio-cultural histories, and the role of the state in land use planning and policy. While traditions continue, Aboriginal communities are undergoing major shifts in social organization, knowledge transfer between generations and the application of land management practices in everyday life.

The following discussion looks at fire related mishaps, conflict and the prospects for ethnography.

FIRE, CONFLICT AND ETHNOGRAPHIC RESEARCH

Violation of significant sites through inappropriate fire management will undoubtedly have social consequences, and ritual responsibility and rights of access will emerge as dominant issues. Gould (1971) has documented one such incident in which a fire desecrated a sacred site associated with particular totemic macropods. Although the ignition source was unclear and damage may not have been intended, the post-fire discussions escalated into intense anger. Insufficient information about the culprits and other pressing social needs eventually quelled the situation. However, Gould highlights the potential for an inflammation of grievances at a later time. Patrick McConvell (pers. comm.) has also witnessed a similar incident in the Kimberley region in which a cache of sacred objects was destroyed. The storage of sacred objects in carefully selected rocks and trees, requires that fires in the vicinity be controlled. In this instance a fire destroyed the objects placed in a tree, and amidst the social tension and drama which ensued, death was considered to be an appropriate penalty for the arsonists. As these were discovered to be Europeans the matter was not pursued. Bradley (1995:30) is similarly illustrative of the emotion and potential hostility which accompanies inappropriate fires. In regard to burning without permission he writes: "Postures of feigned or real anger still occur, people still issue challenges using digging sticks and crowbars as weapons...." The seriousness of these events is also emphasized in Warner's (1958) note that damage to log coffin burials from deliberate burning of country may be sufficient cause for retaliatory homicide. Social tension from indiscriminate burning is evidently not uncommon.

These incidents raise some pertinent points regarding anthropology and the ethnographic orientation of ethnobiology. It is now beyond contention that hunter-gatherers actively manage the landscape, but it must not be assumed that fire plans are implemented without mishap. Although anthropologists have moved beyond simplistic Rousseauian views of human-environment relationships (Friedman 1979), we must be cautious of regarding indigenous people as "paragons of ecological wisdom" (Brunton 1992:1) unable to err in fire management. Lewis (1992, 1994) has commented on occasional mistakes by Aborigines, and in many other societies with a highly developed fire technology, such as the Papuan Tauade, loss of fire control can destroy "trees, gardens, villages and people" and generate neighborhood clashes (Hallpike 1977:204). Even in the hands of experts a failure of judgment in fire management can have enormous environmental and social consequences. Poorly skilled adults, malicious individuals and playful and careless children also abound in all cultures. Political anthropologists have long held an interest in the study of conflict situations (e.g. Gluckman 1965; Hiatt 1965; Meyers 1986) and this orientation is of immense relevance to problems in human ecology and ethnobiology. Situations of fire related tension may therefore be ethnographically rewarding, by bringing into sharper focus Aboriginal perceptions of ecological entities and processes, and the decision making organization which underpins resource management.

Poiner (1985, 1990) has demonstrated the merits of a similar ethnographic strategy in her study of the response to bushfires by the community of the New South Wales rural town of Marulan. While not concerned with ecology, Poiner's research certainly portrays the dynamics of the human environment in which land management is embedded. In the social drama which unfolded, both during and after a major fire event, social relations were strained and new alliances forged. Traditional gender roles were temporarily suspended in some contexts, while the overall secondary position of women was underlined. The usual norms of group membership became more flexible. In general, the heightened tension and sense of community, made clear many social relationships and long-term ties to land and lifestyle which otherwise would have remained obscure. Attachment to kin and country, and the necessity for mechanisms to resolve conflict, are universal themes of human existence. Cross-cultural comparison in the fire prone Australian environment reinforces the need to adopt a broader approach to ethnobiology and fire research.

With regard to Aboriginal burning, analysis of conflict resulting from unplanned or mis-managed conflagrations may reveal new aspects of fire ecology and cosmology, and should throw light on the associated social organization, which has received only limited attention.[4] Furthermore, what has been reported concerning the social organization of burning is frequently contradictory. Bradley (1984, 1995) has indicated that the Yanyuwa people of the Gulf of Carpentaria organize burning along the lines of complementary social groups. Managers of country—matrifiliates—usually burn or request ignition by paternally affiliated kin, whose land ownership represents one side of the dual system in which reciprocity reverses roles on allied estates. Fires of unknown origin are investigated, and if rights are exceeded the perpetrators are strongly challenged. Lewis (1989), in his Kakadu material, points out that despite responsibility to senior clan members, men, women and children may start fires while in flammable country subject to their knowledge of appropriate habitat burning requirements. Yet, in an end note to Lewis' paper, a personal communication from Meehan and Williams is cited which states that: "most 'traditional burning' in Arnhem Land ... [is] carried out by women" (1989:958). Gould (1971) shows that in the central Australian societies the use of fire has no gender or age restrictions, and that fires set for a number of purposes are allowed to burn uncontrolled. Lewis (1992) describes restrictions on intense fires in rainforest patches for ritual and totemic reasons, but gives an account of casually conducted 'corrective' burning to clear neglected country in which fuel loads are extremely high. Resulting fires of great intensity are noted as severely affecting rainforest communities, although Lewis does not discuss any negative ecological or social outcomes. Obviously if totemic sites or significant habitats and species are to be properly managed, the authorization and deployment of people to light fires must be coordinated at some level. Custodial rights and the acquisition of specialist knowledge relating to the pragmatic and esoteric dimensions of land-care are the crucial factors. Conflict may be the context in which ethnographic insights are gained.

High-intensity corrective burning is the subject of a more thorough discussion by Lewis (1994) in which he reveals the Aboriginal logic which integrates this practice with other traditional fire management activities. Regular burning is an action necessitated by moral responsibilities to kin and country, so that restorative fires, even under conditions considered inappropriate by non-Aboriginal fire authorities, may be set to rectify any previous neglect and excess of combustible material. Corrective fires may even be lit with "an almost manic compulsion" for further delays would be highly remiss (Lewis 1991:270). One example given by Lewis, based on information supplied by a biologist who was present, describes the burning of Maria Island to fulfill obligations to a recently deceased kinsman after a long absence from the island and at least fifteen fire-free years. The result was a conflagration which reduced almost the whole island to "4,000 hectares of burnt snags and ash" (Lewis 1994:951) and caused considerable satisfaction for the traditional owners. This is the same island that I have already discussed in the context of a culturally significant and potentially dangerous cypress pine, a species with limited fire tolerance. Consequences for the cypress pine or Maria land owners are unknown.

In the context of social change the potential for mishaps has increased, and this creates new dilemmas for the application of Aboriginal burning in land management programs. Features of the landscape remain a focal point for Aboriginal people in the construction of their ethnic identity. But as I have indicated earlier, traditional patterns of Aboriginal land use have been disrupted and transformed along with the mechanisms for the intergenerational transmission of knowledge and skills. Peter Latz (1995a:81), a botanist with substantial experience in fire research and Aboriginal communities, makes some valid points in regard to Aboriginal burning:

> But it's only years and years of experience that make it look easy...The only trouble is...once your burning system has been stopped it is one hell of a job getting it back again!...This last [fire in the South Australian Mann Ranges] was lit by Aborigines but they didn't realize the problems that occur when the fuel had built up. They had been away from their country in the past and the system had broken down...A whole lot of figs, which are sacred in this country, were burnt out of existence and the rock wallaby[5] which is practically extinct on this range, has lost some of its tucker.

Like Latz (1995a; 1995b), I strongly suggest that there is much to be learned from Aboriginal people which can be of benefit to fire ecologists, anthropologists and government and private land managers. Researchers, however, should be mindful that intentional Aboriginal burning is not always the best practice for sound environmental stewardship, and an understanding of fire behavior and the potential for mistakes and unintended outcomes is essential (cf., Johannes and Lewis 1993).

CONCLUDING REMARKS: IMPLICATIONS FOR ETHNOBIOLOGY

Evidently more research and new strategies are required to investigate fire ecology and Aboriginal burning. Interdisciplinary dialogue is also essential to informed anthropological discourse. Systems of ethnobiological classification incorporate important species level information but are not an adequate representation of Aboriginal fire use and knowledge. I have commented on the volatile nature of fire and the potential for disputes and social tension due to mis-management. Loss of fire control appears more frequent than is acknowledged and problems are inevitable given the nature of children and the inherent disparities in human intentions and competence. Social upheaval may be a key to revealing Aboriginal perspectives on environmental phenomena and ecological processes as well as the socio-political context of burning. For ethnobiology in general, there is clearly a case for a broadening of theoretical dimensions as a means of understanding the application of ethnobiological knowledge in practical resource management. The analysis of conflict will open up new ethnographic ground and may bridge the divide between the ethnoscience school and other branches of anthropological inquiry.

NOTES

[1] This issue is far from resolved. The literature on prehistory and paleoecology is vast and a discussion beyond the seminal viewpoint of Jones and Horton's influential response is not warranted here. Stephen Pyne (1991) has produced a well-crafted and comprehensive synthesis of existing material from a range of disciplines and makes some interesting comments on the evolving interdependence of flora, fire and humans. Flannery (1995) provides another important account including an argument for the role of Aboriginal burning in consuming accumulated fuel and increasing fire frequency following the extinction of the herbivorous megafauna (cf., Bowman 1991). But despite the widespread influence of Jones' thesis most researchers would agree that evidence is sparse, and the issue will remain contentious until much more research is done (Bowman and Brown 1986; Bowman 1995b; Latz 1995b).

[2] My background, prior to anthropology, was in agriculture, forestry and park management. I have witnessed, and been involved in, many incidents in which experienced personnel have made incorrect judgments and lit fires which have reacted rapidly to unforeseen conditions.

[3] A kangaroo relative and a member of the family Macropodidae.

[4] In 1992 Professor Henry Lewis wrote: "... consideration of the social dimensions involved in such activities have all but been ignored." (p. 23). This situation has not substantially changed since.

[5] See note 3, above.

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ABSTRACTS OF PRESENTATIONS

at the 19th Annual conference of the Society of Ethnobiology
Santa Barbara Museum of Natural History
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Plants in Mexican Folk-Art, Alamos, Sonora: *ADAMS, Karen R. Crow Canyon Archaeological Center.*

A trip to the old mining town of Alamos in southern Sonora, Mexico, turned up some interesting folk-art. Hispanic women and their families in the small nearby village of La Aduana are making a wide variety of items, primarily from locally available materials, to sell to tourists. Their crafts include necklaces, bracelets, rosaries, wreaths, dried flower arrangements, corn husk dolls, carved wooden animals, and insects with innovative wings. This folk-art is both pleasing to the eye and easy on the earth.

Latest News on Old Bones: Interactions Between Humans and Mammoths in North America (keynote address): *AGENBROAD, Larry, Dept. of Geology, Quaternary Studies Program, Northern Arizona University.*

Mammoths existed on the North American continent from 1.7 million years ago to 11,000 years ago. In that interval they radiated—geographically and biologically—to occupy nearly every habitat on the continent, north of the tropical rain forests. Humans were contemporary with New World mammoths for at least ±500 years (11,500–11,000 yr B.P.) prior to their extinction. Were they a causal factor in extinction, or did they deliver the coup de grace to a population already in stress?

Cultural Aspects of Maize Corn in the Central Mainland of Mexico: *ALVAREZ DEL CASTILLO, Carlos, National School of Anthropology and History and RODRIGUEZ CHAVEZ, Juan Manuel, School of Sciences, National Autonomous University of Mexico.*

Field studies were carried out on the oral traditions related to maize in four states: Guerrero, Mexico, Michoacan and Morelos. The main topics on which research was focused were: rites of creation and passage, rain ceremonies, and offerings to tender and dry ears of corn. Mexican culture was analyzed using the best known bibliographical sources and all the data gathered among contemporary ethnic groups. Field works consisted in tracking sites where wild maize—known as teozintle—is still extant. This sort of maize is considered to be the ancestor of our tamed brand of maize. In order to assess the survival of cultures' values, polls were performed in four states and 201 ears of corn were collected. As it happened, all of them were identified as belonging to one or another of eight well-defined strains: Maíz Anco, Pepitilla, Conejo, Tuxpeño, Vandeño, Cacahuacintle, Cónico and Zamorano, as well as two races of teozintle, known as Balsas and Valles Altos (*Zea mays* ssp. *parviglumis* and *Z. mays* ssp. *mexicana*).

Tribal Horticulture, Maintenance of Biodiversity, and Park Boundary Issues: *ANDERSON, M. Kat, American Indian Studies, University of California, Los Angeles.*

Many national parks and protected areas have been designated without regard to the role that indigenous people played in modifying the landscapes that are being preserved: many of these areas do not fit the definition of a pristine, unaltered wilderness. Native Americans influenced the structure, composition, distribution, and extent of many vegetation types in different geographic regions, acting as agents of environmental change through plant dispersal, habitat modification, and genetic modification. They influenced biological diversity in wildlands by maintaining ecosystem diversity, patchy environments, and habitats for rare and endangered plant species. Several horticultural techniques employed by California peoples will be discussed using examples from Southern Sierra Miwok, Foothill Yokuts, and Western Mono peoples. These will be compared with examples showing the ecological consequences of managing protected areas with a "hands-off" approach. It is argued that the folk scientific knowledge of native people is an important component which conservation biology has overlooked. Both the application of native wildland management methods and the preservation of long-term ecological associations between native people and wildland environments are valuable complements to other strategies for preserving biodiversity. Indigenous land management and use patterns should be considered when designating new park boundaries.

Seasonality of Catfish Procurement in the American Southwest: *ARNTZEN, Kristen R, University of Michigan, Ann Arbor and SPETH, John D, University of Michigan, Ann Arbor.*

Recent excavations at the Henderson Site, a small 13th-century AD farming village near Roswell in southeastern New Mexico, yielded over 2,000 well-preserved fish bones, including many pectoral spines of the channel catfish (*Ictalurus punctatus*). Studies by wildlife specialists have demonstrated that the season of death of catfish can be estimated from the annual growth increments seen in thin-sections of the pectoral spines. Analysis of a preliminary sample of the Henderson spines suggests that fishing was confined to a relatively brief period in the late summer and/or early fall. Seasonality data derived from five other animal species (bison, antelope, jackrabbit, cottontail, and prairie dog) yield comparable results, indicating that most, and perhaps all, hunting and fishing at Henderson took place between approximately early spring and early fall. These results suggest that Henderson was occupied for only part of each year probably being abandoned shortly after the harvest and reoccupied again the following spring.

Plant Foods and Ceramic Production: What Can One Tell Us About the Other?: *ATTARIAN, Christopher J, Dept. of Anthropology, University of California, Los Angeles.*

Recent disagreements over the degree of political complexity of the Mochica culture postulate either a system of local chiefdoms or a developed agrarian state. The method of production of staple goods is seen as a variable with which degrees of political complexity can be measured. Using a data set of botanical remains at a Moche IV-V (AD 500-750) ceramic production site in the Chicama Valley, Peru, variation within the diet of craft specialists is correlated to different degrees of production intensity. Two questions are asked: (1) can seasonal occupation be determined from the botanical remains? And, (2) are different provisioning techniques evident, and if so, can they be correlated to different degrees of management over production by a controlling institution? From this information an association is drawn from production to managing institutions to the degree of political complexity such institutions imply.

Measuring the Importance of Coast Miwok Use Plants Using the Turner Index: *BECKWITH, Brenda R, California State University, Sacramento.*

Ethnobotanical research with the Federated Coast Miwok (California) centered on a locality of cultural significance. Dr. Nancy Turner's Index of Cultural Significance was modified to measure the importance of plants used. Data were compiled from literary sources and from interviews. The abundance of culturally significant plants was determined by vegetation surveys. Combining these approaches and resulting data, continuity of plant use was demonstrated and the distribution of use plants was mapped. This study has shown that the Turner Index is an important ethnobotanical method and can be easily adapted to a diversity of contemporary Native peoples.

The La Venta Olmec Subsistence Project: *BRADFORD, Katherine, Dept. of Anthropology, California State University, Northridge.*

While Olmec art and architecture have received much attention during the last half-century, Olmec subsistence economies remain poorly understood. This project is designed to investigate the development of settlement and subsistence patterns in the La Venta support area. Work conducted during 1994 and 1995 resulted in the recovery of cultural materials dating to the Early and Middle Formative periods. A comprehensive sampling strategy, incorporating collection of 50-liter samples, was employed. Remains recovered from a house floor include charred maize, squash, beans, and palm nuts.

Trial and Error in the Choice of Medicinal Plants: *BRETT, John A, University of Colorado, Denver.*

A widely held and intuitively attractive explanation for the identification of medicinal plants in prehistory and by indigenous peoples states that "useful plants" are identified through a process of "trial and error." This paper will demonstrate the fallacy of this approach. Specifically, deciding which plants are suitable for trial, and recognizing an "error" can only proceed when there are cultural criteria by which the value or usefulness of a particular plant can be assessed. The value or usefulness of a plant is not based on a random process of sampling, but rather assessed via a thorough knowledge of the environment and clear expectations on what a particular kind of plant should do when consumed or applied in the context of health, illness, and curing.

Why Coprolite and Trace Elemental Studies of Mummies Conflict: *BREWER, Melissa L, University of Nebraska, Lincoln.*

The strontium-based trace elemental analysis of Chinchorro mummies from Chile indicate that this ancient, preagricultural society obtained 90% of its food from the ocean. Previous coprolite analysis showed 50% of the dietary components were from terrestrial plants. An ongoing weight quantification of the coprolites attempts reconciliation of these reconstructions. It appears that the authors of the strontium analysis did not consider that Chinchorro ate mollusk shell and fish bone which are high in strontium. It appears that visual analysis of coprolites underestimates the contribution of meat because meat is completely digested. A realistic dietary reconstruction will result from understanding the biases of different types of dietary analysis.

Wild Plum = "Little Peach": A U.S. Southeast Linguistic Trait: *BROWN, Cecil H, Northern Illinois University, DeKalb.*

Across the U.S. Southeast, Native American languages have linguistically accommodated the European introduced peach by referring to it through use of respective terms for the native plum. This has taken the form of marking reversals in which native words originally designating plum have shifted in reference to peach, with modified (overtly marked) "peach" terms used to denote plum (e.g., "little peach" = plum). Marking reversals were motivated throughout the region by a radical change in the relative cultural importance of the two referents, wherein, the introduced peach surpassed the native plum in salience. Since this lexical flip-flop occurs only infrequently and sporadically in other North American languages, it is clearly a Southeast areal trait. Its distribution is probably accountable both to diffusion (facilitated by area *lingua francas* such as Mobilian Jargon) and to independent development.

The Meaning of Maize in Upland Southeast Asia: *BURCH, Carmen, Connecticut College.*

Introduced to Southeast Asia over 400 years ago, maize has altered human-environment relationships and reshaped the economies of swidden cultivators throughout the region. Now, often deemed a "native" crop by those who grow it, in many cases, maize, not rice, serves as the staple food. It is tempting to interpret these transformations in positive terms, as a Southeast version of maize as "enabler"; however, local judgements, as encoded in myth, ritual, and daily practice, offer a more equivocal view of this American plant. Based on field research with the ToMaki, a Toraja people living in the interior mountains of Sulawesi, this paper considers the cultural role and meaning of maize in Toraja society. Unlike rice, a crop synonymous with food and life itself, maize is associated with death. ToMaki thinking about maize is a reminder that plants called "foods" have many facets, and when eaten, say many things.

Advances in the Study of Medicinal Plant Complexes of Mexico: *Toloaches* (*Datura*) and *Arnicas* (*Heterotheca*): *BYE, Robert, Instituto de Biología, Universidad Nacional Autónoma de México (UNAM), LINARES, Edelmira, Instituto de Biología, UNAM and DELGADO, Guillermo, Instituto de Química, UNAM.*

Medicinal plant complexes (groups of taxonomically distinct plants that share similar folk names, forms and purposes of utilization and morphological characteristics) probably have similar chemical composition or pharmacological activity. The dominant taxon (popularly accepted as the most effective) is employed outside of its area of natural distribution while the other taxa are substitutes. *Toloaches* (at least 6 species of *Datura*, Solanaceae, of arid lands) are applied to various skin ailments and have tropane alkaloids. *Arnicas* (20+ taxa, mostly Asteraceae) are used for skin ailments and to reduce inflammation and are dominated by *Heterotheca inuloides* (Asteraceae).

Fish and Fishing at Cuello, Belize: Evidence from the 1990-1993 Excavations: *CARR, H. Sorayya, Boston University and FRADKIN, Arlene, Florida Museum of Natural History.*

Renewed excavations in 1990-1993 at the Maya site of Cuello provide an opportunity to expand upon insights derived from previous work, particularly regarding the Middle Preclassic period. New faunal data provide further substantive evidence for previously suggested changes over the course of the Preclassic in the quantity and kinds of fish used by this inland community. In the Middle Preclassic, fish was a minor resource procured mainly from freshwater bodies, but Cuello already had coastal contacts, as evidenced by the presence of several marine species.

Evolution of Concepts in Ethnobiological Studies: *CLÉMENT, Daniel, Canadian Museum of Civilization.*

Every scientific discipline defines itself among other things by particular concepts. The history of ethnobiology which spans one century has seen its interest in traditional societies shift from utilizations of living organisms, to their classification, to knowledge people have of the same organisms. Such a shift was accompanied by the use of different concepts either in defining the subject of study or in the methods used to gather data and analyse it. With the use of concepts such as "knowledge," "natural history," "folklore" and the more recent "TEK" for "traditional ecological knowledge" and the very seldom "science" to qualify other peoples' representations of living organisms, ethnobiology has not really advanced in recognizing that other societies can have true sciences. The same conclusion stands out when one examines the evolution of studies devoted to classification: the authors very seldom use such concepts as "species" and "genus" in the Western sense to qualify other peoples' taxonomies, preferring when they are not basing themselves on a Linnean model, new terms which are more and more ambiguous and tend to hide the nature of other peoples' ordering systems. If ethnobiology wishes to evolve, it should leave ethnobiology to ethnobiologists and biology to every other society's relationship to living organisms inasmuch as these relationships are based on reason and logic (logos) which is the essence of science.

Are Farmers' Rights Contingent on Conservation?: *CLEVELAND, David A., University of California, Santa Barbara.*

Discussion of the rights of local and indigenous farmers over crop genetic resources is polarized, with one side arguing for the rights of farmers to their traditional folk crop varieties (FVS). It is often implied that farmers have inherent rights to their FVs because they conserve this biodiversity within sustainable farming systems, and that this is valuable for the world community. Those who disagree cite examples of the lack of genetic conservation and sustainability in traditional farming systems and the need for rights to genetic resources to be based on Western, industrial concepts. It is, therefore, important to understand the extent to which farmers' rights are or are not contingent on their conservation, the role of FV conservation in sustainable farming systems, and under what conditions farmers do conserve the genetic diversity of FVs. Discussion of data and values relevant for these issues is important for progress at the FAO Fourth International Conference on Plant Genetic Resources and at the meetings of the Convention on Biological Diversity later this year.

Northern Sinagua Diet and Subsistence: An Evaluation of Current Models of Sociopolitical Organization and Settlement Pattern: *CONRAD-REINGOLD, Bruce G., Northern Arizona University.*

Until recently little paleoethnobotanical research had been conducted on diet and subsistence among the Northern Sinagua of the post Sunset-Crater eruption Angell, Padre, Elden, and Turkey Hill phases in the Flagstaff locality of the Colorado Plateau. Building on Hunter's research, quantified data obtained from analysis of macrobotanical remains from three roughly contemporary habitation sites of varying size is used to evaluate competing models of Northern Sinagua sociopolitical organization and settlement pattern proposed by Pilles (sedentary chiefdom society, hierarchical settlement pattern, intensive agricultural production, complex trade networks) and Kamp and Whittaker (semi-sedentary egalitarian society, dispersed non-hierarchical settlement pattern, mixed subsistence).

Tooth Tartar as a Clue to Diet: *CUMMINGS, Linda Scott, Paleo Research Labs and MAGENNIS, Ann, Colorado State University.*

Diet often is reconstructed based on indirect evidence. Human tooth tartar traps food particles, preserving a record of food consumed. Dental calculus removed from primary and secondary burials at Kichpanha, a lowland Maya site in north central Belize, was examined to identify imbedded phytoliths, starch granules and debris as indicators of diet. Kichpanha is a small, peripheral site occupied from the Preclassic to the Early Postclassic (900 BC - 900 AD).

Giraffe Meets Llama and Wallaroo: Animals in Rock Art on Three Continents of the Southern Hemisphere (poster): *DEAL, Nan, Santa Barbara Museum of Natural History.*

This photographic poster presentation examines the relationships of humans with animals among the hunting peoples of Tanzania and Northern Australia through their rock paintings, and among the pastoralists of Northern Chile through their immense geoglyphs.

The Biogeography of Mesoamerican Textiles (poster): *DeAVILA, Alejandro, University of California, Berkeley, and SERBO, A.C.*

Spinning, dyeing and weaving represent the most diversified technology in the material culture of contemporary Mesoamerican peoples. This paper examines the traditional use of textile fibers and dyestuffs of plant and animal origin in Mexico and Guatemala in relation to the geographical patterns of biological diversity in this region. Based on fieldwork in several areas of Mexico and a review of the literature, I map out the distribution of fibers and dyes in nine broad subregions. The number of species used in textile manufacture, as well as the size of the repertory of fabric structures, correlates well with the relative magnitude of the estimated total flora and fauna of each area, and with the number of languages spoken there, as a measure of cultural diversity. Two regions stand out in this survey: Oaxaca and the Maya lowlands as the areas of respectively greatest and lowest diversity. I trace the biogeographic affinities of salient plants used as fibers and dyes, and find a greater representation of lineages of neotropical origin than might be expected by chance. In addition to the maps, I include a listing of species documented for different regions, and brief descriptions of the traditional use in Oaxaca of two plant colorants and a mollusc dye not previously recorded, as well as two bark fibers and a wild silk formerly gathered to be netted or woven.

Developing Curriculum in Ethnobotany: *ELOHEIMO, Marja, The Evergreen State College, Olympia.*

Students are seeking and educators are designing curriculum in ethnobotany. This paper describes one undergraduate level year-long "Series in Ethnobotany." Discussion includes: growth and change of curricular content; value of a regional approach; academic and institutional contexts; role of involvement in community-based projects such as campus and museum ethnobotanical gardens, regional American Indian basketmakers' gatherings, and a Tribal medicinal native plant garden; the addressing of intercultural and environmental complexities; and consideration of instructional philosophy and goals.

The Creation and Maintenance of Soil Fertility in a Subsistence Agriculture in Portugal: *ESTABROOK, G.F., University of Michigan.*

Eastern Central Portugal contains an area of soft, precambrian shales that have eroded into steep-sided hills with sparse soil, very low in nutrients and available water capacity, and readily eroded during seasonal rains. In the 13th Century, some people left the fertile soils of basaltic origin nearby to settle in these infertile shale hills (perhaps to escape plague or economic suppression). The agricultural technology they developed, based on cycling large quantities of organic matter, has sustained human life for six centuries. Data sources for this paper include: 300 years of church records, five months' personal interviews and observations, and laboratory analysis.

Gender in Maya Plant Taxonomy: A Cultural Logic (poster): *FAUST, Betty B., Sección de Ecología Humana,Unidad Mérida, Mexico.*

Research with a Maya hmèen (a priest-shaman, expert in ritual practice, traditional knowledge, and healing) in Campeche, Mexico (1992-95), has revealed that Maya definitions of plant gender provide a mechanism for distinguishing species of similar appearance which grow in the same habitat. The definitions of gender are not related to those used by botanists, but rather to characteristics of human gender in Maya culture. These characteristics form a set of binary oppositions used to differentiate similar species, in many cases differentiating plants most useful for medicine from those which closely resemble them but are less effective. The logic of gendered differentiation extends beyond the cases where the distinction is useful in plant medicine to a set of general rules applicable to all plants; however in practice, the reference to gender occurs almost exclusively in situations involving the procurement of plants for medicine.

Paleo-Indian Diet in the Southern San Joaquin Valley: *FENENGA, Gerritt, California State University, Bakersfield.*

Archaeological research in the Tulare Lake Basin of the Southern San Joaquin Valley of central California is beginning to provide a picture of early human ecological adaptation in this region. Data recovered from lakeside sites containing fluted projectile points and other diagnostic early artifacts suggest the inhabitants exploited a broad spectrum of resources. These include a variety of lacustrine species such as fishes, turtles, and birds. Shellfish, although present, do not appear to have been utilized. Terrestrial species were also used, and these range from micromammals to large extinct game, including *Bison* and *Mammuthus*. The diversified nature of faunal assemblages from these early sites indicates Paleo-Indian diet was not unlike that of later opportunistic hunter-gatherers. The lack of shellfish suggests it is unlikely that early lacustrine adaptations of Paleo-Indian groups in the interior of western North America were a pre-adaptation for coastal shellfish exploitation, if these populations later migrated to coastal areas as some scholars have suggested.

A Multi-Cultural Perspective on Prehistoric Agriculture: *FISH, Suzanne K., University of Arizona and FISH, Paul R., University of Arizona.*

As part of a recent archaeological project in central Arizona, five Native American traditional farmers evaluated the productive potential of a designated study area and the prehistoric agricultural remains within it. Because indigenous cultivators did not occupy the area during post-contact times, these consultants came from surrounding regions of the Southwest and were of four different cultural affiliations. Although they agreed on aspects of agricultural practice and potential, none were able to effectively assess local variables critical to cropping, such as the timing of frosts and precipitation. The backgrounds of these individuals also differ in social and technological repertoires related to farming. Consultant comments underscore the importance of highly localized knowledge and suggest factors that should be considered when studying population movements of agriculturalists in the past.

Retention vs. Loss of Ethnobotanical Knowledge: A Northern Paiute Example: *FOWLER, Catherine S., University of Nevada, Reno.*

Without doubt, present-day Northern Paiute people know less about their natural worlds than did their ancestors. There are some obvious reasons for this: changes in subsistence and settlement, patterns of knowledge transmission, loss of language, etc. But the exact process still remains to be better documented. Through the analysis of museum collections, early vocabularies and field notes, and more recent fieldwork, an attempt is made to quantify some of the rates of loss among Northern Paiute peoples, and to discuss why some of the data pattern as they do.

Pollen Washes and Archaeological Inference: *GEIB, Phil R., Navajo Nation Archaeology Department, and SMITH, Susan J., Laboratory of Paleoecology, Northern Arizona University.*

It is common practice in archaeology to collect pollen from grinding tools to make inferences about plant use. Adequate interpretation of pollen wash data depends upon understanding how pollen becomes deposited on grinding tools. Pollen may indeed be present on edible plant portions, but does it survive various preparation techniques such as roasting and parching? If pollen survives, how much would become deposited upon grinding tools? To help answer these queries, we conducted a series of experiments designed to provide an independent frame of reference between the processing of various seeds and the deposition of pollen. We winnowed, parched, and ground seeds of various grasses and weeds commonly exploited by prehistoric people of the Colorado Plateau. *Zea mays* was also processed. The seeds were washed for pollen before and after parching, and pollen washes were collected after grinding both raw and parched seeds. The results of our experiments are detailed and implications presented regarding the interpretation of pollen washes from archaeological grinding tools.

The Use of Fresh-Water Mussel Valves in Shelling Green Corn by Indians of the North American Prairies and Plains: *GRADWOHL, David M, Dept. of Anthropology, Iowa State University.*

This presentation discusses the contemporary, ethnographic, historic, and archaeological evidence for the use of fresh-water mussel shells as implements in shelling green corn. Today, the Mesquakie Indians of central Iowa harvest green or "milk" corn in the summer. The corn is parboiled and then shelled off the cob by using clam shells collected along the Iowa River. To date, this practice is documented for eleven Native American groups in the North American Prairies and Plains extending back to the period of first observations by French explorers. Similar fresh-water mussel shell artifacts are found along the Des Moines River at archaeological sites of the Oneota Tradition (ca. 1000-1200 AD), along with evidence for the growing, harvesting, storing, and processing of corn. Comparable objects are noted in other Iowa sites, as well as some in Missouri, Kansas, Nebraska, South Dakota, and North Dakota. The documentation of this practice for nearly 1000 years into the preset is symbolic of the many continuities of Native American dietary and religious traditions in the face of so-called assimilation by Euro-Americans.

Medicinal Mushrooms: *HOBBS, Christopher, Institute for Natural Products Research.*

The cultural use of fungi for food, medicine, wound dressing and other external applications, and as a source of dye is common throughout the world. In Asia, over 200 species are mentioned as medicinal agents in the *Fungi Pharmacopeia*. A number of fungi were known to the ancient Greeks and Romans for use as medicines, some of which, such as the "panacea mushroom," *Fomes officinalis*, were official in Western pharmacopeias from the 18th and 19th centuries. Species from the family Polyporaceae like Reishi and Maitake, as well as shiitake from the Tricholomataceae are considered cultural treasures in Japan and China. Modern medicine has supported the use of a number of immunomodulators in the treatment of cancer and AIDS, among a host of other chronic diseases. Members of the genus *Psilocybe* and *Amanita muscaria*, the fly agaric, are used in parts of Europe, Mexico, and South America in healing and divinatory rituals.

A Utility Profile Analysis of Artidactyl Remains from Tommy Tucker Cave (CA-LAS-1): *HOLANDA, Kimberley L., California State University, Chico.*

Over the past two decades, the validity of body part representation as a means of assessing site function related to strategies of hunter-gatherer subsistence and settlement have been both supported and questioned. Artiodactyl remains from Tommy Tucker Cave exhibit strong patterning in the presence and absence of particular elements and element portions. Taphonomic issues, such as density mediated attrition and the activity of scavengers, are addressed and dismissed as bearing responsibility for the observed patterning. It is suggested that the Tommy Tucker assemblage reflects decisions made by hunter-gatherers related to the differential processing, transport, and discard of carcasses. The analysis provides insight into how the cave may have functioned, particularly in relation to settlement, mobility, and hunting related logistics.

The Role of Ethnobotany as a Linkage Between the Worlds of Ecosystem Management and Native Americans: *HOUSLEY, Lucile A., Botanist, Bureau of Land Management, Lakeview, Oregon, and HANES, Richard C., Oregon State Archaeologist, Bureau of Land Management.*

In the process of the social assessment report for the Interior Columbia Basin Ecosystem Management Project, the role of cultural plant uses and recognition of plant communities was a starting point for dialog between the Government cultural land managers and the people living within tribal communities. Ecosystem management is perceived by Federal and State land agencies as a hierarchy of decision making based on a linear, one-directional model. However, the world view of natural resources by traditional American Indians is based on a mutual intercausality which can be viewed as an interconnected cycle. The key role that ethnobiology played in the process which culminated in a document will be discussed, as well as the two-way dialog which has begun to help define future land use management.

Zooarchaeological Evidence for Changes in Cervid Biogeography: Prehistoric Deer and Elk Hunting in Coastal Southern California: *HUDSON, Jean, Dept. of Anthropology, University of California, Los Angeles.*

Exceptional organic preservation at the archaeological site of SBA-1010, Barka Slough, yielded a large sample of identifiable cervid bone dating between roughly 2900 BP and 1300 BP. Taxonomic and metric analyses suggest the presence of tule elk (*Cervus elaphus nannodes*) as well as abundant California mule deer (*Odocoileus hemionus*). Some of the individual deer are of unusually large size relative to modern comparative specimens. Local environmental reconstructions suggest possible correlation with a period of cooler and wetter climate. Zooarchaeological analysis, including deer body part distribution, adds to our understanding of the relative importance of marine and terrestrial resources in local prehistory, implying a forager, rather than a collector strategy.

Salish Narrative Character Speech and Traditional Ecological Knowledge: *IGNACE, Marianne B., Simon Fraser University and Secwepemc Cultural Education Society.*

This paper will demonstrate how the speech of animals and other characters in Interior Salish mythical discourse provides a way of encoding and inscribing onto collective memory, traditional ecological knowledge about animals, plants, the territory, and their interrelationship. While the linguistic and aesthetic aspects of character speech have previously been examined, their ethnobiological dimension has largely remained unexplored. Drawing on examples from Interior Salish narratives, this paper will contribute to our understanding of indigenous forces of disseminating traditional ecological knowledge.

Gum and Resin Chewing by the Maasai of East Africa: *JOHNS, Timothy, McGill University, Quebec, and MAHUNNAH, R.L.A., Institute of Traditional Medicine, Tanzania.*

A questionnaire on patterns of chewing of gums and resins from plants was carried out with 100 Maasai women and men in Tanzania and Kenya. Eighty-five percent of those interviewed chew gums. More than 80% of women and 65% of men chew at least once a week. Among the 10 gums and resins identified in the survey, *Commiphora africana* (osilalei) was preferred by 90% of the persons interviewed. Gums may play a positive role in the lipid metabolism of the Maasai.

Some Aspects of Marine Subsistence at Shuku, Rincon Point, During 2,000 Years of Chumash Occupation: *JOHNSON, John R., Santa Barbara Museum of Natural History.*

In 1988, an opportunity presented itself for the Santa Barbara Museum of Natural History to conduct archaeological test excavations at CA-VEN-62A, the former site of the coastal Chumash town of Shuku. Radiocarbon dating reveals that the base of the shell midden dates to about 2,000 years BP. Site occupation spans most of the Middle Period and all of the Late Period in Chumash prehistory. Major climatic events transpired within this period that have been argued to have led to major transformations in Chumash society. This study examines several categories of invertebrate and vertebrate remains to reconstruct marine subsistence shifts that may correlate with episodes of environmental change.

Gitksan Plant Classification: *JOHNSON-GOTTESFELD, Leslie M., Department of Anthropology, University of Edmonton, Alberta.*

The Gitksan have a roughly hierarchical classification of plants. The general domain 'plant' is unmarked. Several broad groupings of the "life form" sort can be distinguished. Three of these are large groupings composed of a number of subordinate generics: trees, '**gan;**' 'plants,' '**sgan;**' and berry or fruit plants, '**maa'y.**' 'Plants' include a diverse mixture of forms ranging from small trees, to perennial herbs and prostrate sub-shrubs. The 'plant' and the 'berry' groups overlap extensively. The remainder are residual taxa which are "empty" containing a few or no named subtypes: grass or hay, '**habasxw;**' 'leaves,' or herbaceous plants, '**yens;**' 'flowers,' '**majagalee;**' moss, '**uumhlw;**' and fungi, '**gayda ts'uuts.**' Ninety-one distinct generics (excluding synonyms) have been documented; 83 represent vascular plants and eight represent mosses, fungi and lichens. A mixture of morphologic and utilitarian characters seem to underlie the system of plant classification. The relationship of partonomy to utility and classification is explored.

Assessing Traditional Resource Management for *Sabal uresana*: *JOYAL, Elaine, Arizona State University, Tempe.*

An ethnoecological approach was designed to assess traditional resource management (TRM) for *Sabal uresana*, a wild-harvested palm native to Sonora, Mexico. Participant observation and formal interviews identified the following harvest practices: limiting access to populations, "sparing", controlling harvest times and levels, and choice of leaf age and palm size. Surveys across populations identified several patterns of size-class distribution and harvest. Leaf size was found to be larger in unharvested palms. Experimental harvests reduced leaf production, thus slowing palm growth. A matriz model found lambda ≥1. Survival, especially of the larger size-classes, accounted for ca. 90% of total elasticity. Simulations of observed harvest response changed the stable-stage distribution. Thus, "sparing" is the single most important contributor to long-term population maintenance ("alpha" management). However, leaf harvest practices, while more subtle, affect population structure over time ("beta" management). This study provides a model for assessing TRM for wild-harvested species and for identifying practices which function as *de-facto* conservation traditions.

Archaeofaunal Patterns in Rural Gold Rush Mining Communities: An Example from Northern California: *JUNG, Shannon, California State University, Chico.*

The analysis of the faunal assemblage from Forks of Butte (CA-BUT-854) offers insights into the economic and ethnic composition of a rural mining community during the early period of the California Gold Rush. The faunal remains are part of a large refuse dump that was generated by Riley's Inn. The quality of pork and beef suggests that members of Forks of Butte had low economic status. The comparison of the Forks of Butte faunal assemblage with assemblages from urban Euro-American sites, of the same time period, reveals significant differences in the types and proportions of species consumed. The greater proportions of pork and chicken, in comparison to beef and duck, are more similar to historic faunal assemblages from urban Chinese sites.

Anthropogenic Enhanced Fire Regimes: "Aboriginal Overkill?": *KAIB, Mark, Laboratory of Tree-Ring Research, University of Arizona, BAISAN, Christopher, Laboratory of Tree-Ring Research, University of Arizona, and SWETNAM, Thomas, Laboratory of Tree-Ring Research, University of Arizona.*

The extent of anthropogenic effects on ecosystems through use of fire is the subject of some controversy. Fire-scar chronologies from a network of 63 sites in the Southwestern United States can be used to test the extent of such anthropogenic ecosystem influence. While individual sites display a wide variety of unique characteristics, as a whole, region-wide fire synchrony is significantly correlated to climate, demonstrating the possible scale of climate-generated ecosystem processes. Some sites display anomalous periods of high fire frequency, which, in context with historical ethnographic accounts and fire-climate data, suggest anthropogenic enhancement. Anthropogenic fire patterns must first be resolved at specific well-documented sites before larger scale, mountain- to region-wide, ecosystem influences can be invoked. Site-specific anthropogenic fire patterns will be analyzed across several spatial scales to illustrate the possible extent of anthropogenic fire effects.

Ethnobotanically-Useful Prairie Plants Collected for Anti-Cancer and Anti-HIV Compound Testing: *KINDSCHER, Kelly, Kansas Biological Survey, University of Kansas, and MANFREDI, Kirk, Chemistry Dept., University of Northern Iowa.*

We have collected 1 lb of material for 30 ethnobotanically useful prairie plants and are subjecting them to anti-HIV and anti-cancer screens. Plants were collected in Kansas, Nebraska, and South Dakota from a list of prairie plants that had medicinal uses by Native Americans of the Great Plains. Species include: locoweed (*Astragalus bisulcatus*), bush morning glory (*Ipomea leptophylla*), and silver-leaf scurfpea (*Psoralea argophylla*). Preliminary results suggest that by using plants that have a history of medicinal uses, even if those uses are different than the screens (HIV and cancer in this case), a higher percentage of positive screens will be found.

Gardens of Eden: An Ethnohistoric Reconstruction of the *Maohi* (Tahitian) Cultivation System: *LEPOFSKY, Dana, Dept. of Archaeology, Simon Fraser University, British Columbia.*

Tahiti, perhaps more than any other Polynesian island, conjures up images of a tropical paradise where beautiful people live in a bountiful lush environment which readily provided for all needs. This image of Tahitians (*Maohi*), promulgated by the earliest European explorers in Polynesia, has influenced the way anthropologists have characterized traditional *Maohi* lifestyle. This is especially apparent in the reconstruction of the *Maohi* cultivation system. However, the view of a non-intensive cultivation system is at odds with what is known about the highly complex *Maohi* socio-political system of the precontact and early contact era. A detailed review of the ethnohistoric literature reveals that the *Maohi* cultivation system was both highly extensive and intensive. Both the coast and inland were extensively cultivated by the *Maohi*. Six cropping subsystems encompassed the cultivation of a diversity of taxa and varieties within taxa. Intensive components of the cultivation system include reduced fallow periods, methods to enhance fertility, terracing, and the construction of irrigation systems. Labor-intensive gardens, where crops were raised exclusively for the elite, illustrate the close relationship between cultivation and the complex socio-political system of the *Maohi*.

Plants Sacred to the Ancient Maya (poster): *LITZINGER, William, Environmetal Studies, Prescott College and BRUCE, Robert, Depto. de Lingüística, Museo Nacional de Antropología, México.*

Approximately 100 plant species are examined which may have had religious importance for the Ancient Maya. Although represented by more than 40 different plant families, many of these species have similar morphological features, such as very distinctive tubular corollas, hairs, spines, and thorns. Discussion of the hypothesis that these plants evoke imagery associated with ancient Mayan cosmological or religious concepts is based on a consideration of the special morphological attributes of these plants, the linguistic analysis of their Maya plant names, and ethnographically and historically recorded details of their uses.

Historic *Vaccinium* Processing in the Cascade Uplands, South-Central Washington: *MACK, Cheryl, Gifford Pinchot National Forest, Washington, and McCLURE, Richard, Gifford Pinchot National Forest, Washington.*

Among the native peoples of south-central Washington state, berries of the genus *Vaccinium* hold a significant place among traditional foods. In historic times, the berries were collected in quantity at higher elevation in the central Cascade Mountains, and the surplus harvest dried for winter use. Berries were dried along a shallow trench using indirect heat from a smoldering log. To date, archaeological investigations in the Gifford Pinchot National Forest have resulted in the identification of 234 *Vaccinium* drying features at 27 sites along the crest of the Cascades. High feature densities demonstrate extensive protohistoric and historic upland land use reflecting the economic and cultural significance of the resource. Analyses have included archaeobotanical sampling, radiocarbon dating, and identification of associated features, incorporating ethnohistoric and ethnographic studies. Site investigations shed new light on the importance of montane resources to Columbia River peoples. Strategies for future research are proposed.

Growth Analysis of Five Populations of "Quintoniles" (*Amaranthus* spp.) from Sierra Norte of Puebla, Mexico: *MAPES, Cristina, Jardín Botánico, Instituto de Biología, Universidad Nacional Autónoma de México, DIAZ, Araceli, Jardín Botánico, Instituto de Biología, Universidad Nacional Autónoma de México, and BYE, Robert, Jardín Botánico, Instituto de Biología, Universidad Nacional Autónoma de México.*

Five populations of green edible amaranths from Sierra Norte of Puebla (*Amaranthus hypochondriacus* L. Africano, Mixteco and Azteca, *A. hybridus* and *Amaranthus cruentus* L. Mexicano) were cultivated for 149 days under uniform conditions in Chalco, Valley of Mexico. Plant height, leaf area, biomass, biomass allocation, and growth rate were measured periodically. *A. hybridus* and Mexicano reached their maximum height more rapidly than Africano, Azteca and Mixteco. The total leaf area of the five populations was significantly different among them, with Mixteco producing the greatest (2.91 m^2). Africano and Mixteco allocated 1.1 and 6% of the standing biomass to reproductive parts 149 days after germination, while Azteca and Mexicano allocated 18% and A. hybridus 42%. The relative growth rate (RGR) was comparable for Africano, Mixteco and *A. hybridus* with a general decline over time. The leaf area quotients (LAQ) for all five populations were at their maximum at the beginning of the cultivation and declined to zero at the end except Mixteco. The pattern of early biomass allocation for vegetative parts and later biomass allocation to reproduction coincided with that of plants selected for edible leaves rather than for grain production. In the vegetable forms, which usually are semicultivated, humans have assured a prolonged availability of edible leaves by selecting plants which delay the development of inflorescences and produce a high proportion of leaves over extended periods of time.

Patterns of Mollusk Use in a Nineteenth Century Colonial Context: *MARTINEZ, Antoinette, University of California, Berkeley.*

While relationships between a human culture and associated living organisms can change dramatically with the arrival of another group, some strategies for survival and success may transcend the changes attributed to "cultural differences." The comparison of archaeofaunal remains from the nineteenth century Native Alaskan Village of Fort Ross and associated Kashaya Pomo villages provides patterns, contrasts, and points of departure for the discussion of the processes of culture change. Supported by extensive archaeological and ethnohistoric data, this presentation will focus on the use of, and attitudes towards, mollusks by the segments of this colonial population defined herein by ethnicity, gender, and political power within a rugged northern California coastal setting.

Contemporary California Indian Basketry Symposium: *Symposium Chair: MATHEWSON, Margaret, University of California, Berkeley, WALLACE, Kathy, Yurok/Karuk/Hupa; DQ University, SCHWALEN, Emily, Cherokee; University of California, Davis, MANRIQUEZ, L. Frank, Tongva/Ajachemem, Sonoma State University, BATES,* *Jennifer D., Tuolumne MeWuk; Chairperson, California Indian Basketweavers Association, UNZUETA, Gilbert, Chumash; Oakbrook Park Chumash Interpretive Center; and PARKER, Julia, Miwok/Pomo; Yosemite National Park.*

Contemporary California Indian basketweavers maintain a close relationship with native plants. This symposium will outline some of the issues faced by collectors in the modern landscape including access rights, land development, spraying of herbicides and pesticides, museum and archival research, and the revitalization of fading traditions. The presentation will begin with a slide show of fiber plants in California.

A Success Story of Rejuvenation of Biodiversity in Denuded Forest for Traditional Health-Care (poster): *MEHTA, M.B., International Tree Crop Research Institute, India Chapter.*

In developing countries where the rich biodiversity of forest is threatened due to heavy demands on it by human as well as cattle populations, efforts were made in the past to reforest through plantations of only economically important species. In the process, rich flora which provided medicinal plant products of great therapeutic value in the Traditional Health Care System were being lost, as no efforts were made to plant other than two or three timber species. The therapeutic values and uses are mentioned in ancient Indian treatises written in 1600-3000 BC. The rejuvenation effort was carried out with people's participation, and 125 species with known therapeutic values and uses were selected for planting in 27,000 hectares of forest in the watershed of a river valley in western India. The success of plantations is visible, and within three years of the work, 15 species of trees were seen to regenerate naturally—a phenomenon not seen in the degraded forests in the last three decades. A list of species with their traditional therapeutic values was prepared and is appended with this paper. The paper is an honest presentation of the author's work in the field, as a forester with 34 years of experience.

Archaeological Investigations of Fish Remains at Ancient Lake Cahuilla: Evidence for Lacustrine Adaptation of Endemic Colorado River Fishes (poster): *MOFFITT, Linda R., Dept. of Anthropology, University of California, Riverside, and MOFFITT, Steven A., Dept. of Anthropology, University of California, Riverside.*

The remains of native Colorado River fishes, currently listed as endangered or threatened species, were recovered at seven of twenty-eight archaeological sites recently investigated along the shoreline of desiccated Lake Cahuilla, in the Coachella Valley, Riverside County, California. The fish elements collected support evidence obtained at thirty-one additional Lake Cahuilla sites for the predominant presence in the lake of two of the five known native Colorado Riverine fishes, the Razorback sucker (*Xyrauchen texanus* [Abbott]) and the Bonytail chub (*Gila elegans* [Baird]). The essentially exclusive presence of these two species in the archaeological assemblages associated with the lake reflects the successful adaptation of these riverine species to a warm-water lacustrine environment in prehistory.

Recycling Ethnoherpetological Knowledge: Marine and Desert Reptiles in Seri Indian Crafts Promotion and Environmental Education: *NABHAN, Gary Paul, Arizona-Sonora Desert Museum, ROSENBERG, Janice, University of Arizona,*

ROMERO, Pedro, Seri Tribal Governor, and LAWLER, Howard, Arizona-Sonora Desert Museum.

The Seri Indians of Sonora, until recently, depended upon marine and land reptiles to meet a significant portion of their dietary needs; reptiles were also important symbols in art and religion. Over the last three decades, sea turtle populations in the Sea of Cortez and desert tortoises on the Sonoran mainland have dramatically declined; however, desert tortoise and chuckwalla densities remain high on Tiburon and San Esteban Islands, where the Seri are biosphere reserve managers. At the request of the tribal governor, we collaborated with the Seri elders to develop a primer for Seri schoolchildren focusing on the cultural significance, natural history and economic importance of these reptiles so that traditional knowledge and values could be reinforced in a school setting. In addition, we have promoted Seri carvings of desert and marine reptiles, a craft which acknowledges the Seris' distinctive ethnobiological knowledge.

Las Aves en el Pensamiento Teotihuacano y Maya: *NAVARIJO ORNELAS, Lourdes, Instituto de Biología, Universidad Nacional Autónoma de Mexico.*

Son estudiadas las aves que figuran en la pintura mural prehispánica del sitio de Teotihuacan en el Valle de México, así como las plasmadas en los muros de cinco sitios mayas de la República Mexicana. El objetivo de esta presentación es el de dar a conocer a la riqueza de especies utilizadas como objetos culturales en el lenguaje pictórico, lo que nos provee, en primer término, de valiosa información biológica. En segunda instancia, nos acerca a las formas de pensar de estos pueblos, en razón de que en cada una de las escenas pictóricas se puede leer el papel de las aves como símbolos para expresar y perpetuar ideas y conceptos que denuncian la existencia de mecanismos de asociación entre los eventos naturales y los culturales que influyeron en la vida de los teotihuacanos y mayas.

(Birds in Teotihuacano and Mayan Thought)

(Birds depicted in prehispanic mural painting from the site of Teotihuacan in the Valley of Mexico were studied, as well as the wall frescoes of five Mayan sites in the Republic of Mexico. The objective of this presentation is to give an idea of the richness of species utilized as cultural objects in pictorial language, which firstly provides us with valuable biological information. Second, we address the thought processes of these communities, since in each of the pictorial scenes one can read the role of birds as symbols to express and perpetuate ideas and concepts that indicate the existence of mechanisms of association between natural and cultural events that influenced the lives of the Teotihuacanos and Mayas.)

Stable Carbon Isotopic Discrimination of Maize and Bison in the Central Great Plains: *NELSON, Gretchen A., University of Nebraska, Lincoln, and REINHARD, Karl J., University of Nebraska, Lincoln.*

In the central Great Plains, bison and maize are two main sources of C4 signal in historic and prehistoric diet. As part of repatriation analysis sponsored by the Omaha Tribe of Nebraska, stable carbon and stable nitrogen analyses were conducted of Omaha skeletons dating between 1780 and 1820. Analysis of collagen alone indicated a change in diet, probably reflecting increased meat consumption over time. Analysis of bioappetite clearly shows that the historic diets of the Plains were reliant on bison meat. The value of appetite analysis in diet reconstruction has been accepted only in the last two years. This analysis shows that such studies are especially useful in distinguishing C4 plant versus C4 meat signals in archaeological bone.

Taproots, Taboos and Transformations: *PEACOCK, Sandra L., University of Victoria, British Columbia, and TURNER, Nancy J., University of Victoria.*

Balsamroot (*Balsamorhiza sagittata*, Asteraceae) figures prominently in traditional lifeways of the Salishan-speaking people of the interior of British Columbia. It was a dietary staple, a powerful medicine and a spiritual helper. Clues to the cultural significance of balsamroot lie in its chemical constituents and the manner in which these are transformed through culturally prescribed practices. In this paper, we examine the nutritional and medicinal properties of this taprooted perennial and discuss the methods used to transform it from a low-use plant into a highly-valued resource.

Without Willow: Replacement Patterns and stylistic Outcomes in Western Mono Basketry: *POLANICH, Judith, Hearst Museum, University of California, Berkeley.*

Prehistoric migrations brought Mono peoples from the east to the west flank of California's Sierra Nevada, into a new biotic environment. Essential Owens River willow species were no longer available for use in twined basketry and the Mono chose replacements from chaparral species abundant in their new home. In this paper, I reconstruct how the Western Mono identified, tested, and standardized use of the several plants which replaced the riparian willows. These new materials brought about profound but subtle changes in culinary baskets and caused a stylistic revolution in baby cradles, essentially creating what we now know as Western Mono twined basketry.

The Dynamics of Chinampa Agriculture: A Middle Postclassic Case Study: *POPPER, Virginia S., Institute of Archaeology, University of California, Los Angeles.*

Chinampa farming, the system of raising fields in the swampy lakes of the Basin of Mexico, has long been recognized as a remarkable form of intensive agriculture. The study of plant remains from a Middle Postclassic (AD 1150-1350) Chinampa settlement in Lake Chalco illustrates that chinampa farming was a dynamic system, varying according to natural and cultural conditions.

Which Came First—The Cowboy or the Tumbleweed?: *PUSEMAN, Kathryn, Paleo Research Labs.*

Russian thistle (*Salsola* sp.), also called tumbleweed, is noted in botanic literature to have been introduced into North America around 1873 or 1874; however, charred *Salsola* seeds have been recovered from prehistoric archaeological sites in Utah, Colorado, Nebraska, and Wyoming. Two charred *Salsola* seeds were recovered from a hearth at Site 5WL1794 in northeastern Colorado that yielded a radiocarbon date of 2970 ± 90 BP. The two charred seeds were sent to the University of California Radiocarbon Laboratory for AMS dating. These two seeds yielded a prehistoric radiocarbon date, providing a strong argument for the presence of a native *Salsola* in North America prior to the 1800s introduction.

"He Never Paid Them for Their Acorn Trees": Conflicts over Gathering Rights in the Yosemite Valley in the Late 19th Century: *RAYMOND, David, San Francisco State University.*

After the Yosemite Valley was made a park in 1864, some of the indigenous Ahwahneechee Miwok continued to live there, surviving by working in the tourist industry, and by hunting and gathering. In 1869, the Yosemite park manager banned "cutting oak limbs" to harvest acorns. The Ahwahneechee responded that he had never paid them for the Valley, nor for the trees. What did the park manager hope to accomplish by this restriction? Why did the Indians respond by asserting their land rights in the Valley? The answers to these questions illustrate the difficulties of using historical accounts as sources of ethnobotanical information.

Can Ethnobiology Really Contribute to Alleviating Native American Diabetes in the Plains?: *REINHARD, Karl J., University of Nebraska, Lincoln.*

In conjunction with the Omaha Tribe of Nebraska, anthropologists from the University of Nebraska have been working to understand the basis for diabetes for six years. This work is done in consort with medical professionals and medical anthropologists who have 14 years of experience with the disease. Initially, research was based on the premise that diabetes had a three-part basis in diet, activity patterns, and genetics. Gradually there has been the realization that the disease also relates to grief, familial relations, self-esteem, and an ill-defined factor termed "stress". In the context of these findings, the applied roles of ethnobiology and archaeology are assessed.

Archaeobotany of an Open Residential Site in Stillwater Marsh, Western Nevada (poster): *RHODE, David, Quaternary Sciences Center, Desert Research Institute, Reno.*

Flooding in Stillwater Marsh in the early 1980s exposed a rich archaeological record of marshside habitation in the Carson Sink, western Nevada. Excavations at one site, 26Ch1062, revealed numerous archaeological features, including the remains of at least two probable houses. Flotation analysis of nineteen features from the site resulted in the recovery of abundant plant remains. These remains, coupled with recent analyses of plant remains in coprolites from nearby Hidden Cave, provide new clues into the use of marsh plant resources in the Carson Sink.

Bracken Fern: Collection, Processing and Management for Sustainable Yields of Basket Materials (poster): *RUCKS, Meredith, Heritage Program, Lake Tahoe Basin Management Unit, USDA Forest Service, with KIZER, Mrs. Marie, Washoe Elder, JACKSON, Mrs. Teresa, Washoe Elder, MARTINEZ, Mrs. Joanne, Washoe Elder, and CONWAY, Mrs. Florin, Washoe Elder.*

This poster exhibit describes the first season (August - October 1995) of field trips conducted by the Forest Service and Washoe participants to identify areas where gathering and management of traditional plants would be desirable. Washoe elders, including master basket makers, soon focused on Meeks Bay which includes an extensive meadow accessible to them but restricted from use by the general public. Although the meadow includes many plant resources of interest, the basket makers were intent on locating stands of bracken fern with thick, straight rhizomes. The exhibit will describe the micro-habitat of desirable bracken and rhizome collection and processing by Washoe Elders. The exhibit will also solicit information on bracken ecology and use from others in order to better describe the ecology of basket bracken and design a long-term study of the effects of gathering practices and plant tending for achieving and maintaining rhizome attributes sought by basket makers.

A Model of Indigenous Botany: *SALMON, Enrique, The Baca Institute of Ethnobotany.*

Indigenous plant/healing paradigms will often locate a plant at the center of a cultural cosmological circle. Cycling around the plant are four aspects of the plant-human relationship. These aspects include mental, physical, social, and spiritual relationships to the plant. The aspects are anchored by cultural history, identity, language, land base, and beliefs of the particular culture. Traditional indigenous people synthesize all these aspects and anchors to each other and to the plant in order to construct a paradigm of the plant world: an indigenous botany. The indigenous botany will be presented as a model by which ethnobotanical researchers can compare their perceptions of the particular cultures they study. An indigenous perception of the botanical world is necessary in order to fully comprehend the distinct intricacies of the plant-human relationship.

Evaluating the Toxic Health Hazards to Native Californians Engaged in Traditional Environmental Management Activities (Mathewson symposium): *SCHWALEN, Emily, Ecology Dept., University of California, Davis.*

Conventional exposure risk assessment has been proposed for use in evaluating the toxic health hazards to Native Californians engaged in traditional environmental management activities. Certainly, the present loading of pesticides and other toxics has altered the potential health risks for traditional gatherers and basketweavers from those that were experienced in precolonial times. For those Native Californians that are actively involved in cultural recovery activities, these risks should be known and reduced wherever possible. Cultural survival of the invaluable environmental knowledges and skills of Native Californians requires the physical health and survival of these individuals. While some of the risks associated with traditional practices can be characterized as similar to those experienced by such at-risk workers as farmworkers, many aspects of traditional gatherer exposure are quite different. There are several exposure routes for gatherers, such as continued dermal contact and ingestion of collected materials over extended periods of time, that are quite different from worker exposure. Also, gathered materials include materials used for textiles, food, medicine, fuel, and ceremony. These complex routes of exposure from multiple sources must be considered if reasonable estimates of traditional gatherer risk are to be developed. Several options beyond conventional risk assessment are useful to understand the real health hazards. This approach could be productive for indigenous cultural workers worldwide involved in cultural revival among similarly threatened groups and ecosystems.

Ethnomedicinal Studies in Ladakh (Little Tibet): *SHARMA, G.K., Dept. of Biology, University of Tennessee.*

Ladakh is one of the most secluded parts of the enigmatic Himalayas. Furthermore, its medicinal flora and the indigenous system of medicine—the Amchi system—remain shrouded in the forbidding elevations of this arid and vast plateau. The area under investigation—the restricted region of Shyok and Nubra Valleys adjoining Siachen glacier in Ladakh—faced dereliction in the past. It is, therefore, a virgin site for ethnobotanical studies of the local flora. The present study attempts to investigate the ethnomedicinal lore of the area, known for its remoteness and inaccessibility. The area ranges from 4,000 to 7,000 meters in elevation and lies at 35°20' to 36°10' North Latitude and 78°20' to 82°10' East Longitude.

Crop Population Size and In Situ "Conservation" for Farmers' Needs: *SOLERI, Daniela, Arid Lands Resource Sciences, University of Arizona.*

In traditionally based agricultural communities, farmer selection and management have combined with natural selection to produce crop landraces or folk varieties. In many of these communities there are trends toward reductions in the number of household farming, number of varieties of a species being grown, area of land cultivated, and area devoted to folk varieties. These changes raise questions about the size of remaining folk variety populations and their structure and diversity. Locally adapted population structure and genetic diversity are recognized as contributing to the success of these varieties in meeting low-input farmers' needs. The purpose of this paper is to use current theoretical insights into the effect of small population size on plant populations to investigate, hypothetically, the effect of the sort of reductions listed above on the genetic diversity present in folk variety populations.

Recent Results in Identification of Residues and Adhesives from the Southwestern Great Basin: *STACEY R.J., Dept. of Archaeological Sciences, University of Bradford, United Kingdom, HERON C., Dept. of Archaeological Sciences, University of Bradford, SUTTON, Mark Q., Dept. of Sociology and Anthropology, California State University, Bakersfield, and FOX A., Dept. of Archaeological Sciences, University of Bradford.*

Ethnographic data on the use of natural products as adhesives and sealants is sporadic and unspecified. Recent results of continuing work on the chemical identification of amorphous deposits surviving on stone tools, ceramics, and perishable artifacts from various archaeological sites in the southwestern Great Basin are reported. Materials identified include lac resin, pinyo pitch, and a combination of the two. Implications for aboriginal technology are discussed.

An Update on the Vegetal Cordage from Bayou Jasmine, Louisiana: *STANDIFER, Marie S., Dept. of Plant Biology, Louisiana State University, Baton Rouge, KUTRUFF, Jenna Tedrick, School of Human Ecology, Louisiana State University, and TUCKER, Shirley C., Dept. of Biological Science, University of California, Santa Barbara.*

In ongoing investigations of the vegetal cordage from the Bayou Jasmine site in Louisiana, examples of braided cordage, fiber strands, and plant parts have been studied. A calibrated, radiocarbon date of 1600-1292 BC makes the cordage one of the oldest textile remains in the Southeast. Technical analysis of cordage specimens provided information about the fiber strands and the techniques used in braid construction. The botanical analysis revealed that the fiber strands were made from the roots of a monocotyledonous plant, probably a grass or sedge, which had not previously been reported as a fiber source. DNA analysis is being attempted as a possible aid in identification.

Economic / Ethnobotany in a Liberal Arts Context: Challenges and Strategies: *STURGEON, Karen B., Biology Dept., Linfield College, Oregon.*

In this paper, I trace the development of an economic / ethnobotany course at a private liberal arts institution of 1500 students. I describe the challenges I faced and the strategies I used to locate the course in a curriculum organized around traditional disciplinary boundaries and expectations. As one who trained as an evolutionary biologist and botanist, I describe the strategy I used to educate myself about ethnobotany and to develop a syllabus that would attract and serve the needs of students from several disciplines. I discuss the challenges I faced in focusing on the four Willamette Valley "plant cultures"—agriculture, horticulture, silviculture, and viticulture (an economic botany approach). At the same time, I tried to reflect on the value and meaning of plants in modern and indigenous human cultures in the valley and elsewhere (an ethnobotanical approach). I share these challenges and strategies in the spirit of support for others wishing to develop such a course and encouragement for practicing economic and ethnobotanists interested in developing texts, lab manuals, and other curriculum materials or in offering workshops and seminars for the purpose of sharing their expertise with the wider community of educators.

Quemado Alegre: Explorations of Detail, Scale and Comparability: *TOLL, Mollie S., Museum of New Mexico, and McBRIDE, Pamela J., Museum of New Mexico.*

LA 5047, located in the Mogollon Highlands of Western New Mexico, is a site with remarkable interpretive riches, deriving largely from special preservation conditions. The site includes a pitstructure which burned while still in daily use during the Early Pithouse period (AD 200-600). Collapse of the roof during the fire preserved abundant botanical remains in and around the archaeological features, tools, and containers which structured their everyday use. This study relates a variety of experimental methods developed to recreate burn conditions and extract details of routine subsistence chores. Working with this assemblage forced consideration of questions of scale and comparability of floral data recovered under very different preservation circumstances, in local open sites and dry shelters, and farther afield under diverse climatic and soil situations.

Documenting Plant Knowledge of the Secwepemc of British Columbia: A Collaborative Research Project: *TURNER, Nancy J., University of Victoria, British Columbia, IGNACE, Marianne B., Secwepemc Cultural Education Society / Simon Fraser University, IGNACE, Ronald, SCES / SFU, NICHOLAS, George, SCES / SFU, and KUHNLEIN, Harriet V., Centre for Nutrition and the Environment of Indigenous Peoples, Quebec.*

The Secwepemc Ethnobotany Project, ongoing since 1990, has aimed to document the traditional plant knowledge of these interior Salish peoples of southern

British Columbia. Their territory is extensive and ecologically diverse, encompassing grasslands, forests, and montane ecosystems, and many specialized habitats, all of which are integral to Secwepemc life. This paper explores the complex relationships among various aspects of plant knowledge and use, including: ecological setting, food and medicine systems, plant nomenclature and classification, historical settlement, worldview and past and present land and resource use patterns.

In a Pig's Eye: Javelina Complications of Coprolite Identification: *VINTON, Sheila Dorsey, University of Nebraska, Lincoln.*

Determining the origin of the feces is the first obstacle encountered by coprolite analysts. Several techniques have been developed to determine human origin. In practice, these are primarily "hands-on" evaluations of pre-rehydration morphology, rehydration color, rehydration smell, and content. Recently, purported "human" coprolites from Arizona were submitted for analysis. The coprolites were morphologically consistent with humans, and rehydration characteristics were not unusual. However, the analysis of the contents revealed an unusual dietary pattern most consistent with javelinas. It is clear from this experience that archaeologists and analysts must be familiar with the javelina feces to prevent collection of spurious data.

Out of Africa: The Impact of Millets in South Asia: *WEBER, Steven A., Washington State University, Vancouver.*

When do millets first appear in South Asia? How important were they in the rise and collapse of Harappan Civilization? Previous analysis of millets has been based on scant evidence, meaning that the true significance of millets has not been recognized. Using new data, this paper will explore the role these plants played in early civilizations in South Asia. This new evidence indicates that not only were African millets introduced not all at once but over a long period of time, beginning prior to the third millennium BC, but it is their integration into well-developed subsistence systems in the second millenium BC that is closely associated with significant socio-political change.

Prehistoric Pinniped Exploitation at Two Sites at Point Argüello, California: *WILLIAMS, Christopher, Dept. of Anthropology, University of California, Santa Barbara.*

There is a debate in the archaeological literature concerning whether or not the prehistoric coastal inhabitants of California and Oregon routinely exterminated mainland pinniped populations early in prehistory. One side of the debate argues that pinnipeds were driven to offshore refuges, and coastal hunter-gatherers developed watercraft to continue the profitable exploitation of these animals. Data heretofore presented in this debate is inconclusive. New faunal data from two long-inhabited prehistoric sites near Point Argüello, California, indicate the inhabitants obtained pinnipeds locally on the mainland coast throughout prehistory. Even though some overhunting in the Point Argüello area may have occurred, it does not appear that local mainland populations were ever permanently eliminated. The author has concluded that the Point Argüello inhabitants never had to travel to the Santa Barbara Channel Islands, or trade with island inhabitants to procure pinnipeds.

Herbal Remedies and Cures in Mexico: *WILLIAMS, Nancy, Dept. of Anthropology, University of California, Santa Barbara.*

This project compares and contrasts the use of herbal remedies through autobiographical accounts of childhood illnesses as experienced by women who live in and around the Colonia La Esperanza, Tijuana. Most grew up in rural Mexican households with little or no access to bio-medicine. Examined in this study are the memories of symptoms, remedies, preparations, ritual, and quality of care. Herbs were used for almost every illness. Many of these women currently use the same preparations to treat their own children. This study highlights the significant role herbs continue to play in this economically stressed colonia, despite the copious splattering of bio-medical clinics.

Consequences of Overexploitation on the Leeward and Virgin Islands: *WING, Elizabeth S., Florida Museum of Natural History.*

Evidence for overexploitation of some animal resources accompanies human population increases during prehistoric times in the Leeward and Virgin Islands. Those animals most affected are land crabs and carnivorous reef fishes. This is despite the fecundity of land crabs that can produce a million eggs a year and the legendary productivity of coral reefs. Compensation for the decline of these resources is seen as a shift to relatively greater use of hermit crabs, intertidal mollusks, herbivorous and omnivorous reef fishes, and land vertebrates such as mice and small birds. Options not taken were expansion of the pelagic fishery or more intensive husbandry of introduced animals.

Bison and Wapiti Exploitation in Eastern Beringia during Late Pleistocene / Early Holocene Times: *YESNER, David R., University of Alaska.*

Archaeofaunal data from the Broken Mammoth and Mead sites in the Tanana Valley of east-central Alaska, as well as from the Dry Creek site in the nearby Nenana Valley, suggest that *Bison priscus* and *Cervus* cf. *elaphus* were the two most important large mammal species hunted during the late Pleistocene and early Holocene of eastern Beringia. Current data suggest that obligatory browsers including *Equus* and *Mammuthus* may have become extinct by ca. 12,000 BP, concident with, or immediately preceding, initial human occupation of the region. At the same time, there is increasing evidence that bison and wapiti persisted regionally into late Holocene times (ca. 3,000 BP). Evidence from artifacts, features, and butchering pattern studies suggests that Broken Mammoth and other early sites were seasonal camps for the primary processing of large mammals, birds and fish, and the subsequent caching of meat as well as retransport to secondary villages. Seasonality studies of both mammalian and avian fauna from these sites suggests primary fall / winter utilization, consistent with similar "overlook" sites on the Plains in which bison were hunted in areas blown free of snow. Studies of contemporary bison (*Bison bison*) in the area, while taxonomically distinct, may offer important analogies for reconstructing late Pleistocene / early Holocene subsistence patterns in eastern Beringia.

NEWS AND COMMENTS

"Unity and Diversity in Ethnobiology"

Society of Ethnobiology
20th Anniversary Conference
March 26-29, 1997
at the
Department of Anthropology
University of Georgia, Athens, GA

CONTACT:
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Registration: $60 ($70 after February 14, 1997)
Student registration: $45 ($55 after February 14, 1997)

Send for information about rates for Native American participants and Latin American students.

Papers: Abstracts must be received by January 15, 1997. Individual presentations and symposium proposals are encouraged on all interdisciplinary research that explores past or present relationships between humans and living organisms. The primary author or presenter must be a member of the Society of Ethnobiology. All attending authors must register for the conference. Papers are limited to 15 minutes.

Wednesday, March 26: Board of Trustees and Editorial Board Meetings; Evening: Welcome reception and registration at the Museum of Natural History

Thursday, March 27: Oral and poster sessions; Plenary Session; Reception

Friday, March 28: Oral and poster sessions; Business Meeting; Evening: Banquet ($26), awards and entertainment

Saturday, March 29: All Day Field Trips: Ocmulgee National Monument ($26, includes lunch) or Tallulah Gorge State Park ($26, includes lunch)

Make checks or money order payable to Ethnobiology Conference and send to Ethnobiology Conference Chair, Department of Anthropology, Baldwin Hall, Room 250, Athens, GA 30602-1619 USA. Please enclose a self-addressed, *stamped* postcard, if you want acknowledgment of receipt.

Visit the Conference website at
http://www.flmnh.ufl.edu.anthro.events.ethno.htm

INTERNATIONAL CONFERENCE ON MEDICINAL PLANTS: MEDICINAL PLANTS FOR SURVIVAL

From 16 to 20 February, 1998, there will be an International Conference on Medicinal Plants Conservation, Utilization, Trade & Cultural Traditions, to be held at the National Institute of Advanced Studies, Indian Institute of Science Campus, Bangalore. The central theme of the conference is Medicinal Plants for Survival.

This conference seeks to bring together people from diverse disciplines who are concerned about the future of medicinal plants and are keen to forge viable forms of regional and international cooperation that will influence policies and promote strategic action. Participants will share experiences, approaches and strategies pertaining specifically to medicinal plants, related to the following areas: (1) Conservation Action (*in situ* & *ex situ*); (2) Databases; (3) National Conservation Policies; (4) Community oriented applications in context of Primary Health Care; (5) Domestication & Cultivation; (6) Trade & Small Enterprise Development; (7) Contributions of Indigenous Knowledge Systems; and (8) Traditional Knowledge & Resource Rights. The conference will bring to bear a new level of analysis and an immediate action program following the conference.

The expected outcomes of the conference are: (1) Guidelines for design of national and global medicinal plant conservation politics and action strategies; (2) Initiatives for global and regional networking of medicinal plant conservation efforts; (3) Initiatives for global and regional co–operation amongst medicinal plant–based efforts related to primary health care, databases, enterprises, cultivation, indigenous knowledge systems, and traditional knowledge and resource rights.

For more information, contact: Foundation for Revitalization of Local Health Traditions (FRLHT), No. 50, 2nd Stage, MSH Layout, Anandanagar, Bangalore–560024, India. Tel. +91.80.3336909 or 3330348, FAX +91.80.3334167, e–mail: root@frlht.ernet.in

THREATS TO THE WORLD'S BIOCULTURAL DIVERSITY

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[Report on the working conference "Endangered Languages, Endangered Knowledge, Endangered Environments", held at U California at Berkeley, October 25-27, 1996. To appear in "Conference Call" column, Anthropology Newsletter, February 1997.]

On October 25-27, 1996, an international group of scholars, professionals, and activists came together at U California, Berkeley for the working conference "Endangered Languages, Endangered Knowledge, Endangered Environments". This event was the first joint meeting of experts from an array of disciplines in the social, behavioral, and biological sciences ranging from linguistics to anthropology, ethnobiology, cultural geography, economics, cognitive psychology, biology, and ecology, along with natural resource conservationists, cultural advocates, and representatives of indigenous peoples. The meeting was called to explore the complex connections between cultural and biological diversity, the interrelated causes and consequences of loss of both forms of diversity, and the role of indigenous and minority languages and of traditional knowledge in biocultural diversity maintenance and the promotion of sustainable human-environment relationships. Participants also discussed plans for integrated research, training, and action in this domain.

Diversity Loss on Earth.—In their respective fields, these various communities of researchers and activists have been calling attention to the dramatic effects of rapidly occurring global processes of socioeconomic and ecological change on the very objects of their concerns: human cultural and linguistic groups and their traditional knowledge; biological species; and the world's environments. An ever-growing body of literature on endangered languages, vanishing cultures, biodiversity loss, and ecosystems at risk is accumulating, attesting to the perceived gravity and urgency of such issues. Underlying these concerns is a common interest in the future of humanity and of life on earth. However, communication all across these fields of endeavor has been slow in developing. The conference was conceived to begin to fill this gap.

Links Between Biological and Cultural Diversity.—Conference participants first established theoretical common ground by considering notions of biological diversity and diversification, on the one hand, and linguistic and cultural diversity and diversification, on the other, and outlining analogies and discrepancies between these different manifestations of the diversity of life. They heard reports about the comparable magnitude and pace of the current extinction crises affecting biological species and human languages, and examined evidence of remarkable overlaps between global mappings of the world's areas of biological megadiversity and areas of high linguistic diversity. The possible factors accounting for these correlations were discussed in light of issues of human-environment coevolution and in terms of various ways that have been proposed by ethnobiologists and human ecologists in which cultural diversity might enhance biodiversity or vice versa. In this perspective, the need to address the foreseeable consequences of massive disruption of such long-standing interactions was stressed, and the converse correlation between low-diversity cultural systems and low biodiversity was noted.

The notion of endemism emerged as of particular relevance in talking about both biological and linguistic diversity, from the point of view of the especially threatened status of species or languages endemic to a single region—or even worse, a single country, making them extremely vulnerable to the vagaries of national sociopolitical and economic processes. Linking the two forms of endemism, a notion of "ethnobiological endemism" was proposed, underscoring the local nature of traditional environmental knowledge and its comparable vulnerability by those same processes. Also centrally relevant to the conference's perspective was evidence concerning indigenous and local peoples' knowledge not only about natural kinds, but also about ecological relations. The need to systematically and comparatively study this ecological knowledge and how it correlates with reasoning about and action vis-a-vis the environment (as in the extraction and use of natural resources) was affirmed.

In describing the structural and functional deterioration that characterizes processes of language loss, linguists pointed to the various levels at which such processes can and do affect the maintenance of traditional environmental knowledge—from loss of biosystematic lexicon to loss of traditional stories and other forms and contexts of communication. The role of various factors of cultural change and acculturation, such as schooling and migration, were explored. Cognitive psychologists provided new evidence about processes of folkbiological knowledge devolution in societies that have moved away from direct contact with nature, although such processes were shown to be less straightforward than earlier studies had suggested.

Numerous case studies were presented on issues of language and knowledge loss and the interactions between cultural and biological diversity, spanning Africa, Asia, Oceania, and the Americas, and covering both indigenous and other local groups, such as migrants, and exemplifying a variety of linguistic stocks and of modes of subsistence, from hunting and gathering to agriculture. Several presentations also illustrated patterns of cultural and linguistic resistance and knowledge persistence, as well as efforts to revitalize languages and cultures that had gone extinct, with a special focus on maintaining or recovering and newly applying knowledge about traditional resource management practices. Finally, a set of presentations was devoted to both grassroots and international initiatives aimed at biocultural conservation, as well as to issues of indigenous land rights and traditional resource rights, that were seen as inextricably linked to the viability of local communities and their languages and cultures. Issues of common property resources were discussed in this connection. New economic models, based on a coevolutionary social and ecological framework, were proposed as the context in which humanity at the end of the millennium could strive to achieve sustainability and maintain biological and cultural diversity.

Future Directions.—While participants agreed in recognizing the interconnectedness of biological, cultural, and linguistic diversity, a shared need was felt for better, more fine-grained ways to define and identify diversity, especially linguistic and cultural diversity. As measured in broad outline, as is traditionally done in the mapping of the languages and culture areas of the world, the two forms of diversity do not yield a good fit, although linguistic diversity is often used as a proxy for cultural diversity. Contradictory results are thus arrived at when biological diversity is cross-mapped onto one or the other. The consensus was that a much higher level of resolution, at the level of individual communities, or even subsections of communities, is required to identify cultural variation relevant to the study of biocultural diversity correlations, i.e., variation reflecting specific local adaptations; and that comparable detailed work needs to be done on linguistic variation. The crucial importance of working in close contact with other colleagues in interdisciplinary teams was stressed, as was the need for interdisciplinary teaching and training. Issues of funding for interdisciplinary research, as well as for applied work aimed at returning the results of research to local communities and at fostering grassroots biocultural conservation efforts, were also discussed. A "white paper", containing conference participants' recommendations at these various levels, is in preparation, as are one or more publications based on the conference, and an informational/educational video (in collaboration with documentary filmmaker Steve Bartz). An extensive set of background readings, prepared by the conference organizer, is also available upon request.

The conference was organized by Luisa Maffi (Institute of Cognitive Studies, U California, Berkeley), and funded by the Wenner-Gren Foundation for Anthropological Research, the UNESCO/WWF-I/Kew Gardens "People and Plants Initiative", and UC Berkeley's Office of the Vice Chancellor for Research, Office of the Deans of Letters and Sciences, and Institute of Cognitive Studies. It was sponsored by the NGO "Terralingua: Partnerships for Linguistic and Biological Diversity", and co-sponsored and hosted by UC Berkeley's Department of Integrative Biology and University and Jepson Herbaria. Participants were: Scott Atran, William Balee, Herman Batibo, Benjamin Blount, Stephen Brush, Ignacio Chapela, Greville Corbett, Alejandro de Avila, Margaret Florey, David Harmon, Jane Hill, Leanne Hinton, Eugene Hunn, Dominique Irvine, Willett Kempton, Manuel Lizarralde, Ian Saem Majnep, L. Frank Manriquez, Gary Martin, Douglas Medin, Katharine Milton, Brent Mishler, Felipe Molina, Denny Moore, Gary Nabhan, James Nations, Johanna Nichols, Richard Norgaard, Christine Padoch, Andrew Pawley, Mark Poffenberger, Darrell Posey, Eric Smith, D. Michael Warren, Stanford Zent. The participant's affiliations, biographical sketches, and conference abstracts, as well as other information about the conference, can be found at the following two WWW sites:

http://ucjeps.berkeley.edu/Endangered_Lang_Conf/Endangered_Lang.html

http://cougar.ucdavis.edu/nas/terralin/home.html

BOOK REVIEWS

Chilies to Chocolate, Food the Americas Gave the World. Nelson Foster and Linda S. Cordell (editors). Tucson: The University of Arizona Press, 1992. Pp. v; 191. $13.95 (paper), $24.95 (cloth). ISBN 0-8165-1324-4.

The essays found in this book originated from a public symposium held in 1988 at the California Academy of Sciences. This volume covers the general themes of crop domestication, diffusion, and diversity. This is similar to many books published around the quincentennial anniversary of Columbus' journey to the Americas. Specifically, the chapters apply these themes to tomatoes, potatoes, amaranth, vanilla, beans, chili peppers, maize, cacao, quinoa, and some lesser known Andean tubers. The contributors to this volume are as varied as the plants discussed. Disciplines include botany, history, anthropology, natural history, diplomacy, art and writing. Therefore, the perspectives and the quality of the chapters varies as well. For instance, the well known maize researcher, Walton C. Galinat, does an excellent job of describing the domestication and diffusion history of corn. The chapters on amaranth and little known roots of the Andes, though, are a bit esoteric.

Other shortcomings of the book include the complete absence of maps, photographs, and citations in the body. This book appears to be written for the general audience, so photographs of crops that are often unknown to the general public would be useful. The lack of maps is also disturbing given the geographic nature of many of the chapters. It is extremely frustrating not to find citations in the body of the chapters. There is a "further reading" section at the end of the book, but this does not make up for the lack of detailed citations in the body itself. The absence of these useful tools gives the reader the impression that the publishers or the editors sought a low-cost, low-labor text.

Although this book does not break any new ground in the discussion of New World plant domestication or diffusion, it is useful because it synthesizes a great deal of historical geographical material on several important plants in a single volume. Another strong point is that it discusses in detail the botanical history of some important plants in a single volume. Another strong point is that it discusses in detail the botanical history of some important, although lessor studied, domesticates, such as vanilla. Because of this, it would be a useful volume to include in the library of anyone interested in ethnobotany and cultural ecology. However, because of the lack of maps, citations, and photographs, and the esoteric approach some of the authors employ, it would not be my first when seeking a text on New World domesticates or on the historical geography of crop plants. Instead, works such as those by Sauer(1993), Viola and Margolis(1991), and Heiser(1985;1990) give, overall, more thoughtful and thorough treatments of the subject.

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VIOLA, HERMAN J. and MARJOLIS, CAROLYN (editors). 1991. Seeds of Change. Smithsonian Institution Press, Washington D.C.

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Agricultural Origins and Development in the Midcontinent. W. Green (editor). Iowa City: Office of the State Archaeologist, the University of Iowa, Report 19, 1994. $15.00 (softcover). Pp. vi; 188. ISBN 0-87414-090-0

In the study of the origins of agriculture in the Western hemisphere, the question of whether plant domestication and animal husbandry were initiated and developed independently in eastern North America prior to the introduction of corn (maize) some one thousand plus years ago, has been the subject of considerable discussions. This volume makes a valuable contribution to elucidating this question, as well as providing a good synthesis of our current knowledge of the changing relationships between native peoples and plants in the Midcontinent areas of the Ozarks (northwestern Arkansas and southwestern Missouri), Illinois, Wisconsin, and Kentucky.

Most of the eight papers in this volume were originally presented at the plenary session of the 34th annual Midwest Archaeological Conference, held at the University of Iowa in October, 1989. A quick look at the reference sections to the papers, however, indicates that most have been updated prior to publication. Consequently, the 1994 publication date can be taken as an approximate indication of the currency of the information in the volume.

The paper by Richard Yarnell, "Investigations Relevant to the Native Development of Plant Husbandry in Eastern North America: A Brief and Reasonably True Account," provides an excellent review of the development of paleobotanical knowledge, divided into the periods 1910 to 1940, 1940 to 1960, 1960 to 1980, and 1980 to 1990. He describes a growing consensus since the mid 1980s, reinforced by other papers in the volume, that plant domestication and husbandry developed independently in eastern North America well before the introduction of corn.

David Asch's paper, "Aboriginal Specialty Plant Cultivation in Eastern North America: Illinois Prehistory and Post Contact Perspective," notes that the oldest remains of *Cucurbita* spp. from eastern North America in a cultural context are of pepo gourd, dated ca. 5000 B.C. in west-central Illinois. Kristin Gremillion's paper, "Evidence of Plant Domestication from Kentucky Caves and Rockshelters," notes that the Cloudsplitter and Newt Kash shelters in Kentucky have provided the earliest securely data thin-testa chenopod (*Chenopodium berlandieri*) in eastern North America at ca. 1500 B.C. Rock shelters in Kentucky have also yielded evidence of domesticated sumpweed (*Iva annua*) ca. 900 B.C., and sunflower (*Helianthus annuus*) ca. 1000 B.C. Gayle Fritz's paper, "In Color and In Time: Prehistoric Ozark Agriculture," reports that reexamination of materials collected in the 1930s from rock shelters in the Ozarks along with radiocarbon dating has established a 2500 year span of prehistoric Ozark agriculture, with domesticated sumpweed, sunflower, chenopod, and squash seeds stored as early as 1200 B.C.

James Gallagher and Constance Arzigian, in a paper titled "A New Perspective on Late Prehistoric Agricultural Intensification in the Upper Mississippi Valley," challenge the dominant view of midwestern Archaeologists that agricultural component of the late prehistoric Oneota culture was nonintensive. They argue that the commonly accepted definition of intensification, which emphasizes surplus economic production and related social structures, is culturally biased, and suggest that the strategy of diversification, in which cultivated crops represent one of multiple food source, was used by the Oneota as an effective means for reducing the risk of food shortages.

The paper by Neal Lopinot, "A New Crop of Data on the Cahokian Polity," provides an interesting example of the subtle cultural bias in archaeological interpretations of prehistory. The Cahokia site, located in the American Bottom of southwestern Illinois, is often pointed to as a prime example of the degree of "civilization" attained by Native North Americans. Relatively recent archaeological work has shown that the "florescence" of the Cahokia polity (Early Stirling subphase) lasted only about 50 years (A.D. 1050 to 1100), and followed by "decline" during the Late Stirling subphase (A.D. 1100 to 1150). With stone-age technology, the weakness of non-sustainable intensive agricultural systems apparently exerts itself very quickly. The Cahokian culture reduced the diversity of diet by clearing oak-hickory forest to make way for polycropping of maize and four starch seeds: maygrass (*Phalaris caroliniana*), little barley (*Hordeum pusillum*), chenopod (*Chenopodium berlandieri*), and Erect knotweed (*Polypodium erectum*). Archeobotanical evidence for the following Moorehead phase indicates a return to normalcy with increased incidence of nut shell and starchy seed, in addition to greater diversity and evenness among crop residues.

Jane Buikstra, Jerome Rose, and George Milner, in a paper titled "A Carbon Isotopic Perspective on Dietary Variation in Later Prehistoric Western Illinois," indirectly shed further light on the Cahokian "florescence." Although this paper focuses on the use of carbon isotope data to evaluate the importance of maize in the diet during the period A.D. 1000 to 1400, I was most struck by the incidental data that were provided on the Early Stirling subphase burials at the Cahokia Mound 72. The classification of burials from which the bone carbon isotope measurements were taken include: (1) high status; (2) mixed sex sacrifices; (3) charnel house (late adolescent and young adult females sacrifices); (4) female sacrifices; (2) mixed sex sacrifices; (6) headless (and handless) male sacrifices. That the Cahokian florescence was characterized by oppressive social structures is under-scored by dental and carbon isotope data suggesting a different region of origin and poorer health status of female sacrifices. My own reading of the archaeological and archaeobotanical evidence presented by Lopinot and Buikstra *et al.* is that the Cahokian florescence was a short lived, pathological culture, and that its decline represented a sensible return to a more environmentally and socially sustainable way of life along the lines described by Gallagher and Arzigian for the Oneota.

I would recommend this book for anyone who is interested in the origins of North American agricultures, or in the prehistory of the midcontinent.

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Traditional Ecological Knowledge. Concepts and Cases. Julian T. Inglis (Editor). Ottawa, Ontario: International Program on Traditional Ecological Knowledge, International Centre, 1993. $19.95 Can. (softcover). Pp. vi; 142. ISBN 0-88936-683-7.

No doubt long ago we were all well–versed in traditional ecological knowledge (TEK). Yet over the years, with each 'rational' leap we took in the name of Western Science, our ability to 'intuit,' or to access deeply held knowledge, steadily withered and lay forgotten along the way. For the many of us who need our memories refreshed on TEK, editor Julian T. Inglis has put together a valuable volume for this end. *Traditional Ecological Knowledge. Concepts and Cases* is a remarkable collection of 13 papers, 12 of which were presented at the Common Property Conference, University of Manitoba, Winnipeg, Manitoba, in September 1991. Also held in conjunction with the Conference was the International Workshop on Indigenous Knowledge and Community Based Resource Management. The paper presented in Chapter 2 is the Workshop's Keynote Address, by Chief Robert Wavey.

In the introductory chapter, Fikret Berkes establishes a solid framework for the content of the text. He arrives at a working definition of TEK and concisely outlines the ways in which it differs from Western Science, Berkes emphasizes TEK's practical significance for science, resource management, environmental assessment, protected areas, conservation education and development planning. As well, he advises a show of appreciation for the cultures that hold this knowledge and suggests that TEK be considered as complementary to Western Science, not as a replacement for it.

In the second article, Chief Robert Wavey of the Fox Lake First Nation, northern Manitoba, identifies TEK as an important cornerstone of Aboriginal self-government. He notes that the government planners and resource developers often overlook the distinction between two types of TEK: that which is instinctively adaptive and acquired over a relatively short period of time; and that body of TEK, which is accumulated over many generations and for specific lands. As a result, unfortunate cultural and ecological consequences for the Aboriginal people often ensue.

In Chapter 3, Kenneth Ruddle gives a noteworthy account of the structural and processual characteristics involved in the transmission of TEK. The paper also contains a good comparison of the traditional education system of the inhabitants of Guara Island in the Orinco Delta of Venezuela with that of the residents of Pukapuka Island in Polynesia.

In the fourth paper, Robert E Johannes outlines the four essential frames of reference for the gathering and organizing TEK information in a usable manner for environmental impact assessment. Johannes refers to these as taxonomic, spatial, temporal and social. The article also contains some insightful comments regarding the attitudes of researchers to TEK, as well as on TEK proprietary issues.

In Chapter 5, Nancy Doubleday discusses Western legal and scientific frameworks and the current attempts to accommodate the TEK framework to the mainstream by way of common property and co-management approaches. She states that even where accommodation does occur, it does not happen easily. Doubleday introduces the consideration of TEK as an element of a worldview rather than instrumental knowledge and argues that natural law offers common ground for the inclusion of TEK.

Andre Lalonde (Chapter 6) presents four superior case studies from Africa which illustrate the utilization of TEK in sustainable development-related issues. Likewise in Chapter 7, Miriam McDonald and Brian Fleming discuss how the development and management of a northern Canadian Inuit community-based eiderdown industry successfully incorporated TEK into the decision-making and management processes.

The eighth paper, by Carl Hrenchuk, directly outlines the divergent viewpoints which exist between the state and northern Manitoba Native communities regarding the use of northern land, resources and property. Hrenchuk emphasizes the need to connect differing sets of ecological knowledge and to recognize and reconcile the fundamental conflict between common and communal tenure. He also includes five superb maps, which cover the South Indian Lakes location, and Cree hunting and trapping travel routes, as well as their prime areas significant to wildlife harvest, commercial fishing sites and community toponyms.

Terry Tobias (Chapter 9) writes of the disparities which occur between Native wildlife harvesting data gathered by government–sponsored development consultants and that accumulated by members of the Métis community of Pinehouse in northern Saskatchewan. He successfully presents a strong argument for the need to include indigenous knowledge in planning processes to avoid misinformation concerning the northern Native economy.

In Chapter 10, Douglas Nakashima demonstrates that the TEK of the Inuit will often outstrip conventional science when it comes to knowledge about many Arctic wildlife species. Using a case study from three Inuit communities in southeastern Hudson Bay, Nakashima gives a thought–provoking account of the totality of Inuit knowledge regarding Hudson Bay Eiders. He compares this with the fragmented data obtained by biologists and wildlife management decision–makers.

Peter Usher (Chapter 11) describes the achievements and problems of one of the earliest indigenous/state co–management Boards in North America. The primary concern of the Board surrounds the management of the Beverly and

Kaminuriak caribou herds, which range between the Northwest Territories, Manitoba, and Saskatchewan. Although the Board members have developed a good working relationship, Usher points out that the TEK of Aboriginal hunters has still not been adequately utilized.

The article by Lloyd Binder and Bruce Hanbidge (Chapter 12) provides another look at co–management and TEK, this time in conjunction with the Inuvialuit land claims settlement in the Western Arctic Region of the Northwest Territories. Five resource co-management bodies exist to implement the wildlife provisions of the Inuvialuit Final Agreement (IFA). The authors present an excellent outline of the functions of a co–management system, discuss the activities of several IFA co–management bodies, and assess their effectiveness and that of the IFA as a total system.

In the final chapter (Chapter 13), Einar Eythorsson explores reasons why the integration of TEK and formal scientific knowledge is often difficult to achieve in management of common property resources. Eythorsson examines the conflict existing between small scale Sami fjord–fishermen, who employ a wide range of TEK, and the Norwegian state fisheries managers, who allow Danish seiners to exploit local and migrating stocks of cod. In conclusion, the author gives us a valuable list of the differing characteristics of local TEK and scientific knowledge.

Julian Inglis has done an admirable job of editing and integrating an assortment of papers which, when put together, give a fairly balanced view of the many practical aspects of TEK. Nevertheless, I feel that the coverage of one of the most important components of TEK has been for the most part overlooked. In our writings, we must begin to acknowledge and discuss the spiritual foundation and truths which form the essence of TEK. If we continue to omit these in the hopes that TEK will be more readily accepted by the scientific community, our gain will be short–lived. In the long run, however, we will lose. By neglecting the 'core' which makes TEK what it is, we merely expand the scientific paradigm, not create major 'shifts' in it.

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NOTICE TO AUTHORS

The *Journal of Ethnobiology*'s revised "Guidelines for Authors" appears in Issue 16(1) on pp. 124–127. If you need a copy of these Guidelines you may request a copy from the Editor. Careful scrutiny of recent issues of the *Journal* should provide appropriate stylistic models for any manuscript you may wish to submit.

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JOURNAL OF ETHNOBIOLOGY

Rarámuri necklace

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COVER ILLUSTRATION: Contemporary Rarámuri (Tarahumara) necklace (necklace #8) of castor bean and coral bean seeds, with a Virgin of Guadalupe pendant of carved pine bark.

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ETHNOBIOTICA

For openers I would like to recognize the efforts of my current editorial assistant, Brian VanHoy, a graduate student in the fledgling Environmental Anthropology program at the University of Washington. Brian brings considerable computer skills to the job, as well as an interest in indigenous forest management. Once this issue is off to the printers, Brian will join me in Oaxaca for the summer. He plans to apply techniques for assessing ethnobotanical diversity described by Bernstein, Ellen, & Antaran in this issue of the *Journal of Ethnobiology*. Brian was awarded an NSF graduate fellowship this year, which he will no doubt put to good use. Brian has been working hard to master the intricacies of PageMaker so that we will be able to present nearly camera-ready copy to the production office here, with substantial savings of time and money.

I got started in the ethnobiology business on the zoological side, stimulated by my passion for birdwatching (a predilection I shared with Ralph Bulmer). I'm a latecomer to ethnobotany. However, my last two research projects – comprehensive ethnobiological accounts of Sahaptin in the Pacific Northwest and of Mixtepec Zapotec here in Oaxaca – have inclined me to the view that the botanical side of the field is the more elaborated in many, perhaps most, of the cultural settings in which we have worked. At least, this is the case among peasant agricultural peoples. In Mixtepec Zapotec, for example, I have so far recorded ca. 650 ethnobotanical taxa but only some 375 ethnozoological taxa, with vertebrates quite thinly detailed. If we calculate "Scientific Species Recognition Ratios" for plants and animals – that is, the ratio of the number of folk taxa recognized to the number of scientific species that occur in the local region – we find that the SSRR for plants is about 0.6 while that for vertebrate animals is closer to 0.3. In other words, they classify plants at twice the level of discrimination they apply to vertebrate animals. (The number of invertebrates is impossible to estimate, but would certainly yield a much lower SSRR.) Why this discrepancy in favor of plants? One obvious explanation suggests itself: peasant farmers are far more dependent on plants than animals for food, fuel, materials, and medicines, plus they have hunted out the larger fauna from the vicinity of their villages. Of course, this answer implies a strong correlation between this aspect of ethnobiological classification and techno-economic factors. I haven't performed the comparative work required to prove this hypothesis – that peasant farmers will emphasize plants over animals to a greater degree than will hunter-gatherers, forest horticulturalists, or urbanites – but it does seem that reported ethnozoological inventories for non-peasant societies are the more highly elaborated. A systematic comparison along these lines would provide an interesting test of the controversial "utilitarianist heresy" (see Brent Berlin, *Ethnobiological Classification*, Princeton University Press, 1992, pg. 3ff). One more project I haven't time at the moment to pursue.

Yours,

Eugene Hunn

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Karen R. Adams is director of Environmental Archaeology at Crow Canyon Archaeological Center in Cortez, Colorado and a private consultant in archaeobotany. Her research in the southwestern U.S. and elsewhere focuses on ancient subsistence strategies and the inter-relations of humans and their environment. She is on the Board of Trustees/Directors of the Society of Ethnobiology and the Baca Institute of Ethnobotany and is Adjunct Professor of Anthropology at Lakehead University, Ontario, Canada. **Enrique Salmón**, of Rarámuri heritage, is director of the Baca Institute of Ethnobotany in Crestone, Colorado. He has an M.A.T. in southwestern studies from Colorado College and is completing doctoral studies in ethnobotany at Arizona State University. He is on the Board of Directors of Native Seeds/SEARCH, the Arizona Ethnobotanical Research Association, and the Indigenous Peoples Restoration Network.

SCOTT ATRAN, PAUL ESTIN, JOHN COLEY, and DOUGLAS MEDIN

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RARÁMURI NECKLACES: A RAPIDLY CHANGING FOLK-ART FORM IN THE SIERRA MADRE OCCIDENTAL OF NORTHERN MEXICO

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ABSTRACT.—Rarámuri women and their families living in the uplands of the Sierra Madre Occidental along the famous Copper Canyon railway make colorful seed bead necklaces. A collection of necklaces purchased in 1994 reveals notable variability. For example, while most appear intended for adornment, some are clearly rosaries, and others have pendants representing religious figures or symbols. The makers have used seeds, various fruit types, stems, wood, and bark of at least 19 different taxa in at least eleven plant families, including fruit or seeds of three domesticates, parts of three taxa naturalized from the Old World, and parts of plants that grow only in the lowlands or deep canyon bottoms. Alterations to raw materials include carving, cutting, filing, and dyeing, as well as soaking prior to piercing. A minimum of five modern materials served as string. Necklace-making appears to be a long-standing Rarámuri tradition, although the diversity of necklaces now available has not been recorded in either historic literature or the limited regional archaeological record. These necklaces, eagerly sought by tourists, represent a rapidly changing folk-art form that helps support their creative Rarámuri makers.

RESUMEN.—Las mujeres y familias que viven en las alturas del Occidental de Sierra Madre junto a la línea de ferrocarril famosa de Barranca de Cobre hacen collares brillantes de semillas. Una collección de collares que habían comprado en 1994 revela variabilidad notable. Por ejemplo, mientras que la mayoría aparece pretentido para decoración, algunos son obviamente rosarios y otros tienen colgantes que representan figuras o símbolos religiosos. Los fabricantes tienen semillas usadas, varios tipos frutales, tallos, madera, y corteza de por lo menos 19 diferentes taxones en por lo menos once familias de plantas, que incluye fruta o semillas de tres domesticates, partes de tres taxones naturalizadas del Mundo Antigua, y partes de las plantas que crecen solo en los planos o fondos de cañones profundos. Alteraciónes primas materias incluyen tallar, cortar, limar, y tenir, tan bien como empapar antes de perforar. Un mínimo de cinco materias se sirvieron como cuerda. La fabricación de collares aparece ser una tradición antigua de los Rarámuri, aunque la diversidad de los collares que están disponsibles no han estado recordado en literatura histórica ni el registro limitado regional de arqueología. Estos collares que están solicitado de las turistas entusiastas, representan una forma del arte folklórico que está cambiando rapidamente que ayuda a mantener sus fabricantes creativos.

RÉSUMÉ.—Les femmes raramuries et leur famille qui vivent dans les hautes terres de la Sierra Madre occidentale le long du célèbre chemin de fer du Cañon del Cobre font des colliers de grains très colorés. Ces colliers sont très diversifiés comme le révèle une collection acquise en 1994. Par exemple, la plupart des colliers de cette collection sont en apparence exclusivement ornementaux, mais certains sont définitivement des rosaires et d'autres comportent des pendentifs à motif, figure ou symbole, religieux. Les artisans ont utilisé comme matière première des graines, diverses sortes de fruits, des tiges, du bois et de l'écorce d'au moins dix-neuf taxons différents appartenant à au moins onze familles botaniques et comprenant des fruits ou des graines de trois plantes naturalisées, des parties de trois plantes introduites de l'ancien monde et des parties de plantes qu'on trouve seulement dans les basses terres ou au fond des canyons profonds. Ces matériaux ont été soit sculptés, coupés, limés, teints ou même trempés avant d'être percés. Au moins cinq matériaux modernes ont été utilisés comme fil. La fabrication de colliers est une tradition ancienne chez les Raramuris, mais la diversité des colliers disponibles aujourd'hui n'a jamais été consignée dans la documentation historique ou les petits dépôts d'archives archéologiques locales. Ces colliers, très recherchés par les touristes, représentent une forme d'art populaire qui évolue très rapidement et qui aide financièrement ses créateurs raramuris.

INTRODUCTION

Colorful seed bead necklaces made by Rarámuri (Tarahumara) women and their families in the Barranca del Cobre area of the Sierra Madre Occidental of northwestern Mexico are sold mainly to tourists traveling the famous Copper Canyon railway. A number of these necklaces were purchased by the authors during two visits to the Sierra Madre uplands in the fall of 1994. The collections were made in the state of Chihuahua on both sides of the continental divide at Divisidero (2320 m) and at Creel (2375 m), in Wapakajipare rancheria some 600 meters below Divisidero, and at the village of Cerocahui (1600 m) (Figure 1).

The largest selection of necklaces was found at the train stop at Divisidero where vendors draped their necklaces over the lips of woven baskets woven of sotol *(Dasylirion)* or beargrass *(Nolina)* leaves, or pine *(Pinus)* needles, so as to be easily seen. Some women laid their necklaces in piles next to their other wares. The second largest selection of necklaces was found in Creel, to which vendors had traveled to sell their folk-art in the streets and restaurants. Here numerous craft shops offered an ample selection. Each necklace cost the equivalent of U.S. $1.50 to $3.00. Thus the project rapidly grew from casual purchasing to a systematic effort to acquire a representative collection. We feel the necklaces gathered adequately represent the diversity of materials used and styles available in 1994. The majority of the necklaces have been deposited at the Baca Institute of Ethnobotany, Crestone, CO.

FIGURE 1.—Area of this study, along the Copper Canyon Railway.

METHODS

Interviews with Rarámuri women in their native language provided their perspectives on various aspects of necklace making, including the terms they used for the parts. We were able to identify most of the materials used in necklace construction by comparing them to specimens curated in the University of Arizona Herbarium (ARIZ), where many scholars continue to document northern Sierra Madre flora. We also researched historic and prehistoric perspectives on the necklaces to assess how this art form is changing. Learning the identities of each raw material revealed which plants people gathered locally and which required longer trips or trading. Strings were directly compared to a wide collection of raw materials including agave, wool, milled cotton, nylon and polyester threads, fishing line, and copper wire. Burning tests often helped in string identification. This study was greatly facilitated by Salmón's ongoing research on Rarámuri ethnobotany (1995, in press).

RESULTS

The materials of necklace construction are quite varied at present (Figure 2A). They include seeds, fruits such as caryopses and achenes, stems, wood, and bark of at least 19 different taxa in at least 11 plant families (Table 1). The pendants can be simple or elaborate carved crosses (Figure 2B), drums (Figure 2C), or represent a religious symbol, such as the Virgin of Guadalupe surrounded by beadwork (Figure 2D).

TABLE 1.—Taxa and parts identified for 29 Rarámuri necklaces purchased in the fall of 1994, organized alphabetically by plant family

Family	Scientific Name	Common Name(s)	Part	Notes
Asteraceae	*Helianthus annuus*	sunflower	achene	domesticated
Bombacaceae	*Ceiba acuminata*	***kapok***	seed	
Cupressaceae	*Juniperus/Cupressus*	juniper/cypress	wood	
Ericaceae	*Arbutus glandulosa*	madrone, *madroño*	fruit	immature and mature
	A. arizonica		fruit	
Euphorbiaceae	*Ricinis communis*	castor bean	seed	introduced
Fabaceae	*Acacia farnesiana*	acacia	seed	
	Albizzia sinaloensis		seed	flat
	Erythrina flabelliformis	coral bean	seed	
	Pisum sativum	pea	seed	domesticated; introduced
	Pithecellobium dulce	***guamúchili***	seed	
	Rhynchosia precatoria	rosary bean	seed	
Fagaceae	*Quercus* spp.	oak	acorn (no cap)	
Liliaceae	*Yucca* sp.	yucca	seed	
Pinaceae	*Pinus leiophylla* type**	pine	bark	
	Pinus type	pine	wood	
Poaceae	*Coix lacryma-jobi*	Job's tears, ***batagá***	caryopsis	cultivar; introduced
	Otatea type**	bamboo	stem	see below
	Zea mays	maize, corn	caryopsis	domesticated
Martyniaceae	*Martynia annuua*	devil's claw	fruit	
Unknown	Unknown dicotyledon	wood	*Ptelea trifoliata?*	

*See Appendix 1 for a more complete listing of common names.
**Use of the word "type" conveys that the necklace material resembles the taxon named, but that the identification is not secure. For example, the grass stems, identified as Otatea type, match bamboo in hardness, but need to be compared anatomically to other robust-stemmed grasses for a more secure identification.

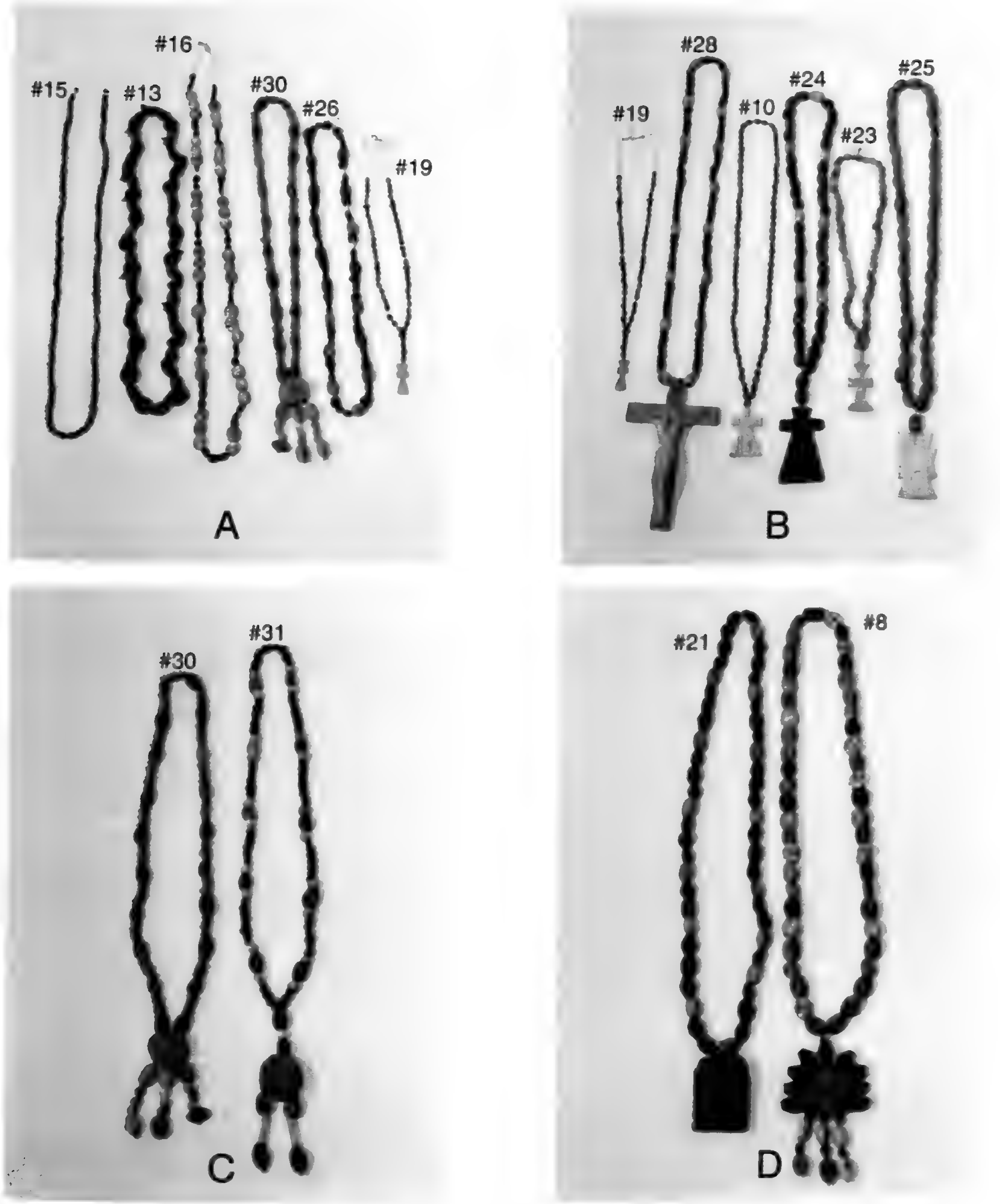

FIGURE 2.—Rarámuri necklaces, illustrating the variety of plant parts utilized. (A) Varied necklace materials, from left to right: necklace #15 of *Rhynchosia;* #13 of *Erythrina* and *Martynia;* #16 of *Ricinis* and *Pithecellobium;* #30 necklace with drum of *Erythrina* and *Albizzia;* #26 of *Ceiba, Erythrina,* and *Yucca;* and #19, a rosary composed of *Acacia.* (B) Necklaces with diverse crosses and symbols, from left to right: #19 with Rarámuri cross; #28 with crucifix and carved Jesus figure; #10 with Rarámuri cross; #24 with Rarámuri cross of carved *Pinus* bark; #23 with Rarámuri cross; and #25 with Tarahumara four-directions symbol. (C) Necklaces with drums. (D) Necklaces with Virgin of Guadalupe, #21 of carved *Pinus* bark (left) and #8 of carved *Pinus* bark surrounded by beadwork (right).

Both domesticated and wild plants are utilized in necklace-making. Domesticates include New World maize (*Zea mays* L.) kernels and sunflower (*Helianthus annuus* L.) achenes and Old World garden peas (*Pisum sativum* L.) (Figure 3A). Among non-domesticates the legume (Fabaceae), ***kapok*** (Bombacaceae), spurge (Euphorbiaceae), and grass (Poaceae) families are well represented. One often sees New World coral beans (*Erythrina flabelliformis* Kearney) and ***kapok*** seeds (*Ceiba acuminata* [S. Wats.] Rose) and Old World castor beans (*Ricinis communis* L.) and pearly white or grey Job's tears (*Coix lacryma-jobi* L.) in combination with other materials (Figure 3B), or alone (Figure 3C).

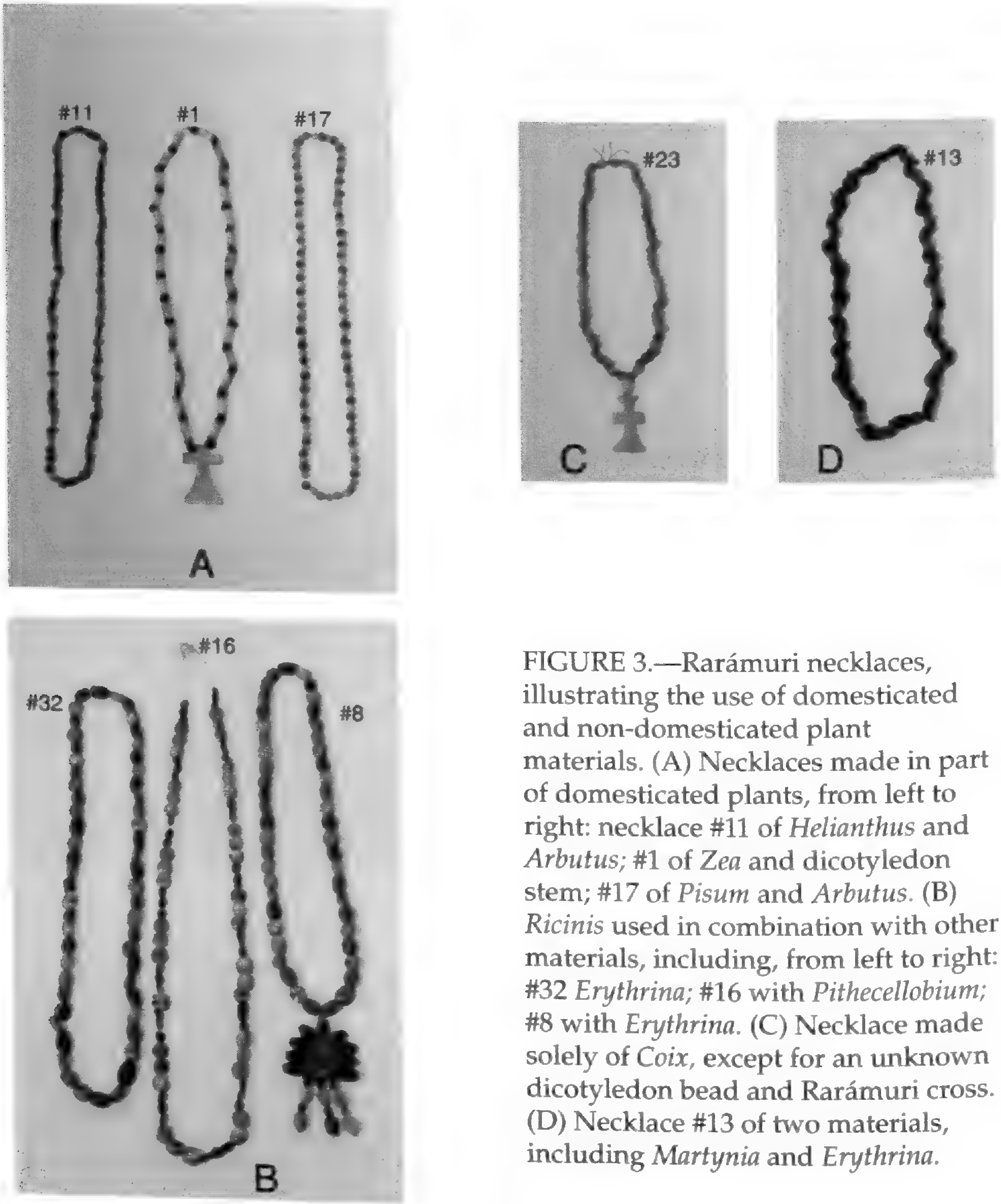

FIGURE 3.—Rarámuri necklaces, illustrating the use of domesticated and non-domesticated plant materials. (A) Necklaces made in part of domesticated plants, from left to right: necklace #11 of *Helianthus* and *Arbutus;* #1 of *Zea* and dicotyledon stem; #17 of *Pisum* and *Arbutus.* (B) *Ricinis* used in combination with other materials, including, from left to right: #32 *Erythrina;* #16 with *Pithecellobium;* #8 with *Erythrina.* (C) Necklace made solely of *Coix,* except for an unknown dicotyledon bead and Rarámuri cross. (D) Necklace #13 of two materials, including *Martynia* and *Erythrina.*

The necklaces or their pendants are strung on a minimum of five modern materials. These include: (a) milled cotton thread; (b) milled synthetic (polyester or nylon) thread, some of which may be cotton-wrapped; (c) nylon fishing line; (d) the flat yellow plastic strips that make up loosely-woven bags in which grapefruit are sold; (e) and copper wire. Notably, no pita *(Agave)* fibers were identified as string. Detailed information on each taxon used can be found in Appendix 1, and necklaces are described in detail in Appendix 2.

DISCUSSION

About necklace-making.—Rarámuri generally soak the beans, seeds, or fruit until they are soft enough to be pierced by a modern stainless steel sewing needle. Madrone fruit are strung while still fresh and soft, and then allowed to dry and shrink down tight against the thread. The Job's tears are said to have a hollow center, permitting easier piercing. Pine bark is easy to carve, and one can see rectangular scars on many living pine trees where bark has been removed for making pendants and other carvings.

Some alterations are made to the natural form of bead types. The necklaces with devil's claw fruit have usually had the short, naturally sharp ends of the claws filed smooth to reduce risk of puncture. On occasion carved wooden beads have been dyed, and acorns are sometimes blackened by cooking them in burned lard. The use of immature green and mature red madrone fruit in different necklaces suggests that people gather resources as they become seasonally available.

The necklace-makers express their artistry in many ways. Although they will make a necklace with only one bead type (Figure 3C), they more commonly use two (Figure 3D). Sometimes differences in the ratios of bead types chosen produce very different patterns, for example, two necklaces made with a 1:1 or 7:1 ratio of Job's tears to coral beans. The color combinations are often striking, such as white garden peas alternating with bright red madrone fruit. Many of the current combinations have been created because their makers say "they are pretty."

Necklaces can display great attention to detail and pendant elaboration. One particularly fine pendant has a carved pine bark visage of the Virgin of Guadalupe surrounded by a series of angular, carved and dyed wooden beads, plus other dangling beads, all held tightly together by copper wire (Figure 2D). This same necklace was the only one on which the artist purposefully singed the thread ends to reduce raveling.

Source of raw materials.—It is of interest to know where the raw materials grow naturally. The necklaces reported here were all purchased in the Copper Canyon uplands above 1600 m, and the majority of the items can be easily acquired in the middle and upper reaches of the barrancas. However, a number are more tropical in nature, and tend to grow in the lower depths of the deep canyons, such as Job's tears *(Coix lacryma-jobi)*, devil's claws (*Martynia annuua* L.), and rosary bean plants (*Rhynchosia precatoria* [L.] D C.). Others available only part-way up the barrancas include coralbean *(Erythrina flabelliformis)*, **kapok** *(Ceiba acuminata)*, and bamboo (*Otatea* sp.). It is clear the necklace makers must either travel or trade to acquire some of their raw materials. The strings reported here are all available commercially.

History of necklace-making.—The Rarámuri claim that necklace-making is traditional. This is borne out by limited Northern Mexico archaeological and ethnographic records. It is important to note, however, that there may well be regional variation in necklace-making, as the archaeological and ethnographic records reported here are not from the current study area, which is centered at Divisidero.

The sparse archaeological record of the northern Sierra Madre in deposits considered Basketmaker — in the U.S. a period spanning some number of centuries B.C. until A.D. 700 — reports seeds of *Erythrina* recovered from one excavated burial site as funeral offerings (Zingg 1940:17). "Seeds" (or rather the fruit?) of a species of madrone (*Arbutus xalapensis* HBK.) recovered from this same site (Zingg 1940:10, 51-52) were interpreted as a food offering, or for making necklaces.

Colonial written records describing Rarámuri life and culture date back to 17th century Jesuit accounts (Perez de Ribas 1645; Neumann 1938; Arlegui 1737; Pfefferkorn 1794; Steffel 1809). However, the first observations by non-Rarámuri of seed and bead necklaces were by Carl Lumholtz in the late 19th century (1902). Lumholtz reported that these very shy people were not very fond of wearing ornaments, and that "they do not like to look at themselves" (1902:151). But he also noted that many of the women and men wore "strings of glass beads... and necklaces made from the seed of *Coix lacryma-jobi,* mainly for medicinal purposes" (1902:151). He observed that the men chose to wear only a single string of the seeds while the women would wear several. The shamans, he noted, wore the seed necklaces at all official functions (1902:151).

After Lumholtz, the next ethnographic reports to mention Rarámuri adornments were those of Wendell Bennett and Robert Zingg (1935) and Zingg (1940). They noted only the seeds of *Coix* being used as necklace and rosary adornment. Thirty years later Pennington reported on necklace materials in use in 1963, although it is clear he drew some of his information from the earlier cited publications. According to Pennington, five plants supplied wood, seeds, or grass grains in preparing beads which were strung upon pita (*Agave* spp.) fiber or upon woolen thread (1963:44, 213-214):

(a) *Coix lacryma-jobi,* or Job's tears, a grass cultivated in garden plots, and identified only from post-Spanish sites. First noted by Lumholtz in 1902.

(b) *Ptelea trifoliata,* the hop tree, which supplied an easily worked wood fashioned into crosses or beads. The necklaces described in this paper contain an unknown dicotyledon wood that may turn out to be *Ptelea.*

(c) "Handsome red beans (*Erythrina flabelliformis*?)", recorded by Steffel (1809) in preparing a necklace; "seeds of a species of *Erythrina* have been recovered from local Basketmaker sites" (Zingg 1940), and were apparently funeral offerings.

(d) Two species of madrone, *Arbutus glandulosa* and *A. arizonica,* also recovered from Basketmaker sites (Zingg 1940).

(e) ***Saaburi,*** an unidentified plant which supplied black seeds for beads, and which we now think may be seeds of *Pithecellobium dulce* (Roxb.) Benth.

The most recent study of Rarámuri plants includes mention of only madrone fruits used for necklaces (Bye 1976).

Since the studies by Pennington (1963) and Bye (1976), there has been an obvious increase in the variety of materials gathered by the Rarámuri for making necklaces, and a general elaboration of this folk-art form. We report the use of at least 19 separate taxa for beads and pendants and at least five separate materials for string, none of them either *Agave* or wool. It seems that Rarámuri necklace-making is a folk-art form changing rapidly to suit new economic opportunities, and reflecting greater access to non-local items such as Old World domesticates, polyester thread, copper wire, plastic grapefruit bags, etc.

The present diversity in necklace materials and styles is likely a response to increased contact with tourists. The completion of the Copper Canyon railway in 1961 opened this portion of the Sierra Madre to larger numbers of visitors (Kennedy 1990). The development of tourism has been made possible not only by the presence of the railway, but also by paving the road from San Juanito to Creel (1982) and by the near completion of the paved road from Creel to Guachochi. Steadily increasing hotel availability since the late 1960s has played a major role in the current boom in tourist visitation.

Significance of necklaces for the Rarámuri.—Although non-vending Rarámuri prefer to wear glass beads, the significance of these necklaces seems to be both religious and medicinal. For example, some necklace creations reflect a 300+ year history of Christian influence in the region, especially those that include carved wooden crucifixes and the Rarámuri Cross (Figure 2B). The Rarámuri Cross is similar to the Christian crucifix, but differs in that the bottom fans out. Some necklaces are clearly rosaries, though they may not be used as Catholics usually use them, but instead are worn at traditional ceremonies and church services.

Carved pine bark visages can represent important religious figures in Rarámuri lives (Figure 2D). For example, the Virgin of Guadalupe is a much-venerated figure whose feast day December 12 is quite important within the religious year. On this day and others during the winter months Rarámuri Matachine dancers, considered soldiers of the Virgin, perform in her honor.

Other necklaces have round Father Sun figures also carved of pine bark. The sun is called ***Reyénari*** in the Rarámuri language. Rarámuri refer to both the sun and the creator as *Dios en el Cielo* (God in Heaven), *El Señor,* and *El Papá* (The Father), and consider the sun a representation of ***Onorúame*** (Salmón 1991).

The necklaces have also served "medicinal purposes," and were part of shaman paraphernalia worn during official functions (Lumholtz 1902:151). In the Basihuare area necklaces of *Erythrina flabelliformis* were considered protection for children from beings associated with water (Merrill 1988:138), while Job's tears necklaces were important to curers (Lumholtz 1902:151). It is interesting that some of the seeds/fruit used in necklace-making are currently medicinal cures. For example, castor beans are made into a paste for gastrointestinal ailments and external application to damaged tissues, coral beans and acacia seeds provide an eye wash, acorn juice treats weak heart problems, and Job's tears are eaten as a preventative (Salmón, in press).

SUMMARY

A 1994 collection of seed bead necklaces purchased from Rarámuri women and their families in the uplands of the Sierra Madre Occidental are quite varied. The makers use seeds, fruit, stems, wood, and bark of 19 different taxa in 11 plant families, including fruit or seeds of domesticates, parts of naturalized plants, and materials that are only available in the lowlands or deep canyon bottoms. Strings are of modern materials such as nylon fishing line and polyester and cotton thread. Some necklaces are clearly rosaries, and others have pendants that represent religious figures such as the Virgin of Guadalupe, or symbols such as the Rarámuri cross. To prepare the materials for stringing, the artists sometimes carve, cut, file, dye, or soak them prior to piercing. These inexpensive necklaces, eagerly sought by tourists, are rarely worn publicly by Rarámuri, who instead prefer to wear glass beads. Yet the necklaces have both religious and medicinal significance to their makers. Rarámuri necklace-making in some form may have a long history, but as a current folk-art form is quite elaborate in comparison to the limited northern Mexican archaeological record and written literature of the colonial period. Tourist visitation to Copper Canyon over the past three decades has provided ever increasing demand for these elegant necklaces, crafted by their makers for beauty, health, and prayer.

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Appendix 1.—Materials of Rarámuri necklace construction, organized alphabetically by taxon. Unless otherwise indicated, ethnobotanical data, including native terms which are in bold italics, are derived from Bye (1985) and from recent field work in Norogachi, Divisidero, Cerocahui, and Creel (Salmón 1995, in press). (Rm) = Rarámuri term; (Sp) = Spanish term

SCIENTIFIC NAME: *Acacia farnesiana* (L.) Willd.
Common name(s): ***chapote*** (Rm), ***wichaká*** (Rm), ***mokowí*** (Rm)
Part: seed
Color: brown
Additional ethnobotanical information: Flowers used in a wash for eye problems, headaches, bruises. Spines made into a tea and drunk for kidney ailments
Alterations: none
Where grows today: Native taxon. Often a small tree. Does well in grasslands, openings in the thorn forest, or in dry deciduous forest, 300-2000 m (McVaugh 1987).

SCIENTIFIC NAME: *Albizzia sinaloensis* Britton & Rose
Common name(s): ***cayábajo*** (Rm)
Part: seeds
Color: some are tan; others are green
Alterations: none
Notes: the tan flattened, but somewhat irregular seed is dicotyledonous, confirmed by two cotyledons emerging from a seed that began germination. The green seed is somewhat similar, but the two may not be identical.

SCIENTIFIC NAME: *Arbutus glandulosa; A. arizonica* (A. Gray) Sarg.
Common name(s): madrone, *madroño* (Sp), ***urúbisi*** (Rm)
Part: fruit, immature and mature
Color: green (immature); red (mature)
Additional ethnobotanical information: knots used for kick balls, berries edible.
Alterations: none
Where grows today: Native, common shrubs of the uplands.

SCIENTIFIC NAME: *Ceiba acuminata* (S. Wats.) Rose
Common name(s): ***chikókawi*** (Rm), ***sikókawi*** (Rm)
Part: seed
Color: brown
Additional ethnobotanical information: The cotton-like seed hairs furnish the buoyant ***"kapok"*** of commerce.
Alterations: none
Where grows today: Large trees, grows in lowlands, up to 900 m in elevation.

SCIENTIFIC NAME: *Coix lacryma-jobi* L.
Common name(s): Job's tears, ***batagá*** (Rm)
Part: caryopsis
Color: pearly white to gray
Additional ethnobotanical information: Necklaces made from the seeds of *Coix lacryma-jobi* worn by both men and women "chiefly for medicinal purposes" (Lumholtz 1902, I:151). This tall, broad-leaved grass is cultivated in garden plots. None found in pre-Spanish archaeological sites (Pennington 1963:213-214). The "seeds" may be ground to flour and made into a coarse but nourishing bread (Sturtevant in Hedrick 1972:184).
Alterations: none
Where grows today. Introduced from tropical Asia. Cultivated in the western barrancas.

SCIENTIFIC NAME: *Erythrina flabelliformis* Kearney
Common name(s): coral bean, *chilicote* (Sp), *colorín* (Sp), ***aposhi*** (Rm)
Part: seed
Color: varied, tan to red to orange
Note: Comparisons to another large Fabaceae seed type, *Sophora secundiflora*, were less satisfactory. *Sophora* seeds are smaller and lack a raised area along their dorsal side. They also bear an indented seed scar (Merrill 1977)
Additional ethnobotanical information: seed crushed and made into a tea for gastrointestinal problems, headaches, toothaches, eye problems
Alterations: none
Where grows today: a native plant, sensitive to frost. In Arizona it grows up to 1670 m (Kearney and Peebles 1960:480).

SCIENTIFIC NAME: *Helianthus annuus* L.
Common name(s): sunflower, ***sewáchari*** (Rm)
Part: achene
Color: black and white
Additional ethnobotanical information: a domesticated taxon
Alterations: none
Where grows today: a New World domesticate that is likely grown throughout the area, in both uplands and lowlands, especially preferring roadsides and fields

SCIENTIFIC NAME: *Juniperus/Cupressus*
Common name(s): juniper, cypress, *táscate* (Sp), ***aorí*** (Rm), ***aborí*** (Rm), ***awarí*** (Rm), ***péchuri*** (Rm)
Part: wood
Color: dark brown (dyed)
Additional ethnobotanical information: leaves used as a tea or wash for colds, toothaches, stomach problems, incense, muscle relaxant
Alterations: carved, dyed
Where grows today: two native genera that grow in the uplands.

SCIENTIFIC NAME: *Martynia annuua* L.
Common name(s): devil's claw, ***choríkari*** (Rm)
Part: fruit
Color: black
Additional ethnobotanical information: Warihio eat the seeds, which are high in oil content, whole or ground (Gentry 1963:92). Rarámuri eat the seeds and young leaves
Alterations: short, naturally sharp claw points have been filed down just a bit to smooth them
Where grows today: a native plant that grows well in the tropical lowlands, up to 1000 m. It is common in fields and other disturbed areas around Alamos, Sonora.

SCIENTIFIC NAME: *Otatea* type
Common name(s): bamboo
Part: stem
Color: tan
Alterations: cut into short segments
Where grows today: a native plant that likes moist canyons and hillsides, up to 1000 m. This identification remains to be confirmed on the basis of anatomical evidence. Other grasses (e.g. *Arundo, Phragmites, Arundinaria, Lasiacis,* and *Muhlenbergia*) may also provide robust stems for bead-making.

SCIENTIFIC NAME: *Pinus leiophylla* var. *chihuahuana* type
Common name(s): chihuahua pine, ***oko-kó*** (Rm)
Part: bark
Color: brown
Note: Also in the region, *Pinus ponderosa* Lawson var. *arizonica* (Engelm.) Shaw has thick, platey bark that could be carved into pendants
Additional ethnobotanical information: leaves made into a tea for headaches
Alterations: carved
Where grows today: one of the many native pines of the upland coniferous forest.

SCIENTIFIC NAME: *Pisum sativum* L.
Common name(s): garden pea
Part: seed
Color: white
Alterations: none
Where grows today: a domesticated plant introduced from the Old World; grown in gardens (Bailey 1974:553).

SCIENTIFIC NAME: *Pithecellobium dulce* (Roxb.) Benth.
Common name(s): ***guamúchili*** (Rm), ***guamútcali*** (Rm)
Part: seed
Color: black
Additional ethnobotanical information: The pulpy, acidulous aril surrounding the seeds is a favorite spring food of Mexicans and Warihio (Gentry 1963:94). Leaves made into a tea for gastrointestinal ailments
Alterations: none
Where grows today: a native tree of thorn forest or tropical deciduous forest, sometimes in dry pine-oak forest, from sea level to 1600 m, now widely planted and naturalized along roads and in other disturbed habitats (McVaugh 1987:234). Often incorrectly thought to be an introduced taxon, since it was carried by the Spanish in colonial times to the Philippines, from where it went to India, where it was first described and named botanically (McVaugh 1987:234).

SCIENTIFIC NAME: *Quercus* spp. (at least two species used)
Common name(s): oak, ***rojí*** (Rm)
Part: acorn, missing the cap
Color: brown, black (dyed)
Additional ethnobotanical information: Bark is crushed and made into an ointment for inflammations and pains. The leaves are made into a tea for gastrointestinal ailments. The juice of the acorns is good for heart problems and an aid during pregnancy.
Alterations: black ones appear dyed, possibly in a bath of burned lard
Where grows today: many native oaks grow in the uplands; no attempt was made to identify the acorns by species.

SCIENTIFIC NAME: *Ricinis communis* L.
Common name(s): castor bean, ***uraké*** (Rm)
Part: seed
Color: mottled; basic color varied, from white to dark brown
Additional ethnobotanical information: Seeds eaten raw for gastrointestinal ailments, and the seeds and leaves together are made into a poultice to treat bruises, swellings, inflammations, and boils. The leaves are also made into a poultice to treat headaches, or used as an ointment for sores and cankers.
Alterations: none
Where grows today: introduced from tropical Africa, robust plants with huge leaves grow lushly in the uplands

SCIENTIFIC NAME: *Rhynchosia precatoria* (L.) D.C.
Common name(s): rosary bean, blackbird's eye, *chánate pusí* (Sp), ***munísowa*** (Rm)
Part: seed
Color: two tone, black and reddish-orange
Additional ethnobotanical information: Gunn (1969) suggests that a single seed of a similar tropical plant of the Old World *(Abrus precatorius)* would be deadly poisonous if ingested by a human. Sturtevant (in Hedrick 1972:17) says the seeds are edible, but among the hardest and most indigestible of all the pea tribe. However, the 1972 edition of this book provides a cautionary publisher's note on the seed's toxicity. The Latin word *precator* means "one who prays." The Mayo are reported to have used the seeds in necklaces (Gentry 1963:100). The Rarámuri used the seed crushed and made into an ointment or poultice to treat back pain and rheumatism.
Alterations: none
Where grows today: *Rhynchosia* is a native liana that grows in shady canyon bottom settings, up to 600 m in elevation, often on north-facing slopes in the tropical deciduous forest (data from ARIZ herbarium sheets).

SCIENTIFIC NAME: *Yucca* sp.
Common name(s): broad-leaved yucca, ***sokó*** (Rm)
Part: seed, thick like a dime
Color: black
Alterations: none
Where grows today: a native plant that can grow between 900 to 2425 m, with pinyon and juniper trees (Kearney and Peebles 1960:187).

SCIENTIFIC NAME: *Zea mays* L.
Common name(s): maize, corn, ***sukú*** (Rm)
Part: caryopsis
Color: deep purple/black
Additional ethnobotanical information: The tassels of maize are used by the Rarámuri as a tea to treat kidney and bladder infections. They consider themselves descendant from corn.
Alterations: none
Where grows today: a New World domesticate that grows all throughout the uplands and lowlands.

SCIENTIFIC NAME: Unknown dicotyledon; diffuse porous
Common name(s): unknown
Part: wood
Color: white
Alterations: carved into beads and crosses
Notes: In 1963, Pennington (1963:214-215) suggested that *Ptelea trifoliata*, the hop tree, supplied an easily worked wood that has been fashioned into crosses or beads. Anatomical comparisons between the 1994 materials and *Ptelea* must still be done.

Appendix 2.—Specific details on individual Rarámuri necklaces purchased in 1994

NECKLACE #1.
Bead Types: 1:1, *Zea mays* caryopsis: unknown dicotyledon stem
Pendant: Rarámuri Cross, unknown dicotyledon wood (fibrous, diffuse porous)
Strung on: undyed synthetic (nylon or polyester) thread.

NECKLACE #2.
Bead Types: 4:1, *Ceiba acuminata* seed: *Otatea* type stem
Pendant: Rarámuri Cross, unknown dicotyledon wood (fibrous, diffuse porous)
Strung on: red-dyed synthetic (nylon or polyester) thread.

NECKLACE #3.
Bead Types: 5:1, *Ceiba acuminata* seed: *Erythrina flabelliformis* seed
Pendant: miniature drum with 2:1, *Ricinis communis* seeds: *Erythrina flabelliformis* seeds
Strung on: light pink cotton thread.

NECKLACE #4.
Bead types: 11:1, *Ceiba acuminata* seed: *Erythrina flabelliformis* seed
Pendant: none
Strung on: light pink synthetic (nylon or polyester) thread.

NECKLACE #5.
Bead types: 1:1, *Quercus* sp. acorn (lacking cap and dyed black): *Erythrina flabelliformis* seed
Pendant: carved *Pinus leiophylla* type bark figure, Father Sun
Strung on: multi-colored synthetic (nylon or polyester) string; may be cotton wrapped.

NECKLACE #6.
Bead types: 7:1, *Coix lacryma-jobi* caryopses: *Erythrina flabelliformis* seeds
Pendant: none
Strung on: light blue heavy single strand fishing line.

NECKLACE #7.
Bead types: 1:1, *Coix lacryma-jobi* caryopses: *Erythrina flabelliformis* seeds
Pendant: none
Strung on: yellow, flat synthetic (plastic) strands (two, parallel and untwisted), as the strands of which commercial fruit (e.g., grapefruit) bags are made.

NECKLACE #8.
Bead types: 1:1, *Ricinis communis* seeds: *Erythrina flabelliformis* seeds
Pendant: carved *Pinus leiophylla* type bark Virgin de Guadalupe face, with nine carved and dyed *Juniperus/Cupressus* wooden angular beads, and 1:1, *Ceiba acuminata* seeds: *Erythrina flabelliformis* seeds. Pendant held together with copper wire.
Strung on: yellow synthetic thread, melted to seal ends.

NECKLACE #9.
Bead types: 3:1, *Ricinis communis* seeds: *Otatea* type stem
Pendant: none
Strung on: pink synthetic (nylon or polyester) thread, possibly cotton wrapped.

NECKLACE #10.
Bead types: solely immature *Arbutus* spp. fruit
Pendant: Rarámuri cross, unknown dicotyledon wood (fibrous, diffuse-porous)
Strung on: undyed cotton thread; 4 strands.

NECKLACE #11.
Bead types: 1:1:, *Helianthus annuus* achenes: mature *Arbutus* spp. fruit
Pendant: none
Strung on: bright green synthetic (nylon or polyester) thread.

NECKLACE #12.
Bead types: 15:3, *Albizzia sinaloensis* seed: *Yucca* sp. seed
Pendant: none
Strung on: yellow, heavy single strand synthetic fishing line, doubled for strength.

NECKLACE #13.
Bead types: 1:1, *Martynia annuua* fruit: *Erythrina flabelliformis* seeds
Pendant: none
Strung on: bright red synthetic (nylon or polyester) thread.

NECKLACE #14.
Bead types: solely *Quercus* sp. acorns, lacking the caps
Pendant: none
Strung on: rose-colored synthetic (nylon or polyester) thread, 3 strands.

NECKLACE #15.
Bead types: solely *Rhynchosia precatoria* seeds
Pendant: none
Strung on: yellow, heavy, 1-strand synthetic fishing line.

NECKLACE #16. Baca Institute of Ethnobotany (BIE) # NA-SW-TA-N-19
Bead types: 3:3, *Ricinis communis* seeds: *Pithecellobium dulce* seeds
Pendant: none
Strung on: pink cotton thread.

NECKLACE #17. BIE # NA-SW-TA-N-17
Bead types: 1:1, mature *Arbutus* fruit: white *Pisum sativum* seeds
Pendant: none
Strung on: white cotton thread.

NECKLACE #18. BIE # NA-SW-TA-N-16
Bead types: 5:4, *Ceiba acuminata* seeds: *Albizzia sinaloensis* seeds (green, flat)
Pendant: none
Strung on: grey synthetic (nylon or polyester) thread.

NECKLACE #19. BIE # NA-SW-TA-N-18
Bead types: 10:1, *Acacia farnesiana* seeds strung lengthwise: *Acacia farnesiana* seeds strung widthwise. This necklace is clearly a rosary.
Pendant: Rarámuri cross, unknown dicotyledon wood (fibrous, diffuse-porous)
Strung on: yellow fishing line.

NECKLACE #20. BIE # NA-SW-TA-N-2
Bead types: 12:2:1, *Ceiba acuminata* seeds: *Coix lacryma-jobi* caryopses: *Erythrina flabelliformis* seeds
Pendant: drum, made of goat skin, red cotton thread, *Otatea* with 2:1, *Erythrina flabelliformis* seed: *Otatea* stem
Strung on: red cotton thread.

NECKLACE #21. BIE # NA-SW-TA-N-3
Bead types: 1:1, red and tan *Erythrina flabelliformis* seeds: carved and black dyed unknown wood
Pendant: carved *Pinus leiophylla* type bark Virgin figure.
Strung on: yellow monofilament.

NECKLACE #22. BIE # NA-SW-TA-N-4
Bead types: solely *Quercus* acorn (lacking cap)
Pendant: Rarámuri cross, carved of *Juniperus* wood.
Strung on: white cotton string.

NECKLACE #23. BIE # NA-SW-TA-N-5
Bead types: solely *Coix lacryma-jobi* caryopses and one carved bead of unknown dicotyledon wood
Pendant: Rarámuri cross, carved of unknown dicotyledon wood.
Strung on: purple synthetic thread.

NECKLACE #24. BIE # NA-SW-TA-N-8
Bead types: 5:1, *Erythrina flabelliformis* seeds: tan *Erythrina flabelliformis* seeds
Pendant: Rarámuri cross, carved *Pinus leiophylla* type bark
Strung on: white cotton thread.

NECKLACE #25. BIE # NA-SW-TA-N-9
Bead types: solely *Quercus* acorn (lacking cap)
Pendant: Tarahumara four directions symbol, carved of *Pinus* wood.
Strung on: white synthetic thread.

NECKLACE #26. BIE # NA-SW-TA-N-11
Bead types: 3:2:1:, Yucca seeds: *Ceiba acuminata* seed: *Erythrina flabelliformis* seeds
Pendant: none
Strung on: yellow nylon thread.

NECKLACE #27. BIE # NA-SW-TA-N-12
Bead types: solely mature *Arbutus* sp. fruit
Pendant: none
Strung on: white nylon thread.

NECKLACE #28. BIE # NA-SW-TA-N-13
Bead types: 8:1, *Ceiba acuminata* seeds: tan *Erythrina flabelliformis* seeds
Pendant: 15 x 8.5 cm crucifix with carved Jesus figure. Both are carved from *Pinus* wood.
Strung on: red nylon thread.

NECKLACE #29. BIE # NA-SW-TA-N-14
Bead types: 23:1, *Albizzia sinaloensis* seed: red *Erythrina flabelliformis* seeds
Pendant: none
Strung on: orange nylon thread.

NECKLACE #30. BIE # NA-SW-TA-N-15
Bead types: 10:1:1:1, *Albizzia sinaloensis* seeds: *Coix lacryma-jobi* caryopsis: *Erythrina flabelliformis* seed: *Coix lacryma-jobi* caryopsis
Pendant: drum, plus three danglers of 1:3:1, *Erythrina flabelliformis* seed: *Coix lacryma-jobi* caryopses: *Erythrina flabelliformis* seed.
Strung on: yellow nylon thread.

NECKLACE #31. BIE # NA-SW-TA-N-2
Bead types: 8:1:1:1, *Ceiba acuminata* seeds: *Coix lacryma-jobi* caryopsis: *Erythrina flabelliformis* seed: *Coix lacryma-jobi* caryopsis
Pendant: drum, plus two danglers of 1:1:1, *Erythrina flabelliformis* seed: *Otatea* type stem: *Erythrina flabelliformis* seed.
Strung on: red cotton thread
Pendant: drum, made of goat skin, red cotton thread, *Otatea* with 2:1, *Erythrina flabelliformis* seed: *Otatea* stem
Strung on: red cotton thread.

NECKLACE #32. BIE # NA-SW-TA-N-1
Bead types: 1:1: *Ricinis communis* seed: *Erythrina flabelliformis* seed.
Pendant: none
Strung on: red cotton thread.

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GENERIC SPECIES AND BASIC LEVELS: ESSENCE AND APPEARANCE IN FOLK BIOLOGY

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ABSTRACT.—Results indicate that the same taxonomic rank is cognitively privileged for biological induction in two diverse populations: people raised in Michigan, and Itzaj Maya of the Peten rainforest. This is the generic species — the level of oak and robin — which is coextensive with Berlin's folkgeneric rank but with a distinct theoretical sense. The findings are unaccounted for by similarity-based models of category formation and induction because such models cannot simultaneously yield different measures of privilege. For example, Rosch and her colleagues suggest that life forms — the level of tree and bird — rather than folkgenerics comprise the "basic level" for many Americans. Rosch, like Berlin, advances such domain-general models of similarity to account for privileged categories as maximally informative clusters of perceptual attributes that best represent "objective discontinuities" in nature. However, this favors cross-cultural differences in the rank privileged in induction as a function of differences in familiarity with the natural environment. Although our data indicate some relative downgrading of knowledge to a higher rank among industrialized Americans and upgrading to a lower rank among silvicultural Maya, these differences are clearly a second-order effect. To account for the absolute privilege of generic species in diverse cultures, a domain-specific view of folkbiology is offered. It favors the idea of the generic-species level as a partitioning of the ontological domains of plant and animal into causal essences. The attribution of essence, and the biological expectations that go with it, is in part independent of actual experience or degree of perceptual familiarity with the kind in question. This reflects a cognitive division of labor between domain-general perceptual heuristics and domain-specific learning mechanisms, which may be an evolutionary design.

RESUMEN.— Nuestros resultados indican que el mismo rango taxonómico es privilegiado cognoscitivamente en dos poblaciones diferentes: gente que creció en Michigan, en los Estados Unidos de Norteamérica, y Mayas Itzaj de la selva tropical del Petén en Guatemala. Este rango taxonómico es la especie genérica — el nivel del encino y el petirrojo — que coincide con lo que Berlin llama el nivel genérico 'folk' pero tiene un sentido teórico distinto. Los modelos de formación de categorías e inducción basados en la similitud no pueden dar cuenta de estos resultados porque tales modelos no pueden producir simultaneamente diferentes medidas de privilegio. Por ejemplo, Rosch y sus colegas sugieren que son las formas de vida — el nivel al que pertenecen árbol y pájaro — más que los genéricos 'folk' las que comprenden el "nivel básico" para muchos norteamericanos. Rosch, al igual que Berlin, propone tales modelos de similitud, generales a todo dominio, para explicar las categorías privilegiadas como conjuntos, maximamente informativos, de atributos perceptuales que mejor representan las "discontinuidades objetivas" de la naturaleza. Esto, sin embargo, favorece las diferencias entre culturas en el rango privilegiado en la inducción como función de las diferencias en familiaridad con el medio ambiente. Si bien nuestros datos indican cierta disminución relativa del conocimiento hacia rangos superiores entre los norteamericanos industrializados, y un aumento del conocimiento hacia rangos inferiores entre los silvicultores mayas, estas diferencias son claramente un efecto de segundo orden. Para responder al privilegio absoluto de la especie genérica en diversas culturas, ofrecemos una perspectiva específica de dominio de la biología 'folk'. Esta perspectiva favorece la idea del nivel de la especie genérica como una división de los dominios ontológicos planta y animal en esencias causales. La atribución de esencia, y las expectativas biológicas que conlleva, son independientes en parte de la experiencia real o el grado de familiaridad perceptual con la clase en cuestión. Esto refleja una división cognoscitiva del trabajo entre la heurística perceptual de dominio general y los mecanismos de aprendizaje de dominio específico, división que puede ser un diseño evolutivo.

RÉSUMÉ.—Notre enquête indique que dans deux populations distinctes, les habitants originaires du Michigan aux États-Unis et les Maya Itzaj de la forêt dense humide du Petén au Guatemala, le même rang taxinomique est cognitivement privilégié lors du processus inductif de connaissance des éléments biologiques. Il s'agit de l'espèce générique — le niveau de chêne et de rouge-gorge — qui est coextensive au niveau du générique populaire de Berlin mais qui a un sens théorique différent. Ces résultats ne peuvent s'expliquer par des modèles de la formation catégorielle et de l'induction fondés sur la similarité, car de tels modèles ne peuvent fournir en même temps une appréciation des différentes échelles de mesure de prédilection qui sont à l'œuvre. Par exemple, Rosch et ses collègues suggèrent que pour de nombreux Américains, les formes de vie — le niveau d'arbre et d'oiseau — constituent le "niveau de base" au lieu des génériques populaires. Comme Berlin, Rosch propose de tels modèles de domaines généraux de similarité pour rendre compte des catégories privilégiées en tant que groupes porteurs d'information maximale d'attributs perceptuels représentant le mieux les "discontinuités objectives" de la nature. Toutefois, ceci laisse croire à des différences culturelles relatives à la sélection inductive du rang qui seraient fonction de différences de familiarité avec le milieu naturel. Bien que nos données indiquent un appauvrissement relatif du savoir vers le haut (les rangs supérieurs de la taxinomie) chez les habitants industrialisés du Michigan et un enrichissement relatif du savoir vers le bas (les rangs inférieurs de la taxinomie) chez les Maya forestiers, ces différences constituent évidemment un effet secondaire. Une perspective spécifique au domaine de la biologie populaire peut rendre compte de la prédilection absolue pour le niveau de l'espèce générique dans diverses cultures. Selon cette perspective, le niveau de l'espèce générique serait le résultat d'un morcellement des domains ontologiques de plante et d'animal en essences causales. L'attribution de l'essence — et les attentes biologiques qui l'accompagnent — est partiellement indépendante de l'expérience concrète ou du degré de familiarité perceptuelle avec la sorte en question. Ceci reflète une division cognitive du travail, entre une heuristique perceptuelle orientée vers le domaine général et des mécanismes d'apprentissage tourné vers le domaine spécifique — ce qui pourrait relever d'un schéma évolutif.

INTRODUCTION[1]

This paper uses a standard tool of cognitive psychology — inductive inference — to explore the cognitive validity of folkbiological ranks. In particular, the study tests whether there is a psychologically privileged rank that maximizes the strength of biologically relevant inferences, and whether this privileged rank is the same across cultures. The crucial question is whether and where in the taxonomic hierarchy a breakpoint or sharp change in inductive strength occurs. The issue directly bears on ideas concerning the basis for the cognitive appreciation of living kinds.

For example, findings by Rosch and her colleagues suggest that members of an industrialized society see category members as fairly similar up to the life-form level, that is, the level of tree or bird (Rosch, Mervis, Gray, Johnson, and Boyes-Braem 1976; see Zubin and Köpcke 1986 for Germany). If so, the major breakpoint or elbow in inductive confidence in such cultures should appear between the life-form level and higher levels. In contrast, observations by Berlin and his colleagues on the salience of the folkgeneric — the level of oak and robin — suggest that the breakpoint in a small-scale subsistence society should be between the folkgeneric level and higher levels (Berlin, Breedlove, and Raven 1973). In the following paragraphs we develop these ideas to motivate the present experiment.

Ever since the pioneering work of Berlin and his colleagues, ethnobiological evidence has been accumulating that human societies everywhere have similar folkbiological structures (Berlin, Breedlove, and Raven 1974; Hunn 1977; Hays 1983; Brown 1984; Atran 1990; Berlin 1992). These striking cross-cultural similarities suggest that a small number of organizing principles universally define systems of folkbiological classification. Folkbiological groups, or taxa, are organized into ranks, which represent an embedding of distinct levels of reality. Most folkbiological systems have between three and six ranks. Taxa of the same rank are mutually exclusive and tend to display similar linguistic, biological, and psychological characteristics.

Ranks and taxa, whether in folkbiological or scientific classification, are of different logical orders, and confounding them is a category mistake. Biological ranks are second-order classes of groups (e.g., species, family, kingdom) whose elements are first-order groups (e.g., lion, feline, animal). Folkbiological ranks seem to vary little, if at all, across cultures as a function of theories or belief systems; in other words, such ranks are universal but not the taxa they contain. Ranks are intended to represent fundamentally different levels of reality, not convenience.[2]

The most general folkbiological rank is the folk kingdom. Examples are plant and animal. Such taxa are not always explicitly named, and represent the most fundamental divisions of the biological world. These divisions correspond to the notion of "ontological category" in philosophy (Donnellan 1971) and psychology (Keil 1979). From an early age, it appears, humans cannot help but conceive of any object they see in the world as either being or not being an animal and there is evidence for an early distinction between plants and nonliving things (Inagaki and Hatano in press). Conceiving of an object as a plant or animal seems to carry with it certain assumptions that are not applied to objects thought of as belonging to other ontological categories, like the categories of substance or artifact (Keil 1989; Mandler and McDonough 1996).

The next rank down is that of life form. Most taxa of lesser rank fall under one or another life form. Life-form taxa often have lexically unanalyzable names (simple primary lexemes), such as "tree" and "bird," although some life-form names are analyzable, such as "quadruped." Biologically, members of a life-form taxon are diverse. Psychologically, members of a life-form taxon share a small number of perceptual diagnostics: stem aspect, skin covering, and so forth (Brown 1984). Life-form taxa may represent adaptations to broad sets of ecological conditions, such as competition among single-stem plants for sunlight and tetrapod adaptation to life in the air (Hunn 1982; Atran 1985). Classifying by life form may occur early on: two-year-olds distinguish familiar kinds of quadruped (e.g., dog and horse) from sea versus air animals (Mandler *et al.* 1991).

The core of any folk taxonomy, according to Berlin, is the folkgeneric level. Like life-form taxa, folkgeneric taxa are often named by simple lexemes, such as "oak" and "robin." Sometimes, folkgenerics are labeled as binomial compounds, like "hummingbird." On other occasions, they may be optionally labeled as binomial composites, such as "oak tree." In both cases the binomial makes the hierarchical relation apparent between generic and life form.

Folkgenerics often correspond to scientific genera or species, at least for the most phenomenally salient organisms, such as larger vertebrates and flowering plants. On occasion generic species can correspond to local fragments of biological families (e.g., vulture) , orders (e.g., bat) and — especially with invertebrates — even higher-order biological taxa (Atran 1987a; Berlin 1992). Folkgenerics may also be the categories most easily recognized, most commonly named and most easily learned by children in small-scale societies (Stross 1973). Indeed, ethnobiologists who otherwise differ in their views of folktaxonomy tend to agree that one level best captures discontinuities in nature and provides the fundamental constituents in all systems of folkbiological categorization, reasoning and use (Bulmer 1974; Hunn 1982; Ellen 1993).

In what follows, we use the term "generic species," rather than "folk genera/folk generic" (Berlin 1972) or "folk species/folk specieme" (Bulmer 1970), for three reasons.[3] First, a principled distinction between biological genus and species is not pertinent to local folk around the world. The most phenomenally salient species for humans, including most species of large vertebrates, trees, and phylogenetically isolated groups such as palms and cacti belong to monospecific genera in any given locale (cf. Hunn 1977).[4] Closely related species of a polytypic genus in a locale are often hard to distinguish, hence no readily perceptible morphological or ecological "gap" can be discerned between them (Diver 1940).

Second, the term "generic species" reflects a more accurate sense of the correspondence between psychologically privileged folkbiological groups and historically privileged scientific groups (Stevens 1994). During the initial stages of Europe's world-wide "Age of Exploration," the number of species increased an order of magnitude. Foreign species were habitually joined to the most similar European species; that is, to the generic type in a "natural system." Historically, then, the distinction between genus and species did not appear until the influx of newly discovered species from around the world compelled European naturalists to mnemonically manage them within a worldwide system of genera built around (mainly European) species types (Atran 1987a).

Third, the term "generic species" reflects their dual character. As privileged mnemonic groups, they are akin to genera in being those groups most readily apparent to the naked eye (Cain 1956). As privileged causal groups, they are akin to species in being the principal loci of evolutionary processes responsible for the appearance of biological diversity (Mayr 1969). In Western science, the dual character of this privileged level of folkbiological taxonomy eventually "fissioned" into species (Cesalpino 1583) and genera (Tournefort 1694).

People in all cultures spontaneously partition the ontological categories animal and plant into generic species in a virtually exhaustive manner. "Virtually exhaustive" means that when an organism is encountered that is not readily identifiable as belonging to a named generic species, it is still expected to belong to one. The organism is often assimilated to one of the named taxa it resembles, but sometimes it is assigned an "empty" generic-species slot pending further scrutiny (e.g., "such-and-such a plant is some [generic-species] kind of tree," cf. Berlin in press). This partitioning of ontological categories seems to be part and parcel of the categories themselves: no plant or animal can fail in principle to belong uniquely to a generic species.

Moreover, data from developmental psychology suggests that young children presume each distinctive living kind to have an "essence," or underlying causal nature, which is responsible for the typical appearance of that kind (Gelman and Wellman 1991). At first this presumption involves only global understanding that the readily visible outsides of living kinds are produced by, but perhaps different from, their initially invisible insides. Children initially lack concrete or specific pieces of knowledge about each kind (Simmons and Keil 1995). Over time, they try to flesh out the causal properties of these presumed essences as responsible for growth (Hickling and Gelman 1995), inheritance (Springer and Keil 1989), and complementary functioning of distinct body parts in a living kind (Hatano and Inagaki 1994). Such intrinsic causal essences, which are universally presumed to be both teleological (unlike the mechanical causes affecting inert substances) and internally directed (unlike externally fashioned artifacts), appear to be unique to the cognitive domain of living kinds and primarily identified with generic species.

Generic species may be further divided into folkspecifics. These taxa are usually labeled binomially, with secondary lexemes. Compound names, like "white oak" and "mountain robin," make the hierarchical relation transparent between a generic species and its folkspecifics. Folkspecifics that have tradition of high cultural salience may be labeled with primary lexemes, such as "winesap" (a kind of apple tree) and "tabby" (a kind of cat). In general, whether and how a generic species is further differentiated depends on the cultural significance of the organisms involved. Occasionally, an important folkspecific taxon will be further subdivided into contrasting folkvarietal taxa: for example, short-haired tabby versus long-haired tabby. Folkvarietals are usually labeled trinomially, with tertiary lexemes that make transparent their taxonomic relationship with superordinate folkspecifics and generic species, for example "spotted white oak."

Thus, in addition to generic species, people everywhere tend to form groups that are both subordinate and superordinate to the level of privileged groups. This regular classification of "groups under groups... is not arbitrary like the grouping of stars in constellations" (Darwin 1859:431). Rather, cultures across the world organize readily perceptible organisms into a system of hierarchical levels that are designed to represent the embedded structure of life around us, with the generic-species level being most informative. In some cultures, but not all, people may develop "theories" of life that are meant to cover all living kinds, such as Western theories of biology (Carey 1985; Atran 1995a). But the very possibility of such theorizing would not exist without a universal construal of generic species to provide the transtheoretical basis for scientific speculation about the biological world. Different biological theories — including evolutionary theory — initially arose to account for the apparent constancy of "common [generic] species" and for the apparent similarities and differences between them (Wallace 1889:1; Mayr 1969:37).

Given these observations, results of psychological studies of privilege or basicness are striking and puzzling. In a justly celebrated set of experiments Rosch and her colleagues set out to test the validity of the notion of a psychologically privileged taxonomic level (Rosch *et al.* 1976). Using a broad array of converging measures they found that there is indeed a "basic level" in category hierarchies of "naturally occurring objects," such as "taxonomies" of artifacts as well as living kinds (cf. Brown, Kolar, Torrey, Troung-Quang, and Volkman 1976). For artifact and living kind hierarchies, the basic level was where: (1) many common features are listed for categories, (2) consistent motor programs are employed for the interaction with or manipulation of category exemplars, (3) category members have similar enough shapes so that it is possible to recognize an average shape for objects of the category. For example, subjects were able to list many more features for chair or dog than for furniture or mammal, but few added features for kitchen chair or terrier. They could also readily construct an average image for chair or dog but not for furniture or mammal. Rosch *et al.* also found that basic-level categories are preferred in adult naming, the level first learned by children, and at which categorization was fastest.

Thus, work by Berlin and Rosch both indicate a privileged level in category hierarchies. Moreover, both claim that this privileged take on naturally occurring objects is directly tied to objective discontinuities in the real world. These objective discontinuities provide the information-rich bundles of perceptual attributes that presumably allow a domain-general perceptual processing mechanism to carve up nature at its fundamental joints.

But here's the rub that motivates the present study: The basic level that Rosch *et al.* (1976) hypothesized for artifacts was confirmed (e.g., hammer, guitar); however, the hypothesized basic level for living kinds (e.g., maple, trout), which Rosch initially presumed would accord with Berlin's generic rank, was not. Instead of maple and trout, Rosch *et al.* found that tree and fish operated as basic-level categories for American college students. Except for very familiar animals (e.g., dog, chicken), Rosch's basic level for living kinds corresponds to Berlin's life-form level.

To explore the cognitive basis for this apparent discrepancy between Berlin and Rosch, we introduce the examination of inductive inference into our study. Inductive inference allows people to extend knowledge beyond their immediate experience and beyond the information they are given, and is a crucial part of category formation and use (Rips 1975; Smith and Medin 1981). Although neither Berlin nor Rosch explicitly deal with inductive inference, such inferences are arguably central to understanding preference for certain categories. For what is privileged about cat relative to mammal or tabby is that the amount of information that can be inferred about the category may be maximized at the level of cat. Thus, knowing that a tabby eats fish, it may be prima facie reasonable to infer that all cats eat fish, but unreasonable to infer from this that all mammals eat fish. Moreover, knowing that a short-haired tabby eats fish is likely as good an indication that all cats eat them as it is that all tabbies do.

If a privileged level carries the most information about the world, categories at that level should strongly support a wide range of inferences about what is common among members. Inferences to a privileged category (e.g., white oak to oak, tabby to cat) should be much stronger than inferences to a superordinate category (e.g., oak to tree, cat to mammal). Moreover, inferences to a subordinate category (e.g., spotted white oak to white oak, short-haired tabby to tabby) should not be much stronger or different than inferences to a privileged category.

The hypothesis motivating our experiment is that the privileged taxonomic level for biological induction is absolute, in the sense of remaining constant across culture, and not relative, in the sense of varying across cultures. Unlike relative privilege, absolute privilege is not primarily driven by general notions of perceived similarity, experience, or cultural expertise. Instead, the absolute inductive privilege of the generic-species level may be anchored in cognitive assumptions peculiar to a universal domain of folkbiology. The idea is that people everywhere presume essential kinds to be the main loci of causal processes that govern the apparent structure of the biological world, even if the superficial and underlying properties of such kinds are at first little known (Atran 1987b; Medin and Ortony 1989; Gelman, Coley, and Gottfried 1994).

Although we expect members of these widely divergent cultures to show absolute psychological privilege at the generic-species level, we may also find evidence of the effects of devolution of folkbiological knowledge leading to secondary differences in induction patterns across cultures. Specifically, Dougherty (1978) argues that lack of contact with the natural world leads to knowledge decay at more specific levels; thus Americans may show secondary privilege for higher-order taxa. Likewise, Itzaj dependence on intimate interaction with the biological world, coupled with a silviculture tradition, may lead to secondary privilege for lower-order taxa.

In addition to examining the competing claims of absolute versus relative privilege, our experiment must also deal with claims for a more general sort of reasoning heuristic, which we deem progressive privilege. What is missing from most perception-based or similarity-based accounts of category formation in class-inclusion hierarchies is an explanation of how inferences are made across the taxonomy from one category to another. Such an explanation is necessary to understand the work that categories do in taxonomic reasoning, and is crucial to any understanding of underlying (biological) relationships. In one of the most elegant attempts to explain similarity-based taxonomic inference to date, Osherson, Smith, Wilkie, López, and Shafir (1990) depict an inferential argument as categorical if its premises and conclusion take the form *All members of C have property P*, where C is a natural category like ROBIN or BIRD, and P remains the same across premises and conclusions. An example is *Guernsey cows are susceptible to mad cow disease; therefore all cows are susceptible to mad cow disease*. The argument is psychologically strong to the extent that belief in its premises engenders belief in its conclusion. Osherson *et al.*'s model is based exclusively on an evaluation of the perceived or presumed similarities between premise and conclusion categories.

The prediction of progressive privilege that follows from this model is that for any given premise category held constant at a particular taxonomic level, argument strength should decrease the higher the level of the conclusion category. Thus, inductive strength should decrease incrementally from varietal to specific, varietal to generic species, varietal to life form, and varietal to kingdom. Also, for any given conclusion category held constant at a particular level, argument strength should increase as one changes the premise category to one that is closer to the conclusion category. For example, inductive strength from varietal to generic species should be less than from specific to generic species.[5] By contrast, our hypothesis entails that absolute rather than progressive privilege will account for inference patterns across folkbiological ranks.

METHODS

Itzaj participants.—Twelve Itzaj — six men and six women — living in the village of San José, Petén, Guatemala participated in the study.[6] Itzaj are Maya Amerindians living in the tropical forest region of Petén, Guatemala. Until recently, men devoted their time to shifting agriculture, hunting, and silviculture, whereas women concentrated on the myriad tasks of household maintenance. The Itzaj comprised the last independent native polity to be conquered by Spaniards (in 1697), and have preserved virtually all ethnobiological knowledge recorded for Lowland Maya since the time of the initial Spanish conquest (Atran 1993). Despite the current awesome rate of deforestation and demise in use of Itzaj language and culture, the ethic of traditional Maya silviculture is still very much in evidence among the generation of our informants who range in age from 50 to 80 years old (Atran, Medin, Lynch, Ross, Vapnarsky, and Ucan Ek' in press). Participants spoke Spanish as well as Itzaj, but testing was exclusively in Itzaj. They were acquainted with the first author, and at relative ease in the testing situation. All were compensated for their participation.

Michigan participants.—The 21 American participants were five men and 16 women who ranged in age from 17 to 25. They were self-identified as people raised in Michigan, and recruited through an advertisement in a local campus newspaper. All were paid for their participation.

Itzaj materials.—Based on extensive fieldwork with the Itzaj, we chose a set of Itzaj folkbiological categories of the kingdom (K), life-form (L), generic-species (G), folkspecific (S), and varietal (V) ranks. We selected three plant life forms: ***che'*** = 'tree', ***ak'*** = 'vine', ***pok~che'*** = 'herb'/'underbrush'. We also selected three animal life forms: ***b'a'al~che' kuximal*** = 'walking animal', i.e., mammal, ***ch'iich'*** = 'birds including bats', ***käy*** = 'fish'. Three generic-species taxa were chosen from each life form such that each generic species had a subordinate folkspecific, and each folkspecific had a salient varietal.[7] Although some Itzaj life-form names are composites (e.g., ***b'a'al~che' kuximal***) while others are primary lexemes (e.g., ***ch'iich'***), previous experiments indicate that this linguistic difference has no impact on inference patterns within Itzaj life forms (López *et al.* in press; Atran in press). Categories used and their approximate English translations are presented in Table 1.

TABLE 1.—Natural kind stimuli used in Itzaj study.

Folk Kingdom	*Life Form*	*Generic Species*	*Folk Specific*	*Varietal*
animal (***b'a'al~che' kuximal*** & ***ch'iich'*** & ***käy***)				
	mammal (***b'a'al~che'***)			
		agouti (***tzu'***)		
			green agouti (***ya'ax tzu'***)	
				large green agouti (***noj ya'ax tzu'***)
		squirrel (***ku'uk***)		
			red squirrel (***chäk ku'uk***)	
				female red squirrel (***chäk ku'uk uchupal***)
		spider monkey (***tuuchaj***)		
			black spider monkey (***b'ox tuuchaj***)	
				male black spider monkey (***b'ox tuuchaj uxib'al***)
	bird (***chi'iich'***)			
		vulture (***ch'om***)		
			black vulture (***b'ox ch'om***)	
				red-headed black vulture (***b'ox ch'om chäk upol***)
		hawk (***ch'uy***)		
			water hawk (***ch'uy-il ja'***)	
				black water hawk (***b'ox ch'uy-il ja'***)
		woodpecker (***kolonte'***)		
			red woodpecker (***chäk kolonte'***)	
				black-backed red woodpecker (***chäk kolonte' b'ox upach***)
	fish (***käy***)			
		catfish (***lu'***)		
			village catfish (***lu'-il kaj***)	
				large village catfish (***noj lu'-il kaj***)

TABLE 1.—Continued.

Folk Kingdom	*Life Form*	*Generic Species*	*Folk Specific*	*Varietal*
		mojara (***b'ox***)		
			yo'mojara (***yo' b'ox***)	
				small yo'mojara (***mo'nok yo' b'ox***)
		sardine (***chilam***)		
			red-tailed sardine (***chäk~nej chilam***)	
				male red-tailed sardine (***chäk~nej chilam uxib'al***)
plant (***che' & pok^che' & ak'***)				
	tree (***che'***)			
		papaya tree (***p'ut***)		
			village papaya tree (***p'ut-il kaj***)	
				yellow village papaya tree (***k'än put'-il kaj***)
		nance tree (***chi'***)		
			savanna nance tree (***chi' chakän***)	
				green joom savanna nance tree (***ya'ax joom chi' chakän***)
		hogplum tree (***ab'äl***)		
			forest hogplum tree (***ab'äl-il k'aax***)	
				forest jobo hogplum tree (***job'o' ab'äl-il k'aax***)
	herb (***pok^che'***)			
		cordoncillo (***pu'uk che'***)		
			male cordoncillo (***pu'uk che' uxib'al***)	
				narrow male cordoncillo (***pu'uk che' uxib'al käs chawak***)
		tomato (***p'ak***)		
			breast tomato (***chu'chu' p'ak***)	
				sweet breast tomato (***ch'uuk chu'chu' p'ak***)
		chili pepper (***ik***)		
			sweet chili pepper (***ch'uuk ik***)	
				red sweet chili pepper (***chäk ch'uuk ik***)
	vine (***ak'***)			
		bean (***b'u'ul***)		
			tzama bean (***tzäma' b'u'ul***)	
				red tzama bean (***chäk tzäma' b'u'ul***)
		squash (***k'uum***)		
			chuyut squash (***chuyut k'uum***)	
				spring chayut squash (***k'ik'i'ix chuyut k'uum***)

Pretesting with Itzaj (Atran 1995b; López *et al.* in press; Atran in press) showed that participants were willing to make inferences about hypothetical diseases. The properties chosen for animals were diseases related to the 'heart' (***puksik'al***), 'blood' (***k'ik'el***), and 'liver' (***tamen***). For plants, diseases related to the 'roots' (***motz***), 'sap' (***itz***), and 'leaf' (***le'***). The properties were chosen according to Itzaj beliefs about the essential, underlying aspects of life's functioning. Thus, the Itzaj word ***puksik'al***, in addition to identifying the biological organ 'heart' in animals, also denotes 'essence' or 'heart' in both animals and plants. The term ***motz*** denotes 'roots', which is considered the initial locus of the plant ***puksik'al***. The term ***k'ik'el*** denotes 'blood' and is conceived of as the principal vehicle for conveying life from the ***puksik'al*** throughout the body. ***Itz'*** denotes 'sap', which functions as the plant's ***k'ik'el*** 'blood'. The ***tamen***, or 'liver', helps to 'center' and regulate the animal's ***puksik'al***. The ***le'***, or 'leaf', is the final locus of the plant ***puksik'al***.

Properties used for inferences about animals had the form, "is susceptible to a disease of the <blood> called <X>." Similarly, properties used for plant inferences had the form, "is susceptible to a disease of the <root> called <X>." For each individual question, "X" was replaced with a phonologically appropriate nonsense name (e.g., "eta") in order to minimize the repetitiveness of the task. The disease types were randomized across trials.

Each participant responded to a total of 53 questions in which he/she was told that all members of a category had a property (the premise), and asked whether "all," "few," or "no" members of a higher-level category (the conclusion category) also possessed that property. The premise category was at one of four levels, either life-form (e.g., L = bird), generic-species (e.g., G = vulture, i.e., ***aj-ch'om*** = Cathartidae), folkspecific (e.g., S= black vulture, i.e., ***aj-b'ox ch'om*** = *Cathartes aura*), or varietal (e.g., V = red-headed black vulture, i.e, ***aj-b'ox chom chäk u-pol*** = mature exemplars of *Cathartes aura*). The conclusion was drawn from a higher-level category, either kingdom (e.g., K = animal), life-form (L), generic-species (G), or folkspecific (S). Thus, there were ten possible combinations of premise and conclusion category levels: L→K, G→K, G→L, S→K, S→L, S→G, V→K, V→L, V→G, and V→S. For example, a folkspecific-to-life form (S→L) question might be, "If all black vultures are susceptible to the blood disease called eta, are all other birds susceptible?" If a participant answers "no," then the follow-up question would be "Are some or a few other birds susceptible to disease eta, or no other birds at all?"

For questions using a folk-kingdom category as the conclusion (L→K, G→K, S→K, V→K), wording reflected several facts about Itzaj names for high-level folkbiological categories. In Itzaj, the term for animals (***b'a'al~che'***, literally 'forest-thing') polysemously refers to: (a) the animal kingdom as a whole (including invertebrates, birds, fish); (b) the more restrictive grouping of quadrupeds (***b'a'al~che' kuximal*** = 'mammals' or 'walking animals', ***b'a'al~che' kujiltikub'aj*** = 'reptiles' or 'slithering animals', ***b'a'al~che' kusiit*** = 'amphibians' or 'jumping animals'); (c) the mammals alone. Moreover, as in many languages (Brown 1984), there is no single label for the plant kingdom in Itzaj, although there is a numeral classifier, ***teek***, used for all and only plants (e.g., ***jun-teek ixi'im*** = a maize plant or 'one-plant maize'). So, for inferences with a conclusion category of animals or plants, the category was presented as a concatenation of major life forms not mentioned in the premise. For example, "If all papaya trees were susceptible to disease "beta" of the leaves, would (all, few, or no) herbs and vines and grasses also be susceptible?"[8]

Michigan materials.—The corresponding life forms for the American students were: mammal, fish, tree, bush, and flower (on "flower" as an American life form see Dougherty 1979). From each life form, we selected three subclasses (e.g., for tree: oak, maple, pine), chosen on predominantly linguistic grounds to correspond to taxa of the generic-species rank. Specifically, generic species are salient taxa often named by simple, primary lexemes (unanalyzable names such as maple or eagle) whose immediate superordinates (life-form taxa) are also named by primary lexemes (tree, bird). We selected subclasses of generic-species taxa to correspond to folkspecifics and varietals, using secondary and tertiary lexemes: for example, sugar maple and spotted sugar maple, or bald eagle and white-collared bald eagle. A complete list of categories used is given in Table 2.[9]

TABLE 2.—Natural kind stimuli used in Michigan study.

Folk Kingdom	*Life Form*	*Generic Species*	*Folk Specific*	*Varietal*
Animal	Mammal	Deer	Whitetail Deer	Northern Whitetail Deer
		Tiger	Bengal Tiger	White-collared Bengal Tiger
		Squirrel	Gray Squirrel	Brown-backed Gray Squirrel
	Bird	Lark	Meadow Lark	Northern Meadow Lark
		Eagle	Bald Eagle	White-collared Bald Eagle
		Sparrow	House Sparrow	Brown-backed House Sparrow
	Fish	Trout	Rainbow Trout	Northern Rainbow Trout
		Shark	Hammerhead Shark	White-collared Hammerhead Shark
		Bass	Largemouth Bass	Brown-backed Largemouth Bass
Plant	Tree	Maple	Sugar Maple	Spotted Sugar Maple
		Oak	Red Oak	Common Red Oak
		Pine	White Pine	Eastern White Pine
	Bush	Elderberry	American Elderberry	Spotted American Elderberry
		Juniper	Eastern Juniper	Eastern Rocky-Mountain Juniper
		Azalea	Torch Azalea	Common Torch Azalea
	Flower	Lily	Day Lily	Eastern Day Lily
		Violet	Blue Violet	Common Blue Violet
		Marigold	Marsh Marigold	Spotted Marsh Marigold

The properties used in questions for Michigan students were "have protein X," "have enzyme Y," and "are susceptible to disease Z." These were chosen to be internal biologically-based properties intrinsic to the kind in question, but abstract enough so that, rather than answering what amounted to factual questions, participants would likely make inductive inferences based on taxonomic category membership (Osherson *et al.* 1990; Heit and Rubinstein 1994). Because some Michigan participants would refuse to give extreme answers of "all" and/or "none," the possible response categories used were "all or virtually all," "some or few," and "none or virtually none." Again, ten types of questions, varying levels of premise and conclusion categories, were presented. Each Michigan participant was presented with a total of 56 questions.

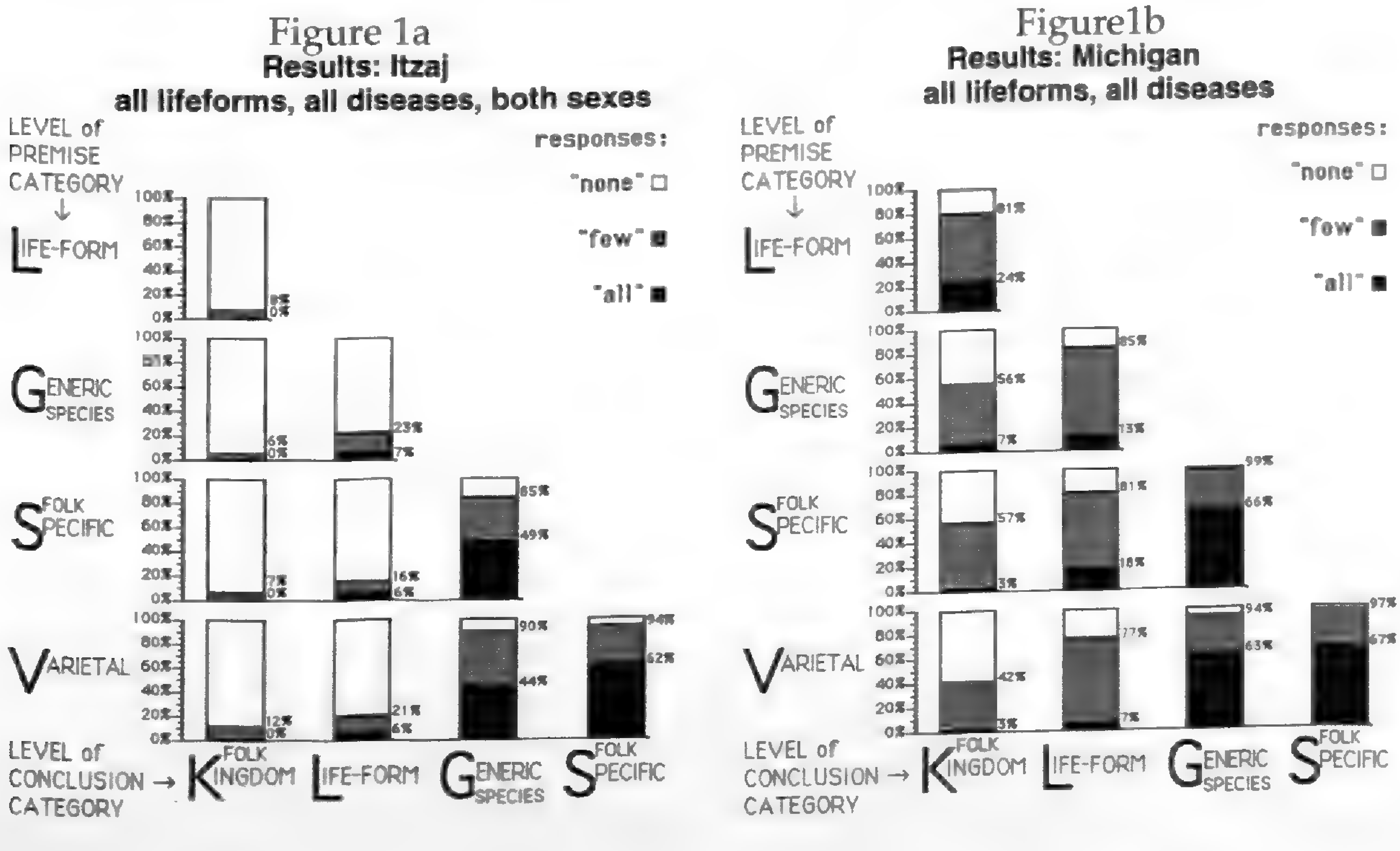
Itzaj procedure.—Questions were presented in random order, varying question levels (premise and conclusion), life-form and generic species, and disease type. The procedure was carried out in the Itzaj Maya language. Participants were tested in San José, Petén, Guatemala, in either a field research station or in homes in the town. Participants were told that foreign researchers wished to learn more about the plants and animals of Petén, and that the Itzaj could help with this.

Michigan procedure.—The questions were presented one at a time, orally, in random order, varying question levels (premise and conclusion), life form and generic species, and question type (protein, enzyme, disease). The procedure was carried out in a laboratory setting.

RESULTS

Responses were scored in two ways. First, we totaled the proportion of "all or virtually all" responses for each question (e.g., the proportion of times respondents agreed that if red oaks had a property, all or virtually all oaks would have that property). Second, we calculated "response scores" for each item by scoring a response of "all or virtually all" as 3, "some or few" as 2, and "none or virtually none" as 1. A higher response score reflected more confidence in the strength of the inductive inference. Scores were analyzed using t-tests with significance levels adjusted to account for multiple comparisons. Finally, a regression analysis of the data was also performed.

FIGURE 1.



The main results of the present study are depicted graphically in Figure 1. Figure 1 summarizes the results from Itzaj and Michigan informants collapsed across life forms, and shows the proportion of "all," "some/few," and "none" responses. For example, given an inference from the folkspecific rank to the generic-species rank (hereafter S→G, e.g., "If all red squirrels have a property, will all squirrels have that property?"), 49% of responses indicated that "all" squirrels, (rather than "some" or "none") would possess the property given that red squirrels did.

The results are organized to address three major questions. First, is the generic-species rank absolutely privileged with respect to inductive inference? Second, is there evidence for relative privilege in folkbiological reasoning patterns, such as devolution of inductive preference to the life-form level among Americans or upgrading of inductive preference at the folkspecific level among Maya? Third, is there evidence of progressive privilege along the lines of Osherson *et al.* (1990), such as a monotonic decrease in inference strength from lower to higher ranks? After initially addressing these questions, we refine our presentation with a regression analysis (Table 3) and a breakdown of results by life form.

Moving along the main diagonals in Figure 1 is equivalent to changing the levels of both the premise and conclusion categories while keeping their relative level the same (with the conclusion level one higher than the premise level). Moving horizontally within each graph corresponds to changing the conclusion category while leaving the premise category constant. Both of these comparisons bear on the question of the absolute privilege of the generic-species rank. Finally, moving vertically within each graph corresponds to changing the premise category while holding the conclusion category constant. These comparisons are relevant to the Osherson *et al.* hypothesis of taxonomically progressive privilege.

Absolute privilege of the generic species.—First, we ask whether induction patterns point to a single inductively privileged level. Coley, Medin, and Atran (in press) examined inferences from a given rank to the adjacent higher-order rank (i.e., V→S, S→G, G→L, L→K), and found a sharp decline in inference strength to taxa above the generic-species level. This elbow in the curve indicated that both American students and Itzaj elders inductively privilege generic-species. We expect the same pattern: V→S and S→G inferences should be nearly equal and similarly strong, and there should be a significant drop in the strength of inferences for taxa ranked higher than the generic species.

As can be seen in Figure 1, results support the view that the generic-species is privileged for both American and Itzaj informants. As predicted, proportions of "all" responses do not differ between V→S and S→G responses, but drop significantly between S→G and G→L inductions: using a within-subject ANOVA and a post-hoc test of pairwise comparisons, for Itzaj $t(134) = 5.98$, $p<.0001$; for Michigan participants $t(259) = 10.38$, $p<.0001$. Finally, G→L inferences do not differ from L→K differences. An examination of combined "all," "few," and "none" response scores reveals the same pattern. For both Itzaj and Michigan participants, only the difference between S→G and G→L inductions is significant along the main diagonal: Itzaj $t(134) = 8.99$, $p<.0001$; Michigan $t(259) = 10.60$, $p<.0001$.

Another way to examine the idea of absolute privilege is to hold the premise constant and examine variations in inductive strength to varied conclusion categories. Moving horizontally in Figure 1, if the premise is held constant and the conclusion category varied for "all" responses, then Itzaj inferences to the generic-species level are still consistently higher than to the life-form level: for S→L vs. S→G, $t(134) = 6.32$, $p<.0005$; for V→L vs. V→G, $t(134) = 5.70$, $p<.0005$. Inferences to folkspecifics do not differ significantly from those to generic species, and inferences to life forms do not differ from those to the folk kingdom. For the Americans, the pattern is almost identical: For S→L vs. S→G, $t(247) = 8.94$, $p<.0005$; for V→L vs. V→G, $t(244) = 11.41$, $p<.0005$. Inferences to folkspecifics are no stronger than those to generic species.

In sum, inferences to the generic species and lower ranks were high and equivalent, and a sharp drop or elbow in inductive strength was found for inferences ranked higher than the generic species. This pattern provides further support for the view that in widely divergent cultures, taxa of the generic-species rank are privileged for inductive inference.

Relative privilege in folkbiological reasoning patterns.—We also looked for evidence of a downgrading of inductive strength to higher ranks among industrialized Americans through attrition of knowledge, and an upgrading of inductive strength to lower ranks among silvicultural Maya through expertise. Of course, the evidence presented above, showing that both ecologically inexperienced Americans and ecologically experienced Itzaj privilege taxa of the same rank, argues against a simple relativist account of cultural differences in folkbiological knowledge. However, the overall effects of cultural experience on folkbiological reasoning may be reflected in more subtle ways that do not undermine the absolute privilege of the generic species across cultures.

Holding the premise category constant and varying the level of the conclusion category, we find in combined response scores some evidence for increased inductive strength for higher-order taxa for Americans versus Itzaj. Both Americans and Itzaj show the largest break between inferences to generic species versus life forms, but Americans show a consistent pattern of rating inferences to life-form taxa higher than to taxa at the level of the folk kingdom: G→K vs. G→L $t(253) = 4.81$, $p<.0005$; S→K vs. S→L $t(253) = 5.33$, $p<.0005$; V→K vs. V→L $t(242) = 5.76$, $p<.0005$. Itzaj show no such differences. Although for Americans both the generic-species and life-form levels are "special" inductively, the generic species is still significantly more so.

In contrast, overall response scores indicate that Itzaj privilege only generic species. But the possibility remains that Maya ecological expertise, particularly in the realm of silviculture, does add marginally significant inductive strength to the lower rank. We further explore this possibility below through regression analysis and an examination of each life form.

Progressive privilege across taxonomic ranks.—By extension, the similarity-based model of taxonomic reasoning proposed by Osherson *et al.* (1990) predicts that inductive strength should be a monotonically decreasing function of the rank distance between premise and conclusion categories; that is, the closer the premise category is to the conclusion category, the stronger the argument should be. In other words, the Similarity-Coverage model predicts that inductive strength should increase if one holds the conclusion category constant and increases the level of the premise category. We were able to directly test this hypothesis by moving vertically through Figure 1.

Results reveal little support for this hypothesis. When "all" responses are considered for the Itzaj, varying the level of the premise category does not change inductive strength. For the Michigan participants, two such comparisons produced significant differences. First, S→L inferences were reliably higher than V→L inferences: t(249) = 2.79, p =.03. However, this pattern was not continued at the next rank: G→L inferences are no stronger than S→L. Second, L→K inferences were reliably higher than G→K inferences: t(169) = 3.07, p =.01. For example, participants consider it significantly more likely that all animals have a protein X if they are told that all birds possess it than if told that all larks possess it.

When combined "all," "few," and "none" responses are considered, results are identical for Itzaj; varying the level of the premise category does not change inductive strength. Likewise for the Americans, the only significant difference in the predicted direction is that L→K inferences are higher than G→K inferences: t(169) = 3.73, p =.002. In sum, our results show that only for Michigan informants does a single premise change (G→K vs. L→K) consistently produce a significant increase in inductive strength for "all" responses as well a combined "all," "few" and "none" responses. The lion's share of inductive strength for both the Americans and the Maya is based almost entirely on the conclusion category no matter how distant the premise category, especially if the conclusion is a generic-species. This does not support Osherson *et al.* (1990).

Regression analysis.—An alternative method of analyzing the data is via a regression analysis, using the Premise and Conclusion levels as categorical factors, as well as life form, type of question asked, and the sex of the participant. The results of this regression are shown in Table 3.

TABLE 3.—Results: Regression analyses. For each factor partial correlation (% of total variance) result in **boldface** indicates it is statistically significant (F > 4)

Itzaj:	*'all' vs. 'few'/'none'*	*'all'/'few' vs. 'none'*	*response score R*
Conclusion = K vs. L G S	**-.086 (0.7%)**	**-.149 (2.2%)**	**-.148 (2.2%)**
Conclusion = K L vs. G S	**-.428 (18.3%)**	**-.601 (36.1%)**	**-.610 (37.2%)**
Conclusion = K L G vs. S	**-.135 (1.8%)**	-.055 (0.3%)	**-.117 (1.4%)**
Premise = L vs. G S V	+.033 (0.1%)	+.001 (0.0%)	+.001 (0.0%)
Premise = L G vs. S V	+.010 (0.0%)	+.008 (0.0%)	+.011 (0.0%)
Premise = L G S vs. V	+.022 (0.0%)	-.059 (0.3%)	-.016 (0.0%)
	other significant factors		
sex of participant = male	**+.204 (4.2%)**	**+.150 (2.3%)**	**+.218 (4.8%)**
life-form = fish	**+.121 (1.5%)**	**+.167 (2.8%)**	**+.189 (3.6%)**
life-form = vine	**-.088 (0.8%)**		

* no other significant main effects for: other life form; any disease type

TABLE 3.—Continued.

Michigan:	*'all' vs. 'few'/'none'*	*'all'/'few' vs. 'none'*	*response score R*
Conclusion = K vs. L G S	**-.090 (0.8%)**	**-.296 (8.8%)**	**-.257 (6.6%)**
Conclusion = K L vs. G S	**-.508 (25.8%)**	**-.183 (3.4%)**	**-.442 (19.5%)**
Conclusion = K L G vs. S	-.026 (0.1%)	-.034 (0.1%)	-.049 (0.2%)
Premise = L vs. G S V	**+.098 (1.0%)**	**+.124 (1.5%)**	**+.140 (1.9%)**
Premise = L G vs. S V	+.023 (0.1%)	+.020 (0.0%)	+.016 (0.0%)
Premise = L G S vs. V	+.049 (0.2%)	**+.101 (1.0%)**	**+.099 (1.0%)**
other significant factors			
sex of participant = male	**+.101 (1.0%)**		**+.059 (0.4%)**
question = disease	**+.063 (0.4%)**		
life form = mammal		**-.122 (1.5%)**	**-.066 (0.4%)**
life form = bird		**-.066 (0.4%)**	
life form = fish		**-.089 (0.8%)**	

* no other significant main effects for: other life form; any question type

Absolute privilege.—For Itzaj, the lion's share of the variance (37.2%) is accounted for by whether the conclusion category is either above the generic-species level or not, once again indicating the privileged status of the generic-species rank. By comparison, the splits based on the life-form and folkspecific conclusion levels account for much less of the variance (2.2% and 1.4%, respectively). There are, however, two other significant factors. First, the sex of participant is notable: male subjects gave significantly stronger inductions than females (4.8%). Second, the fish life form stands out: Itzaj give stronger inductions for fish (3.6%). This is most likely because the Itzaj believe water is the best carrier of disease.[10] For American subjects, the generic-species level conclusion is most privileged (19.5% of the variance for a conclusion level of K-or-L vs. G-or-S, versus 6.6% and 0.2% for splits based respectively on the life-form and folkspecific conclusion levels). Again, the generic-species emerges as the overall privileged rank for induction.

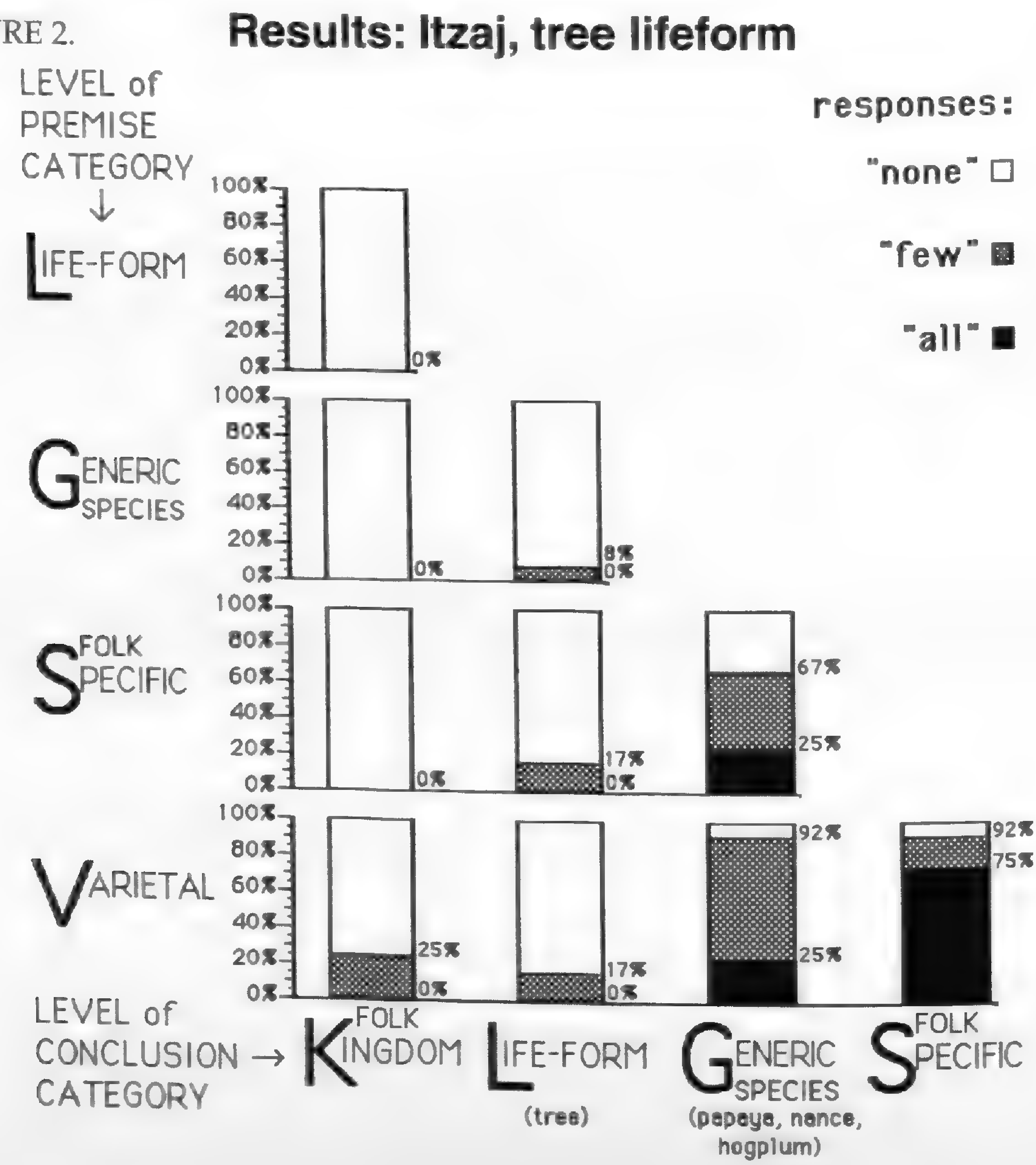
Relative privilege.—Regression analysis revealed a sensitivity to differences among lower-order ranks among the Itzaj that was absent among Michigan subjects. For Itzaj participants, the folkspecific level accounted for small but significant variance (1.4%) beyond the generic-species. For Michigan participants, unlike the Itzaj, the folkspecific level is not differentiated from the generic-species level (0.2%, not significant).

This analysis also confirmed stronger inferences to higher-order taxa among Americans than Itzaj. For Americans, the life-form split has relatively strong effects (6.6% versus 2.2% for Itzaj). This effect of life-form level conclusion stems almost entirely from an increase in "few" responses. Thus, regression reveals further evidence of North American devolution relative to the Itzaj.

Distinctions among life forms.—Results conform to our expectations: taxa of the generic-species rank are inductively privileged for both Americans and Itzaj; little use of general reasoning heuristics is seen, and American folkbiological reasoning patterns are somewhat devolved relative to those of the Itzaj. Yet, this pattern varies somewhat by life form for both groups. For Itzaj, the main pattern, in which only generic species are privileged, is shown for mammal, bird, herb, and vine life forms. For fish, however, the key conclusion level appears to be the life form (fish), not the generic-species (catfish, mojara, sardine). As noted above, Itzaj believe water to be a privileged carrier of disease, so there may be a confound with the property used in the inductions.

For the Itzaj tree life form, there is a significant difference between inductions using conclusions at the generic-species versus folkspecific levels suggesting that Itzaj confer special privileged status upon tree folkspecifics. Itzaj are forest-dwelling Maya who have a long tradition of agroforestry that antedates the Spanish conquest (Atran 1993). A strong ethic of reciprocity in silviculture still pervades the Itzaj, which involves Maya tending trees in order that the forest tend the Maya (Atran *et al.* in press). Figure 2 indicates that the special knowledge and expertise that Itzaj have concerning trees thus conceivably translates into an upgrading of biological interest in tree folkspecifics. In sum, the Itzaj pattern reflects both the overall privilege of the generic species as well as the importance of lower-level distinctions, at least for kinds of trees.

FIGURE 2.



Michigan participants show an exclusive generic-species pattern for the bush and flower life forms. The situation is more complicated for other types of organisms. For fish, there is a significant difference in the proportion of "all" responses for S→L vs. S→K inductions (39% vs. 4%, $t(44) = 2.99$, adjusted $p = 0.02$), which helps produce an overall difference in response score ($t(44) = 3.41$, $p = 0.008$). Similarly, there is a marginally significant increase in the proportion of "all" responses for birds when the conclusion category is "bird" (L) instead of "animal" (K) (25% vs. 0%, $t(38) = 2.31$, $p = .1$). In both cases, Michigan subjects confer some privileged status upon the life-form conclusion categories "fish" and "bird" (although less privilege than the generic-species level, for which pairwise comparisons are significant between adjacent horizontal cells).

GENERAL DISCUSSION

The data presented above clearly indicate a decisive break in inductive strength just above the rank of generic species. The results highlight the generic-species rank as inductively privileged for both American college students and Itzaj Maya. This perhaps surprising commonality contrasts with other evidence we present supporting the downgrading of American folkbiological knowledge versus the upgrading of Maya knowledge, which mitigates the exclusive privilege of the generic species. We find that the Americans have more faith in inferences to superordinate life-form taxa than Itzaj, and Itzaj differentiate among subordinate taxa more than do the North Americans.

In a previous attempt to reconcile the discrepancy between Berlin's observations and Rosch's data, Dougherty (1978) argued that the basic level is a variable phenomenon that shifts as a function of general cultural significance and individual familiarity and expertise (cf. Tanaka and Taylor 1991). Thus, most folk in industrial societies have little familiarity with, knowledge of, and use for various species of trees, fish, birds, and so forth. As familiarity with the biological world decreases, there is a gradual attrition of folkbiological knowledge up the hierarchy, with the basic level devolving from the generic-species to life-form levels. So far so good. But the devolution story makes a stronger prediction: the privileged level for a small-scale society living close to nature should be subordinate to the privileged level for an industrialized society. Our data evinces no such pattern. We now take up the implications of these findings.

In a recent survey of the field of cognitive anthropology, D'Andrade (1995:176-177) describes two competing accounts of "the universal and rapid learning of natural kinds." One position, which he attributes to Atran, holds that evolution has disposed humans to "learn that plants and animals form natural kinds with a special ease and readiness." A competing position, which D'Andrade attributes to Rosch, holds that natural kinds are universally learned so rapidly because "natural kinds have very special structures with many co-occurring attributes." He argues that the debate is presently undecided because:

> evidence for a universal theory of essences is not at this point compelling. However, this area of cognitive anthropology is not well explored, and it may be that even where evidence of a formulated <u>theory</u> of essences is lacking; it can be shown that people have <u>models</u> of plants and animals that implicitly contain the ideas of essence and natural kind.

In what follows, we suggest that such a model of essences for plants and animals is implied by our data , and that this model is specific to the domain of folkbiology (cf. Atran 1987b). Nevertheless, our data also suggest a significant but secondary role for general, experience-based heuristics.

In striking contrast to the rich debate over the descriptive adequacy of accounts of folkbiological taxonomy, there has been little attempt to provide an explanatory account of the psychological mechanisms and processes that actually produce folkbiological groups. A notable exception is Hunn's (1976) "perceptual model," arguably the most influential proposal in ethnobiology (Berlin 1978). This model accords with Rosch's (1973, 1978) general account of the cognitive structure of perceptual and semantic categories in hierarchical structures. These are variants of what psychologists call "similarity-based models" (Smith and Medin 1981), which organize perceptually identifiable categories on the basis of correlation or covariation of stimulus attributes. With such models, one learns to recognize a particular instance of a category by being exposed to multiple instances of the category numerous times. This implies, as Boster (1991) puts it, "the source of biological similarity judgments is in the world, not in the brain."

To illustrate the story from a similarity-based point of view: because the attributes of having a bark, large canines, and a terrestrial habitat usually co-occur only when a dog is present, then their co-occurrence will probably figure in all and only those feature-sets generally associated with the category dog. The mind will "automatically" tend to cluster perceptible features into "gestalts" of maximally covariant attributes, or basic-level categories, because of the "objective" discontinuities that exist in nature. Notice that for the model to work, it is not imperative that any particular feature always be necessary for defining category membership, nor that a given set of features always be sufficient. All that is required is that the exemplars exhibit a readily apparent "family resemblance" among a community of attributes (Rosch and Mervis 1975; Hunn 1982).

Because the processing mechanism is a general-purpose device that can pick out perceptual stimuli from whatever source, it should operate across any cognitive domain that involves separated clusters of perceptual attributes. This includes categories occurring naturally in everyday biological and social contexts as well as those constructed (e.g., artifacts). Later research has tended to confirm Rosch *et al.*'s findings, further showing that the basic level extends to artificial and natural categories, as the level that people most readily recognize and which children most easily name and learn (Waxman 1991; cf. Lassaline, Wisniewski, and Medin 1992).

The same attribute-clustering strategy can be applied recursively at higher and lower levels (Hunn 1976). Thus, the simultaneous presence of fur and live-born offspring might figure in the feature-set that distinguishes the category mammal from other superordinate-level life forms, such as bird, fish and so forth. Similarly, a large body-length to body-height ratio, when added to the feature-gestalt for dog, might figure in the feature-set that distinguishes the subordinate-level category dachsund from other types of dog. The basic level, then, is that above which relatively much information is lost, and below which little information is gained. That is, there is a large gain in information when going from the superordinate or life-form level to the basic level, and there is only a slight gain in information going from the basic level to the subordinate or specific level.

Thus, both anthropology and psychology suggest that privilege or basicness could be a function of correlated features or properties producing natural clusters which are psychologically salient. These salient chunks should organize both category organization and reasoning involving categories (Anderson 1990). Compelling at this view is, however, it is inadequate to describe our findings (cf. Medin 1989). The challenge is to explain why the generic-species rank is privileged for both Maya, who have relatively extensive contact with the natural environment, and American students, who have relatively little. The key problem is that the linguistic and perceptual criteria for basicness used by Rosch *et al.* point to the life-form level as privileged but, as we have just seen, the breakpoint in induction appears at the more specific rank of generic species.

The inadequacy in such accounts of privileged levels may be failure to distinguish domain-general perceptual mechanisms for best clustering stimuli, from domain-specific mechanisms for best determining loci of biological information. To explain Rosch's data, it may indeed be sufficient to rely on domain-general, similarity-based mechanisms. Such mechanisms may generate a basic level in any number of cognitive domains, but not the privileged level of folkbiology. To explain Berlin's data may require, in addition to domain-generic perceptual heuristics, domain-specific mechanisms for the formation of biological categories that are not similarity-based.

Along these lines, a "living-kind module" would involve a domain-specific sort of causal reasoning which may be called "teleo-essentialist" (Atran 1995a; Keil 1995). The idea is that universal, possibly innate, principles lead people to believe that visible morpho-typical patterns of each readily identifiable generic species, as well as non-obvious aspects of biological functioning, are causally produced by an underlying essence. The nature of this essence is initially unknown, but presumed. The learner (e.g., a child) then attempts to discover how essences govern the heritable teleological relations between visible parts, how they link initially ill-perceived internal parts to morpho-typical parts through canonical patterns of irreversible growth, and how they determine the stable and complex functioning of visible and non-obvious parts. Virtually all people, in all cultures, cannot help but follow through this spontaneously triggered "research program," which compels them to deepen and extend the domain of information relevant to living kinds within a taxonomic framework that focuses attention on generic species.

Notice that a generic species may fail to be "basic" in Rosch's sense of a maximally rich cluster of readily available perceptual information, but still privileged as a maximally rich bundle of anticipated biological information. In other words, domain-specific constraints on categorization and category-based reasoning may diverge from domain-general constraints. When and where they do, the expectation is that domain-specific constraints are paramount.

In small-scale societies, adults as well as children learn about generic species just by being told about them, or by seeing a single instance. In our society, one need only describe a single instance in a picture book or point to an isolated example in a zoo or museum to have an adult or child instantly extend that poor and fragmentary instance of experience to indefinitely extendible category. The taxonomic position of the category is immediately fixed as a generic species. This fixture "automatically" carries with it a complex internal structure that is partially presumed and partially inferred, but by no means directly known.

How can people conceive of a given category as a generic species without primarily relying on perception? Ancillary encyclopedic knowledge often may be crucial. Thus, one may have detailed perceptual knowledge of dogs but not of oaks. Yet a story that indicates where an oak lives, or how it looks or grows, or that its life is menaced may be sufficient to trigger the presumption that oaks comprise a generic species just like dogs do. But such cultural learning produces the same results under widely divergent conditions of experience in different social and ecological environments. This indicates that the learning itself is strongly motivated by cross-culturally shared cognitive mechanisms that do not depend primarily on experience.

In conjunction with encyclopedic knowledge of what is already known for the natural world, language is important in targeting privileged kinds by triggering biological expectations in the absence of actual experience or knowledge of those kinds (Gelman and Coley 1991). Language alone, however, would not suffice to induce the expectation that little or poorly known generic species are more biologically informative than better known life forms for Americans. Some other process must invest the generic-species level with inductive potential. Language alone can only signal that such an expectation is appropriate for a given lexical item; it cannot determine the nature of that expectation. Why presume that an appropriately tagged item is the locus of a "deep" causal nexus of biological properties and relationships? Why suppose at all that there is such a nexus that spontaneously justifies and motivates expectations, inferences, and explorations relating little known or nonobvious aspects of a presumably fundamental biological reality?

It is logically impossible that such presumptions come from (repeated exposure to) the stimuli themselves. In other words, input to the mind cannot alone cause an instance of experience (e.g., a sighting in nature or in a picture book), or any finite number of fragmentary instances, to be generalized into a category that subsumes a rich and complex set of indefinitely many instances and stimuli. This projective capacity for category formation can only come from the mind, never from the world alone. The empirical question, then, is whether or not this projective capacity is simply domain-general, or also domain-specific. For any given category domain — say, living kinds as opposed to artifacts or substances — the process would be domain-general if, and only if, one could generate the categories of any number of domains from the stimuli alone together with the very same cognitive mechanisms for associating and generalizing those stimuli. As we have seen, current domain-general similarity models of category formation and category-based reasoning fail to account for the taxonomic privilege of the generic-species level across cultures.

CONCLUSION

Our findings suggest that fundamental categorization and reasoning processes in folkbiology are rooted in domain-specific conceptual presumptions and not exclusively in domain-general, similarity-based (e.g., perceptual) heuristics. People in subsistence versus industrialized cultures may differ on the level at which organisms are most easily identified, but still believe the same absolute level of reality is privileged for biological reasoning, namely, the generic-species rank. This is because they presume the biological world to be partitioned at that rank into non-overlapping kinds, each with its own unique causal essence, or inherent underlying nature, the visible products of which may or may not be readily perceived.[11] People anticipate that the biological information value of these preferred kinds is maximal whether or not there is also visible indication of maximal covariation of perceptual attributes. This does not mean that more general perceptual cues have no inferential value when applied to the folkbiological domain. On the contrary, our evidence points to a significant role for such cues in targeting basic-level life forms as secondary foci for inferential understanding in a cultural environment where biological awareness is poor, as among many North Americans. Possibly there is an evolutionary design to a cognitive division of labor between domain-general perceptual heuristics and domain-specific learning mechanisms: the one enabling flexible adaptation to variable conditions of experience, and the other invariably steering us to those abiding aspects of biological reality that are both causally recurrent and especially relevant to the emergence of human life and cognition.

NOTES

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[2]Generalizations across taxa of the same rank thus differ in logical type from generalizations that apply to this or that taxon. Termite, pig, and lemon tree are not related to one another by a simple class-inclusion under a common hierarchical node, but by dint of their common rank — in this case the level of generic species. A system of rank is not simply a hierarchy, as some suggest (Rosch 1975; Premack 1995; Carey 1996). Hierarchy, that is, a structure of inclusive classes, is common to many cognitive domains, including the domain of artifacts. For example, chair often falls under furniture but not vehicle, and car falls under vehicle but not furniture. There is, however, no ranked system of artifacts: no inferential link, or inductive framework, spans both chair and car, or furniture and vehicle, by dint of a common rank, such as the artifact species or the artifact family.

[3]Botanists and ethnobotanists tend to see privileged groups as akin to scientific genera (Bartlett 1940; Berlin, 1972; Greene 1983). Plant genera in particular are often groups most easily recognized without technical aids (Linnaeus 1751). Zoologists and ethnozoologists tend to view them more like scientific species (Simpson 1961; Diamond 1966; Bulmer 1970), where reproductive and geographical isolation are more readily identified by behavior (Mayr 1969).

[4]For example, in comparative studies of Peten Maya and people from rural Michigan and the urban Chicago area, we found that the majority of mammal and tree taxa in both cultures correspond to scientific species, and most of these taxa also correspond to monospecific genera (López, Atran, Coley, Medin, and Smith in press; Atran in press; Medin, Lynch, Coley, and Atran in press).

[5]The actual magnitude of these changes in inductive strength with specificity of premise and conclusion categories depends on how much similarity changes with specificity. Unless there is some independent measure of similarity, similarity relations become parameters to be estimated from the data. Thus, the Osherson *et al.* induction model could account for a finding of a large drop in inductive strength as the conclusion category moves above the generic-species level or the breakpoint being above the life-form level, depending on which shift led to the larger drop in within-category similarity; however, it cannot simultaneously account for both findings.

[6]Although the subject sample is small, previous experiments have shown that findings for any 12 Itzaj are sufficient to represent a statistically reliable "cultural consensus" (López et al. in press; Atran in press; cf. Romney, Weller, and Batchelder 1986).

[7]For vine, we found only two generic species with both folkspecific and varietal distinctions.

[8]The grass life form, ***su'uk***, was introduced to reflect the full range of plant life forms.

[9]A reviewer pointed out that Northern Meadow Lark is actually a Meadowlark, which is not a lark. It is doubtful, however, that the students knew this since, in a separate experiment, they were only able to identify most exemplars of local bird species as simply "bird."

[10]A reviewer suggested that the fish life form, which contains fewer subordinate taxa than other life forms, is more like a generic species than other life forms, such as the bird or tree life forms. Yet, Itzaj believe that certain subordinate fish taxa, such as ***nate'*** (*Petenia splendida*) and ***aj-b'ox*** (chichilids), have distinctive heart/essences (***puksik'al***), whereas others, like ***aj-k'än b'ox*** (yellow chichilid) and ***aj-ya'ax b'ox*** (blue/green chichilid), share a common ***puksik'al***. Moreover, it is clear from justifications Itzaj give for their inferences that water facilitates contagion among fish. A follow-up inference study using different properties may settle the matter.

[11]By contrast, a partitioning of artifacts (including those of organic origin, such as foods) is neither mutually exclusive nor inherent: some mugs may or may not be cups; an avocado may be a fruit or vegetable depending upon how it is served; a given object may be a bar stool or a waste bin depending on the social context or perceptual orientation of its user; and so on.

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INTEGRATING INNOVATION: THE TRADITIONAL NAHUA COFFEE-ORCHARD (SIERRA NORTE DE PUEBLA, MEXICO)[1]

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ABSTRACT.—Amerindian peoples have long adopted foreign agricultural complexes, such as sugarcane or coffee growing, which they integrated to their environmental knowledge and practices. Through a survey of the plants associated with the traditional coffee orchard among the Nahua of the Lower Sierra Norte de Puebla (Mexico), we shall try to demonstrate that far from being "disastrous monocultivation," it represents both an economic and an ecological response to increasing population pressure in a tropical montane setting. The success of this response depends on soil selection practices and on a form of caring for the coffee shrubs which the Nahua extended from their home gardens to their coffee orchards. Our native informants identified 184 plants, 87% of them useful, which grow spontaneously in the coffee-orchards or are planted there on purpose. Unfortunately, this native knowledge was not taken into account in the modernization schemes of the 70s and 80s, with very negative economic and environmental consequences.

RESUMEN.—Los pueblos amerindios han adoptado desde hace tiempo complejos agrícolas foráneos, como el cultivo de la caña de azúcar y el café, que han integrado a sus conocimientos y a sus prácticas ambientales. A partir de una encuesta sobre las plantas asociadas con el cafetal tradicional entre los nahuas de la Sierra Norte de Puebla (México), trataremos de demostrar que éste, lejos de constituir un "monocultivo desastroso," representa una respuesta económica y ecológica adecuada al incremento de la presión demográfica en un ambiente tropical de montaña. El éxito de esta respuesta depende de la selección de suelos, así como de una forma particular de cuidado de las plantas que los nahuas extendieron de sus huertos caseros a sus cafetales. Nuestros informantes identificaron 184 plantas, 87% de ellas especies útiles, que crecen espontaneamente en los cafetales o se siembran allí a propósito. Desgraciadamente, este rico conocimiento tradicional no se tomó en cuenta cuando se introdujeron a la región en los años 70 y 80 nuevos esquemas para modernizar la cafeticultura, esquemas que trajeron consecuencias económicas y ecológicas muy negativas a mediano plazo.

RÉSUMÉ.—Les peuples amérindiens ont adopté depuis longtemps des complexes agricoles étrangers, comme la culture de la canne à sucre et du café, qu'ils ont intégrés à leurs connaissances et à leurs pratiques environnementales. À partir d'une enquête sur les plantes associées à la caféière traditionnelle chez les Nahuas de basse montagne, dans la Sierra Norte de Puebla, au Mexique, nous tenterons de démontrer que cette caféière constitue une réponse adéquate, au plan écologique et économique, à l'accroissement de la pression démographique dans ce milieu tropical de montagne. Le succès de cette réponse dépend de la sélection des sols, ainsi que d'une forme intensive de culture des plants que les Nahuas ont transposée à partir des jardins domestiques. Nos informateurs ont identifié 184 plantes, dont 87% sont des plantes utiles, qui soit poussent spontanément, soit ont été intentionnellement plantées dans les caféières. Malheureusement, on n'a pas tenu compte de ce savoir ni de ces pratiques lorsqu'on a imposé, dans les années 1970 et 1980, des schèmes de modernisation de la caféiculture qui eurent de graves conséquences économiques et écologiques à moyen terme.

INTRODUCTION

For over fifty years, the dominant trend in Mexico's agricultural policy (as in most of the Third World) has been to encourage productivity increase through crop specialization and a technology package (e.g., SARH 1990). Yet, recent studies have shown the high environmental cost of this type of "modernization" in terms of pollution and desertification (Restrepo 1988:99ff.; Toledo 1985:30ff.) as well as its disappointing results regarding food production itself (Tarrío, Stephen, and Concheiro 1995). In reaction to this, a conservationist perspective has been rising, which sees "Nature" as an equilibrium and human presence essentially as a disruptive factor which has to be either eliminated (the "Natural Parks" option) or at least submitted to strict controls (the "Biosphere Reserves" option). The latter have been created in various native areas and are in principle more flexible, since they allow for the "traditional uses" of the resources by the indigenous population. However, these uses are often being quite arbitrarily defined by the administrators, more inclined to follow the government lines that to respond to local views and needs (Nigh and Rodríguez 1995:181-200). However well-intentioned, conservationist schemes often clash with the conception and practices of the people involved, particularly, although not exclusively, native peoples (see Arizpe, Paz, and Velázquez 1993). For example, in Chiapas' Montes Azules Biosphere Reserve, Indian peasants are still waiting for the "sustainable harvesting schemes" which were to be announced to them twenty years ago, when they were suddenly forbidden to cut trees in order to plant corn. In fact, detailed studies show that environmental deterioration and land conflicts, mostly due to clandestine logging and cattle-raising, *increased* significantly after the creation of the reserve (Fernández, Tarrío, Villafuerte, and García 1994).

Our perspective will be that of ethnoecology, which Toledo (1992) defined as a meeting-place for the various scholars and practitioners interested in the dynamic relationships between humans and their environments, whether they be biologists, agronomists, health or development specialists. The main interest of our research is not to salvage by-gone ways, however interesting that may be for science's sake, but to help find practical alternative methods of producing food, medicine, and other goods and services without putting at risk the long-term productive uses of the environment (this is how we define "sustainable development") (Taller de Tradición Oral and Beaucage 1988).

First of all, regarding "resources," it has been pointed out that they do not exist per se: to be considered a "resource," a given plant, animal, or mineral has to be perceived by a human population as satisfying a given need (Alcorn 1981:221). As we shall argue later on, for a large landowner or a government development agency, a coffee plantation is a combination of basic inputs (land, water, plants, fertilizer, labor) all geared to maximize one single output: coffee. This is often considered to be the *normal* form of production: cash-cropping and the peasant coffee orchard will be considered "unproductive" in relation to it (Nolasco Armas and Toledo Ocampo 1977:36ff.). This overlooks the fact that besides the main crop people also gather firewood, plant fruit trees such as oranges (*Citrus sinensis* [L.] Osbeck) and *sapotes* (*Pouteria sapota* [Jacq.] H.E. Moore & Stern), and hunt birds and small game in coffee orchards. Thus, a variety of important resources come from the same orchard. From the point of view of economic sustainability and bio-diversity, we shall argue that traditional indigenous farming is far more adequate. In spite of the very fragmentary state of present-day knowledge of non-Western systems of resource management, it has been shown that many of them include techniques not only for preserving soil and water, but for reclaiming land that is considered eroded or exhausted by Western standards, through natural terracing, careful fallowing, and plant species combinations (García Oliva 1992; Medellín Morales 1992).

At this crucial point, the scientist's interest may meet that of the natives for whom land and its resources are neither a simple reservoir of idle wealth to be put to use for profit, nor an untouchable whole which has to be preserved at all cost from human intervention.[2] Expropriated from most of their lands for centuries, American aboriginal people are now faced with population growth and progressive depletion of various traditional resources. At the same time, resource-hungry industry puts extra pressure on them to obtain minerals, hydro-electricity, or timber, as in Canada, or to include them in agro-industrial development, as in Mexico. Many native organizations are now struggling for *the right to develop according to their own priorities,* and through the implementation of their own ecological and technological knowledge (Sarmiento 1991:94ff).

Our purpose here will be to describe how Indian farmers from the lower Sierra Norte de Puebla, in east-central Mexico, have modified positively their relationships with their environment in a context of economic and demographic pressure. Extensive farm surveys were carried on in various communities in 1969-1972 and then again in 1979-1982 (Beaucage 1973a, 1973b; Beaucage, Gobeil, Montejo, and Vityé 1982; Beaucage and Montejo 1984). In 1986 and 1987 an ethnobotanical and ethnozoological inquiry in a Nahua community from the Lower Sierra revealed a system of knowledge and use of plants and animals as intricate and diversified as that of the Huastec (Alcorn 1981) or the Highland Maya (Berlin, Breedlove, and Raven 1974; Hunn 1977). Two series of plant specimens were collected, mostly during the summer of 1986. One series of vouchers (they contain about 900 specimens each) is kept by the Taller de Tradición Oral in San Miguel Tzinacapan, the other at the Université de Montréal. Time constraints (the research had to be done from June to August, that is, during the rainy season) prevented us from collecting most specimens in flowering or fruiting stage, a limitation we hope to correct soon through further field research.

Our previous studies on indigenous farming and animal husbandry had overlooked most of their non-farming knowledge of the rich montane tropical environment of the Lower Sierra (see Taller de Tradición Oral del CEPEC and Beaucage 1987, 1988, 1990, 1996). Regarding the plant world, our data show that, besides the basic complex of precolumbian food-crops (such as corn — *Zea mays* L., beans — *Phaseolus* spp.; squash — *Cucurbita* spp.), there is a strong persistence of other native food such as greens, wild or cultivated (see Bye 1981), mushrooms, tree pods, and seeds. The harvesting of forest products, whether they be food, medicine, fuel or raw materials, and the allocation of land between annual crops, fallows, and plantations are integrated into an agroforestal ecosystem which resembles that of shifting cultivation (Arias Reyes 1992) which used to prevail in the area before the implementation of the Liberal reform in the 19th century (see below).

At the same time, the Indian farmer has long integrated a variety of cash-crops, sometimes of precolumbian origin, such as vanilla (*Vanilla planifolia* Andr.) (see Kelly and Palerm 1952) or avocado (*Persea americana* Mill.), but mostly of foreign origin, such as sugarcane (*Saccharum officinarum* L.) (Paré 1979) or coffee (*Coffea arabica* L.) (Durand 1975; Hoffmann and Sallée 1993). The adoption of these crops was long considered due to outside forces (called "modernization" or "capitalist penetration," according to the author's ideology) on a passive Indian population. The active role played by Indian producers in adopting, integrating, and modifying these "foreign elements" into their economy and way of life is not commonly addressed. In fact, there is a considerable amount of confusion in the debate regarding what should be called "native" or "traditional", particularly in areas, such as Mexico, where the original inhabitants have been in direct contact with Europeans for centuries. Contrary to those who claim that the term should be limited to techniques or resources of precolumbian (or at most, colonial) origin, we will try to demonstrate that:

1) The generalized adoption of coffee-growing by Nahua and Totonac farmers, well into the 20th century, as an *addition* to corn-growing, was an ecological response to a double challenge: the transformation of communal titles into private smallholdings *(desamortización)* during the late 19th century, which prevented them from moving crop sites as they had done before (Ramírez, Jaímez, and Valderrama 1992:16), and a rapid population increase (Beaucage 1995:354), which challenged the sustainability of the previous short-fallow *milpa* agriculture. Moreover, the same demographic growth made sugarcane (which had been previously added as a cash-crop) non-sustainable on a large scale.

2) On the extremely broken environment of the Sierra, a clear pattern of traditional *soil-selection* emerges: on the gentler, more fertile slopes, *milpas* were interspersed with coffee orchards, while the steeper and rocky ones were devoted to coffee-growing alone, or kept for firewood, timber, hunting, and collecting purposes. This pattern helped to preserve the soil fertility and moisture and the overall sustainability of the agro-forestal system which progressively came to be mostly a *milpa*-coffee orchard system.

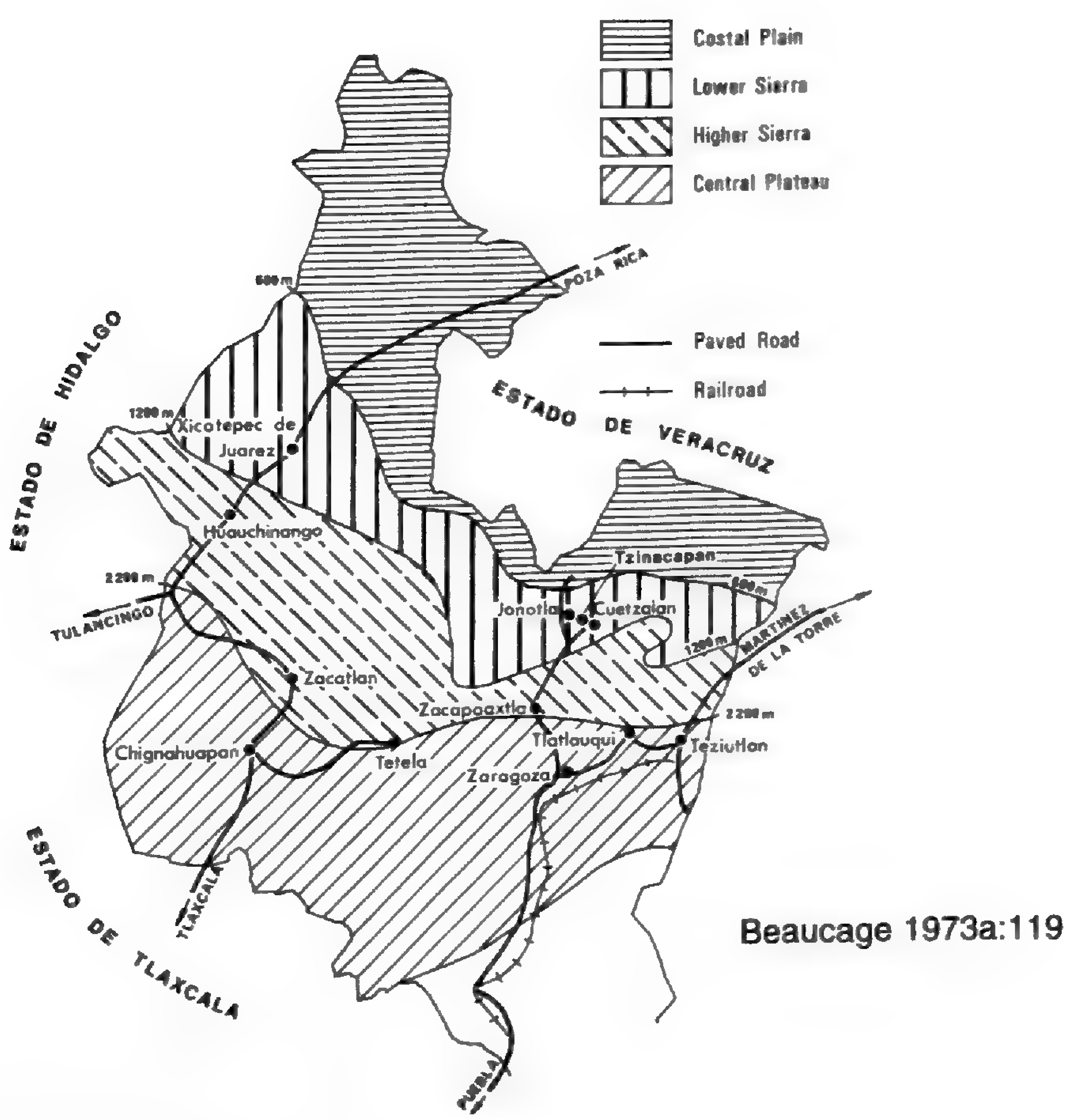
3) The native way of managing the coffee-orchard itself, far from being "disastrous monocultivation," in fact recreated on the steep slopes a diversified environment analogous to the tree cover which was being replaced (with hundreds of associated vegetal and animal species). This was made possible because of a specific pattern of plant care, including intensive "hand-weeding" of the orchards.

4) These three basic features were threatened after World War Two, when higher international prices for coffee and the improvement of the road network made the *substitution* of *milpa* by coffee orchards increasingly advantageous from an economic point of view. But it appears that the real challenge came in the mid-seventies, when the State Coffee Board (Instituto Mexicano del Café) gradually imposed in the Lower Sierra a technology-credit-marketing package which involved new coffee varieties, strict monocultivation, and a change in working patterns, together with fertilizers and, lately, pesticides.

THE ENVIRONMENT AND THE PEOPLE

The community of San Miguel Tzinacapan, where this study was carried out, is part of the Municipio of Cuetzalan, in the Eastern Sierra Madre. The area, administratively known as the Sierra Norte de Puebla, encompasses four different ecosystems (Pacheco Munguía 1969) (Figure 1):

FIGURE 1.— Ecological zones in the Sierra Norte de Puebla (Mexico)



1) The central highlands, with altitudes over 2000 m, occupy the south western part. The climate is cold and dry with annual rainfall under 1000 mm. It is devoted to grain-growing and cattle-ranching, and its present, mostly mestizo population, lives in relatively large villages and towns. The main food crops are corn, barley (*Hordeum vulgare* L.) and beans, while alfalfa (*Medicago sativa* L.) is grown on irrigated plots as cattle fodder.

2) The Sierra Madre Oriental in its higher section (1500 to 2000 m) is cold and subhumid, with annual average rainfall around 1500 mm. The area was originally covered with a highland forest of oaks (*Quercus* spp.) and pines (*Pinus* spp.), with other species such as sweet gum (*Liquidambar styraciflua* L.). Only vestiges of this flora remain in deep canyons or mountain tops, since most of the land has been cleared for agriculture and pasture. It is densely populated; the farmers, mostly Nahua Indians (plus some Otomi in the Northwest) live dispersed among the hills. They grow corn, beans, and some vegetables for subsistence. Mixed orchards are planted as a complement: avocados (*Persea americana* L.), apples (*Malus communis* L.), plums (*Prunus* spp.), pears (*Pyrus communis* L.), and peaches (*Prunus persica* L.). They keep a few pigs and poultry, sell forest products (firewood, charcoal, and timber) at lively local markets and migrate to the lowlands to work as farm hands and woodcutters.

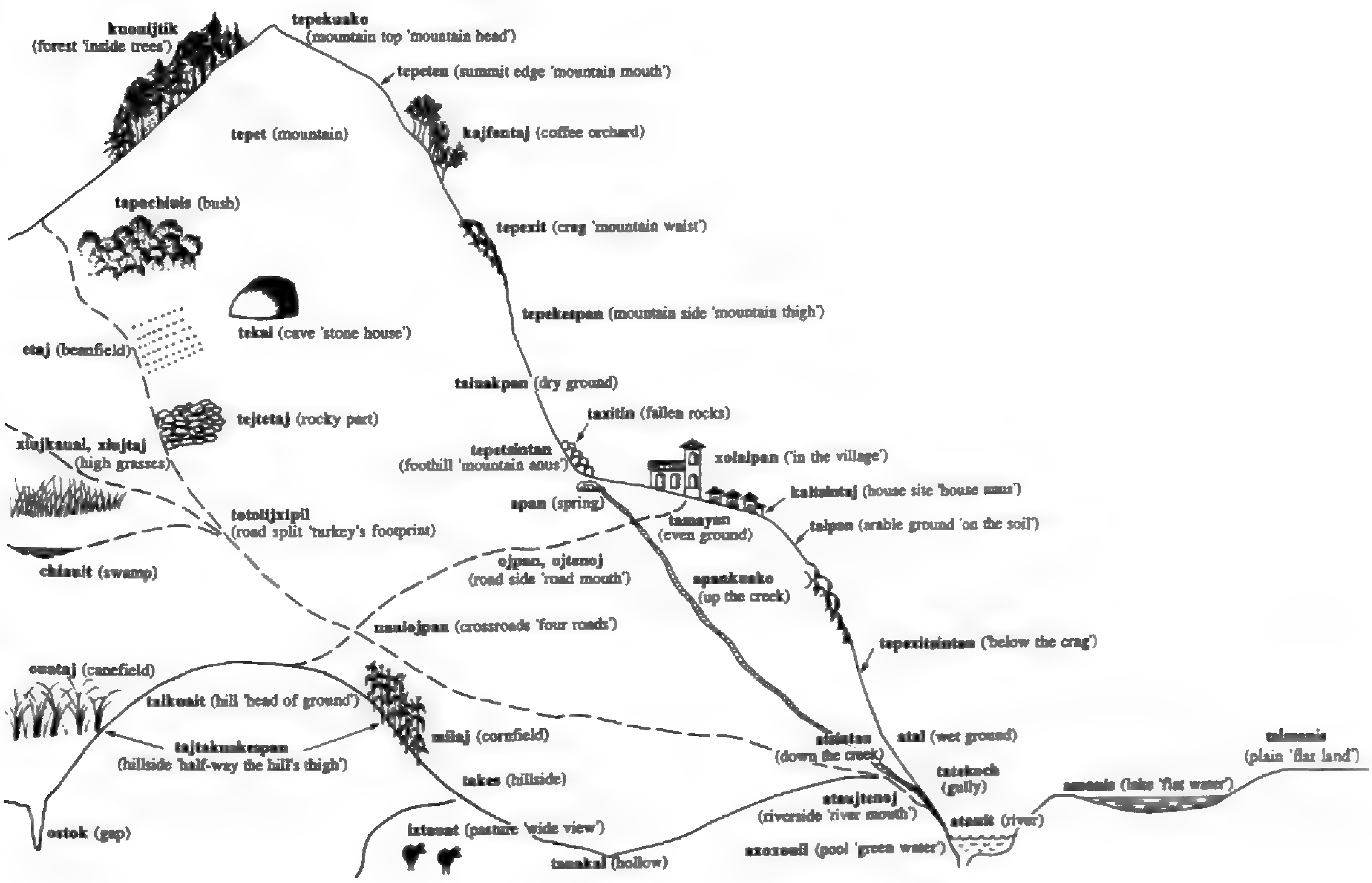
3) The lower Sierra (between 500 and 1500 m) is warm and humid (rainfall averaging between 2000 and 4000 mm a year). It was originally a zone of montane tropical forest, with such typical elements as cedar (*Cedrela odorata* L.), mahogany (*Swietenia macrophylla* King), and giant ferns (e.g., *Cyathea mexicana* Schlecht. & Cham.). Here too, the original vegetation is to be found only in the most inaccessible parts. Population is extremely dense (275 per km^2), semi-dispersed, and mostly Indian: Nahua to the north and south, Totonac in the middle. Farmers grow corn for subsistence (two crops a year are possible), coffee, "allspice" (*Pimenta dioica* [L.] Merril), *sapote*, oranges, and some sugarcane (*Saccharum officinarum* L.) for sale. San Miguel Tzinacapan, the Nahua community we shall be dealing with, is located in the southern part of this ecosystem. Approximately one-third of its 3000 inhabitants live in the main settlement *(cabecera)*, at approximately 750 m above sea level; the others are scattered in small villages and hamlets, downhill to the north (Figure 3).

4) Further north and east, the coastal plain (under 500 m) is hot and humid (1500 to 2000 mm of rainfall per year). It was a zone of tropical forest and savannahs, which has given way to large pastures, cornfields, and plantations (vanilla, bananas [*Musa* spp.], citrus fruits). Its sparse population is mostly mestizo except to the north, where Totonac Indians predominate.

A NAHUA VIEW OF THE ENVIRONMENT

The Nahua from the Sierra have developed a very precise knowledge of the different components of their rugged environment, of its plant cover as well as agricultural potential, all of which is reflected in a rich topographic terminology. For the lower Sierra alone, we collected 31 terms referring to different geotopes and ecotopes (Figure 2). The various geotopes refer to a vertically-defined environment, its two main elements, the mountain and the river, being metaphorically assimilated to the human body. The mountain's 'head' ***(tepekuako)*** is the summit; its 'lip' ***(tepeten),*** the summit edge; its 'waist' ***(tepexit),*** the crags, its 'thighs' ***(tepekespan),*** the mountain sides; and its 'anus' ***(tepetsintan),*** the foothills. Similarly, the stream ***(apan, atauit)*** has its source or 'head' ***(apankuako),*** its 'lips' or shores ***(ataujtenoj),*** and its 'anus' ***(atsintan),*** which is the lower course. Rolling hills are 'heads of the land' ***(talkuait).***

FIGURE 2.—Nahuat Ethnotopography (Lower Sierra Norte de Puebla)



Plants, either wild or grown, bear a specific relation to a given niche (***ichanyojko,*** 'its home'). For example, corn and cane have to be planted on proper 'soil' ***(tal),*** that is on the lower and more gentle hill-sides, while coffee and fruit trees may be planted on the steeper, rockier slopes, where beans may also be sown on (burnt) shrub ***(tapachiuis).*** Bananas thrive on the richer alluvial soil of the river shores ***(ataujtenoj).*** The village itself is usually built on a ridge ***(tatempa),*** half-way up the hillside, where permanent springs ***(apan)*** are to be found, with hamlets and individual farms scattered through the intensively cultivated countryside. Hundreds of toponyms are attached to the village lands, marking every topographic particularity: hill, ravine, rock, or spring, and relating it either to an animal or plant, or to some physical or supernatural trait (Taller de Tradición Oral and Beaucage 1996).

ETHNICITY AND CLASS IN THE SIERRA

Four different ethnic groups are found in the Sierra: the non-Indians or mestizos, dominant on the plateau and the coast; the Nahua, whose habitat stretches from the highlands to the lower mountain slopes; the Totonac, concentrated in the latter area and in the adjacent lowlands; and a pocket of Otomi Indians in the northwestern highlands. The Indian population of the Sierra for 1990 can be estimated at over 320,000, including about 210,000 Nahua, 100,000 Totonac and 9,500 Otomi[4]. As elsewhere in Mexico, Indian population is steadily increasing, in spite of emigration and acculturation, which affects particularly the highland Nahua.

Mestizos are a minority in most of the lower Sierra and usually dwell in the small township centers *(cabeceras municipales)* where they live off commerce and professional services; the wealthier of them control business and local administration, and own plantations and pastureland in the surrounding countryside. These holdings, although not large by Mexican standards, contrast with the tiny plots of the peasants, most of them Indians. For example, in Cuetzalan, in 1970[5], 1,122 farmers (45% of the total) owned less than one hectare, while another 1,022 (41%) had slightly over two hectares. At the other end of the spectrum, six owners had a total of 1,540 ha (Dirección General de Estadística 1975:63, 75). On the other hand, between one quarter and one third of Indian farmers in a given community own no land at all, and work as sharecroppers and farm hands. (For a detailed analysis of the social and economic structures of the Sierra, see Arizpe 1973; Beaucage 1973a, 1973b; Chamoux 1981; Durand 1975; Paré 1973).

There is little, if any, physical difference between the Indians and most mestizos. Moreover, nowadays young Indian men have replaced the traditional white *calzones* and shirts with factory-made clothes. In the lower Sierra, however, the vast majority of Indian women still wear the distinctive white skirt and embroidered blouse, wide red belt, and *huipil*. Both mestizos and Indians now live in settlements which have much in common: colonial churches and tile-roofed houses at the center, huts made of planks and cardboard at the periphery, surrounded by fruit trees and coffee groves. The basic food is everywhere the corn-cake or *tortilla*, complemented with beans, hot peppers (*Capsicum* spp.), and a variety of wild and cultivated greens (known as *quelites* in Mexico, ***kilit*** in Nahuat; see Bye 1981).

Yet, a closer look reveals that ethnic differentiation is one of the basic dimensions of social life in the Sierra. On Sunday, the market day, in a large township center such as Cuetzalan, the streets are filled with Indian people from the surrounding countryside. They speak Nahuat (see note 3) among themselves, but most will address merchants in Spanish. In fact, only the streets, the market place, and the co-op[6] house are theirs; they make short stops in the shops to purchase some goods or have a drink; then most leave town long before dark, to return to their villages and hamlets. Indians and non-Indians have talked and exchanged in a very ritualized way, but have not mixed.

Ethnic identity, in the lower Sierra, does not belong to the symbolic level of interaction alone. It entails for its members sharing a way of life, including a particular way of making a living and a particular relationship to the environment. Although both the economy and the ecology have undergone important changes during the last hundred years, the Indian way ***maseualkopan)*** is still quite differentiated from the non-Indian way ***(koyokopan),*** and consciously so. In order to understand the present-day pattern of resource management, it is necessary to have a look at the historical process of interaction and conflict between the two groups, in this particular environment.

HISTORICAL BACKGROUND: THE FORMATION OF A CULTURAL ECOSYSTEM

It appears that at the time of the Spanish conquest, what is now known as the Lower Sierra did not constitute an autonomous society. Globally designated by the Aztecs as ***Totonacapan*** ("Totonac country"), it had been conquered some centuries before by Nahuat-speaking Chichimecs who divided it into various domains (De Carrión 1965:20). The stretch of land between the Tozan and the Apulco rivers, which includes Cuetzalan and Tzinacapan (Figure 3) appears to have been scarcely inhabited, forming a buffer zone between the Totonac, who lived to the north of the Tozan river, and the Nahua who settled south of the Apulco. A few generations before the arrival of the Spaniards, the whole region was incorporated into the Aztec Empire (García Martínez 1987:47).

The Spanish chroniclers of the 16th century mention the lower Sierra. Like today, the subsistence of the Nahua and Totonac was based on the cultivation of corn and other food-crops: peppers, beans, squash, and greens (González 1905:129-130). Poultry-breeding, fishing, and hunting were additional sources of food, and it is reported that "they cure themselves with many herbs which grow in the mountains and crags" *(ibid.).* Apart from working for their local lords, they had to pay a tribute to the Aztecs: people from the higher Sierra contributed liquidambar resin and skins; those from the lower Sierra gave luxury garments made of locally-grown cotton (*Gossypium hirsutum* L.) and precious feathers (e.g., from *Trogon* spp., ***kuesaltotot;*** hence the name "Cuetzalan"). Those from the adjacent lowlands had to send salted fish, honey, and peppers (Paso y Troncoso 1980:51ff; Beaucage 1974:31-32). The only mention of trade by the chronicler refers to salt, which "they bring from Teguacan [Tehuacán], a town that is forty leagues away from here" (González 1905:130). Available data thus show that in the 16th century, Indians of the Sierra exploited the varied resources of their environment as is still done today: the land for diversified farming, the rivers for fishing, and the forest for hunting and collecting.

After the Spanish conquest, the Indians were subjected to the harsh regime of the *encomienda.* Natives were "bestowed" on a conquistador who could use their labor at will, and who was supposed to convert them to Catholicism (Gibson 1964:58-97). This regime, which allowed all kind of abuses, was of short duration in the Sierra. Because no mines were found, greedy *encomenderos* soon found better prospects elsewhere. At the end of the 16th century, Indian communities were given a semi-autonomous status *(repúblicas de indios)* under the tutelage of civil servants *(corregidores, alcaldes mayores)* (García Martínez 1987:311-319).

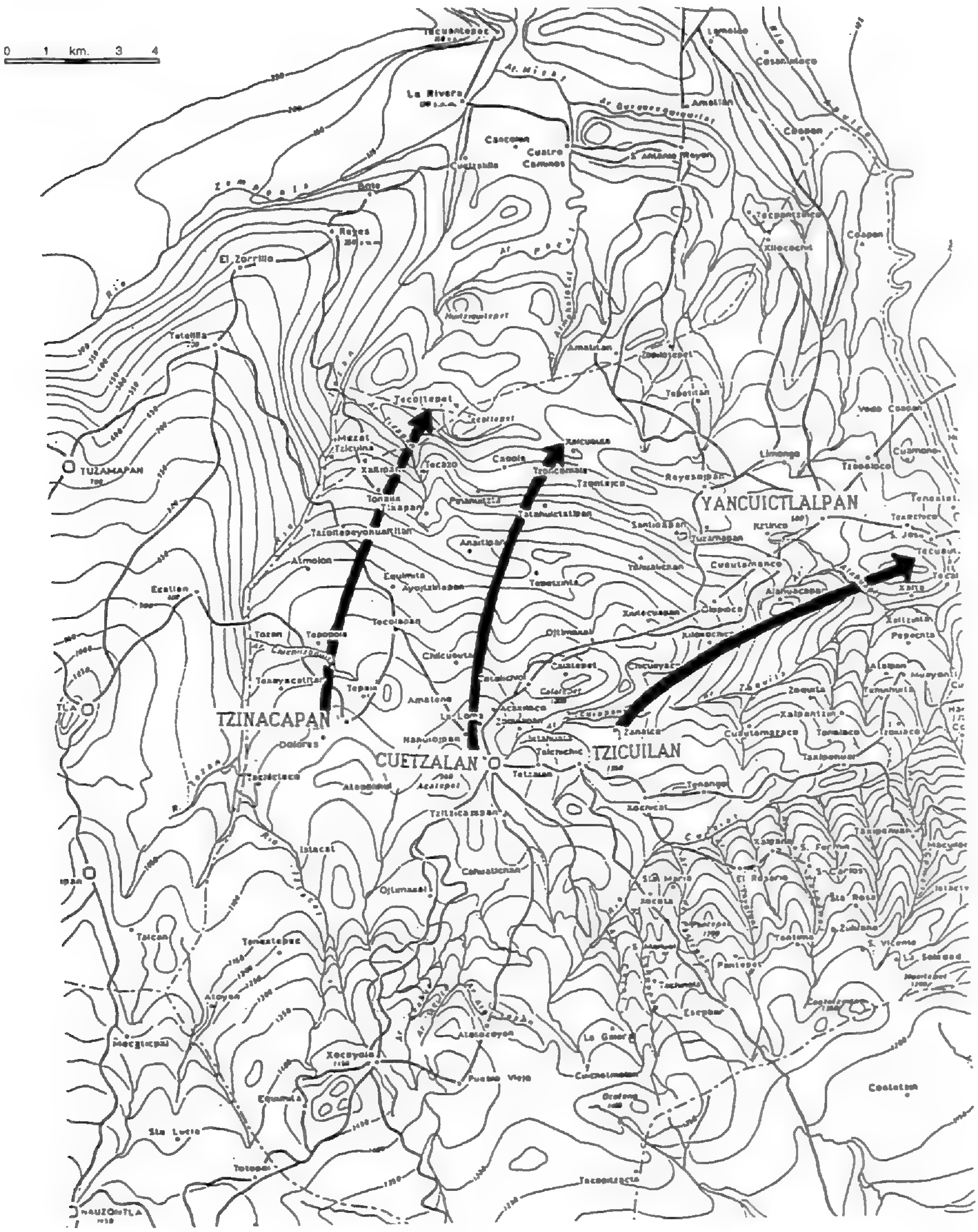
In spite of sparse contacts with foreigners, epidemics took a heavy toll in the Sierra as elsewhere in the New World. In the 1581 survey, all communities claim that their population had dwindled due to "fever" and "pestilence." It seems that the decline was greatest in the lower Sierra and the lowlands: in both areas some communities disappeared altogether, including "Quetzalcoatl," which was located near where Cuetzalan is today (*ibid.:* 114). In the 1550s, when it received its first land grant, Cuetzalan had a total population of 240 (*ibid.:* 324, 358). From the beginning of the 17th century on, however, one can observe a stabilization and steady if small population increase among the natives. Cuetzalan already was a parish with a resident priest, and its people cultivated corn, peppers, and cotton; fished and raised chickens *(Gallus gallus)* and turkeys *(Meleagris gallopavo)* (Mota y Escobar 1940:225). In 1725, we know that there were various settlements within the parish (AGN Indios 50:f 344r); in 1788, it had 740 tribute-payers, which indicates approximately 3,700 inhabitants (AHML 26/3/1788). One century later, there are 1,470 household heads listed, which allows a total population estimate of about 7,350 (AHMC: *Padrón de vecinos*).

This growth induced a steady extension of the agricultural frontier at the expense of the tropical forest which originally covered most of the township. Generally speaking, the population moved from the three main settlements in the center downhill to warmer slopes to the north (Figure 3). Elders state that the village of Tzinacapan ("Bat Spring") was established in the foothills to take advantage of a permanent spring, since the springs to the north dry up in April-May. The people went to farm in the lower hills (between 500 and 700 m) where corn can be harvested twice a year. The exploitation of different ecological levels also allowed for a large number of crops. A 1904 document lists 58 local crops, 36 of them native, including grains, legumes, fruits, and greens (Ramírez, Jaímez, and Valderrama 1992:29-30). The "cold" area to the south of Tzinacapan, over 1000 m, supported only one crop of corn per year, and was never settled nor steadily farmed by the Indians. It was kept as a forest and used for firewood, timber, and game supply. The forested areas also provided large *Beilschmiedia* (Lauraceae) leaves for thatch, fruits and berries to collect, as well as certain staples which were eaten during periods of food shortage, such as the root of the ***pesmakuouit,*** or tree fern.

This generalized exploitation of resources was made possible through communal land tenure. Colonial authorities had acknowledged the existence of communal land titles *(común de naturales)*, and made them the basis of the local Indian community. Until the end of the 18th century, no one came to the Sierra to challenge it. Any Indian family could hunt, pick wild products, cut timber, and farm wherever seemed fit and an empty plot was available. An 1877 document states:

> Prior to the *Ley de desamortización* [1856 law which suppressed Church and Indian land titles], the Indian class, the most numerous, would till in small scale, sowing every year a plot without paying any rent, so as to satisfy their basic needs and, once the harvest was picked, would move to another spot where they would make another small clearing, forgetting [*sic*] the one they had made before (AHMC 12/9/1877, quoted by Ramírez, Jaímez, and Valderrama 1992:16).

FIGURE 3.—Internal Migrations and Land Occupation:
Municipio de Cuetzalan (1870-1970)



This farming system was criticized as "primitive" by the Cuetzalteco bourgeoisie, who wanted to suppress the communal land tenure that went with it; in the same way many modern agronomists consider permanent cultivation the *normal* form of farming and hold "slash-and burn agriculture" responsible for erosion and deforestation. However, anthropologists have argued for years that, in a tropical mountain rain-forest (such as the Philippines or the lower Sierra) it may be the optimal farming technique, as long as the population is not too dense (Conklin 1957). The yearly relocation of the "small plots," together with long fallow periods and rapid secondary growth, inhibits soil exhaustion and erosion. Nearly continuous rainfall, drizzle, and fog make for a thick ground vegetation (mostly *Bidens* spp.and *Melampodium divaricatum* [Rich.] DC) in cornfields at harvest time. And population, in mid-19th-century, was 54.3 inhabitants per km^2, so there was little pressure on the land.

Indians strongly resisted the parcelization of communal lands after 1860, not because they rejected "progress," but because they saw land-hungry mestizos take advantage of the suppression of Indian titles to fence off their corn lands, turning them into pastures, and to cut their *Beilschmiedia* groves to plant the first coffee orchards. The native leader Francisco Agustín Dieguillo (Palagosti) led an armed uprising which succeeded in stopping the expropriation (Thomson 1991). However, the new law finally was imposed and Indians asked for, and obtained, individual land titles *(adjudicaciones)* for their plots. This prevented massive land expropriation in this part of the Sierra, as occurred elsewhere in Mexico during the long reign of Porfirio Díaz (1876-1910). However, mestizos did grab much of the "unused" land to the south of Tzinacapan and converted it into pastures and coffee orchards.

Individual landownership allowed for the development of cash-cropping in the lower Sierra: sugarcane, and later, coffee. Sugarcane had long been known, but it seems that its cultivation increased considerably during the first half of the 20th century, as a rapidly increasing population was pushed further down the hills. There they found fertile lands and abundant firewood, needed for the transformation of cane-juice into brown sugar, the raw material for the rum distilleries opened by local mestizos. In the late 1930s, as firewood became scarce and as the road network expanded, allowing cheaper sugar to come in from Veracruz, sugarcane was progressively replaced by coffee. The causes of its success are no mystery: at post-World War Two prices, the output of an hectare of coffee orchard reached about four times that of a cornfield (Beaucage and Montejo 1984:14,18). With better roads, the region could also import increasing amounts of corn from the neighboring plateau and export its coffee overseas more easily.

PLANT ASSOCIATIONS IN THE COFFEE ORCHARD *(KAJFENTAJ)*

The ethnobotanical inquiry was carried out among 52 members of the community of San Miguel Tzinacapan, 35 men and 17 women: farmers, craftsmen, and healers. Specimens were collected with informants throughout the countryside, and interviews were conducted in Nahuat in the village.[7] We recorded 636 generic taxa, of which the Nahua explicitly associated 184 with coffee, when asked, "Where does it grow more?" (*¿Kanin semi mochiua*?) and "What grows with it?" (*¿Toni seki mochiua kampa mochiua nejín*?). The most frequently mentioned plant associate is the native Inga tree ***(chalauij)***, which gives coffee the necessary shade. Among the 184 coffee-associated plants, 128 (69%) are considered by the Nahua to be 'wild' or 'not planted' (***mochiua saj:*** 'it grows by itself'); 33 (18%) are usually planted (se kitoka: 'one plants it' or no se kitoka: 'one can also plant it') while the remaining 21 (13%) are not planted but do receive some special care (***se kikaua, mochipaujtani:*** 'one spares it', 'one weeds around it'). Thus, most associated plants, in a microenvironment supposedly altered by human beings, grow from seeds that have been brought by the wind, water, or unplanned human or animal intervention. Those which are planted are mostly post-conquest fruit trees: orange (*Citrus sinensis* L.), lemon (*Citrus limetta* Risso.), mango (*Mangifera indica* L.), while those which are either planted or protected are precolumbian plants grown for food: e.g., pepper-bush (***chiltekpin,*** *Capsicum annuum* L.); ornament (e.g., ***chamakijisuat,*** *Heliconia bihai* L.f.); or fencing (e.g., ***chakaykuouit,*** *Bursera simaruba* L. [Sarg.]).

With reference to the native classification, 81 (44%) of the associated plants are 'trees' ***(kuouit)***, 34 (18%) are 'herbs' ***(xiuit)***, 27 (15%) are 'vines' ***(kuamekat)***, and the rest are distributed among the other 12 Nahuat "life forms" (Taller de Tradición Oral and Beaucage1987:27ff.). The environment of the Sierra and the microecology of the orchard explain why such a large proportion of the associated plant are trees: a plant that needs much sunlight will not thrive under the double screen of the coffee trees and the *Inga;* shade-intolerant plants, e.g., mandarin orange (***xokoklavoxochit,*** *Citrus reticulata* L.), are planted on the edge or 'lip' of the orchard ***(kajfentajtenoj)***.

Regarding the uses of these plants, 57 (31%) are food plants (***se kikua,*** 'one eats it'), 48 (26%) are used as remedies ***(pajti)***, at least 36 (19%) are used specifically as firewood ***(tikuouit)***, 18 (10%) as timber ***(kalkuouit)***, and 12 different flowers and palms as ornaments for domestic or church altars (6%). The rest either have specialized uses such as basketmaking, fences, tying, etc. (48, or 26%), or are defined as 'useless' ***(amo kualtia para teyi)*** (25, or 13%). This distribution pattern is similar to that of the 636 generic taxa identified in our general inquiry[8] (Taller de Tradición Oral and Beaucage 1987:23-24). When asked about what they get out of a coffee orchard (apart from coffee itself), people spontaneously mention 'firewood', of which an average family needs about 55 kg (three forty-pound loads) a week. Apart from fruits, which are seasonal, during most of the year, the coffee orchard will yield mushrooms ***(nanakat)***, wild edible herbs such as ***metstsonkilit*** (*Xanthosoma nigrum* [Vell.] Stellf.), herbal remedies such as ***akokojxiuit*** (*Piper sanctum* Schlecht), and various vines used for basketmaking (Table 1).

Within such diversity, there are basic associations. The most fundamental is that between the coffee plant (***kajfenkuouit,*** *Coffea arabica* L.) and its 'shadow' ***(yekauil),*** most usually provided by the genus *Inga* ***(chalauij):*** *I. leptoloba* Schlecht and *I. latibracteata* Harms. ***(kuamekachalauij);*** *I. spuria* Humb. & Bonpl. ex-Willd. ***(tiltikchalauij);*** *I. xalapensis* ***(atenchalauij);*** *I. jinicuil* ***(xonekuilkuouit).*** In effect, the C. *arabica* brought to the area in the 1860s (today called *café criollo,* "native coffee") grows best under shade, which enables it to stand the short dry season (April-May) and protects its flowers and young fruit from the violent winds and showers of the late winter and summer. *Inga* has been known to the natives of the area for a long time, and is used for living fences, firewood, and even food: the inner part of its pod is a delicacy. It would appear that the first mestizo planters selected it because of its particular properties: from cuttings planted in the ground, it grows easily and more quickly than the coffee plants, and the adult tree will spread a large, umbrella of foliage 20 m above the ground. Moreover, its leaves make an excellent manure. It suffers no damage from pruning, which is necessary when the foliage becomes too thick.

Nahua and Totonac Indians also used *Inga* for shade when they started growing coffee. But there stops the parallel with the mestizos. For they had different views and techniques which oriented their utilization of the plant. First, mestizos plant their coffee trees in rows, on gentle slopes, at a distance of about three meters, for a total density of 1000 coffee plants per hectare, covered by up to 100 *Inga* trees. The yearly pruning is done after the end of the harvest (January) and the ground cleared by machete during the dry season (April-May). Apart from increasing production, pruning keeps the coffee shrubs from growing too high, which would make harvesting more time-consuming.[9] Before the introduction of new varieties in the 1970s, the same bushes were grown until their production declined markedly, that is, after 20 years. New saplings would then be matched with the old plants, the older being cut as the younger started producing.

Native coffee farming differs in five important points: 1) Traditionally, they keep their best land for corn and planted coffee shrubs on the rockier, steeper hills, as well as between houses on the village site ***(xolalpan).*** While successful mestizo farmers prefer to specialize in coffee and buy their corn, Indian farmers insist on the necessity of producing at least a part of their own subsistence needs: cash-cropping should be reserved for market goods. As one informant stated it:

> Nice is the life of the farmer. He plants his corn and weeds it and then he harvests it so that he does not need to buy any (Beaucage 1987:35).

2) They plant coffee saplings in 'beds' ***(koyok),*** four at a time, more irregularly and at a greater distance (four-five meters apart) than the mestizos. Apart from the limitations of a more rugged terrain, this technique makes for an easier picking, since the trees will bend to the outside when the branches are loaded with grain. Pickers gently pull the branches down as they work so as to make further work easier. 3) They do not prune the coffee nor *Inga* trees systematically, but cut off the overgrowth all year round, whenever they need firewood.

> First comes firewood; we need it all year round. So there is no sense in cutting all the branches at once and letting them rot. (Nahua male farmer)

4) The Indians also used to weed the orchards by hand:

> We always weed by hand. If we see some herb useful for curing or some (useful) sapling, we let it grow; if it is useless, we pull it out. (Nahua female farmer)

5) Finally, among the natives, the life-cycle of coffee plantations is directly linked with the family cycle. Indian farmers often plant a new coffee-orchard (or renew an old one) as they settle as young family heads. In the extended patrilineal family, sons (and sometimes daughters) are allocated parts of the father's lands so as to become progressively independent. This original plantation will often be kept in production up to 30 years or even more, for natives are loath to cut down a plant which is still bearing fruit ***(takistok ok).*** Since a man is not expected to engage in heavy farming labor inputs after fifty, it will be his sons, usually, who will start the coffee cycle again.[10]

As a result, Indian coffee orchards, in contrast to mestizo plantations, are interspersed with citrus trees, mangoes, *sapotes,* yucca (*Yucca* spp.), and allspice, together with the odd oak, cedar, mahogany, and any other tree which had been preserved while clearing or whose seed had been dropped by a bird or squirrel. These trees also provide shade for the coffee, and are harvested and pruned when their foliage becomes cumbersome. Around the little hut ***(xajkal)*** that is built to shelter the family during the long harvesting season (October to January), the housewife soon adds some peppers, squash, and flowers for the domestic altar. Even the "useless" plants are cut into pieces with the machete and spread on the ground as vegetal manure.

Informants explain the differences between mestizo coffee farms and theirs as follows:

> Mestizos from Cuetzalan have money, and we don't. They buy corn and firewood. They pay people to weed their coffee orchards, so they want the work to be done quickly. While *we do it by hand,* a little every day, as we go to the fields (Nahua female farmer).

The reference to economic status, while quite real, does not explain everything. Let us go back to the weeding technique which, I propose, has been crucial in giving the Indian coffee orchard its actual ecological characteristics. The weeding of cornfields ***(milmeua),*** an obviously much older practice, is done with the hoe (***tasaleuia,*** from ***salo,*** 'hoe'), various men working in a row, moving uphill; while the clearing of high grasses and shrubs ***(tauiteki)*** is done with the machete. So the hand weeding of the coffee orchards was neither copied from mestizos nor transferred mechanically from the main crops. Where did it come from?

A closer look at the plant association gives us a clue. We see that among the plants associated with coffee shrubs are 12 kinds of flowers; among them, hortensias (*Hydrangea hortensia* D.C.) and camelias *(Camellia japonica)* which are not usually planted in the bush. Moreover, when asked about the 'proper place' or 'home' ***(ichanyojkan)*** of the 184 plants, 15 of them were said to belong to the 'house site' or 'backyard' ***(kaltsintaj, kalikampa).*** This includes many of the fruit trees and the useful shrubs. An aerial look at an Indian village of the Sierra shows that the village itself is probably the most intensely cultivated area (Mathieu 1986:38). Long before the introduction of coffee, this area around the houses was already planted with fruit trees and ornamental plants and contained a small fenced garden, with edible and medicinal herbs.[11] This is the area where weeding by hand was traditionally done, both for esthetic purposes and to enhance the growth of protected plants.

> If you clear it with the machete, it won't last long. The weeds will soon be back and choke your flowers; and make you wet with dew when you walk! (Nahua male farmer)

We suggest that, when the natives progressively adopted coffee growing during the first half of this century, they considered it an extension of the home garden ***(kalikampa)*** and applied to it the same intensive techniques. The small size of the orchards (usually under one hectare) and the fact that the labor input in coffee-growing does not interfere with the main corn cycle, made it possible. So a convergence of factors (land-ownership, local history, market trends, and most of all, Indian knowledge of intensive farming) made the traditional Indian coffee orchard (and, to a much lesser extent, the mestizo coffee orchard) a remarkably adequate substitute for the forest cover which was being removed from the steep slopes of the Sierra under growing population pressure. In a traditional orchard, one can walk on a thick layer of decaying leaves and humus and feel the freshness in the air, and, even in the dry season, hear the bees and birds buzzing and singing.

EPILOGUE: THE INSTITUTO MEXICANO DEL CAFÉ AND THE INDIAN FARMERS

In the 1970s Mexico became at once short of food and short of foreign currency to buy the industrial inputs its economy required. For the Green Revolution, which the government (and its foreign sponsors) were so proud of, never extended further than the large and mid-sized farms that produced for industry and export. As for the millions of peasant families that had been given small *ejido* plots in the hills and were supposed to feed the cities forever, they did it, until the land was too exhausted to feed their own families. In 1969 the breaking point was reached and the price of corn started to rise; wages followed, and Mexico had to buy millions of tons of grain abroad (Mérigo Orellana 1979). At the same time, the countryside, which had been relatively quiet for thirty years, saw the revival of peasant unrest (Bartra 1979).

To solve this multiple problem, the Echeverría and López Portillo governments had one basic solution: modernize the countryside so as to increase the productivity of the peasant producer. From 1978 on, especially, substantial funding and technical support was channeled to that purpose. In the lower Sierra it took the dual form of *Plan Zacapoaxtla,* a global development program with a staff of agronomists, and a coffee development program, managed by a special government agency, the Mexican Coffee Institute (INMECAFÉ). Each institution carved out its own sphere of activity: for most farmers, the co-operative (which the Plan Zacapoaxtla counselors helped to put in place) was the place to buy cheap corn and to sell allspice and *sapote,* while INMECAFÉ gave credit and bought coffee at a better price than the traditional intermediaries (Beaucage *et al.* 1982).

For the Mexican State, its scientists and intellectuals, the peasant farming problem appeared as an opposition between Science and Ignorance, Rationality and Tradition. Often, but not always, based on correct evaluations of regional ecosystems, agricultural policy aimed at substituting for peasant ways a techno-economical package designed to maximize the productivity of land and labor. The more centralized the agency, the less room was left for local technicians and administrators to take into account peasant knowledge and practices, what Bourdieu called *le sens pratique* (1980). The experience of INMECAFÉ is quite pathetic in this respect.[12]

Following the Green Revolution philosophy, this agency viewed the small traditional orchards of coffee bushes and fruit trees as unproductive. It extended credit to peasant farmers, under the condition that they should "renew" their orchards, that is, increase their size and plant them with new high-yield varieties: e.g., Mondo Novo, Caturra, Borbón. The new varieties start producing three years after planting, instead of after five, and give two to four tons per hectare instead of one. They were shorter (so, easier to reap) and needed no shade, but did need fertilizer and careful yearly pruning. Enticed by the credit opportunities and the good prices paid from 1978 to 1986, a majority of Indian farmers entered the government scheme. Much corn land was converted to coffee: in 1982, the net income for the latter was ten times higher, per hectare, than the best *milpas* (Beaucage and Montejo 1984:23-24). However, money was now badly needed, not only to buy corn at ever-increasing prices, but even to buy firewood, which was getting scarce. In the 1980s the patchwook of dense, dark green orchards and bright green cornfields was giving way to an homogeneous scene of rows and rows of new coffee plants. INMECAFÉ officials could boast that, "thanks to the State efforts and peasant cooperation," the traditional coffee orchard was almost a thing of the past.

Their reasoning worked well in the abstract: a given number of high-yield coffee shrubs per hectare, combined with a given amount and kind of fertilizer, and a given number of man-days, should produce four tons of beans instead of one. But all other plants had to be removed, since they compete with coffee for sunlight and soil nutrients; and all weeding had to be done with the machete or with herbicide. In order to have access to credit and marketing services Indian peasants had to lay aside the experience achieved by generations of farmers in this rich but delicately balanced environment, and accept the abstract logic of the developers.

However, INMECAFÉ's program depended for its success on various conditions, some of which were clearly beyond local control, such as prices of food and farm inputs and, most of all, the international price of coffee. It stuck to its policy throughout the 1980s, although it was increasingly evident that worldwide overproduction could only lead to a market collapse. This occurred in 1989, when the U.S. and the other Western countries refused to sign a new international agreement on coffee quotas and floor prices. In a matter of months, prices paid to the producer fell from $0.60 US to $0.20 US per kg. For example, 1992 prices were not high enough to pay for harvesting, let alone growing, coffee. The Mexican Coffee Institute, which had run up a multi-million dollar debt, was dissolved. As if that were not enough, a December 1989 frost damaged or killed most coffee plants above 500 m throughout the Gulf Coast region.

Eight hundred thousand families throughout the tropical mountains of Mexico were affected. Most farmers simply picked whatever coffee was left, without putting additional labor into maintenance. Those spared by the frost discovered that the new varieties had quickly-decreasing yields when the expensive fertilizers were no longer applied, and that they stopped producing altogether after 15 years, while previously they had lasted up to 30 years. Many then decided to cut down their orchards and plant corn instead, adding the risk of quick erosion. The better-off were — and still are — those whose had kept their multipurpose orchards, mostly older farmers. For their *café criollo,* under the shade of *Inga* trees, better resisted the frost, and they still could sell oranges and *sapotes* on the national market. Some younger men, ruined smallholders or unemployed farm hands, left for Mexico City or the U.S; others joined radical peasant Indian movements, as in Chiapas (Harvey 1995).

In the aftermath of the crisis, independent organizations of coffee-growers have been formed (see Hoffman 1993; Paré 1993; Tulet 1993), which try to reconcile the constraints of the market with peasant practical sense. There is a trend back to multiple-resource management, which takes into account both the fragility of the tropical mountain environment and the unpredictability of international markets (Velázquez and Paré 1993; Olvera Rivera and Millán Vázquez 1994). In the Sierra de Puebla as in the other tropical mountainous areas, coffee-monocultivation may prove in the long run to have been a big mistake, largely induced by the outside, and painfully corrected through peasant experience after the collapse.

NOTES

[1]The present paper is based on a long-term research carried on jointly by the authors in San Miguel Tzinacapan, Municipio of Cuetzalan, in the Sierra Norte de Puebla, Mexico. The Taller de Tradición Oral (Oral Tradition Workshop) includes ten Nahua Indians and two mestizos and has devoted itself for more than 15 years to the collection, transcription, translation, and publication of local oral traditions. It was established in 1980 at the initiative of a local schoolteacher, Alfonso Reynoso Rábago, and became part of the Centro de Estudios y Promoción Educativa Para el Campo (CEPEC). CEPEC is a local NGO, made of Indians and non-Indians, engaged in education and rural development: a high school, a kindergarten, a clinic, and various projects such as chicken and pig-raising, carpentry, beehives, etc. In 1986 and 1987, the Taller and Pierre Beaucage collected data on traditional knowledge and practices regarding plants and animals among the Nahua. The analysis of our ethnobiological data is still in progress. Since 1988 we have also investigated local archives in San Miguel, in the town of Cuetzalan, and in Libres, the district seat in colonial times. This research, which was carried on with the help of Carolina Ramírez, Gabriel Jaímez, and Pablo Valderrama, provided important complementary data on the patterns of land occupation in the Cuetzalan area. The acronyms AMAT (Archivo del Municipio Auxiliar de Tzinacapan), AHMC (Archivo Histórico Municipal de Cuetzalan), and AHML (Archivo Histórico Municipal de Libres) refer to these sources, while AGN refers to the Archivo General de la Nación in Mexico City.

[2]Luc Ferry (1992) has suggested that both visions, the utilitarian view of Nature and the preservationist one, in spite of their apparent antagonism, are aspects of the same ideology. On the one hand, the material world exists only to be dominated and used by man; on

the other hand, some sanctuaries have to be preserved "intact" so as to comfort Western public opinion, while massive environmental deterioration continues.

[3]Nahua Indians in the Sierra speak two dialectal varieties: *Nahuatl* to the North (Huauchinango-Xicotepec area) and *Nahuat* to the South (Zacapoaxtla-Cuetzalan-Teziutlan area). Following contemporary Mexican usage, we will refer to the people as "Nahua" and to the languages as either "Nahuatl" or "Nahuat," respectively.

[4]Our figures are based on the XI Censo Nacional de Población y Vivienda 1990 (Instituto Nacional de Estadística, Geografía y Censos 1992). The absence of any legal definition of the category "Indian" makes for a large amount of variation from one census to the other. It is also worth noting that Mexican statistics now include children under five; they were systematically excluded from the figures on Indian population before.

[5]I refer here to the 1970 census of the Dirección General de Estadística (now INEGI) since the more recent data I had access to proved to be relatively unreliable for the municipality *(municipio)* as a whole.

[6]In the 1970s a strong peasant movement gave birth to a regional co-operative, the ***Tosepan Titataniske*** ('Together We Shall Win'). By creating possibilities of social ascension to Indians, the co-operative challenged the hierarchy which existed before in mestizo-Indian relationships. As a symbol of this change, a two-story building was built in the town of Cuetzalan, where the Indians feel free to come and chat, and shelter from the rain, while in town.

[7]For a detailed methodology of the inquiry see Taller de Tradición Oral and Beaucage 1987, 1988. For the botanical identification of the specimens, we relied on the few publications available to this day for the Sierra (Martínez 1984, 1985). The expected publication of the extensive botanical research done in the Sierra under the direction of Miguel Ángel Martínez, will help the final analysis of our data.

[8]The general distribution is as follows: edible plants: 24.8%; medicinal plants: 23.6%; firewood: 13.7%; construction: 11.0%; raw material for crafts: 6.6%; ornamental plants: 9.0%; fodder: 3.6%; "other uses": 10.8%. It is interesting to note that this grossly corresponds to the pattern observed by Benz *et al.* among mestizo farmers in a mountainous, wooded area in western Mexico, although the later show a higher concentration of medicinal plants (31.7%) (1994:31).

[9]Men and boys climb the trees to pick the higher branches. Women and young children pick the lower branches and gather the ripe berries that have just fallen.

[10]A similar association between plantation cycle and family cycle has been observed by Ortiz among the Páez of Colombia (1967:214), and may be quite general as a management pattern of long-term investment (cattle, fishing gear, and plantations) among petty producers.

[11]The presence of this home garden with intensive cultivation of a combination of plants is attested in various parts of Indian Mesoamerica (Kelly and Palerm 1952:140-141; Flores Guido 1992:29-31; Caballero 1992).

[12]From the beginning in 1974, Plan Zacapoaxtla had a broader mandate, that of "social and economic development." Thus, its staff was able to reorient the original, strictly productivist perspective in a way which allowed for the participation of Indian producers. Among other initiatives, the regional co-operative, ***Tosepan Titataniske,*** supplied subsidized staple foods and fertilizers, and successfully engaged in marketing non-traditional fruit crops such as allspice and *sapote.*

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BOOK REVIEW

Hunting the Wren: Transformation of Bird to Symbol. Elizabeth Atwood Lawrence. Knoxville: University of Tennessee Press, 1997. Pp. xx, 234. Illus., index. ISBN 0 87049-960-2 (cloth).

One of the strangest customs in the annals of ethnozoology is the Hunting of the Wren. Throughout most of the Celtic core areas of Europe — the British Isles, France, and probably neighboring areas (data is poor) — there was once a custom of hunting a wren (*Troglodytes troglodytes*, the "winter wren" in American English) shortly after Christmas. In the British Isles, the hunt was traditionally on St. Stephen's Day (December 26), the ceremonial day of the first Christian martyr and the day on which the British exchange their Christmas gifts. Accompanying songs referred to the wren as the "King of Birds." It was killed and brought home — often borne by two or more strong men, on a huge pole, as though it were a monster animal. Its meat or feathers were then distributed for good luck, at least in some versions of the practice.

Several folktales give accounts of why the wren is the "King of Birds," but they have rather an *ad hoc* quality. Many independent observers have come to the same conclusion: the real reason (or at least one real reason) for the wren's royal title is the fact that it sings an amazingly long and beautiful song throughout the year, even in the worst winter storms. Significantly, the wren is a "power bird" in Haida mythology too, and this reviewer (unaware of the earlier literature) reinvented the same explanation after hearing the wren's song rise clear and sweet over the howling wind and lashing rain of Haida Gwaai southwesters.

Countless variants of the hunt take place. It appears likely that the original form is the one in which meat is shared for luck. The cult is clearly associated with Celtic religion, being tightly linked with surviving Celtic culture. Lawrence airs sympathetically several theories that link it with the mysterious Druids.

Much of this book is devoted to explanations of the wren hunt. Great numbers of folklorists, ethnologists, and psychologists have speculated on the custom. Solar-cultists, survivals-hunters, symbolists, and interpreters of all stripes have utilized their ingenuity. The Freudians, of course, weighed in with truly creative sexual interpretations. For all these explanations, there is not one shred of evidence; they can be described only as flights of fancy. Every would-be decoder has taken bits and pieces of custom out of context and used them in a highly selective fashion to support a theory that, to the other decoders, seems preposterous. This book is thus a sobering read for those who would interpret culture. Not only scientists, but humanistic scholars as well, must look seriously at evidence, if they wish to contribute to something more than the wearisome history of human folly.

Lawrence is properly cautious. She invokes E.O. Wilson's hypothesis of biophilia to explain human interest in so insignificant an animal, and then works upward from the actual traits of the wren. Not only its song, but also its hole-nesting habit, its skulking ways, its dull color, and its rather weak flight are relevant to its folkloric image. She shows how these traits are observed, transformed, and symbolically used in various forms of the wren hunt. There is much left to explain, but, with the wren hunt rapidly disappearing, we will probably never know its secrets.

This book is valuable to ethnobiologists for several reasons. First, it reminds us what an incredible amount of religious and symbolic lore accumulates around animals, even in "civilized" and "rational" Europe. Second, it serves as a cautionary note about what can and cannot be explained, and how wild are the ideas of some who thought they were being "scientific." In fact, this book's greatest value may be as a sort of museum of fantasies in the name of "theory." Third, it is an excellent and sympathetic portrait of both bird and believers. Lawrence is a cautious, thorough scholar, recording with style and with detachment this strange cult and its even stranger scholarly career.

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THE USE OF PLOT SURVEYS FOR THE STUDY OF ETHNOBOTANICAL KNOWLEDGE: A BRUNEI DUSUN EXAMPLE

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ABSTRACT.—This paper describes a technique for using plot surveys to measure individual informants' ethnobotanical knowledge of forests, as applied to the Dusun community of Merimbun in Brunei. Two knowledgeable but non-literate Dusun informants enumerated marked plots of both recent and old secondary growth mixed dipterocarp forest near the village. They were able to provide names (other than life-forms or the most general basic and intermediate categories) for 86-97% of species growing in the plots. Between 152 and 170 plant names were elicited by the surveys. In all cases, about 88% of the names were at the basic naming level and 12% below. The surveys reveal the breadth of biodiversity knowledge of particular types of forest and highlight differences in the knowledge of individual informants and the ways in which that knowledge is organized. The plot-survey technique provides a way of measuring the comprehensiveness of local knowledge of plants with reference to all plant types found within circumscribed plots in locally recognized biotopes, and may be useful as a rapid means of assessing local ecological diversity.

RESUMEN.—Este artículo describe una técnica para usar encuestas de parcela a fin de medir el conocimiento etnobotánico que tienen los informantes individuales acerca de los bosques, aplicada a la comunidad dusun de Merimbun en Brunei. Dos informantes dusun, conocedores del bosque si bien analfabetas, enumeraron parcelas marcadas de bosques secundarios mixtos de dipterocarpáceas, tanto de crecimiento reciente como bosques secundarios más viejos, cerca de la aldea. Fueron capaces de suministrar los nombres (aparte de las formas de vida o las categorías básicas o intermedias más generales) de entre un 86 y un 97% de las especies que crecían en las parcelas. Entre 152 y 170 nombres de plantas fueron elicitados por las encuestas. En todos los casos, alrededor del 88% de los nombres estuvieron al nivel básico de nombramiento, y 12% por debajo de éste. Las encuestas revelan la amplitud del conocimiento de la biodiversidad de determinados tipos de bosque, destacando las diferencias en el conocimiento de informantes individuales, y las formas como es organizado ese conocimiento. La técnica de encuestas de parcela proporciona una manera de medir la extensión del conocimiento local de las plantas con referencia a todos los tipos de plantas encontradas dentro de parcelas circunscritas en biotopos reconocidos localmente, y puede ser útil como un método rápido de valoración de la diversidad ecológica local.

RÉSUMÉ.—Dans cet article, nous décrivons une technique d'utilisation de levé de terrain pour mesurer la connaissance ethnobotanique d'informateurs individuels relative aux forêts, telle qu'exemplifiée dans la communauté dusun de Merimbun au Brunei. Deux experts dusun non scolarisés ont dressé un inventaire de terrains marqués, près du village, constitués de forêt de diptérocarpacées mixte de croissance secondaire ancienne et récente. Ils ont nommé (sans compter les termes utilisés pour désigner les formes de vie ou les catégories de base et les catégories intermédiaires les plus générales) entre 86 et 97% des espèces poussant dans ces lots. De 152 à 172 noms de plantes ont été élicités durant ces enquêtes. Dans tous les cas, environ 88% des noms étaient des termes de base et 12% de niveau inférieur. Cette étude montre l'envergure de la connaissance de la biodiversité de types particuliers de forêts, elle met en évidence la variation de la connaissance entre les informateurs et les façons dont la connaissance est organisée. La technique de levé de terrain permet de mesurer la totatité de la connaissance locale des plantes, par rapport à tous les types de plantes qui se trouvent à l'intérieur de terrains circonscrits dans des biotopes reconnus localement, et peut s'avérer utile comme moyen d'accès rapide à la diversité écologique locale.

INTRODUCTION

We address aspects of the knowledge and use of forest plant species by the Dusun, an indigenous minority group in Brunei. We analyze data on the composition of forest plots obtained through inventory surveys conducted with two Dusun informants. The standard technique in most ethnobotanical work has been the collection of herbarium specimens, sometimes acquired systematically, though more often opportunistically, from a range of different biotopes.[1] Through this method it is possible to discover what informants know about any individual plant collected, but it does not give an overall picture of what is known about a particular patch of habitat or forest type, in part because it is hard work collecting identifiable voucher specimens for all different kinds of plants in even a small area (Martin 1995:155). Indeed, until quite recently the diversity and biomass of the herbaceous component of tropical forests in particular have been greatly underestimated, partly because of the absence of appropriate plot surveys (Poulsen 1996). Moreover, a conventional ethnobotanical herbarium collection cannot be used to determine how many plants are recognized in a given habitat, and what proportion of these might be useful; nor can it tell us much about the plants people are unable to identify or recognize. Part of the work of assessing ethnobotanical knowledge involves assessing ethnobotanical ignorance (cf. Ellen 1979). More specifically, although we now have increasing evidence concerning indigenous knowledge of rainforest species, and although we know that to some extent that knowledge (measured in numbers of names for plants) broadly reflects biodiversity

(Berlin 1992:99; Ellen in press), in depth knowledge of individual species and general knowledge overall is always skewed to some degree by the uses to which plants are put. We know of no previously published attempts to test informants' knowledge of all plant life contained within designated patches of forest. It was for this reason that in the Brunei study we have chosen to supplement more conventional strategies with plot inventories.

We are concerned here with the problems and materials of both cognitive anthropology and rainforest ecology. By using a plot-survey technique we were able to measure individual informants' ethnobotanical knowledge, defined in terms of their ability to name plants. Our study also provides evidence for the organization of ethnobotanical categories. Finally, it enables an assessment of the biological character of uncultivated areas, the extent of diversity, and an estimate of the potential economic value of the areas. The results of plot studies can contribute to the development of what Hunn (1982) has called a "post-ethnoscientific ethnobiology," by situating knowledge about plants in a broader context of human-environment relations.

PLOT SURVEYS IN ETHNOBOTANICAL WORK

The use of quantitative studies of plots to understand the composition of particular biological habitats is long-established in plant ecology. The idea of a systematically or randomly-selected quadrat, "a square area marked off as a sample of any vegetation it is desired to study closely," was introduced by Tansley (Tansley and Chipp 1926:57; see also Tansley 1923:94-129). For Tansley and Chipp, quadrats could either be simple lists of all plants within a space (list quadrats) or graphic illustrations of the structure of an association as seen in a ground plan (quadrat charts), in which species were indicated using some kind of notation (Tansley and Chipp 1926:58). For early workers, quadrats were often thought to be inappropriate for woody vegetation, where line or belt transects were considered more convenient and quicker (Tansley and Chipp 1926:58, 61-62). Moreover, it was seldom possible in a forest to include woody and herbaceous vegetation in the same quadrat chart, the necessary scales being too divergent. Similarly, a single chart could not capture significant stratification of the kind now well demonstrated for tropical rainforests (Tansley and Chipp 1926:59; see also Tansley 1923:94-129; Richards 1952:22-38; Whitmore 1990:27). However, by the 1960s quadrats or plot surveys had become commonplace in ecological studies of even rainforest, having been pioneered by P. W. Richards in the 1930s (Richards 1939; Richards, Tansley, and Watt 1940). They are now an essential tool in all serious analyses of composition, structure, and dynamics. Since the work of Odum (1971:17), plots have also become a statistical device for obtaining limited sample areas from which total counts can be made to estimate a standing crop of plants or for measuring energy capture and release. In Brunei, the first permanent plots were established in 1957 by Peter Ashton at Kuala Belalong and Andulau (Ashton 1964:5-8).

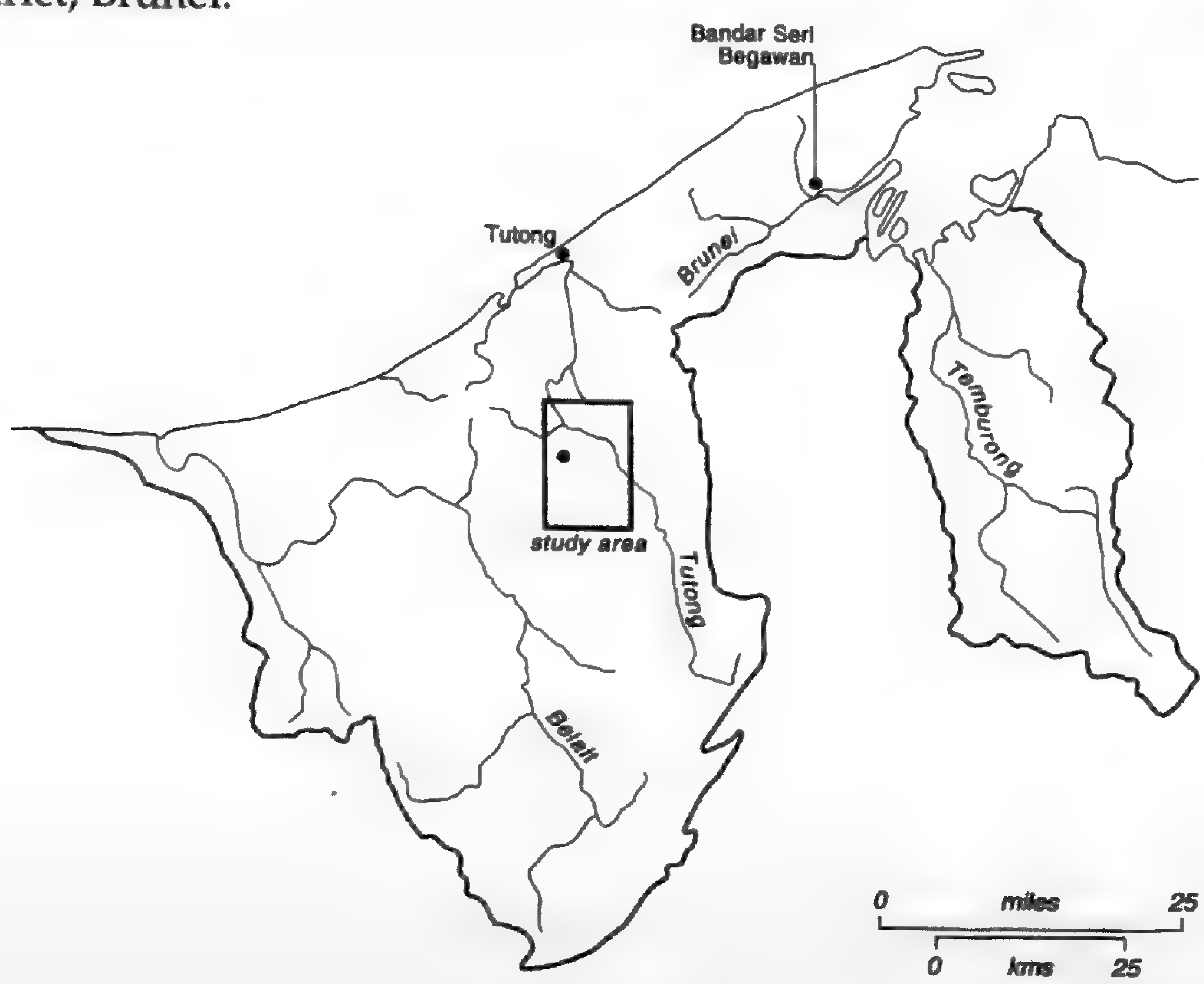
In ethnobotany and human ecology plot surveys first made an appearance in studies of swiddening, though less as a tool to assess plant knowledge and classification than as a means of establishing the agricultural and ecological character of swiddens by censusing their floral composition (initially Conklin 1957:85-86;

more recently, e.g., Boster 1983; Johnson 1983; Vickers 1983), and as a way of monitoring planting decisions in different years (Boster 1984). Plot surveys have also been used to measure the value of non-timber products in the context of debates relating to the economics of sustainable rainforest extraction (Peters, Gentry, and Mendelsohn 1989). Much of this work, which has been conducted largely in the Amazon basin, has been inspired by the research of botanists associated with the New York Botanic Gardens. However, despite this incentive and other work (Balée 1986, 1987; Balick and Mendelsohn 1992; Bennett 1992; Boom 1987), we are aware of no published accounts which report the use of plot surveys to complement general work on ethnobotanical knowledge, as opposed to those focusing on measurements of usefulness. There is, however, an important precedent for our work in the research of Stross (1973). Although not using a measured quadrat, Stross had Tzeltal informants name plants along a predetermined route, including both forests and cultivated areas, and thus he was able to measure and compare informants' ethnobotanical knowledge. Boster (1986) used a similar experimental method, guiding Aguaruna informants through gardens he had planted with up to 61 varieties of manioc.

ETHNOGRAPHIC BACKGROUND

The field site for the project reported here was the Dusun village of Merimbun, located in the Rambai mukim (administrative sub-district), Tutong district, the traditional homeland of the Brunei Dusun. Merimbun village comprises three hamlets, one at Lake (Tasek) Merimbun, consisting of seven houses, and smaller hamlets at Kuala Ungar (three houses) and Pulau Rita (four houses). The present population consists of about 100 people spread over an area of about five km^2 (Figure 1).

FIGURE 1.—Map of the research site, the Dusun village of Merimbun, Tutong district, Brunei.



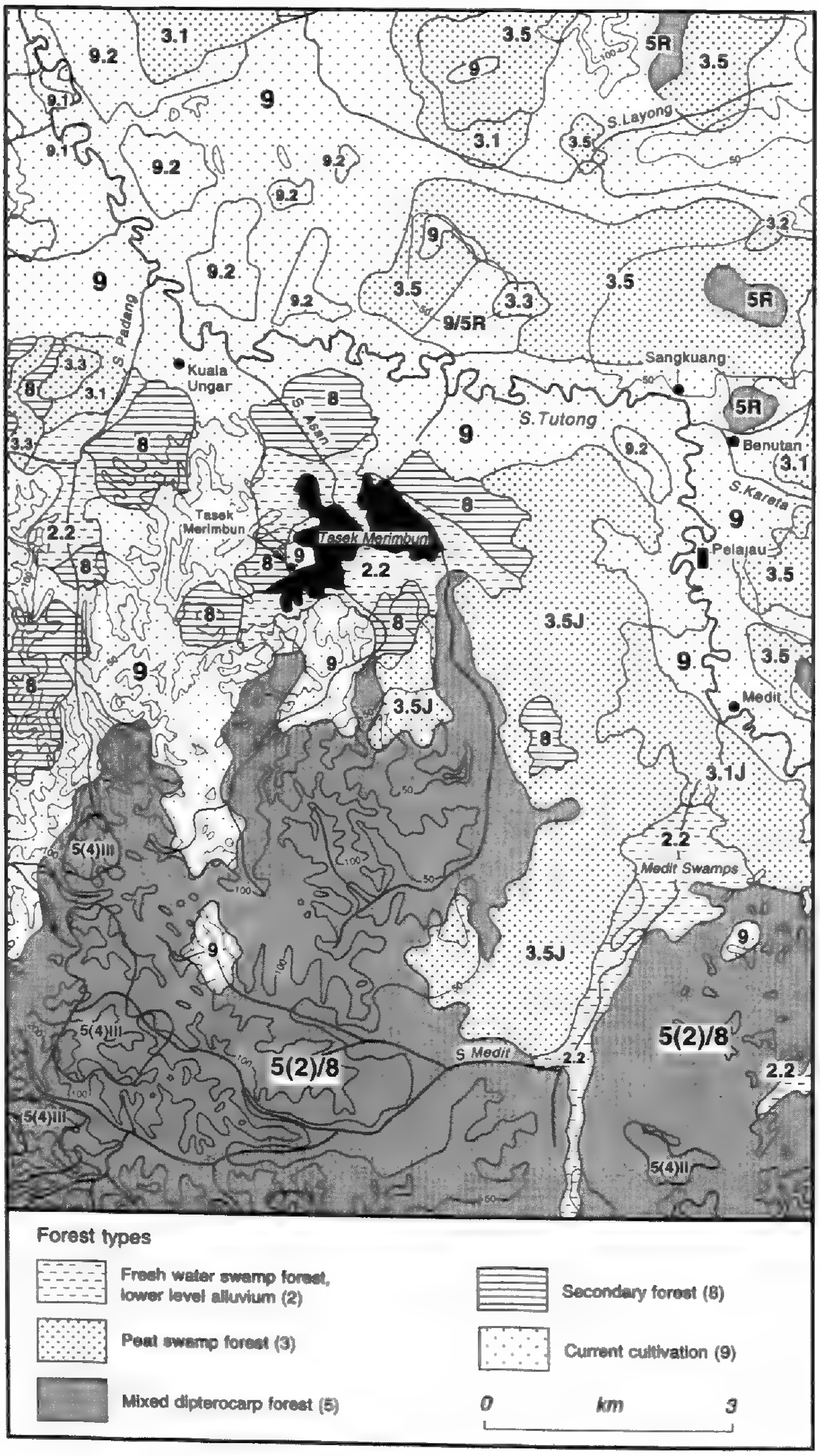
The Dusun are one of seven ethnic groups in Brunei constitutionally recognized as Malay. The Brunei Dusun seem to be a branch of the Bisaya, an ethnic group based in Limbang, a district once belonging to Brunei, but ceded to Sarawak in 1890.[2] Since they are officially classified as Malay there are no up-to-date demographic statistics specifically about the Dusun population, though a well considered estimate is that there are 5,000 non-Muslim Dusun in Brunei (Antaran 1993:19). (More recent information suggests that this estimate could be low.) It is clear, however, that the cultural population labelled "Dusun" by insiders and outsiders alike (defined usually in terms of adherence to language, ritual practices and beliefs, and through non-adherence to Islam) is decreasing as a result of marriages to Malays and Chinese, and through conversion to Islam. Furthermore, traditional Dusun language and culture is not being effectively reproduced (Kershaw 1994). In large part, this is due to social and economic mobility. With a large public sector economy, Bruneians are abandoning traditional economic pursuits to join a labor force away from their villages. As this occurs, traditional social formations, and the cultural knowledge which sustains them, decline (Ellen and Bernstein 1994; Bernstein in press).

The period of rapid growth in Brunei's economy in the 1950s corresponds with the transformation of Dusun culture and society, and its assimilation into modern Brunei society, including conversion to Islam and language shift converging on Malay. During this period of oil-based development, Dusun in large numbers began leaving their villages and seeking wage labor; education in Malay also became available through the building of rural schools. While the Dusun are now fluent in Malay, previous generations had imperfect command of the tongue, and if they spoke it at all, it was "falteringly or with strong accents" (Kershaw 1994).

Prior to this transformation, Dusun were almost entirely rice agriculturalists, supplementing their starch staple from cultivated fruit orchards and by hunting, gathering, and fishing. Some species in orchards and forest overlap, indicating long-standing human modification of the rainforest environment and selection of wild species for cultivation and genetic improvement. Examples are ***lalet*** (the durian, *Durio* spp., especially *D. zibethinus* L.), ***embokot*** *(Nephelium macrophyllum),* and ***julok*** (*Lepisantes fruticosa* [Roxb.] Leenh). The most sought-after fruits are ***sibut*** (*Dacryodes expansa* [Ridl] H.J. Lam) and ***kalokog*** (*Willughbeia* sp). Besides fruit trees, a large number of vegetables are grown (Antaran 1993:71-72) and wild vegetables are gathered, particularly edible ferns. There is evidence of selective management of palms, such as ***dabor*** (*Daemonorps fissa* Blume) and ***benjiru*** (*Licuala paludosa* Griff. and *Licuala spinosa* Wormsb).

The forests in this region are of lowland mixed dipterocarp type, but show interesting variations (Figure 2). The drainage basin, of which Lake Merimbun is the center, contains freshwater swamp forest (both levee alluvium [***emparan***] and lower level alluvium); peat swamp forest and ***padang*** forest (both dominated by ***encarangan,*** *Dactylocladus stenostachys* Oliver); mixed dipterocarp forest with uneven canopy, or moderately open with some medium or large emergents; dipterocarp forest with a dense uneven canopy, with medium-sized and large crowns on steep terrain (25-35°); secondary forest; and currently cultivated land (including some swamp rice land and plantation, but mainly swidden) (Brunei Forest Resources Planning Study, Forest Type Map 1984: Sheet 4; fieldnotes).[3]

FIGURE 2.—Schematic illustration of major forest types in the Dusun region.



The Dusun language has no overall term for uncultivated land. The Dusun word for forest ***(entalun)*** refers only to land never known to have been under cultivation. ***Gapu'*** refers both to abandoned fields and secondary forest, that is, land known to have been brought under cultivation. Habitats are classified as 'hilly' ***(bukid)***, 'swampy' ***(payoh)***, and 'alluvial' ***(gana)***. Ground types are classified into 'compressed' ***(pidot)*** and 'uncompressed' ***(padang)*** land, the latter being sparsely covered with small plants. Grassy swamp land in secondary forest is known as ***emparan***.

METHODOLOGY

The plot-survey technique was used to supplement data on Dusun ethnobotany obtained through herbarium collection, interviews, and participant observation. In the course of the Merimbun study, Bernstein and Antaran used local Dusun guides to locate suitable forest from which to collect plant specimens. The main guides were four men in their late 50s or older. Five hundred and thirty-five plants were collected, among them 436 with different and non-synonymous names. Plants collected (mostly fertile specimens) were discussed with informants, labeled, pressed in newspaper, and delivered to the Brunei Forestry Centre herbarium at Sungei Liang. Here they were sorted and provisionally identified. The first set of each voucher specimen was retained by the Forestry Centre (BRUN), the duplicates sent to the Royal Botanic Gardens at Kew (K), and triplicates deposited at the University of Kent Ethnobiology Laboratory (UKC) where they were available for further examination and despatch to other herbaria.

By presenting the names of plants that had been collected to a wide range of Dusun informants it became clear that substantial knowledge of forest plants was limited to a few people, mainly older men. Division of knowledge by age has been reported quite widely in the ethnographic literature (Hays 1974; Ellen 1979:346; Boster 1980; Berlin 1992:119-21; Zent 1994), and we know something of how botanical knowledge is acquired and lost (Dougherty 1979). In the Brunei Dusun case, however, the asymmetry between young adult males and men over 50 would appear to be more marked. Young men generally failed to recognize large numbers of plant names elicited through fieldwork with older men. This may, in part, reflect the disappearance of ethnobotanical knowledge due to rapid transition to a wage-based economy, universal primary education, and movement away from rural settlements to peri-urban residences (Ellen and Bernstein 1994). While certain women are knowledgeable about uncultivated plants, the male informants selected were judged to have greater knowledge of plants found mainly in more remote forests, because of their hunting activities, in which no women participate. Moreover, women could not be used as guides because of prevailing social mores.

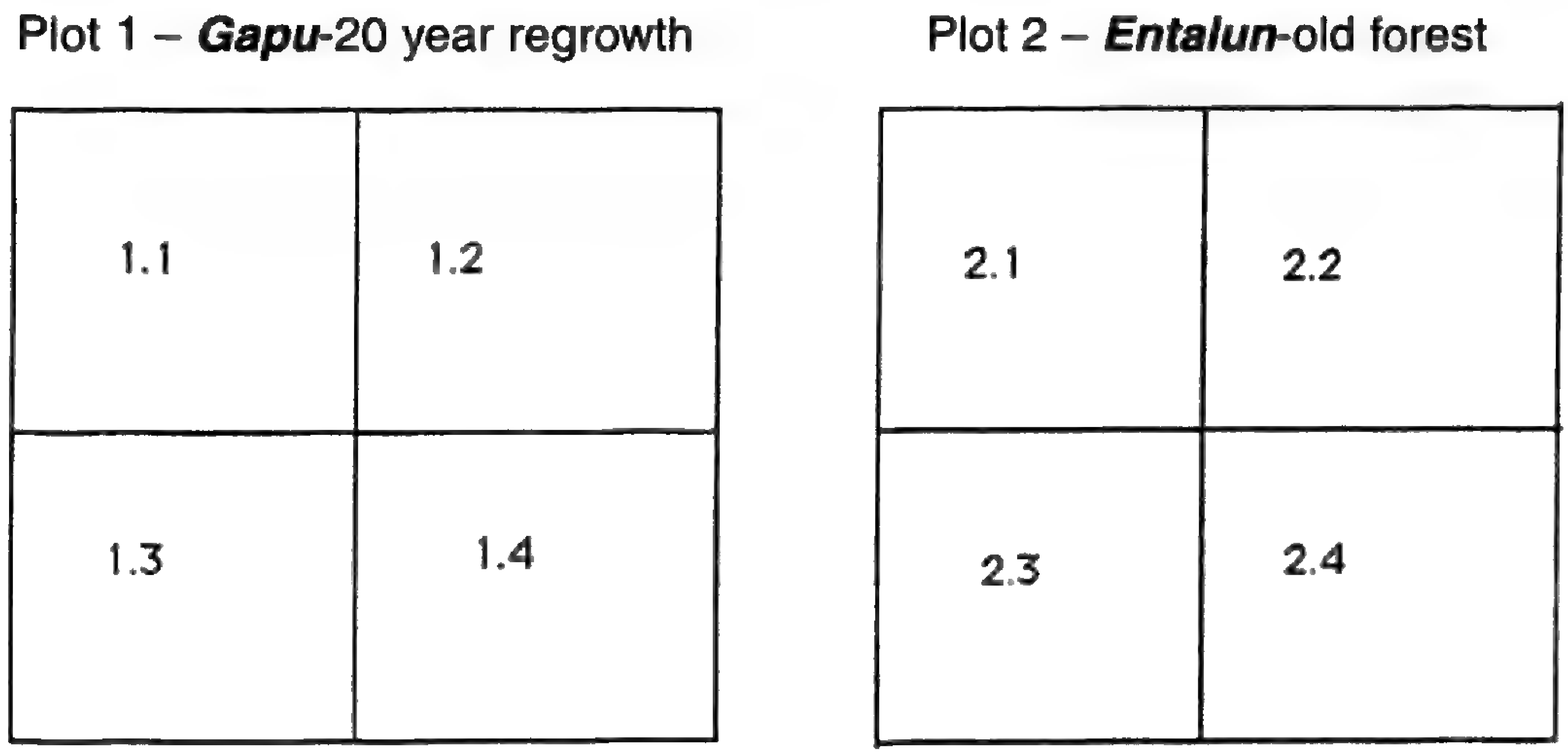
In effect, our study of Dusun ethnobotanical knowledge was to a great extent one of salvage ethnography, documenting for posterity a fast-disappearing body of knowledge. To gain a measure of the extent of the knowledge of plant diversity in given forest vegetation types, rather than the global ethnobotanical knowledge of particular informants, or the maximum knowledge of some omniscient speaker-hearer, it was decided to supplement other methods with a plot survey approach. At this stage in the work we were unaware of the existing techniques of plot survey employed by other ethnobotanists (Martin 1995).[4]

On 18 and 19 August 1993 two different sites of uncultivated land were selected, representing two different vegetation types (cf., Phillips and Gentry 1993a, 1993b): a forest area that had been utilized by Merimbun residents but never brought under cultivation in living memory, and another area that had been brought under cultivation more than 20 years previously, but which had subsequently regenerated. We were advised in this task by an informant. Both sites were within a few minutes of the asphalt-paved road from Merimbun to Bukit Sawat and one to two km from the houses of the informants. Both had a similar underlying geology and soil composition.[5] From mid-August until 2 September, for a total of 11 days (including three half-days), the plots were enumerated by two Dusun men. Both were locally born; neither had received any formal education, though both were able to write their names. Both were traditional non-Muslim Dusun, though in common with many Dusun, some of their children had converted to Islam. The first informant, Umpoh bin Madah (aged 68), spoke Malay and Iban as well as Dusun, and the second, Gumpol bin Payor (aged 77), spoke Penan in addition to those languages. (He is married to an Iban woman.) Gumpol could also understand some spoken Chinese and could read Chinese numerals, since he had associated closely with Chinese and worked for them many times over the years. Both men had supported themselves through hunting, and Umpoh still did so at the time of fieldwork. The two men chosen for this task were also the primary informants used in plant-collection. They were considered within their community to be the most knowledgeable about forest plants. Others who may have been comparably competent could not be used because of their poor health.

The two plots described in this paper were located in areas described as ***gapu' bukid*** and ***entalun bukid***. Selection of sites was based on typicality as judged by the informant, and also accessibility. The ***gapu'*** plot (plot 1) at Pok Lutong was on a 15-25° east-facing slope estimated by our informants to have been cleared at least 20 years previously. The largest trees were between 17 and 36 cm dbh (diameter at breast height), with five m or more between them. The ***entalun*** patch (plot 2) at Pok Kalod (alternatively Pok Ajong) is nearer the lake, on a 20-30° northeast-facing slope never known to have been cleared for cultivation. Here, the largest trees included a few between 54 and 70 cm dbh. Plot 1 was located in an area indicated as "under cultivation" and plot 2 as "secondary forest of at least 25 years" in the Forestry Planning Map dated 1984. The data on which compilation of this map was based must in some cases have been rather old and partial, though the match between official records, field observations, and informant judgements is encouraging.

The sides of the plots were in each case 48 meters. These were then each divided into four giving a total of eight quadrats of about 576 m^2 each (Figure 3).[6] These were marked off with tape for study. Informants were asked to name every plant they could identify within a quadrat and to indicate those plants they could not name, either because they did not know the name, because they had forgotten the name, or because they thought the plant had no basic name. Umpoh surveyed quadrats 1.1, 1.4, 2.1, and 2.4, while Gumpol surveyed 1.2 and 2.2. To be sure a plant had been counted, the informant or Antaran would mark it with spray paint. Bernstein recorded data on a clipboard and entered it into a laptop computer the same evening.

FIGURE 3.—Tasek Merimbun plot quadrat notation



As others have found in practice, not every plant can be registered in this way. It is very time-consuming to record smaller plants, and seedlings are not readily identifiable using non-laboratory techniques. Although informants undertook to name as many individual plants as they could, a decision was taken to eliminate the smallest plants for the purposes of the quantitative survey. This was done by ignoring plants less than 3 cm high. Effectively, this meant grasses, moss, mushrooms, the common fern ***engkubuk*** (*Nephrolepis biserrata* [Sw.]), and most very small seedlings, especially of ***ubor*** (*Eugenia* or *Syzigium* spp.).[7] Secondly, a distinction was made between "large" plants and all others. This physical distinction corresponded approximately to a functional one: namely distinguishing trees which were regarded as having any use in their observed state. Thus, trees observed as immature seedlings and saplings with no uses were eliminated from the survey. In practice, "large" plants surveyed included trees with a diameter of at least 8 cm at breast height (dbh), and vines and rattans of at least 2 cm diameter. Our goal was not to map out or measure particular plants, but more simply to assess the ethnobotanical knowledge of our two informants. For this reason, we did not limit our study to plants having a diameter >10 cm. dbh, but included all plants noticed by our informants, whether or not they could name them. Informants were also asked individually about the uses of each of the plants registered in the surveys. A short subsequent visit in April 1994 enabled us to check the plots and, with the aid of photography, make estimates of average canopy height, emergent tree formations, and to measure the distances between larger trees.

As our informants enumerated the plants found growing in each quadrat, they also found plants they were unable to identify with a basic (generic) name. In these cases they would say that they did not know which plant it was, or else that they had forgotten the name. In virtually all cases they assigned the plant to some higher-order category. It should be stressed that the names our informants provided were free responses to stimuli, and were not elicited through some test where they had to choose one answer or another.

In retrospect, some important shortcomings of our technique are apparent. When we conceived the study we thought that by having informants survey adjoining plots it would be possible to increase the range of plant names (and hence species) included in the study. We did not take into account our informant's comparative fallibility, which only emerged in the analysis of the data. As a result of choosing this tactic, and by using only two informants for this work, we are unable to establish a consensus on plant names even within the Tasek Merimbun Dusun community (see Romney *et al.* 1986 on methodological questions surrounding informant competence, reliability, and consensus; cf. Boster 1986). Most villagers deferred to the authority of a few older individuals who were reputed to have superior knowledge of the forest environment and were considered to be "experts." The reputation of our informants for highly reliable knowledge of forest plants was borne out in plant collection work. In the course of the study we repeatedly interviewed our informants to check earlier statements, and Umpoh and Gumpol were very consistent in their answers. In very rare cases they provided different names for the same plant. One such plant was called ***akau bina manunggul*** by Umpoh and ***akau bina entakad*** by Gumpol. (In either case, the plant is Fabaceae.) When this discrepancy was mentioned to Gumpol, he said that ***akau bina manunggul*** was a different plant. Umpoh avoided saying that Gumpol was mistaken.

We did not insist at the outset on a standard measure of a hectare, but rather let our informant determine the size of the plot in terms of an "acre," as this unit is used and defined in contemporary Brunei. It would have been preferable to have used a plot of a standard size, such as 100x100 m, subdivided into plots of 10x10 m, and to have used a quantitative rather than qualitative and subjective measure of "large" plants. Given the opportunity to re-do this study we would have used three size categories: < 10 cm dbh, 10-20 cm dbh, and >20 cm dbh. Finally, a potential for error is introduced in that we did not collect voucher specimens of plants surveyed in the plots, but relied on linking common names with species, as determined in the general ethnobotanical survey and other sources.

Despite all these drawbacks, we feel that our findings may be useful to ethnobotanists and ecologists working in Southeast Asian rainforests, and we present them in the interest of stimulating further research. The advantage of our methodology is that vernacular names for all but the tiniest of visible plants within a quadrat were collected; thus we are able to represent informants' overall knowledge of plants within an environment. The technique also produced a number of unknown plants and forgotten plant names, allowing us to calculate a ratio of known to unknown plants. In this way, the study yields a quantitative measure of ethnobotanical knowledge in terms of self-reporting. Since we do not define knowledge in terms of consensus (Romney, *et al.* 1986; Boster 1986), our technique does not require the use of a large number of informants, but may be carried out with only one informant.

The floristic composition of the two plots is summarized in Table 1. Most identifications of Dusun plant names are based on our herbarium study. Plant names elicited in the plot studies were keyed to the names given for voucher specimens (usually collected with the same informants), which have been identified at Kew. Additional identifications were obtained from the Kew Brunei Checklist Project

Database and Pukul and Ashton (1964). It is important to note, following Berlin's seventh general principle of ethnobiological classification (1992:25-26), that vernacular terms at the folk-generic rank, as used by knowledgeable speakers of a language, are generally coterminous with the names of Linnaean taxonomy; that is, they tend not to refer to a variety of similar-looking plants in a number of genera or families. While some discrepancies and ambiguities remain, it is possible to identify all but a few Dusun plant names at least to botanical family and usually to genus (Table 1). But given the effect of the large number of plants unidentified at the basic level, at present it is possible to identify only 77.6% of enumerated plants in plot 1 and 82.0% of enumerated plants in plot 2.

Table 1.—Inventory of number of genera and individual plants for each botanical family in two Tasek Merimbun forest plots.

	Plot 2: Old Secondary Growth			*Plot 1: 20 Year Re-Growth*		
FAMILY	*genera*	*plants*	*%*	*genera*	*plants*	*%*
Anacardiaceae	1	18	.3	1	36	.9
Anisophylaceae	2	231	3.6	2	58	1.5
Annonaceae	3	34	.5	5	22	.6
Apocynaceae	1	3	.0	2	24	.6
Araceae	1	200	3.1	3	45	1.1
Araliaceae	0	0	.0	1	1	.0
Arecaceae	8	571	9.0	4	206	5.2
Asteraceae	0	0	.0	1	2	.0
Bombacaceae	1	2	.0	0	0	.2
Burseraceae	2	49	.8	2	10	.2
Celastraceae	1	1	.0	1	7	.2
Commelinaceae	1	17	.2	1	6	.2
Connaraceae	2	94	1.5	2	109	2.7
Costaceae	1	1	.0	1	1	.0
Cyperaceae	2	31	.5	3	15	.4
Dilleniaceae	2	50	.8	2	72	1.8
Dipterocarpaceae	1	19	.3	1	8	.2
Ebenaceae	1	2	.0	1	1	.0
Eleacapaceae	1	55	.9	1	10	.2
Euphorbiaceae	3	153	2.4	5	62	1.6
Fabaceae, Mimosoideae	3	401	6.3	5	19	.5
Fabaceae, Caesalpinoideae	1	40	.6	1	10	.2
Fabaceae, Papilinoideae	2	464	7.3	1	493	12.4
Fagaceae	1	31	.5	1	1	.0
Flacourtiaceae	0	0	.0	2	2	.0
Flegellariaceae	0	0	.0	1	2	.0
Gnetaceae	1	6	.1	1	8	.2
Guttiferae	1	18	.3	1	22	.6
Hypoxidaceae	1	14	.2	1	252	6.4
Irvingiaceae	1	17	.2	1	3	.1
Lauraceae	2	209	3.3	1	56	1.4
Lecythidaceae	1	28	.4	0	0	.0
Loganiaceae	1	68	1.1	1	18	.5

TABLE 1.—Continued.

	Plot 2: Old Secondary Growth			Plot 1: 20 Year Re-Growth		
FAMILY	*genera*	*plants*	*%*	*genera*	*plants*	*%*
Marantaceae	0	0	.0	2	9	.2
Melastomataceae	2	61	1.0	2	122	3.1
Meliaceae	3	11	.1	2	7	.2
Meliosmaceae	1	52	.8	1	1	.0
Menispermaceae	1	16	.2	1	15	.4
Moraceae	2	37	.6	2	243	6.1
Myristicaceae	2	23	.3	2	20	.5
Myrsinaceae	1	2	.0	1	21	.5
Myrtaceae	2	1041	16.3	3	56	1.4
Nepenthaceae	1	1	.0	0	0	.0
Nephrolepidaceae	0	0	.0	1	*	
Ochnaceae	1	81	1.3	0	0	.0
Olacaceae	0	0	.0	1	15	.4
Ophilossuceae	1	1	.0	0	0	.0
Oxalidaceae	1	9	.1	1	8	.2
Pandaceae	1	18	.3	1	28	.7
Piperaceae	1	4	.0	1	1	.0
Polygalaceae	0	0	.0	1	6	.2
Poaceae	0	0	.0	1	*	
Rhizophoraceae	2	15	.2	2	32	.8
Rubiaceae	7	174	2.7	7	162	4.1
Rutaceae	1	3	.0	1	38	.8
Sapindaceae	3	493	7.7	2	324	8.2
Schizaeaceae	0	0	.0	1	5	.1
Simaroubaceae	2	57	.9	2	42	1.0
Sterculiaceae	1	202	3.2	2	191	4.8
Theaceae	1	3	.0	1	6	.2
Thymeleacaceae	1	3	.0	1	5	.1
Tiliaceae	1	10	.2	3	12	.3
Triurdaceae	0	0	.0	1	7	.2
Ulmaceae	0	0	.0	1	1	.2
Verbenaceae	2	12	.2	1	76	.2
Zingiberaceae	2	39	.6	4	15	.4
RESIDUAL PLANT TYPES						
Ferns		9	.1		12	.3
Fungi		*			6	.2
Mosses		*			0	.0
TOTAL ACCOUNTED FOR		5226	82.0		3077	77.6
UNDETERMINED RESIDUE		1145	18.0		890	22.4
TOTALS	55 families 93 genera	6371 plants	100.0	62 families 109 genera	3967 plants	100.0

*Uncounted

These results show that Fabaceae-Papilionoideae is overwhelmingly the most common family in plot 1 (recent secondary growth), with 12.4% of all plants. The second best represented family is Sapindaceae with 8.2%, followed by Hypoxidaceae with 6.4%, and Moraceae at 6.1%. In all, at least 109 genera in 62 families were enumerated for this 20 year regrowth plot.

In plot 2 (old secondary growth), five families dominated: Myrtaceae (16.3%), Arecaceae (Palmae) (9.0%), Sapindaceae (7.7%), Fabaceae-Papilionoideae (7.3%), and Fabaceae-Mimosoideae (6.3%). Ninety-three genera in 55 families were present, including eight palm genera and seven Rubiaceae. (these numbers are all minimal).

In a recent study, Poulsen *et al.* (1996) inventoried a hectare of hill dipterocarp forest in Temburong District. This involved the enumeration of all trees >10 cm. dbh. They identified 231 species in 43 families. Dipterocarpaceae and Euphorbiaceae were dominant, followed by Anacardiaceae, Ebenaceae, Flacourtiaceae, and Myristicaceae. The Temburong study was botanically more thorough than our own work and was undertaken in an area with far less recent disturbance. The number of families represented is roughly comparable, though both the rank order and content of the most common families is noticeably different.

PLANT ENUMERATION STUDIES AS EVIDENCE OF CLASSIFICATORY KNOWLEDGE

Primary Dusun plant categories.—There is no single, overall word in the Dusun language that encompasses all plant life, but plants can be grouped into various categories above the basic naming (generic) level (Bernstein 1996). The major named categories are ***kayuh*** ('tree'), ***akau*** ('vine'), and ***uwai*** ('rattan'). A smaller and less important, but physically salient category is ***kulat*** ('fungus'). These categories are life forms in Berlin's (1992) sense, being highly distinctive morphotypes containing a large number of sub-categories. However, there are a number of other general categories the content of which is less well defined: ***usak*** 'flower', ***sakot*** (alternately ***sakot tanah*** or ***sakot bumi***) 'weed', ***raun*** 'leaf', and ***umbus*** or ***sancam*** 'vegetable'. These are neither morphotypes nor completely exclusive. Some plants can be placed by informants in one of these categories as well as in a more obvious morphotypical life-form or other category; in other words, they cut across morphotypical categories and overlap amongst themselves. But while these plant categories are problematical in not conforming to the tidy analytic distinctions of ethnobotanists, they are not simply plant partonyms (e.g., "flower," "leaf"), and are regularly used by Dusun to classify plants into more inclusive groups. Both life forms and these more problematical categories comprise primary plant categories, in that they are characterized by maximal inclusion within their particular domain (Ellen 1993:91). It would violate the Dusun perception of their plant word to separate them out cognitively as special-purpose rather than general-purpose categories.

Neither grasses nor herbaceous plants are labeled by a single Dusun life-form term, though there is some covert recognition that grasses are physically distinctive. Several named types of grass are placed in the categories ***kumpau, telasai,*** and ***rumput,*** which are conceptually linked. A similar pattern prevails for gingers ***(tumid-lingkuas-layoh),*** ferns ***(gerajai-paku-limputong-engkubuk-kuban),*** bananas ***(punti-rutai-binci-encarawan-powow),*** and palms of the genus Licuala ***(silad-benjiru-ukang)*** (Bernstein and Ellen in press). All are covert categories at the intermediate rank (Bernstein 1996). Other primary categories, the existence of which is demonstrable, but which have an ambiguous classificatory status, are a group of palms, ***pinang,*** focused on *Areca catechu,* and ***bulu'*** (bamboo). These primary categories are summarized in Table 2.

TABLE 2:—Main primary Dusun plant categories encompassing forest species.

Life-forms
- ***kayuh*** 'tree'
- ***akau*** 'vine'
- ***uwai*** 'rattan'
- ***kulat*** 'fungus/mushroom'

Covert Intermediates
- ***punti/rutai/binci/encarawan/powow*** 'bananas'
- ***gerajai/paku/limputong/engkubuk/kuban*** 'ferns'
- ***tumid/lingkuas/layoh*** 'gingers'
- ***kumpau/telasai/rumput*** 'grasses'
- ***silad/benjiru/ukang*** 'licuala palms'

Problematic: indeterminate rank
- ***bulu'*** 'bamboo'
- ***pinang*** '*Areca* and similar palms'

Problematic: non-taxonomic
- ***usak*** 'flower'
- ***sakot/sakot tanah*** 'weed'
- ***raun*** 'leaf'
- ***umbus/sancam*** 'vegetable'

Not surprisingly, the great majority of plants named in the plots were placed in the ***kayuh*** 'tree' life form, followed by ***akau*** 'vine' and ***uwai*** 'rattan'. Other categories were less salient: fewer both in number of individual plants and in number of kinds. For example, in his survey of two quadrats of plot 2 totaling 1152 m^2, Gumpol identified 158 different plant names. Of these, 103 were ***kayuh,*** 26 were ***akau,*** and 8 were ***uwai.*** Twenty-one were other kinds of plants. In Gumpol's plot 2 survey , 111 ***kayuh,*** 19 ***akau,*** and 9 ***uwai*** were named. Only 14 were other kinds of plants. These findings support the proposition that the category ***kayuh*** dominates Dusun ethnobotanical classification, with ***akau*** a distant second. The salience of ***kayuh, akau,*** and ***uwai*** is reflected in their frequency, in contrast to all other terms listed in Table 2, confirming their special life-form status (Bernstein 1996).

Breadth of knowledge.—For the most part informants had no trouble providing names even for small seedlings, though we have no independent confirmation of their identifications.[8] However, there was in each of the surveys a residual fraction of plants our informants were unable to identify. As Table 3 shows, in both surveys conducted by both men, there were some plants for which the informant either did not know the name or said he knew it but could not remember it. When "un-

TABLE 3.—Plot survey summaries.

Plot 1, 20 year regrowth	Umpoh		Gumpol	
All plants counted	2917		1052	
Large plants counted	*476*	*16.3%*	*186*	*17.7%*
Basic name unknown - all	357	12.2%	38	3.6%
Basic name unknown - large	*9*	*0.3%*	*0*	*0.0%*
Basic name forgotten - all	63	2.2%	0	0.0%
Basic name forgotten - large	*0*	*0.0%*	*0*	*0.0%*
Total labeled categories identified	170		152	
Basic and primary categories	151		135	
Plot 2, old secondary growth	**Umpoh**		**Gumpol**	
All plants counted	5206		1162	
Large plants counted	*398*	*7.6%*	*119*	*10.2%*
Basic name unknown - all	611	11.7%	44	3.8%
Basic name unknown - large	*41*	*0.8%*	*11*	*1.0%*
Basic name forgotten - all	71	1.4%	10	1.0%
Basic name forgotten - large	*12*	*0.2%*	*0*	*0.0%*
Total labeled categories identified	158		156	
Basic and primary categories	132		139	

known" and "forgotten" plants are added together and divided by the total number of plants enumerated, it can be seen that Umpoh failed to identify 14.4% of plants in plot 1 ***(gapu')*** and 13.1% of plants in plot 2 ***(entalun).*** Gumpol failed to identify 3.6% of plants in plot 1 and 4.8% of plants in plot 2. Thus, informants were very consistent in their ability to identify plants, regardless of forest type.

"Failure to identify" in this case means failure at the basic naming level (Berlin's generic rank).[9] As can be seen from Table 4, only one plant in the entire survey could neither be recognized nor classified in any way by one of our informants. All other plants were classified in some more inclusive grouping. From Table 4 we can see exactly which categories these are. The data indicate the indistinctiveness of the category ***usak*** 'flower'. Some unknown plants were classified as both ***akau*** 'vine' and ***usak,*** while others are classified as both ***usak*** and ***gerajai*** (a kind of fern), even though they were non-flowering. Data acquired in the course of herbarium collection reveal that some plants are included in the ***kayuh*** category along with ***usak.*** In short, the ***usak*** category appears to lack any definite, essential core (Atran 1990); instead, it appears to be a heterogeneous grab-bag capable of including many incompletely known plants.

TABLE 4.—Breakdown of unidentified and incompletely identified plants in plot surveys.

	Umpoh		Gumpol	
Plot 1 survey.				
Primary category	All plants (%)	Large plants only	All plants (%)	Large plants only
kayuh — unknown	139 (4.7)	9	27 (2.5)	
kayuh — forgotten	38 (1.3)	16		
akau — unknown	91 (3.1)			
akau — forgotten	21 (0.9)		11 (1.0)	
akau-usak — unknown	1 (0.0)			
usak — unknown	113 (3.8)			
usak — forgotten	2 (0.0)			
kuban — unknown	10 (0.3)			
layoh — forgotten	1 (0.0)			
uwai — forgotten	1 (0.0)			
layoh group *	1 (0.0)			
bakong group *	4 (0.1)			
Plot 2 survey.				
Primary category	All plants (%)	Large plants only	All plants (%)	Large plants only
akau — unknown	286 (5.5)	19	19 (1.6)	5
akau — forgotten	25 (0.5)	6	1 (0.0)	
akau-usak — unknown	2 (0.0)			
usak — unknown	35 (0.7)			
usak-gerajai — unknown	1 (0.0)			
lingkuas group — unknown	17 (0.3)			
gerintik group — unknown	2 (0.0)			
kuban group — unknown	1 (0.0)			
gerajai group — unknown	2 (0.0)			
bakong group *	2 (0.0)			
tumid group — unknown	1 (0.0)			
barasan tanah'*	1 (0.0)			
tisil *			12 (1.0)	

* Name at folk-specific rank not provided

Layoh, tumid, and ***lingkuas*** are different kinds of ginger. ***Gerintik, kuban,*** and ***gerajai*** are all kinds of fern. Plants identified in the survey as "a kind of ***bakong,***" "a kind of ***layoh,***" or "a kind of ***tumid***" presumably indicate kinds below the basic naming level, though their precise intermediate status is ambiguous. From data accompanying the systematic collection of ethnobotanical herbarium vouchers we found that, besides plants called ***tumid*** (including ***tumid entalun*** ['forest ***tumid***', Costaceae] and ***tumid lamatai*** ['ghost ***tumid***', *Plagiostachys strobilifera* (Baker) Ridl.]), the ***tumid*** category also includes plants called ***encalongon*** (*Plagiostachys crocydocalyx* [K.Schum.] Burtt & R.M. Smith), ***kunyit*** ('turmeric', *Curcuma longa* Valeton), ***sagang*** (*Etlingera punicea* [Roxb.] R.M. Smith), and ***sumbang*** (*Hornstedtia reticulata* [K.Schum.] K. Schum.), as well as the various binomially-labeled sub-categories (e.g., ***kunyit lamatai*** ['ghost turmeric', *Hedychium longicornutum* Griff.]).[10] These terminal categories differ in a number of ways from the unmarked, common form of a generically identified plant. Some data in Table 4 refer to unknown kinds of the basic categories ***bakong*** (Crinum) and ***tisil*** *(Urophyllum)*. These are identifications at the basic naming level. Another plant, ***barasan tana'*** (*Pandanus* sp.), is presumably a contrasting sub-category, since there are other kinds of ***barasan***. An unknown kind of ***barasan tana'*** presumably indicates the existence of contrasting categories at a more specific level.

Some plants may not be given names at the basic (generic) level. Umpoh could not identify many plants he classified as ***usak,*** saying they had no name, i.e., no basic name.[11] However, Gumpol identified no plants as unknown ***usak*** in either of his two surveys. ***Kulat*** 'fungi' found in the plot surveys, all lacked basic names. Only edible mushrooms are known by basic names within the Dusun community under study (with the exception of ***kulat jelundong*** 'shade mushroom' and its sub-type ***kulat jelundong purak*** 'white shade mushroom'), and no edible mushrooms were encountered in any of the places surveyed.

In other cases, while plants may be identified in the sense that they represent familiar forms previously encountered, their "true" basic names may be unknown or lacking. Thus, in the surveys, some plants were identified as ***akau uru lanok*** 'burn medicine vine', ***kayuh penawar racun*** 'poison antidote wood', ***kayuh unun sigup*** 'tobacco cure wood', and ***akau unun sigup*** 'tobacco cure vine': descriptions rather than proper names (Berlin *et al.* 1974:49-51). In some cases synonyms exist. For example, the weed *Sciaphila* is commonly known as ***penawar racun*** 'poison cure', but the name ***piurag*** is also used by some informants. Similarly, ***akau unun sigup*** may refer to the plant known as ***akau kapal*** (*Luvunga* sp.).

A small fraction of plants were identified below the basic naming level. As can be seen in Table 3, 152-170 named folk categories were identified in each of the surveys, but 17-28 of these are classified below the basic level. For example, two kinds of ***jimpalang*** were identified in plot 2 by Umpoh: 'small-leafed' (*Vitex vestita* Wall., Verbenaceae) and 'large-leafed' (*Barringtonia lanceolata* [Ridley] Payens, Lecythidaceae). Umpoh also found three kinds of ***benawar*** in the same plot: 'red' ***benawar,*** 'white' ***benawar,*** and 'hill' ***benawar.*** Of the 158 categories he named in this plot, only 132 different basic categories are indicated. This corresponds well to the results of the inventory made by Gumpol of an adjacent quadrat of plot 2, in which 156 categories were identified, including 139 basic categories. In all cases, about 12% of all categories are below the basic naming level.

This figure is somewhat less than the 18-20% of polytypic generic taxa in folk biological classification estimated by Berlin (1992:123) for horticultural peoples. Our lower proportion of polytypic to monotypic taxa may be explained by the fact that the areas surveyed were all untreated, and thus were not subject to recent human interference. Although the surveyed grounds contained plants that may have been saved from previous destruction in shifting cultivation, they contained no deliberately planted species. According to Berlin, it is these managed species that are particularly prone to polytypy. Thus, our quadrat studies do not reflect the full compass of Dusun ethnobotanical classificatory knowledge.

The most differentiated basic category is that labelled ***ubor***, referring to a number of *Eugenia* and *Syzigium* species (Myrtaceae).[12] In all, 12 kinds of ***ubor*** were identified by the two informants in the surveys, the unmarked reference type ***(ubor)***, plus 11 contrasting marked subcategories.

The differences between the two informants are instructive. Umpoh, who was also the main informant used in the voucher collection phase of the study, was meticulously thorough in counting plants, which partly explains why he counted almost five times as many plants in plot 2, and 2.9 times as many plants in plot 1, as Gumpol, despite the fact that he surveyed areas only twice as large in both cases. Greater densities of plants classified as "large" are also found in Umpoh's surveys, particularly for plot 2. But a slightly higher fraction of plants are categorized as large in both of Gumpol's surveys than in Umpoh's.

Umpoh was unable to identify a large number of plants, particularly those he categorized as ***usak*** 'flower', suggesting that he was using this term in a residual sense (Hunn 1977:57-58; Hunn 1982:834-835; Taylor 1990:64-65; Ellen 1993:83). As can be seen from Table 4, he found 113 unknown ***usak*** in Plot 1 plus two for which he had forgotten the names, and 35 unknown ***usak*** in plot 2. Gumpol, on the other hand, identified no plants in either patch he surveyed as unknown or forgotten ***usak***. In the other plant categories, too, the greater breadth of Gumpol's knowledge compared with Umpoh's is evident, though, as noted, Umpoh appears to have been more thorough in counting plants, and this may account, in part, for the discrepancy. Moreover, very few Dusun individuals could recognize as many plants as Umpoh, and those who did lacked the stamina, patience, or eyesight needed to undertake the strenuous and tedious work of surveying the plots. Umpoh, who provided basic names for 86 to 88% of plants, can be said to be about 90% as competent in terms of supplying names as Gumpol.[13] His rate of failure to identify plants by basic names was three times as great as Gumpol's. However, it cannot be automatically concluded that these measures reflect their overall ethnobotanical knowledge.

PLACING VALUE ON FOREST

One of the factors which initially drew us towards the use of plot surveys was the debate on the valuation of tropical rainforest, and of attempts to place values on specific delineated patches (Peters, Gentry, and Mendelsohn 1989).

Let us turn now to the makeup of the areas surveyed in terms of the usefulness of plants identified.[14] We have already noted that the admittedly crude category of "large plants" (mainly mature trees) corresponds approximately to those regarded by our informants as useful in their observed state. In other words, immature plants are less useful than mature plants. By looking, therefore, at the figures for "large" plants compared to those for all plants assessed in the study, we can see what trees and other plants are of use at the present time or at some time in the future, and in what numbers. It was interesting to discover that the number of such plants in proportion to the total number of plants in the ***gapu'*** 'recent secondary growth' plots was about double that in the ***entalun*** 'old secondary growth' plots. The informants found 10.2% and 7.6% "large" plants in the ***entalun*** survey, but 17.7% and 16.3% in the ***gapu'*** survey. These findings are particularly striking, in the context of the debate on the valuation of tropical rainforests (Peters, Gentry, and Mendelsohn 1989), because they are the opposite of what we might have expected, namely that older forest contains a higher density of larger, and therefore more useful, trees.

Some variation between the plots can be seen in Table 5, in which the five most commonly named plants in one informant's surveys are ranked and keyed against the ranking (in parentheses) of that same plant in the other informant's survey for the same plot. While the rankings within plots 1 and 2 for the total number of plants are very similar for both informants, there is quite a divergence in the rankings for large plants. In part, this may be explained by Umpoh's inability to provide many basic names, especially for small plants.

TABLE 5.—Ranking and use of the five most common plants: Old forest and secondary forest compared.

Plot 1, ***Gapu'*** '20-year regrowth' survey, ranked according to Umpoh's survey, all plants.

Rank	Name	Identification	Frequency —Umpoh	Frequency —Gumpol	Uses
1	***tawir***	*Fordida splendidissima*	267	140(1)	firewood, medicinal, calendrical
2	***lamba***	*Curculigo villosa*	252	uncounted	vegetable
3	***julok***	*Lepisantes fruticosa*	195	77(3)	edible fruit and leaves
4	***leginit***	*Ficus uncinata*	114	52(4)	edible fruit
5	***lalet manuk***	*Leptonychia heteroclita*	89	79(2)	medicinal leaves

Plot 1, ***Gapu'*** '20-year regrowth' survey, ranked according to Umpoh's survey, large plants only.

Rank	Name	Identification	Frequency —Umpoh	Frequency —Gumpol	Uses
1	***uwai selika***	*Korthalsia jala*	35	1(31)	frame for carrying basket
2	***leginit***	*Ficus uncinata*	30	10(3)	edible fruit
3	***pawu***	*Euodia*	26	8(5)	none
4	***tembagan***	*Artocarpus elasticus*	22	2(19)	bark for straps
4	***benawar bukid***	*Pternandra*	22	10(3)	firewood

TABLE 5.—Continued.

Plot 2, ***Entalun*** 'old secondary growth' survey, ranked according to Gumpol's survey, all plants.

Rank	Name	Identification	Frequency —Umpoh	Frequency —Gumpol	Uses
1	***tawir***	*Fordida splendidissima*	241(3)	141	firewood, medicinal, calendrical
2	***julok***	*Lepisantes fruticosa*	396(2)	67	edible fruit and leaves
3	***ubor***	*Syzygium* or *Eugenia*	897(1)	66	dye for fish net
4	***uwai buluh giok***	*Calamus sarawakensis*	181(4)	49	tying
5	***tisil***	*Urophyllum*	90(11)	44	none except firewood

Plot 2, ***Entalun*** 'old secondary growth' survey, ranked according to Gumpol's survey, large plants only.

Rank	Name	Identification	Frequency —Umpoh	Frequency —Gumpol	Uses
1	***tawir***	*Fordida splendidissima*	27(2)	18	firewood, medicinal, calendrical
2	***royon***	(unidentified)	9(8)	12	house frames
3	***tisil***	*Urophyllum*	3(27)	11	none except firewood
4	***libas ropungur***	*Sauropus?*	29(1)	10	firewood, houseposts
4	***sarapa'***	(unidentified)	12(5)	10	eaten with Piper beetle

We will concentrate further on the five most common plants in Umpoh's Plot 2 surveys and Gumpol's Plot 1 survey, shown in Table 5. By considering only the five most common plants in each group it is possible to capture a surprisingly high percentage of plants in the plots as a whole. In both plots 1 and 2, the five most prevalent plant names account for slightly more than 30% of all plants. The frequencies for the 25 most commonly occurring plant categories in the two plots, illustrated in the histograms in Figures 4 and 5, show reverse J-curves representing the pronounced fall-off from initial high frequencies.

When we look at "large" plants there is more variation. In plot 1, the ***gapu'*** plot, 28.4% of large plants in the area surveyed (37.6% of those identified) by Umpoh were in the top five, compared to 36.0% in the area surveyed and identified by Gumpol. Turning to Gumpol's survey of plot 2, the five most common large plants totalled 61, accounting for over 53% of all large plants (56.5% of identified plants) counted in the survey. In Umpoh's plot 2 survey, by comparison, the first five named plants[15] totalled 117, and accounted for only 29.4% of large plants enumerated (33.8% of those identified) by Umpoh in that plot. It must be noted that "unknown ***kayuh***" and "unknown ***akau***" together account for 10.3% of large plants surveyed by Umpoh in plot 2, and ***kayuh*** and ***akau*** for which basic names have

FIGURE 4.—Frequency of the 25 most common identified plants in Umpoh's plot 1 *(Gapu')* survey

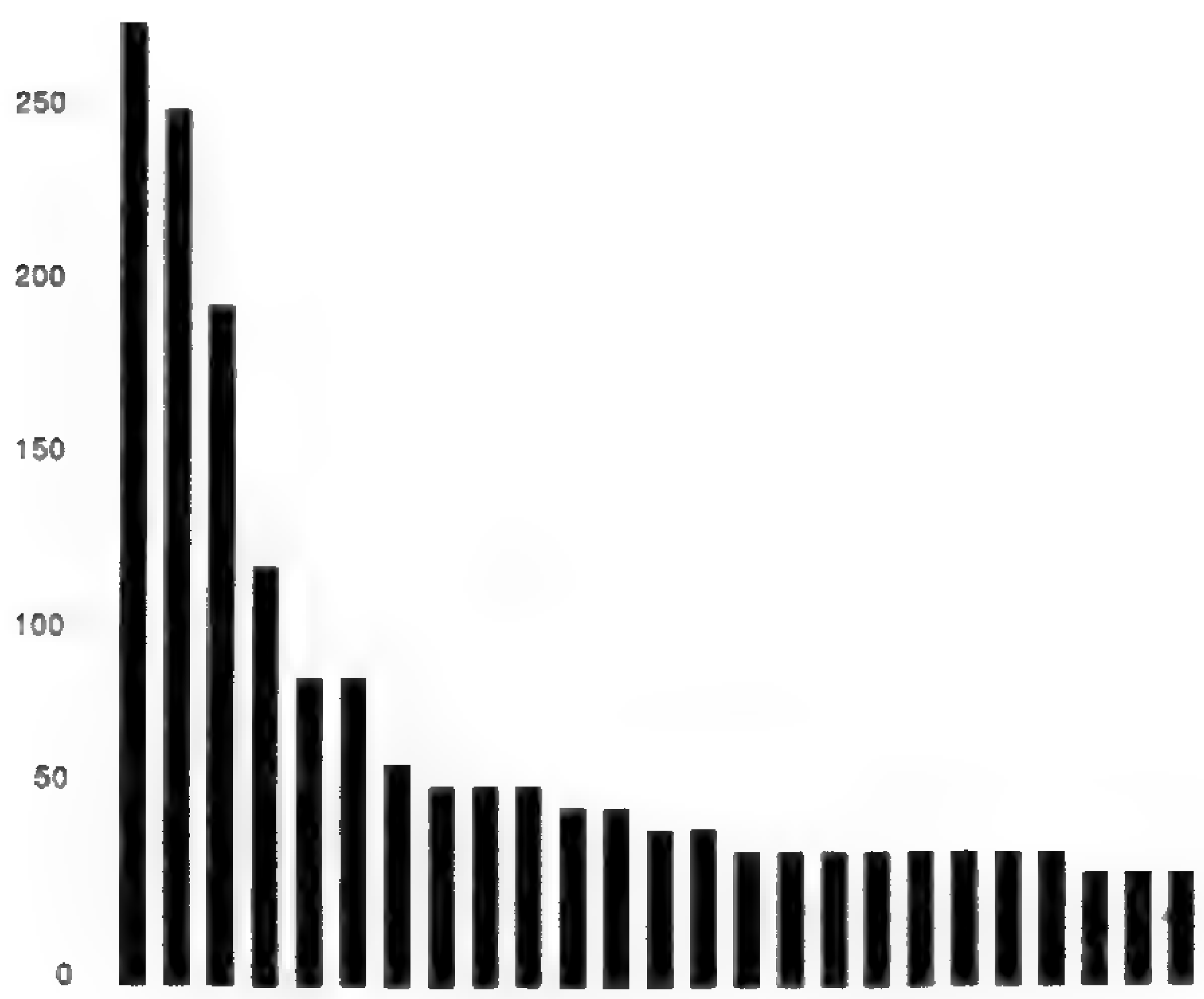
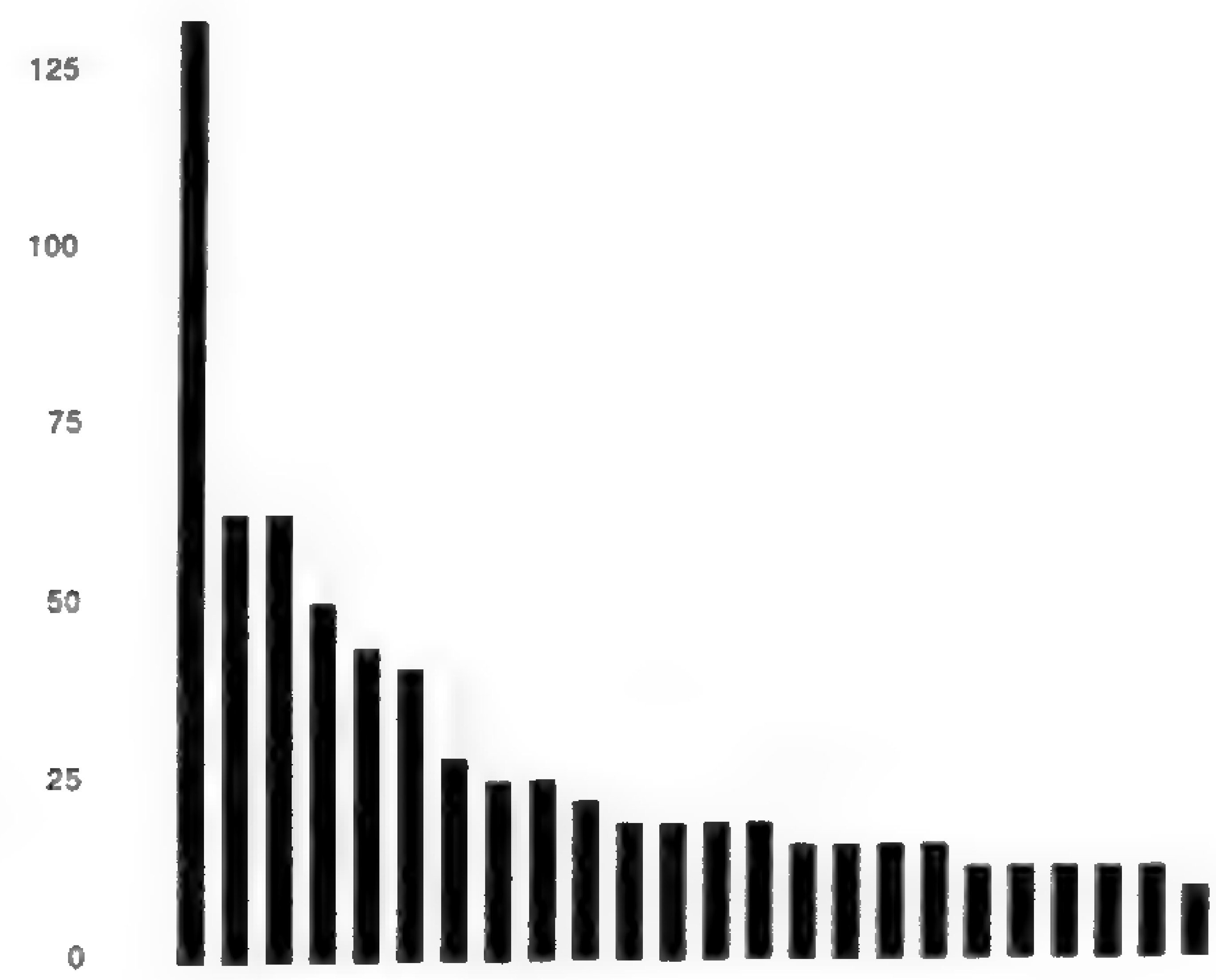


FIGURE 5.—Frequency of the 25 most common identified plants in Gumpol's plot 2 *(Entalun)* survey



been forgotten account for another 3.0%. Apart from the high proportion of large plants in Gumpol's plot 2 survey, the figures are quite consistent with the generalization that the five most common plant categories, regardless of size, account for about 30% or slightly more of the plants in a plot. This observation can be tested empirically through further use of the plot survey methods described here.

The inverse of this finding is that a large number of plant types are sparsely distributed, and have only a few representatives in a plot. In Gumpol's plot 2 survey, 56 named kinds of plants had only one representative, while another 27 had two. The total kinds of plants represented by only one or two individuals (83), is about half the number of named categories found in the survey (83/156 = 0.54). This relationship holds in Umpoh's survey of plot 1, in which 49 named categories were found only once, and another 21 were found twice, which together are nearly half (70/170 = 0.41) of the categories enumerated in the survey. The long tails of the frequency charts illustrated in Figures 4 and 5 can be seen in Figure 6, showing that, in both surveys under inspection, increasing numbers of taxa are represented by ever fewer individuals.

As far as the most inclusive categories are concerned, Table 5 shows that tree ***(kayuh)*** is the most common, as in the ethnobotanical voucher data. However, rattan ***(uwai)*** is the fourth most common plant in Gumpol's plot 2 survey and the most common large plant in Umpoh's plot 1 survey. ***Lamba,*** which is classified in the problematical categories ***sancam*** (vegetable) and ***raun*** (leaf), is the second most common plant in Umpoh's plot 1 survey. Also, among those plants not in the first five most common categories, many non-***kayuh*** plants feature. For example, in Gumpol's survey of plot 2, the top fifteen plants identified at the basic level include three ***akau*** and three ***uwai;*** Umpoh's survey of plot 1 includes in the top fifteen three ***akau*** and one ***uwai.***

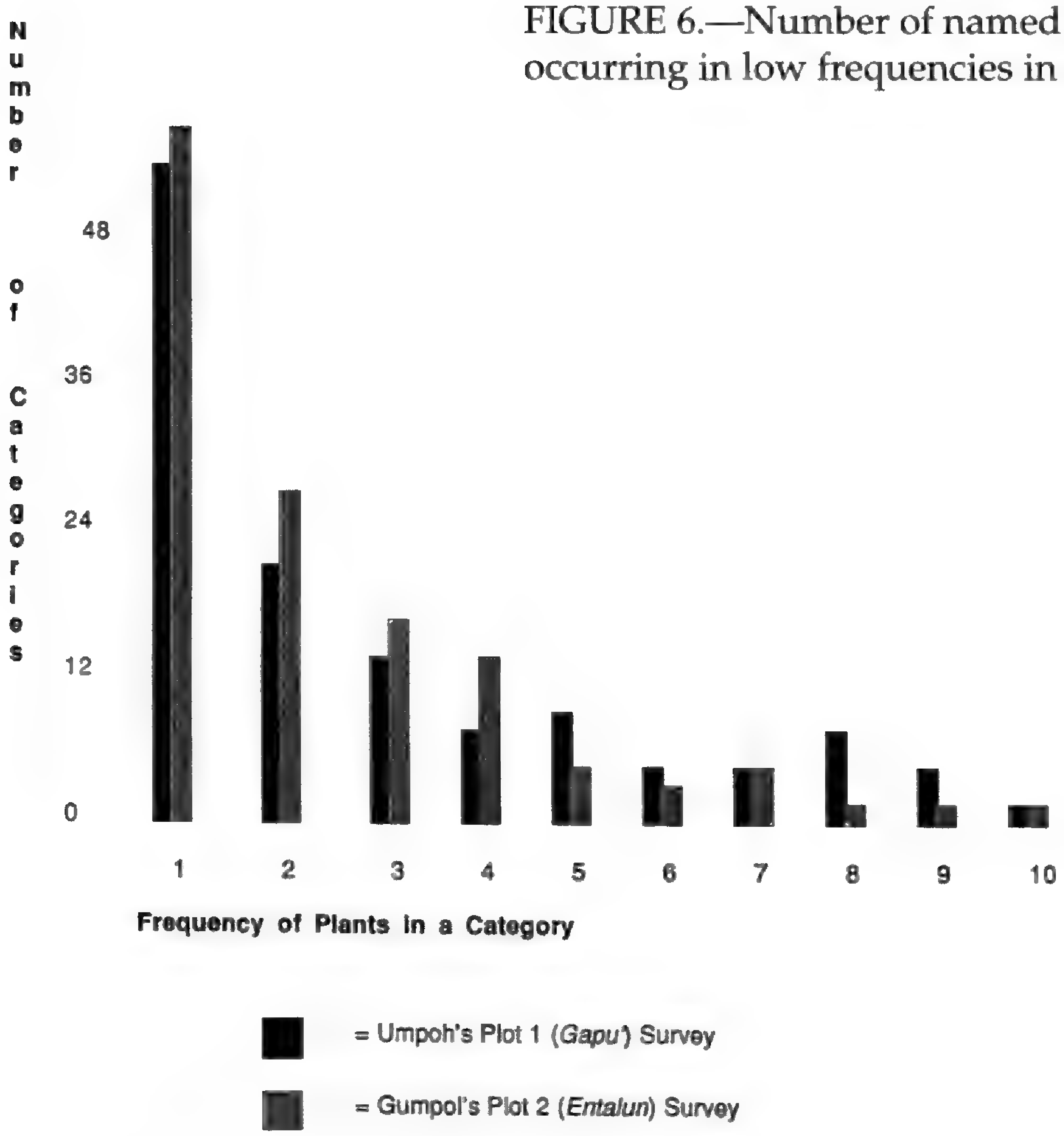


FIGURE 6.—Number of named plant categories occurring in low frequencies in two plots

Let us now consider the use-values of the five most common plants in all categories. Table 5 indicates a range of uses mentioned for each plant, but none of the first five most common plants are especially valued, using any measure. Two exceptions are ***uwai selika*** (*Korthalsia ferox* Becc.), a useful rattan cord, though not regarded as the best, and ***royon*** (unidentified), a preferred wood for house construction. The other plants are of less value, some much less. For example, while it is true that the fruit of the ***leginit*** (*Ficus uncinata* [King] Becc.) tree is edible, it is not especially collectable or marketable. Similarly, the root of the ***tawir*** tree (*Fordia splendidissima* [Miq.] Buijsen) is medicinal, but very few people know of this use or would make or use a medicine from it if they did. And while ***sarapa*** (unidentified) is an important ingredient in the ***betel*** quid and is thus useful for habitual ***betel*** chewers, the tree is common and not highly valued. Many valuable fruit trees, hardwoods, and other economic products are found in small numbers within the small patches we surveyed.

The clearest finding concerning the value of the ***entalun*** patch is the high number of economically useful ***royon*** trees in proportion to their total number in the patch (12 of 13), while the useful rattan ***uwai buluh giok*** (*Calamus sarawakensis* Becc.) is found in high absolute numbers (49), though only two, or four percent, were of sufficient maturity to be worth extracting. In the ***gapu'*** survey we find large numbers of the edible but not highly valued ***lamba*** (*Curculigio villosa* [Kurz] Merrill). Among the harvestable plants in this patch are 35 valued ***uwai selika*** rattans (*Korthalsia ferox* Becc.). Both plots are characterized by an abundance of ***tawir*** (*Fordia splendidissima* [Miq.] Buijsen) and ***julok*** (*Lepisantes fruticosa* [Roxb.] Leenh.) trees.

CONCLUSION

Plot surveys have a long history in quantitative ecology, and have been used in rainforest research for more than half a century. However, in ethnobotany they are relatively novel. In this paper we have described a technique using plot surveys to measure the ethnobotanical knowledge individual informants have of particular patches of forest.

By using the plot method Bernstein and Antaran were able to measure the completeness of their herbarium collection, and supplement the database with information on 132 kinds of plants that had not been otherwise collected, but which had been identified by informants in the surveys. In most cases the plants matched those found elsewhere for which voucher specimens were available. (As few species in the plots yielded fertile specimens, the collection of vouchers in any case would not anyway have provided firm determinations.) The same technique also provides a rapid means of assessing local ecological diversity using folk terms keyed to determinations obtained through the systematic collection of voucher specimens. Of course, folk-botanical nomenclature does not correspond perfectly with scientific determinations, and informants cannot always provide names and may be inconsistent or wrong in their judgment. Nevertheless, such a method is less time-consuming than the possible alternatives, and is sufficiently precise for many useful applications. It might well complement other participatory rural appraisal (PRA) and rapid rural appraisal (RRA) techniques.

Our principal discovery, however, has been the utility of plot surveys as an instrument for the study of ethnobotanical classification. Knowledgeable but non-literate Dusun informants provided names (other than life-forms or the most general basic and intermediate categories) for 85.6-96.4% of plants growing in marked plots. Of those plants named, the more expert of our two informants provided 158 names in two plots (each 24x24 m) of secondary dipterocarp forest totalling 1152 m^2, 88% of the names being at the basic naming level and 12% below. Furthermore, informants found little difficulty in allocating both named and un-named plants to more-inclusive, life-form-like and intermediate groupings. The rank order of numbers of identifiable plants per category varied depending on whether all plants, or only those of sufficient size to be useful, were counted. We have also found that in each of the plots examined the five most common folk categories of plants account for about a third of all enumerated plants. Plants occurring only once or twice in a plot account for about half of all named plants.

Although our survey dataset is small, we believe it indicates a new way of measuring the comprehensiveness of local knowledge of plants with reference to all types found within the boundaries of specified sample plots in locally recognized biotopes, and provides a useful angle on the question of the empirical "adequacy" of such knowledge when compared with existing measures, such as that based on the correspondence of folk categories to scientific species. The surveys also reveal the breadth of biodiversity knowledge of particular types of forest, highlight differences in the knowledge of individual informants, and the ways in which that knowledge is organized. In turn, this sheds light on the uneven character of indigenous knowledge distribution and how this relates to the intrinsic patchiness of species distribution.

NOTES

[1]For a classic statement on method see Berlin, Breedlove, and Raven 1974:46-61. For older accounts of conventional ethnobotanical collecting techniques, see e.g., Barrau n.d.; Parham 1955. Since this research was completed, information on the methodology of ethnobotanical studies has been synthesized and substantially updated by the publication of a methods manual by Martin (1995).

[2]See Peranio (1972, 1976, 1977). The Brunei Dusun are distinct from another ethnic grouping, indigenous to Sabah (another part of northern Borneo), also known as Dusun (see Appell 1978; Appell and Harrison 1968). The dialect spoken by the Dusun of Kuala Penyu in Sabah is very close to Bisaya (Roger Peranio, personal communication). While similarities in ritual and folklore suggests a relationship between the "Dusunic peoples" of Sabah and the Brunei Dusun, the exact nature of the connection between them has not been demonstrated.

[3]See Cranbrook and Edwards (1994) for a report on an interdisciplinary study of the rainforest in the Batu Apoi Forest Reserve at Kuala Belalong in Brunei.

[4]For an excellent summary of recent use of plot surveys in ethnobotany and for a discussion of field techniques published since we conducted our own study see Martin (1995:156-9).

[5]This part of the Middle Tutong Plain is characterized by Quarternary alluvium consisting of clays and loams, sand, and gravelstone sometimes overlain by swamps (Franz 1980:34-35; Wilford 1961).

[6]By comparison, Balick and Mendelsohn (1992) surveyed 2 plots, one 0.28 and one 0.25 ha; while Peters, Gentry, and Mendelsohn (1989) undertook a systematic botanical inventory of 1.0 ha of forest.

[7]Other miniscule plants occurring in large numbers in some surveys, and thus not counted, include ***natu gapu*** *(Araceae)* and ***akau genonop*** *(Jacquemontia tomentella).*

[8]Our two informants did not always agree on plant names. Disregarding synonyms which both informants recognized, we estimate that informants provided different basic names for approximately one-two percent of the plants identified. This estimate is based in part on discrepancies in the identification of plants collected as herbarium specimens.

[9]Ellen (1993:65) has distinguished identification from classification on the grounds that though both entail class inclusion, the distinction is one recognized in many languages and, pragmatically, by local experts. Thus, an informant may "know" that a certain plant is a distinctive "kind of" ***akau*** (classification) yet be unable to provide a label or relate it to something identical he or she has seen (identification).

[10]A possible explanation for this phenomenon is that ***tumid*** is a polysemous term referring to taxa at two levels of inclusiveness: ***tumid***$_1$ refers to the plant category including ***kunyit,***

sagang, and ***sumbang*** and ***tumid***$_2$ refers more specifically to plants contrasting with ***kunyit, sagang,*** and ***sumbang,*** within this category. The alternative explanation is that the term for one sub-category of ginger plants is used casually to label various other kinds of gingers in the absence of a fully acceptable overall cover term.

[11] Both Hunn (1982) and Turner (1974) have described similar instances of "empty" spaces within life-forms.

[12]*Syzigium* is often included within *Eugenia*, but this is a point on which taxonomists differ, and "the differences between *Syzigium* and *Eugenia* are obscure" (Forest Department 1978:174).

[13]In plot 1, Umpoh identified 85.6% as against Gumpol's 96.4%: 0.856 ÷ 0.964 = 0.888. For plot 2, Umpoh identified 86.9%, as against Gumpol's 95.4%: 0.869 ÷ 0.954 = 0.911.

[14]Voeks (1994) describes a use of the plot survey method to elicit information specifically about the utility of rainforest plants among settled Penan (former subsistence hunter gatherers) in Brunei. Voeks' 44 year-old Penan informant recognized a total of 53 useful species in a 0.96 ha mixed dipterocarp plot, out of about 300 species of trees over 5 cm dbh.

[15]***Libas gapunguh*** (29), ***tawir*** (27), ***ubor*** (25), ***semerutu*** (24), and ***teratus*** (12).

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IMPORTANCE OF PLANTS IN THE *CH'A CHAAK* MAYA RITUAL IN THE PENINSULA OF YUCATAN

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ABSTRACT.—This study was carried out in the Mayan farming area in the state of Yucatan, Mexico. Twelve Mayan rain rituals, ***ch'a chaak***, literally "rain calling," were attended. Thirty-eight plant species were used during these rituals, which lasted four to seven days each. A high percentage (63%) of these plants are symbolically related to rain. Many are succulents. Eleven of the twelve rituals that we attended were followed by rain. Of the 38 plants used in the ***ch'a chaak***, 33 are native, only five having been introduced since the arrival of the European conquerors. We calculated an elaborated index of cultural "purity" for these rituals of 87%. These rain rituals draw on the total cultural knowledge the Mayans have of their environment, thus preserving this valuable knowledge is important.

RESUMEN.—El estudio de la ceremonia maya del ***ch'a chaak*** (que significa el llamado de la lluvia) se realizó en el área maya milpera en el estado de Yucatán. Se asistió a doce rituales y se encontró que durante el proceso del rito, el cual dura cuatro días y a veces hasta una semana, se usan 38 especies vegetales en diversas formas. Un alto porcentaje (63%) de estas plantas están relacionadas con la lluvia, según la creencia de los milperos; algunas de ellas son suculentas indicadoras de humedad, lo cual le da efectividad a sus rezos. De las doce ocasiones que asistimos al rito de invocación a la lluvia, once de ellas fueron efectivas. El rito en sí conserva una gran pureza, ya que de las 38 plantas usadas, 33 son nativas del área milpera y sólo cinco han sido introducidas a partir de la llegada de los europeos. El porcentaje de pureza se calculó en base a un índice de relación; el resultado fue de 87% de pureza, lo cual refleja el hecho que casi todas las plantas empleadas en el ***ch'a chaak*** son nativas del área. El rito encierra el conocimiento total que la cultura maya tiene de su medio ambiente; conservarlo es importante, ya que es un conocimiento cultural valioso.

RÉSUMÉ.—Cette étude a été réalisée dans une région agricole maya de l'État de Yucatan au Mexique où nous avons assisté à douze rituels de pluie (***ch'a chaak***, littéralement « appel à la pluie »). Trente-huit espèces végétales ont été utilisées durant ces cérémonies qui duraient de quatre à sept jours chacune. Un pourcentage élevé (63%) de ces plantes est lié symboliquement à la pluie et plusieurs plantes ont, de façon caractéristique, des tissus gonflées de substances liquides. Onze des douze rituels auxquels nous avons participé ont été suivis de pluie. Trente-trois des trente-huit plantes utilisées sont indigènes et cinq seulement ont été introduites après l'arrivée des conquérants européens. Le degré de « pureté » culturelle de ce rituel a été évalué à 87 % selon une méthode de calcul élaborée. Ce rituel met à contribution la connaissance culturelle totale maya de l'environnement et la sauvegarde de ce savoir de grande valeur en est d'autant plus importante.

INTRODUCTION

The current research was carried out between 1992 and 1993 in the maize region of Yucatán state, México, situated in the traditional Yucatec Maya area (Figure 1). Maya maize farmers call the season of the year in which rain is scarce the *canícula*. The Maya still practice the ***ch'a chaak*** ceremony, an ancient ritual in which they invoke the rain god ***chaak*** for rain so that they do not lose the current crops in their *milpas* (maize fields) (Flores and Ucan Ek 1983; Flores 1987). Prior to this study, permission was given by 12 Maya priests who perform this ritual (***h'men***) to observe their activities as part of the Yucatan Ethnoflora Program of the Universidad Autónoma de Yucatán (UADY).

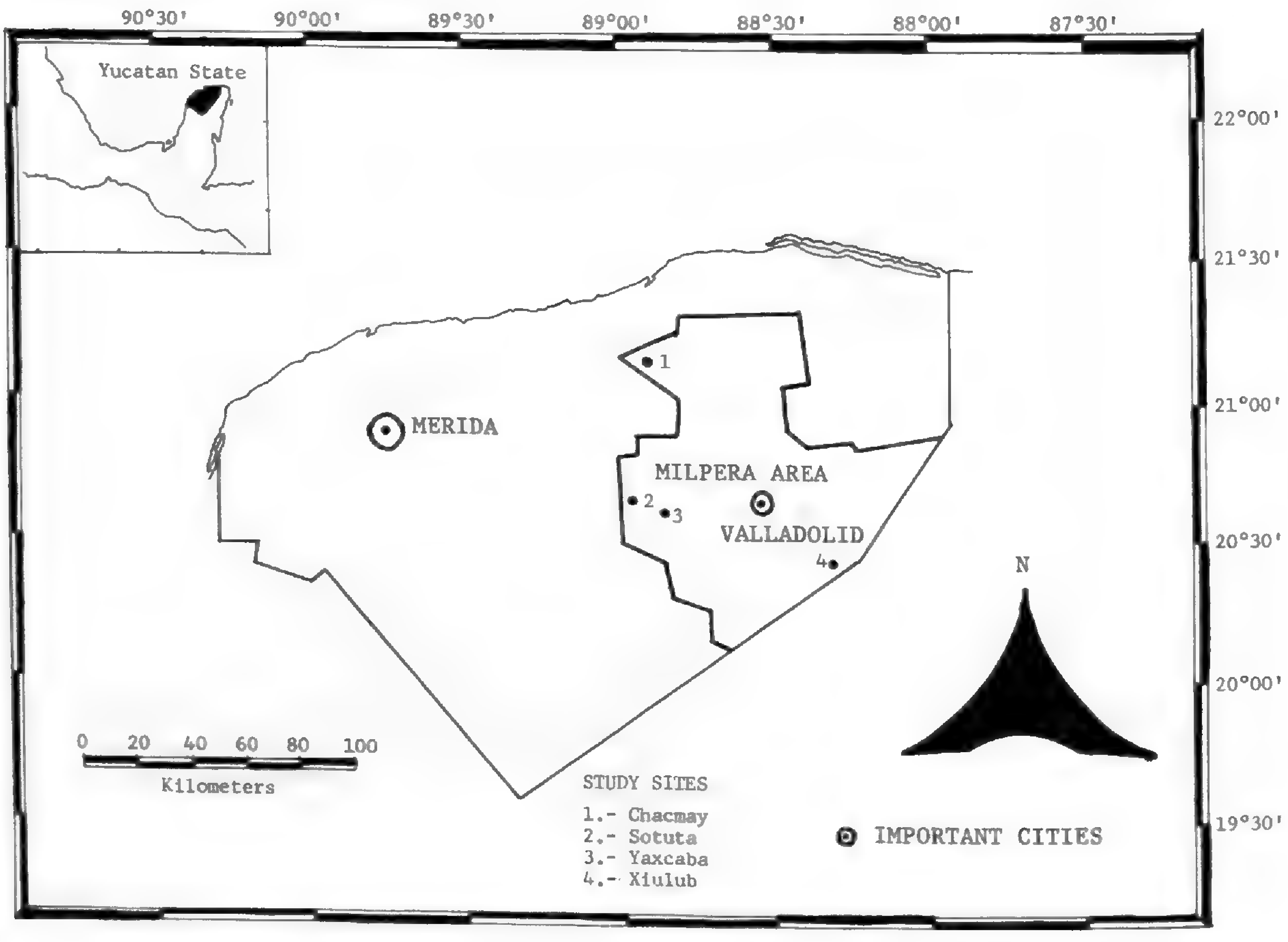
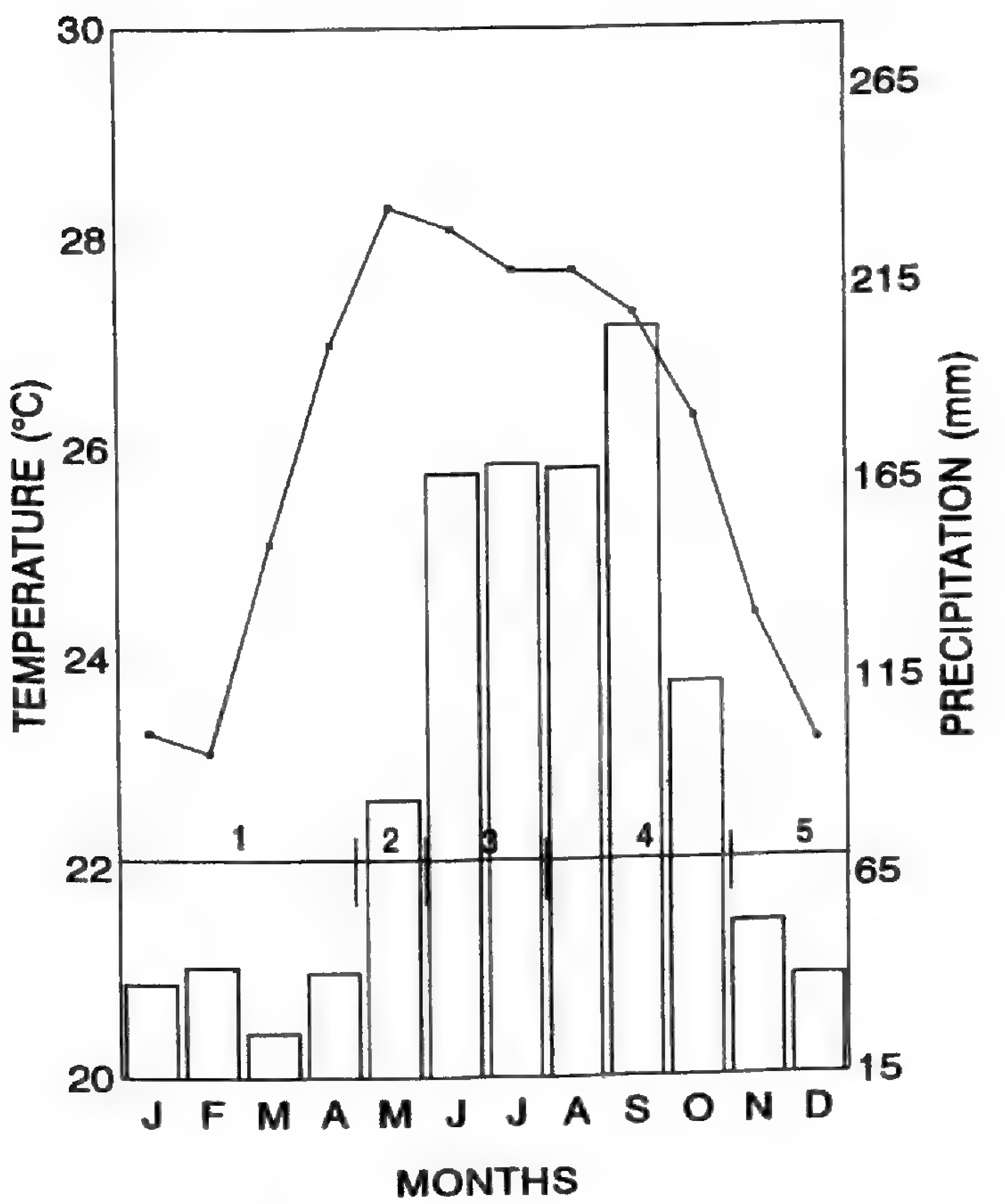


FIGURE 1.—Milpera area in Yucatan state where this study was carried out.

Mesoamerica people, including the Maya, cultivate more than corn. True *milpa* cultivation, as practiced by the Maya, involves mixed cropping of many types of squashes, watermelon and other types of melons, chilis, tomatoes, tubers such as sweet potatoes and other starchy roots (*macales*), jícamas, sugar cane, onions, and beans (De Landa 1978; Harrison and Turner 1978; Hernández X. 1981; Adams 1982; Coe 1986; Flannery 1982; Sanabria 1986; Gómez-Pompa, Grey, and Chan 1986; Pérez Toro 1981; Teran and Rasmussen 1994). The *milpa* has conserved germplasm while providing subsistence to the people of the Americas through time (Steggerda 1941; Vavilov 1951; Várguez 1981; Wolf 1983; Sosa, Flores, Gray, Lira, and Ortiz 1985).

The Yucatec Mayan maize area is located in the east-central region of the Yucatan Peninsula. It has a sub-humid tropical climate, with summer rains and an average annual precipitation of between 800 and 1200 mm (García 1973). The dry season lasts from January to April and the wet season from May to December (Figure 2). This yearly cycle of drought and rain characterizes the *milpero* cycle in the major part of Mesoamerica (Wolf 1983). The dominant vegetation type is medium-height subdeciduous forest. This type covers a large area of the state of Yucatan (Flores and Espejel 1992); it is where traditional agriculture is generally practiced.



1. Dry period (corn harvest) and preparation of the soil (slash and burn).
2. Period of planting the corn with the first rain.
3. Canícula period (during the absence of the rain 15 to 30 days) time in which the ***ch'a chaak*** is performed.
4. Rainy period.
5. End of rainy season.

FIGURE 2.—Climate graph of the milpera zone of Yaxcaba, Yucatan, Mexico.

Frequently, in June and July there is a dry period, called the *canícula* by local farmers, in which the maize seeds planted at the onset of the rains need additional water for their development. The duration of this period is a constant concern of the *milperos*, since it may cause the loss of the crops essential to their survival.

It is possible that this situation motivated the Maya to give the elements of nature a high status in their religion and a role as gods in their pantheon. They worship the sun, wind, rain, plants, and animals. Images of these natural elements are prominent in ancient Mayan sculptures, pyramids, and the temples in which they offered products of their daily activities, especially agricultural products, to their gods (Morley 1983; Thompson 1984; Sodi 1991; Coe 1986).

OBJECTIVES AND METHODS

The objectives of the current research were: 1) To list plants used in the ***ch'a chaak*** ritual practice, 2) to understand the reasons for the use of diverse plants in this ritual, and 3) to quantify the native plants used in this ritual and their purity of use through time.

To accomplish these objectives we obtained prior authorization from the ***h'men*** and the *milperos* holding ***ch'a chaak*** ceremonies in various parts of the maize zone of the state of Yucatan. This study was accomplished between May and July in the period of the *canícula*. Plants observed and collected for the diverse activities of this ritual were identified using Latin names, and were prepared for, and deposited in, the Herbarium of the Universidad Autónoma de Yucatán and in the Xal Herbarium in Xalapa, Veracruz. Interviews focused especially on the ***h'menob*** (plural of ***h'men***), their helpers, the ***itzaeob*** and the ***chaaqueob***, "men who call the rain." These are usually the youngest participants and they produce sounds like toads during the ritual. We also interviewed the *milperos* and elderly people of the region (Figure 3). Research results are incorporated in the Floral and Ethnobotanical Information Bank at the Universidad Autónoma de Yucatán (BADEPY and BAFLOPY). Maya names of plants are interpreted according to Sosa *et al.* (1985) and Barrera-Marín, Barrera-Vázquez, and Franco (1976).

The calculation of cultural purity is a simple relationship we call the Index of Purity, which is the percent of native plants to all plants used in the ritual. This index is expressed by the following formula:

I.P.R. = 100(TPU - TPI)/TPU,

in which: IPR = Index of Ritual Penetration, TPU = Total number of plants used in the ritual, and TPI = Total number of introduced plants used (i.e., those not native to the Americas).

TABLE 1.—Plant species used in the ***ch'a chaak*** ritual in the milpera zone in the state of Yucatan.

Plant Family[1]	Species	Maya Name	LF[2]	Part Used	Notes
AGAV	*Agave angustifolia* Haw.	***xix ij***	H	green leaves	To cover tamales in the ***pib***
ASTER	*Viguiera dentata* (Cav.) Sprengel	***taj***	H	leaves	To cover tamales in the ***pib***
BIGNONI	*Crescentia cujete*	***joma'luuch***	T	fruits (*jícaras*)	Sacred drink for recipients
BIX	*Bixa orellana* (L.)	***kiwi***	T		Tamale condiment
BORAGIN	*Cordia gerascanthus* (L.)	***bacalche'***	Sh	leaves	To cover tamales before burial and cooking
BORAGIN	*Ehretia tinifolia* A.DC.	***beek***	T	leaves	To cover tamales in the ***pib***

TABLE 1.—Continued.

Plant Family[1]	Species	Maya Name	LF[2]	Part Used	Notes
BURSER	*Bursera simaruba* (L.) Sarg	***chakaj***	T	stems	1) To construct altar cross, whips, and machetes 2) To call the rain and scare away "bad winds"
BURSER	*Protium copal* (Schlecht. & Cham.) Engl.	***poom te***	T	resin	1) Burned to purify environment and assistants 2) Resemble rain drops; serve as offering for good ***chaak***
FAB	*Acacia gaumeri* Blake	***box kaatsim***	T	wood	Most important wood for cooking tamales in the ***pib***
FAB	*Caesalpinia yucatanensis*	***taak'in che'***	T	wood	Used in cooking
FAB	*Lonchocarpus longistylus* Pittier	***ba'al che'***	T	bark	Fermented in water and honey of European bees for ritual drink ***balche'***
FAB	*Lysiloma latisiliquum* (L.) Benth.	***tsalam***	T	wood	To construct the altar and stir the branches in the fire
FAB	*Mimosa bahamensis* Benth.	***sak kaatsim***	T	wood	Heats ***pib*** tamales without smoke/steam
FAB	*Phaseolus lunatus* (L.)	***iib***	H		Ritual food of ***ch'a chaak***
FAB	*Phaseolus vulgaris* (L.)	***bu'ul***	H		Ritual food of ***ch'a chaak***
FAB	*Piscidia piscipula* (L.) Sarg.	***ja'abin***	T	branches	To adorn arches and regulate the rain
FAB	*Pithecellobium albicans* (Kunth) Benth.	***chimay***	T	wood	To cook tamales
LILI	*Allium cepa* (L.)	***xku***	H		To flavor food
LILI	*Allium sativum* (L.)	***kukut***	Sh		To flavor food
MALPIGH	*Bunchosia glandulosa* (Cav.) DC.	***siip che'***	Sh	branches	To make a cluster used by ***h'men*** and by ***itza*** to purify assistants
MALV	*Abutilon umbellatum* (L.) Sweet	***sak le'***	Sh	leaves	To cover tamales in the ***pib***

TABLE 1.—Continued.

Plant Family[1]	Species	Maya Name	LF[2]	Part Used	Notes
MALV	*Hampea trilobata* Standley	***jool***	T	shoots	1) To construct the altar and to stir broth
				branches	2) To cover tamales in the ***pib***
MUS	*Musa paradisiaca*	***platano***	H	leaves	To envelop corn tamales
PIPER	*Piper auritum* H.B.K.	***xmakulan***	Sh		To give fragrance to tamales and cover them for cooking
PO	*Zea mays* (L.)	***nal***	H	fruits	1) To make the tamale masa and ***sak k'ool***, or soup
				seedlings	2) Placed at the four corners of the altar
POLYGON	*Coccoloba cozumelensis* Hemsley	***boob***	T	leaves	To cover soil of ***pib*** hole and to cover and carry tamales to the altar
POLYGON	*Gymnopodium floribundum* Rolfe	***dzidzilche'***	T	wood	Important for cooking tamales
POLYGON	*Neomillspaughia emarginata* (Gros.) Blak.	***saj iitsa'***	Sh	leaves	To cover the biggest part of the ***pib***
RUBI	*Randia longiloba* Hemsley	***k'ax***	T	fruits	To make whistles with which the priests call the winds to bring rain
RUT	*Citrus aurantifolia* (Christh.) Swingle	***limón***	T	juice	Important accompaniment to the meal
RUT	*Citrus aurantium* (L.)	***pak'aal*** *(naranja agria)*	T	juice	Important accompaniment to the meal
SOLAN	*Capsicum annum* (L.)	***xmaax iik chile maax***	H		Condiment important to the dishes
SOLAN	*Capsicum frutescens* (L.)	***iik*** *(habanero)*	H		Condiment for ***atole***
SOLAN	*Lycopersicon esculentun* Miller	***p'ak***	H	fruits	To prepare tamales and sacred food and, because they contain much water, to call rain

TABLE 1.—Continued.

Plant Family[1]	Species	Maya Name	LF[2]	Part Used	Notes
SOLAN	*Nicotiana tabacum* (L.)	***k'uts***	Sh	leaves	Cigarettes which assistants smoke to scare away bad winds which divert the rain
STERCUL	*Guazuma ulmifolia* Lam.	***piixoy***	T	shoots	1) To construct the altar
				bark	2) To make lashings
VIT	*Cissus rhombifolia* Vahl	***xtakan xtaab ka'an***	V	vine	Holds up the corners of the altar; oriented toward the four cardinal points
VIT	*Vitis tiliifolia* Humb. & Bonpl.	***xta'ka'anil***	V	vine	Fastens trees to corners of the altar and used to call the rain-filled winds

[1] Botanical family names have been abbreviated by eliminating the invariant suffix -ACEAE.
[2] LF = Life form: H = herb, Sh = shrub, T = tree, V = vine.

TABLE 2.—Number of species and percentages by family of all plants used in the ***ch'a chaak*** ritual.

Plant Family	Number of Species	Percent of Total Species
AGAVACEAE	1	2.6%
ASTERACEAE	1	2.6%
BIGNONIACEAE	1	2.6%
BIXACEAE	1	2.6%
BORAGINACEAE	2	5.3%
BUSERACEAE	2	5.3%
FABACEAE	9	23.7%
LILIACEAE	2	5.3%
MALPIGHIACEAE	1	2.6%
MALVACEAE	2	5.3%
MUSACEAE	1	2.6%
PIPERACEAE	1	2.6%
POACEAE	1	2.6%
POLYGONACEAE	3	7.9%
RUBIACEAE	1	2.6%
RUTACEAE	2	5.3%
SOLANACEAE	4	10.5%
STERCULIACEAE	1	2.6%
VITACEAE	2	5.3%
TOTAL	38	100.0%

RESULTS

A great diversity of plants are used in the ***ch'a chaak*** ritual (see Tables 1-4). First, we determined the scientific names (family, genus, and species) of the plants used in the ritual; we also noted the Maya names of the plants, their life forms, and their use in the ritual. Table 2 shows the percentages of plants used by family; in Table 3 we classify the plants according to their primary use in the rite; and in Table 4 we list the plants by life form.

TABLE 3.—Primary uses of plants associated with the ***ch'a chaak*** ritual.

Life Form	Number of Species	Percent of Total Species
Species related to the wind	2	5.3%
Divert the dry winds	3	7.9%
Ritual essentials	4	10.5%
Protectors of water	5	13.2%
Associated with water	24	63.2%
Total	38	100.1%

TABLE 4.—Life forms of plants used in the ***ch'a chaak*** ritual.

Life Form	Number of Species	Percent of Total Species
Trees	19	50.0%
Shrubs	7	18.4%
Herbs	10	26.3%
Vines	2	5.3%
Total	38	100.0%

Morley (1983) and Thompson (1984) considered the ***ch'a chaak*** to be one of the most elaborate Maya rituals, attaining its greatest complexity in the Classic period of the Maya civilization. During the Classic period the Maya knew their environment well and had developed extraordinary levels of culture and social organization (Redfield 1968).

The present study permits us to understand how this ritual develops over a four to seven day period, as it is currently practiced in the forest near the *milpa*. The ***h'men*** (Maya priest), his helpers, and the *milpero*s of the area jointly organize the ritual.

No women or children are present. Sometimes women collaborate by preparing meals, but they stay away from the place where the ceremony is taking place. This was what we observed in Yaxcabá. In two other places, children were admitted to imitate frogs while the ***chaaque*** were calling the rain.

Ceremonial activities involve knowledge of plants, animals, climate, astronomy, chemistry (fermentation), soils, medicine, and combustion (firewood). These activities also require knowledge of prehispanic and posthispanic religion and culinary arts. In sum, the ***ch'a chaak*** is a practice that integrates much of the philosophy and religion of the Maya. It has been described previously in great detail by authors cited in the bibliography. It is closely tied to the most important agroecosystem of the region, the *milpa* (cf. Alcorn 1984).

Plant species are used in the ritual for the preparation of the altar, of the sacred drink (***balche'***), and of ritual foods and condiments. In all activities directly related to the ritual they use a total of 38 plant species of 19 botanical families. In this list we exclude plants that only indirectly relate to the rite; for example, plants eaten by the animals they hunt in the forest as part of the ritual.

Of the 19 families utilized, the legume family (Fabaceae) is the most prominent (Table 2), contributing nine species (23.7 %), including those used to prepare the sacred ritual drink ***balche'***. Of the 38 species used, 33 are native while five were introduced by the Spanish. Our index of ritual putity (IPR) shows that the Maya ***ch'a chaak*** ritual, as currently practiced, is strongly conservative of local traditions, since 87% of the plants used are native. In this rite they use all of the primary life forms: trees, shrubs, herbs, and vines (see Table 4), with trees most prominent among the ritual plants.

Trees are used for the altar where they put the cross and lay down the other implements (Figure 3). Among these trees are *Bursera simaruba* (***Chakaj*** "water stick"), *Piscida piscipula* (***ja'abin*** "the one which brings the water"), a tree that by its blooming announces the coming of the rains. It is also an indicator of the dry season, when its leaves fall. The bark of the ***balche'*** tree (*Lonchocarpus longistylus*) is used to prepare the sacred drink for the rite. Other trees have some specific use, such as good firewood, e.g., ***box catzin*** (*Acacia gaumeri*). Such wood burns fast and produces little smoke, important conditions for the preparation of the ***pib*** (food cooked in an underground oven made with stones). The earth oven must receive just the right amount of heat so that the ***pib*** neither tastes smoky nor is blackened.

FIGURE 3.—Gratitude offering to god ***chaak***. Note the plants used to construct the altar for the ***ch'a chaak*** ritual.

In total, trees constitute 50% of the plant species used in the rite, followed by herbs, 26.3%, especially corn, the plant central to the rite. Ears of corn pointing to the four cardinal directions, are aligned precisely in each of the four corners of the altar, where the ***chaaqueob*** "men who call the rain" sit. Other herbs used produce odors on being heated, such as ***taj*** (*Viguiera dentata*), onion (*Allium cepa*), and garlic (*Allium sativum*). Others are seasonings that flavor the food, e.g., tomato (*Lycopersicon esculentum*). The vines used have succulent stems, a property that the Mayas say attracts rain (see Tables 1, 4).

The Mayas have selected ritual plants by criteria they relate to water. For example, tubers which store water are said to attract water. The same association exists for plants with thick fleshy stems and stalks or with juicy fruits and seeds. Everything is valued in relation to water, which is the precious liquid of life to the Maya.

Some trees indicate the presence of moist soils and are also ritually important. Among these are bananas (*Musa* spp.) which, though introduced, have great ritual value as indicators of humidity. This principle may also explain the ritual value of plants used to cover ritual foods, such as ***beeb*** or "roble" (*Ehretia tinifolia*), ***boob*** (*Coccoloba cozumelensis*), and ***saj iitsa*** (*Neomillspaugia emarginata*). As mentioned previously, ***ja'abin*** (*Piscidia piscipula*) is an indicator of wet or dry conditions according to the falling of its leaves. If the tree loses its leaves at the beginning of the dry season during the months of November and December, the forthcoming season will be dry, but if the leaves stay on the tree until the beginning of the rainy season, it indicates a very wet season.

The vines which support the altar are oriented to the cardinal points (see Figure 3). These vines should have fleshy shoots to attract the rain. This is especially true for those oriented to the east and west, directions of the rain-bringing winds. By contrast, those parts of the altar oriented to the north or south may include non-fleshy plants, such as the bark of *Piscidia piscipula, Hampea trilobata,* and *Abutilon umbellatum*, since these directions have no winds which bring rain.

CONCLUSION

The ***ch'a chaak*** ritual demonstrates the great knowledge the Maya people have of the elements of nature. It evolved in conjunction with the *milpa* system of agriculture and is clearly bound to the cultivation of the *milpa*. The ***ch'a chaak*** is one of the most purely traditional of Maya rituals. It is practiced today essentially as it has been since prehispanic times. We estimate that the ritual invocations and prayers to the deities are 80% Maya and only 20% Catholic. Almost all of the ritual is performed in the Maya language. Virtually all of the plants used in the ritual have Maya names and traditional uses. In the case of the ritual plants used, there is a Purity Index of 87%, with only five introduced species: banana, lemon, sour orange, onion, and garlic. These introduced plants are used for the preparation of the meals offered to the Rain God (***chaak***) and are eaten at the end of the ritual by the attendants. (Maya people believe that garlic keeps away the bad winds that take the rain away.) The sacred drinks, incense and honey, are common to all these rituals. Though today honey from the introduced European honey bee (*Apis mellifera*) is used; honey from native stingless bees (*Melipona* spp.) was used prior to the arrival of the Spanish.

ACKNOWLEDGEMENTS

The authors thank the ***h'menob*** and the *milperos* of the towns of Tixcacaltuyub, Yaxcabá, Sotuta, Cantamayek, Chacmay, Xocen, and Xuilub (Mayan communities of Yucatan). Special thanks goes to H'men Jacinto Tzab and to Rodolfo Díaz for obtaining permission for us to observe the rites, as well as to Professor Eleazar Méndez, Vicente Simá Moo, and Nidelvia Méndez, who helped us obtain permission to attend the ***ch'a chaak*** ceremonies in the communities of Sotuta and Yaxcabá. We also thank Dawn Hammond for the English translation of this paper.

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RECENT DOCTORAL DISSERTATIONS OF INTEREST TO ETHNOBIOLOGISTS XIV

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ABSTRACT.—This bibliography includes recent dissertations of interest to ethnobiologists. For each is given the page number where it may be found in *Dissertation Abstracts* (D.A.) and the order number for dissertation copies from University Microfilm International, P.O. Box 1764, Ann Arbor, Michigan 48106-1346 U.S.A. (Telephone: 313-761-4700 or 800-521-3042; 800-343-5299 from Canada).

RESUMEN.—En este bibliografía se incluyen disertaciones recientes de interés a los etnobiólogos. Por cada uno se da el número de la página donde se halla el resumen en *Dissertation Abstracts* (D.A.), y el número de encargar un ejemplar de la disertación de University Microfilm International, P.O. Box 1764, Ann Arbor, MI 48106-1346 USA (telefono: 313-761-4700 o 800-521-3042; desde Canada 800-343-5299).

RÉSUMÉ.—Cette bibliographie comprend quelques dissertationes recentes d'interet aux ethnobiologistes. Chez chaqu-une on donne le numéro de la page où se trouve le résumé dans Dissertation Abstracts (D.A.), et le numéro de commander un exemplaire de la dissertations de University Microfilm International, P.O. Box 1764, Ann Arbor, MI 48106-1346 USA (telephone: 313-761-4700 ou 800-521-3042; de Canada 800-343-5299).

INTRODUCTION

This is the fourteenth in an annual series of bibliographies listing selected dissertations drawn from the pages of *Dissertation Abstracts* (D.A.). All listings were made by scanning the titles and abstracts published in D.A. and making subjective decisions as to which ones might be relevant to work in ethnobiology or related disciplines such as ecological anthropology and economic botany.

Dissertations categorized in D.A. under Agricultural Economics, Agriculture, American Studies, Anthropology, Botany, Ecology, Environmental Studies, Folklore, Geography, Health Science, Home Economics, Language, Linguistics, Paleobotany, Paleoecology, Palynology, Sociology, and Zoology were considered for inclusion in the list. An attempt was made to be as inclusive as possible, but some dissertations may have been overlooked. Comments and suggestions would be welcome for items to include in next year's edition.

Dates covered by the present paper include: Volume A (Humanities and Social Sciences): September 1995- August 1996 and Volume B (Sciences and Engineering): September 1995-August 1996. Note that these are the dates for the issues of D.A. in which the abstracts appear, rather than the dates of acceptance of the dissertations themselves.

The dissertations are listed below alphabetically by author, along with the year of acceptance, title, institution, length, adviser or major professor, number(s) of the page(s) in D.A. on which the abstract may be found, University Microfilms order number, and the ISBN number when this information was included.

Most of the dissertations accepted at institutions in the United States, and some of those from Australia, Canada, South Africa, and the United Kingdom may be obtained from University Microfilms International, P.O. Box 1764, Ann Arbor, MI 48106-1346, either on microfilm or published by microfilm xerography. Quality of printed matter is generally excellent, but that of figures and photographs varies with the quality of the original. Current prices may be obtained by calling 800-521-3042; 313-761-4700 from Alaska, Hawaii, or Michigan; or 800-343-5299 from Canada. Further information and current prices, as well as information regarding how to order dissertations listed above with no UMI order number, may be obtained from UMI Dissertations Information Service, 300 North Zeeb Road, Ann Arbor, MI 48106-1346, USA.

DISSERTATIONS

AMICK, DANIEL SCOT. 1994. Folsom diet breadth and land use in the American Southwest. University of New Mexico, 485 pp. Adviser: Lewis R. Binford. Order no. DA9522270. D.A. 56(3):990-991-A.

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ABSTRACTS OF PRESENTATIONS

at the 20th Annual Conference of the Society of Ethnobiology
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26-29 March 1997

Fun with colonial Maya dictionaries, or how I enjoyed my Christmas vacation. *E. N. ANDERSON, University of California, Riverside.*

The *Bocabulario Maya Than,* the earliest Spanish-Yucatec Maya dictionary (ca. A.D. 1600), contains a large number of animal and plant terms, carefully spelled and often well defined. This permits historical research on the development of Yucatec; Yucatec terms for introduced animals and plants are especially interesting. Much cultural information is included, especially medical indications for the plants. Some important notes on food can also be extracted.

The biogeography of Mesoamerican art. *Alejandro de AVILA, SERBO, A.C. and University of California, Berkeley.*

Scores of plant and animal species have been employed in Mesoamerica since antiquity as colorants, adhesives, fibers for paper and textiles, and resins for lacquer. In this paper I review historical and contemporary sources to compile a list of species used in traditional arts in Mexico, Guatemala, and El Salvador. A majority of these taxa are of neotropical or pantropical affinity, with surprisingly few representatives of Nearctic and temperate groups. I discuss some implications of this observation with reference to Mesoamerican cultural history.

Secwepemc medicinal plants of British Columbia: Cultural to chemical perspectives. *Kelly BANNISTER, University of British Columbia.*

Ethnobotanical studies of traditional medicines can reveal much about the phytochemical-mediated interactions which exist between plants and humans. In this respect, it is important that the biological context of assessing the plants be determined by the cultural context of plant usage. This paper will combine cultural beliefs and practices as the basis for how plants are perceived and used as medicine in the Secwepemc culture with a biochemical approach in examining the biological and chemical properties of plant medicines used to treat infections caused by microorganisms.

Local perceptions of the landscape around the Catacachi-Cayapas Ecological Reserve, Ecuador. *Ilyssa BERG, University of Georgia.*

Local perceptions of the landscape around the Catacachi-Cayapas Ecological Reserve, Ecuador are discussed. As part of a larger study on the comparative ethnoecology around the Reserve, research was conducted in the Mestizo mountain community, La Loma. The study attempts to reconstruct the La Loma landscape through local histories of community settlement, social demography, participatory maps of the area, and resource use.

Biodiversity of highland Maya diet. *Elois Ann BERLIN and Brent BERLIN, University of Georgia and ECOSUR.*

Maya subsistence has long been associated with the maize-beans-squash complex. Little attention has been devoted to the use of wild food resources. Preliminary data collection sheds light on the complexity of Maya diet. This paper represents a preliminary exploration of the non-domesticated species harvested and consumed by the Maya. Our data demonstrate that, even in the context of rapid population growth, uncontrolled economic development, out-migration, and cultural transformation due to evangelization and other forces of acculturation, Maya dietary knowledge and practice continue to reflect and contribute to the biodiversity of the central highlands of Chiapas, Mexico.

Tapir and squirrel: Further nomenclature meanderings toward a universal sound-symbolic bestiary. *Brent BERLIN, University of Georgia.*

In *Ethnobiological Classification* (1992) I proposed that the names applied to living things, especially the names for animals, often reflect some aspect of the inherent qualities (essence) of the organisms being named. Particularly relevant for animal names is the productive use of sound symbolism, either in the form of simple onomatopoeia, or for the more complex associations of certain sounds with sensations of size, movement, and texture. This paper presents tentative findings from an examination of the words for 'tapir' (*Tapirus terrestris*) and 'squirrel' (*Sciurus* spp.) in South American Indian languages and claims that the names for these species are strongly influenced by the processes of size-sound symbolism.

Ethnobiological nomenclature as a source of personal names. *Ben G. BLOUNT, University of Georgia.*

The nomenclatural system that human societies apply to local flora and fauna are relatively well documented and understood. A much less explored topic is the use of ethnobiological nomenclature as personal names for individuals in society. This paper is a report on preliminary research on the extent and nature of the use of ethnobiological terms as ethnonyms in Native North American societies and among English-speakers in the U.S. Comparisons show that societies differ in their use of the name sources and in the types of ethnobiological names used. The results suggest differential cultural attitudes toward local flora and fauna.

Introduced living things and lexical borrowability. *Cecil H. BROWN, Northern Illinois University.*

Words for 77 objects and concepts introduced to the Americas by Europeans, including 35 living things (e.g., horse, cow, apple, and lettuce) and 42 artifacts (e.g., butter, candle, scissors, and soap) are surveyed in 292 Native American languages and dialects spoken from the Arctic Circle to Tierra del Fuego. Introduced living things are found to be much more frequently named by European language loans than are artifacts, while artifacts are much more frequently labeled by words coined in native languages. A sociolinguistic model is proposed to explain the differential lexical borrowability of words for items of acculturation.

Prehispanic ceremonial flowers in contemporary Mexico. *Robert BYE and Edelmira LINARES, Universidad Nacional Autónoma de México.*

Mesoamerican cultures considered flowers to be sacred, hence their use was severely restricted. Flowers were involved in establishing, maintaining and terminating relationships in the Aztec world. Over 33 blossoms had ceremonial functions in central Mexico during prehispanic times. The concept of flower was an important metaphor for communication and also included mushrooms and processed fruits. Floral horticulture was highly developed. After the collapse of the Triple Alliance, flowers were incorporated into the commoners' lives. The syncretism of indigenous and European values of flowers persists today. These points are illustrated by various botanical examples.

Origin and evolutionary tendencies of the traditional homegardens of the tropical lowlands of Mexico. *Javier CABALLERO, Universidad Nacional Autónoma de México.*

Homegardens are an agrosilvicultural system widespread among the indigenous peoples of the tropical lowlands of Mexico. Archival research as well as the comparison of several case studies suggest that present homegardens may not have originated in prehispanic times as commonly thought, but involve a combination of prehispanic agrosilvicultural practices and the technological innovations introduced to Mesoamerica by the Spaniards. Homegarden cultivation developed as a response to changes in settlement patterns and land use occurring since the early colonial period. At present this system is undergoing a rapid transformation which is a result of economic modernization and cultural change.

Wild trees and social relationships in northern Ghana. *Joanna CASEY, University of South Carolina.*

Shea (*Butyrospermum parkii*) and ***dawadawa*** (*Parkia clappertonia*) are the most important wild plant resources used by the people of Northern Ghana. These trees are of value as foods, medicines, building materials, and sources of income, and they also have very important social functions. Recent western interest in these products, particularly ***shea***, is changing the social and economic position of ***shea*** and ***dawadawa*** in Ghanaian society. This paper explores the multiplicity of roles of ***shea*** and ***dawadawa*** in Northern Ghana, and the impact of western involvement on the relationships between people and these resources.

Ethnobotany in a public school setting. *Deborah DUCHON, Georgia State University; and Paméla SEZGIN, Fulton County Public School System.*

The Teaching Museum-South, a unit of the Fulton County Public School System (Georgia), has instituted an interdisciplinary ethnobotany program for students and teachers. The centerpiece of the program is an "ethnobotany garden," which is used to teach classes in history, science, social studies, and art. The first staff development course for teachers will cover the basic fields and subfields of ethnobotany and how to integrate it into the curriculum.

Societal niche and concepts of environmental interconnectedness. *Gabriela FLORA, University of Georgia.*

Nature can be divided into the biophysical reality and the social construction of that reality. An analysis of the cultural construction of that reality was conducted in the Manupali Watershed in the Philippines. An adaptation of the Thematic Apperception Test, which consisted of a series of 12 pictures related to biodiversity and water usage from the area, was utilized to elicit perspectives on concepts of environmental interconnectedness. The responses were desegregated by geographic location, ethnicity, gender, and membership/non-membership in an environmental group to give insight into the connection between societal niche and perceptions of the environment.

Ethnobotany is for the birds. *Richard I. FORD, University of Michigan.*

In San Juan Pueblo, New Mexico, birds and plants are distinguished in folk taxonomy but from a human behavior perspective they are interrelated. From an ecological vantage they are also related. This paper will examine the plants that are recognized as bird food, the plants that form the technological bases for procuring birds for food and ritual, and other ways their relationship contributes to ethnobiology.

Animal figures in floor mosaics at Roman Sepphoris, Lower Galilee, Northern Israel. *Arlene FRADKIN, Florida Museum of Natural History.*

Animal pictorial representations in the floor mosaics of a large public building at the site of Sepphoris, a major city in the Galilee during the Roman period, are described. Zoological subjects include one mammal, several birds, and a number of Mediterranean fish. Only a few of these animals, however, are represented in the archaeological faunal remains. The mosaic zoological depictions were most likely derived from pattern books, as some of these subjects also appear in other Roman site mosaics in identical stylistic renderings.

Of plants and petroglyphs: Archaeobotany at the Narrows Rockshelter (3CW35). *Gayle FRITZ, Washington University; and Jerry HILLIARD, Arkansas Archeological Survey.*

A midden deposited during late prehistoric times in northwest Arkansas gives evidence of plants processed at a rockshelter site where human figures were pecked and painted on the rear wall. The midden and the rock graphics seem to date to the same general period, but the connection, if any, between the artists and the people responsible for the archaeobotanical remains is unclear. Rather than reflecting ritual use of plants, or even the normal maize-rich diet expected of Mississippian-related groups, the assemblage is dominated by nut shells, especially hickories. We offer alternative scenarios for this enigmatic archaeological association.

Prevalence of gastro-intestinal infections and treatment with biologic products. *John FURLONG, Stephen BARRIE, and Martin LEE, Great Smokies Diagnostic Laboratory.*

Intestinal parasites are an important problem in developing areas. They are also found at a rate of approximately 25% of the ill population in the U.S. There are multiple ramifications to undiagnosed and untreated amebic and bacterial infections, from increased morbidity and mortality to poor growth and developmental delay. We present statistics and a literature review illustrating the scope of the problem and focus on the treatment with biologic products of various origins. Also discussed are other factors that affect gastrointestinal resistance to repeated or persistent infections, emphasizing dietary and non-pharmaceutical interventions.

An ethnobiological study at El Cielo Biosphere Reserve. *Claudia GONZALEZ, Miami University.*

A study from an ethnobiological perspective was conducted in 1993-1995 in Ejido Joya De Salas, Jaumave, Tamaulipas, Mexico at El Cielo Biosphere Reserve on the Sierra Madre range. The focus was to identify which ecological and social impacts have developed from the interrelationship between the reserve and natural resource demands of the local campesinos; how local community-based knowledge will be applied in conservation plans and programs regarding extraction of natural resources; and in what ways local participation meets the conservation objectives of El Cielo.

Nutritional analysis of archaeobotanical remains: Implications and applications. *Ferenc GYULAI, Biohistory International.*

Contrary to expectations, complex organic compounds, e.g., amino acids, are often preserved in archaeobotanical materials such as seeds. Qualitative and especially quantitative comparisons with food resources through time measure their relative nutritional content and value. In many ways older food plant varieties were nutritionally superior to modern ones. Productivity in volume alone may be a false measure of actual nutritional value. Coupled with natural fitness from lack of exposure to intensive modern intrusions (chemical fertilizers, herbicides and pesticides), ancient food plants are again being considered for commercial production in the development of ecologically sound sustainable agriculture.

Plants for making civilization. *Leo Aoi HOSOYA, University of Cambridge.*

Introduction of rice cultivation from Continental Asia to Japan around 300 B.C. is an interesting example of what may happen when a society introduces a non-local plant with its characteristic field system as a new economic base. This led to quite a different type of food production management by the community and to changes in the organization of Japanese society itself. Using charred plants from archaeological sites, this paper examines how social change occurred through Japanese relationships to the new type of food production in its early stage, referring to historical and ethnographic examples of plant management as evidence of political strategies in various societies.

Mixtepec Zapotec ethnobiological classifications: A preliminary sketch. *Eugene HUNN, University of Washington; and Donato ACUCA V., SERBO, A.C.*

The ethnobiological classification system of the Zapotec-speaking communities of San Juan and San Pedro Mixtepec in the Sierra de Miahuatlán, Oaxaca, Mexico, is extraordinarily well conserved despite nearly 500 years of contact with Spanish-speaking colonial powers. Mixtepec Zapotec — in line with other well-documented Otomanguean groups — departs from the expectations of Berlin's General Principles of Ethnobiological Classification and Nomenclature in explicitly marking life-form membership and in the use of a complex of overlapping life forms, which may be defined in terms of culturally prominent plant parts, e.g., 'leaf' and 'flower'. In conclusion, we speculate on the future of this traditional ethnobiological system.

Northern Secwepemc ethnobotany: Teaching and learning about plants and their context. *Marianne B. IGNACE, Simon Fraser University; and Elders of the Cariboo Tribal Council.*

Since 1991, Nancy Turner, Marianne Ignace, and many others have carried out an extensive research project on Secwepemc ethnobotany with the southern communities of the Secwepemc Nation in the Interior of British Columbia. In 1996, this project extended to the five northern communities of the Secwepemc Nation. At their own request, it took the shape of an anthropology course in ethnobotany offered through the Secwepemc Cultural Education Society/Simon Fraser University Program for First Nations. This paper will narrate and show with audiovisual materials the results and context of this project as a productive example of collaborative research and education, where the roles of teachers and students mix and complement each other, and at times reverse.

Resource use and economic activity in northwest Ecuador. *Eric JONES, University of Georgia.*

Northwest Ecuador has been the source of much biological and botanical research given its status as one of the world's biological "hotspots." Much less research, however, has focused on the human populations which inhabit this tropical eco-region. I discusses ethnographic research in the area of the confluence of the San Miguel and Cayapas Rivers in NW Ecuador. I compare the adaptations of Afroecuadorian and Chachi groups to the mix of subsistence and wage-earning activities in the context of what Whitten calls a "boom-bust political economy." The relationship between the area's biodiversity and this localized exploitation also will be discussed.

Ethnobotany in restoration: Prairie and wetland restoration projects. *Lisa KAHN and Kelly KINDSCHER, University of Kansas.*

Two developing restoration projects will include ethnobotanically useful plants to encourage involvement of local community members. In a prairie restoration south of Kansas City, we have planted edible and medicinal plants to promote use and management of this area by a new local school. In addition, we are designing a wetland restoration for the Prairie Band Potawatomi Reservation in northeast Kansas that incorporates plants useful to tribal members, including calamus, sweetgrass, and groundnuts. We believe that community level involvement will both increase the success of these restorations and be more satisfying to the people involved over time.

Nutrient content of Secwepemc plant foods. *Harriet KUHNLEIN, McGill University; Nancy J. TURNER, University of Victoria; Marianne B. IGNACE, Simon Fraser University and Secwepemc Education Institute; Sandra PEACOCK and Dawn LOEWEN, University of Victoria.*

Sixteen traditional plant food species used as bulbs, taproots, berries, lichen, fruit, or leaves were collected and analyzed for several nutrient components. Protein, crude fat, moisture, ash, and total dietary fiber results were used to determine digestible carbohydrate (by difference) and estimated energy. Calcium, copper, iron, and zinc were determined as nutritional minerals using atomic absorption spectrophotometry. Dietary fiber was highest in taproot and lichen samples; protein exceeded 5% in nuts, dried bulbs, and one sample of leaves. Except for nuts, fat contents were low. Calcium exceeded 200 mg/100g in dried taproots and one sample of leaves; lichen contained large amounts of iron and zinc.

Seasonal and anthropogenic carbohydrate changes in bulbs of yellow glacier lily, *Erythronium grandiflorum* Pursh. *Dawn LOEWEN, University of Victoria; and John W. MULLIN, Agriculture and Agri-Food Canada.*

Bulbs of *Erythronium grandiflorum* were an important "root" vegetable traditionally used by the Secwepemc and other Plateau Peoples of British Columbia. The bulbs were gathered in large quantities and commonly dried and then cooked in earth ovens ("pit-cooked"). The present research investigated the carbohydrate profile of the raw bulbs and its changes both over the course of a growing season and under different treatment regimes (wilting, boiling, air drying, and pit-cooking). The dominant carbohydrates—starch, sucrose, glucose, fructose, and fructan—showed particularly distinctive changes seasonally and upon drying. Nutritional and health implications of the constituent carbohydrates are also discussed.

On the nature of ethnobiological data sources and collectors. *Will McCLATCHEY, University of Florida.*

Biological ethnographic data are documented from an array of sources and by an array of researchers. The "quality" of data sources varies and so does the accuracy of intermediary informants. Cultural experts may be considered as having a higher quality of information concerning their areas of expertise than would their non-expert counterparts. In a similar manner, researchers may have certain areas of expertise which bias their ability to record information. Secondary researchers frequently have little or no way to discern the level of expertise of either the data source or the researcher. This paper will examine the problem of data categorization.

Anthropogenic stands of an economically important species of palm in the Ecuadorian Amazon. *Christopher MILLER, University of Georgia.*

Recent interest in the conservation of tropical forests has focused on ways in which local peoples and forest managers can sustainably harvest products from ecosystems. In this paper, I examine the ecology of an economically important palm species, *Jessenia batava*, in the Ecuadorian Amazon. This species is primarily harvested by humans for its fruit. It is hypothesized that dense stands of this species are anthropogenic. Sensitivity analyses of a population growth model illustrate the importance that human factors play in the overall ecology of *J. batava.*

Prehistoric upland agriculture near Casas Grandes, Chihuahua, Mexico. *Paul MINNIS, University of Oklahoma.*

Recent exploratory research, including aerial photography, soil tests, feature mapping, and excavation, focused on prehistoric upland agriculture around the important prehistoric center of Casas Grandes and documented extensive and variable food production strategies. These systems are then related to the demographic, political, and ritual dynamics of the regional polity. We conclude that the success of upland agriculture may have been critical to the regional dominance of Casas Grandes.

Preferences of animals among the Matlatzinca children of San Francisco Oxtotilpan, in the state of Mexico, Mexico. *Lourdes NAVARIJO, Instituto de Biología.*

The population of Matlatzinca-speaking people is seriously reduced. For that reason, perceptual and evaluative elements of school-age children's attitudes towards animals were investigated. They are the heirs of the knowledge and traditions of the ethnic group. A basic scheme of motives for the selection of preferences according to the utility and qualities children assigned to animals is developed. Mammals and birds are the groups most preferred.

Fiber processing and dental wear in female skeletons from Peru. *Gretchen NELSON and Karl J. REINHARD, University of Nebraska.*

Recent analysis of dental wear shows that dietary phytoliths caused severe microwear and abrasion among people of certain ancient cultures. In 1996 we initiated a microscopic evaluation of dental pathology patterns in Formative Period teeth from southern Peru. Macroscopically, female teeth exhibited extreme wear of the anterior and posterior dentition and male teeth exhibited little or no wear. We hypothesized that processing plant fiber for weaving by women was the basis of the wear dichotomy. Using scanning electron microscopy, we evaluated the phytoliths from textiles and dental calculus. Differential microwear was detected on the surface of male and female teeth. Females exhibited more dental microwear consistent with phytolith abrasion. The phytoliths from the textiles are consistent with the phytoliths in the dental calculus. Therefore, the hypothesis that sex differentiated activities contribute to phytolith dental wear is supported by analysis. This is the first documentation of non-dietary phytolith abrasion in prehistoric peoples.

Long-term Secwepemc plant use: Archaeobotanical investigations in the interior plateau, British Columbia. *George P. NICHOLAS, Simon Fraser University.*

Since 1991, archaeological investigations in Kamloops, British Columbia, have systematically recovered plant remains from habitation sites representing at least 6,000 years of occupation. These sites, located on glacial lake terraces above the present Thompson River, reveal new aspects of prehistoric land use in the region. Evidence of past plant use includes seeds, charred material, and substantial quantities of birchbark. This paper reviews the overall project, discusses the use of bark in the Interior Plateau, and describes several features, including a birchbark and cottonwood bark-lined storage pit. These investigations, which include the participation of Native people, extend our knowledge of Secwepemc plant use into the prehistoric past.

Participatory investigation into traditional natural resource management in Bolivia. *Mercedes NOSTAS, James JOHNSON, Sergio JAVIVI, and Wendy R. TOWNSEND, Proyecto de Investigación, CIDOB.*

The Confederation of Indigenous Pueblos of Bolivia (CIDOB) has begun participatory investigation into the knowledge base residing within 28 cultures of lowland Bolivia. The program assists communities to describe and analyze their traditional natural resource technologies, thus making participants more resistant to external pressures for inappropriate change. Research experience gained by communities will promote communication as partners with the scientific community. The resulting participatory research capacity will aid development of territorial management plans, a requirement for legalization of territories under Bolivian law.

Creating carbohydrates: Inulin and the chemistry of pitcooking. *Sandra PEACOCK, University of Victoria.*

Balsamroot (*Balsamorhiza sagittata*), a former root staple of indigenous peoples of the Canadian Plateau, was first reported to contain inulin in the 1930s. Inulin, an indigestible polysaccharide, can be hydrolyzed to fructose through cooking. Traditionally, balsamroot was pitcooked in earth ovens, a process believed to convert the inulin into digestible carbohydrates. However, this process had never been documented for balsamroot. In 1990, we replicated a traditional interior Salish earth oven, pitcooked balsamroot, and analyzed the raw and cooked samples. The results are reported and the implications of these results to issues of prehistoric root resource use and intensification are discussed.

Achieving interdisciplinary synthesis in dietary reconstruction. *Deborah PEARSALL, University of Missouri.*

Understanding what people ate at various times in prehistory is fundamental for understanding how past populations survived and prospered. My goal in this paper is to assess how, and to what extent, diet can be reconstructed from the archaeological record using the remains of plants and animals preserved at sites and dietary indicators in the human skeleton. I present a method for integrating multiple indicators of diet and illustrate the approach first by predicting dietary and health indicators for eight idealized diets of the New World tropics, and second by applying the approach to two archaeological case studies.

The over-exploitation of Atlantic rangia clams *(Rangia cuneata)* and hard clam *(Mercenaria* spp.*)* from six archaeological sites in the southeastern United States. *Irvy QUITMYER and Douglas S. JONES, Florida Museum of Natural History.*

Ethnobiologists have recently documented changes in island environments that resulted from prehistoric human occupation. These studies indicate that prehistoric people had a profound effect on the landscape, as well as on plant and animal communities. Changes in archaeological animal communities are more difficult to identify in continental coastal sites because of methodological constraints and because such changes were not anticipated by investigators. This study shows that in six prehistoric sites in the southeastern United States the harvest of Atlantic rangia clams *(Rangia cuneata)* and hard clams (*Mercenaria* spp.) significantly reduced the mean ontogenetic age of the populations.

Medicinal use of yerba mansa (*Anemopsis californica*). *Benjamin RANGEL, University of California, Riverside.*

Anemopsis californica (Saururaceae), commonly known as "Yerba mansa," is a very well known medicinal plant that was used by Native Americans in the southwest of the USA and northern Mexico to treat several external and internal illnesses. We have isolated and identified the essential oils from this plant and have conducted bioassays to identify the components responsible for the antiseptic properties attributed to *A. californica*. We identified three compounds in the essential oils that had fungicidal activity. These are methyl eugenol, thymol, and elemicin.

Comparative ethnoecology of ethnic groups living near two ecological reserves. *Robert E. RHOADES and Virginia NAZAREA, University of Georgia.*

Ethnoecology is an emerging, powerful perspective from which to understand resource recognition and management; and the schemas, scripts, and action plans that orient people in the landscape and determine productivity, equity, and sustainability of their practices. This paper presents results from a comparative ethnoecological study of diverse ethnic groups living near the boundaries of two ecological reserves (Cotacachi-Cayapas in Ecuador; Mt. Kitanglad in the Philippines). Inter- and intra-cultural variations in perceptions and management of the landscape will be analyzed.

Paleodietary implications of coprolites from Hidden Cave, Nevada. *Dave RHODE, Desert Research Institute.*

Plant macrofossils and fish remains have been analyzed from a series of coprolites from Hidden Cave, on the margin of the Carson Sink, western Nevada. Many of these coprolites had pollen contents previously reported by Mehringer and Wigand in 1985. Study of these macrofossil remains allows paleodietary inferences to be extended considerably. Implications for prehistoric subsistence in the Carson Desert will be made with reference to recent models of regional land use, subsistence change, paleoenvironments, and the occupation history of the cave itself.

Theory into practice: Shaman Pharmaceuticals' ethnomedical research in Tanzania. *Rowena K. RICHTER, Shaman Pharmaceuticals.*

Shaman Pharmaceuticals is in the business of researching and developing pharmaceutical drugs from plants which are used by traditional healers and traditional birth attendants. Reciprocity in the short and medium term is the cornerstone of Shaman's relationships and allows them to be mutually beneficial from the outset. Examples from Shaman's collaborations with Tanzanian communities and organizations will be given. Field research with a team representing both genders of ethnobotanists and physicians will be presented.

Reconstruction of small-scale historic landscapes using opal phytolith analysis. *Irwin ROVNER, Biohistory International.*

Decay-in-place plant residues, specifically opal phytoliths, are particularly useful in reconstructing small scale landscape patterns at historic period sites in the eastern United States. In addition to detecting the appearance of Europeans through alterations in land use patterns and introduction of new flora, phytoliths can provide floral patterns at highly specific levels, e.g. the community and even the household. Several studies at sites dating from the colonial period to the 20th century provide information on the history of a variety of cultural patterns and small scale ecological effects.

Makah whale hunting and environmental politics. *Jennifer SEPEZ, University of Washington.*

This paper outlines the ecological, anthropological, and political issues arising from a proposal by the Makah Indian Tribe of northwest Washington to resume hunting the formerly endangered California gray whale. The proposal created considerable controversy at the 1996 International Whaling Commission meetings and was withdrawn from consideration until June 1997. The last native whaling controversy in the United States, the Inuit bowhead hunt of the late 1970s, shaped the IWC's current policies on aboriginal subsistence hunting, and provides an interesting comparison to the Makah case.

Ethnomedicinal lore in the Himalayas. *G. SHARMA, University of Tennessee.*

The Himalayas, extending from Afghanistan to Burma, cover a 3,000 km long arc and are the home of several indigenous systems of medicine which are known to serve more than 500 million people on the Asian continent. It is estimated that 2,000 botanical species are used for medicinal purposes in the Ayurveda, one indigenous medical system. Similar figures exist for the Amchi and Unani indigenous systems of medicine. Furthermore, ethnomedicinal lore is highly organized with complex recipes and modes of processing that ensure maximum efficacy of the folk medicines. Some of these medicinal plants and their ethnomedicinal lore are vulnerable to anthropogenic pressures. Hence, the need to conserve these species for the amelioration of human health is urgent.

The contribution of traditional resource management of white root to cultural and ecological restoration. *Michele STEVENS, University of California, Davis.*

This paper identifies Traditional Resource Management practices by California Indians on white root (*Carex barbarae*) populations, and describes the effects of tending from both a cultural and scientific perspective. White root is one of the most difficult basketry materials for weavers to obtain, and plant populations have been reduced throughout its range. Ethnographic techniques are utilized to document white root ethnobotany. Cultural techniques were simulated experimentally to document their effects on plant growth. This study demonstrates the significance of traditional tending practices to restoration.

"Nothin' like our red pea!" The cultural relevance of heirloom varieties: Lessons learned from the U.S. South. *Eleanor TISON and Diana DRY, University of Georgia.*

Although not a center of agrobiodiversity, the US harbors pockets of farmer-bred, locally maintained crop varieties. The proliferation of regional grassroots seed exchange groups demonstrates a resurgence of interest in these traditional, or heirloom, plant varieties presenting both possibilities and problems for sustaining genetic resources. In particular, we address the need to investigate and document local knowledge about and cultural relevance of heirlooms for specific ethnic traditions and communities. Focusing on the community-based conservation of a local heirloom cowpea variety (*Vigna unguiculata*) in coastal Georgia, we discuss the potential for linking in situ conservation with cultural and community survival.

Plant food resource ranking along the Upper Klamath River of Oregon and California. *Donn TODT, Ashland Oregon Parks Department.*

Ethnographic, biogeographic, nutritional, and experimental data are used to rank the relative value of plant food resources available in the pre-contact period to indigenous peoples of the Upper Klamath River on the Oregon-California border. Only a few are ranked highly enough to have influenced food procurement strategies. This information supplements the archaeological record and helps clarify the relationships between indigenous peoples and resources along the Upper Klamath River. While the study focuses on a particular location, the methodology may have broader utility in the evaluation of the role of plant foods in hunter-gatherer diets.

Healer vs. Shaman: Evidence for the practice of medicine in 17th-century New Mexico. *Mollie S. TOLL and Pamela J. McBRIDE, Museum of New Mexico.*

Contents of baskets found in a rock shelter in the Galisto Basin, southeastern New Mexico, offer a unique opportunity to observe the components of a working pharmacopoeia from 350 years ago. The individual and collective identities of these plant materials provide an interesting counterpoint to what is known ethnographically about historic practices among both Pueblo and Spanish populations in the central and northern Rio Grande Valley.

Working together for people and plants: Goals and outcomes of the Secwepemc ethnobotany project, British Columbia. *Nancy J. TURNER, University of Victoria; Darrell EUSTACHE, University College of the Cariboo; and Marianne B. IGNACE and Ron IGNACE, Simon Fraser University and Secwepemc Education Institute.*

The Secwepemc Ethnobotany Project was initiated in 1990 as a collaborative project that aimed to document the rich botanical knowledge of the Secwepemc (Shuswap) Interior Salish peoples of British Columbia. The Project, funded by the Social Sciences and Humanities Research Council of Canada, includes among its goals the active participation not only of the elders who are the major knowledge holders, but of younger Secwepemc students and researchers. Major goals are to stimulate interest in ethnobotanical knowledge among Secwepemc people of all ages and to provide a base of information that can be applied in education programs, land tenure and treaty negotiations, and land and resource management within the Secwepemc homeland.

The vegetational origins of some medicinal plants of the Mosetenes of Muchanes, Alto Bení, Bolivia. *Lourdes VARGAS R., National Herbarium of Bolivia.*

The Mosetenes inhabit the Alto Rio Bení of Bolivia at Muchanes (67° 15' W and 15° 12' S). The vegetation is tropical rainforest although the landscape is Andean foothills. Of the 88 species of plants identified as medicinal by the Mosetenes, 60% came from primary forest and 40% came from secondary forest. Of the 28 species of medicinal plants in semi-domestication, 14% came from primary forest, 57% from secondary forest, and 29% from other garden plots.

Analysis of Inca and Chiribaya culture coprolites from Peru and Chile. *Sheila DORSEY VINTON and Karl J. REINHARD, University of Nebraska.*

Analysis of Inca and Chiribaya culture coprolites from Peru and Chile shows that maize *(Zea mays)* and yuca or manioc *(Manihot esculenta)* were the main sources of carbohydrate. However, macroscopically and microscopically there is differential representation of these two food items. The ratio of microscopic starch grains to macroscopic fiber is high in maize relative to yuca. Consequently, there is a quantitative error in representing these two food sources from either macroscopic or microscopic analysis. Evaluating the ratio of fiber to starch of manioc, we have developed correction coefficients to estimate the amount of starch associated with a given amount of fiber from these plant sources.

The historical ecology of the southeastern longleaf pine: A South Florida perspective. *Karen J. WALKER, Florida Museum of Natural History.*

Longleaf pine, *Pinus palustris*, accounted for an estimated 90 million acres of the southeastern U.S. woodlands at the time of European contact. Today, roughly 3 million acres remain. The demise of these forests was a result of interplay between the forest's ecology and Euro-American activity. Grasses, soil moisture, and periodic fire were critical ecological players while domestic animals, agriculture, fire-suppression, and lumbering were critical human-related factors. Old growth longleaf forests in south Florida were the southernmost forests in the longleaf's geographic range. Documentary research, oral history, and archaeological survey concerning one such forest near Fort Myers illustrate the historical process of longleaf ecological change.

Ecology of mesquite patch gardens. *Lori WEINGARTNER, California State University, San Bernardino.*

Cahuilla, and possibly Chemehuevi, inhabitants of the California Mojave desert planted cultigens in association with mesquite. Transects of one cultigen, tepary beans, were planted across mesquite hummocks and measurements of available nitrogen, soil temperature, water potential, relative humidity, and light penetration, taken to examine the possibility of a nurse plant effect of the mesquite on the tepary. The first set of transects planted (spring 1996) failed to establish and other difficulties were encountered. However, seed germination did demonstrate positive correlation with soil temperatures. Another set of transects will be planted in spring 1997.

Creativity and improvisation in African American gardens and yards. *Richard WESTMACOTT, University of Georgia.*

In this paper I will describe the plants and other objects used in the decoration of African American yards. I will explore the plants and configuration of plants found in yards and gardens based on a study of approximately fifty homes in three regions of the rural South (the Low Country of South Carolina, the Black Belt in Alabama, and the Southern Piedmont in Georgia). Methods of acquisition, design criteria, preferences in the choice of plants and for specific color combinations, properties and meanings associated with plants, as well as attitudes towards management and change will be discussed.

Pre-Columbian human uses of mammals in the West Indies. *Elizabeth WING, Florida Museum of Natural History.*

Mammals may be grouped as domestic, captive, and wild. The ways each of these was used differs and has implications for colonization of island archipelagos. Captive animals moved between islands had the potential to be a subsistence resource as wild resources became stressed from overexploitation. However, this does not seem to be the way most captive animals were used. Domestic animals, dogs and guinea pigs, were apparently not used primarily for food either. Wild mammals were intensively exploited, presumably for food. The evidence for these differences will be presented and explanations proposed.

Prehistoric plant remains from Site EeRb 140, a multi-component site within the present-day Secwepemc Territory, British Columbia. *Michèle WOLLSTONECROFT, Simon Fraser University; and Gladys BAPTISTE, Simon Fraser University and Secwepemc Education Institute.*

This paper summarizes the archaeological plant remains recovered from site EeRb 140 near Kamloops, British Columbia. EeRb 140 is a multi-component mid-late prehistoric site located near the confluence of the South and North Thompson rivers on the southern British Columbia Plateau. Examining a multi-component site allows for the observation of changes in plant use over time. The archaeobotany of EeRb 140 is also compared with plant use at nearby contemporaneous Plateau sites. Further, the archaeobotanical data are compared and contrasted with known Secwepemc plant use.

The use of personal computers in zooarchaeology. *Tim YOUNG, Florida Museum of Natural History.*

Personal computers now have the power and speed to deal with large data sets, such as complete archaeological collections, without having to translate them into numerical codes. Also archaeological collections can be merged so that inter-site questions can be explored, considering temporal or spatial changes. Although similar questions could be researched in the past, the answers would take time to develop. Today answers can be obtained immediately. This presentation will show the culmination of two years of work by the Environmental Archaeology Laboratory at the Florida Museum of Natural History.

NEWS AND COMMENTS

TWO NEW RESEARCH FELLOWSHIPS AVAILABLE

The William P. Clements Center for Southwest Studies in the Department of History at Southern Methodist University in Dallas welcomes applications for two research fellowships:

- The Clements Research Fellowship in Southwestern Studies, open to individuals doing research on southwestern America, broadly conceived, within any field in the humanities or social sciences.
- The Summerlee Research Fellowship, specifically in the field of Texas history.

The fellowship holders would be expected to spend the 1998-1999 academic year at SMU as Research Fellows of the Clements Center. The fellowships are designed to provide time for senior or junior scholars to bring book-length manuscripts to completion. Each Research Fellow will teach one course during the two-semester duration of the fellowship and will participate in Center activities. Each awardee will receive a stipend of $30,000, health benefits, a modest allowance for research and travel expenses, the support of the Center, access to the holdings of the DeGolyer Library, and a subvention toward the publication of their books.

Applicants should send a vita, a description of their research project, a sample chapter or extract, and three letters of reference from persons who can assess the significance of the proposal and the scholarship record of the proposer. Send applications to David J. Weber, Director, Clements Center for Southwest Studies, Dept. of History, SMU, Dallas, TX 75275-0176. Applications must be received by January 15, 1998. The award will be announced on March 2, 1998.

Visit the web site at: http://www.smu.edu/~swcenter/.

CLEMENTS-DEGOLYER LIBRARY FELLOWSHIPS

The William P. Clements Center for Southwest Studies offers an annual fellowship to encourage broader and more intensive use of the special collections at DeGolyer Library, Southern Methodist University. The award consists of a $1,000 stipend available for stays of one month or longer to conduct research at the DeGolyer.

Applications should include an outline of the project, indicating its pertinence to DeGolyer Library and the length of time expected to be spent there, a curriculum vita, and two letters of reference.

Deadlines for applications: March 15 and September 15; awards announced April 1 and October 1. For further information, please contact: Jane Elder, Associate Director, Clements Center for Southwest Studies, Southern Methodist University, Dallas, TX 75275-0176; tel.: (214) 768-3684; fax: (214) 768-4129; e-mail: swcenter@mail.smu.edu.

JOB OPENING

Assistant Professor — Ethnobotany

Connecticut College seeks to fill a tenure-track position in the field of ethnobotany. The appointment will be made jointly in the departments of Anthropology and Botany. This position will complement the College's strong programs in anthropology, botany, and environmental studies; specific areas of training and research interests are open, but the successful candidate must be broadly educated and able to interact with faculty and students across a range of disciplines. Applicants should have ethnographic fieldwork experience and a focus on plant systematics and local use of indigenous species.

Teaching responsibilities will include an ethnographic area course, an ethnobotany course, and additional courses of the candidate's design that will complement offerings in Anthropology, Botany, and Environmental Studies. Teaching load is five courses for the academic year, with important laboratory sections counting as a full course. Connecticut College is committed to research as an important component of undergraduate education; the successful candidate will be expected to develop a program which will involve undergraduates in some component of his or her research. A Ph.D. is required; postdoctoral work and teaching experience are desirable.

Connecticut College is a highly selective, independent, four-year liberal arts college enrolling ca. 1600 students. Facilities include the Olin Science Center, a 16,000 specimen herbarium, TEM, SEM with x-ray microprobe capabilities. The 450-acre Connecticut College Aboretum surrounds the College and is used extensively for teaching and research. Application should include a CV with a list of potential referees and statements of the candidate's philosophy on teaching and research at the undergraduate level. Application review will begin December 1, 1997 and continue until the position has been filled. All material should be sent to: R. Scott Warren, Chair, Ethnobotany Search Committee, c/o Box 5213, Connecticut College, 270 Mohegan Avenue, New London, CT 06320-4196. Email inquiries may be addressed to rswar@conncoll.edu. Connecticut College homepage address is http://camel.conncoll.edu/ Connecticut College is actively seeking to increase faculty diversity, AAEOE.

BOOK REVIEWS

The Animal World of the Pharaohs. Patrick F. Houlihan. London: Thames and Hudson, 1996. Pp. xv, 245. Copiously illustrated in B & W and color. Index. ISBN 0-500 01731-X (hardcover).

Here is yet another book that is close to essential reading for ethnobiologists, but is well outside the normal ethnobiology citation universe and therefore might be missed.

Patrick Houlihan provides a valuable, up-to-date, and accurate overview of Ancient Egyptian knowledge and use of animals. He covers the entire 3000-year run of Egyptian civilization, in a work that is as much illustration as text, so the treatment is at a rather introductory level. It is none-the-less important for that.

Ancient Egypt is famous for its religious regard for animals. Houlihan begins his book with this theme. He is careful to point out that the animals were not literally worshipped; they were revered as emblematic of gods, and sometimes as demonstrating some of the qualities of those gods. Reverence did reach amazing levels, however. One temple alone mummified at least four million ibises. Others mummified countless cats, crocodiles, cattle, and other fauna. These were sacrificed; pets, by contrast, were apparently not sacrificed when their masters died, as they often were in early China.

The Egyptian fondness for animals was not purely an abstract, cultish mater. Egyptians delighted in hunting and fishing; lords and ladies are shown in these activities. Egyptians not only kept pets, but named and loved their dogs and cats. Many officials and court members had themselves painted with their pets beside them. The pets are shown in highly naturalistic form, and seem well cared for, often being adorned with lovely collars. Not only dogs and cats, but also baboons, green monkeys, mongooses, birds, and other fauna were kept. Some pharaohs had full-scale zoos. The Egyptians also had their animal tales, and a whole chapter on "Animals in Humor and Wit" (pp 209-217) is found herein.

Of course, Houlihan eventually gets to mere utility, and discusses the value of cattle, donkeys, and so on in the domestic economy. He contradicts some hoary myths; those baboons picking figs in trees were, he believes, pets, rather than trained harvesters like the coconut-picking monkeys of southeast Asia. Cheetahs too seem more likely to have been display animals than trained hunters.

Ancient Egyptian artists were superb. No one since has made better paintings of some of the birds and fishes of Egypt. Thanks to this, one can recognize these creatures, and perhaps the most valuable ethnobiological aspect of this book is Houlihan's careful identification of mammals and of the birds that were previously lumped as "ducks" or "geese" or the like. He identifies the species. His identifications seem correct, except for a "Bittern" on Plate V that is actually a Black-crowned Night Heron. Fish are less easy to call, but he has done an excellent job with them.

There has been much recent debate about the degree to which Ancient Egypt was an "African" civilization. Houlihan stays strictly away from this issue, but my impression is that the animal world of the pharaohs was a quite African one.

(By contrast, the domesticated plants were almost all derived from the Near East.) Of course, most of the animals were African; but even Near Eastern animals like the dog and sheep were integrated into an African world. The complex religious symbolism and the cosmology behind it seem primarily African, though, of course, not without influences from elsewhere. Also African is the intense, complex emotional involvement with the animal world, from religion to pet-keeping. Certainly the treatment of cattle seems close to that of the Nuer and other Sudanic groups. These (or, rather, their ancestors) no doubt were much influenced by their distant northern neighbor; but did the influence flow only one way? I doubt it.

The book is primarily an art book — one would call it a "coffee tabler" if the text weren't so good and so ethnobiologically sophisticated. The plates are superb art, superbly reproduced. Bird lovers may be the most pleased.

For a dog lover, however, there is one picture that is worth the price of the book. Figure 57 (pg 80) is a rough sketch, but obviously by a master artist. It is from the coffin of one Khuw, of the Twelfth Dynasty. Khuw is leading his dog Menyupu ("He is a Shepherd" — probably a name, not just a job description). Menyupu is a beautiful, rather basenji-like dog, in splendid condition, with a fine collar and leash. The artist has perfectly captured Menyupu's loving, trusting gaze as he follows his master into whatever eternity art and devotion can give.

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Wild Men in the Looking Glass: The Mythic Origins of European Otherness. Roger Bartra. Translated by Carl Berrisford. Ann Arbor: University of Michigan Press, 1994. US$49.50. Pp. 232. Illus. ISBN 0-472-10477-2 (hardcover).

The Artificial Savage. Roger Bartra. Translated by Christopher Follett. Ann Arbor: University of Michigan Press, 1997. US$47.50. Illus. ISBN 0-472-104577 (hardcover).

Few things are more interesting or significant to ethnobiologists than the human tendency to people the world with imaginary beasts. Often it is the very people who impress us with their incredible and minutely detailed knowledge of the environment who have the richest store of beliefs in nonexistent wildlife. Europe has at least its share of unreal animals, and among the most interesting of them is the "wild man," the *Homo sylvestris*. Long ignored by anthropologists, this individual has at last found a chronicler.

These books are, in effect, a single two-volume monograph on the "wild man" or "savage" in European tradition. The European "wild man" — usually male, though wild women and whole families are reported — was a mythical creature, virtually identical to the "sasquatch" and "bigfoot" of North America. He was usually portrayed as huge, hairy, club-wielding, and antisocial. Wild folk were usually considered nonlinguistic. Some wild folk did have large societies, even armies, but usually they lived in family groups. They were usually fierce, rude, and unmannerly, but sometimes they had "natural" virtues of kindness and sympathy.

Belief in wild men goes back at least to the dawn of literature; *Enkidu* in the *Epic of Gilgamesh* fits all the stereotypes. The Greek and Roman writers treated extensively wild men (among the satyrs, fauns, nymphs, and other strange creatures of the forest). Stories of wild men flourished especially in the medieval and renaissance periods. Folk legend and travel narrative provided accounts and pictures. More sophisticated authors such as Spenser and Hans Sachs used the wild man ironically or poetically, to comment on conventional society. (The Flintstones and Alley Oop, are, in a sense, descendants of this tradition; "Natural Man" has been displaced to the remote, dinosaur-inhabited past, and stories about him have been displaced to the child level.)

The Age of Discovery pushed wild men out of Europe. At first the Native Americans were regarded as "savages" in the classic European sense. It was not real Indians, but "savages," that John Locke was contemplating when he used "America" as an example of humanity in a state of "nature." Later, the "savage" was displaced to even less known shores: Africa and Australia. Finally, in the 20th century, the "savage" was shown not to exist — though a few diehard adventurers still seek the sasquatch of northwest American, the *yeti* of Tibet, the *yeh-jen* of China, and the hairy giant of the Brazilian Amazon. (*Yeh-jen* stories in China have sometimes led primatologists to isolated populations of the golden langur, a large, furry monkey that occasionally walks erect.)

Wild men were considered to be humans in their natural state. Apparently the mythmakers assumed that humans existed in a wild form, just as dogs, cattle, and pigs did. The wild man was to social man as wolves are to dogs, aurochs to cattle, and wild boars to pigs. Humanity without the blessings of civil society would be fierce, cruel, and rapacious; would have no codes to regulate sex and violence; and would have no language, no arts, no shelter, nor hierarchy. But such humans might have rudimentary social instincts.

The Age of Discovery disproved the more wild and naive accounts of this kind, and introduced people to real apes, who had been a least some of the inspiration of the early stories. Nicolaas Tulp described an orang-utan under the name *Homo sylvestris* (which is, in fact, a literal translation of "orang-utan"). Non-human apes and human "savages" were differentiated. By the mid-16th century, knowledge had progressed to the point where the Catholic Church could rule that America's indigenes were human, not animals.

The second volume focuses on the latter-day writers, farther from the forest, who used the wild man as a takeoff point for philosophy: Hobbes, Locke, Rousseau, Defoe, Shakespeare (think of Caliban), and so on. Bartra does not go into detail on the obvious carry-over from these authors into classic ethnography. Nor does he discuss the non-European wild men (such as the *yeti*). Perhaps a third volume will treat these issues. It soon becomes quite obvious to any reader who knows 19th-century anthropology — Tylor, Morgan, and the rest — that their "savages" were Hobbes' and Locke's wild men, not actual humans. Adam Kuper, in his important history of early anthropology, *The Invention of Primitive Society* (Routledge, New York, 1988), asked where early ethnologists got their highly detailed, wholly unrealistic concept of the "savage." Now we know.

Indeed, we still have this "artificial savage" very much with us in the writings of sociobiologists and others who have no experience with actual indigenous peoples. Economists and political scientists often simply assume the accuracy of Hobbes' classic description of savage life as "solitary, poore, nasty, brutish and short" (Thomas Hobbes, *Leviathan*, Dutton, New York, 1950 [orig. 1657], pg 104).

Bartra's scholarship is superb, and he has missed very few items of importance. Perhaps the most significant is his failure to note that Rousseau's famous "noble savage" was not wholly imaginary; Rousseau was aware of the chimpanzee and was doing his best to describe its way of life (see Rousseau, *The First and Second Discourses Together with the Replies to Critics*, and *Essay on the Origin of Languages*, ed. and trans. by Victor Gourevitch; Harper and Row, New York, 1986, pg 215 — a note in the *Second Discourse* which originally appeared in 1750). Indeed, recent writings on the chimp do make it seem very much like Rousseau's powerful, rough, but sociable wild man (see e.g., Frans de Waal, *Good Natured*; Harvard University Press, Cambridge, 1996).

This pair of books is essential reading for anyone interested in imaginary beasts, or in the history of social science (not just anthropology). In fact, I would rank it as the most important new contribution to the history of social science to come along in a decade. It completely transforms our understanding of the foundations of the social science enterprise. Hobbes, Locke, Rousseau, Tylor, and indeed, much of the European intellectual community, appear not as cool logicians, nor yet as builders of stereotypes, but as typical people — talking from the cultural positions they knew. They grew up with accounts of the wild man, and these accounts colored their views of humanity.

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Myths and Tales of the White Mountain Apache. Grenville Goodwin. Tucson, Arizona: The University of Arizona Press, 1994. $16.95 (paper). Pp. xxix; 223. ISBN 0-8165-1451-8.

In this reprint of the original 1939 publication, Grenville Goodwin, in collaboration with Apache translators and storytellers, brings the reader into the world of the White Mountain Apache through their own oral history. He does this through a series of stories (57 to be exact) recounting the history of the Apache people as seen through the eyes of select tribal elders. Goodwin informally groups the stories according to their subject matter, beginning with the creation of the Apache world and moving through stories about cultural figures, stories about religious figures (*gaan*), and Coyote stories, which are usually moral tales told to children.

Prior to the stories themselves, Goodwin provides a basic introduction to Apache history, culture, and society. Although somewhat dry, this preface is thorough and well worth reading. By including the names and backgrounds of his Apache collaborators, as well as the background of the stories and the proper etiquette for story-telling, Goodwin was clearly ahead of his time (to do so was an uncommon practice among social scientists of the 1930s).

New in this edition are a preface by White Mountain Apache Tribal Chairman Ronnie Lupe; a forward by Elizabeth A. Brandt, Bonnie Lavender-Lewis, and Philip J. Greenfeld; and a key to written Apache by Brandt and Greenfeld. The preface by Lupe is important because it shows the support of the White Mountain Apache tribe for this publication, something often neglected. For those interested in linguistics, the key to written Apache points out changes which have occurred in this language since the time Goodwin originally did his research in the 1930s.

A major point brought out in the forward by Brandt, Lavender-Lewis, and Greenfeld is that the term "myth," while used in the book's title, is a poor one because it is easily misunderstood. Some readers may see this term and assume that the stories contained within are not true. To the Apache people, however, these stories are history and should not be seen as anything less. For example, the sixth account given by Goodwin is entitled "Emergence" and deals with the Red Ant People who traveled from under the earth to the surface to populate the earth. Along with Badger and Porcupine, these were the first people on earth. Birds, and then humans, came to the earth later. This story could be construed as a "myth" which is untrue or as an historical account of the beginnings of the earth. To truly understand its meaning to the Apache, one must not automatically assume the former.

As for these stories themselves, we feel that it is not our place to critique or criticize their authenticity or validity. These stories represent one version of White Mountain Apache oral history. Although other White Mountain Apache may have a different interpretation of this history, it is best left for them to interpret, not us.

After experimenting with reading the stories silently and then aloud, we strongly recommend the latter. Not only is this how they were meant to be heard, we found that we understood them better in doing so. In addition, keep in mind that the stories were originally told in Apache and that the English translation may not flow as smoothly as the original.

For those who would like to learn about the White Mountain Apache and the Fort Apache Reservation area, *Myths and Tales of the White Mountain Apache* is a good introduction to the foundations of Apache culture: religion, kinship, and subsistence. For readers who are already familiar with the people and/or the area, it supplies a more in-depth understanding of both. Overall, this book provides valuable insights into the Apache world from an Apache point of view and is well worth the read.

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Local Knowledge and Agricultural Decision Making in the Philippines: Class, Gender, and Resistance. Virginia D. Nazarea-Sandoval. Ithaca and London: Cornell University Press. 1995. Pp. xiii; 226. ISBN 0-8014-2801-7.

This is a book of rich ethnographic detail set in a clear theoretical and historical context. The work focuses on the rural community of Kabaritan in the northern Philippine island of Luzon. Modern Kabaritan is a diverse collection of peasant landholders, tenant farmers, and landless laborers. Each of these socio-economic categories employs varied strategies for making a living in the increasingly crowded lands of the area, struggling to meet household production targets by taking what advantage they can of opportunities for diversification. The proximity of urban markets; improvements in regional infrastructure, agriculture, and aquaculture; and land reforms have given differential advantage to some people over others.

Drawing on ecological models of the cognized environment and on decision making theory, Nazarea-Sandoval outlines a specific model of agricultural decision making. Cognitive processes enshrined in cognized models constrain choices, as do environmental factors. Beyond this, local factors of the history of the development of the local community have led to the emergence of distinct, locally recognized socio-economic categories in the population.

Nazarea-Sandoval argues that cultural constructs of local reality are not equally distributed in the community; there are distinctive patterns in distribution that are referable to gender and socio-economic status, or "class." The important contribution of this book to ethnobiology and ecology is the careful presentation of ethnographic illustration of the importance of attending to micro-level variation in the distribution of environmental knowledge and its impact on human decision making in relation to exploitation of the environment.

Following an outline of the theoretical orientation and research methodology, Nazarea-Sandoval provides a detailed account of the geographic, demographic, and historical setting of Kabaritan. Of particular note for the theoretical orientation of the book is a fine-grained discussion of the social organization of ownership of productive resources and the organization of labor. The principal material of the analysis is contained in Chapters 4 to 6. Chapter 4 on "Operational Reality: Opportunities and Constraints" examines the environmental circumstances at large and the varied adaptive strategies available to households depending upon socio-economic opportunities. The local economy of Kabaritan is essentially one of small scale wet-rice production and fishing. In recent years, some households have moved into conversion of rice-fields into ponds for raising tilapia fish fingerlings. Limitations on capital reserves, land holdings, and available labor generally constrain households to make choices between rice or aquaculture as the primary source of household income, but as is common in other peasant communities, there are strong pressures to diversify into other forms of marginal production, including production of vegetables and cut flowers for urban markets. Wage labor has become increasingly prevalent in the community, with many households of middle and upper socio-economic strata hiring landless laborers.

Chapter 5, "Cognized Models: Ethnoagronomy and Ethnogastronomy" provides careful documentation of the variable cognitive prominence given to agronomic and dietary factors of subsistence. Of particular interest is Nazarea-

Sandoval's analysis of the different cognitive images of land-use options and gastronomic evaluations of different crops and rice varieties according to the gender and socio-economic status of informants.

Chapter 6, "Decision Making as Interface" examines the process of choice in allocation of resources at the intersection between environmental constraints (the operational reality) and the cognized models of actors as these vary across socio-economic categories and gender. The distribution of tasks in the agricultural and fish-raising calendar show marked patterns according to both gender and socio-economic status.

This book is the result of meticulous fieldwork. Methodologically, much emphasis is placed upon data obtained from a sample of 12 households representing three socio economic strata of the community. While the qualitative and quantitative data are impressive, I am left wondering whether the sample size is sufficient to sustain some of the conclusions about the patterns of distribution of knowledge and adaptive strategies.

Nonetheless, the detailed ethnographic material presented by Nazarea-Sandoval amply supports her general point that not only is there differential access to resources — a point well established in peasant studies — but that knowledge pertaining to the organization of production and consumption is similarly unevenly distributed. Of course, this is not to say that certain sectors of the local community are "less informed" than others (although this may be the case in respect to formal education), but rather that there are local variants of folk knowledge. While this has long been acknowledged in ethnobiology, one of the major contributions of this book is the demonstration of the situation in the context of practical decision making in subsistence.

The text is well-written and augmented by clear diagrams, figures, tables, and photographs. Production is of a high standard as one would expect from this press, although 17 pages of critical material were missing from Chapter 6 of the review copy!

This book is recommended for those interested in the interface between ethnobiology, ecology, and rural development.

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COMPACT DISK REVIEW

Secwepemc Kus (We are the Shuswap). Secwepemc Cultural Education Society. 1994. Secwepemc Cultural Education Society, 355 Yellowhead Highway, Kamloops, British Columbia, Canada V2H 1H1. Tel: (250) 828-9779.

Plantas Medicinales de México: Usos y Remedios Tradicionales (Medicinal Plants of Mexico: Uses and Traditional Remedies). Centro de Tecnología, Electrónica e Infomática (CETEI). 1996. Camino Real a Xochimilco No. 60, Tepepan, Xochimilco, México, D.F. 16020. Tel: 420-59-59.

Secwepemc Kus (We are the Shuswap): This Macintosh-based CD is produced and published by the Secwepemc peoples of British Columbia, Canada, and presents a segment of their ethnobotanical world from their perspective. Upon opening the CD, the viewer is presented with a narrated slide show that briefly introduces the Secwepemc people and the local environment and then proceeds through a twenty-minute tour of spring, summer, and fall, emphasizing the important plants — primarily edible — available at each time of the year. In addition to the slide show, there is a database with additional information on each of the plants, including their Secwepemc name, English name(s), and scientific name, and a brief description of the plant and how it is utilized.

The interface to this disk is clean, intuitive, and easy to navigate; the photography and layout are very good. The slide show can be interrupted at any time by pressing "Return," which puts the viewer into the first page of the database. Navigating from here is as simple as clicking on either plant names, pictures, or one of the icons to return to the slide show, credits, or plants by season. I would like to have seen more information on the culture, history, and ecological context of the Secwepemc, and, of course, more plants would definitely be good. While the 23 plants included are well treated, this can be only a sampling of the plants available and used by the Secwepemc.

Plantas Medicinales de México: Usos y Remedios Tradicionales: This IBM-compatible PC disk is an elaboration of the book *Tes Curativos de México* (Linares, Bye, Penafil 1990) and, though it is not without problems, is a fine example of the dynamic opportunities available through multimedia. Upon opening the disk, there is a series of full-page graphics on the various organizations that participated in production, then a slide of various medicinal plants and two flag icons: Mexico and U.S. Choosing one opens the program in one or the other language — an important option. The following screen begins the true access to the material on the disk. The user has a number of options available at this point, some more obvious than others. For example, by clicking on the word "Use," the following screen presents a series of short video clips on uses of plants in Mexico, as well as pictures of male or female forms which, by clicking on a particular region, brings up illnesses and treatments characteristic of that area. It is here that the primary drawback to this CD appears. None of the computers on which I tried this disk had the necessary system software installed to play the audio portion of the videos. The videos themselves ran and are interesting (though grainy), but the audio could not be accessed, severely limiting the value of the videos and the CD. In order to listen to the audio, it is necessary to go into the system files and add the sound drivers ("Waveplay") to handle the format on the disk. For one used to computers and comfortable with their organization, this is not a major chore, but for the average user, it presents a potentially insurmountable obstacle to full use of the disk. Nothing about this requirement is noted in the otherwise useful instructions. CDs ought to be "plug and play"; that is, one should simply drop them into the player and go.

With the exception of this severe limitation, this is a remarkable disk, packed with information which can be accessed in a variety of places. The superb hypertext links allow one to access information about plants through the scientific or common name, through the medicinal uses of the plants, or through a "Card File" that allows systematic exploration of the included plants. All terms that are not obvious are highlighted in color. Clicking on these highlighted terms produces a definition (red) or a citation (blue). The descriptions of the plants and their uses are detailed, accurate, and accompanied by beautiful photographs taken in a variety of contexts. Pressing on the "Mixed With" icon gets a listing of the plants or materials generally mixed with this plant in medicinal preparations. Each of these are also hypertext linked to their associated data. Finally, the "Help" icon provides a page of definitions for each of the icons. I would recommend an initial visit here because the meaning of some icons is not immediately obvious.

These two compact disks (CDs) represent an important and interesting departure from the usual approaches to recording ethnobotanical information. While printed formats continue to be the primary method of recording traditional plant knowledge, the rapid emergence of electronic publishing ("multimedia") represents a significant new orientation that has the potential to more accurately reflect the perspectives of those peoples and communities most knowledgeable about the plants. The technology of multimedia provides the opportunity to present information in a fashion distinctly different from the essentially linear format imposed by written language. Conceptually, there are no limits to the way in which the material can be organized. By using a variety of materials — photos, text, sound recordings, video — hyperlinked according to the designer's orientation, it is possible to present the material in essentially any format, structure, or style desired.

The opportunities provided by multimedia technology, such as CDs, are especially exciting at this time, when many indigenous peoples are striving to preserve ethnobotanical knowledge. For example, many communities are establishing or enhancing gardens, often as houseyard gardens or as community-organized and maintained gardens, featuring those plants considered most significant to the preservation of knowledge of traditional plant use. While these are important efforts, they necessarily involve removing plants from their environmental context and planting and maintaining those species in garden settings. The removal of a culturally significant plant from its "natural" habitat, may in turn, lead to the loss of knowledge regarding the ecology of that plant. Fortunately, the dynamic format and massive information storage capacities of electronic publishing provide the opportunity to include a wide range of knowledge about individual plants and their associations which are not as easily captured in a printed format. This base of information can serve as an archive and elaboration of knowledge on the plants in the garden, as well as on a wider range of plants and their associations than can be reasonably maintained in a garden. Independent of presentation formats, many databases now will support images, text, and sounds as part of the database, allowing for powerful and innovative archival and education projects.

The World Wide Web is becoming increasingly important as a medium in which to store and display ethnobotanical knowledge, particularly information on medicinal plants (see, for example, Michael Moore's medicinal plant home page). However, there are some major structural limitations to the Web that reduce its value: it is expensive to develop and maintain a site and it is expensive to access the Web due to computer costs and connect charges. Consequently, the Web is largely unavailable in many parts of the world lacking adequate phone lines, computers, and technical expertise. At present, then, CDs represent an important new medium for permanent storage and distribution of ethnobotanical material that can be managed and controlled by local populations. New technologies in CD design, such as Digital Versatile Disk (DVD), will greatly enhance the storage capacity of CDs, further improving their utility. Furthermore, CDs are portable, accessible, and relatively inexpensive to produce and purchase and so can be the electronic equivalent of the locally published books so widespread in the developing world.

With the increasing accessibility of multimedia, ethnobiologists should be collecting data with this possibility in mind. Whether the effort is directed to CDs or to the World Wide Web is not really the issue. What is important, I believe, is that all collectors should be thinking about these multimedia approaches in their research activities, gathering not only the usual information (names, uses, preparations, administrations, etc.), but also detailed narratives about the ecological context of the plants (audio recorded where possible), detailed photographic and/or video documentation of plant use, and ecological and use contexts.

In short, the use of these new data archiving and presentation methods permit not only a broader and deeper recording of traditional knowledge, but also recordings that better reflect indigenous conceptions of the environment and its resources.

Pioneering conceptual work by researchers such as Virginia Sandoval (1990), William Balée (1994), Eugene Hunn (1990), Brent and Elois Ann Berlin (1996), Thomas Smith (1996), and others on dynamic, indigenously-oriented preservation of knowledge has come a major step closer to reality in these two CDs. I personally am excited by the prospects represented here and look forward to other efforts. The prices on both are attractive (less than US$30), making them as accessible as many books with similar information. As of this writing, neither disk is distributed in the United States and must be ordered directly from the producers.

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BOOKS FOR REVIEW — SEPTEMBER 1997

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Journal of Ethnobiology 17(1):147-148 Summer 1997

SHORT COMMUNICATION

VEGETABLES, ROOTS, AND WISDOM IN OLD CHINA

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Jennifer Sepez and Eugene Hunn recently discovered a fascinating quotation: "Only those who can appreciate the least palatable of vegetable roots know the meaning of life." It was ascribed to a Chinese sage, Hung Tzu-ch'eng. To track it down, they contacted E.N. Anderson, who in turn sought out Yenna Wu, colleague at University of California, Riverside, and an expert on Chinese literature. She was able to direct him to two translations, where further lore about this quote could be found.

The first of these, *A Chinese Garden of Serenity* (trans. by Chao Tze-chiang; Mount Vernon, New York: Peter Pauper Press, 1959) was the actual source of the quote. It is used as an epigraph on the title page. This book is very short (60 small pages) and presents excerpts from Hung's thought, freely translated.

Fortunately, the other book, *The Roots of Wisdom*, translated and introduced by William Scott Wilson (Tokyo: Kodansha International, 1984), gives a complete scholarly translation with excellent annotations. Scott's punning title beautifully captures Hung's own double meanings.

The quote had a history. It was not by Hung: he himself used it as an epigraph. It was actually written by one Wang Hsin-min, a philosopher of the Sung Dynasty (960-1258). Wang is almost totally obscure, but the remark achieved fame because it was quoted by Chu Hsi (1130-1200), the great Confucian philosopher whose thought shaped Chinese life (for better or worse) from his time until now. Scott's more literal translation reads: "If one is able to chew the vegetable greens and roots well, he should be able to do all things" (Hung 1984:9). Wang was obviously thinking of one of Confucius' most famous remarks: "To eat plain foods [lit., vegetables] and drink water, to bend an elbow for a pillow: is there also no pleasure in this? But to be unrighteous and thus gain wealth and rank: I regard these just as floating clouds" (Scott's translation; Hung 1984:154). Chu Hsi commented on Wang's tagline: "In looking at the men of today, there are many who run counter even to their own true minds because they are unable to chew the vegetable roots" (*ibid.*).

Hung's book is titled *Ts'ai Ken T'an* in Chinese; this literally means "Edible-greens and Roots Discourses." Essentially nothing is known of Hung except this one book, which was published in 1596 — significantly, almost the same time as Li Shih-ch'en's *Pen-ts'ao Kang-mu*, China's greatest herbal and the greatest pre-modern botanical work in any language. There has even been some speculation that Hung did not exist, his name being merely a *nom de plume* of someone else. However, Hung had his own pen name, Hung Ying-ming, and it seems unlikely that someone developing a fictional persona would have given it two names.

Hung's book is, of course, not about vegetables. It barely mentions food at all. It is, rather, a moral and meditative tract. Based on Wang's and Confucius' lines, it idealizes the simple life and criticizes fame and fortune. Hung advocated a stoical, realistic outlook, but also full enjoyment of the real satisfactions of life: flowers in spring, simple foods, meditating over a favorite book, and the like. Such a life is *tan*, a word that can mean either "insipid" or "subtly and delicately flavored"—depending on your perception.

The Chao translation is subtitled "Reflections of a Zen Buddhist," but Hung was not a Zen Buddhist. He was actually an eclectic Confucian, grafting some Buddhist images onto a Confucian "root." He advocates moderation, lack of ambition, and being good for its own sake; he explicitly rejects Buddhist quietism and retreat. His ideal person actively helps people, but expects no return from them (while, on the other hand, returning to the full any favor he or she may receive from others). Those who know the joys of plain vegetables will also be free enough from the world to see the best in people and things, and to extend trust. Trials and betrayals are learning experiences, not devastating setbacks. By contrast, those involved in the hunt for status and wealth have to be suspicious all the time. They have too much to lose.

The true sage hides his or her abilities, but never hides friendship and warmth toward people. He or she adapts to circumstances, but never compromises on basic principles. Similarly, the sage avoids confusion and overcommitment, yet manages an active life of service to humanity— being no more attached to quietness than to action.

Thus, what seemed to be a tract on ethnobotany turned out to be a thoughtful and moving guide to humanity. As another Chinese sage once said in a similar case: "I came to learn about farming, but stayed to learn about life."

NOTICE TO AUTHORS

The *Journal of Ethnobiology*'s revised "Guidelines for Authors" appears in Issue 16(1) on pp. 124–127. If you need a copy of these Guidelines you may request a copy from the Editor. Careful scrutiny of recent issues of the *Journal* should provide appropriate stylistic models for any manuscript you may wish to submit.

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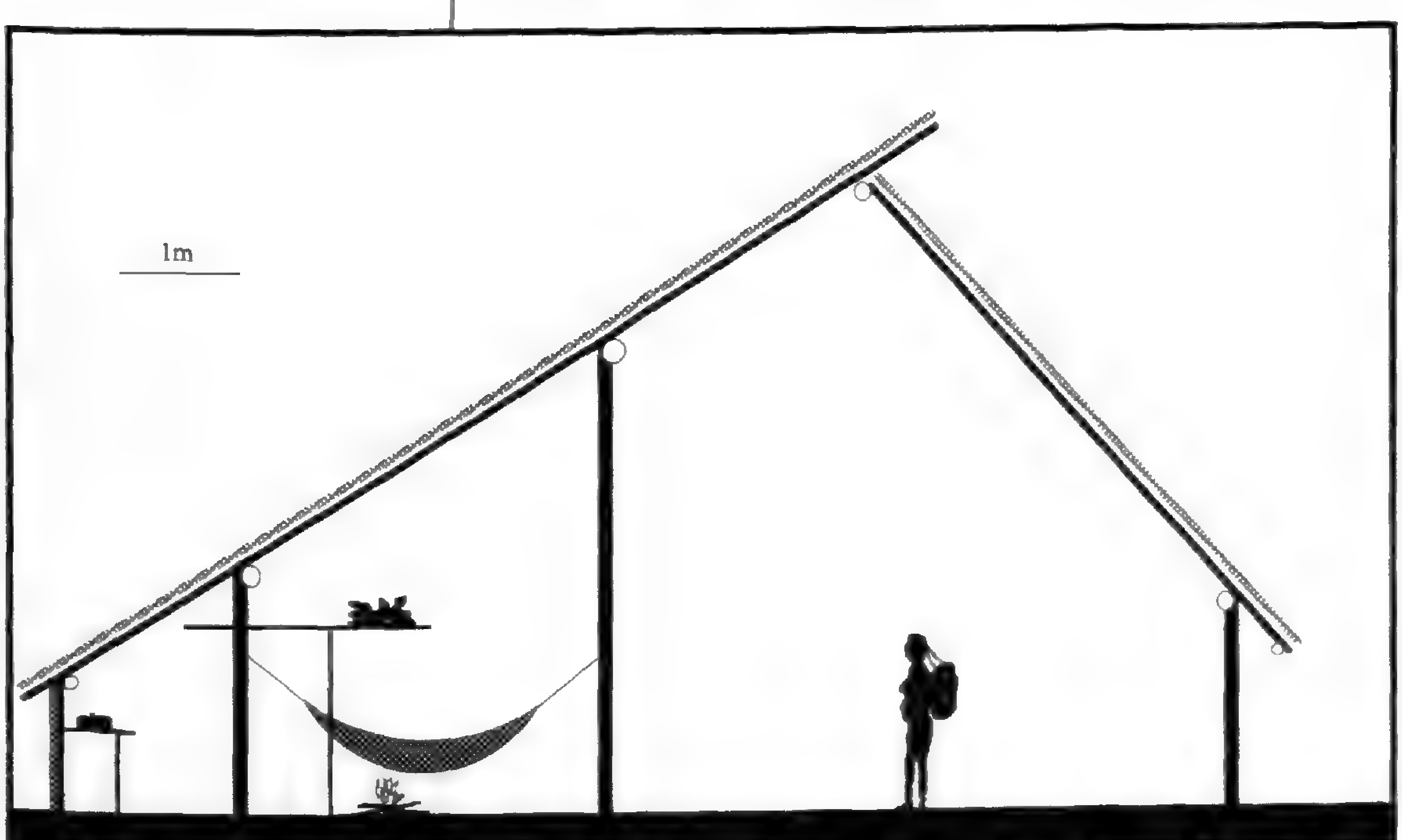

Yanomami Round-House

Volume 17, Number 2 Winter 1997

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ISSN 0278-0771

COVER ILLUSTRATION: Cross-section of the ***Watoriki*** round-house (to scale), showing the principal components (excluding thatch details), from Milliken and Albert this issue, pg. 221.

Journal of Ethnobiology

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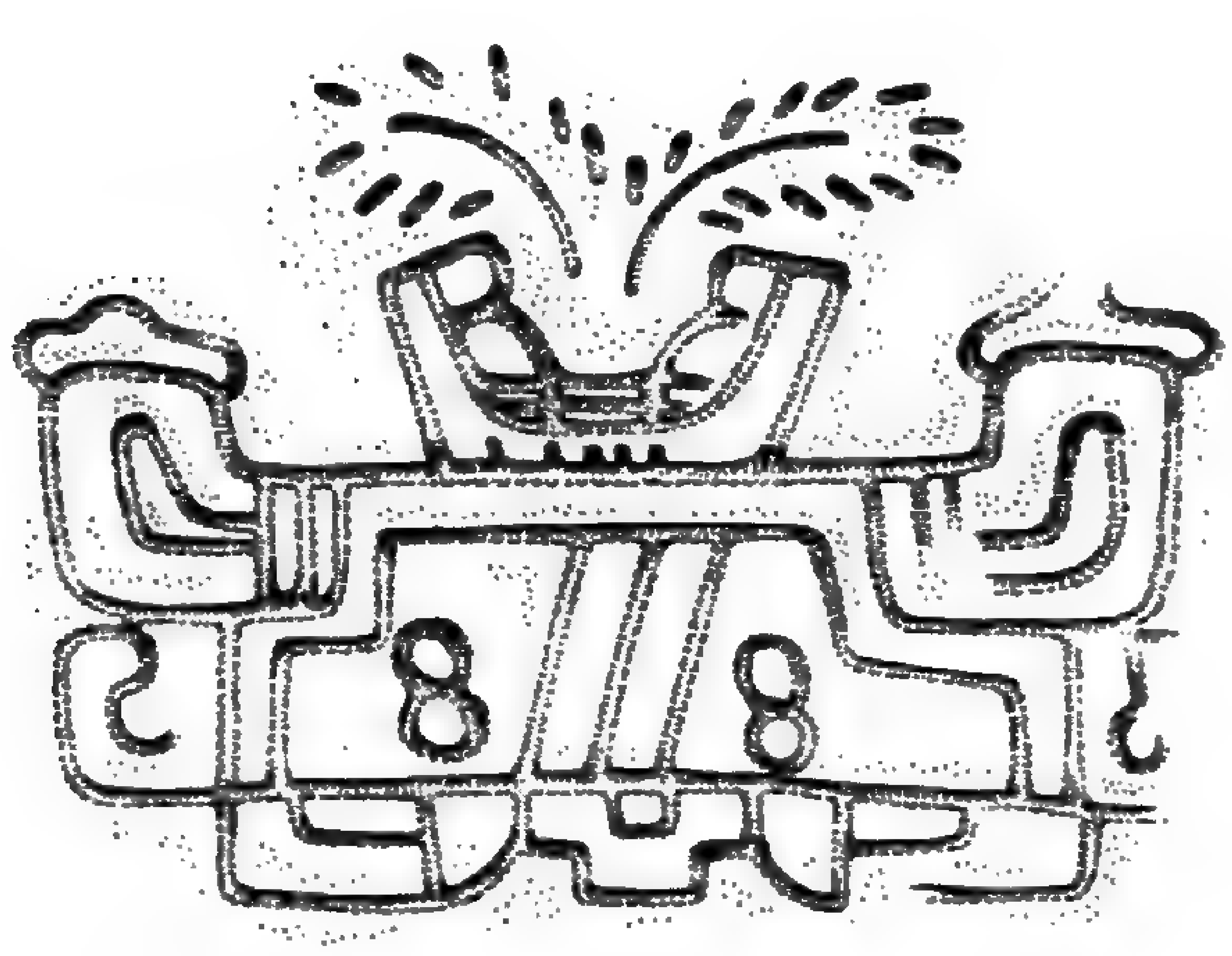
ETHNOBIOTICA

By the time you read this I will have completed my third year as editor of the *Journal of Ethnobiology*. It has not been easy. Editing the *Journal* is not, in my opinion, a proper job for one person, already employed full-time. I'm afraid to count up the hours it has consumed. Hardest has been battling the two-headed monster of schedule and budget: staying on schedule and within the budget. We briefly got on schedule with Volume 16, Number 1, but then slipped seriously into the red. I was struggling to learn what things cost and the relationship between an editorial decision and a bill we would receive some months later. There were failures in communication with those who composed, printed, and mailed the journal. One complex table had to be redone in page proof at a cost of $2000! I was real green, and I don't mean conservationist.

Just as I was getting the hang of it, I got my research grant and took off for a year in Mexico. I had then to coordinate all phases of the operation from afar via e-mail. Without Jennifer Sepez and Brian Van Hoy, my student assistants, I would have gone down with the ship. I thank my department and the Graduate School at the University of Washington for funding. But once more we slipped inexorably behind schedule, even as we got the budget under control. Volume 17, Number 1 was right on budget but four months late. I pray that Volume 17, Number 2 will catch us up two months and stay within the budget. My goal is to finish Volume 18 at the end of 1998 on time and under budget. I will then gratefully pass the torch to my successor, as yet unnamed.

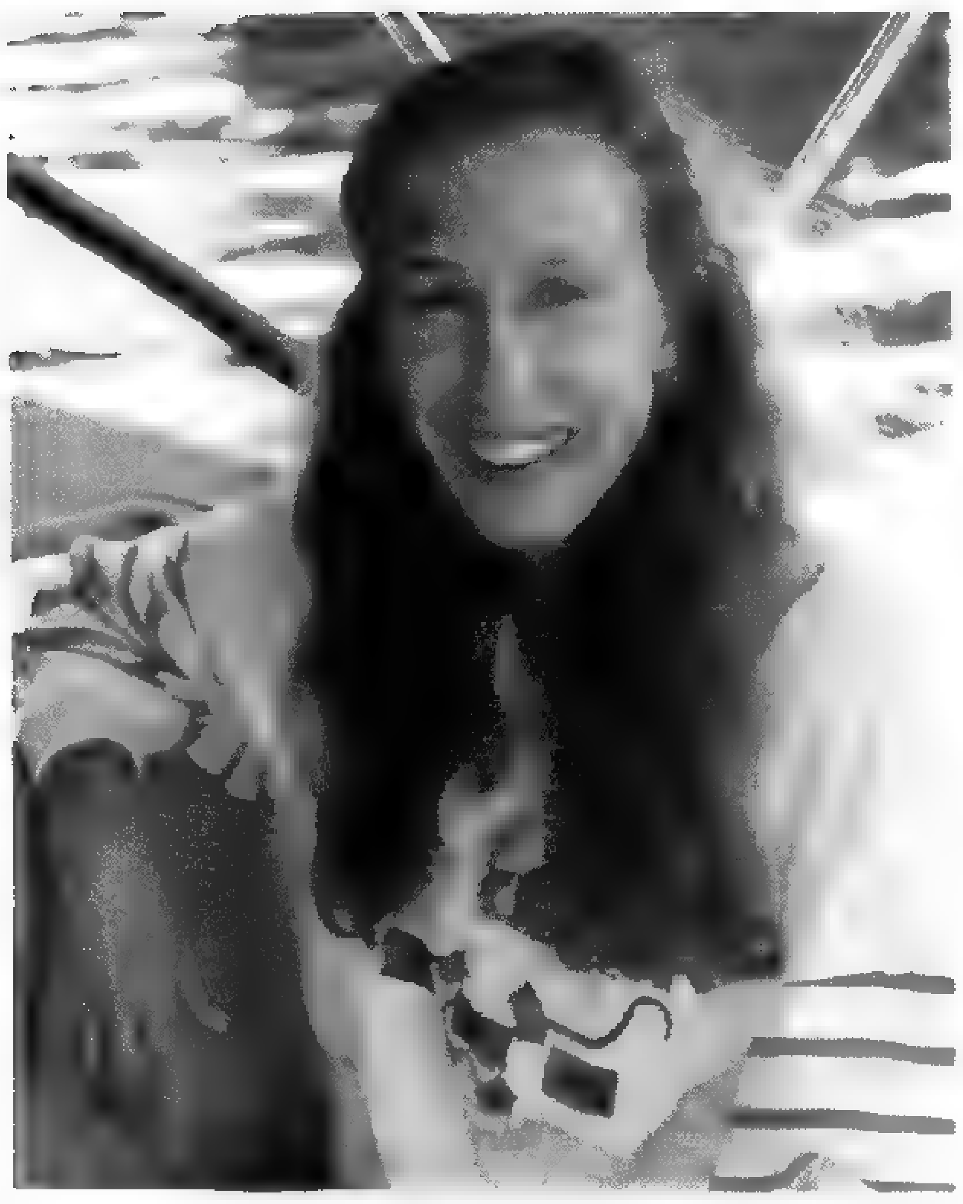
Despite the frustrations and the daily burden of the job, I take pride in the new cover design, the always diverse and stimulating content, and the fact that subscriptions seem to be on the increase. I believe that will be our salvation: more subscribers means reduced cost per subscriber, which should free our resources for expansion and innovation. I welcome any and all comments, suggestions, and criticisms as, in truth, this journal belongs to all of us.



Eugene Hunn

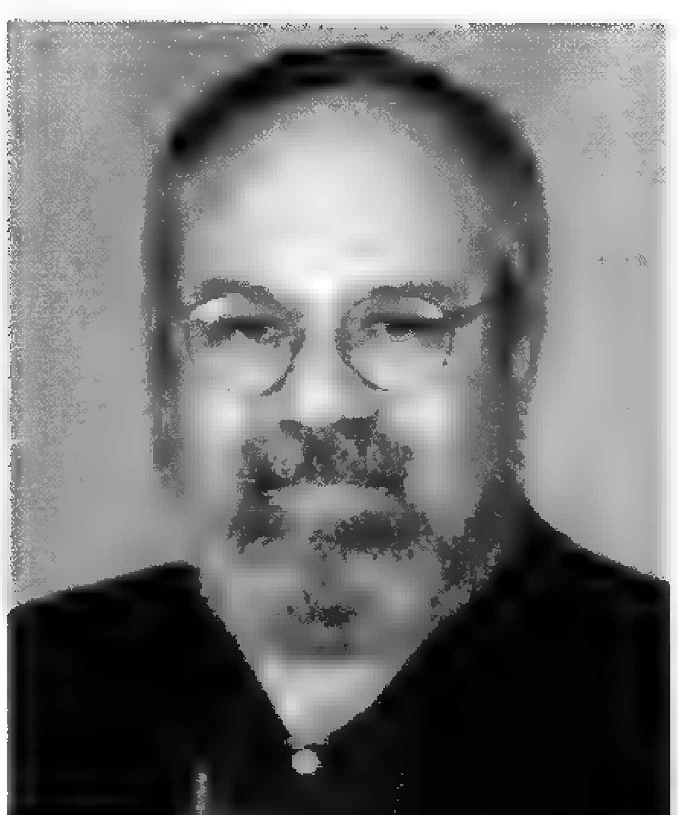
Toponym glyph from Monte Albán, Oaxaca for Miahuatlán 'place [in the water] of the maize tassels', approximate Nahuatl translation of the local Zapotec name, ***Guìzdòo.*** This town was subject to the rulers of Monte Albán between 200 BC and 100 AD.(Joyce Marcus, "Zapotec writing," Scientific American, February 1980, pg 56). Hunn's current ethnobiological research is at San Juan Mixtepec 50 km se of Miahuatlán.

AUTHORS IN THIS ISSUE



M. KAT ANDERSON

Kat Anderson is an ethnoecologist with the National Plant Data Center of the USDA's Natural Resources Conservation Service. She studies the plant uses, harvesting strategies, and land management practices of indigenous peoples on wildlands and assesses the potential application of traditional ecological knowledge for restoring endangered ecosystems and species. A unique feature of her research is the use of the western scientific experimental approach to simulate indigenous horticultural practices and assess their potential ecological effects on the productivity and yield of wild plant populations. She is currently an assistant researcher on the faculty of the Department of Environmental Studies, University of California, Santa Cruz, Santa Cruz, CA 95064.



FELIX G. COE and **GREGORY J. ANDERSON**

FeliX G. Coe earned his Ph.D. in Botany at the University of Connecticut. He is an Assistant Professor of Biology at Tennessee Technological University. Dr. Coe's research interests include floristics and ethnobotany of Mesoamerica and the southeastern United States. Dr. Coe is a native of eastern Nicaragua, where most of his recent research has been conducted. He has also studied the ethnobotany of the Garífuna, Rama, and Sumu. Several journal articles report the results of this previous work. He is now working on a book in English and Spanish on the medicinal plants of the eastern Nicaraguan region. **Gregory J. Anderson**, Distinguished Alumni Professor at the University of Connecticut, conducts research in economic botany, plant reproductive biology, and systematics. He has specialized in Latin American Solanaceae, with a focus on the domestication and evolution of the pepino (*Solanum muricatum*). He is past president of the Society for Economic Botany.

WILLIAM MILLIKEN and **BRUCE ALBERT**

William Milliken has conducted ethnobotanical research and botanical surveys in rainforest areas in Brazil, Indonesia, and New Guinea since 1987. Currently employed as a freelance researcher and writer, he spent four years at the Royal Botanic Gardens Kew as ethnobotanical Research Fellow, during which time the present study was conducted. **Bruce Albert**, anthropologist, is a senior researcher of the Institut Français de Recherche Scientifique pour le Développement en Coopération (ORSTOM, Paris). He has worked since 1975 with the Yanomami Indians of Brazil, conducting ethnographic research (ritual and political organization, ethnohistory and social change, cosmology and ethnicity) and participating as consultant anthropologist in field projects (health, education) or legal initiatives (land and human rights) for the Yanomami and Brazilian or European support NGOs.

THOMAS POZORSKI and **SHEILA POZORSKI**

Thomas Pozorski and **Sheila Pozorski** are both Professors of Anthropology in the Department of Psychology and Anthropology at the University of Texas-Pan American in Edinburg, Texas. They have been conducting archaeological fieldwork on the north coast of Peru since 1970, working at sites ranging in date from 5000 B.C. to A.D. 1750. Results of their investigations have been published in two books and 50 articles. Their current project is the investigation of the rise of prehistoric civilization in the Casma Valley. Their interests include the development of complex society, Andean archaeology, subsistence and ecology, prehistoric agriculture, archaeological ethnobotany and ethnozoology, and archaeological method and theory.

VALERIA SOUZA, CLAUDIA SILVA, VALERIE BOUCHET, ALDO VALERA, JENNIFER BAIN, ERICKA MÁRQUEZ, and **LUÍS E. EGUIARTE**

Valeria Souza directs the Laboratory of Experimental and Molecular Evolution at the Universidad Autónoma de México. With funding from a MacArthur fellowship, she and her colleagues analyze the ecology, population genetic structure, and coevolution of bacteria and plants, with special emphasis on how crop management practices affect the interactions of symbiotic bacteria *Rhizobium* and their bean hosts. In this way they hope to improve local agricultural systems. Dr. Luis E. Eguiarte designed the present project, Jennifer Bain conducted ethnographic research, while the remaining students were involved in various ways, especially helping with the genetic analyses. Left to right in the photograph are Claudia Silva,, Aldo Valera, Jennifer Bain, Valeria Souza, Luis Eguiarte, and Carlos Llorens, with Jordan Golubov in front. Valérie Bouchet and Ericka Márquez had not yet joined the team when this photo was taken.

ROBERT M. YOHE, II

Robert M. Yohe, II is currently the State Archaeologist and Interim State Historic Preservation Officer for the state of Idaho. He also serves as Director of the Archaeological Survey of Idaho and Adjunct Assistant Professor of Anthropology at Boise State University. Yohe holds a doctorate in Anthropology from the University of California, Riverside and has spent nearly two decades conducting archaeological research in the deserts of southeastern California and the northern Great Basin. He was the Director of the Cultural Resources Facility (now the Center for Archaeological Research) at California State University, Bakersfield when the archaeological investigations in Death Valley described in this volume were conducted in 1992.

Journal of Ethnobiology 17(2):149-169 Winter 1997

FROM TILLAGE TO TABLE: THE INDIGENOUS CULTIVATION OF GEOPHYTES FOR FOOD IN CALIFORNIA

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ABSTRACT.—One of the oldest forms of tillage in the world is the digging of subterranean organs of wild plants for food and other purposes. Many areas were managed for increased densities and abundances of wild plants with edible corms, bulbs, tubers, and rhizomes. The horticultural techniques of digging, replanting, and sparing, in conjunction with larger-scale habitat management, created ecological effects at the species, population, community, and landscape levels. California provides a vivid example of an area where tillage was an important element in a comprehensive land management system that was in place for millennia. It is hypothesized that native California tillage activities mimicked natural disturbances with which plants coevolved, and played an ecological role that is now vacant in many wildlands, where Native Americans can no longer harvest and manage plants. Their land management system needs to be studied, described, interpreted, and experimentally mimicked to better understand indigenous disturbance regimes. It is suggested that some wildland areas would benefit from the reintroduction of management and harvesting regimes that authentically mimic indigenous techniques.

RESUMEN.—Una de las formas más antiguas de labranza en el mundo fue excavar los órganos subterráneos de plantas silvestres para obtener alimento y para otros propósitos. Muchas áreas fueron manejadas para incrementar la densidad y abundancia de plantas silvestres con cormos, bulbos y tubérculos comestibles. Las técnicas hortícolas de escarbar, replantar y dejar plantas para que proliferen, junto con el manejo del hábitat a mayor escala, crearon efectos ecológicos al nivel de especie, población, comunidad y paisaje. California ofrece un ejemplo elocuente de un área donde la labranza fue un elemento importante en un sistema integral de manejo del terreno que operó a lo largo de milenios. Se plantea como hipótesis que las actividades de labranza de la población indígena de California simulaban las perturbaciones naturales con las cuales habían coevolucionado las plantas, y que jugaban un papel ecológico ahora vacante en muchas áreas naturales, donde los indigenas ya no pueden cosechar y manejar las plantas. Sus sistemas de manejo del terreno deben ser estudiados, descritos, interpretados y reproducidos experimentalmente para entender mejor los regímenes indígenas de perturbación. Se sugiere que algunas áreas naturales se beneficiarían de la reintroducción de regímenes de manejo y cosecha que imitaran las interacciones indígenas de una manera auténtica.

RÉSUMÉ.—Une des plus anciennes formes de labourage au monde consistait à fouiller la terre pour en extraire les organes souterrains des plantes sauvages utilisés comme aliments ou à d'autres fins. Plusieurs endroits étaient gérés afin d'augmenter en densité et en abondance les plantes sauvages qui comportaient des rhizomes, des bulbes et des tubercules comestibles. Les techniques d'horticulture d'extraction, d'ensemencement et de jachère associées à une gestion de l'habitat à grande échelle a produit des effets écologiques aux niveaux de l'espèce, de la population, de la communauté et du paysage. La Californie fournit un exemple frappant d'un endroit où le labourage était un élément important dans un système global de gestion des terres, en place depuis des millénaires. Nous émettons l'hypothèse que les activités de labourage des Amérindiens de la Californie mimaient les perturbations naturelles du milieu où coévoluaient les plantes et ont joué un rôle écologique qui maintenant fait défaut à plusieurs terres sauvages où les autochtones d'Amérique ne peuvent désormais plus récolter et gérer les plantes. Leur système de gestion des terres doit être étudié, décrit, interprété et mimé de façon expérimentale afin de mieux comprendre les régimes de perturbation autochtones. Il est suggéré que quelques endroits sauvages pourraient bénéficier d'une réintroduction des régimes de gestion et de récolte qui mimeraient de façon authentique les interactions autochtones.

INTRODUCTION

The digging of underground plant parts for food is still a common activity in many indigenous societies around the world. The Dena'ina of south-central Alaska, for example, dig the edible tubers of Alaska carrots (*Hedysarum alpinum*) with a moose leg bone or horn, cut off the thick end of the tuber, and then bury it to insure that more potatoes will grow (Kari 1987:127). The Tarahumara of the mountains of Chihuahua gather wild onions (*Allium* spp.) with a digging stick, then release the lateral daughter bulbs to perpetuate the plant (Bye 1985). The Australian aborigines of Victoria still dig up the tubers of *murnong* (*Microseris scapigera*), and gathering areas historically were burned over to increase production (Gott 1983). The Indians of the Pacific Northwest selectively harvest camas (*Camassia* spp.) bulbs, leaving the smaller ones behind for future harvests (Turner and Kuhnlein 1983:241). In California, these underground swollen stems (known as bulbs, corms, tubers, or rhizomes) traditionally provided a very important source of carbohydrates, vitamins, minerals, and fiber in the diet. Today, there are a small number of harvesters in some California tribes that still gather edible bulbs and corms, spare whole plants, and replant cormlets and bulblets to allow for future regeneration (Anderson 1993). In the anthropological literature on California the generic term applied to these plants was "Indian potatoes" or "root-crops." In the botanical literature they are called geophytes—vascular plants that die back to underground storage organs during periods unfavorable for growth (Rundel 1996).

Embedded within such plant-human interactions were ancient horticultural techniques, adopted cross-culturally, that ensured long-term harvests of wild geophytes. It is hypothesized that even before the full development of agriculture, humanity's relationship with edible geophytes had already shifted from one of predation to one of mutualism. Over long periods of time, tillage, selective harvesting, and burning had subtle, yet nonetheless profound, ecological impacts at the species, population, community, and landscape levels within a multitude of habitats in different parts of the world. Digging up the subterranean organs of wild plants for foods was perhaps the oldest form of tillage, one that became the precursory management technique and the ecological foundation for the development of root crop agriculture in some areas. The digging of subterranean plant parts was traditionally a female responsibility in most North American cultures, and the role of women in vegetation management in North America has often been undervalued and underrecorded (Hunn 1981; Hunn and French 1981).

Some of the best evidence for such management comes from California, where root crops were a staple food in almost every indigenous society. These cultures utilized fire, the sparing of plants, the replanting of propagules, and other techniques to promote desired densities and to perpetuate high population levels of certain species. The management of diverse geophytes for food in California has been selected as an example that suggests the sophistication and complexity of past resource management systems that probably shaped the ecology of wildlands in California. This paper provides an overview of the role of geophytes in California's indigenous subsistence economies, the horticultural practices that were applied to "wilderness" areas, and the potential associated ecological effects that might have resulted from them. It then identifies three types of research that are needed to reconstruct the details of this interaction: ethnobotanical research, observational studies, and field experiments.

INDIAN USES AND HARVESTING OF GEOPHYTES

From the northwestern coasts to the southeastern deserts, "root-crops" comprised a dietary staple in almost every region of California (Barrett and Gifford 1933; Chesnut 1902; Driver and Massey 1957). The vegetational resources of California helped sustain some of the highest native population densities in North America (Heizer and Elsasser 1980). Geophytes were utilized for food, dyes, glues, medicines, and other purposes (Figures 1, 2), although only food uses are consid-

FIGURE 1.—An unidentified Native American couple from California digging the tuber of *Lomatium californicum*, probably used medicinally and ceremonially.

FIGURE 2.—A close-up view of the medicinal tuber of *Lomatium californicum*. Photograph taken by J.P. Harrington, courtesy of the Santa Barbara Museum of Natural History.

FIGURE 3.—The bulbs of mariposa lilies (*Calochortus* spp.) were once eaten by numerous California Indian tribes. Photograph by Kat Anderson.

FIGURE 4.—The corms of golden brodiaea (*Triteleia ixioides*) were dug in the central Sierra Nevada by the Sierra Miwok. Photograph by Kat Anderson.

ered here. The most prominent genera that were gathered for their edible underground swollen stems in California included *Allium, Brodiaea, Calochortus, Camassia, Chlorogalum, Dichelostemma, Lilium, Perideridia, Sanicula,* and *Triteleia* (Figures 3, 4).

The harvesting of edible geophytes was accomplished with a hardwood digging stick, often fire-hardened for additional strength. After European contact, gatherers began to use a pointed iron bar with a handle, a modern adaptation of the wooden digging stick (Fowler 1986). The digging of plant parts for food was generally the task of women, but sometimes communal gathering parties of whole families were organized to participate in exceptionally important plant harvests (e.g., the Sierra Miwok; Barrett and Gifford 1933). Tubers and bulbs were (and continue to be) harvested in the spring before flowering, during flowering, and during seeding, depending upon species, use, tribe, and individual family. Oral interviews conducted by myself (Anderson, interview notes, unpublished), Heffner (1984), and others confirm that some edible underground parts are still harvested today by some gatherers in various tribes (Figure 5).

FIGURE 5.—The delicate-tasting tubers of *Sanicula tuberosa* are still gathered among the tall ponderosa pines by the Southern Sierra Miwok in the Sierra Nevada and eaten raw. Photograph by Kat Anderson.

The extreme importance of geophytes in the subsistence economies of native groups is reflected in their inclusion in lunar calendars, in special ceremonies that honored these ethnobotanically important plants, and in their mention in the mythologies of various tribes (Schulz 1954:60). For example, in the Pomo lunar calendar, the month of ***butich-da*** (June) was named for the mature bulbs of a unidentified species in the *Brodiaea* complex (Kroeber 1925:209). In one Bear River tale, Coyote leads his grandmother to a place where there are plenty of potatoes; she takes her digging stick and goes with him and begins digging. According to a Northeastern Maidu creation story:

> "The creator walked upon the new made world, creating living things.... As he sat resting and eating he took what remained of plants he had been eating and cast them across the meadows and said that was the place where Indians would dig roots" (McMillin 1963).

The food offered to early missionaries and explorers frequently consisted of bulbs of *Chlorogalum* and corms in the *Brodiaea* complex (Latta 1977: 65; Kroeber 1925:277). Bulbs were also sometimes recorded as emergency back-up foods during lean acorn years (Powers 1877:423).

DECLINING GEOPHYTE POPULATIONS

A number of the edible geophytes that traditionally have been important in the subsistence of California Indians are declining in population size and density in the areas where Indians used to gather them. The Paiute of Surprise Valley in northeastern California commented in the early 1930's that, "Nowadays there is little root gathering, one very good reason being that the plants are no longer to be found" (Kelly 1932:101). In 1938, ethnographer Gladys Nomland reported that the Bear River Indians of northwestern California could no longer gather camas, as a result of the cultivation of fields, and stock grazing (Nomland 1938). According to Roger Raiche (personal communication 1988),[1] blue camas used to be more common in the San Francisco Bay area, but is now hard to find. The decline of this and other geophyte populations appears to be due to recent changes in the land use practices of Anglo-American settlers, rather than to climatic changes or Indian exploitation.

Some of the possible factors that have contributed to this decline in numbers of tubers and bulbs would include livestock grazing; fire suppression, urban development, agriculture, introduced weeds, changes in water regimes, and commercial overexploitation. Furthermore, the recent introduction of feral pigs (*Sus scrofa*) to California has undoubtedly created ecological effects on different ecosystems which have hardly been studied by scientists (Barrett 1990). An overabundance of feral pigs, an animal not native to California, may lead to a decrease in bulb populations, since pigs do not discriminate between bulbs and bulblets, and intense rooting might decrease the productivity of wild bulbs. Fire suppression policies that have been enforced for decades in numerous ecosystems also may have increased shade and plant competition and decreased the population size of some geophytes. In areas subjected to urban development or agriculture, bulbs and corms completely disappear; the uprooting caused by plows and tractors allows them to desiccate in the sun. Perhaps these geophytes can only survive exposure to moderate amounts of disturbance.

The possibility that the historical levels of rhizome, bulb, tuber, and corm production that were achieved at well-known subsistence locations may have been mediated by human intervention is particularly intriguing (Anderson and Nabhan 1991). Although they did not realize it, the colorful landscapes of California that so impressed early writers, photographers, horticulturalists, and landscape painters were essentially edible landscapes. *Plagiobothrys* spp., *Calandrina* spp., and yellow composites were relished for their seeds; *Amsinckias* were harvested for their greens; mariposa lilies (*Calochortus* spp.), blue camas (*Camassia quamash*), yampah (*Perideridia* spp.), and brodiaeas (*Dichelostemma* spp., *Triteleia* spp., and *Brodiaea* spp.) were dug for their delectable bulbs—and all were harvested in quantities that seem unimaginable today.

According to many ethnographic accounts, bulbs and corms were gathered in great abundance. Latta (1977:45) stated that among the Yokuts, several varieties of Brodiaea were dug and "eaten by the ton." The lemon-yellow globe tulip (*Calochortus pulchellus*) —which is now rare and endangered—was common in open woods and was gathered in "considerable quantity" by the Indians of Mendocino County (Chesnut 1902:323). Uldall and Shipley (1966) recorded an abundance of blue camas that was gathered by the Nisenan in the early days.

Traditional gathering sites were visited annually, over long periods of time, apparently without exhausting the resources (Latta 1977; Gayton 1948; Pilling 1978). There are also references to gathering tracts that were specifically owned and maintained by particular families; the Atsegewi, for example, laid claim to particular patches of edible roots (Kroeber 1925:317). Sometimes a gathering site even carried the name of the plant that was being gathered. ***Ket'-en chou*** was a name given to a valley in Mendocino County because of the large numbers of ***Ket'-en*** (blue camas) plants that occurred and were gathered there by the Wailaki (Chestnut 1902:327). One of the brodiaeas was so important to the Wiyot as a food source that its name was given to both Lindsey Creek and to a camp site near its head where many of the corms were gathered at certain seasons (Loud 1918:234). These and similar accounts suggest the abundance and density of geophytes in the places where they were gathered.

Chestnut (1902:323,329) reported that gathering sites contained up to 200 Ithuriel's spears (*Triteleia laxa*) per square foot and stated that "great tracts" of mariposa lilies (*Calochortus venustus*) grew on open hillsides throughout Mendocino County and furnished "potatoes" to the Indians. Pedro Font noted in 1776 that great quantities of soaproot (*Chlorogalum pomeridianum*) were eaten by the Hulpumne Yokuts in the Central Valley: "The amole is the food which most abounds, and the fields along here are full of it" (Latta 1977:65). One would expect that the continual use of a traditional site over time would cause depletion of the bulb resources. Thus, this phenomenon of plant abundance at traditional gathering sites suggests that the gathering was judicious and involved management, and therefore probably had benign or even beneficial effects upon populations of geophytes.

GEOPHYTES AND DISTURBANCE

Virtually every ecosystem in California has evolved in association with disturbance (Christensen 1988). Lightning fires, tree windfalls, herbivory, landslides, and flooding are some of nature's processes that not only destroy but renew vegetation. Studies in South Africa, where Mediterranean ecosystems similar to those found in California exist, have shown that geophytes often thrive in disturbed environments. Certain geophytes, such as *Micranthus* spp., have evolved specific adaptations in response to being a food source for mole rats (*Bathyergus* and *Cryptomys* spp.). Ecological field research has demonstrated that highly palatable corms are harvested by mole-rats, eaten on route to the burrow, and cached for later eating. In the process, some of the cormlets sited on the stem above the corm as well as some of the corm segments are dispersed, thus ensuring the plant's future existence. Some scientists have, in fact, hypothesized that the species-rich geophyte vegetation of the western Cape might be partially a result of the activities of burrowing rodents (Lovegrove and Jarvis 1986).

In California numerous mammals regularly dig up the bulbs, corms, and tubers of herbaceous plants, including black bears (*Ursus americanus*), mule deer (*Odocoileus hemionus*), exotic pigs, and pocket gophers (*Thomomys* spp.) (Chestnut 1902; De Nevers and Goatcher 1990; Hunt 1992). Many of these geophytes reproduce vegetatively through offsets, some of which may be effectively dispersed by animals while they are in the process of eating the mature, larger corms or bulbs. George Works and others have observed areas where wild pigs have rooted; the bulbs, a year or two later, "are thicker than they ever were" (Work 1995). The late James Roof put forth the hypothesis that pocket gophers had a mutualistic relationship with blue dicks (*Dichelostemma capitatum*), since gophers were scattering the cormlets and thinning the beds, which in turn benefited the dispersal of the plant, controlled overpopulation, and reduced the risk of consequent nutrient depletion (Roof 1981). An insightful Karuk story published by J.P. Harrington actually connects the gopher with the spread and abundance of tubers:

> "Sometimes they [the Karuk] see at some place a lot of Indian potatoes and then they dig in under. Behold there are lots underneath... And in the myths Gopher.... packed ***ŭ pva'amáy'av*** [tubers] around; he packed them around. ***A'ikrê^n n*** [sugar loaf bird] brought them in from Scott Valley, he brought some in for his younger brother. He said to his young brother: 'do not let my wife see you when you are eating the ***ŭ pva'amáy'av*** [tubers]...' And that is why he used to eat it upslope, upslope then, Gopher. It came up, every place he went; those were the only places where there was ***ŭ pva'amáy'av*** [tubers], the places where he went" (Harrington 1932:66).

Could Native American digging practices have effectively mimicked the disturbance regimes of other mammals? If so, the gathering of geophytes with a digging stick may have been part of a mutualistic relationship, in which both the gatherer and the plant were symbionts; in other words both benefited. The image of California Indians as incipient horticulturalists conflicts sharply with the old stereotype that was still in effect and promoted by anthropologist Alfred Kroeber as late as 1961:

> "As the Indians of California, except for two or three tribes at the southeastern border, did not practice agriculture and in fact knew nothing about it, their situation was very different. Where one gathers wild foods or depends on hunting and fishing, even where the land is fertile and fruitful, it is obvious that its resources must in time be exhausted. There is no replanting, no restocking, there is no breeding; and so the human population is bound to scatter out increasingly to find its food" (Kroeber 1961:90).

HORTICULTURAL PRACTICES

Ecologists have tended to ignore Native Americans as an ecological force actively shaping plant communities. However, plant associations are the consequence of historical processes, and it therefore behooves ecologists and land managers to elucidate the role of Native Americans as an additional source of disturbance in the landscape. Early anthropologists created a simple dichotomy in which domesticated plants were seen as "cultivated," while all wild plants were labeled "not cultivated" (Holmes 1909). Recently scholars such as Ford (1985) and Harris (1989) have proposed that plant-human interactions in the area of prehistoric food production be conceptualized as a continuum, where the focus is upon the diversity and interrelations of activities by means of which people have, in the past, exploited both wild and domestic plants and animals. This new perspective emphasizes a full spectrum of plant species ranging from wild, to cultivated, to semi-domesticated, to domesticated.

While most California Indian tribes did not practice domesticated agriculture, they utilized a variety of horticultural techniques—such as burning, pruning, sowing, tilling, and selective harvesting—which nevertheless had ecological effects at different scales of biological organization. If ethnobiologists could decipher the ecological principles embedded in these land management systems, it might help to restore disturbance regimes that maintained particular ecosystem states and drove biological diversity (Anderson and Moratto 1996). If many geophytes were adapted to indigenous disturbance regimes, the alteration or removal of those regimes might have caused populations to dwindle.

The disturbance of geophyte populations through small and large mammal activity, lightning fires, or landslides, probably activates new vegetative reproduction, increasing the size and quantity of new bulblets and cormlets. Various California Indian tribes took advantage of this plant adaptation, using human-made disturbances such as burning and tillage to stimulate growth in fragments left after harvesting (Figure 6). Geographer Carl Sauer got it half right when he called the root digging of native people "unplanned tillage" (Sauer 1967:178). Tillage is defined as the removal of earth during the harvesting of underground perennial plant organs (e.g., roots, rhizomes, corms, bulbs), often followed by the subsequent dividing of these organs and the leaving of individual fragments in the soil (Anderson and Moratto 1996). Tillage may have resulted in the enhancement of certain plants, both in quality and in numbers. The digging of edible underground parts also may have "thinned" the resource, separating smaller individuals and activating their growth, thus increasing the size of the tract, aerating

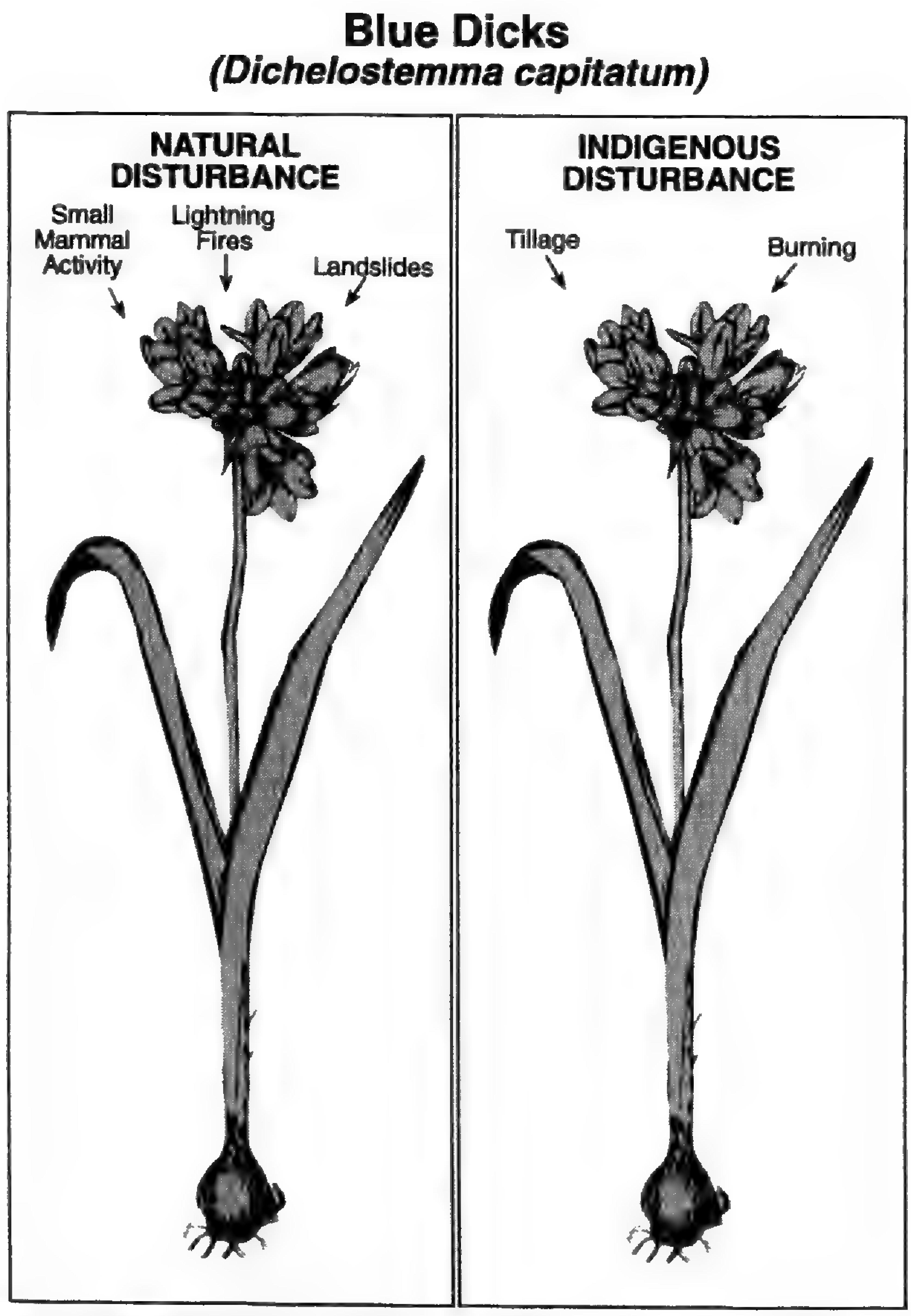

FIGURE 6.—It is hypothesized that indigenous burning and scattering of the small offsets while digging for bulbs and tubers closely mimicked natural disturbance regimes with which geophytes coevolved.

the soil, reducing weed competition, and preparing the seedbed for increased seed germination rates (Peri 1985).

Conversations with elders in various tribes in the Sierra Nevada make it clear that their procedures, passed down through millennia, were intentional—were and continue to be planned tillage. There were, in fact, five major types of activities that were designed to ensure future bulb and corm production: (1) the conscious replanting of bulblets or cormlets; (2) the sparing of whole plants; (3) harvesting after plants had gone to seed; (4) burning selected areas; and (5) irrigation. Today, for example, some individuals of the North Fork Mono and Chukchansi Yokuts tribes separate the smallest bulbs of wild onions and rebury them to insure that more will grow next year. At least one person of Yokuts and Western Mono descent breaks off soaproot plants at their roots so they will grow into new plants (Anderson, interview notes, unpublished). When harvesting different *Dichelostemma* and *Brodiaea* spp., some Wukchumni Yokuts in Tulare County and the Sierra foothills spare half of the plants in a cluster and remove the "babies" to put back in the ground (Anderson 1992).

The deliberate management of geophyte populations has been documented to some extent in the historical literature. Peri and Patterson (1979) reported that the Cloverdale and Dry Creek Pomo cultivated "root-crops" by loosening the earth with their digging sticks, which mixed surface nutrients into the ground, improved drainage and allowed a better absorption of moisture during the growing season; thus, the growth and abundance of bulbs and corms were enhanced. The Cahuilla Indians in southern California gathered the mature corms of blue dicks but were careful to replant the cormlets (Bean and Saubel 1972). The Yurok, Hupa, and Tolowa who still harvest the bulbs of *Lilium* spp. in northwestern California, selectively harvest the biggest bulbs, replanting small bulbs for later harvesting (Heffner 1984). The Northern Maidu people purposefully left some plants of wild carrot (*Perideridia* spp.) and camas to ensure future production (Potts 1977). The Luiseno in southern California transplanted certain tubers, as well as bulbous plants such as *Allium* spp. (Shipek 1977). J.P. Harrington recorded in his field notes that the Chumash on Santa Rosa Island gathered the corms of blue dicks after the plants had died back, taking only the corms and leaving the seedheads behind, thus ensuring that seed remained at the site (Timbrook 1993:56). The Owens Valley Paiute

FIGURE 7.—Photograph taken in 1931 by J.P. Harrington showing a Wintu couple, Rosa Charles and Billy George, digging for yampah (*Perideridia* spp.). Photo courtesy of the Santa Barbara Museum of Natural History. Yampah fields like this one were periodically burned by different tribes to recycle nutrients, decrease plant competition, encourage the growth of yampah, and keep surrounding vegetation from encroaching.

practiced ditch irrigation on the east side of the Sierra Nevada; a number of native plants were artificially watered to increase their productivity and abundance, including blue dicks (Lawton et al. 1993).

Habitats, as well as specific plant populations, were manipulated with deliberately-set fires. Areas were burned to reduce plant competition, facilitate gathering, recycle nutrients, and increase the size and number of bulbs and tubers (Figure 7). Bulbs may lie dormant for a decade or more waiting for fire or other favorable environmental conditions before flowering.

Schoolcraft (1860) reported that the Indians burnt off the grass in northwestern California "for the purpose of collecting aniseed [very likely *Perideridia* spp.] with greater ease." Baxley, during a visit to Yosemite Valley in the 1860s, witnessed such an indigenous fire: "Areas of *haukau* [unidentified species] were fired in Yosemite Valley by the Miwok for the purpose of clearing the ground to more readily obtain their winter supply of these 'sweet potato roots'" (Baxley 1865). Shepherd (1989:411) recorded for the Wintu that, "Where the ground has been burned, wild potatoes grow in bunches and ripen big."

Peri and Patterson (1979) reported that the Pomo deliberately burned areas to increase the production of bulbs and corms. The Chumash, Miwok, Western Mono, and Pomo burned certain areas in the fall of the year to promote the growth of edible bulbs, reduce plant competition, and keep woody vegetation from encroaching (Lewis 1993). Today, at least one elder of Chukchansi Yokuts/Miwok descent in the Sierra Nevada recalls burning areas for "wild potatoes" (*Perideridia* spp. and *Sanicula* spp.) in August or September in ponderosa pine forests and meadows; the burning was done to fertilize the ground and to make the tubers bigger and more plentiful. Two Western Mono elders recall the burning of areas in the Sierra foothills in autumn to increase the numbers of wild onions and tubers of *Sanicula tuberosa* (Anderson, interview notes, unpublished).

One of the indigenous peoples' motivations in setting frequent fires in the mixed coniferous forests of the Sierra Nevada was probably to promote the diversity, density, and abundance of many kinds of geophytes. Some of the edible tuberous and bulbous plants that grow in open forests, and which might have benefited from light surface fires, include *Sanicula bipinnatifida, Sanicula tuberosa,* and *Balsamorhiza sagittata,* gathered by the Sierra Miwok; *Sanicula tuberosa* and *Calochortus monophyllus,* gathered by the Maidu; *Calochortus venustus,* gathered by the Sierra Miwok and the Tubatulabal; and *Lilium pardilinum,* gathered by the Sierra Miwok and the Maidu (Anderson, interview notes, unpublished; Barrett and Gifford 1933; Duncan 1963:60; Powers 1877:424).

REGIONAL PATTERNS OF GEOPHYTE USE

The successful exploitation of edible geophytes over long periods of time reflected not only cultural adaptations relating to choices of foods, but an understanding of plant adaptations to natural disturbance regimes as well. Comparative analyses of plant uses between tribes may reveal repetitive patterns of utilization of specific plant species across linguistic boundaries and between geographic regions. Species that were commonly managed over large geographic areas could be investigated further to discover details about former indigenous disturbance regimes and about the structure and function of the particular culturally-modified ecosystem. By understanding the plant's place in the successional sequence and ecology of the ecosystem, and its response to different disturbance regimes, it may in turn be possible to elucidate the ecological or cultural processes that drive biological diversity and create specific ecosystem states. By managing for specific ecosystem states it may be possible to bring back associated plant species, which in turn will attract wildlife that would thrive in the altered ecosystem.

One species that was commonly exploited for its edible corm in California was blue dicks. Blue dicks had a wide historical use as a food (Figure 6). While a majority of tribes in California probably ate the corms of this plant, anthropologists often did not identify blue dicks to the species level—frequently lumping

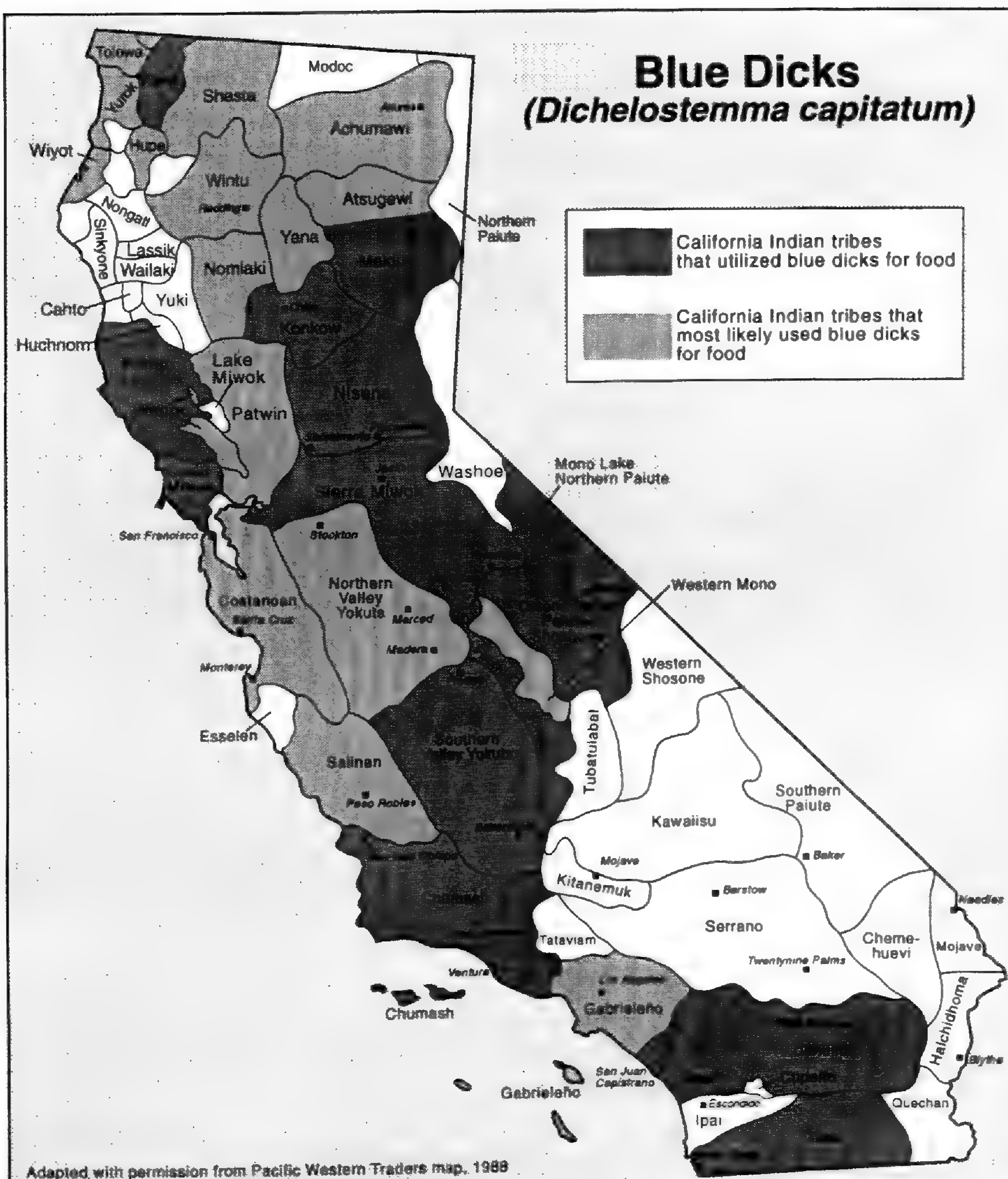

FIGURE 8.—California map showing the widespread use of one geophyte species, blue dicks (*Dichelostemma capitatum*), that crosses linguistic and geographic boundaries.

them under the generic term "Brodiaeas". Blue dicks were once categorized in the genus *Brodiaea*, at a time when many anthropologists were conducting their ethnobotanical research, and they were usually identified by systematists as *Brodiaea capitata* or *Brodiaea pulchella*. Therefore, the map (Figure 8) indicates tribes where utilization is inferred because the ethnographer only recorded the common name, or identified plants at the genus, but not species level.

If the same plant species was used by many cultural groups, as was the case with blue dicks, it may mean that the utilization was an ancient one—as the diffusion and adoption of a specific plant use across cultures takes time. Even more importantly, the wide utilization may point to a species that gains a reproductive advantage when managed by humans, making it an extremely attractive, sustainable food source, and partially explaining its adoption by many different societies. Harvesting and manipulating plant populations in certain ways created predictable ecological outcomes that enabled humans to increase the concentration of plant resources, and thereby intensify their resource use in defined areas.

POTENTIAL ECOLOGICAL EFFECTS

Species level.—Through human selection, protection, and replanting, certain geophyte species may have undergone genetic change. It is now recognized that genetic changes in plants can occur in relatively short amounts of time through human selection, as in the case of devil's claw (*Proboscidea parviflora*), a recently domesticated and diffused Native American crop (Nabhan and Rea 1987). The excavation of plants with vegetative reproductive parts and the replanting of such parts would tend to select for specific genotypes that would hold up well to (and perhaps even thrive under) human harvesting regimes. Human selection would favor mature corms and bulbs that produced the greatest number of cormlets and bulblets, because by intentionally replanting them, they would also leave the greatest number of offspring. Those genotypes that were easily uprooted while remaining completely intact—with all roots and vegetative structures—or that produced few vegetative offsets, would have been selectively extirpated or severely reduced in numbers in the population.

The potential linkage between a society's horticultural practices and utilization of particular plant species and the cultural selection pressures exerted on those species has not been sufficiently studied for edible underground swollen stems. However, the low variability in particular populations of *Camassia quamash* in California, for example, may be due to the selective harvesting practices of different tribes (Susan D'Alcamo, personal communication 1997).[2] One potentially fruitful avenue of future research might involve a comparison of the morphological and genetic variation in populations of a native species gathered in several different tribal territories with the different harvesting and management regimes of each tribe.

Population level.—The numbers, sizes, and densities of favored geophyte species were probably heightened through human intervention. A regime of repeated burning not only augmented useful plant parts but in many cases increased the size of the gathering tract. Because edible plants such as wild onions are often extremely small, and tribes required large quantities for consumption and storage, gathering sites were probably managed for high population densities, and plants were therefore encouraged to grow in a clumped or aggregated pattern. Dense populations of plant species at known collection sites would significantly reduce labor costs and eliminate the uncertainty and time involved in a random or haphazard search for useful plants in the landscape.

Community level.—Vegetation dominated by coniferous forest was often managed for maximum vertical structural complexity, which heightened biodiversity and encouraged a variety of geophytes to grow in the understory. The forests of California were manipulated to create areas with a tree, shrub, and herbaceous physiognomy, giving the forests a layered effect. The herbaceous component of these plant communities was extremely important, and it was carefully managed to provide foods, as well as basketry, cordage, and medicinals (Anderson, interview notes, unpublished). The growth of small trees and brush thickets was discouraged by means of frequent burning, and sometimes by hand weeding (Essene 1942; Dixon 1905:201; Drucker 1937). Frequent burning in conifer forests encouraged widely-spaced, large-diameter trees, creating a vertical structure characteristic of old-growth forests. Today, in many of our national forests where fire is excluded, canopy coverage has reached maximum values, and the understory is impoverished in plant species diversity—in part due to the small number of species that can tolerate extreme shade (Pickett 1976).

Periodic burning occurred within many other plant community types, creating large and small openings that favored populations of desired plant species. An emphasis was placed on encouraging many sun-loving plants. The spatial effect of encouraging specific populations of plant species to grow at numerous gathering sites was a high degree of "patchiness," with plant species in varying successional stages occurring within more homogeneous, naturally-occurring plant community types. Studies of chaparral, oak woodland, and coniferous forest communities have shown that geophyte species richness after fire or other disturbances reaches its maximum values within a few years and then dwindles as the shrub or forest canopy closes (Keeley 1981; Spies and Franklin 1989). Previous studies have emphasized the fact that shade-intolerant plants are the most useful in terms of indigenous needs (Lewis 1993; Reynolds 1959). The result of regular, light-surface burning was maximal biodiversity.

Landscape level.—Landscapes can be viewed as mosaics of ecosystems, generated by disturbance (Pickett 1976). Native Americans complemented natural processes and introduced systematic disturbance in order to maximize plant community diversity. They recognized that each plant community type harbored a unique array of plant and animal species and that some plant community types, while covering small land surface areas, harbored extremely useful and varied plant life. These communities were maintained in a holding pattern rather than being allowed to succeed naturally into a new plant community type. Some examples of special plant community types that contained abundant geophytes and were burned to maintain and in some cases expand their extent would be valley grasslands, montane meadows, and coastal prairies (Anderson 1993).

PROPOSED METHODS FOR RECONSTRUCTING INDIAN-GEOPHYTE RELATIONSHIPS

A full understanding and explication of wild plant production systems will be achieved only through the development of a better rapprochement between the social, historical, and biological sciences than presently exists (Blackburn and Anderson 1993). It would require the sustained and cooperative efforts of scholars using both human- and land-centered avenues of research. Human-centered approaches would involve ethnobotanical studies which record the uses, storage, preparation, manufacturing, gathering methods, and management techniques employed with wild species, through interviews and participant observation. The actual monitoring and detailed analysis of the dynamics of plant production sites, the simulation of these techniques through a series of experiments, the study of the natural history of the wild species, and the potential application of this information to modern wildland management, all comprise facets of a more land-centered approach. These different approaches are explained more fully below.

Ethnobotanical studies.—More ethnographic studies of native peoples that explore the multidimensionality of traditional ecological knowledge with respect to one focal plant species are needed. Native people are the repositories of generations of keen observation and diligent experimentation that has finely tuned their relationships with nature. In some cases indigenous people are still practicing native plant management adjacent to their homes. Such studies entail interviewing Native Americans in a cultural context, usually at their homes. Questions are presented in a non-technical language, yet are still designed to elicit detailed responses that provide cultural information about the plant's manipulation that is related to perceived biological and ecological outcomes. This information, if detailed enough, will be useful to the fields of plant ecology and conservation biology. Harvesting and management information, for example, should be collected with regard to such environmental variables as season, frequency, intensity, scale, and pattern of disturbance. Cultural objectives for harvesting and management—such as recycling nutrients, decreasing insect pests, increasing fruit production, or removing accumulated dead material—need to be meticulously recorded.

Assembling a reference collection of slides, photographs, and herbarium specimens of plants for consultant identification and recall of harvesting, management and use information is extremely helpful in substantiating and enriching information gained from oral interviews. In addition to interviews, it is important to view native consultants in different situations, such as out in the field in direct contact with nature. Often sites are chosen for special environmental conditions including level of light, moisture, plant associations, soils, and elevation. Recording these site criteria demonstrates the finely-grained distinctions Native Americans make in their selection of suitable areas for plant collection.

Observational studies.—The natural history of most native plant species is not well known. According to the eminent biologist E.O. Wilson, the biodiversity in our temperate forests, for example, is fragile and still poorly understood (Wilson 1993). Therefore, observational studies that give the researcher solid information about a plant's life history characteristics, pollination ecology, seed dispersers, and other essential aspects of the species' biology and ecology are a very important complement to ethnobotanical research. Additionally, such studies investigate the environmental conditions under which the plant grows, such as soil types, moisture regimes, plant associations, slope, aspect, and light requirements.

Greenhouse and field experiments.—Once enough descriptive information is available about harvesting and management strategies for geophytes, and observational studies have been conducted to learn about the natural history of the species, this information would form a basis for the design of experiments which would empirically test the effects of various gathering and horticultural techniques (specifically tillage, burning, and cormlet replanting) on the growth and productivity of particular native plants, as well as on biodiversity and habitat heterogeneity in specific geographic regions (Figure 9). The experimental approach has the advantage of focusing on specific questions and/or hypotheses relating to the effects of harvesting strategies and indigenous horticultural practices on specified features or characteristics of individual plants, populations, or plant communities. They require quantitative data which are subjected to appropriate analyses to test stated hypotheses and/or answer relevant questions. Because of the complexity of the ecological processes concerned, this approach would require long-term experiments carefully designed and constrained to discern patterns and levels of effects with reasonable confidence.

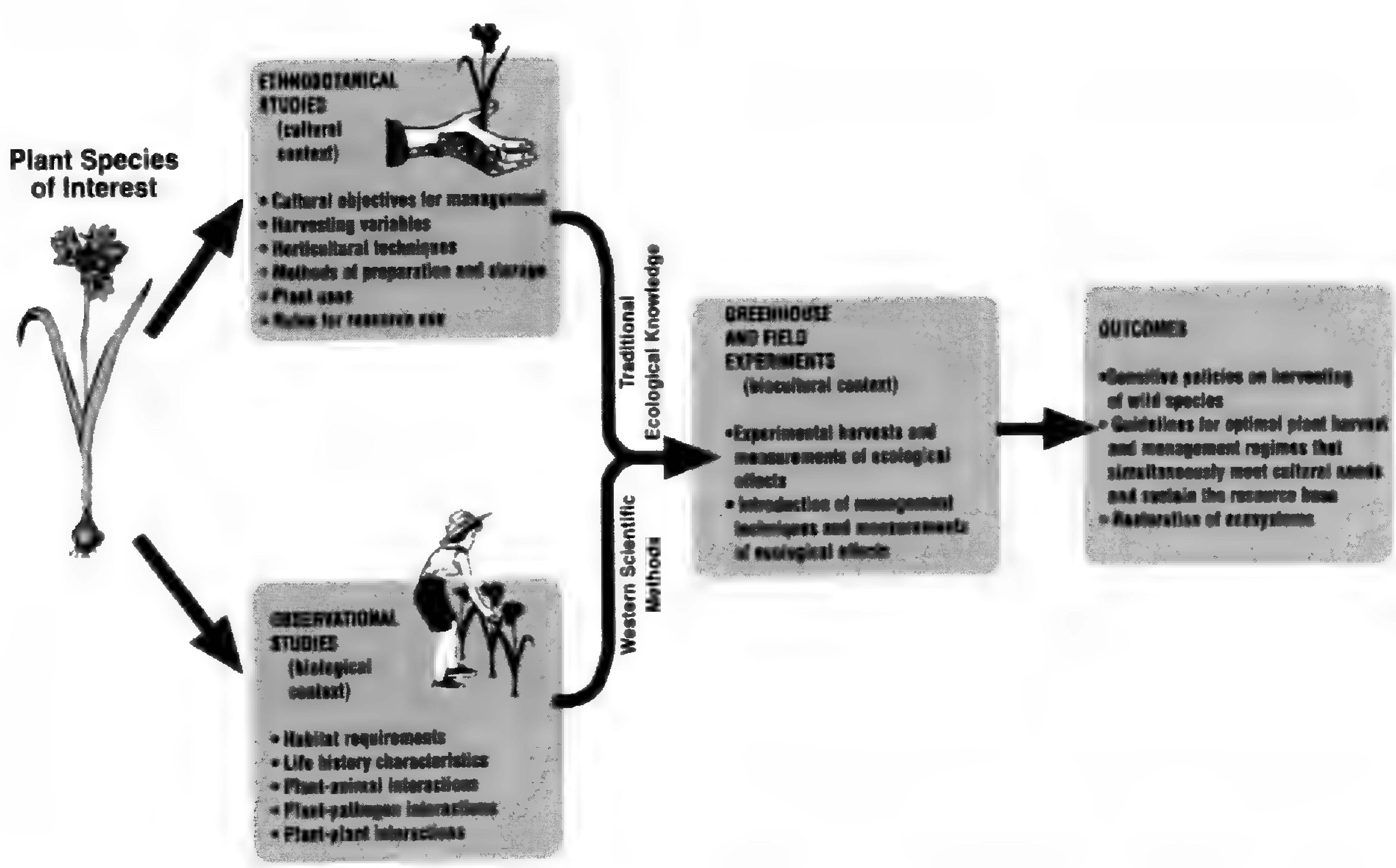

FIGURE 9.—Three types of research that are needed to reconstruct the details of interactions between indigenous peoples and geophytes. The descriptive and interpretive evidence of these systems provided by ethnobiologists, and natural history information provided from observational studies, form a logical basis for the development of experiments and the testing of hypotheses to objectively assess the interrelations and impacts of indigenous cultural practices on plant resource productivity and vegetation.

CONCLUSIONS

The cultivation of geophytes by burning, sparing plants, replanting of propagules, and harvesting after seeding has been an important element in comprehensive indigenous land management systems that have been in place for millennia, and that have encompassed many California wildland areas. Indigenous women, as the major plant harvesters, played a substantial role in shaping California's landscapes, producing ecological consequences at several levels of biological organization. It is hypothesized that women's tillage activities mimicked the natural disturbances with which geophytes coevolved, and that women played an ecological role that is now absent from many wildlands, where Native Americans usually can no longer harvest and manage plants. Their management systems need to be studied and described through ethnobotanical research; then interpreted and experimentally mimicked to elucidate indigenous disturbance regimes and ecological effects. A logical outgrowth of these studies would be the restoration of ecosystems with all of their former biological diversity, as well as the development of sensitive policies regarding sustainable wild harvesting (Anderson 1996; Figure 9). Some areas would greatly benefit from the reintroduction of management and harvesting regimes that authentically mimic ancient indigenous interactions.

NOTES

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ETHNOBOTANY OF THE MISKITU OF EASTERN NICARAGUA

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ABSTRACT.—The Miskitu are one of the three indigenous groups of eastern Nicaragua. Their uses of 353 species of plants in 262 genera and 89 families were documented in two years of fieldwork. Included are 310 species of medicinals, 95 species of food plants, and 127 species used for construction and crafts, dyes and tannins, firewood, and forage. Only 14 of 50 domesticated food species are native to the New World tropics, and only three to Mesoamerica. A majority of plant species used for purposes other than food or medicine are wild species native to eastern Nicaragua. Miskitu medicinal plants are used to treat more than 50 human ailments. Most (80%) of the medicinal plants are native to eastern Nicaragua, and two thirds have some bioactive principle. Many medicinal plants are herbs (40%) or trees (30%), and leaves are the most frequently used plant part. Herbal remedies are most often prepared as decoctions that are administered orally. The Miskitu people are undergoing rapid acculturation caused by immigration of outsiders. This study is important not only for documenting uses of plants for science in general, but also because it provides a written record in particular of the oral tradition of medicinal uses of plants of and for the Miskitu.

RESUMEN.—Los Miskitus son uno de los tres grupos indígenas del oriente de Nicaragua. Los usos por parte de éste grupo de 353 especies de plantas comprendidas en 262 géneros y 89 familias fueron documentados durante dos años de trabajo de campo. Están incluídas 310 especies medicinales, 95 especies de plantas alimenticias, y 127 especies empleadas para construcción y artesanías, colorantes y taninos, leña y forraje. Solamente 14 de 50 especies alimenticias domesticadas son nativas del neotrópico y sólo tres se originan en Mesoamérica. La mayoría de las especies de plantas empleadas para otros propósitos que alimento y medicina son especies silvestres nativas del este de Nicaragua. Las plantas medicinales miskitus son usadas para tratar más de 50 padecimientos humanos. La mayoría (80%) de las plantas medicinales son nativas del Oriente Nicaragüense, y dos tercios de ellas tienen algún principio bioactivo. Muchas de las plantas medicinales son hierbas (40%) o árboles (30%), y las hojas son la parte de la planta usada con mayor frecuencia. Los remedios de origen vegetal son preparados la mayoría de las veces como decocciones que son administradas oralmente. La gente miskitu está siendo aculturada rápidamente por causa de la inmigración de fuereños. Este estudio es importante no solamente por documentar usos de las plantas para la ciencia en general, sino también porque proporciona un registro escrito en particular de la tradición oral de usos medicinales de plantas por y para los miskitus.

RÉSUMÉ.—Les Miskitu sont un des trois groupes autochtones de l'est du Nicaragua. Deux années de recherche ont permis d'inventiorer 353 espèces utilisées réparties en 262 genres et 89 familles. Les plantes médicinales des Miskitu interviennent dans le traitement de plus de 50 maladies humaines. La majorité (80%) des plantes médicinales sont indigènes à l'est du Nicaragua et la plupart (65%) contiennent des principes bioactifs. Ces plantes sont surtout des herbes (40%) ou des arbres (30%) et les feuilles sont l'élément le plus utilisé. Les remèdes à base de plantes sont absorbés surtout sous forme de breuvages. La plupart des plantes comestibles sont cultivées, mais seulement 14 des 50 espèces les plus importantes pour les Miskitu sont indigènes aux tropiques du Nouveau Monde et uniquement trois à l'Amérique centrale. L'acculturation des Miskitu augmente rapidement à cause d'une forte immigration. Cette étude est donc importante: elle permet de documenter l'utilisation des plantes pour des besoins scientifiques et préserve les connaissances orales relatives à l'exploitation des plantes médicinales par les Miskitu.

INTRODUCTION

The present geographical distribution of the Miskitu people encompasses southeastern Honduras, the northeastern coast of Costa Rica, and eastern Nicaragua. The Miskitu, Rama, and Sumu are more closely related culturally to groups in the lowlands of South America than to cultures of Mexican and Mayan affinity. This association is based on a number of Miskitu cultural features reminiscent of South American groups. These traits include a hunting and fishing economy with little emphasis on agriculture; manioc (104 *Manihot esculenta* [the numbers are a guide to finding the species in the Appendix, which also includes the Miskitu names]) rather than maize (350 *Zea mays*), is the principal cultigen; emphasis on canoe travel; excessive intoxication during rituals; use of low wooden seats and hammocks; and the manufacture of bark cloth (Adams 1956; Conzemius 1932; Kidder 1940; Mason 1962; Stone 1962, 1966). The languages spoken by the Miskitu and their neighbors, the Rama and Sumu, belong to the Macro-Chibcha linguistic group of Columbia and northern Ecuador (Kidder 1940; Mason 1962; Stone 1966).

Before the arrival of Europeans in eastern Nicaragua, the Miskitu were a small group of about 1,600 people living between the Rio Coco and the Krukira (Conzemius 1932) (Figure 1). However, their demography and political organization changed dramatically during the 17th and 18th centuries, following contact with buccaneers and traders from whom they obtained firearms (Dozier 1985; Helms 1971; Smutko 1985). The Miskitu name is derived from the word musket given to them by buccaneers and traders (Smutko 1985). The Miskitu used these newly acquired firearms to subdue neighboring groups enabling them to extend their territory to the north into Honduras, and to the south into the Pearl Lagoon area north of Bluefields (Bell 1989; Conzemius 1932; Smutko 1985). The Miskitu population is currently estimated at over 75,000, greater than the combined population of all other indigenous groups in eastern Nicaragua (Buvollen and Buvollen 1994; CIDCA 1982; Hale and Gordon 1987). However, most still live in small vil-

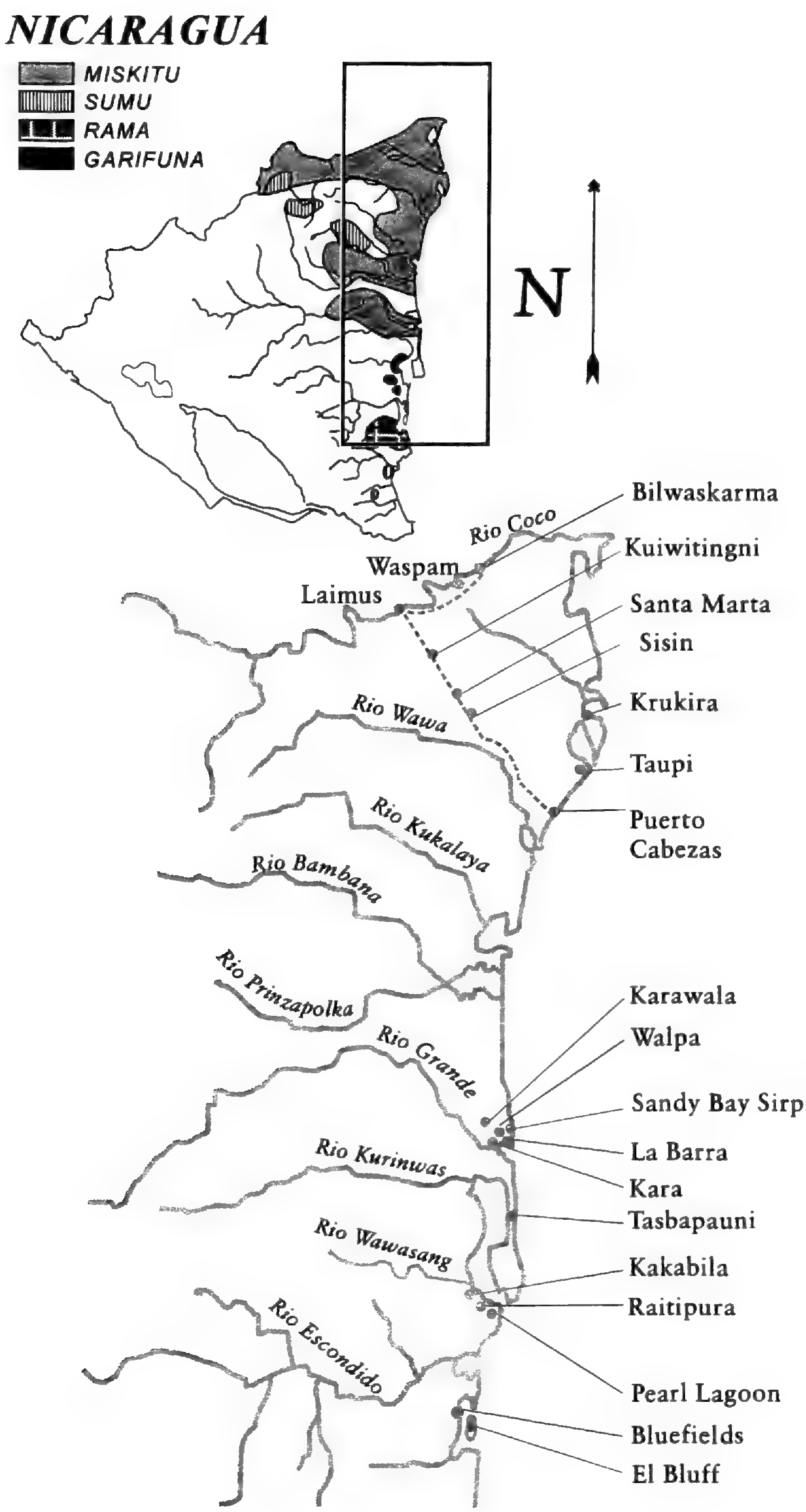

FIGURE 1.—Indigenous groups and Miskitu settlements in eastern Nicaragua.

FIGURE 2.—The Miskitu village of Tasbapauni with coconut palms, ***kuku*** (*Cocos nucifera*), growing in dooryard gardens.

lages of 200 to 300 inhabitants, usually located along rivers and the coast. The largest Miskitu settlement in southeastern Nicaragua is Tasbapauni (Figure 2) with about 1,000 persons (Hale and Gordon 1987; Nietschmann 1972, 1979). In recent times, many Miskitu have migrated to larger communities (e.g., Bluefields, El Bluff, Managua, and Puerto Cabezas) seeking wage work.

The traditional Miskitu lifestyle seems to be disappearing almost as fast as that of the Rama, the most highly acculturated group of eastern Nicaragua. However, many aspects of Miskitu culture remain in place. Their primary occupations remain fishing and hunting, supplemented by subsistence agriculture and gathering of wild resources. However, many work for wages in the extraction of timber, exploitation of ores, and in the fishing industries owned by Westerners. They participate in the regional market economy, speak "Creole" (English spoken in eastern Nicaragua), Miskitu, and Spanish. Most are Christians.

Studies of Miskitu culture in eastern Nicaragua have been primarily in anthropology and ethnohistory (Conzemius 1932; Dennis 1981, 1984; Helms 1971; Nietschmann 1969, 1972, 1973, 1979, 1990). Other than general observations by traders and travelers (Bell 1989; Roberts 1827), Miskitu plant use has been recorded for only a select group of medicinal plants (Barrett 1994a, 1994b; Dennis 1988). To better document the plant use heritage of these people, an ethnobotanical study was conducted in Miskitu areas of eastern Nicaragua. This study occurred at a time when the loss of traditional Miskitu customs was greater than at any other time in history. Our objective was to document as many Miskitu traditional plant-use practices as possible before this knowledge was lost through acculturation.

STUDY AREA AND ENVIRONMENT

Eastern Nicaragua, locally referred to as the Atlantic Coast, was formerly known as the department of Zelaya. It is now divided into the Región Autónoma Atlántico Norte (RAAN) and Región Autónoma Atlántico Sur (RAAS). It covers an area of 56,430 km^2, approximately 56% of the national territory. It is located between 11° and 15° N latitude and 83° and 85° W longitude. The area has a tropical climate, with a rainy season of six-eight months (May-November), but with no well defined dry season. The average annual rainfall is 3,810 mm (Sutton 1989). The dominant vegetation types are pine forest and broadleaf evergreen forest, the latter including swamp forest. Pine forests of Caribbean pine (6 *Pinus caribaea*), cover an area of about 3,806 km^2. The largest tract of pine forest is located in the northeast between the Rio Coco and Puerto Cabezas. Other areas with pine savannas are found around Karawala and Pearl Lagoon. The broadleaf evergreen forest contains important timber species such as mahogany (*191 Swietenia macrophylla*), Spanish cedar (189 *Cedrela odorata*), and rosewood (125 *Dalbergia hypoleuca*).

The Eastern Lowlands remain essentially undeveloped and isolated from the rest of the country due to the abundance of rivers, high density of forest, and high rainfall. Although access roads to some areas have been built recently, transportation is still primarily by boat and airplane. The largest cities are Bluefields and Puerto Cabezas.

METHODS

This study involved interviews with traditional medicine practitioners (e.g., bonesetters, herbalists, midwives, and shamans) and other knowledgeable individuals among the general populace. To document and supplement data gathered indirectly over decades by Coe (a native of the region), extensive field work was conducted during 1992 and 1993. This included ethnobotanical surveys of markets and open-ended interviews of nine traditional medical practitioners. Sixteen locations (El Bluff, Kakabila, Kara, Krukira, Kuiwitingni, La Barra, Pearl Lagoon, Puerto Cabezas, Raitipura, Rio Grande, Sandy Bay Sirpi, Santa Marta, Sinsin, Tasbapauni, Tuapi, and Walpa [Figure 1]) were visited. Voucher specimens were collected to document the species cited.

Techniques used for gathering ethnobotanical data are described in more detail in Coe and Anderson (1996a). Interviews were conducted in "Creole," Miskitu, and Spanish. An interpreter was employed to help with interviews conducted in Miskitu. Since curing is considered a profession among the Miskitu, practitioners expect to receive payment for their services, thus, informants were paid a nominal fee or given other materials requested (e.g., cooking utensils, fishing hooks, food, machetes) in exchange for their time and information.

Voucher specimens were deposited at the Herbarium of the Atlantic Coast of Nicaragua (HACN) in Bluefields (established by Coe in 1992), the Herbario Nacional Managua Nicaragua (HNMN), the Missouri Botanical Garden (MO), and the University of Connecticut (CONN). The majority of voucher specimens were identified at The University of Connecticut, Storrs, and at the Missouri Botanical

TABLE 1.—Taxonomic rank and plant-use category of plant species used by the Miskitu in eastern Nicaragua.

	Food	*Medicinal*	*Other*	*Total*
Families	46	85	43	89
Genera	76	234	103	262
Species	95	310	127	353

TABLE 2.—Status of ethnobotanical plant species used by the Miskitu in eastern Nicaragua.

Status	*Total*	%
Wild	278	79
Semi-domesticated	48	14
Domesticated	15	4
Purchased	12	3
Totals	353	100

Garden, St. Louis. Voucher specimens in doubt were sent to specialists at the Missouri Botanical Garden and the New York Botanical Garden (NY). Names of localities and common names of plants were verified to the extent possible using published sources (CIDCA 1985, 1986, 1989; Duke 1972; Guerrero and Soriano de Guerrero 1985; Heath and Marx 1961; Howes 1974; Incer 1985; Martinez 1991; Morton 1981; Smutko 1985; Uphof 1968).

RESULTS

The Miskitu use a taxonomically diverse group of plants, including 353 species among 262 genera and 89 families (Appendix; Table 1). Some 310 of these are medicinals, 95 are food plants, and 127 are for other uses such as beverages, construction and crafts, dyes and tannins, firewood, forage, and spices and condiments (these totals include plants with multiple uses).

The Miskitu obtain plant materials from agricultural fields, dooryard gardens, forests, and markets ("purchased" in Table 2). The degree of dependence on these sources is cyclic because of the boom-or-bust economy of eastern Nicaragua. When wage labor in Western enterprises is readily available, reliance on market goods increases. When wage employment is scarce, however, the reliance on market goods decreases and the dependence on traditional subsistence harvests (agricultural fields, dooryard garden, and the forest) increases. One positive aspect of this economic instability has been that traditional plant use information has been preserved; to survive lean economic times the Miskitu have had to continue to use and, therefore, to remember, traditional plant-use practices.

Agricultural fields.—Until recently, Miskitu agriculture was practiced strictly for subsistence, with production primarily for household or local consumption (Helms 1971). However, after European contact, some crops such as banana (325 *Musa paradisiaca* var. *sapientum*), common beans (148 *Phaeolus vulgaris*), *cacao* (274

Theobroma cacao), and rice (342 *Oryza sativa*), became commercially important, especially during the late 1800s and early 1900s. These cash crops attracted men to agricultural work (Helms 1971). Before that time, men engaged mostly in fishing and hunting, with women responsible for agricultural work (Helms 1971; Kerns 1982).

The Miskitu agricultural cycle starts with the planting of common beans in January and ends with the harvest of rice in November. Crops may be cultivated as monocultures (one species per field, e.g., common beans or rice), or as multiple crops (e.g., banana, cush-cush yam *Dioscorea trifida* [317], or manioc [104]; also dasheen *Colocasia esculenta* [298], maize [350], annatto *Bixa orellana* [51], *yautia Xanthosoma sagittifolium* [302], pineapple *Ananas comosus* [310], and sugar cane *Saccharum officinarum* [348]), or as a sequence of crops (cultivation of several crops in the same field at different times during the agricultural cycle, e.g., common beans, followed by maize, squash *Cucurbita moschata* [87], and watermelon *Citrullus lanatus* [86]).

The particular crop and the manner in which it is cultivated depends on soil quality. Soils of eastern Nicaragua are predominantly alluvial, with quartzite dominant in the north and laterite in the south (Incer 1975; Taylor and Salas 1959). Agricultural practices consist of crop rotation and field fallowing. Fields are cleared in February or March and burned in early May. Most planting is done with the coming of rain in late May and early June. Planting, weeding, and harvesting are done manually with planting sticks and machetes. Agriculture is practiced by individuals or family units, except in the cultivation of common beans and rice for which group labor is involved. A community effort in the cultivation and harvesting of these two crops is emphasized because of their economic importance. The system of sharing or exchanging labor within the community is known in Miskitu as ***pana-pana*** or "you help me and I help you."[1] The Miskitu practice slash-and-burn agriculture on plots of one-two hectares known as ***insla***. These fields are generally located inland from the less fertile coastal areas. Domesticates grown in these fields are the major food and cash sources. Agricultural production for the Miskitu is more closely tied to the regional market economy than is true for the Garífuna and the other indigenous groups of eastern Nicaragua (Coe and Anderson 1996a). When jobs are not available in Western enterprises, only about 30% of the foods produced by the Miskitu are sold in regional markets, the vast majority being used for household or local consumption. When such jobs are readily available, the vast majority of agricultural goods produced are sold in regional markets (Coe, personal observation). The cash earned is used to purchase desired Western goods, but redirection of work from subsistence activities can cause a shortfall in the local food supply. To compensate for these shortages, foods that under normal circumstances are considered supplementary (mostly semi-domesticates and wild species – see list below) are consumed as staples. These food shortages can have a major impact on Miskitu dietary intake of carbohydrates, protein, minerals, and vitamins (Cattle 1976).

The most important Miskitu food plants are field crops that come from both the New World (NW) and Old World (OW) tropics (including Africa, the southeast Asia and the Pacific islands) (Table 3), including: manioc (104) (NW), banana

TABLE 3.—Origin and status of food plants used by the Miskitu in eastern Nicaragua.

Origin	Status					
	Domesticate	*Purchased*	*Semi-domesticate*	*Wild*	*Total*	*%*
Native to Nicaragua	3	0	7	35	45	47
Introduced	9	8	20	0	37	39
Naturalized	0	0	11	2	13	14
Total	12	8	38	37	95	100
%	13	8	40	39	100	

(325) (OW), plantains (324 *Musa paradisiaca*) (OW), rice (342) (OW), common beans (148) (NW), *yautia* (302) (NW), dasheen (298) (OW), maize (350) (NW), pineapple (310) (NW), and sugar cane (348) (OW). The first six are the mainstays of the Miskitu diet. Pineapple, sugar cane, and maize are cultivated as supplements to staple foods with surpluses sold in regional markets. Common beans and rice are produced primarily for sale in regional markets and are the most important cash crops. Common beans are native to Mesoamerica and have been a staple food for centuries for many indigenous groups; thus, it is surprising that the use of common beans among the Miskitu is fairly recent, first documented at the turn of the century (Conzemius 1932). Rice, on the other hand, is an Old World crop introduced in the 1780's, that is cultivated more extensively due to favorable soil conditions in the area (Conzemius 1932; Helms 1971). Only after the decline of the banana plantations in the early 1940s did common bean and rice production become commercially important to the Miskitu (Helms 1971).

Dooryard gardens.—Species grown in dooryard gardens are used for food or medicine (Table 4). Most dooryard garden food plants are domesticates. Only six of the 20 most important dooryard garden food plants are the same as those grown in agricultural fields. The primary function of these dooryard gardens is for quick and easy access to foodstuffs. A secondary function is to provide medicinals used to treat day-to-day illnesses.

Markets.—The use of market goods by the indigenous people of eastern Nicaragua is determined primarily by the availability of cash, secondly by proximity to Western retail outlets/stores in rural and urban areas, and thirdly by their history of contact with Western culture. Miskitu access to and dependence on Western goods is due to a long history of contact and acceptance of Western culture, facilitated by the fact that many of the natural resources sought by Europeans (e.g., ore, rubber, timber) were found on Miskitu owned land. Even though the Miskitu participate in a market economy and work sporadically for wage labor, the traditional skills of hunting, fishing, gathering, and agriculture are still maintained. During market recessions, traditional activities cushion the economic impact of lost wages and provide subsistence and material necessities until outside jobs are again available.

The Miskitu purchase only 12 plant species from markets (Table 2). These species are important because they are the major source of spices and condiments. Eight of these 12 are used as spices and condiments and 11 for medicine (obvi-

TABLE 4.—Species grown in dooryard gardens.

Species[1]	Life Form[2]	Status[3]	Origin[4]
Most Important Foods			
Anacardium occidentale (9)	T	D	NW
Annona muricata (15)	T	D	NW
Artocarpus altilis (193)	T	D	OW
Carica papaya (63)	T	D	NW
Chrysophyllum cainito (255)	T	SD	NW
Capsicum chinensis (263)	S	D	NW
Capsicum frutescens (264)	S	D	NW
Citrus aurantifolia (245)	T	D	OW
Citrus paradisi (247)	T	D	NW
Citrus sinensis (248)	T	D	OW
Cocos nucifera (307)	T	D	OW
Colocasia esculenta (298)	H	D	OW
Mangifera indica (10)	T	D	OW
Melicoccus bijugatus (253)	T	SD	NW
Musa paradisiaca var. sapientum (325)	H	D	OW
Musa paradisiaca (324)	H	D	OW
Persea americana (161)	T	D	NW
Tamarindus indica (151)	T	SD	OW
Theobroma cacao (274)	T	D	NW
Xanthosoma sagittifolium (302)	H	D	NW
Less Important Foods			
Bixa orellana (51)	S	SD	NW
Chrysobalanus icaco (68)	T	W	NW
Coccoloba uvifera (221)	T	W	NW
Hibiscus sabdariffa (175)	S	SD	OW
Manilkara zapota (256)	T	D	NW
Spondias purpurea (12)	T	SD	NW
Syzygium malaccensis (203)	T	SD	OW
Medicinals			
Asclepias curassavica (30)	H	W	NW
Blechum brwonei (7)	H	W	NW
Cassia alata (114)	S	W	NW
Cassia occidentalis (118)	S	W	NW
Kalanchoe pinnata (85)	H	W	OW
Momordica charantia (91)	V	W	OW
Turnera ulmifolia (281)	S	W	NW

[1] Numbers in parenthesis () are the index numbers used in the Appendix
[2] T = tree, S = shrub, V = vine, H = herb
[3] D = domesticate, SD = semi-domesticate, W = wild
[4] NW = New World, OW = Old World

ously, a number of these are used both as spices and medicinals). Species purchased include: cinnamon (160 *Cinnamomum zeylanicum*), cloves (202 *Syzygium aromaticum*), coffee (229 *Coffea arabica*), garlic (320 *Allium sativum*), ginger (353 *Zingiber officinale*), nutmeg (195 *Myristica fragrans*), and onion (319 *Allium cepa*) of the Old World; and maize (350), potato (272 *Solanum tuberosum*), and tobacco (265 *Nicotiana tabacum*) of the New World. Only three species native to eastern Nicaragua were documented as being used as spices; they are: barsley (158 *Ocimum micranthum*), *mejorana* (156 *Hyptis capitata*), and false thyme (289 *Lippia micromera*). These are obtained from disturbed sites and from the wild.

TABLE 5.—Status and life form of medicinal plants used by the Miskitu in eastern Nicaragua.

	Life Form					
Status	*Tree*	*Shrub*	*Vine*	*Herb*	*Total*	%
Wild	58	31	45	105	239	77
Semi-Domesticates	7	4	1	1	13	4
Domesticates	23	7	5	12	47	15
Purchased	4	2	0	5	11	4
Total	92	44	51	123	310	100
%	30	14	16	40	100	

Forest.—The Miskitu use native forest products for food, medicine, fiber, construction materials, and crafts. Like the Garífuna (Coe and Anderson 1996a), the Miskitu obtain most (77%) of their medicinals from the forest ("wild" in Table 5). Most of these medicinal species are herbs and forest trees. As described above, agricultural fields and dooryard gardens provide most of the materials used for sustenance and to earn money. However, foods obtained from the forest can play an important nutritional role by providing minerals, lipids, and vitamins (Cattle 1976). Therefore, knowledge and use of forest resources are vital to good health, even though the forest is a much less important source of calories. Of the 37 native forest species that provide food, the four most important are peach palm (304 *Bactris gasipaes*), American oil palm (309 *Elaeis oleifera*), Tonka bean (136 *Dipteryx oleifera*), and sapodilla (256). The uses of these species are discussed in more detail in the section dealing with foods and medicines.

PLANT PROCESSING AND USE

Plant materials used by the Miskitu are often processed to prolong their storage life and/or to make them edible or usable. Processing is by dehydration, frying, boiling, roasting, toasting, and/or parching. The preferred methods are boiling and dehydration. Food crops most frequently treated by these methods are banana (325), coconut (307), maize (350), manioc (104), peach palm (304), and plantain (324). Processing of these foodstuffs is done primarily by women. Medicinal plants are processed by practitioners or their apprentices. For purposes of discussion, the species the Miskitu use are presented in the following use categories: beverage, construction and craft, dye and tannin, firewood, food, forage, medicine, and spice and condiment. Many species have multiple uses.

Beverages.—Both Old World and New World species are used to prepare alcoholic and non-alcoholic beverages. The four most popular beverages are ***mishla***, ***sitsa*** or ***bisbaia***, ***bunya***, and ***wabul***. The first two are alcoholic beverages; the last two non-alcoholic (more detail below). Beverages are made from banana (325), cush-cush yam (317), dasheen (298), and plantain (324), of the Old World; and maize (350), manioc (104), peach palm (304), sweet potato (80 *Ipomoea batatas*), and Tonka bean (136), of the New World. Other beverages of lesser importance are made from lime (245) and sweet orange (248), of the Old World; and *huiscoyol* (305 *Bactris major*), cashew (9), grapefruit (247), *nancite* (169 *Byrsonima crassifolia*), and pineapple (310), of the New World. Six of 16 species used for making beverages are Old World domesticates, introduced by Europeans during the 16th and 17th century. Prior to this, beverages were made from native or introduced New World species. Today, with a few exceptions, traditional beverages are being replaced by Western beverages.

Mishla is prepared by peeling and boiling the roots of manioc after which the water is poured off and the roots allowed to cool. Once cooled, the women (generally men do not participate) chew the manioc into a thick paste, and then spit mouthfuls into wooden bowls. Filled bowls are emptied into large clay or wooden vessels or Western made containers to which warm water is added. The mash is then stirred, and covered with leaves of *cola de gallo* (306 *Calyptrogene ghiesbreghtiana*) or banana. Fermentation starts in four to six hours and continues for 48-72 hours before the brew is drunk. Sugar cane juice is sometime added to the mash to accelerate fermentation. This last practice is fairly recent among the Miskitu because sugar cane was not introduced until 1633 into eastern Nicaragua (Conzemius 1932; Smutko 1985). Another alcoholic beverage is a *chicha* made from maize (350), locally called in Miskitu ***sitsa*** or ***bisbaia*** depending on how it is prepared. Like ***mishla***, ***sitsa*** is prepared by chewing the maize to accelerate fermentation. ***Sitsa*** is the only beverage distilled by the Miskitu. Prior to European contact, Amerindians were not familiar with the process of distillation (Belt 1874). ***Bisbaia*** is made by placing maize mixed with water in large containers that are buried until the contents ferment.

The most popular non-alcoholic beverage is the ***îbu*** drink. This beverage is made from the seeds of the Tonka bean (136) tree. The cotyledons are removed from the seeds and boiled in water for softening and extraction of aromatic oil. The oil is skimmed off while boiling and is used as a hair tonic. Once softened, the cotyledons are mashed with a mortar and pestle (***unu mihta***) into a thick paste. The drink is made by mixing the paste with water or coconut milk and sugar.

Wabul is a beverage prepared from green or ripe banana or plantain (324). The peeled fruits are boiled in water until thoroughly cooked, then mashed into a paste with a wooden mortar and pestle made from Tonka bean wood, after which either water or coconut milk is added. Sometimes banana or plantain are cut in lengthwise slices then sun dried and stored as is or pulverized for later use. ***Bunya***, on the other hand, is made mostly from root crops such as manioc, *yautia* (302), dasheen (298), sweet potato (80), or cush-cush yam (317). On occasion, ***wabul*** is made with peach palm (304) fruits. These are boiled and mashed into a paste with a mortar and pestle then rolled into leaves of banana, plantain, *cola de gallo* (306), or swamp lily (322 *Thalia geniculata*) and stored for later use. For consumption the paste is removed from the leaves, then mixed with water and drunk. The paste used in preparing this beverage is always taken when traveling long distances, especially on hunting expeditions and during timber cutting. The mash keeps well and can be easily prepared into a beverage.

FIGURE 3.—Dwelling being built with traditional materials in the village of Tasbapauni (includes structural logs of leche amarilla, ***samu*** [*Symphonia globulifera*], and thatch of American oil palm, ***batana*** [*Elaeis oleifera*]).

Construction and crafts.—The Miskitu still rely on traditional materials for building of dwellings and other structures (Figure 3). However, in larger communities Western building materials are becoming more and more popular especially for the construction of homes and boats (e.g., galvanized metal sheet). In this study, 68 species were documented as still being used in construction and crafts. Prior to the arrival of missionaries in the 17th and 18th centuries, Miskitu dwellings consisted of one room dirt floor units with sidewalls made from bamboo (331 *Bambusa vulgaris*) and roofs made from palm thatch (Conzemius 1932). Subsequently, structures were built on wooden stilts and consisted of a living area and a kitchen (Conzemius 1932; Roberts 1827). An elevated structure serves to keep the house drier and cleaner, and discourages livestock from wandering through homes. Sidewalls of dwellings are made from bamboo (331) stems, wood of Caribbean pine (6) (the most popular wood for this purpose), mahogany (191), *Santa María* (70 *Calophyllum brasiliense*), and Spanish cedar (189). The major supports for homes such as corner poles, roof support poles, and stilts are made of the hard, durable wood of the Tonka bean (136) tree. Other popular species used are *nancitón* (99 *Hyeronima alchorneoides*), *cedro macho* (188 *Carapa guianensis*), *leche amarilla* (72 *Symphonia globulifera*), *laurel* (55 *Cordia alliodora*), and *San Juan* (296 Vochysia ferruginea). Roofs are thatched with a variety of palm leaves, the most important being saw cabbage palm (303 *Acoelorraphe wrightii*). Sometimes entire roofs are thatched solely with these leaves. Other palm leaves of less importance used for thatch are African oil palm (308 *Elaeis guineensis*), coconut, American oil palm (309), and *cola de gallo* (306). Increasingly homes have roofs made entirely or partly from galvanized sheets, known in Creole as "zinc" (Figure 2).

The house framework and roof thatch are frequently held together with cordage made from the fibrous inner bark of balsa (53 *Ochroma pyramidale*), *guácimo* (278 *Luehea seemannii*), *mahoe* (176 *Hibiscus tiliaceus*), *peine de mico* (277 *Apeiba aspera*), trumpet tree (65 *Cecropia peltata*), and *mariposa* (174 *Hibiscus bifurcatus*). Other species used to a lesser extent for securing the house frame are snakeroot (29 *Aristolochia trilobata*), *bija* (47 *Arrabidaea chica*), and *hoja chigüe* (93 *Davilla kunthii*).

Household utensils used by the Miskitu are similar to those of the other indigenous groups of eastern Nicaragua (Coe and Anderson 1996a). These are made from traditional and Western materials. Traditional materials include fibers obtained from the fruits of the kapok tree (52 *Ceiba pentandra*) used for making mattresses and pillows. Other traditional materials include the wood of Tonka bean (136), mahogany (191), rosewood (*Dalbergia brownei* [124], [125], *D. tucurensis* [126]), *cedro macho* (188), *santa maría* (70), Caribbean pine (6), and Spanish cedar (189). A popular Miskitu household utensil is the mortar and pestle (Figure 4) used for grinding grains and food preparation; these are usually carved out of Tonka bean (136) logs or other hardwood. Another popular household item is the ***kubus*** (Figure 5), a rectangular table used as a "stove" for cooking. The frame of the ***kubus*** is built from Tonka bean (136) wood and filled with clay and sand.

Gourd drinking utensils are used in many households, but these are slowly being replaced by Western containers. Traditional drinking vessels are made from split and hollowed-out fruits of bottle gourd (89 *Lagenaria siceraria*) and tree gourd (48 *Crescentia cujete*). Most kitchen utensils, especially vessels for holding liquids, are Western-made and are obtained as gifts or purchased in regional markets. However, in some instances the stems of bamboo (331) are still used as vessels for carrying water. Traditional cooking utensils are made from bamboo, mahogany (191), rosewood (124, 125, 126), and Spanish cedar (189). Today, however, Western wares made from aluminum, iron, and plastic, especially pots and pans, largely serve this purpose.

The Miskitu are very skilled dugout builders and handlers. During the 18^{th} and 19^{th} centuries they were employed by European traders as dugout handlers (Conzemius 1932; Roberts 1827). Today, dugouts are still the main means of transportation. The dugout canoe, locally called ***duri*** or ***pitpan,*** is carved out of logs from trees of *cedro macho* (188), kapok tree (52), mahogany (191), *nancitón* (99), *palo de sangre* (196 *Virola koschnyi*), *Santa María* (70), and Spanish cedar (189). *Nancitón* is preferred for its resistance to rot and marine borers or barnacles. On the other hand, mahogany and Spanish cedar, though less resistant to rot and marine borers, are much lighter.

FIGURE 4.—Mortar and pestle (made from the wood of Tonka bean, ***îbu*** [*Dipteryx oleifera*]) used for grinding grains and in food preparation.

FIGURE 5.—The ***kubus*** is a rectangular table made from the wood of Tonka bean, ***îbu*** (*Dipteryx oleifera*). It is used for cooking; on its surface a mixture of clay and sand holds fires above the floor.

The Miskitu make baskets, guitars, hammocks, wood carvings, and other crafts mostly for household use. Carvings and other crafts are made from balsa (53), *cedro macho* (188), kapok tree (52), *laurel* (55), *mahoe* (176), mahogany (191), rosewood (124, 125, 126), and Spanish cedar (189). Fibers used for cordage, fishing line, and threads for sowing and weaving are obtained from *guácimo* (278), *mahoe* (176), *peine de mico* (277), trumpet tree (65), and wild pine (311 *Bromelia pinguin*). Bark cloth is obtained by retting the bark of wild fig (194 *Ficus insipida*) and subsequently bleaching it with the juice of sour orange (246 *Citrus aurantium*). Craft items are sold locally to visitors and are also taken to regional markets.

Dyes and tannins.—Prior to the introduction of synthetic dyes to eastern Nicaragua, the Miskitu relied on several native species as sources of dyestuff (Roberts 1827; Smutko 1985). The two most popular dyes were annatto (51) (NW) and indigo (141 *Indigofera suffruticosa*) (NW) used by the natives for dying bark cloth made from the inner bark of wild fig (194). Indigo is used for its blue pigment and annatto for its red, orange, or yellow dye, the color depending on the concentration of pigment. Annatto dye is also used as an insect repellent and/or body paint during rituals. Indigo dye is painted on the forehead of newborn babies and over windows and doors to ward off evil spirits. Today, these natural dyes remain in use, mostly by people living in isolated areas; Miskitu living in and around Western settlements use mostly synthetic dyes and fabrics. Dyes still in use include the following colors and their sources: black obtained from *leche amarilla* (72), brown from mahogany (191), gray from *guayabón* (77 *Terminalia oblonga*), red from *bija* (47), and yellow from annatto. These dyes are used primarily for coloring of clothing, crafts, and foods.

Tannins are obtained from the bark of black mangrove (282 *Avicennia germinans*), button mangrove (74 *Conocarpus erectus*), cocoplum (68 *Chrysobalanus icaco*), *guayabón* (77), *hoja chigüe* (93), *nancite* (169), red mangrove (224 *Rhizophora mangle*), and sapodilla (256). These extracts are used primarily for the curing of hides into leather.

Firewood.—Relatively few species are used for firewood (only 6% of all the species) considering that most tree species are potential fuel. Selection of firewood is based on properties such as burning time and moisture content, as well as availability. These selection criteria may explain the low number of species used for firewood. The Miskitu recognize certain species as possessing superior burning qualities for certain applications. The species with the best burning qualities are Caribbean pine (6), *guayabón* (77), locust (140 *Hymenaea courbaril*), *nancite* (169), pigeon bush (147 *Pentaclethra macroloba*), provision tree (54 *Pachira aquatica*), red mangrove (224), sapodilla (256), and Tonka bean (136). These are used when fires of high temperatures and long-burning times are required, such as in the making of sugar, distillation of alcohol, frying, and preservation of foods. Also, foods that are fried or prepared for long term storage require high temperatures to assure that they are thoroughly cooked to prevent spoilage. The five most widely used firewood species include Caribbean pine, red mangrove, pigeon bush, *nancite*, and provision tree. These five not only have good burning properties but are ubiquitous. Some species with inferior burning qualities are used as substitutes during emergencies, such as fiddlewood (294 *Vitex kuylenii*), *guácimo* (278), *indio desnudo* (60 *Bursera simaruba*), *leche amarilla* (72), *peine de mico* (277), and wild fig (194).

TABLE 6.—Food plants of the Miskitu of eastern Nicaragua arranged by origin and status.

	Status					
Origin	*Domesticate*	*Purchased*	*Semi-domesticate*	*Wild*	*Total*	%
New World Tropics	14	0	4	25	43	46
Old World Tropics	19	5	0	1	25	27
Mesoamerica	3	0	0	4	7	7
South America	4	2	1	0	7	7
Caribbean	4	0	1	1	6	6
Asia	3	0	0	0	3	3
Africa	2	1	0	0	3	3
Pantropical	1	0	0	0	1	1
Total	50	8	6	31	95	100
%	53	8	6	33	100	

Foods: Origin, dispersal, and systematics.—In spite of the fact that 66% of the food plants used by the Miskitu are species native to the New World tropics, most are not native to Nicaragua (Table 6). Prior to the introduction of domesticates, the Miskitu diet consisted mostly of wild collected root crops, game, and seafood (Bell 1989; Conzemius 1932; Exquemelin 1993; Roberts 1827). The most important staple foods are a select group of domesticates (see below), only three of which are native to Mesoamerica. The Miskitu were encouraged to adopt Old World crops by European settlers who considered native staple foods less desirable for consumption (Bell 1989).

The main staples of the Miskitu diet, with the exception of manioc (104), are Old World domesticates that include banana, breadfruit (193 *Artocarpus altilis*), coconut, dasheen (298), rice, and sugar cane. The arrival in the Americas of these six Old World food crops is fairly well understood, with the exception of coconut and dasheen (Crosby 1973; Heiser 1990; Hobhouse 1986; Sauer 1993). The first record of sugar cane in eastern Nicaragua is 1633 when it was introduced by the British as a gift to the Miskitu king. Subsequently the British went on to establish sugar cane (348) plantations at Cabo Gracias A Dios and Bluefields (Conzemius 1932; Smutko 1985).

Miskitu food plants are distributed among 46 plant families (Table 1). The family with the most species used is the Fabaceae (Table 7). The most important species in this family is the common bean which, along with root crops, are mainstays of the Miskitu diet. The remaining eight food plants of the Fabaceae are minor and are used only as incidental or famine foods. However, the Euphorbiaceae is actually the most important by virtue of the great dependence on manioc (104). The Miskitu are not unusual, however, given that manioc may be the most widely used root crop of indigenous groups of the New World lowland tropical forest (Heiser 1990; Schultes 1988).

TABLE 7.—The 17 plant families with the most species used by the Miskitu in eastern Nicaragua (rank ordered by total).

Family	Food	Medicinal	Other	Total
Fabaceae	9	38	28	75
Poaceae	4	10	21	35
Rubiaceae	3	20	2	25
Euphorbiaceae	3	13	4	20
Verbenaceae	2	13	4	19
Arecaceae	5	6	7	18
Solanaceae	5	11	2	18
Asteraceae	0	16	0	16
Malvaceae	2	8	5	15
Anacardiaceae	4	4	4	12
Apocynaceae	1	10	1	12
Malpighiaceae	2	7	3	12
Cucurbitaceae	4	4	2	10
Rutaceae	4	6	0	10
Musaceae	3	3	3	9
Piperaceae	2	6	0	8
Araceae	2	3	0	5

Palms are widely used, but do not constitute a major part of the dietary consumption of the Miskitu. The most important Miskitu palm species (Arecaceae) are the coconut, American oil palm (309), and peach palm (304). Coconut (307) endosperm is used for food, fodder, and cooking oil. Prior to the introduction of coconut, American oil palm and peach palm were the most important species of the palm family to the Miskitu (Conzemius 1932; Bell 1989; Roberts 1827). American oil palm was a very important source of food, fodder, and oil (Conzemius 1932; Bell 1989). American oil palm (309) extract is still used, though to a lesser extent than formerly, as cooking oil, lamp fuel, hair tonic, and medicine. Peach palm fruit is used primarily as an incidental food and also for making a beverage and medicine. African oil palm (308) and *huiscoyol* (305) are also used for food, beverage, and oil.

The Poaceae ranks second in overall species use and third in number of species utilized as food (Table 7). Among these are maize and rice; the latter is the most important as both a cash and food crop. As previously discussed, maize is cultivated primarily for making *chicha* and to a lesser extent for food, forage, and fodder. Maize was and still is considered a "foreign" crop identified with Spanish culture (Conzemius 1932; Helms 1971; Roberts 1827), but has lately gained wider acceptance among the Miskitu.

The Solanaceae is second (tied with the Arecaceae) in number of species utilized for food and sixth in overall species use. Nevertheless, this family is not a major food source for the Miskitu. Its importance is due to chile peppers (bird pepper [264] *Capsicum frutescens*, gourd pepper [263] *C. chinensis*, and sweet pepper [262] *C. annuum* var. *glabriusculium*), all used primarily as spices.

The Rutaceae (number three in species used for food) includes the citruses (grapefruit [247], lime [245], sour orange [246], and sweet orange [248]). Most are native to southeast Asia and were introduced from the Canary Islands to Haiti by the Spaniards in 1516 and later to the American mainland (Sauer 1993) — and thus presumably to Nicaragua. Though citruses are seasonal foods, they contribute vitamins and minerals to the Miskitu diet, especially because the staple foods are nutritionally deficient in vitamins and minerals, but very high in protein and carbohydrates (Cattle 1976). Citruses are also cash crops of minor importance.

Forage.—The Miskitu use a variety of plants for animal feed. Forage plants used include both wild and domesticated species of the New World and Old World tropics. Feeding of small livestock (e.g., chickens, goats, pigs) around the compounds is done mostly by women. Large livestock (e.g., cattle, horses), on the other hand, are mostly fed by men. Most animals are fed ground copra, locally called "bran" in Creole, made from the dried endosperm of coconut, the ripe fruits of American oil palm (309), dried maize, and the grain and husks of rice. Large animals are allowed to graze openly during most of the day but are corraled in the evening and fed bran. Cattle are fed mostly maize and several other species of grasses (carpet grass *Axonopus compressus* [329], jungle rice *Echinochloa colonum* [335], *Ischaemum timorense* [338], dropseed *Sporobolus virginicus* [349], and guinea grass *Panicum maximum* [343]). Other species sometimes used for forage are banana, manioc, peach palm (304), plantain (324), and yams (*yautia* [302], cush-cush yam [317], dasheen [298]).

FIGURE 6.—Mr. Florentine Joseph, the most highly regarded Miskitu shaman in eastern Nicaragua.

FIGURE 7.—Mrs. Midora Christian, a Miskitu midwife from the village of Tasbapauni collecting leaves of *chasmol*, ***tataku*** (*Operculina pteripes*), a medicinal plant.

Medicines.—Ethnomedicinal information was obtained from shamans (Figure 6), midwives (Figure 7), and the general populace. Information gathered included the type of plant material used in the preparation of remedies, the affliction treated, the mode of preparation, and the mode of administration (Appendix). The Miskitu herbal pharmacopoeia consists of 310 species (Table 8). In contrast to most of the previous categories, about 80% of the medicinal plants are native to eastern Nicaragua. The majority of the medicinal plants are herbs (39%) and trees (29%) (Table 9). Almost two thirds of medicinals have some bioactive principle, including alkaloids (59%) and glycosides (5%) (Appendix). Materials used in medicinal preparations included bark, flowers, fruits, leaves, roots, sap, seeds, and stems (wood). In some instances the entire plant was utilized, root included. The most frequently utilized plant part was the leaf (218 species), followed by the bark (59 species; Table 10). These results are similar to those documented among the Garífuna by Coe and Anderson (1996a).

TABLE 8.—Origin and status of medicinal plants used by the Miskitu in eastern Nicaragua.

Origin	**Status**					
	Domesticated	*Purchased*	*Semi-domesticated*	*Wild*	*Total*	%
Native to Nicaragua	9	2	6	231	248	80
Introduced	27	9	6	4	46	15
Naturalized	11	0	1	4	16	5
Total	47	11	13	239	310	100
%	15	4	4	77	100	

TABLE 9.—Origin and life form of medicinal plants used by the Miskitu in eastern Nicaragua.

Origin	**Life Form**					
	Tree	*Shrub*	*Vine*	*Herb*	*Total*	%
Native to Nicaragua	66	34	44	102	246	80
Introduced	18	10	5	12	45	14
Naturalized	5	2	3	8	18	6
Total	89	46	52	122	309	100
%	29	15	17	39	100	

TABLE 10.—Parts used of medicinal plants of the Miskitu of eastern Nicaragua. Numbers tabulated from citations in column 5 of the Appendix.

Parts Used	Total
Leaf	218
Bark	59
Whole Plant	52
Root	50
Fruit	43
Stem	27
Sap	22
Seed	18
Flower	3

Herbal remedies are prepared as decoctions, poultices (mashed, crushed or chopped plant part), infusions (steeping plant parts in hot water), juice (extract of any plant part), baths (plant parts are placed in hot water or boiled until steam is obtained), and syrups (plant part boiled to a thick paste). The two most frequently cited modes of preparation of herbal remedies are decoctions and poultices (Table 11). Decoctions are prepared by boiling plant parts in water then decanting the liquid. When cooled, the decoctions are presented to patients for them to drink. In other cases, the decoctions are used hot or cold to wash the afflicted area. In addition, on certain occasions the patient is bathed in the decoction. Poultices are also effective because they are made from plant exudates or plant parts that are placed directly on the afflicted area. Poultices allow direct delivery of the bioactive principle to the body. Materials prepared as decoctions or poultices are mixed with a variety of foods, spices, and pharmacological agents prior to being administered as medicinals.

TABLE 11.—Mode of preparation of medicinals used by the Miskitu of eastern Nicaragua. Numbers tabulated from citations in column 6 of the Appendix.

Mode	Total
Decoction	273
Poultice	63
Infusion	24
Juice	21
None	12
Bath	10
Syrup	3

TABLE 12.—Mode of administration of medicinal preparation of the Miskitu of eastern Nicaragua. Numbers tabulated from citations in column 7 of the Appendix.

Mode	Total
Oral	263
Topical	134
Bath	15
Inhalation	1

The most frequently encountered modes of administration are oral (263 species), and topical (134 species; Table 12). These two modes of administration may be preferred because they are most effective in delivering bioactive compounds to the body (Coe and Anderson 1996b).

Survey information indicated that the 12 most popular medicinal species used by the Miskitu were Christmas blossom (114 *Cassia alata*) (Figure 8), cowfoot (216 *Piper auritum*), fever grass (333 *Cymbopogon citratus*), *bejuco guaco* (39 *Mikania*

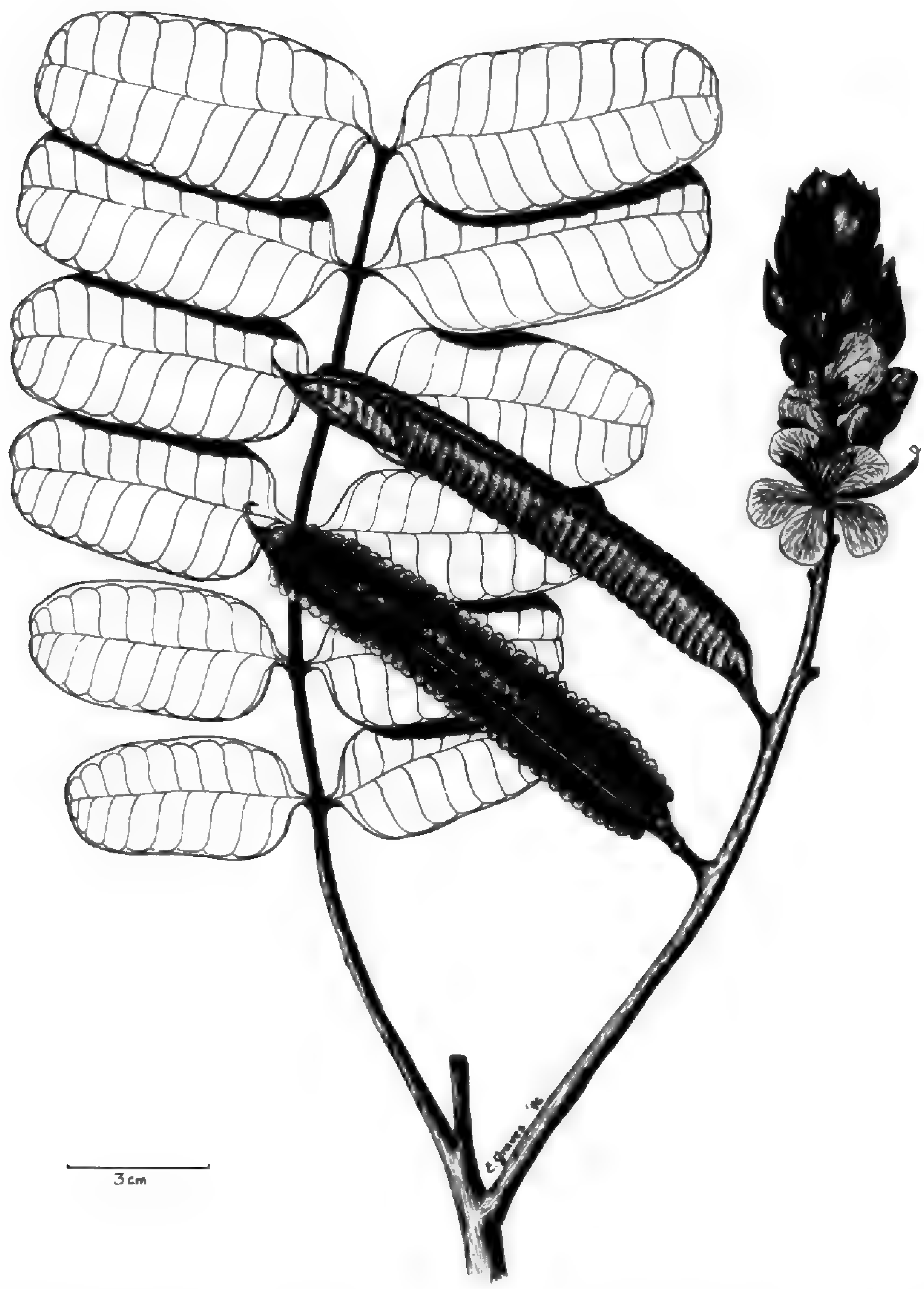

FIGURE 8.—Christmas blossom, ***kislin***, (*Cassia alata*, Fabaceae), the most widely used medicinal plant in the Miskitu pharmacopoeia.

cordifolia), fitsy bush (212 *Petiveria alliacea*), jackass bitters (41 *Neurolaena lobata*), John Charles (157 *Hyptis verticillata*), piss-a-bed (118), red head (233 *Hamelia patens*), balsam pear (91), vorvine (292 *Stachytarpheta jamaicensis*), and wild rice (259 *Scoparia dulcis*).

Spices and condiments.—The Miskitu use very few species for spices and condiments. Only 16 species were so documented, of which eight are wild; two are domesticates of the New World tropics, and six are domesticates of the Old World tropics. The native spices and condiments include annatto (51), barsely (158), catnip (288 *Lippia alba*), cowfoot (216), *culantro* (18 *Eryngium foetidum*), false thyme (289), *mejorana* (156), wild sage (56 *Cordia curassavica*), bird pepper (264), and gourd pepper (263) (the latter two are domesticates). The introduced Old World spices and condiments include cinnamon (160), cloves (202), garlic (320), ginger (353), nutmeg (195), and onion (319). Miskitu use of Old World spices and condiments is probably attributable to their extended contact with British and other Europeans. Of course, it is also true that the vast majority of spices used anywhere in the world are of Old World origin (Heiser 1990). Five of the 10 native spices and condiments used are collected from disturbed sites and the remaining five are grown in dooryard gardens. All of the Old World spices and condiments are purchased either from traveling (usually by boat) mestizos merchants or from markets.

DISCUSSION

The Miskitu are highly acculturated, but maintain many aspects of traditional plant use. The conservation of botanical knowledge has played an important role in Miskitu culture. When wage labor is no longer available, traditional agricultural practices serve as a source of food and money. Plants used by the Miskitu are diverse, including 353 species of which 310 are medicinals and 95 are food plants. As with the Garífuna (Coe and Anderson 1996a), the largest plant-use category by the Miskitu is as medicinals.

Not surprising, given that they live nearby to one another, the Miskitu and Garífuna use many of the same species (70% overlap) and exchange a considerable amount of ethnobotanical knowledge. This is attributable not only to the proximity of the groups (particularly around Pearl Lagoon) but also to the recent arrival of the Garífuna into eastern Nicaragua. That is, many Garífuna practitioners (i.e., herbalists, midwives, shamans) learned the use of this new flora as apprentices under Miskitu mentors. The 30% of species exclusive to the Miskitu are mostly species of pine savannas and the upland tropical moist forests absent from the lowland swamp forest ecosystem where the Garífuna reside. The greatest similarities in plant use between the two groups are among the food plants (Coe and Anderson 1996a). On the other hand, medicinal plant uses are very different. The similarity of food plants used by the Miskitu and Garífuna can be attributed to their equal dependence on a relatively small group of introduced domesticates. The differences in medicinals is determined primarily by the availability of the species, a factor promoted by the different habitats in which each group is centered.

An effect of acculturation is the widespread substitution of Western goods and medicines for native products and traditional healing. This has caused a decline in the number of local craftsmen and herbalists skilled in the use of local plant resources. For example, vessels made from gourds have been replaced by empty tin cans and plastic pails. Hand woven fish nets (Figure 9) and traps have been replaced by nylon gill nets and galvanized wire fish traps.

Ethnomedicine.—Miskitu plant lore is a blend of Amerindian and European knowledge passed from generation to generation by oral tradition (Conzemius 1932). The Miskitu were the first indigenous group of eastern Nicaragua to be introduced to Western medicine (in 1935 by the Moravian missionaries; Wenger 1945). In spite of this, they continue to rely on traditional medicine as a major source of health care, especially for non-life threatening illnesses. Western medicine is used mostly to treat serious illnesses (Helms 1971; Roberto Hodgson, personal communication, 1993).

The continued reliance of the Miskitu on herbal remedies for curing is reflected in the wide variety of plants used in their pharmacopoeia (Appendix). These uses remain despite the introduction of Western medicine and the negativity of missionary groups towards traditional cures. Healing with herbal medicine or Western

FIGURE 9.—Miskitu fisherman weaving a nylon net.

medicine among the Miskitu is generically called ***sika***. Those who cure with herbal remedies are collectively known as ***sika uplika***, or medicine people. A herbalist is referred to as a ***daktar*** in Miskitu. A ***daktar*** treats illnesses of natural origin such as cold, dysentery, fever, malaria, pain, and snakebite. Practitioners specialized in treating supernatural illnesses — believed to be caused by spirits — are called ***sukia***. Supernatural illness are treated with a combination of herbal remedies and rituals. ***Sukia***s are viewed as evil heathens by Christian Miskitu and Westerners in general. Today, only a few ***sukia*** are still practicing because of persecution by missionaries. However, ***daktars*** can be found in most communities and are widely respected for their abilities.

Miskitu healers protect their ethnomedicinal knowledge for several reasons. Some believe that sharing their herbal knowledge with others will result in the loss of their healing powers. Others believe that medicinals are owned by a supernatural being called ***dawan***, from whom consent is needed and monetary tribute must be paid for the use of medicinals. Consent from ***dawan*** is requested through prayers, and tributes are made by burying money at the base of a plant prior to its collection. Some healers claim that herbal remedies are private property and charge large sums of money for information. These are indigenous concepts of intellectual property rights.

Herbal remedies are sometimes mixed with Western pharmaceuticals to increase their efficacy. On several occasions Coe witnessed practitioners mixing aspirin with juice extracted from tree of life (85) for treatment of pain. Field data indicate that the Miskitu make the most use of modern pharmaceuticals in their herbal remedies (Coe, personal observation). This is perhaps due to comparatively early exposure to Western medicine (Wenger 1945), and to their continued contact with Western culture.

The two most feared illnesses among the Miskitu are ***bulpis*** — loss of skin pigmentation — and ***grisi siknis*** — possession of females by evil spirits. ***Bulpis*** afflicts almost everyone living in the rural areas of eastern Nicaragua. Coe observed victims afflicted with ***bulpis*** among the Garífuna, Mestizo, Miskitu, Rama, and Sumu of southeastern Nicaragua. However, it is more prevalent among the Miskitu of northeastern Nicaragua (Conzemius 1932; Coe, personal observation). The disease is first evidenced as a small area of skin depigmentation that eventually spreads over the entire body. Western trained physicians believe ***bulpis*** is caused by a bacterial infection that destroys skin melanin (Roberto Hodgson, personal communication, 1992). However, no Western medical treatment or cure has been found for this illness. Although I was not able to document a traditional cure for ***bulpis***, some healers allege to have cured victims in the early stages of the disease. Generally, once contracted, the disease remains for life. People that contract this disease are treated like lepers. Due to the social stigma associated with ***bulpis***, victims usually remain secluded, especially in advanced stages of depigmentation. Most people believe the disease is transmitted by food or beverages. For this reason, extreme care is taken not to ingest foodstuffs from unknown sources. Each healer has a unique herbal remedy for treatment of ***bulpis***. Remedies are administered orally and/or topically as decoctions and poultices. Medicinals most frequently cited as ingredients in remedies are balsam pear (91) leaves, bamboo (331) leaves and stem, Christmas blossom (114) leaves, dodder (79 *Cuscuta americana*), jackass bitters (41) leaves, *leche amarilla* (72), *nancite* (169) bark, red mangrove (224) bark, and sea beans (137 *Entada gigas*) cotyledons.

The victims of ***grisi siknis*** are believed to be possessed by evil spirits or by the devil. While growing up in eastern Nicaragua, Coe had several opportunities to observe women afflicted by this illness. Though ***grisi siknis*** is a gender biased illness (Dennis 1981), no evidence of cultural bias exist (i.e., afflicting only Miskitu females); the victims Coe observed were of several ethnic backgrounds (i.e., Creole, Miskitu, Sumu). The afflicted woman is in a state of hysteria characterized by periods of convulsions and trances during which she speaks to the spirits in tongues. Depending on the severity, it takes four-six men to restrain an afflicted person. In the worst cases, victims are tied up to prevent them from self-injury. Coe observed a ***sukia*** prepare a treatment for ***grisi siknis*** that consisted of a decoction and a poultice made from *culantro* (18), fitsy bush (212), garlic (320), and rubbing alcohol. The victim was given a bath and the decoction was rubbed over the entire body. Also a poultice is tied to the victims head or held over the nose for inhalation of vapors. The treatment is usually given for four to six days, but in severe cases the treatment continues for up to two weeks.

CONCLUSION

Miskitu individuals retain a broad-based knowledge of plants used for food, medicine, and other use. Older individuals are more knowledgeable than younger individuals regarding medicinal plant use. On the other hand, younger individuals are more knowledgeable than older individuals regarding food plants used as incidental foods. Overall, men are more knowledgeable than women with regard to the use of wild species — mostly trees, shrubs, and vines. On the other hand, women are more knowledgeable than men regarding the uses of species grown in dooryard gardens and around households; these are primarily herbaceous species. The passage of botanical knowledge from generation to generation among the Miskitu underscores the importance of plant resources in Miskitu culture for both subsistence and well-being.

Eastern Nicaragua remains largely unknown in terms of the flora, and consequently the potential for the discovery of foods and medicines. Wild edible crops and medicinal species require further evaluation of their nutritional and pharmacological properties. Also, investigations are needed to determine the productivity, harvestability, and regenerability of plants used by the Miskitu. The protection and long term conservation of the forest in eastern Nicaragua can only be achieved, we believe, by integrating the needs and concerns of the indigenous population into plans for the exploitation and conservation of these resources.

The way people perceive and use the resources of their environment is directly related to their culture (Anyinam 1995). Once cultural belief systems are disrupted by external forces, attitudes and behavior of peoples toward a positive relationship with nature erode rapidly (Anyinam 1995). The Miskitu culture continues to be fragmented and threatened by development pressures. Traditional medicine acquired over thousands of years is steadily disappearing. We believe that the preservation of Miskitu culture can contribute to the preservation and conservation of the remaining less-disturbed forests in eastern Nicaragua because of the close relationships between native peoples and their environment.

NOTES

[1] According to CIDCA (1985) the Miskitu alphabet consists of the following letters: ***a, â, b, d, g, h, i, î, k, l, m, n, p, r, s, t, u, û, w, y***; vowels with diacritical marks are pronounced with a long duration, e.g., ***kâpi*** is pronounced "kaapi," ***sîka*** is pronounced "siika," and ***kûka*** is pronounced "kuuka".

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APPENDIX: MISKITU PLANTS AND THEIR USES

Key:
[1]Scientific name of the angiosperm families follows Cronquist (1981); the order within dicots and monocots of families, genera, and species is alphabetical
[2]Common Names: c = Creole; m = Miskitu; s = Spanish; spelling follows CIDCA (1985, 1986, 1989), Heath (1913, 1927, 1950), Heath and Marx (1961), and Smutko (1985)
[3]Uses: F = Food; M = Medicine; O = other (construction, crafts, fiber, dye)
[4]Medicinal Applications: A = Aches and Pains; B = Bites and Stings (snake, scorpion, insects); C = Childbirth and Pregnancy; D = Diarrhea; E = Emetic; F = Fever; G = Digestive; (stomach ache, ulcers, etc.); H = Hypertension; I = Infections; J = Diabetes; K = Diuretic; L = Respiratory & Pulmonary Disorders (cold, coughs, etc.); M = Malaria; N = Burns; O = Abortifacient; P = Worms and Intestinal Parasites; Q = Astringent; R = Rituals; S = Skin Rashes and Sores; T = Tonic and Anemia (blood fortifier); U = Cuts and Hemorrhage; V = Venereal Diseases; W = Female Disorders (Menstruation, Hemorrhage); X = Purgative and Laxative; Y = Constipation; Z = Tooth Extraction
[5]Material Used: B = Bark; C = Flower; E = Seed; F = Fruit; L = Leaf; M = Stem; P = Whole Plant; R = Root; S = Sap
[6]Mode of Preparation: (See section on medicinals for further explanation.) B = Bath; D = Decoction; I = Infusion; J = Juice of crushed parts; N = None; P = Poultice; S = Syrup
[7]Mode of Administration: (See section on medicinals for further explanation). B = Bath; I = Inhalation; O = Oral; T = Topical
[8]Alkaloid/Glycoside Test. Alkaloid tests: N = not tested and no literature search; -L = none in literature; +L = Alkaloids reported in the literature; + (present) or 0 (absent) in Coe tests (see Methods and Materials). Glycoside tests: A limited literature search for glycoside was conducted only for those species that tested negative for alkaloids; /+L = present, /0 = none reported
[9]Voucher Number: C = common, introduced and or naturalized, one or no voucher collected; N = common native, only one voucher collected for all groups; NV = No voucher; P = Purchased in regional markets and stores in larger towns, not grown in eastern Nicaragua; # = F.G. Coe accession numbers
a=Cambie and Ash 1994; b=Duke 1994; c=García-Barriga 1992; d=Hegnauer 1962-1994; e=Morton 1981, 1987; f=Raffauf 1996; g=Tyler, Brady, and Robbers 1985; h=Willaman and Hui-Lin Li 1970; i=Willaman and Shubert 1961

Scientific Name[1]	Common Names[2]	Uses[3]	Medicinal[4]	Part[5]	Prep.[6]	Adm.[7]	A/G[8]	Sp.#[9]
MICROPHYLLOPHYTA, GLOSSOPSIDA								
SELAGINELLACEAE								
1. Selaginella sertata Spring	***waha bîbi (m)***	M	F,I	P	D	O	+	4267
PTERIDOPHYTA, FILICOPSIDA								
ADIANTHACEAE								
2. Acrostichum aureum L.	***limi dusa (m)***	M,O	A,F,Y	L,R	D	O	+,+La	3537

Scientific Name[1]	Common Names[2]	Uses[3]	Medicinal[4]	Part[5]	Prep.[6]	Adm.[7]	A/G[8]	Sp.#[9]
POLYPODIACEAE								
3. Pityrogramma calomelanos (L.) Link	***waha pihni (m)***	M,O	F	L,R	D	O	0/0	4059
SCHIZAEACEAE								
4. Lygodium heterodoxum Kuntze	***unta kyuca (m)***	M,O	B,S	L	D	O,T	0/0	2770
5. L. venustum Sw.	***watawa (m)***	M,O	B,S	L,M	D	O.T	0/0	4459
CONIFEROPHYTA, CONIFEROPSIDA								
PINACEAE								
6. Pinus caribaea Morelet	***awas (m)***	M,O	A,L	S	P	I,T	N/0	4430
MAGNOLIOPHYTA, MAGNOLIOPSIDA (DICOTS)								
ACANTHACEAE								
7. Blechum brownei Juss.	***inma paskaia (m)***	M	B,D	L,P	D	O	+	3706
AMARANTHACEAE								
8. Amaranthus spinosus L.	***auia kiaka (m)***	M	A,F,I	L,P	D	O	+Lb	3932
ANACARDIACEAE								
9. Anacardium occidentale L.	***kasuh, kasau (m)***	F,M,O	A,D,S	B,L	D	O,T	+	4460
10. Mangifera indica L.	***manggu, mankru (m)***	F,M,O	A,D,S	B,L	D	O,T	+	4461
11. Spondias mombin L.	***pahara (m)***	F,M,O	D,F,I,S	B,L	D	O	0/0	2274
12. S. purpurea L.	***pahara (m)***	F,M,O	D,F,S	B,L	D	O	0/0	2924
ANNONACEAE								
13. Annona sp.	no local name	M	D	L	D	O	0/0	2133
14. A. glabra L.	***punu (m)***	F,M	A,C,L	B,E,L	D,P	O,T	+Lh	2914
15. A. muricata L.	***Saput (m)***	F,M	C,D,F	B,E,L	D	O	+Lh	2900
16. Cananga odorata L.	***ilang-ilang (m)***	M,O	R	B,C,R	B,D,I	B,T	+La	2905
17. Guatteria amplifolia Triana & Planch.	***pispis (m)***	M	D,V	B,L	D	0	+	2915
APIACEAE								
18. Eryngium foetidum L.	***bilta, kiasaura (m)***	F,M	D,G,L,P,R	L	D,I	B,O	0/+Le	3454

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APOCYNACEAE								
19. Allamanda cathartica L.	***tangni lalahni (m)***	M,O	E,X	F,L,S	D	O	+,+Ld	2823
20. Echites umbellata Jacq.	***bins unta kyuka (m)***	M	B	R	D	O	+	3490
21. Lacmellea standleyi (Woodson) Monach.	***utbaia utbaia (m)***	F,M	D	L	D	O	+	3412
22. Mandevilla hirsuta (A. Rich.) Schum.	***sitan inma (m)***	M	F,I,V	L	D	O	0/0	3367
23. M. villosa (Miers) Woodson	***unta kyuka (m)***	M	F	L	D	O	0/0	2208
24. Odontadenia puncticulosa (Rich.) Pull.	***latawira (m)***	M	B	L	D	O	+	2142
25. Rhabdadenia biflora (Jacq.) Müll. Arg.	***tataku (m)***	M	F,S	L	D	O,T	0/0	4066
26. Tabernaemontana arborea Rose ex Donn. Sm.	***aras mahbra (m)***	M	F,X	L,S	D	O	+Lc	3296
27. T. chrysocarpa Blake	***buhksa mahbra (m)***	M	F,I	L,S	D	O	+	4462
28. Thevetia gaumeri Hemsl.	***yul mahbra (m)***	M	A,F,I	E,L,S	D	O	+	4451
ARISTOLOCHIACEAE								
29. Aristolochia trilobata L.	***kuntribu (m)***	M,O	B,G,H,L,T	L,P	D,I	O	+,+Ld	2661
ASCLEPIADACEAE								
30. Asclepias curassavica L.	***piuta saika (m)***	M	B,F,P,S	L	D,P	O,T	+,+Lh	2677
ASTERACEAE								
31. Bidens pilosa L.	***lalahni tangni (m)***	M	L	L	D	O	+Lh	2652
32. B. riparia HBK	***sîka tara (m)***	M	L	L	D	O	+	3231
33. Clibadium pittieri Greenm.	***inma saura (m)***	M	S,T	L,P	D	O,T	0/0	4346
34. Elephantopus spicatus Juss. ex Aubl.	***aktar, aras inma (m)***	M	A,F	L	D	O,T	+	3564
35. Eleutheranthera ruderalis (Sw.) Schltdl.	***upla saura (m)***	M	F,S	L	D	O,T	+	4189
36. Florestina latifolia (DC.) Rydb.	***lilia sara (m)***	M	P	L,P	D	O	0/0	4349
37. Matricaria chamomilla L.	***twî (m)***	M	G	P	D	O	+Lg	2653
38. Melampodium divaricatum (Rich. ex Pers.) DC.	***pianka (m)***	M	D,G	P	D	O	+	4135
39. Mikania cordifolia (L.f.) Willd.	***guahku (m)***	M	A,B,F	L,M,P	D,P	O,T	+,+Lh+	3315
40. Milleria quinqueflora L.	***mairin tangni (m)***	M	F,S	L,P	D	O	+	4351
41. Neurolaena lobata (L.) R. Br	***yâkal satka (m)***	M	F,H,M,P,S	L	D	O,T	+Ld	2552
42. Pluchea odorata (L.) Cass.	***pusa pain (m)***	M	L,P	L,M	D	O	+Lg	2042
43. P. purpurascens (Sw.) DC.	***piaka pauni (m)***	M	L,P,R	L,P	B,D	B,O	+	4165
44. Synedrella nodiflora (L.) Gaertn.	***sabatana (m)***	M	D,L,U	L,P	D	O	+Lh	3651
45. Tagetes erecta L.	***pabula tangni (m)***	M	A,L,W	L,P	D	O	+Lg	2762
46. Wedelia trilobata (L.) Hitchc.	***kaisinpata (m)***	M	B,F,I,L,W	F,L,M	D	O	0/0	4208

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BIGNONIACEAE								
47. Arrabidaea chica (Humb. & Bonpl.) Verl.	***sirisiri (m)***	M,O	D,Q,S,T	L	D	O	+Lc	3760
48. Crescentia cujete L.	***kahmi, kramuta (m)***	M	D,F,L	F,L	D,S	O	0/+Lc	2654
49. Macfadyena unguis-cati (L.) A.H. Gentry	***pûs asmala (m)***	M,O	F,U	L,M	D	O	+	2368
50. Tabebuia rosea (Bertol.) DC.	***auka (m)***	M,O	D,F	B	D	O	N/0	2672
BIXACEAE								
51. Bixa orellana L.	***aulala, tmariñ (m)***	F,M	D,L,N,S	E,L	D,I	O,T	+Lb	2855
BOMBACACEAE								
52. Ceiba pentandra (L.) Gaertn.	***sinsin (m)***	M,O	E,K,Q	B	D	O	0/0	2868
53. Ochroma pyramidale (Cav. ex Lam.) Urb.	***puhlak (m)***	O	–	–	–	–	–	2916
54. Pachira aquatica L.	***pukru (m)***	F,M	D,S,T	B	D	O	0/0	2881
BORAGINACEAE								
55. Cordia alliodora (Ruiz & Pav.) Oken	***tât auhya (m)***	M,O	S,T	E,L	D,P	O,T	-L/0	2922
56. C. curassavica (Jacq.) Roem. & Schult.	***riskupata (m)***	F,M	A,D,F,H	L	D	O,T	+	2890
57. C. inermis (Mill.) I.M. Johnst.	***kiasaika (m)***	M	A,F	L	D	O	0/0	4340
58. C. spinescens L.	***riskupata***	M	A,C,F,H	L	D	O	+	3875
59. Heliotropium indicum L.	***misri wâika (m)***	M	B,D,S	L,P	D	O	+Lh	4123
BURSERACEAE								
60. Bursera simaruba (L.) Sarg.	***limsi, daktar (m)***	M,O	I,S,T	B	D	B,O	0/0	3545
61. Protium panamense (Rose) I.M. Johnst.	***dus mâ damni (m)***	M	A,P	B	D,P	O,T	0/0	2475
62. Tetragastris panamensis (Engl.) Kuntze	***sahkal (m)***	O	–	–	–	–	–	4383
CARICACEAE								
63. Carica papaya L.	***tawas, tuas, twas (m)***	F,M	P,S,U,Y	F,L,S	D,J	O,T	+Lg	NV
CARYOPHYLLACEAE								
64. Drymaria cordata (L.) Willd. ex Roem. & Schult.	***ispara saika, sumu mairen (m)***	M	A,L	P	D	O,T	+Ld	4437
CECROPIACEAE								
65. Cecropia peltata L.	***plan, plang (m)***	M	A,F,W	L	D	O	+Lc	3462
CELASTRACEAE								
66. Salacia belizensis Standl.	***lasap (m)***	F,M	A,T	P	D	O,T	0/0	3366
CHENOPODIACEAE								
67. Chenopodium ambrosioides L.	***inma tahpla (m)***	M	P	L	J	O	+Lb	4452

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CHRYSOBALANACEAE								
68. Chrysobalanus icaco L.	***bihu, tawa (m)***	F,M,O	D,Q	B,R	D	O	0/0	2925
69. C. pellocarpus G. Mey.	***bihun (m)***	F,M	D,Q	B,R	D	O	0/0	3041
CLUSIACEAE								
70. Calophyllum brasiliense Cambess	***krasa (m)***	M,O	A,L	B,S	D	O,T	-L/0	3048
71. Garcinia mangostana L.	***mangosteen (c)***	F,M	A	B,S	N,P	T	+Le	NV
72. Symphonia globulifera L.f.	***samu (m)***	M,O	A,S	B,S	D,P	T	+	3075
COMBRETACEAE								
73. Combretum fruticosum (Loefl.) Stuntz	***kalila kûm (m)***	M	D,Q	B,F,L	D	O	0/0	2393
74. Conocarpus erectus L.	***mankru sirpi (m)***	M,O	D,Q	B,L	D	O	0/0	4355
75. Laguncularia racemosa (L.) Gaertn.	***mankru pihni (m)***	M,O	D	B	D	O	0/0	2678
76. Terminalia catappa L.	***amans (m)***	F,O	–	–	–	–	–	2708
77. T. oblonga (Ruiz & Pav.) Steud.	***labina (m)***	O	–	–	–	–	–	4388
CONNARACEAE								
78. Connarus lambertii (DC.) Sagot	***tuktuk (m)***	M,O	D,Q	B,L	D	O	+	3801
CONVOLVULACEAE								
79. Cuscuta americana L.	***unta kyuka (m)***	M	S	L,M	D,P	T	+	2918
80. Ipomoea batatas (L.) Lam.	***tawa (m)***	F,M	U	L	D	T	+	3637
81. I. mauritiana Jacq.	***latawira (m)***	M	B,S	L	D,P	O,T	0/0	4061
82. I. pes-caprae (L.) R.Br.	***kâbu unplâplapra (m)***	M	F,S,T	L	D,P	O,T	+,+Lg	2907
83. Merremia discoidesperma (Donn. Sm.) O'Donell	***wail amans (m)***	M	S,U	L,M	D	T	+	2850
84. Operculina pteripes (G. Don) O'Donnell	***bitta tataku, latawira, tataku (m)***	M	B,U	L	P	T	+	2884
CRASSULACEAE								
85. Kalanchoe pinnata (Lam.) Pers.	***bradutki (m)***	M	A,L	L	D,P	O,T	0/+Lb	3434
CUCURBITACEAE								
86. Citrullus lanatus (Thunb.) Mansf.	***raiapisa, rayapisa (m)***	F	–	–	–	–	–	2717
87. Cucurbita moschata (Duchesne ex Lam.) Duchesne ex Poir.	***iwa (m)***	F	–	–	–	–	–	2746
88. Fevillea cordifolia L.	***mukula (m)***	M	A,B,E,G	E	I,P	O,T	0/0	3920
89. Lagenaria siceraria (Molina) Standl.	***pispis (m)***	M,O	G,S,X	L	D	O,T	0/0	2732
90. Luffa cylindrica (L.) M. Roem.	***kahmi (m)***	M,O	A,P	L	D,P	O,T	+,+Ld	3402

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91. Momordica charantia L. M,S,T	***tasplira,twasplira (m)***	F,M	A,C,H,I,J,L,	L,M	D	O,T	+,+Lh	3633
92. Sechium edule (Jacq.) Sw.	***makula (m)***	F	–	–	–	–	–	2721
DILLENIACEAE								
93. Davilla kunthii A. St. Hil.	***yahal (m)***	M,O	D,Q	B,L,M	D	O	0/0	2706
EUPHORBIACEAE								
94. Acalypha arvensis Poepp. & Endl.	***blâ sîka (m)***	M	B,S	L,P	D	O,T	0/+Ld	3642
95. Amanoa potamophila Croizat	***siuli saura (m)***	M,O	X	F	D	O	0/0	4093
96. Croton punctatus L.	***riskupata (m)***	M	F,I	F,L,R	D	O	+Lg	4059
97. Euphorbia hyssopifolia L.	***bla saika (m)***	M	A,C,I	L,P	D	O	0/0	4038
98. E. thymifolia (L.) Millsp.	***mahkira, talalaya (m)***	M	A,C,I	L,P	D	O	+Lg	2903
99. Hyeronima alchorneoides Allemão	***nancitón (s)***	O	–	–	–	–	–	4364
100. Jatropha curcas L.	***pisik (m)***	M	D,F,P,V,X	L,S	D	O	+Lh	2749
101. J. gossypiifolia L.	***twis twis (m)***	M	D,I,S,X	L	D	O	+Lh	4360
102. J. hastata Jacq.	***pisik (m)***	M,O	F,X	L	D	O	0/0	5322
103. J. urens L.	***pisik (m)***	M,O	C,I,U	L,R	D	O	0/0	2789
104. Manihot esculenta Crantz	***yauhra (m)***	F,M	A,D,F	L,R	D	O	0/+La	3269
105. Pedilanthus tithymaloides (L.)Poit.	***birdflower (c)***	F,M	A,O,W,X	L,R,S	D,N	O	-L/0	2783
106. Phyllanthus acidus (L.) Skeels	***kumpira waitni (m)***	F,M	F,T	L	D	O	+Ld	2751
107. Ricinus communis L.	***sîka tara (m)***	M	A,F,X	E,L	D,P	O,T	+Lh	3507
FABACEAE								
108. Abrus precatorius L.	***bins silbyara (m)***	M	F	F,L	D	O	+Lh	4033
109. Andira inermis (Wright) HBK	***piuta lang lang (m)***	M	F,P,X	B	D	O	+Lh	2786
110. Arachis hypogaea L.	***pinda (c)***	F	–	–	–	–	–	2752
111. Bauhinia guianensis Aubl.	***urus mina-mangka (m)***	M	T	B,M	D	O,T	0/0	2734
112. Cajanus cajan (L.) Millsp.	***bins tikbus (m)***	F,M	L,S	F,L	D	O,T	+,+Lc	3363
113. Canavalia maritima (Aubl.) Thouars	***tangni kâbu un(m)***	M	F,X	E,L,R	D	O	+,+Lg	4229
114. Cassia alata L.	***kislin, krismis tangni sus saika (m)***	M	D,H,I,P,S,T,X	F,L	B,D,J,P	B,O,T	+,+Lh	3204
115. C. fistula L.	***bisbaia dapa (m)***	M	L	F	D,N	O	+Lg	2787
116. C. grandis L.f.	***bisbaira mina (m)***	F,M	P,S,T,X	F,L	D,J,S	O,T	0/+Lb	3440
117. C. hirsuta L.	***tasma (m)***	M	F,W	E,L	D	O	+Lc	3586
118. C. occidentalis L.	***singsingya (m)***	F,M	F,G,I,L	L,P,R	D,J	O,T	+,+Lg	3627

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119. C. reticulata Willd.	***sus saika (m)***	M	A,B,I,S	L,R	D	O	+	2799
120. C. tora L.	***bins sirpi (m)***	F,M	F,X	L	D	O	0/0	3404
121. C. undulata Benth.	***cuscus (m)***	M	F,X	L,R	D	O	0/0	3291
122. Crotalaria retusa L.	***saihka inma (m)***	M	S,U,X	L	D,P	O,T	+Lh	4227
123. C. verrucosa L.	***pyuta bastar (m)***	M	S,X	L	D	O,T	+Lh	3720
124. Dalbergia brownei (Jacq.) Urb.	***rusul (m)***	M,O	D,Q,S	B,L,M	D	O,T	0/0	4082
125. D. hypoleuca Pittier	***rusul (m)***	O	–	–	–	–	–	4325
126. D. tucurensis Donn. Sm.	***rusul (m)***	O	–	–	–	–	–	4391
127. Desmodium adscendens (Sw.) DC.	***dusa karnira (m)***	M	A,G,I,S	L,P,R	D,I	O	+	4118
128. D. barbatum (L.) Benth. & Oerst.	***latawira (m)***	M	A,I,S,V	L,R	D	O	0/0	3310
129. D. canum (J.F. Gmel.) Schinz & Thell.	***latawira saika (m)***	M	A,F,I,S,V	L,R	D	O	+	4043
130. D. glabrum (Mill.) DC.	***latawira, latawira saika (m)***	M	A,F,I,S	L,R	D	O	0/0	2535
131. D. triflorum (L.) DC.	***latawira (m)***	M	A,I	L,R	D	O	+	2767
132. Dialium guianense (Aubl.) Sandwith	***slim (m)***	M,O	D,Q,S	B,L	D	O,T	-L/0	4392
133. Dioclea sp.	***sûla nâkra (m)***	M	A,S	L	D,P	T	+	2865
134. D. megacarpa Rolfe	***inma bylyanhta (m)***	M,O	A,S	L	D,P	T	+	3243
135. D. reflexa Hook. f.	***aras nâkra (m)***	M	A,S	L	D,P	T	+Lh	2840
136. Dipteryx oleifera (Benth.) Taub.	***ebu, îbu (m)***	F,M,O	A,Q,Z	B,F	D,P	O,T	+Ld	2326
137. Entada gigas (L.) Fawc. & Rendle	***sûla nâkra (m)***	M	A,S	F	P	T	0/0	4356
138. Enterolobium cyclocarpum Griseb.	***tuburus (m)***	O	–	–	–	–	–	4374
139. Gliricidia sepium (Jacq.) Steud.	***lulakira, pispis (m)***	M,O	I,S	B,L	D,P	T	0/+Lb	4253
140. Hymenaea courbaril L.	***laka, lawa (m)***	M,O	A,D,F,L	B,S	D,P	O,T	0/0	3417
141. Indigofera suffruticosa Mill.	***blû (m)***	M,O	B,F,R	P,S	D	O,T	+Lg	2773
142. Inga edulis G. Martens	***bribri (m)***	F,O	–	–	–	–	–	2776
143. Lonchocarpus latifolius (Willd.) HBK	***yul tât (m)***	M,O	S	F,R	D	T	0/0	4070
144. L. pentaphyllus (Poir.) DC	***lî tât (m)***	O	–	–	–	–	–	2567
145. Mimosa pudica L.	***king aula (m)***	M	A,G,P,W	L,M,P,R	D	O	+,+Lh	2254
146. Mucuna urens DC.	***kuakua, kwakwa (m)***	M	A,B,G,S	S	D,P	T	+Lh	2870
147. Pentaclethra macroloba (Willd.) Kuntz	***krikaika (m)***	M,O	B,F,S	B	D	O,T	+	2446
148. Phaseolus vulgaris L.	***bins, snek, snik (m)***	F	–	–	–	–	–	2758
149. Pithecolobium dulce (Roxb.) Benth.	***twitwi (m)***	M,O	D,Q	B	D	O	+Lh	3766
150. P. recordii (Britton & Rose) Standl.	***siksa mâ (m)***	M,O	D,Q	B	D	O	0/0	4076

Scientific Name[1]	Common Names[2]	Uses[3]	Medicinal[4]	Part[5]	Prep.[6]	Adm.[7]	A/G[8]	Sp.#[9]
151. Tamarindus indica L.	***ambran (m)***	F,M,O	I,P,X	B,F,L	D	O	+Lb	2783
152. Vigna luteola (Jacq.) Benth.	***liwa saika (m)***	M	L	P	D	O	0/0	4171
FLACOURTIACEAE								
153. Casearia aculeata Jacq.	***pyuta piaia (m)***	M,O	S	L	D,P	T	+	3859
GENTIANACEAE								
154. Coutoubea spicata Aubl.	***liwa sâkaia (m)***	M	A,F	L	D	O	0/0	2587
GESNERIACEAE								
155. Solenophora tuerckheimiana Donn. Sm.	***asdura pata (m)***	M	A,S	L,P	D,P	T	0/0	3940
LAMIACEAE								
156. Hyptis capitata Jacq.	***kua mahbra (m)***	M	G,L	L,P	D	O	0/0	3561
157. H. verticillata Jacq.	***wahiwin saika (m)***	M	H,I,L,S	L,R	D,I	O,T	+	2671
158. Ocimum micranthum Willd.	***sîka kaira (m)***	F,M	A,F,G,I,R	L	D,I	O,T	0/0	2234
LAURACEAE								
159. Cassytha filiformis L.	***wiak wani (m)***	M	A,P	P	D,P	O,T	+Lh	4174
160. Cinnamomum zeylanicum Blume	***cinnament (c)***	F,M	D,G,T	B,M	D	O	0/0	2763
161. Persea americana Mill.	***sikia (m)***	F,M	D,L,O,W	B,E,L	D	O	+Lg	3356
162. Phoebe sp.	***no local name***	M	A	F,L	D	O	+	4179
LOGANIACEAE								
163. Spigelia anthelmia L.	***liwa sâkaia (m)***	M	P	P	D	O	+,+Lh	2820
LORANTHACEAE								
164. Struthanthus cassythoides Millsp. ex Standl.	***tati sau (m)***	M	A,B,L,S	L,P	D,P	O,T	+	3850
LYTHRACEAE								
165. Cuphea mimuloides Cham. & Schltr.	***mâia (m)***	M	D,T	P	D	O	0/0	4055
MALPIGHIACEAE								
166. Banisteriopsis argentea C.B. Rob. ex Small	***samu (m)***	M,O	S	B,L,M	D	T	+Lc	2896
167. B. cornifolia C.B. Rob. ex Small	***sîka wani (m)***	M	B,S	B,L,M	D	T	+	3311
168. Brysonima sp.	***krabu (m)***	F,M,O	Q	B	D	O	+	3376
169. B. crassifolia (L.) HBK	***krabu (m)***	F,M,O	A,D,Q	B	D	O	+	2857
170. Heteropteris multiflora (DC.) Hochr.	***twisa târa (m)***	M	L,Q	L	D	O	+	3481
171. Hiraea quapara (Aubl.) Morton	***bibi rakaika (m)***	M	S,U	L	D	T	+	2139
172. Stigmaphyllon pseudopuberum Nied.	***pyuta wâkia (m)***	M	Q,V,Z	L	D	O,T	0/0	3796

Scientific Name[1]	Common Names[2]	Uses[3]	Medicinal[4]	Part[5]	Prep.[6]	Adm.[7]	A/G[8]	Sp.#[9]
MALVACEAE								
173. Abelmoschus esculentus (L.) Moench	***kataramas (m)***	F,M	C	L	D	O	+Lg	4440
174. Hibiscus bifurcatus Cav.	***dinar tangni (m)***	M,O	C,F,L,S,W	F,L	D	O	+	3475
175. H. sabdariffa L.	***suril (m)***	F	–	–	–	–	–	2745
176. H. tiliaceus L.	***sani (m)***	M,O	F,Y	B,L	D	O	+	2189
177. Kosteletzkya pentasperma (Bertol.) Griseb.	***mairin tangi (m)***	M,O	S,U	L	D,P	T	+	3529
178. Pavonia rosea Schltr.	***tangni sirpi (m)***	M	I,V,W	R	D	O	+	4151
179. Sida acuta Burm. f.	***aras kauka, dinar, yu tangni (m)***	M,O	A,C,L,W	L,P	D	O	+Lh	3977
180. S. rhombifolia L.	***brum sirpi, dinar (m)***	M,O	A,C,F,L	L	D	O	+Lh	3587
181. S. spinosa L.	***yu tangi sirpi (m)***	M	D,I,S	L	D	O,T	+Lh	2251
MELASTOMATACEAE								
182. Acisanthera quadrata Pers.	***asdura pata, sari sirpi (m)***	M	F	L,M	D	O	0/0	3245
183. Miconia albicans (Sw.) Triana	***blú sirin (m)***	F,M,O	S	L	D	T	0/0	2656
184. M. laevigata (L.) DC.	***sirin (m)***	M,O	S	L	D	T	0/0	4309
185. Nepsera aquatica (Aubl.) Naudin	***siri (m)***	M	S	F,L	D	T	+	3375
186. Tibouchina aspera Aubl.	***sari (m)***	M	L	F,L	D	O	0/0	4144
187. Tococa guianensis Aubl.	***waha plît (m)***	O	–	–	–	–	–	2833
MELIACEAE								
188. Carapa guianensis Aubl.	***swa (m)***	M,O	D,F	B	D	O	+,+Lg	2803
189. Cedrela odorata L.	***wiñkur, yalam (m)***	M,O	A,F,T	B	D	O	-L/0	4365
190. Melia azedarach L.	***paradis (m)***	M,O	A,D,S	B,L	D	O,T	+Ld	4453
191. Swietenia macrophylla King	***yulu (m)***	M,O	F	B	D	O	+Lg	4413
MENYANTHACEAE								
192. Nymphoides humboldtianum (HBK) Kuntze	***liwa sâkaia (m)***	M	F,P,S	L,P	D	O,T	0/0	2118
MORACEAE								
193. Artocarpus altilis (Parkinson) Fosberg	***breadfruit (c)***	F,M	A,H	L,S	D,P	T	0/+La	3423
194. Ficus insipida Willd.	***tatalaya (m)***	M,O	A,G	S	I,P	O,T	+	3482
MYRISTICACEAE								
195. Myristica fragrans Houtt.	***nutmeg (c)***	F,M	G	F	D	O	+Lc	2753
196. Virola koschnyi Warb.	***bahnak (m)***	M,O	A,D,F	B,L,S	D,P	O,T	+Lg	2398
MYRSINACEAE								
197. Stylogyne guatemalensis Blake	***butku plun (m)***	F,M,O	G,L	L	D	O,T	0/0	2583

Scientific Name[1]	Common Names[2]	Uses[3]	Medicinal[4]	Part[5]	Prep.[6]	Adm.[7]	A/G[8]	Sp.#[9]
MYRTACEAE								
198. Calyptranthes chytraculia var. americana McVaugh	*kiaka (m)*	F,M	G,L	L	D	O	0/0	4075
199. Eugenia acapulcensis Steud.	*manani (m)*	M	F,G	L	D	O	0/0	3916
200. E. axillaris (Sw.) Willd.	*tablira (m)*	M	D,T	L	D	O	0/0	3990
201. Psidium guajava L.	*kru, sikra (m)*	F,M,O	D,G,H,I,P,S	B,L	D,I	B,O	+Lb	3441
202. Syzygium aromaticum (L.) Merr. & Perry	*cloves (c)*	F,M	A,C,G,O	C	D	O	0/0	4442
203. S. malaccensis (L.) Merr. & Perry	*apil (m)*	F,M	A,S	B,L,S	D,P	T	+	3452
NYCTAGINACEAE								
204. Neea stenophylla Standl.	*no local name*	M	G	L	P	T	0/0	3782
OCHNACEAE								
205. Ouratea nitida (Sw.) Engl.	*tubana (m)*	M	L	L,P	D,P	T	0/0	4170
206. Sauvagesia erecta L.	*lilia sara (m)*	M	A,B,F,G,L	P	D,P	O,T	0/0	4201
ONAGRACEAE								
207. Ludwigia octovalvis (Jacq.) Raven	*slilma sirpi (m)*	F,M	F,G,L	F	D	O	0/0	3223
OXALIDACEAE								
208. Averrhoa bilimbi L.	*mimbru (m)*	F,M	D,F	F,L	D,J	O	-L/0	2784
209. A. carambola L.	*dusmâ tahpla (m)*	F	–	–	–	–	–	2754
PASSIFLORACEAE								
210. Passiflora biflora Lam.	*drap sirpi (m)*	M	F,I,K	L,P	D	O	0/0	4104
211. P. quadrangularis L	*drap, tutbuñ (m)*	F,M	A,F,J,P	L	D,J	O,T	+Lh	3511
PHYTOLACCACEAE								
212. Petiveria alliacea L.	*kiski, sabatkira (m)*	M	A,D,R	L,P,R	I,P	O,T	+Ld	3959
213. Phytolacca rivinoides Kunth & Bouché	*tilba pata (m)*	F,M	E,X	L,R	D	O	+Lc	3422
PIPERACEAE								
214. Peperomia pellucida (L.) HBK	*sumu mairen (m)*	M	B,I,V,W	P	D	O	0/0	3750
215. P. peltata C. DC.	*upla kalula (m)*	M	B,I,V,W	P	S	O	0/0	3525
216. Piper auritum HBK	*kauput, sîka tara(m)*	F,M	A,C,F,G,L	L	I,J,P	O,T	+,+Lg	2719
217. P. hispidum Sw.	*lulubak bak (m)*	M	A,F,G	L	B,I	B,O	+,+Ld	2457
218. P. jacquemontianum (Kunth) DC.	*lulubakbak, lula sara, bakbak ya (m)*	M	A,F,G	L	B,I	B,O	+	3956
219. P. peltatum L.	*sikatara, bulput (m)*	F,M	A,F,G	L	D,P	B,O,T	+,+Ld	3931

Scientific Name[1]	Common Names[2]	Uses[3]	Medicinal[4]	Part[5]	Prep.[6]	Adm.[7]	A/G[8]	Sp.#[9]
POLYGONACEAE								
220. Antigonon leptopus Hook. & Arn.	***unta kyuka (m)***	F,M,O	V	R	D	O	0/+La	2766
221. Coccoloba uvifera (L.) L.	***waham (m)***	F,M	D,G,S	B,L	D	O	0/0	3446
222. Polygonum punctatum Elliott	***pyâwira inma (m)***	M	S	P	D	T	0/0	3419
PORTULACACEAE								
223. Portulaca oleracea L.	***tital tangni (m)***	M	P	P	D	O	+Lb	2786
RHIZOPHORACEAE								
224. Rhizophora mangle L.	***mankru (m)***	M,O	D,S	B	D	O	0/+La	2097
RUBIACEAE								
225. Alibertia edulis (Rich.)	***liwa dus mâ***	F,M	A,C,Q	B,L	D	O,T	0/0	4352
226. Borreria laevis (Lam.) Griseb.	***kalila, li dukya saika, twisa (m)***	M	B,L,S,U,W	P	D,P	O,T	+	3265
227. Chiococca alba (L.) Hitchc.	***sriri (m)***	M	G,S,Y	R	D	O	+	4176
228. Cinchona pubescens Vahl	***quina, quinina (h)***	M	D,F,M	B,M	D	O	+Lh	2740
229. Coffea arabica L.	***kâpee, kâpi (m)***	F,M	F,U	E	D,N	O,T	+Lf	NV
230. Guettarda elliptica Sw.	***lasat (m)***	M,O	T	L	D	O	0/0	4195
231. Hamelia axillaris Sw.	***silbyara (m)***	M	B,I,S	L,P	D,P	O,T	+	2503
232. H. barbata Standl.	***silbyara (m)***	M	B,I,S	L,P	D,P	O,T	+	2588
233. H. patens Jacq.	***yamni sîka (m)***	M	B,F,I,M,S,U,W	L,P	D,P	O,T	+	2768
234. H. rovirosae Wernham	***silbyara (m)***	M	B,F,I,S,U	F,L,M	D	O,T	+	4236
235. Hemidiodia ocimifolia (Willd.) Schum.	***kanabala (m)***	M	G	L	D	O	+	4002
236. Morinda citrifolia L.	***kwirku apil (m)***	M	A,N	L	P	T	+Lh	2769
237. M. panamensis Seem.	***kwirku apil (m)***	M,O	D,X	B,L	P	T	0/0	2596
238. Posoqueria latifolia (Rudge) Roem. & Schult.	***kuramaira,***	F,M	D,Q	B,L	D	O	+	4315
239. Psychortria sp.	***dus mâ pauni (m)***	M	A,S	L	B,P	O,T	0/0	2416
240. P. capitata Ruiz & Pav.	***wail kâpi (m)***	M	T,U	L,M	D,P	O,T	0/0	2414
241. P. elata (Sw.) Hammel	***inma pauni (m)***	M	F,S	F,L,M	D	O,T	+	2477
242. P. ipecacuanha (Brot.) Stokes	***wâkia (m)***	M	D,E,F,L	R	D	O	+Lh	4447
243. P. poeppigiana Muell.	***tangni pauni (m)***	M	I,S,U	F,L,M	D	T	+	3984
244. Richardia scabra L.	***pulpul (m)***	M	D,E,F,L,S	P,R	D	O,T	0/0	4156
RUTACEAE								
245. Citrus aurantifolia (Christm.) Swingle	***laimus, leimus (m)***	F,M	C,D,F,G,I,L,P	F,L,R	D,J	O	+Lc	3677
246. C. aurantium L.	***arins tahpla (m)***	F,M	D,F,G,H,I,K,L	F,L,R	D,I,J	B,O	+Lh	4449

Scientific Name[1]	Common Names[2]	Uses[3]	Medicinal[4]	Part[5]	Prep.[6]	Adm.[7]	A/G[8]	Sp.#[9]
247. C. paradisi Macfad.	***sadik (m)***	F,M	D,F, H	F	J	O	+Ld	3681
248. C. sinensis (L.) Osbeck	***arins, andris (m)***	F,M	D,F,H,L	F,L	D,J	O	+Lh	4450
249. Murraya paniculata (L.) Jack	***limonaria (s)***	M	A	L	N	O	+Lh	4338
250. Ruta graveolens L.	***kiski sakbatkira (m)***	M	A,P,R	L,M	D,I	O,T	+Lh	4454
SAPINDACEAE								
251. Cupania rufescens Triana & Planch.	***bila bila (m)***	M,O	A,D,S	L	B,D	B,O	0/0	4275
252. C. scrobiculata Rich.	***kaliltara wâika (m)***	M,O	A,D,S	L	B,D	B,O	0/0	2488
253. Melicoccus bijugatus Jacq.	***suksuk (m)***	F,M	D,Q	E,L	D	O	0/0	3435
254. Sapindus saponaria L.	***sniwawa (m)***	O	–	–	–	–	–	2771
SAPOTACEAE								
255. Chrysophyllum cainito L.	***apil (m)***	F,M	D,F,Q	F,L	D,N	O	+Le	3353
256. Manilkara zapota (L) P. Royen	***eban, îban (m)***	F,M	A,S	S	P	T	+Le	2792
SCROPHULARIACEAE								
257. Bacopa procumbens (Mill.) Greenm.	***bibi rakaika (m)***	M	A,X	L	D,J	O,T	0/0	4441
258. Lindernia diffusa (L.) Wettst.ex Dugand & Jacks.	***arbustabul,***	M	X	P	D	O	+	4158
259. Scoparia dulcis L.	***haraspata (m)***	M	B,C,T,W	L,P,R	D	O	+,+Lh	3976
SIMAROUBACEAE								
260. Quassia amara L.	***wanabaka (m)***	M	B,F,M,T	M	D	O	+,+Lh	3824
261. Q. simarouba L.f.	***sinsira (m)***	M,O	D,M,S,T,W	B	B,D	B,O	0/+Le	4404
SOLANACEAE								
262. Capsicum annuum var. glabriusculium (Dunal) Heiser & Pickersgill	***anmak, kuma (m)***	F,M	A,L,S	E,F,L	D,N	O,T	+Lh	4330
263. C. chinensis Jacq.	***anmak, kuma (m)***	F,M	A,L,S	E,F,L	D,N	O,T	+	3605
264. C. frutescens L.	***anmak, kuma (m)***	F,M	I,L	F,L	D,J	O,T	+Lh	2748
265. Nicotiana tabacum L.	***twâhko, twâku (m)***	M,O	A,B	L	N	O,T	+Lh	NV
266. Physalis angulata L.	***pyâwira dus mâ (m)***	M	F,I,M	L,P	I	O	+Lh	3700
267. P. cordata Mill.	***bilta (m)***	M	I,K	L,P	I	O	+	3700
268. Solanum asperum Rich.	***susul (m)***	M,O	S	L	D	T	+Lh	3258
269. S. lycopersicum L.	***tumatis (m)***	F,M	S	L	J	T	+Lh	2831
270. S. mammosum L.	***kuswa mahbra (m)***	M	A,I,L,S	E,F,L	D,P	O,T	+Lh	2913
271. S. torvum Sw.	***dusmâ kyayá (m)***	M	A,B,F,S	L	D,P	T	+Lh	2892
272. S. tuberosum L.	***pitita (m)***	F,M	G	R	J	O	+Lh	NV

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STERCULIACEAE								
273. Melochia villosa (Mill.) Fawc. & Rendle	***yuma saika (m)***	M	A,G,L	L,R	D	O	+	4331
274. Theobroma cacao L.	***kakai, kakao, kakay (m)***	F,M	S,U	E,L	P	T	+Lh	2815
275. Waltheria americana L.	***wiwi saika (m)***	M	D,F,Q,S,T,U	L	D	O,T	+Lh	4131
276. W. glomerata Presley	***alwani saika (m)***	M	D,Q,T,U	L	D	O,T	0/0	2609
TILIACEAE								
277. Apeiba aspera Aubl.	***urus bamba (m)***	M,O	L,Q,S	B,L	D	O,T	0/0	2377
278. Luehea seemannii Triana & Planch.	***wiwi saika (m)***	M,O	Q	B,L	D	O	0/0	2785
TURNERACEAE								
279. Turnera odorata L.	***sukwan (m)***	M	A,L,T	L	D	O	0/0	4140
280. T. pumilea L.	***saika rakaia (m)***	M	A,L	L	D	O	0/0	4332
281. T. ulmifolia L.	***klua tangni (m)***	M	A,F,L,X	L	D	O	+Lh	3896
VERBENACEAE								
282. Avicennia germinans (L.) L.	***mankru siksa (m)***	M,O	D	B	D	O	0/0	2824
283. Callicarpa acuminata HBK	***pulkin (m)***	M	D	L	I	O	+	3284
284. Citharexylum caudatum L.	***dama (m)***	M,O	L	L	D	O	+	2203
285. Clerodendrum thomsoniae Balf.	***rice and beans (c)***	M,O	S	L	P	T	0/0	2292
286. Lantana camara L.	***butku plun (m)***	M	S	L	D,P	T	+Lc	NV
287. L. trifolia L.	***butku plun (m)***	M	A	L	P	T	+Lc	1002
288. Lippia alba (Mill.) N.E. Br. ex Britton & Wilson	***sîka siahka (m)***	F,M	C,F,G,I,W	L	D,I	O	0/+Lc	3912
289. L. micromera Schauer	***waha sirpi (m)***	M	C,G,I,K,L,W	L	D,I	O	0/+Lc	2920
290. Phyla nodiflora (L.) Greene	***las las (m)***	M	R,S	P	D,P	O,T	+Lg	2778
291. Stachytarpheta cayennensis (Rich.) Vahl	***sîka tahpla (m)***	M	G,P,X	L	D	O	+Lc	2898
292. S. jamaicensis (L.) Vahl	***sîka tahpla (m)***	M	F,P,X	L	D	O	+Lg	2875
293. Tamonea spicata Aubl.	***kiaya (m)***	F,M	F,G,L	L	D	O	+	4162
294. Vitex kuylenii Standl.	***blû tangni (m)***	M,O	I,S	B,L	D,P	B,T	0/0	2312
VITACEAE								
295. Cissus sicyoides L.	***karas wihta (m)***	M	A	L,M,R	D	T	0/0	3869
VOCHYSIACEAE								
296. Vochysia ferruginea G. Martens	***yamari (m)***	O	–	–	–	–	–	4336

Scientific Name[1]	Common Names[2]	Uses[3]	Medicinal[4]	Part[5]	Prep.[6]	Adm.[7]	A/G[8]	Sp.#[9]
LILIOPSIDA (MONOCOTS)								
ALOEACEAE								
297. Aloe vera L.	***kyurtakaia sut (m)***	M	B,N,S,X	L	J	O,T	+Lg	2743
ARACEAE								
298. Colocasia esculenta (L.) Schott	***balyanhta (m)***	F	–	–	–	–	–+	2788
299. Philodendron scandens K. Koch & Sello	***kura siaka (m)***	M	B,S	L,M	D,P	O,T	+	3416
300. Syngonium angustatum Schott	***piuta saika (m)***	M	A,S	L,P	D	T	-L/0	2711
301. Xanthosoma mexicanum Liebm.	***wail duswa (m)***	M	S	L	D	T	0/0	4345
302. X. sagittifolium (L.) Schott	***duswa (m)***	F	–	–	–	–	–	2791
ARECACEAE								
303. Acoelorraphe wrightii (Griseb. et. H. Wendl.) H. Wendl. ex Becc.	***papta dusa (m)***	M,O	D	R	D	O	0/0	2782
304. Bactris gasipaes Kunth	***supa (m)***	F,M,O	G	F	D	O	0/0	2772
305. B. major Jacq.	***papta dusa kyayal (m)***	F,M,O	P,X	R	D	O	0/0	3725
306. Calyptrogene ghiesbreghtiana (Linden & H. Wendl.) H. Wendl.	***kalita wâika (m)***	O	–	–	–	–	–	NV
307. Cocos nucifera L.	***kuku (m)***	F,M,O	D,P	F	D,I	O	+Lc	NV
308. Elaeis guineensis Jacq.	***batana (m)***	M,O	G,X	F	D	O	N/0	NV
309. E. oleifera (Kunth) Cortés	***ohon,uhun (m)***	F,M,O	G,X	F	D	O	N/0	NV
BROMELIACEAE								
310. Ananas comosus (L.) Merr.	***pihtu (m)***	F,M	B,I,U	F,L	D	O	+Lg	2727
311. Bromelia pinguin L.	***ahsi (m)***	O	–	–	–	–	–	2737
COMMELINACEAE								
312. Commelina erecta L.	***butku sirpi (m)***	M	S	L,M	J	T	0/0	4360
CYPERACEAE								
313. Cyperus luzulae (L.) Retz.	***kukra saika (m)***	M,O	D	R	D	O	0/0	3691
314. Kyllinga tibialis Ledeb.	***twîkâbu (m)***	M	F	R	D	O	+	4114
315. Rhynchospora barbata (Vahl.) Kunth	***twî kusni (m)***	O	–	–	–	–	–	2635
316. R. ciliata Vahl.	***krikri (m)***	O	–	–	–	–	–	4199
DIOSCOREACEAE								
317. Dioscorea trifida L.	***usi (m)***	F	–	–	–	–	–	2844

Scientific Name[1]	Common Names[2]	Uses[3]	Medicinal[4]	Part[5]	Prep.[6]	Adm.[7]	A/G[8]	Sp.#[9]
HAEMODORACEAE								
318. Xiphidium caeruleum Aubl.	***swilawan (m)***	M	A,B,S,W	L	D	O,T	0/+Ld	4439
LILIACEAE								
319. Allium cepa L.	***inyan (m)***	F,M	L,P	R	J	O	N	NV
320. A. sativum L.	***gyalik,kyalik (m)***	F,M	A,H,P	R	J	O	N	NV
321. Hypoxis decumbens L.	***anansi (m)***	M,O	D	R	D	O	0/0	4443
MARANTACEAE								
322. Thalia geniculata L.	***waha (m)***	O	–	–	–	–	–	4446
MUSACEAE								
323. Musa sp.	***plâs (m)***	F,M,O	B,D,U	F,S	N,P	O,T	+Lg	NV
324. M. paradisiaca L.	***plâtu (m)***	F,M,O	B,D,U	F,S	N,P	O,T	+Lg	NV
325. M. paradisiaca var. sapientum (L.) Kuntze	***siksa (m)***	F,M,O	B,D,U	F,S	N,P	O,T	+Lh	NV
POACEAE								
326. Acroceras zizamioides (HBK) Dandy	***twî (m)***	O	–	–	–	–	–	2493
327. Andropogon leucostachyus HBK	***twî (m)***	O	–	–	–	–	–	2695
328. A. virgatus Desv.	***twî (m)***	M,O	F,S	L,R	D	O	0/0	2055
329. Axonopus compresus (Sw.) P. Beauv.	***twî (m)***	O	–	–	–	–	–	4271
330. A. poiophyllus Chase	***twî (m)***	O	–	–	–	–	–	2621
331. Bambusa vulgaris Schrad. ex Wendl.	***klar (m)***	M,O	D,F,S	R	D,P	O,T	+Lg	2711
332. Coix lacryma-jobi L.	***twî ma (m)***	M,O	A,I,S	E,R	D	O	+La	2646
333. Cymbopogon citratus (Nees) Stapf	***twî rih (m)***	F,M	F,G,L	L	I	O	+Lg	3682
334. Dichanthelium sphaerocarpon var. floridanum (Vasey) Davidse	***twî (m)***	O	–	–	–	–	–	2686
335. Echinochloa colonum (L.) Link	***twî (m)***	O	–	–	–	–	–	4258
336. Eleusine indica (L.) Gaertn.	***twî (m)***	M	F,I,W	R	D	O	+Lh	4329
337. Gynerium sagittatum (Aubl.) P. Beauv.	***yauhrus (m)***	M,O	B,I,K,S,V	R	D	O	0/0	3870
338. Ischaemum timorense Kunth	***twî (m)***	O	–	–	–	–	–	3325
339. Leptocarpydium lanatum (HBK) Nees	***twî (m)***	O	–	–	–	–	–	4321
340. Mesosetum blakei Swallen	***twî (m)***	O	–	–	–	–	–	4323
341. Olyra latifolia L.	***twî (m)***	M	S	L,R	D	T	0/0	3428
342. Oryza sativa L.	***rais (m)***	F,M	D,S	E	B,I	B,O	+Lh	2756
343. Panicum maximum Jacq.	***twî târa (m)***	O	–	–	–	–	–	2759
344. P. mertensii Roth	***twî (m)***	O	–	–	–	–	–	2538

Scientific Name[1]	Common Names[2]	Uses[3]	Medicinal[4]	Part[5]	Prep.[6]	Adm.[7]	A/G[8]	Sp.#[9]
345. P. pilosum Sw.	***twî (m)***	O	–	–	–	–	–	2600
346. P. purpurascens Raddi	***twî para (m)***	O	–	–	–	–	–	2761
347. Paspalum punchellum Kunth	***twî (m)***	O	–	–	–	–	–	2082
348. Saccharum officinarum L.	***kayu (m)***	F,M,O	D,I,L	L,M	D,J	O,T	-L/0	2764
349. Sporobolus virginicus (L.) Kunth	***twî (m)***	O	–	–	–	–	–	2027
350. Zea mays L.	***aya (m)***	F,M,O	I	C	D	O	+Lh	2766
SMILACACEAE								
351. Smilax spinosa Mill.	***chiny, tá wâkia (m)***	M	B,S,T	R	D	O	0/+Lc	2735
XYRIDACEAE								
352. Xyris ambigua Beyr. ex Kunth	***rati (m)***	M	G,S	P	D	O,T	0/0	2632
ZINGIBERACEAE								
353. Zingiber officinale Roscoe	***marid tangni, sinsa (m)***	F,M	G,L	R	D	O	0/+La	2826

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THE CONSTRUCTION OF A NEW YANOMAMI ROUND-HOUSE

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ABSTRACT.—The results of a complete quantitative survey of the plant species used in the construction of a recently built communal Yanomami round-house (***yano***) are presented, together with descriptions of construction techniques and nomenclature. A total of 52 species were recorded as having been used. The most important species employed were *Xylopia* sp. (Annonaceae) for rafters and tie beams, *Manilkara huberi* (Sapotaceae) and *Centrolobium paraense* (Leguminosae) for posts, *Socratea exorrhiza* (Palmae) for walls and thatch supports, *Geonoma baculifera* (Palmae) for thatch, and *Heteropsis flexuosa* (Araceae) for lashing. The choice of species is discussed in the light of recent changes in the lifestyle of the Yanomami and is compared with records of other indigenous Amazonian architecture.

RESUMO.—São apresentados os resultados de um levantamento completo das espécies vegetais utilizadas na construção de uma habitação coletiva Yanomami (***yano***) recentemente erigida, juntamente com descrições das técnicas e nomenclatura dessa construção. Foi registrado um total de 52 espécies, das quais as mais importantes são: *Xylopia* sp. (Annonaceae) para vigas e traves de amarração, *Manilkara huberi* (Sapotaceae) e *Centrolobium paraense* (Leguminosae) para postes, *Socratea exorrhiza* (Palmae) para paredes e esteios do teto de palha, *Geonoma baculifera* (Palmae) para teto de palha e *Heteropsis flexuosa* (Araceae) para amarração. Discute-se a seleção de espécies à luz de recente mudanças no estilo de vida Yanomami, seleção essa que é comparada à descrição da arquitetura de outros povos indígenas da Amazônia.

RÉSUMÉ.—Cet article présente les résultats d'un relevé complet des espèces végétales utilisées dans la construction d'une habitation collective yanomani (***yano***) récente. Il comprend également une description des techniques et de la nomenclature relatives à cette construction. Des 52 espèces enregistrées, les plus importantes sont : *Xylopia* sp. (Annonaceae) pour les poutres et les soliveaux de la charpente, *Manilkara huberi* (Sapotaceae) et *Centrolibium paraense* (Leguminosae) pour les poteaux, *Socratea exorrhiza* (Palmae) pour les parois de la maison et les lattes de la toiture, *Geonoma baculifera* (Palmae) pour la couverture de palmes et *Heteropsis flexuosa* (Araceae) pour les ligatures. Ce choix d'espèces est analysé dans la perspective des changements qu'a récemment connu le mode de vie yanomani et il est comparé avec les résultats d'autres études sur l'architecture amérindienne d'Amazonie.

INTRODUCTION

Early in 1993 the ***Watoriki theri pë*** Yanomami, led by their headman Lourival, moved into a new ***yano*** (communal round-house) at the foot of the Serra Demini in northern Brazilian Amazonia (Figure 1). Construction of the house had been carried out over a period of several months, during which they had camped nearby in temporary shelters of the type used during long hunting and gathering trips. The distance that they had come from their last ***yano*** was short (2-3 km). This short move was prompted by the unexpected drying up of the stream (and spring) near the last ***yano*** during a very harsh dry season.

This micro-move is the latest relocation of the ***Watoriki theri pë*** at the end of a long series of migrations from the upland territory of the Serra Parima to the lowlands of the Demini river basin. Coming from the headwaters of the Rio Parima near the Venezuela/Brazil border, the fathers of the oldest ***Watoriki theri pë*** were living in the upper Rio Mucajaí region during the first decades of the 20th century. They then migrated south on the Upper Rio Catrimani and its tributaries. These macro-moves formed part of the general Yanomami expansion from the highland region of the Orinoco/Rio Branco headwaters into the surrounding lowlands, which began during the 19th century. This was probably caused by a demographic boom due to techno-economic change (acquisition of metal tools and new cultigens from neighboring groups, who had been in direct contact with the white frontier since the mid-18th century), and the availability of unoccupied land due to the dramatic decline in the populations of those neighboring groups during the 19th century (see Albert 1985: 29-42).

After migrating progressively through the Catrimani headwaters, the ***Watoriki theri pë*** arrived on the upper Lobo d'Almada river (a major tributary of the Catrimani river) in the late 1960s. Lourival (the current leader) and his older brothers then moved again, south, to a tributary of the Mapulaú (***Werehisipi u***) river, where in 1973 the majority of them, including Lourival's elders, were killed by an unknown epidemic. At this time, a road was in the process of being built across the lands into which they had moved, the BR-210 or Perimetral Norte, which has since been abandoned in that region. A contact post was set up in the area in 1974 by the Brazilian Indian Foundation (FUNAI) on the Rio Mapulaú, and the ***Watoriki theri pë*** settled there, soon becoming affected by another disastrous epidemic coming from the Catrimani river basin in 1977 (probably measles). The Mapulaú post was abandoned by FUNAI and burned by the Indians. A new post was later opened (1978-1979) at the foot of the Serra do Demini (its current location), near the end of the Perimetral Norte road (km 211). Since the end of the 1970s the ***Watoriki theri pë*** have, by a series of micro-moves, been gradually migrating towards this post and establishing increasingly regular contact. They now live only 30 minutes walk from the Demini FUNAI post, and receive regular medical attention from the CCPY (Comissão Pró-Yanomami) nurse who is based there. The head of the FUNAI post is a Yanomami man (Davi Kopenawa), who lives with his family in the village, and the CCPY nurse is the only non-indigenous person living there.

In July/August 1994, during a follow-up study of the medicinal plants used by the people of ***Watoriki*** (Milliken and Albert 1996), we found that even though almost two years had lapsed since termination of the construction of the new roundhouse, many of its inhabitants were able to identify without difficulty the types of trees from which each of the components of the house had been made. A comprehensive inventory of those tree species was carried out, and notes were made on the construction techniques and details, the results of which are presented here. Although the structure of some Yanomami dwellings has been described in various parts of their territory (Chagnon 1968; Fuerst 1967; Lizot 1984), and some of the principal construction materials used in those areas have been catalogued (Fuentes 1980; Lizot 1984), this is the first complete and quantitative inventory to have been carried out.

FIGURE 1.—Approximate location of the study area (Demini FUNAI Post)

THE STUDY SITE

The village of ***Watoriki*** (62°49′W, 01°31′N) lies in dense lowland evergreen rainforest at an altitude of approximately 150 m a.s.l. The climate is seasonal with a wet season between April and September and annual precipitation in excess of 2000 mm. The land to the south and south-east of the village is largely flat, traversed by streams, some of which, as we saw, tend to stop flowing in the dry season. The country rock of the area consists of metamorphics of the lower Pre-Cambrian Guiana Complex. Close to the village are numerous granitic hills and outcrops with steep smooth sides of bare reddish rock undergoing typical "onion-skin" weathering. The characteristic vegetation capping these outcrops includes agaves, cacti, and other succulents. To the north and north-west of the village, hills rise towards the watershed between the Amazon and Orinoco basins. Although the soils in the area are largely clayey, dystrophic red-yellow latosols (RADAMBRASIL 1975), there are patches in the vicinity of the village which are distinctly sandy. The forest is diverse and mixed, showing a fairly typical composition for the region, with tree species representative of both the Amazon and Guayana regions present (see Steyermark *et al.* 1995).

METHODS

Detailed drawings and photographs were made of the construction details of the ***yano***. Each of the categories of components was numbered, and their Yanomami names were recorded. A systematic quantitative survey of the names of the plants used to make each of these components was then conducted, category by category. From these data, a single list was composed of the Yanomami names for all of the plants employed in the construction of the ***yano***. These plants were then collected in the surrounding forest (with Antonio Yanomami), and their names and uses were double-checked by consensus with at least one other resident in the village. Voucher specimens were kept, initially preserved in 70% alcohol (Schweinfurth method). These specimens, where fertile, have been lodged in the herbaria at Boa Vista (MIRR), Manaus (INPA), Kew (K), and New York (NY). Sterile voucher specimens are maintained at Kew only.

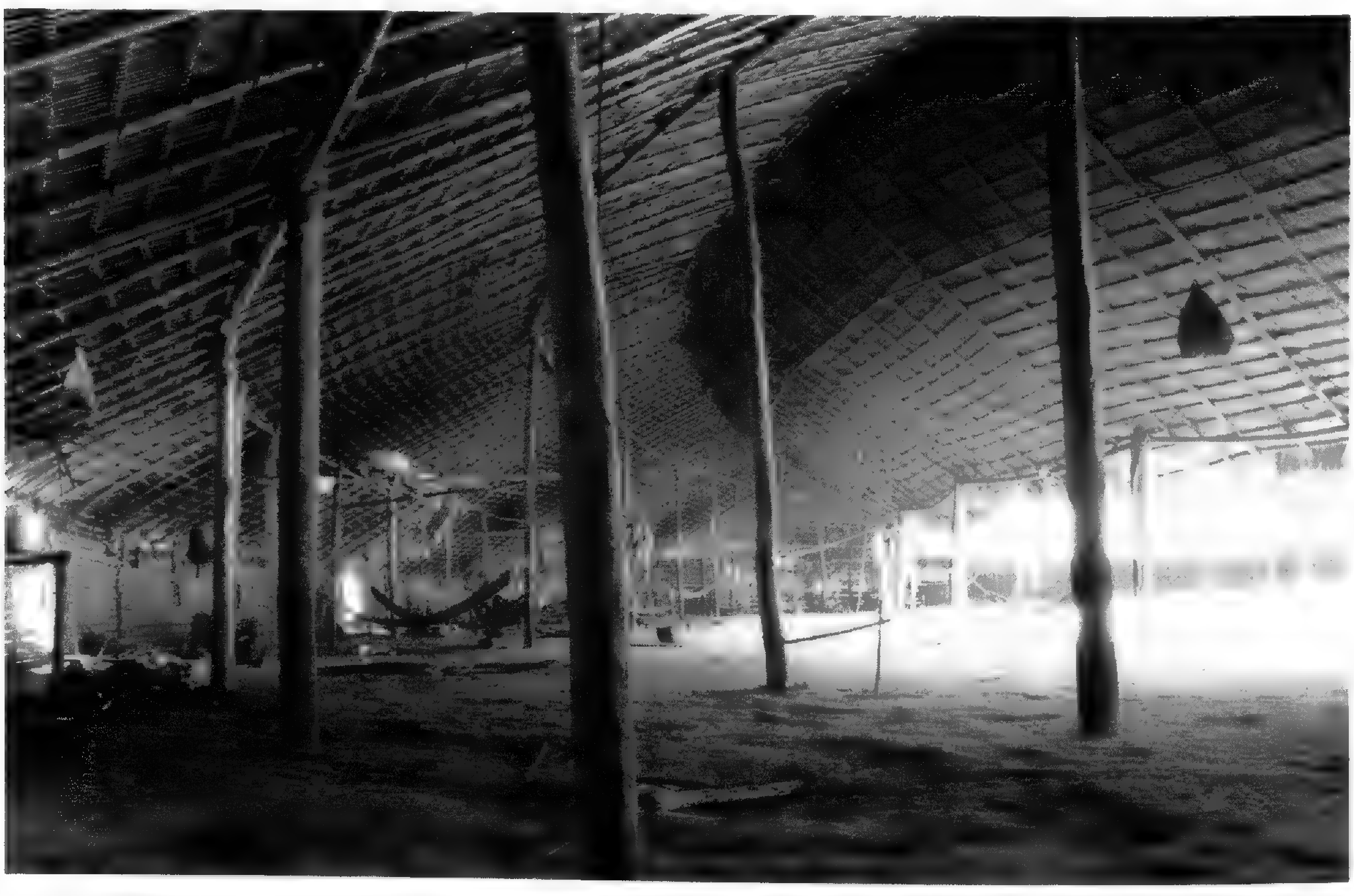

FIGURE 2.—Interior of the ***Watoriki*** round-house, with the opening to the central "plaza" on the right, and the outer wall on the left.

THE CONSTRUCTION AND COMPOSITION OF THE *YANO*

The ***yano*** at ***Watoriki*** consists of a covered ring-shaped structure approximately 80 m in diameter, walled on the outside and open on the inside (Figure 2). It is built in a clearing (***yano a roxi***) large enough to ensure that the tallest trees in the adjacent forest will not cause damage if they fall. At the centre of the ***yano*** is a large open space (***yano a miamo***). The Yanomami live in family groups scattered around the ring, each of which has its own cooking fire about which the hammocks are positioned. This conforms essentially to the typical layout of an open Yanomami round-house (***yano*** ***mat***^{h}***a***), as described and illustrated by Chagnon (1968), Fuerst (1967), and Lizot (1984). Houses vary in size but are always round, so the size of the opening in the centre (***yano kahiki*** or "***yano***'s mouth") necessarily increases as the diameter of the house increases. In the smallest "closed" houses (***yano komi***), this is reduced to a small smoke-hole at the centre, sometimes capped by a type of thatched chimney. The topmost point of a ***yano komi*** is known as the ***yano oraka***.

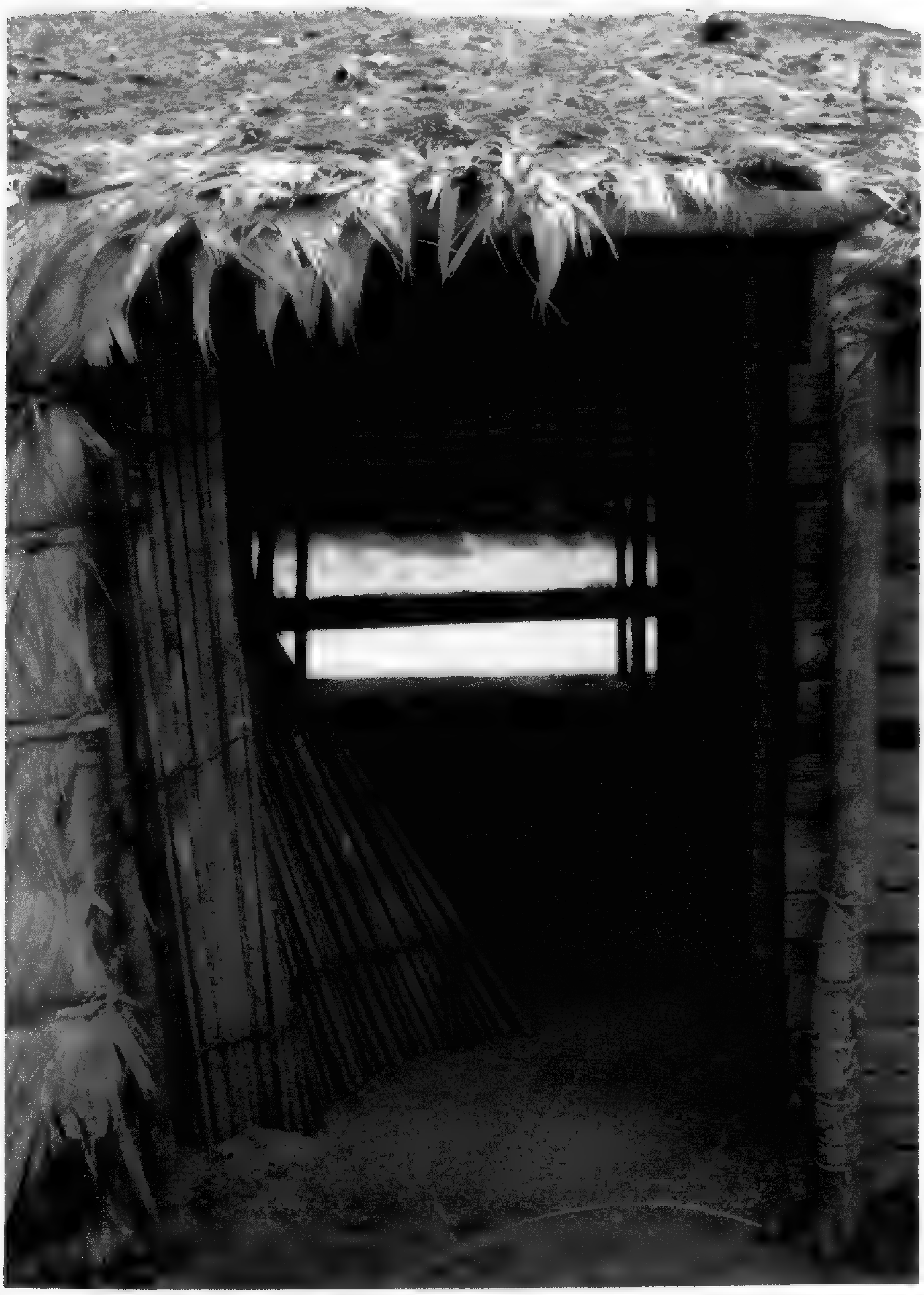

FIGURE 3.—Detail of one of the main doors (***pata yoka***) at ***Watoriki***, looking inwards. Note the thatched wall on the left, the *Socratea*-wood wall on the right, and the folding door (also made from *Socratea* wood).

The outer wall at ***Watoriki***, about 1.25 m high, is breached by four main doors, which are blocked off from the adjacent living areas by short walls (Figure 3, 4). These principal openings lead directly to the main trails which run from the village to the nearby streams, to the gardens, and to the other Yanomami villages in the region. Main doors (***pata yoka***) are classified according to where they lead: ***hwama yoka*** ("guest doors") and ***periyo yoka*** (trail doors) open onto the principal paths where visitors and travellers enter and leave the village. In addition, there are ***rama yoka*** (hunting doors) where hunting paths leave, ***napë yoka*** (stranger doors) where paths lead to white settlements, ***hutu yoka*** where paths lead to the gardens, and doors where paths leading to water (***mãu uka yo***) leave the village. There are also a number of other, smaller, doors (***wai yoka***) which open onto the ***yano a roxi*** clearing, and are used by the families who live alongside them. The floor of the roofed area is made of beaten earth, raised slightly above the level of the central "plaza." A considerable quantity of water can accumulate in this central area during heavy rainstorms, which is channeled out through two drains. The roof of the ring is made up of two parts; the outer (main) roof which covers the living area and which slopes outwards, and the inner (secondary) roof which slopes inwards (Figure 5). The outer roof overlaps the inner (about 5 m above ground level), preventing rain from entering the small gap which separates them. This gap allows the smoke of the cooking fires to escape.

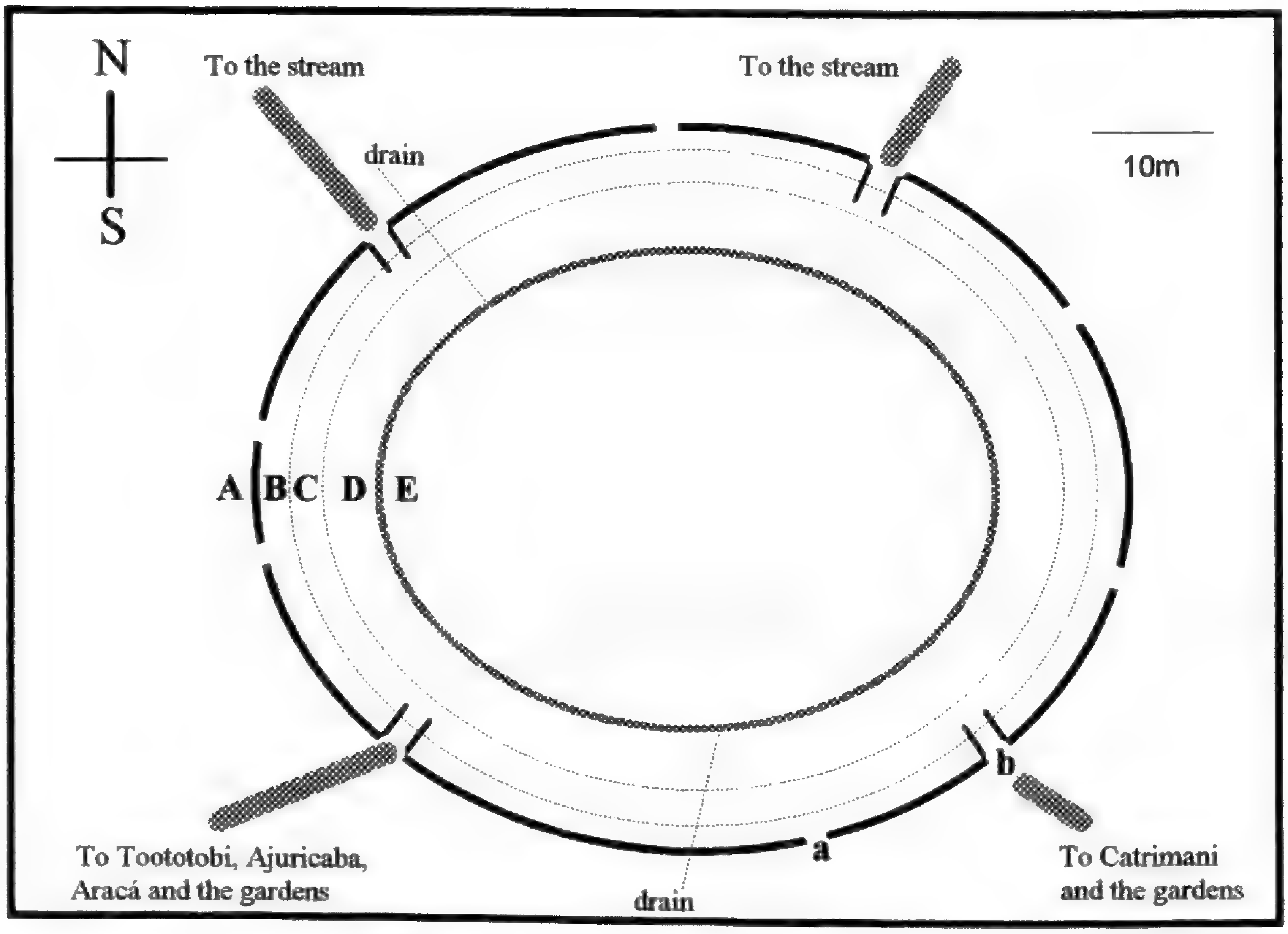

FIGURE 4.—Aerial plan of the ***Watoriki*** round-house, showing the living areas, doors and principal trails. A) ***yano a roxi*** (clearing around ***yano***); B) ***yano a xĩkã*** (feminine space), ±1.5 m width; C) ***nahi*** (hearth, family space), ±3 m width; D) ***yano a hẽhã*** (masculine space), ±5.25 m width; E) ***yano a miamo*** (central "plaza"); a) ***wai yoka***; b) ***pata yoka*** (see text for more details on doors).

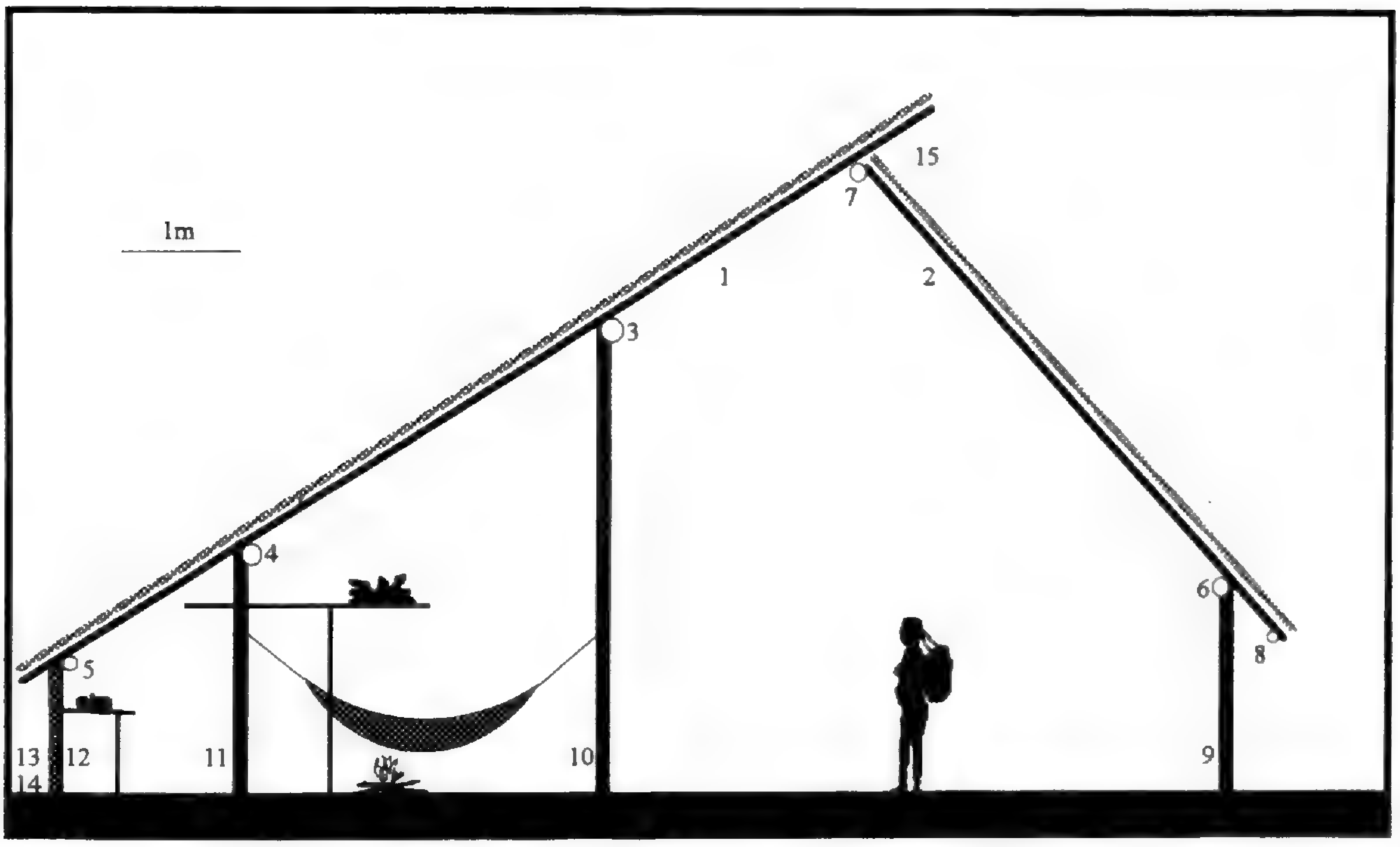

FIGURE 5.—Cross-section of the ***Watorikɨ*** round-house (to scale), showing the principal components (excluding thatch details). On the right is the opening to the central "plaza." 1-2) ***yano araatima nahikɨ*** or ***yano naanahikɨ*** (rafters); 3-8) ***yano nahikɨ mamo*** (tie-beams/purlins); 9) ***xatia kɨkɨ*** or ***hẽhãã kɨkɨ*** (posts); 10) ***hẽhããtima nahikɨ*** or ***hẽhãã kɨkɨ*** (posts); 11) ***t^honahima nahikɨ*** or ***t^honahima kɨkɨ*** (posts); 12) ***xĩkããtima nahikɨ*** or ***xĩkãã kɨkɨ*** (posts); 13) ***arana kɨkɨ*** or ***aranakɨ*** (outer wall); 14) ***yano koro*** (outer wall base); 15) ***yano ora*** (high point of roof).

The roofed area is approximately 10 m in breadth, of which a little less than half is used as living space, occupied by clusters of hammocks around cooking fires and by racks and shelves on which food and a few belongings are stored. This includes the outer "female" portion behind the women's hammocks (***yano a xĩkã***), and inside this the hearth area occupied by the men's and children's hammocks (***nahi***). The portion between the hearths and the central opening is known as (***yano a hẽhã***). This inner half of the roofed area is kept clear and is used for communal and ceremonial activities and as a corridor. These zones, which are shown in Figure 4, correspond to the spaces between the concentric rings of posts shown in Figure 5. The central open area (***yano a miamo***) is also for ceremonial use and acts as a playground for children, etc. The overall impression is one of airiness and space, resulting in an extremely pleasant living environment. The outer wall keeps out most of the wind, the inner opening allows sufficient light to enter, and the roof keeps the temperature comfortable even on the hottest of days.

The roof is thatched with the fish-tail-shaped leaves of *Geonoma baculifera*, a small lower-understory palm. These are folded in half and tied by the rachis, closely overlapping, to thin lengths of wood from the ***manakasi*** palm *Socratea exorrhiza* (Figure 6). The resulting "tiles" are placed horizontally across the rafters, again closely overlapping, and secured with the tough but flexible aerial roots of the epiphytic/climbing aroid *Heteropsis flexuosa*. During the roofing process a rough scaffolding, ***yano ĩrakɨ***, is erected. *Heteropsis* (***masi kɨkɨ***) roots, which are also used for basketry, are employed throughout the house for lashing its various components together. The aerial roots of the epiphytic climber *Thoracocarpus bissectus* and the stems of the lianas *Callichlamys latifolia* and *Arrabidaea* sp. were also said to be suitable for this purpose. To thatch one square meter of roof, approximately 160 *Geonoma* leaves are used, and an estimated 500,000 leaves, calculated by estimating the roof area, were used for the whole building. To prevent the small leaves from being displaced or damaged in strong winds, the leaves of the larger palms *Maximiliana maripa* and *Jessenia bataua* are attached (vertically) on top of the *Geonoma* thatch.

FIGURE 6.—Detail of the thatch at ***Watoriki***. Note the slender *Socratea* wood slats around which the individual leaves are folded, visible at the top right of the picture. Each leaf is folded double at the midrib (at the edge furthest from the camera).

A quantitative list of the 52 species recorded as used for timber, thatch, and lashing in the construction of the ***yano*** at ***Watoriki***, and the components for which they were employed, is given in Tables 1 and 2. However, it should be borne in mind that since it was found that a few of the Yanomami plant names, such as ***sikãri a***, were found to refer to more than one species of tree (generally in the same genus or family), this may also be the case for others. It is likely therefore that a greater number of species were actually employed in the construction of the ***yano*** than is estimated here.

Most of the principal wooden components of the house had been stripped of their bark, but this was not universally the case. The bark had been left on the rafters from where they cross the outside tie-beams to their outer ends, probably to help protect them from the weather. In the choice of wood for rafters, the criteria are primarily length (9 m for the outer roof) and straightness, and secondarily, strength and lightness. Trees of the families Myristicaceae, Annonaceae, and certain Leguminosae are particularly well suited for this purpose on account of their

TABLE 1.—Inventory of the wooden components of the ***Watoriki*** round-house, listed by tree species. Column numbers correspond to the numbered components in Figure 5.

Family	Species	Name	Voucher No. (WM, K)	1	2	3	4	5	6	7	8	9	10	11	12	Total
Annonaceae	*Anaxagorea acuminata* (Dun.) A. St.-Hil.	***rãina tihi***	1774	1												**1**
	Duguetia lepidota (Miq.) Pulle	***amatha hi***	1803	4			6									**10**
	Fusaea longifolia (Aubl.) Saff.	***hwapo mahi***	1881	1	2	4	3	6							2	**18**
	Guatteria sp.	***seisei unahi***	2082	47	44	1		3	1	2						**98**
	Xylopia sp.	***yao nahi***	2014	366	91	24	34	16	10	17	12					**570**
Apocynaceae	*Aspidosperma* sp.	***rahaka mahi***	1975				1	1	1						1	**4**
Bignoniaceae	*Tabebuia capitata* (Bur. & K. Schum.) Sandw.	***masianari kohi***	2053											1		**1**
Burseraceae	*Protium fimbriatum* Swart	***weyeri hi***	1765	1												**1**
Chrysobalanaceae	*Couepia caryophylloides* R. Ben.	***wãro uhi***	2015		6			1							23	**30**
	Licania aff. *heteromorpha* Benth.	***maraka axihi***	2040	3	5				1							**9**
	Licania kunthiana Hook.f.	***maraka nahi***	2035		3											**3**
	Licania cf. *polita* Spruce ex Hook.f.	***xihini hi***	2045	2	11											**13**
Elaeocarpaceae	*Sloanea macrophylla* Benth. ex Turcz. vel sp. aff.	***akapa ahi***	2038		1											**1**
Euphorbiaceae	*Croton matourensis* Aubl.	***ara usihi***	1923	1							1					**2**
	Maprounea guianensis Aubl.	***yĩp~i hi***	2072		1											**1**
	Pogonophora schomburgkiana Miers	***tihitihi nahi***	2043	1										2		**3**
Flacourtiaceae	*Casearia guianensis* (Aubl.) Urban	***yãpi mamo hi***	2050		3			1		1	2				10	**17**
	Casearia javitensis Kunth	***waxia hi***	1787		3											**3**
Lauraceae	*Aniba riparia* (Mez) Kunth	***thuë mamo hi***	1993	2	5			5	4		3		8	4	25	**56**
	Licaria aurea (Huber) Kosterm.	***hõkõ mahi***	2002		1											**1**
	Nectandra sp.	***rapa mahi***	2063	1												**1**
Lecythidaceae	*Eschweilera coriacea* (A.DC.) Mori	***hokoto uhi***	2007												1	**1**
Leguminosae	*Centrolobium paraense* Tul.	***hewë nahi***	1989									17	15	23	6	**61**
	Martiodendron sp.	***paxo hi***	2054		1									1		**2**
	Tachigali myrmecophila (Ducke) Ducke vel aff.	***kataa nahi***	2047	58	30	7	2	10	10	11	4				4	**136**
	Zollernia paraensis Huber	***uki sihi***	1959										1			**1**
Meliaceae	*Trichilia* sp.	***akanaxi ahi***	2011					1							7	**8**
Monimiaceae	*Siparuna decipiens* (Tul.) DC.	***maharema ahi***	1724					1							12	**13**
Moraceae	*Pourouma ovata* Tréc.	***mominari usihi***	2041		2											**2**
	Pourouma tomentosa Miq. ssp. *persecta* Standl. ex C.C. Berg	***kahu akahi***	2044	2	3											**5**
	Pseudolmedia laevis (R. & P.) Macbride	***asoa sihi***	1741								1					**1**

TABLE 1.—Continued.

Family	Species	Name	Voucher No. (WM, K)	1	2	3	4	5	6	7	8	9	10	11	12	Total
Myristicaceae	*Iryanthera laevis* Mgf; *Iryanthera juruensis* Warb.	***sikāri a***	2048/9	20	129			2		1	15				7	**174**
	Virola elongata (Benth.) Warb.	***yākōana a***	1780	2	3											**5**
Myrtaceae	*Eugenia flavescens* DC vel sp. aff.	***pore hi***	2052			1	6		1			4	2	1	75	**90**
	Eugenia sp.	***korokoro sihi***	2065												1	**1**
	Myrcia sp.	***totori mamo hi***	2033	1		3	3	5				12	3	4	32	**63**
Palmae	*Bactris monticola* Barb. Rodr.	***mokamo si***	1983	1	1											**2**
	Socratea exorrhiza (Mart.) H. Wendl.	***manaka si***	1866								9					**9**
Quiinaceae	*Quiina florida* Tul. vel sp. aff.	***naxuruma ahi***	2037	1		2	3						1			**7**
Rubiaceae	*Duroia eriopila* L.f.	***hera xihi***	1749	1					2			2			2	**7**
Sapotaceae	*Chrysophyllum argenteum* Jacq.	***naĩra hi***	2046										1		11	**12**
	Manilkara huberi (Ducke) Standl.	***xaraka ahi***	2042		1							12	22	43		**78**
	Pouteria caimito (Ruiz & Pav) Radlk.	***paxo wāt^{h}emo hi***	2010										1			**1**
	Pouteria cladantha Sandw.	***hõrõmo nahi***	2039	2	2	1		2				3	2		3	**15**
	Pouteria hispida Eyma	***yãwa xihi***	2064												1	**1**
	Pouteria venosa (Mart.) Baehni ssp. *amazonica* Penn.	***maĩko nahi***	2074												7	**7**
Violaceae	*Amphirrhox surinamensis* Eichl.	***maxopo mahi***	1708												55	**55**
	Rinorea lindeniana (Tul.) O. Kuntze	***okora xihi***	1895		1										23	**24**
		Unnamed				1			2							**3**
				518	349	44	58	54	32	32	47	50	56	79	308	1627

architecture. Of these, Hallé *et al.* (1978) assign *Iryanthera* and *Virola* (Myristicaceae) to the Massart model of tree architecture, *Xylopia* (Annonaceae) to the Roux model, and *Tachigali* and *Sclerolobium* (Leguminosae) to the Petit model, all of which are defined as having "monopodial orthotropic trunk axes with plagiotropic branches" (straight unbranched trunks with horizontal branches). The Annonaceae and Myristicaceae account for 81% of the 867 rafters used at ***Watorikɨ*** (64% and 17% respectively). Young individuals of *Tachigali myrmecophila* (Leguminosae) are also used in considerable numbers. The preferred species for rafters is *Xylopia* sp., which makes up 53% of all the rafters and 71% of those of the outer roof. The reason for the difference in these figures is that the outer roof, which is of the greatest importance since it covers the living area, was built first. When it came to the building of the inner roof, however, the remaining *Xylopia* trees were said to have been so far away from the village that a greater proportion of other species (notably *Iryanthera* spp.) were used instead.

TABLE 2.—Species used for thatching, lashing, and minor structural elements in Yanomami roundhouse construction

Species	Family	Uses	Voucher specimens
Arrabidaea sp.	Bignoniaceae	Stem for lashing	2018
Callichlamys latifolia (Rich.) Schum.	Bignoniaceae	Stem for lashing	2019
Geonoma baculifera (Poit.) Kunth *	Palmae	Fronds for thatch	2034
Heteropsis flexuosa (Kunth) Bunting*	Araceae	Roots for lashing	2008
Jessenia bataua (Mart.) Burret*	Palmae	Fronds for securing thatch	-
Maximiliana maripa (Correa de Serra) Drude*	Palmae	Fronds for securing thatch	- -
Socratea exorrhiza (Mart.) H. Wendl	Palmae	Wood for thatch supports, walls, doors	- -
Thoracocarpus bissectus (Vell.) Harl.	Cyclanthaceae	Roots for lashing	1994

* Species used at ***Watorikɨ***

The requirements for the tie-beams, which must also be slender and strong but which are generally considerably shorter than the rafters, are met by most of the species used for the latter. Again *Xylopia* and *Tachigali* are strongly represented. The lesser need for length, however, allows some of the harder species which are more commonly used for posts to be used, whereas the greater need for strength perhaps precludes the use of certain rafter species such as *Iryanthera* and *Virola*. The support posts (***yano nahikɨ***), of which the innermost three rings are the most important structurally, must be very strong and, as they are partially buried, resistant to rotting. Close-grained hardwoods are used for these posts. Of the 185 posts of these three inner rings, 97% are made from the wood of the four tree families: Sapotaceae (45.5%), Leguminosae (31%), Myrtaceae (14%), and Lauraceae (6.5%). Two species are particularly important: *Manilkara huberi* (42% of the posts) and *Centrolobium paraense* (30%). The outermost ring of posts is represented by a greater variety of species (21) since, although it supports a considerable weight, it is made up of a far greater number of posts (308) and thus individual strength is of less importance.

The outer wall of the ***yano*** is made up either of split sections of the trunk of *Socratea exorrhiza* (a wood which is particularly easy to split and thus ideal for the purpose), laid vertically or horizontally, or of thatch of the type used for the roof (Figure 3). These thatched walls are supported by a line of slender uprights (***xĩkãhamɨ kɨkɨ*** or ***xĩkãmahihamɨ kɨkɨ***). *Socratea* is also used for the short walls beside the four main entrances. The composition of the wall and of other structural components varies around the perimeter, demonstrating the individuality of the family groups living beside it. The family which is to live in a particular section of the round-house is largely responsible for its construction, so the species used in any area will depend to some extent upon personal preference. In the case of the outer wall, this may depend upon whether the inhabitants remember the days when inter-village skirmishes were common in the area where they lived, that is, when the strength of the wall (or in some cases of an outer palisade) as a defense was of greater importance than it is now. According to Smole (1976), these outer palisades, which are more common in the Parima highlands, would be maintained only when raids were expected. Fuerst (1967) described walls at Toototobi which were composed of an inner layer of *Socratea* planks and an outer layer of thatch, thus serving both as an effective wind-break and as a substitute for a palisade.

DISCUSSION: THE *YANO* IN CONTEXT

Watorikɨ** in the context of previous Yanomami studies.*—Fuentes (1980), in his general studies of the plants used by the Yanomami in Venezuela, listed the Yanomami names of 11 trees which were commonly used for house construction. Not all of these were identified, but they included the genera *Centrolobium*, *Duguetia*, *Eschweilera*, *Tabebuia* and *Tachigali*, all of which were recorded in the present study, as well as one member of the Burseraceae. Four plants were recorded as used for lashing, including *Heteropsis* and *Cydista* (Bignoniaceae), the second of which was not recorded at ***Watorikɨ, but corresponds to the other bignoniaceous lianas collected there. In his travels among the upland Yanomami, Prance (personal communication) recorded a much greater use of the wood of *Eschweilera* spp. for posts than was found at ***Watorikɨ***, where it was virtually absent. Lizot (1984) cites the use of eight preferred trees from his upland study area in Venezuela, and the occasional use of a further eight. Again, the majority of these were not identified, but they included *Duguetia*, *Eschweilera*, *Tachigali*, *Guarea* (Meliaceae), *Geissospermum* (Apocynaceae), and *Pera* (Euphorbiaceae), the last three of which were not used at ***Watorikɨ***.

Watorikɨ** in the context of change.*—The ***Watorikɨ theri pë lived for approximately five years in their last ***yano***, before moving to the present site. This is an average time for a Yanomami group to remain in one place. These moves generally occur after a minimum of two-three years and a maximum of five-seven years, intensification of contact having a tendency to increase the amount of time spent in one place up to this maximum or beyond. As has been mentioned, the ***Watorikɨ theri pë*** moved to their current location primarily because water remains available there during the dry season. They have developed a degree of dependence on trade goods and medical assistance from the FUNAI post (Demini), and claim that they have no plans to move again in the forseeable future. The concern was expressed that further migration in the direction of the post would take them further away from a supply of *Geonoma* leaves for thatching. It would also almost certainly result in an increased dependence and in furtherance of social change, which was also of some concern to some of the older people in the village. Instead, they intend to return to the old practice of trekking when the hunting becomes difficult or when the thatch needs to be replaced (the latter having been unnecessary in the past), or, for example, when the women need a large supply of *Heteropsis* roots to make new baskets. Traditionally they would have spent about one third to half the year away from the village, hunting and gathering and living in temporary camps considerable distances away. During this time of fallow, the game would return to the vicinity of the village, the pests and parasites (cockroaches, chiggers, etc.) would die off, and the bananas and manioc and other crops would ripen and mature in the swidden gardens. This fallow practice has largely died out with the process of sedentarization and with movements towards sources of medical support and trade goods (metal tools and pans, glass beads, shorts, etc.). However, it appears that the new demands created by that sedentarization, for materials which would formerly have been met by moving on to a new area, could lead to a renaissance of the trekking practice.

In discussions of the construction of the ***Watorikɨ yano*** and the necessity of maintaining it over a relatively long period, the major preoccupation among the Yanomami interviewed was with the thatch and the availability of *Geonoma* leaves for its replenishment. The gathering of the half million or so leaves for its initial thatching was evidently a mammoth task, and it seems that *G. baculifera* takes a long time to regenerate. It is interesting that Balée (1994), in his study of the ethnobotany of the Ka'apor Indians of the Eastern Amazon, cites this species as one of only two which are directly threatened with "micro-local extinction [extirpation] by traditional Ka'apor forest utilization." In some of the longer-established Ka'apor settlements, the *Geonoma* palms in the surrounding forests have been so depleted that they have had to resort to using other palm genera for thatching.

The thatching of the roof provides a clear example of the dynamic nature of Yanomami construction techniques. Prior to the construction of the ***yano*** at ***Watorikɨ***, the houses used by this group consisted only of an outwards sloping roof and a back wall, as is still the case among most other Yanomami communities of the region. The inner roof, which gives the advantage of shade throughout the day, was a relatively recent introduction. It was said to have been borrowed from the Shamatari (western Yanomami) village of ***Kapirota u*** (situated on the Jutaí, a tributary of the Demini river near the Aracá New Tribes Mission), which the ***Watorikɨ theri pë*** used to visit regularly. The thatching technique, which is described above, was said to have been learned from workers employed at an SPI (Indian Protection Service) post, established on the upper Demini in the early 1940s when a border commission team (CBDL) came to the region. These workers were generally from other Indian groups such as the Tukano, and would help to build houses and camps using their own traditional thatching techniques. At the time the upland Yanomami were using the leaves of *G. deversa* (WM1729, K) for their thatch, supported by the aerial roots of *Heteropsis* — a technique also in current use by the Maiongong Indians in the uplands to the north. When the ***Watoriki theri pë*** moved down into the lowlands, where *G. baculifera*, a better thatching species, is found in greater abundance, they adopted the method used today. This is the same technique described by Fuerst (1967) from a ***yano*** on the Toototobi river.

TABLE 3.—Some tree species used for construction by the ***Watoriki theri pë*** when they lived in the uplands

Yanomami name	Species	Family	Voucher (WM, K)
hayama sihi	-	-	
hõkõ mahi	*Licaria aurea* (Huber) Kosterm.	Lauraceae	2002
iroma sihi	*Ocotea* sp.	Lauraceae	2073
mãiko nahi	*Pouteria venosa* (Mart.) Baehni	Sapotaceae	2074
maima si	*Euterpe precatoria* Mart.	Palmae	1904
naxuruma ahi	*Quiina florida* Tul. vel aff.	Quiinaceae	2037
paroko xihi	*Dialium guianense* (Aubl.) Sandw.	Leguminosae	2070
paya hi	*Sclerolobium* sp.	Leguminosae	2075
poxe mamokasi hi*	*Pouteria* sp.	Sapotaceae	2084
rapa hi	*Martiodendron* sp.	Leguminosae	2076
t^huë mamo hi	*Aniba riparia* (Mez) Kunth	Lauraceae	1993
yĩpĩ hi	*Maprounea guianensis* Aubl.	Euphorbiaceae	2072

* The preferred construction species

In the past there would have been considerably less need for the Yanomami to be as discerning about the timber species used in the construction of the house as they had been at ***Watoriki***, since the group would have moved again to a new site before the wood had a chance to rot. A list of some of the tree species said to have been used by the group in the past is given in Table 3. The cutting of a large hardwood tree, particularly before the introduction of effective cutting tools, would have been an arduous task and one worth avoiding if it was not necessary. Furthermore, the choice of available species would have been different in the upland regions from which these people came. Now, building for a longer-term residence, the Yanomami have had to choose rot-resistant hardwoods for their house — particularly for the support posts. The range of species with the right properties for semi-permanent posts is clearly much smaller than that for temporary posts or other components. Both *Centrolobium paraense* and *Manilkara huberi*, the preferred species, are widely recognized in the timber trade as extremely resistant to rot (Rizzini 1971). In terms of the materials used, the ***yano*** at ***Watoriki*** cannot therefore be said to be a *typical* (or "traditional") Yanomami construction in the strict sense. It has been consciously adapted to suit the changing circumstances, as indeed have many other aspects of their material life. This capacity for adaptation and change, which is vital for the survival of any population over the long term, is one of the strengths of the Yanomami.

Although tradition obviously plays an important part in the choice of materials for house construction, opportunism is inevitably an important factor as well.

There is a limit to the distance which any piece of wood is worth carrying, however pressing the needs for durability, and the composition of the forest in the immediate vicinity of the chosen site will evidently influence strongly the composition of the house (or conversely the location of the house may perhaps be affected by the composition of the forest). In quantitative analyses of the useful properties of the trees in delimited forest hectare plots, as perceived by four Amazonian forest tribes, the percentage of species seen as suitable for construction varied from 30.3% (Tembé) to 2.9% (Panare) (Prance *et al.* 1987). The degree to which the house will be built of "ideal" species will be determined by the abundance of those species in the area, the necessity for an "ideal" house, and the manpower and technology available. The possession of a chain-saw, for instance, would doubtless have had a significant effect on the species used at ***Watoriki***.

An example of the effect of such technological change was observed among the Waimiri Atroari Indians, also in the State of Amazonas (Milliken *et al.* 1992). When one of the groups living close to the BR174 highway built a hen-house in 1989, they chose to construct it entirely from the wood of a species of *Manilkara* which grows in abundance in the *caatinga* (white-sand) forests some distance from the village. They were able to do this because they had the use not only of a chain-saw, but also of motorized transport to bring the timber back to the village. Other groups living far from the road, however, were observed to have used a far greater diversity of tree species in their buildings, and this would almost certainly have been the case with the hen-house in similar circumstances. Thirty-two percent of the tree species in one hectare of *terra firme* forest were said by the Waimiri Atroari to be suitable for construction (Milliken *et al.* 1992).

Watoriki *in the context of Amazonian construction*.—To continue the comparison with the Waimiri Atroari, one can observe considerable similarities in the use of construction species between ***Watoriki*** and the Waimiri Atroari village of Maré (situated far from the road which crosses their lands). At Maré, as at ***Watoriki***, the rafters were made from the wood of various Annonaceae (including *Xylopia*), Myristicaceae (including *Iryanthera* spp.), and *Tachigali myrmecophila*. The main support posts were all made from *Minquartia guianensis* Aubl. (Olacaceae), a very hard and resistant wood much used for this purpose in Amazonia but apparently absent from the forest at ***Watoriki***. This species is so prized by the Tembé Indians of Pará that there is a taboo on its burning, the breaking of which is said to result in numerous deaths in the village (Balée 1987). The outer ring of posts at Maré, as with the Yanomami, was built from a broad range of genera including *Eschweilera*, *Licania*, *Pouteria*, *Quiina*, and various Lauraceae and Meliaceae. As with the Yanomami house, the main lashing material used at Maré was *Heteropsis* sp.

Heteropsis roots (known as *cipó titica* in the Brazilian vernacular) are, by virtue of their strength, flexibility and (in many areas) abundance, probably the most commonly used lashing material in the Amazon. Although the fibrous inner barks of certain species of Lecythidaceae and Annonaceae are sometimes used for this purpose, such as by the Wai-Wai of SE Roraima State (WM personal observation), it seems that the *Heteropsis* vines are more durable. However, there are also references to the use elsewhere of bignoniaceous and cyclanthaceous vines in house construction (as recorded at ***Watoriki***). According to Boom (1987), for example, the Chácobo of Bolivia employ the genera *Anemopaegma, Arrabidaea, Cydista,* and *Melloa* (Bignoniaceae) and also use *Thoracocarpus bissectus* (Cyclanthaceae). According to Glenboski (1983), the Tikuna of Colombia use a species of *Asplundia* (Cyclanthaceae) for lashing, and the Cayapa of Ecuador use both *Asplundia* and *Paragonia* (Bignoniaceae) species in the same way (Barfod and Kvist 1996).

TABLE 4.—Comparison of the principal plant families employed in house construction (numbers of species used) at ***Watoriki*** with those from three studies in Peru.

Watoriki	Pinedo-Vasquez *et al.* (1990)	Parodi (1988)	Phillips and Gentry (1993)*
Sapotaceae (6)	Annonaceae (12)	Annonaceae (14)	Lauraceae
Annonaceae (5)	Palmae (5)	Palmae (12)	Myristicaceae
Palmae (5)	Sapotaceae (4)	Sapotaceae (6)	Annonaceae
Chrysobalanaceae (4)	Humiriaceae (2)	Leguminosae (6)	Leguminosae (Caesalpinoideae)
Leguminosae (4)	Melastomataceae (2)	Lauraceae (5)	Meliaceae
Euphorbiaceae (3)	Moraceae (2)	Moraceae (5)	Leguminosae (Papilionoideae)
Moraceae (3)	Myrtaceae (2)	Guttiferae (3)	Burseraceae
Myristicaceae (3)	Rubiaceae (2)	Cyclanthaceae (3)	Guttiferae

* Listed by descending "family use value"

It is noteworthy that the two most important plant families employed in construction at ***Watoriki*** (in terms of numbers of species used for the wooden components) were the Annonaceae and the Sapotaceae, since these two families were likewise the most important represented in two published lists of construction materials used in Peru presented by Parodi (1988) and Pinedo-Vasquez *et al.* (1990) (see Table 4). As with the Yanomami, the Sapotaceae were used principally for support posts and the Annonaceae for rafters and beams at these locations. In another Peruvian study (Phillips and Gentry 1993), an analysis was made of the numbers of species employed for each of the principal components of houses. In that study, 122 tree species were cited as suitable for beams and rafters, etc., whereas only 44 were cited for house posts, and Balée (1994) reports that 48 species are used by the Ka'apor Indians of Brazil for roof parts but only 10 for posts. Similar proportions were found at ***Watoriki***, where 38 species were used for the roof components and 14 for the three principal load-bearing rings of house posts. These figures emphasize the particularly specialized requirements of the buried posts.

The degree to which a tree trunk will resist rotting and termite attack depends both on chemical and physical factors. The wood (secondary xylem) of certain species of *Eschweilera*, for example, contains silica (Ter Welle 1976), and it seems that this provides some degree of resistance to termites. Many Chrysobalanaceae (e.g., *Licania*) also contain silica, which is extracted from the ashes and used to strengthen pottery by many Amazonian tribes (Prance 1972). Balée (1994) suggests that this is the reason for their frequently being used for rafters and beams by the Ka'apor. Similarly, the phenolic compounds found in various members of the Lauraceae and Sapotaceae (see Schultes and Raffauf 1990) may be responsible for their resistance to fungal rot. In a review of the timber properties of certain Guyanan species (Fanshawe 1948), *Pouteria cladantha* and *P. venosa* (Sapotaceae) have been described as "very resistant to decay."

A comparison of the tree species used for construction at ***Watoriki*** with the choice of species by the Chácobo of Bolivia again shows considerable similarity at the generic level. There, the genera employed for posts included *Aniba, Ocotea* (Lauraceae), *Manilkara, Pouteria* (Sapotaceae), *Eschweilera* (Lecythidaceae), and *Dialium* (Leguminosae), and those used for rafters, etc., included *Guatteria, Anaxagorea, Duguetia, Xylopia* (Annonaceae), and *Aspidosperma* (Apocynaceae) (Boom 1987). These correlations, which could probably be found between semi-nomadic peoples all over the forested regions of the Amazon basin, are more obvious than the correlations found when comparing certain other use categories of plants (e.g., medicines). This should not be surprising; the properties of the wood of the trees in an area will very soon become clear to anybody who regularly has to fell them manually in order to make swidden clearings, and who will then observe their relative rates of decomposition as they lie in the fields.

CONCLUSION

The ***yano*** described at ***Watoriki*** is largely typical (structurally) in the context of traditional Yanomami dwelling construction, but the choice of species used to build it has been adapted to meet the demands of small changes in the group's lifestyle, and certain building techniques have likewise been modified. Adaptive changes in house construction are a common phenomenon amongst tribal peoples entering sustained contact with outside societies, and in this case one of the primary factors promoting change has been the increasing sedentariness of the group, resulting from their rising dependence on health support and trade goods, which has led to a need for more durable construction materials. This shift towards a more sedentary lifestyle is widespread among the contacted indigenous groups of Amazonia.

The choice of materials used at ***Watoriki*** will also have inevitably been influenced by the altered availability of suitable plant species in the lowland forests to which the group has recently migrated, and by the relatively recent introduction of more effective cutting tools than they traditionally possessed, facilitating the use of harder wood and larger trees. These changes in the available plant resources and in their use are reflected in many aspects of Yanomami ethnobotany, including in their use of medicinal plants (see Milliken and Albert 1996) and in their choice of food plants.

There are very clear similarities in the choice and use of building materials at ***Watoriki*** with those of other Amazonian tribes, resulting from the extensive knowledge of the strength and durability of plant materials which these peoples evidently possess, and the similarity of their circumstances, resources, and technological capabilities. These similarities in species choice are particularly evident in the more specialized components such as thatching and lashing materials. The notably large number of species used in the construction of the ***Watoriki*** round-house (52 or more) may to some extent be a consequence of its very considerable size and the limited local availability of the most suitable (ideal) species. This is clearly evident in the case of the choice of wood for rafters. However, this is also a reflection of the outstanding breadth and diversity of knowledge which the Yanomami possess as regards the useful properties of the plants of their environment.

The Yanomami are a highly adaptable people, and are ready to alter many aspects of their material culture in order to suit changing circumstances, or to benefit from new resources or technology originating either from other Yanomami groups or from outsiders. However, only when the outside social and cultural pressures of contact are still limited can these alterations be maintained within an overall traditional frame. Compared with some of the more radical changes observed among many Amazonian indigenous groups, such as the common shift from large communal dwellings to clusters of small family houses, the changes in overall building design seen at ***Watorikɨ*** are minimal, reflecting the comparative paucity of influence which the regional Brazilian society has had upon them to date. The abandonment of communal dwellings, which is likely to have significant effects upon the cohesion of a group, is much more likely to be the result of direct pressures from outsiders (e.g., missionaries and FUNAI workers), than to be an adaptive response to changing circumstances.

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BOOK REVIEW

Seasonally Dry Tropical Forests. Stephen H. Bullock, Harold A. Mooney, and Ernesto Medina (editors). Cambridge University Press, Cambridge, UK, 1995. Pp. xvii 450. $100.00 (cloth). ISBN 0 521 43514 5.

Over the past few decades major research and conservation efforts have focused on saving the tropical "rain" forests. Dry forests, however, occupy a much larger portion of the tropics than do rain (and moist) forests. Furthermore, because the climate is more hospitable to *Homo sapiens*, most tropical-dwelling folks have chosen to call what is dry "home" (it is where the species evolved, after all). Dry tropical forests have thus been used, changed, and degraded to a greater extent and for a longer period of time than adjacent humid forests. Although rain forest research and conservation efforts are much needed, basic and applied research to direct management and conservation of dry forests are even more critical. A stated goal of this volume is to summarize what is known of these forests in order to direct further research.

This book is a compilation of the proceedings of a symposium held at the Estación de Biología Chamela, Jalisco, México, and sponsored by the Universidad Nacional Autónoma de México (UNAM). The year is not indicated. It is a refreshingly well-edited text. Each chapter is clearly outlined with its own summary and references, and a comprehensive index to the volume is provided. The focus of *Seasonally Dry Tropical Forests* is admittedly slanted toward the neotropics (10 of the 17 chapters). This bias reflects the present state of knowledge in the neo- versus paleotropics and, if anything, points to the dearth of studies in the Old World. With only one or two exceptions (e.g., Matson and Vitousek), the chapters summarize existing studies on various aspects of dry tropical forest ecology and often make comparisons with rain/moist forests. It is a valuable addition to anyone's library who works anywhere in the tropics.

The introductory chapter by Bullock, Mooney, and Medina provides a detailed synopsis of each contributed chapter. Four chapters review the distribution and structure of tropical dry forests in Central America and the Caribbean (Murphy and Lugo), Brazil (Sampaio), Africa (Menaut, Lepage, and Abbadie), and Thailand (Rundel and Boonpragob), including human impacts. Graham and Dilcher have contributed a chapter on the (Cenozoic) paleobotany of northern Latin America and the southern United States (only microfossil records exist). Three chapters examine the diversity of neotropical dry forests' woody species (Gentry, to whom this volume is dedicated), vertebrates (Ceballos), and life forms of higher plants (Medina).

The remaining chapters address specific ecological aspects of neotropical dry forests, drought responses in trees (Holbrook, Whitbeck, and Mooney), plant reproduction (Bullock), and plant-herbivore interactions in Mesoamerican tropical dry forests (Dirzo and Dominguez), and physiological ecology of tropical dry forests in general, namely biomass distribution and primary productivity (Martinez-Yrmzar), nutrient cycling (Jaramillo and Sanford), biology of the below-ground system (Cuevas), and a nitrogen trace gas emissions study at Chamela (Matson and Vitousek).

Most of these chapters address the impacts of humans on dry tropical forests to some degree. Only the last two chapters have human/environment interactions as their theme. As such they will be of greater interest to ethnobiologists. Maass reviews the ways in which conversion of tropical dry forest to pasture and agriculture affect the environment. He then compares these impacts with humid forests to emphasize the importance of developing appropriate management. The final chapter on the ethnobotany of the Mexican tropical dry forests (Bye) provides a summary of research done to date, and includes an analysis of plant use between two biological stations in Mexico's dry (Chamela) and wet (Los Tuxtlas) tropics.

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CHERIMOYA AND GUANABANA IN THE ARCHAEOLOGICAL RECORD OF PERU

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ABSTRACT.—Most researchers commonly assume that both cherimoya (*Annona cherimolia*) and guanabana (*Annona muricata*) have long been a part of the prehistoric record of ancient Peru. However, archaeological and ethnohistoric research in the past 25 years strongly indicates that cherimoya was not introduced into Peru until ca. A.D. 1630 and that guanabana is only present after ca. A.D. 1000 and is mainly associated with sites of the Chimu culture.

RESUMEN.—La mayoría de los investigadores suponen que tanto la chirimoya (*Annona cherimola*) como la guanábana (*Annona muricata*) han sido parte del registro prehistórico del antiguo Perú por largo tiempo. Sin embargo, las in vestigaciones arqueológicas y etnohistóricas de los últimos veinticinco años indican fuertemente que la chirimoya no fue introducida al Perú sino hasta 1630 D.C., y que la guanábana está presente sólo después de aproximadamente 1000 D.C., y está asociada principalmente con sitios de la cultura chimú.

RÉSUMÉ.— La plupart des chercheurs supposent couramment qu'une espèce de pomme cannelle (*Annona cherimolia*) et le corossol (*Annona muricata*) ont fait partie, pendant une longue période, de l'inventaire préhistorique du Pérou. Toutefois, les recherches archéologiques et ethnohistoriques des vingt-cinq dernières années indiquent fortement que la pomme cannelle *A. cherimolia* ne fut introduite au Pérou qu'aux environs de 1630 apr. J.-C. et la présence du corossol n'est attestée qu'en 1000 apr. J.C. et uniquement associé aux sites de la culture chimú.

Two members of the custard apple family (Annonaceae), cherimoya or chirimoya (*Annona cherimolia* Mill.) and guanabana or soursop (*Annona muricata* L.), have long been cited as important tropical fruits for the prehistoric inhabitants of ancient Peru. However, archaeological research over the past 25 years has uncovered evidence indicating that current general perceptions of the past utilization and importance of these two fruits are based on misconceptions. Current evidence suggests that cherimoya was not introduced to Peru until the early 17th century whereas guanabana was introduced to Peru in late precolumbian times and is associated almost exclusively with Chimu sites dating to A.D. 1000 or later.

Modern botanical information on the two species is limited. The native home of the cherimoya is believed by some botanists to be the temperate mountain valleys of southwestern Ecuador near the area of Loja (National Research Council 1989:229), although most authorities suggest that its wild habitat extends into similar valleys in northern Peru (De Candolle 1959:176; Hill 1952:417; MacBride 1938:757; Popenoe 1921:334, 1945:17; Rehm and Espig 1991:193; Sauer 1950:528; Towle 1961:38). Cherimoya is currently more widely grown and eaten than guanabana, although its popularity and production, even in Latin America, are still much less than such introduced fruits as bananas and oranges. Cherimoya is grown and eaten as a dessert fruit and used as a flavoring or filling in most of western South America, parts of Central America, and Mexico, and is consumed in limited quantities by people in the United States, Japan, and western Europe (National Research Council 1989:229). Along coastal Peru, most cherimoya trees occur as part of house gardens and are not grown in large commercial orchards (ONERN 1972a:226, 259, 1972b:236, 1973:182).

Native habitat information about guanabana is less well known. Most authorities state that guanabana is native or probably native to the West Indies (De Candolle 1959:173; Hill 1952:418; MacBride 1938:752; MacMillan 1956:248). Sauer (1950:427) states that guanabana, a more tropical fruit than cherimoya, was widely grown in early times from Central America to southern Peru; however, this distribution undoubtedly reflects artificial extension of the natural growing area of guanabana by humans during some undetermined time in the past. In Peru, guanabana, like cherimoya, is eaten as a dessert fruit and used as flavoring and filling. It is also grown in house gardens, but is much less frequently seen at local markets.

Both cherimoya and guanabana are desirable because each fruit contains a large amount of sweet white pulp. Of the two fruits, cherimoya has slightly sweeter, less fibrous pulp than guanabana—characteristics that most likely account for its current greater popularity. Both contain a number of dark brown to black seeds imbedded within the pulp of the fruit. There is overlap in the fruits' size and shape. Cherimoyas normally weigh about 0.5 kg, but can weigh up to 3 kg. They vary in shape—heart-shaped, conical, oval, or irregular. Guanabanas, on the other hand, tend to be somewhat larger and even more irregular in shape, and can weigh up to 7 kg (National Research Council 1989:237-238). Both have a dark green skin that is "bumpy" in appearance, but this is where the similarity ends. Close examination of a cherimoya (Figure 1) reveals that it has large, scalelike impressions or prominent protuberances whereas a guanabana (Figure 2) has distinctive small, prickly bumps that make it feel rough to the touch. This difference in external appearance provides one of the key clues concerning the proper identification and role of both cherimoya and guanabana in the archaeological record of Peru.

Of the 19 species of *Annona* recorded from Peru (Brako and Zarucchi 1993:38-40), only three species, *Annona cherimolia*, *Annona muricata*, and *Annona squamosa*,

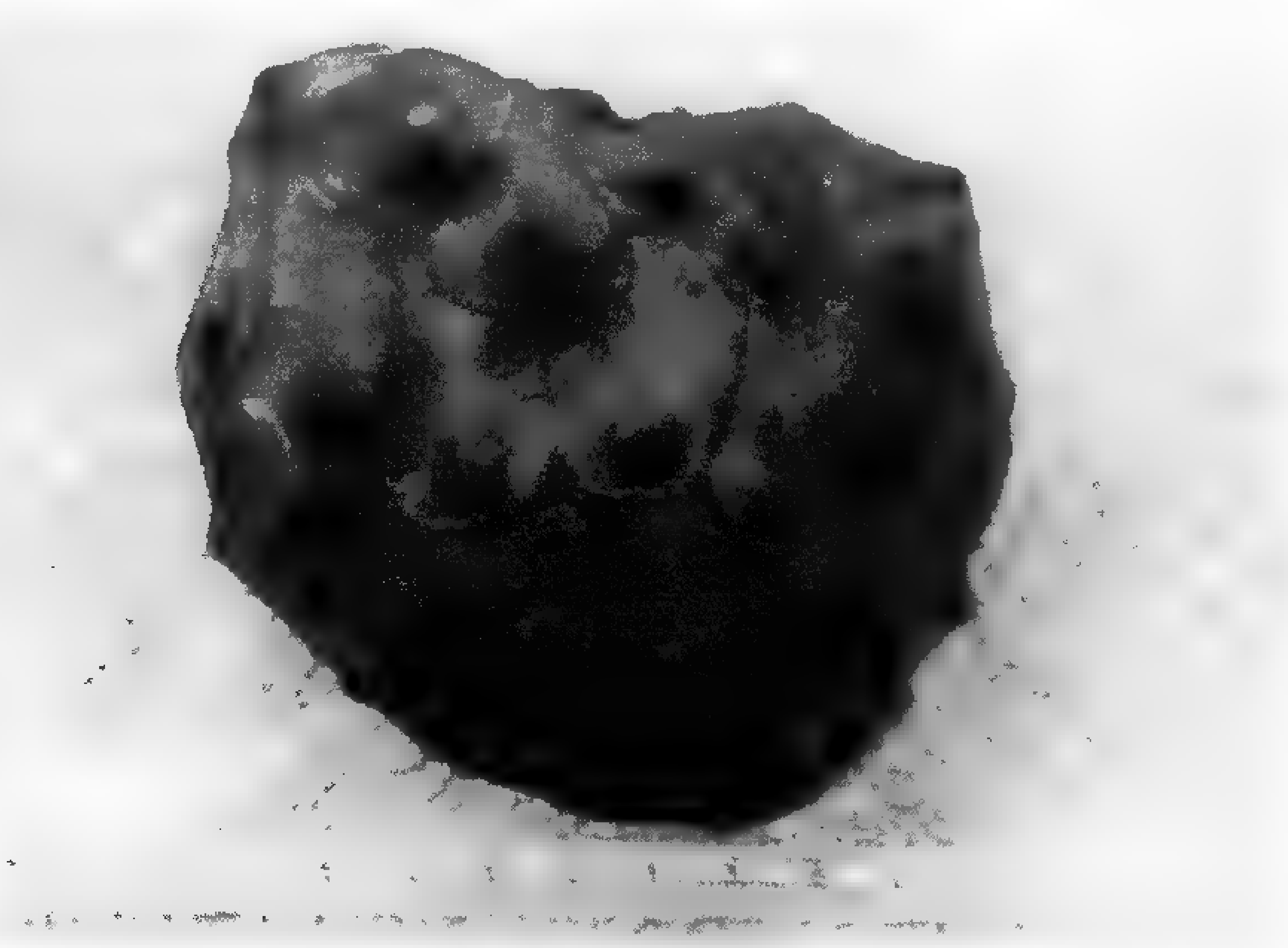

FIGURE 1.—Whole cherimoya (*Annona cherimolia*) fruit showing large scalelike protuberances on its exterior.

FIGURE 2.—Whole guanabana (*Annona muricata*) fruit showing small, prickly protuberances on its exterior.

have been cited as part of the prehistoric archaeological record of Peru (Towle 1961:18-19). Of the three species, the sweetsop, *Annona squamosa,* can be readily dismissed as a misidentification. The only claim for its pre-Columbian presence is a single statement made Wiener (1880:601) who says that the sweetsops were used as models for pottery vessels. Although no illustrations accompany this statement, it is highly likely that he was referring to Chimu pottery modeled after guanabana fruit (see below).

FIGURE 3.—Comparison of (a) modern cherimoya (*Annona cherimolia*) seeds, (b) modern guanabana (*Annona muricata*) seeds, and (c) archaeological guanabana seeds from Manchan in the Casma Valley. Guanabana seeds have a distinctly ribbed surface, are strongly laterally compressed and elliptic in section with a well-developed or thickened hilum. Cherimoya seeds are less strongly compressed and subterete in section with a weakly-developed hilum.

The actual seeds of cherimoya and guanabana resemble one another to a certain degree, but are distinct from seeds of other species of *Annona*. As part of the research for this paper, we made a comparative study of *Annona* seeds at both the New York Botanical Garden and the Harvard Herbaria in August 1996. Cherimoya and guanabana seeds at both institutions closely resemble our recent collections of cherimoya and guanabana seeds from Peru (NYBG voucher number E-581 for cherimoya; NYBG voucher number 2086 for guanabana). None of the other 17 species bears many similarities to either cherimoya or guanabana.

To the untrained eye, the seeds of cherimoya and guanabana can be easily confused. We believe that this is the reason for previous claims for the presence of cherimoya in the prehistoric record of coastal Peru. In 1970, when one of us, Shelia Pozorski, conducted her first midden excavation in Peru, she initially identified the numerous seed remains from Cerro La Virgen in the Moche Valley as cherimoya. However, with the help of a local consultant, Rudolfo Gutierrez, who brought her examples of both fruits, she was able to correctly identify the seeds as guanabana and ultimately to demonstrate that no cherimoya seeds were present (Griffis 1971:58, Table 7). Subsequent to the 1970 field season, we have made several collections of modern cherimoya and guanabana specimens from various areas between the Lambayeque and Rimac Valleys of coastal Peru. Examinations of these specimens have demonstrated the validity of the distinction between the two seed types.

The seeds of the two fruits are similar, but close inspection shows that they can be readily distinguished and correctly identified. Both cherimoya seeds and guanabana seeds are similar in color (dark brown to black) and in size (cherimoya [n = 173]: 12.5-20 mm long [mean = 17.2 mm], 7.5-12 mm wide [mean = 9.6 mm], 5-8.5 mm thick [mean = 6.5 mm]; guanabana [n = 195]: 14-20 mm long [mean = 17.2], 8.5-13 mm wide [mean = 10.1], 4-8 mm thick [mean = 6.1 mm]). However, guanabana seeds have a distinctly ribbed surface, are strongly laterally compressed and elliptic in section with a well-developed or thickened hilum. Cherimoya seeds are less strongly compressed and subterete in section with a weakly-developed hilum (Figure 3). The distinction between the two types of seeds is especially important because seeds are normally the only remains of these fruits encountered in the archaeological record. Dr. Michael Dillon, Curator of Phanerogams at the Field Museum, has verified this distinction between the two seed types (Michael Dillon, personal communication, February 1997). We have deposited voucher specimens of modern cherimoya and guanabana seeds from Casma as well as archaeological guanabana seeds from the site of Manchan at both the Department of Botany at Southern Illinois University and the Field Museum of Natural History in Chicago (Field Museum voucher numbers: modern cherimoya = F1960628; modern guanabana = F1960633; archaeological guanabana = F1961656).

ARCHAEOLOGICAL RECORD FOR CHERIMOYA AND GUANABANA

General works on Peruvian prehistory frequently state that both cherimoya and guanabana were utilized by ancient Peruvians, beginning with the Moche culture (100 B.C.-A.D. 600) on the north coast (Bennett and Bird 1960:117; Benson 1972:78; Lanning 1967:15, 179; Lumbreras 1974:102; Mason 1969:76). References to the two fruits, however, are invariably included as part of a sentence listing a series of plants cultivated by the Moche people, without any critical assessment of the validity of the statement. All the authors of these general references apparently derived their lists, without much alteration, from Larco Hoyle (1946:163). In contrast, *Moche Art of Peru*, a much more in-depth work on the Moche culture, does not list either of the fruits as part of the Moche plant inventory (Donnan 1978:56-64).

The published archaeological evidence concerning cherimoya and guanabana is surprisingly sparse. Two lines of evidence have traditionally been used to support the existence of the two fruits in the prehistoric record of Peru—pottery vessels molded into the shapes of whole fruits and seed remains from the fruits (Figures 3-4). Claims that pottery vessels were made from molds of the actual cherimoya fruit first appeared in the late 19th century (Wiener 1880:601) and persisted into the 20th century (Safford 1917:19; Towle 1961:38-39). In no case, however, has an illustration of a cherimoya vessel been published. Pottery vessels based on molds of guanabana fruit have also been reported since the late 19th century (Safford 1917:19; Towle 1961:39; Wiener 1880:601), and such vessels do exist, but are rarely illustrated (Yacovleff and Herrera 1934: figure 1f). Our personal observations of museum collections and exhibits in Peru have revealed that only the Chimu culture, dating to the Late Intermediate Period (A.D. 1000-1470) of the Peruvian north coast, produced pottery vessels, usually jars, that realistically depict whole fruit. Even though they are consistently mislabeled as cherimoya, these vessels invariably depict guanabana (Figure 4). The skin of the fruit depicted on these vessels has the small, prickly bumps that are distinctive of guanabana fruit. We have never seen a cherimoya vessel, and this observation concurs with Yacovleff and Herrera's (1934:276) detailed study of ceramics in the National Museum in Peru.

FIGURE 4.—Late Chimu blackware jar depicting a whole guanabana fruit. Chan Chan site museum.

Actual botanical remains of cherimoya and guanabana have not often been reported. Costantin and Bois (1910:257, figure 10) illustrate one of five reputed cherimoya seeds found in the late 19th century at the site of La Rinconada near Lima on the central coast of Peru (Figure 5). The illustration provided is not of high quality, but the seeds depicted are more similar to seeds of guanabana, having a ribbed appearance and a flattened perimeter ridge. Safford (1917:19) describes three varieties of cherimoya that reputedly came from unspecified prehistoric graves at Ancon, located just north of Lima (Figure 5). He does not illustrate any of these specimens, however, making it difficult to assess his claim. Nevertheless, Safford (1917:19) appears to be the primary source upon which subsequent authorities base the identification of cherimoya in the prehistoric record, apparently without any subsequent confirmation of identification (Sauer 1950:528; Towle 1961:38-39; Yacovleff and Herrera 1934:276).

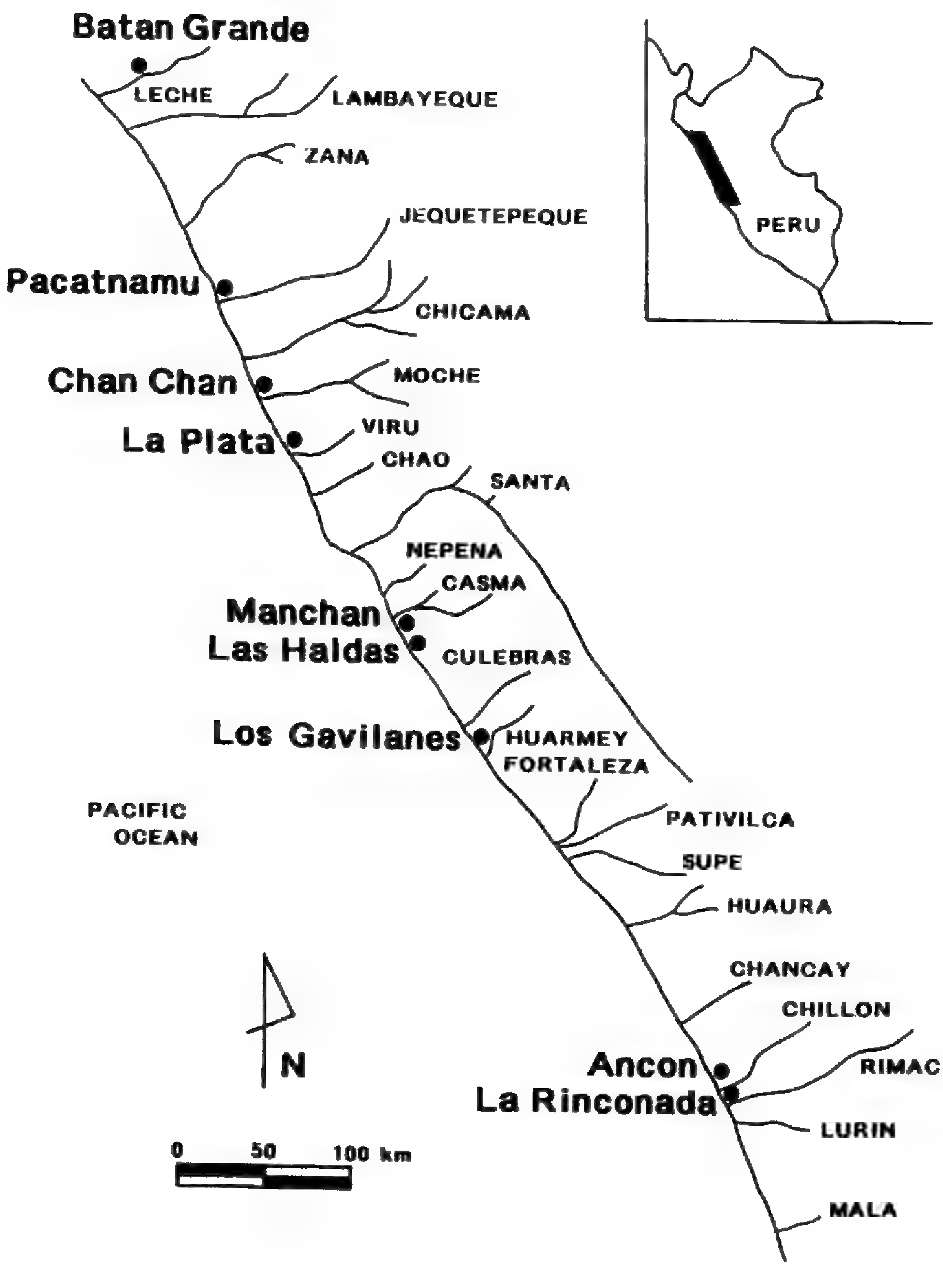

FIGURE 5.—Location of prehistoric sites where seeds have been identified as guanabana (*Annona muricata*) or cherimoya (*Annona cherimolia*). The authors believe all of these examples to be guanabana and to date after ca. A.D. 1000.

In the more recent archaeological record, Shimada (1980:172) states that cherimoya was found at Sapame, within the Batan Grande complex of the La Leche Valley of the north coast of Peru (Figure 5), in stratigraphic layers dating somewhere between the Middle Horizon (A.D. 600-1000) and the Late Horizon (A.D. 1470-1532). Botanical identifications were done by Melody Shimada. These specimens are not illustrated, however, and his Table 4 (Shimada 1980:202) lists the remains as *A. muricata*, not *A. cherimolia*. We believe that these are more likely guanabana remains, the dates of which are somewhat uncertain because of their archaeological context. At Pacatnamu, near the mouth of the Jequetepeque Valley (Figure 5) , Gumerman (1991:95-102) reports abundant guanabana remains from the Chimu occupation that dates between A.D. 1100 and 1370 (Donnan 1986:22). His identification of the guanabana remains agrees with our direct observations of seed remains at the site. In the Viru Valley, Collier (1955:214) recovered two guanabana seeds (identified by Hugh C. Cutler) at the late Chimu site of La Plata (Figure 5). No guanabana remains were recovered from the pre-Chimu sites of Castillo de Tomaval and Huaca de la Cruz (Towle 1952:352-356).

Popper (1982:149-151) states that nine cherimoya seeds were found in the upper levels of Los Gavilanes, a Late Preceramic (2500-1800 B.C.) site excavated by Bonavia (1982) in the Huarmey Valley on the north central coast (Figure 5). Some scholars (Pearsall 1992:190, 194; Quilter 1991:398-399) accept this identification as well as the Late Preceramic date. However, examination of the accompanying illustration (Popper 1982:fotografía 32) plus a brief personal inspection of the seeds in 1978 at Bonavia's laboratory in Lima have convinced us that these seeds are actually those of guanabana. Moreover, given the small number of seeds found, their context, and the presence of late ceramic sites very near Los Gavilanes, it seems very likely that the nine guanabana seeds are late intrusions into the early site. In the Casma Valley on the north coast, Fung Pineda (1969:54, 128) recovered seeds that she very tentatively identified as cherimoya from a test pit containing Chimu-related ceramics at the coastal site of Las Haldas (Figure 5). No illustrations of these seeds are provided, making assessment difficult. However, our personal observations of the midden in the vicinity of the test pit, where remains of guanabana seeds are visible, suggest that her collections were seeds of guanabana, not cherimoya.

Our own excavations and studies of subsistence in the Moche and Casma Valleys on the north coast have never uncovered a single cherimoya seed. Guanabana seeds, on the other hand, are extremely common, but only in association with Chimu sites dating to the Late Intermediate Period. In the Moche Valley (Figure 5), the late Chimu sites of Chan Chan, Cerro La Virgen, Choroval, and Caracoles all contain abundant remains of guanabana seeds (Griffis 1971:58, Table 7; S. Pozorski 1976:159, 165, 172, 181, 189, 201; 1979:180, Table 2; 1980; 1982:183-196). Significantly, no guanabana seeds were recovered from the early Chimu reoccupation on top of Huaca del Sol nor in any of the other five excavated middens dating to pre-Chimu times (S. Pozorski 1976:223-233; 1979:Table 2, 165-180). This strongly suggests that the introduction of guanabana into the Moche Valley did not occur until after the early portion of the Late Intermediate Period, probably around A.D. 1100 or 1200.

In the Casma Valley (Figure 5), excavations at Manchan, dating to late Chimu through early Colonial times (A.D. 1300-1600; Mackey and Klymyshyn 1981:101), by Moore (1981:118) recovered large quantities of guanabana seeds and skins. We were consulted to help with analysis of the plant and animal remains from the Manchan excavations and can confirm that all of Moore's identifications of guanabana remains are correct (Figure 3). No cherimoya remains were uncovered, even in the early Colonial portions of the site.

Of the few midden studies from other areas of Peru that have been carried out and published, none has reported remains of either cherimoya or guanabana. These studies include the far north coast near Piura (Huapaya 1991:192), the Ancon-

Chillon portion of the central coast (Cohen 1975:58-60, Table 1; 1978:41, Table 1), the Chincha Valley of the south coast (Sandweiss 1992:124-135), and the Upper Mantaro region of the central highlands (Hastorf 1993). Although future studies may expand distribution patterns, current evidence of guanabana remains appears restricted to the north and north-central portions of the Peruvian coast.

ETHNOHISTORIC RECORD AND LINGUISTIC EVIDENCE

The early ethnohistoric record in Peru is in accord with the securely dated archaeological evidence for cherimoya and guanabana. During the mid-16th century, Cieza de León (1986:202-204) recorded the presence of guanabana as well as other indigenous and introduced European crops growing along the Peruvian coast. Significantly, however, although Cieza de León is known to have been a careful observer, cherimoya is not mentioned. Subsequently, Father Bernabe Cobo claims to have introduced cherimoya to Peru from Guatemala in 1629:

> "Only a few years ago the cherimoya was introduced to the kingdom of Peru. I first saw this fruit in the city of Guatemala in 1629 [while] walking to Mexico; this fruit appeared to me so sweet that I felt its absence in this kingdom [Peru]; and thus, I sent from there a good quantity of its seeds to a friend so that he could distribute them among friends which he did. When I returned [to Peru] from Mexico after 13 years, I found many fruit-bearing trees...." (Cobo 1964:240-241, our translation)

Safford (1917:19) refutes Cobo's claim, however, based on his unsubstantiated identification of cherimoya from the Ancon graves. Yacovleff and Herrera (1934:276), while acknowledging Cobo's statement, accept Safford's refutation. S. Pozorski (1976:259), on the other hand, took Cobo, one of the more reputable colonial sources on Peru, at his word because his statement correlated well with her data from the Moche Valley. As discussed above, archaeological evidence uncovered since that time continues to support Cobo's contention that it was he who introduced cherimoya to Peru early in the 17th century or, at the very least, support the view that cherimoya was not introduced to Peru until the early Colonial Period.

Linguistic evidence sheds some light on the issue of the prehistoric presence of guanabana and cherimoya. The word "guanabana" does not appear to be Quechua because it is not glossed in any of the 16 Quechua-Spanish dictionaries produced for the Andean region that we consulted (Academia Mayor de la Lengua Quechua 1995; Carranza Romero 1973; Cerron-Palomino 1976; Cusihuaman 1976; Domingo de Santo Tomás 1951[1560]; Guardia Mayorga 1967; Hornberger and Hornberger 1983; Lara 1971; Lira n.d.; Park, Weber, and Cenepo 1976; Parker and Chavez 1976; Perroud and Chouvenc 1970; Quesada 1976; Ricardo 1951[1586]; Soto Ruiz 1976; Swisshelm 1972). This is not surprising because guanabana is associated archaeologically with the prehistoric Chimu culture which had a more limited distribution on the north and north-central coast where non-Quechua languages persisted until well into the Colonial Period. The word "guanabana" could, therefore, have been part of one or more of the north coast languages associated with the Chimu or could have been borrowed, along with the adopted fruit, from peoples even further north. However, this word does not appear on any of the few existing word lists for these little-known indigenous north coast languages (Cerron-Palomino 1995:195-203; Kosok 1965:248-249).

"Chirimoya," the Spanish spelling of cherimoya, appears in some, but not all, Quechua-Spanish dictionaries (present in Academia Mayor de la Lengua Quechua 1995:66; Carranza Romero 1973:18; Cusihuaman 1976:38; Lara 1971:84; Parker and Chavez 1976:54; Perroud and Chouvenc 1970:35; Soto Ruiz 1976:38; absent in Cerron-Palomino 1976; Guardia Mayorga 1967; Hornberger and Hornberger 1983; Lira n.d.; Park, Weber, and Cenepo 1976; Quesada 1976; Swisshelm 1972). Significantly, "chirimoya" does *not* appear in the two extant Quechua-Spanish dictionaries from the 16th century (Domingo de Santo Tomas 1951[1560]; Ricardo 1951[1586]). This evidence supports our contention that cherimoya was introduced in colonial times, during the early part of the 17th century. Breaking the word "chirimoya" down into its component parts, we surmise that it comes from "***chiri***" meaning "cold" and "***moya,***" "***muru,***" "***muhu,***" "***muju,***" or "***muya***" meaning seed—although the reasons for the use of this word combination are not entirely clear. Apparently, the word "chirimoya" was coined in the 1630s or later from two Quechua words existing at the time, "***chiri***" and "***moya,***" but only after the fruit was introduced to Peru.

DISCUSSION

The two fruits discussed in this paper, cherimoya (*Annona cherimolia*) and guanabana (*Annona muricata*), have different chronological and spatial distributions of use in Peru. Archaeological and ethnohistoric evidence strongly indicates that cherimoya, despite its current greater popularity compared to guanabana, was not introduced into Peru until about A.D. 1630. No botanical remains (seeds or plant parts) of cherimoya have been conclusively shown to have been recovered from securely dated archaeological contexts nor have any depictions of cherimoya ever been documented on pottery vessels or other media in prehistoric Peru. Once cherimoya was introduced from Central America, however, it quickly became a favorite fruit among the coastal Peruvian population because of its sweet flavor. Prior familiarity with guanabana likely facilitated its rapid acceptance and spread.

Guanabana, on the other hand, is present in the pre-Columbian record, but only very late (after about A.D. 1000) and almost exclusively associated with the Chimu culture on the north coast. In fact, we believe that the presence of guanabana seeds is useful as a distinctive time marker for Chimu sites on the north coast. Seeds and occasionally other plant parts such as skins of guanabana have been found in abundance at Chimu sites in the Jequetepeque, Moche, and Casma Valleys, but are absent in earlier middens excavated in the Moche and Casma Valleys. Rare depictions of whole guanabana fruits, which form the bodies of pottery vessels, occur only on Chimu ceramics.

One might ask "Why does guanabana appear so late in the prehistoric record?" and "Why did it become so popular?" The late appearance of guanabana is likely correlated with the Chimu conquest and incorporation of valleys to the north of the Chicama-Moche Valley heartland into their growing state organization. Contact with people in the Jequetepeque Valley at sites like Pacatnamu probably made the Chimu people aware of guanabana by at least A.D. 1100. During this early expansion northward, the Chimu people added guanabana to their diet (S. Pozorski 1976:277, 1979:180-182, 1980:193, 1982:194-196). Its popularity can be attributed to the sweet flavor of its white pulp. How early and in what manner the people of the Jequetepeque Valley came to utilize guanabana is unknown. It is entirely possible that some sort of tropical forest-coastal trade network was responsible for its introduction into that area.

Certainly questions remain about the origins and distributions of both cherimoya and guanabana in the archaeological record. Cherimoya, as stated above, has not been positively identified anywhere in prehistoric Peru, and archaeological knowledge of guanabana is limited. Due to a less intensive investigation, the use of guanabana in the southern portion of the Chimu state, between the Huarmey and Chillon Valleys, is largely undocumented. Specifically, the seeds from La Rinconada (Costantin and Bois 1910:257) and Ancon (Safford 1917:19), which we believe are guanabana, lack precise cultural affiliation. North of the Jequetepeque Valley, the only possible guanabana remains documented are Shimada's (1982) finds in the La Leche Valley, and their reported date is equivocal. Excavations in far northern Peru; in Ecuador; and in other areas of northwestern South America, Central America, and the West Indies might clarify the aboriginal use of both fruits and reveal evidence of trade relationships. The late introduction of guanabana is of special interest because most prehistoric cultigens are present much earlier in the archaeological record. The introduction of guanabana could be associated with the establishment of new trade and/or political relationships between the Peruvian north coast and the highland and tropical forest areas of far northern Peru and southern Ecuador.

Given the preservation conditions within many of these areas, however, the chances of recovering physical remains of the fruits are less than optimal. Nevertheless, given modern archaeological recovery techniques and emphases on subsistence reconstruction, attempts to recover botanical remains of cherimoya and guanabana along with other floral and faunal remains should be a part of overall investigative strategies. Furthermore, the conclusions reached in this paper are based primarily on a careful examination of the archaeological record and secondarily on the ethnohistoric record. This fact should serve as a reminder that the archaeological record, despite its incompleteness, can effectively be used to more accurately document specific events as well as correct preconceived ideas about past phenomena.

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ETHNOMICROBIOLOGY: DO AGRICULTURAL PRACTICES MODIFY THE POPULATION STRUCTURE OF THE NITROGEN FIXING BACTERIA *RHIZOBIUM ETLI* BIOVAR *PHASEOLI*?

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ABSTRACT.—We analyze how agricultural practices affect the levels of genetic variation and the genetic structure of beans (*Phaseolus vulgaris* and *P. coccineus*) and of their associated bacteria *Rhizobium etli*. Two contrasting communities in the state of Puebla, central Mexico, were selected for this study: San Miguel, a Nahuatl community where traditional agricultural work is done almost exclusively by women, and Calpan, where men cultivate crops using modern techniques. The results are compared with previous research from Morelos, also in central Mexico. We found that San Miguel has maintained its agricultural tradition for generations. In recent years, women have played an important role not only in preserving this tradition but also in conserving the biological diversity in their plots. In Calpan, by contrast, the local varieties of beans have been replaced by commercial varieties and the women participate minimally in agriculture. In general terms, the genetic diversity of *R. etli* associated with cultivated beans (both *P. vulgaris* and *P. coccineus*) is high in all the communities we studied, while it is lower for the rhizobia associated with wild beans. The population structure of *Rhizobium etli* is different in the two communities: the most fertile and intensively managed plots are similar in this respect, while the least managed plots resemble the site of wild *P. vulgaris*. This research indicates that agricultural practices and local environmental conditions affect the genetic structure of both cultivated beans and their associated bacteria.

RESUMEN.—Analizamos cómo las prácticas agrícolas afectan los niveles de variación genética y la estructura genética de los frijoles (*Phaseolus vulgaris* y *P. coccineus*) y de sus bacterias asociadas, *Rhizobium etli*, y el papel de las mujeres en la conservación y manejo de esta diversidad genética. Se seleccionaron dos comunidades contrastantes en el estado de Puebla, en el centro de México: San Miguel, una comunidad náhuatl donde el trabajo agrícola tradicional lo llevan a cabo casi exclusivamente mujeres, y Calpan, una comunidad mestiza donde los hombres cultivan el campo usando técnicas modernas. Los resultados se comparan con investigaciones previas realizadas en Morelos, también en el centro de México. Encontramos que San Miguel ha mantenido su tradición agrícola por generaciones. En años recientes, las mujeres han jugado un papel importante no sólo preservando esta tradición sino conservando la diversidad biológica en sus parcelas. Sin embargo, en Calpan las variedades locales de frijol han sido substituídas por variedades comerciales y las mujeres están perdiendo sus tradiciones y su contacto con la tierra. En términos generales, la diversidad genética de *R. etli* asociado a frijoles cultivados (tanto *P. vulgaris* como *P. coccineus*) es alta en todas las comunidades estudiadas, mientras que para los rhizobia asociados a frijoles silvestres es menor. La estructura poblacional de *Rhizobium etli* es diferente en las distintas comunidades estudiadas, siendo las parcelas más fértiles y más intensivamente cultivadas similares entre sí, mientras que las parcelas manejadas menos intensivamente se parecen al sitio de *P. vulgaris* silvestre. Este trabajo indica que las prácticas agrícolas, la influencia de las mujeres y las condiciones ambientales locales afectan la estructura genética tanto de los cultivos como de sus bacterias asociadas.

RÉSUMÉ.—Dans cet article, nous analysons l'effet des pratiques agricoles sur les niveaux de variation génétique et la structure génétique des haricots (*Phaseolus vulgaris* et *P. coccineus*) et des bactéries (*Rhizobium etli*) qui leur sont associées et le rôle des femmes dans la conservation et la gestion de cette diversité génétique. Deux communautés contrastantes de l'état de Puebla dans le Mexique central ont été sélectionnées: San Miguel, une communauté nahuatl où le travail agricole traditionnel est du ressort presqu'exclusif des femmes, et Calpan, une communauté métisse où ce sont les hommes qui pratiquent l'agriculture avec des techniques modernes. Nous avons comparé nos résultats avec une autre étude que nous avions menée à Morelos qui est aussi situé dans le centre du Mexique. Nous avons découvert que San Miguel a maintenu ses traditions agricoles à travers les générations. Dans la période récente, les femmes ont joué un rôle important non seulement en préservant ces traditions mais également dans la conservation de la diversité biologique sur leurs lopins de terre. Toutefois, à Calpan, les variétés locales de haricots ont été remplacées par les variétés commerciales et les femmes sont en train de perdre leurs traditions et leur rapport à la terre. Dans l'ensemble, la diversité génétique de la bactérie *R. etli* qui est associée aux haricots (autant à *P. vulgaris* qu'à *P. cocineus*) est élevée dans toutes les communautés étudiées, bien qu'elle le soit moins dans le cas des rhizobiums associés aux haricots sauvages. La structure de la population de *Rhizobium etli* est différente selon les communautés étudiées, les lots les plus fertiles et les mieux gérés étant similaires tandis que les lots les moins bien gérés se rapprochant davantage des sites sauvages de *P. vulgaris*. Cette recherche montre que les pratiques agricoles, l'influence des femmes et les conditions environnementales locales affectent la structure génétique à la fois des récoltes et des bactéries associées.

INTRODUCTION

Mexico is a country with an enormous cultural and biological richness (Ramamoorthy *et al.* 1993; Flores-Villela and Gerez 1994). This legacy is being lost at an unprecedented rate because of increasing demographic, economic, and technological pressures. In order to preserve crop diversity, it is necessary to understand the relationship between the human management of these species and their genetic diversity. The process of domestication is an ideal system to understand the influence of humans over biological diversity (Doebley 1989). Usually, the domestication process erodes the natural genetic diversity of the organisms under domestication (Doebley 1989; Escalante *et al.* 1994). However, relatively high levels of genetic variation can be maintained as landraces by indigenous cultures (Kaplan 1981; Brush 1986; Altieri and Merrick 1987; Doebley 1989). It has been suggested that rural women play an important role in the preservation of genetic diversity by their use of traditional knowledge of agricultural practices as well as by the use of seeds with "old" genotypes (Brush 1986; Bain 1993).

The common bean, *Phaseolus vulgaris*, is an ancient crop species. Domesticates appear in the archeological record 7,000 B.P. in both Mesoamerica and South America (Gentry 1969; Kaplan 1981; Delgado *et al.* 1988). In Mexico, the common bean and the related cultivated perennial species *P. coccineus*, are normally nodulated by strains of the nitrogen-fixing bacteria, *Rhizobium etli* (Segovia *et al.* 1993; Souza *et al.* 1994). Beans, as most legumes, allow certain strains of *Rhizobium* to penetrate into their roots and subsequently to develop nodules where nitrogen fixation occurs. The nodule structure and the transformation of the atmospheric nitrogen to ammonia is an active process mediated by the plant as well as the bacteria in the nodules, representing one of the clearest examples of symbiosis (Long 1989). Nitrogen fixation efficiency, number of nodules, and their size depend on the correct molecular signals between both symbiotic partners (Long 1989; Souza 1990). Traditionally, the evolutionary biology of the plant host and the bacteria has been studied as two separate entities without considering human influence on their genetic diversity, even though there is evidence that humans have contributed to the spread of rhizobia around the world by transporting seeds and soil from one continent to the other (Martínez-Romero and Caballero Mellado 1996).

Population genetics of wild and cultivated *P. vulgaris* and *P. coccineus* from central Mexico has been studied by Piñero and Eguiarte (1988) and Escalante *et al.* (1994). *P. coccineus* from central Mexico has a high genetic diversity (measured as H, the mean expected heterozygosity in Hardy Weinberg equilibrium, range 0.18-0.27) and intermediate outcrossing rates (t range 0.59 to 0.69, Escalante *et al.* 1994). In this species, the domestication process has neither eroded the levels of genetic variation nor changed the mating system (Escalante *et al.* 1994). *P. vulgaris*, in contrast, is highly inbred (almost entirely self-pollinated), and has very low levels of genetic variation ($H = 0.041$; Escalante *et al.* 1994).

The population genetics of *Rhizobium* sp. have been studied by several authors (Piñero *et al.* 1988; Demezaz *et al.* 1991; Segovia *et al.* 1991; Souza *et al.* 1992, 1994; Eardly *et al.* 1990 1995; Strain *et al.* 1995), who have found high levels of genetic diversity in *Rhizobium* associated with cultivated legumes (H ranges from 0.46 to 0.69). Souza *et al.* (1994) described similar results in the rhizobia associated with cultivated beans of Morelos in central Mexico ($H = 0.41$). However, the rhizobia associated with wild *P. vulgaris* in Morelos presented a much lower genetic diversity ($H = 0.11$).

The main objectives of this research were to analyze how agricultural practices affect the genetic diversity of crops and of the bacteria associated with them, and to explore the role of women in the conservation and management of the genetic diversity of beans and their rhizobia. To achieve these objectives, two contrasting communities in the central Mexican state of Puebla were selected: San Miguel Acuexcomac, a Nahuatl community where traditional agricultural work is done almost exclusively by women, and San Andrés Calpan, a Mestizo community where men cultivate the fields using modern techniques. The results were compared with those of previous research from Tepoztlan and Santiago Tepetlapa, Morelos (Souza 1990; Souza *et al.* 1994). In both communities we studied the role of women in agriculture and the population genetics of cultivated beans (*Phaseolus vulgaris* and *P. coccineus*) and nitrogen fixing bacteria *Rhizobium etli*. This is the first study where the interaction between the beans and the nitrogen fixing bacteria is analyzed in different agrosystems with the purpose of understanding the effect of plant and soil management on the bacteria.

METHODS

Study Sites.—The sites where this research was carried out are located near Mexico City, in the highlands of central Mexico, their general characteristics are described in Table 1. We chose these communities because one (San Miguel) presented the lowest bean production registered in the state of Puebla, while Calpan has one of the highest yields in the state (Table 2) (INEGI 1994; M. Colunga and D. Piñero personal communication).

TABLE 1—General characteristics of the study communities in Puebla and Morelos, Mexico.

Characteristics/Sites	Calpan, Puebla	Santiago, Morelos[b]	San Miguel, Puebla[c]
Climate[a]	temperate	subtropical	semi-arid
Elevation[a]	2,500 m	1,500 m	2,100 m
Coordinates[a]	99°30´W, 19°05´N	99°05´W, 18°59´N	98° 05´W, 18°50´N
Vegetation[a]	oak and pine forest	tropical deciduous forest	scrubland
Rainfall[a]	800-1,000 mm	1,000 mm	500-600 mm
Soil management	tractor, hand and chemical weeding	hand weeding	minimal tilling and hand weeding
Agrochemical use	fertilizer, pesticide	fertilizer, pesticide	low levels of fertilizer
Soil structure and fertility	sandy clay loam, sandy loam; fertile	sandy clay loam; fertile	clay, sandy clay loam; eroded
Soil pH	6.2	5.5	8.3
Culture	acculturated, Nahuatl no longer spoken	rural, Nahualt	rural, Nahuatl
Family	male dominant	male dominant	men are absent 75% of the time
Cultivars in same plot	bean plots separated by a row of fruit trees	beans	many bean varieties, corn, squash, and associated greens
Average number of plant spp./plot	5-7 species/plot	not studied	16-21 species/plot

[a] Zamora Rodríguez 1989; Inegi 1994
[b] Souza 1990; Souza *et al.* 1994
[c] Niehe 1988; INEGI 1994

San Miguel Acuexcomac, Puebla (hereafter San Miguel), is an indigenous (Nahuatl) community in the municipality of Cuautinchán near the Valsequillo Dam. The land in San Miguel has been marginal for agriculture since pre-Columbian times. Agriculture is mainly a polyculture system, cultivating corn, beans, squash, chili, and different greens. At present, the land in San Miguel is cultivated mainly by women, since most of the men are working in Los Angeles, California (Niehe 1988; V. Souza personal observation). The soil has low levels of soluble nitrogen (nitrates), and a moderate alkalinity (Figure 1); rainfall is lower and more irregular than in Calpan (Niehe 1988).

San Andrés Calpan, Puebla (hereafter Calpan) is the seat of a municipality close to Cholula and Huejotzingo. Calpan is an acculturated community where the indigenous language is no longer spokey. Here, the capitalization process and the input of mechanized technology have allowed an increase of agricultural productivity (Table 1) (Zamora Rodriguez 1989), but at a high cultural and biological price: agricultural traditions as well as germ plasm are being lost. In Calpan, the land is cultivated mostly by men with the help of their families (V. Souza personal observation). The soil has more soluble nitrogen and a more balanced pH than San Miguel, making it more fertile (Figure 1); Calpan has a more predictable rain pattern and a more temperate climate than San Miguel because of the shadow of the Popocatepetl volcano (Zamora Rodríguez 1989).

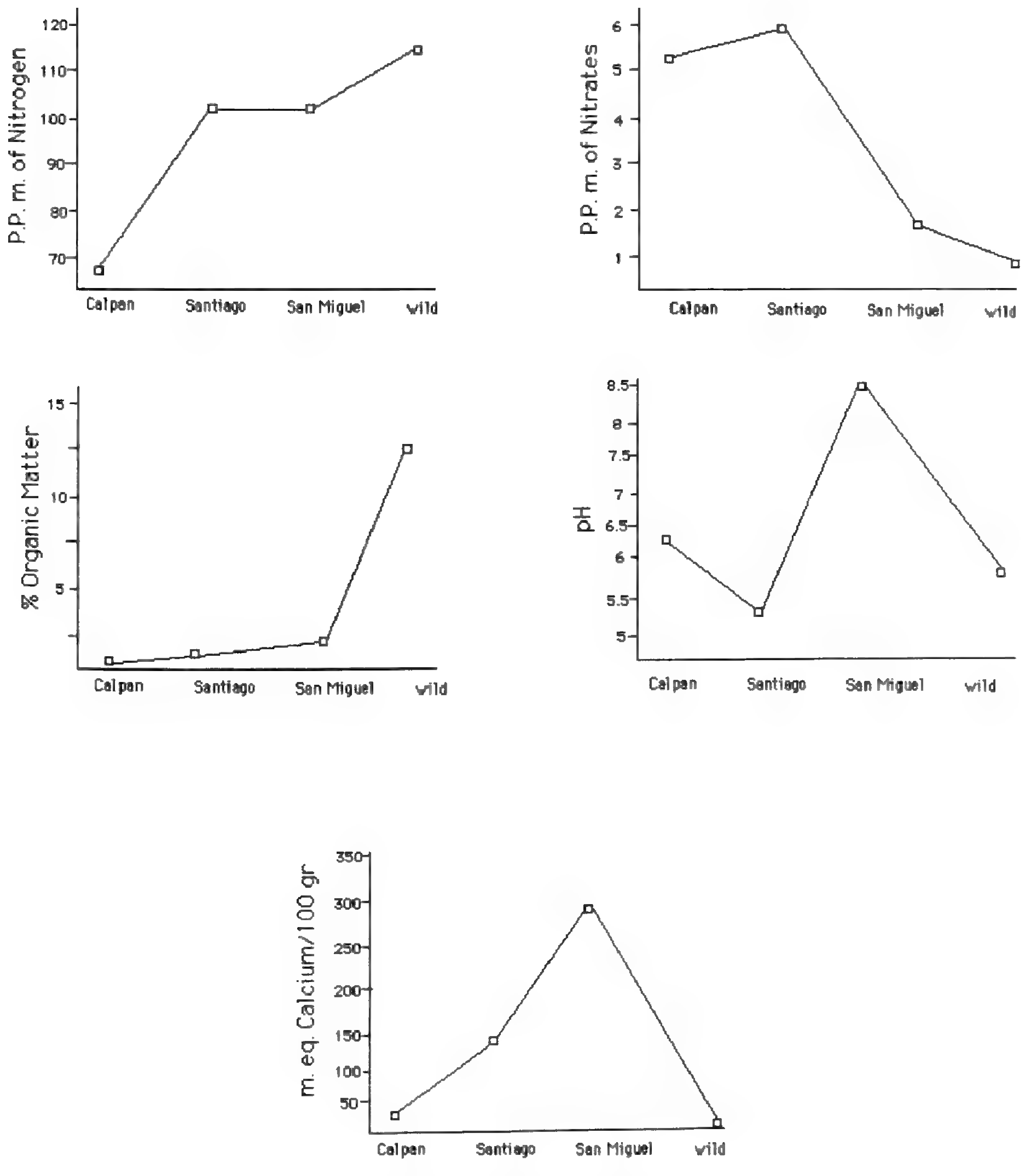

FIGURE 1.—Concentration of total nitrogen, soluble nitrates, organic matter, pH, and calcium in the soil of the studied sites.

Santiago Tepetlapa, Morelos (hereafter Santiago) is a small community with a long history of bean cultivation since pre-Columbian times (Souza 1990; Souza *et al.* 1992, 1994). Although the culture is Nahuatl, the language is being lost by the younger generations (Table 1). Rainfall at this site is fairly predictable and abundant in the summer (García 1988). Santiago has undergone significant socioeconomic changes in the last 10 years, because of its proximity to the village of Tepoztlán, an expensive resort for people from Mexico City. Many agricultural plots have been sold to outsiders to build country villas (V. Souza, personal observation). In Santiago the crops are cultivated mostly by men without the help of women. Women work mostly as housekeepers in the villas or at home. The soil in Santiago is acid and very rich in nitrates (Figure 1) due to the input of chemical fertilizers.

Tepoztlan, Morelos (hereafter, "wild site") is where we found wild populations of *P. vulgaris* and *P. coccineus* (Souza 1990; Souza *et al.* 1992, 1994). This is a very disturbed oak forest heavily grazed by cows and horses. It is located 3.7 km nw of the town of Tepoztlán and 7 km n of the town of Santiago. Rainfall in this area is fairly predictable and abundant in the summer. The soil at this site is the poorest of all in calcium but relatively rich in organic matter (Figure 1).

Ethnography.—We made eight visits to the communities of Calpan and San Miguel (four two-day visits to both sites). We interviewed women, taping the conversations, having first obtained permission from them to do so. Although a questionnaire was prepared, the interviews were made in an informal and casual manner that brought into conversation previously prepared questions. Subsequently, the questions and answers were analyzed in order to obtain general response patterns, to asses the way in which the women from these communities perceive their relationship with the crops they tend and with natural resources in their surroundings. The interviews took place mainly in homes, though a couple of times we approached the women while they were shopping, so that the persons accompanying them (usually their children or friends) participated as well. We interviewed 13 women in Calpan and 12 in San Miguel. In both places we sought to interview women of different ages.

Sampling procedures for the beans and R. etli.—Agricultural plots in San Miguel and Calpan were sampled during 1994 (Table 2). The plots were selected based on families that were willing to share their land and a portion of their bean crop so that we could do our research. The plants within each plot were selected using random numbers and a grid map. The approximate number of active nodules present in each plant was counted and ten active nodules were collected from each plant. A leaf sample of each sampled plant was collected and stored at -80° C, in order to assess the genetic structure of the plants for all plots. A soil sample from each plot was also taken. One hundred randomly selected seeds from each plot were measured and weighted and their color was scored. The productivity per plant was evaluated *in situ* by hand harvesting ten randomly selected plants per plot. The aerial part of the plant was stored in a large plastic bag, taking care to preserve all the loose leaves. The seeds from each plant were stored in a separate bag. In the laboratory the plants and seeds were dried in a stove at 350° C. The dry weight of the plants and seeds from each site were compared using a Student's *t*-test (Sokal and Rohlf 1981).

TABLE 2—Sampling scheme, characteristics of the beans, number of strains, and electrotypes (ETs) of *Rhizobium etli* obtained from each site.

Characteristics	Calpan, Puebla	Santiago, Morelos	San Miguel, Puebla
Sampled plots (year)	3 (1994)	1 (1987), 1 (1988)	3 (1994)
Sampled plants/plot	10	100 (1987)[a], 32 (1988)	10
Bean productivity (INEGI 1994)	high (2.5 ton/ha)	medium (1 ton/ha)	subsistence (ranges from1 kg to 0.5 ton/plot)
Average dry weight seed /plant (± s.d)	0.68 ± 0.13	n/a	0.890 ± 0.01
Average bean size (cm ± s.d)	1.23 ± 0.12	1.02 ± 0.10	1.42 ± 0.24
Average bean weight (gm ± s.d)	0.38 ± 0.09	0.32 ± 0.05	0.59 ± 0.31
Different colors of bean seeds	4	1	6
Bean variety	"amarillo" and "mantequilla", *P. vulgaris*, wild *P. coccineus*	"negro jamapa", *P. vulgaris*	landraces of *P. vulgaris*; cultivated *P. coccineus*
Average ot total nodules per plant (± s.d)	297 ± 27.61	105 ± 25.25	345 ± 48.32
Average active nodules /plant	34.50 ± 8.62	14.00 ± 5.21	48.50 ± 5.40
Average number of active nodules/1 gm root dry weight (± s.d.)	40.22 ± 4.93	not analyzed	98.74 ± 16.65
Number of strains isolated from 10 random plants	122	270	229
ET/stains	0.508	0.352	0.393

[a] From 99 plants only one nodule was extracted, while from one plant all the nodules (52) were extracted, see Souza *et al.* (1994).

Bacterial isolates.—The nodules were washed in 10% sodium hypochloride and rinsed twice with sterile water. Nodules were smashed in Petri dishes with Peptone Yeast Extract medium (PY, Souza 1990) and grown for two days at 30° C. One strain was isolated and grown again in a new Petri dish. This procedure was repeated twice to obtain a pure strain or clone. Each strain was kept at -80° C in UL (Glicerol-Peptone minimum media, Souza 1990; Souza *et al.* 1994). We isolated 351 strains for this analysis: 229 from San Miguel and 122 from Calpan, from three randomly selected plots at each site.

Electrophoresis procedures for beans.—We analyzed the genetic diversity of both species of beans in the sites we sampled using isoenzyme electrophoresis in cellulose acetate membranes (Hebert and Beaton 1993). Since most of the loci that have been studied in *P. vulgaris* are monomorphic (Escalante *et al.* 1994), we were able to analyze only three polymorphic loci: malic enzyme (ME, EC 1.1.1.40), isocitrate dehydrogenase (IDH, EC 1.1.1.42), and 6-phosphoglucose dehydrogenase (6-PGDH, EC 1.1.1.49). For *P. coccineus* four polymorphic loci were analyzed (ME, IDH, 6-PGDH, and malate dehydrogenase [MDH, EC 1.1.1.37] as an extra enzyme).

The genetic variation was estimated as the average expected heterozygosity in Hardy-Weinberg equilibrium, *H* (Hedrick 1983; Escalante *et al.* 1994) which ranges from zero, if there is no genetic variation, to a theoretical maximum of one, if there are an infinite number of alleles, each with the same allelic frequency.

Electrophoresis for bacteria.—Before each electrophoresis, the strains to be analyzed were grown in solid PY and two days later transferred to liquid PY (50 ml). After two days, the cultures were centrifuged at 6000 rpm during 5 min to obtain the cell pellet. The supernatant was eliminated and the pellet resuspended in 1 ml of Tris HCl pH8 buffer. Addition of 0.1 ml of lysozime (0.075 mg/ml) ensured lysis of the bacterial walls, and the resulting suspension was frozen twice at -80°C for 15 min. It was then centrifuged at 12,000 rpm during 5 min. The supernatant containing the protein lysate was distributed in three 1.5 ml plastic tubes and stored at -80°C. The strains from Morelos were analyzed using isoenzyme electrophoresis in starch as described by Selander *et al.* (1986) and Souza *et al.* (1994). For the strains from Puebla, electrophoresis was performed in membranes of acetate cellulose (Hebert and Beaton 1993). Seven polymorphic enzymes were used: isocitrate dehydrogenase (IDH, EC 1.1.1.42), peptidase (PEP, EC 3.4.11), phosphoglucomutase (PGM, EC 5.4.2.2), glucose 6-phosphate dehydrogenase (G-6PDH, EC 1.1.1.49), xanthine dehydrogenase (XDH, EC 1.1.1.204), malate dehydrogenase (MDH, EC 1.1.1.37), and malic enzyme (ME, EC 1.1.1.40).

Measurement of Bacterial Diversity.—From allele frequencies, the genetic diversity for an enzyme locus was estimated again as the expected virtual (since the bacteria are haploid) heterozygosity in Hardy-Weinberg equilibrium (*H*), and was estimated as $H = (1\text{-}Sx_i^2)[n/(n\text{-}1)]$, where x_i is the frequency of the i-th allele and n is the number of genotypes (or electrotypes, ET) (Selander *et al.* 1986; Souza *et al.* 1994). The average genetic diversities were calculated hierarchically considering the diversity of the rhizobia within each plant, within each plot, from each site, and the total diversity using the ETDIV program for bacterial population genetics (Whittham 1990).

Genetic diversity was also estimated by the number of electrophoretic morphs (electrotypes or ETs) divided by the number of strains analyzed. The higher value (n ETs / n strains = 1) is obtained when all the isolates are genetically different, and the lowest (1/n strains) is obtained when all the isolates are identical. This estimate is obviously sensitive to the number of strains collected and the number of loci used in the analysis, but it reflects information on the degree of diversity and clonality of the population (Souza *et al.* 1994).

Genetic Differentiation of the Bacteria.—We used three modified indices related to the G_{st} index to estimate the genetic differentiation at three hierarchical levels (Souza *et al.* 1994):

1) plant level $G_{pp} = (H_{plots} - H_{plants})/H_{plots}$
2) plot level $G_{ps} = (H_{sites} - H_{plots})/H_{sites}$
3) site level $G_{st} = (H_{total} - H_{sites})/H_{total}$

where H_{plants} is the average genetic diversity of *R. etli* within plants in a plot; H_{plots} is the average genetic diversity within plots; H_{sites} is the average genetic diversity within a community (Calpan or San Miguel) and H_{total} is the total genetic diversity of the sample in a given state (Puebla or Morelos). These indices range from zero, if there is no genetic differentiation at that level (this can happen if all units at that level have exactly the same alleles with the same frequencies), to one, if there is maximum genetic differentiation (meaning that the compared units share no alleles) (Souza *et al.* 1994).

RESULTS

Ethnographic Studies.—In this study, we held informal interviews with the people from both San Miguel and Calpan and observed their agricultural practices for a year. Important differences were observed in the way women from both communities grow their crops, manage their soils, and use the local vegetation (collection of medicinal and edible plants, fruit trees, and woody plants for fuel, as summarized in Table 3). The most interesting difference among women from these two communities is how they perceive their environment and select and store seeds, For example, more seed parameters (size, color, and general aspect) are used by the women in San Miguel than in Calpan.

TABLE 3. —Percentage of interviewed women that reported participating in each activity
(interviews: San Miguel, 12; Calpan, 13).

Activity	Calpan	San Miguel
Cultivate beans and maize in same plot	7.7%	91.7%
Weed by hand	53.3%	91.7%
Separate seed by size	76.9%	100.0%
Separate seed by color[a]	7.7%	33.3%
Separate corrugated or parasitized seed	30.8%	41.7%
Sow and harvest at new moon	0.0%	41.7%
Collect fuelwood	30.8	66.7%
Buy fuelwood	84.6%	33.3%
Collect edible and medicinal plants	46.2%	83.3%
Tend animals	46.2%	66.7%
Grow fruits/flowers in home gardens	100.0%	100.0%
Grow fruit trees and collect fruits	46.2%	0.0%
Weave palm	0.0%	16.7%
Are healers	0.0%	8.3%

[a] Each bean seed color represents a variety with different cooking and storage quality.

The observed differences could be due to the predominance of Nahuatl agricultural traditions in San Miguel and to the fact that in San Miguel there is an almost complete absence of men during many months each year due to migration to the U.S.A. The men return to their homes for the San Miguel festival (September) and for the winter (from November 1, to celebrate the dead, and from Christmas through early March for the preparation of the land). During these few months they discuss with the rest of the family future agricultural planning, seed selection, and the amount of land to be assigned to each cultivar. During the rest of the year, women see themselves as mere "helpers" of their absent husbands, even though women are in charge of the agricultural and commercial activities for much of the year. Calpan has a more "traditional" family structure in the sense that most men are present during the year, and women's activities are limited to that which the husband or father "allows them" to do (Table 3). In Calpan there has been a gradual loss of agricultural traditions, "Because working in the fields is not profitable any more, people are leaving; young people study but cannot find jobs, so they just stay around, doing nothing." At the same time, the seed stock of the community (germ plasm) has suffered pressure from the market, and local varieties have replaced commercial varieties which "sell better, although they do not taste as good."

Bean morphology and diversity.—Beans in San Miguel are larger and heavier than those from Calpan (see Table 2; t = 15.67, p<0.001; t = 18.72, p<0.001; respectively), and show a high diversity both in color (six colors in San Miguel; four colors in Calpan), size (variation coefficient = 17.21 in San Miguel; 10.21 in Calpan, Table 2), and weight (variation coefficient = 51.80 in San Miguel; 23.69 in Calpan, Table 2). The *criollo* varieties from San Miguel are also as rich in protein as those from Calpan (average = 3.26% total nitrogen in Calpan; 3.32% in San Miguel; analyses at the Instituto Nacional de Nutrición, Mexico City). Besides, the yield per plant (dry weight of the seeds/aerial dry weight of the plant) is significantly larger in San Miguel than in Calpan (Table 2; t = 6.9, p<0.001).

Cultivated and wild *P. vulgaris* have very low levels of genetic variation (Figure 2; *H* ranges from 0.016 to 0.025), with slightly higher levels for the wild *P. vulgaris* and the cultivated population from San Miguel (*H* = 0.025 and 0.023, respectively). Low levels of genetic variation for cultivated *P. vulgaris* have been described previously by Escalante *et al.* (1994). The slightly higher genetic diversity in San Miguel may be due to a more diverse stock of local seeds. The germplasm in San Miguel is actively and carefully maintained by each family, and the criteria to harvest, store, and select seeds is more complex than in Calpan (Table 3), where the seed supply is changing constantly due to the input of government agencies.

Phaseolus coccineus populations have substantially higher levels of genetic diversity than the common bean (Figure 2; range of *H* is 0.24-0.368). The cultivated population of *P. coccineus* in San Miguel has lower variation levels than *P. coccineus* from other localities in central Mexico (*H* = 0.24), which may be due to the fact that the weather and soil in San Miguel are not part of the normal ecological range of this species, which occurs naturally in temperate oak forest with cooler climate and higher humidity (Escalante *et al.* 1994).

Genetic Structure of Rhizobium etli.—Genetic diversity of rhizobia and beans: The *H* values and the ET/strains indices and their relationships with the variation levels of the host plants are shown in Figure 2. In terms of *H*, rhizobia associated with wild *P. vulgaris* and wild *P. coccineus* have lower levels of genetic variation (*H* range is 0.118 to 0.335), while the rhizobia associated with both cultivated *P. vulgaris* and *P. coccineus* have higher levels of genetic variability, with *H*, ranging from 0.407 to 0.542 (Figure 2 and Table 4). The ETs/strains index indicates, again, that the wild *P. vulgaris* associated rhizobia have the lowest levels of genetic variation. while the second lowest are the cultivated *P. vulgaris* population. The highest levels of genetic variation occur in the rhizobia associated with *P. coccineus*, regardless of being wild or cultivated. When we compare the levels of genetic variation of the host plants with their associated bacteria, in *P. vulgaris* there is a negative correlation between plant and bacterial genetic variation (Figure 2). This is explained, at least in part, by the ecological dominance patterns discussed below.

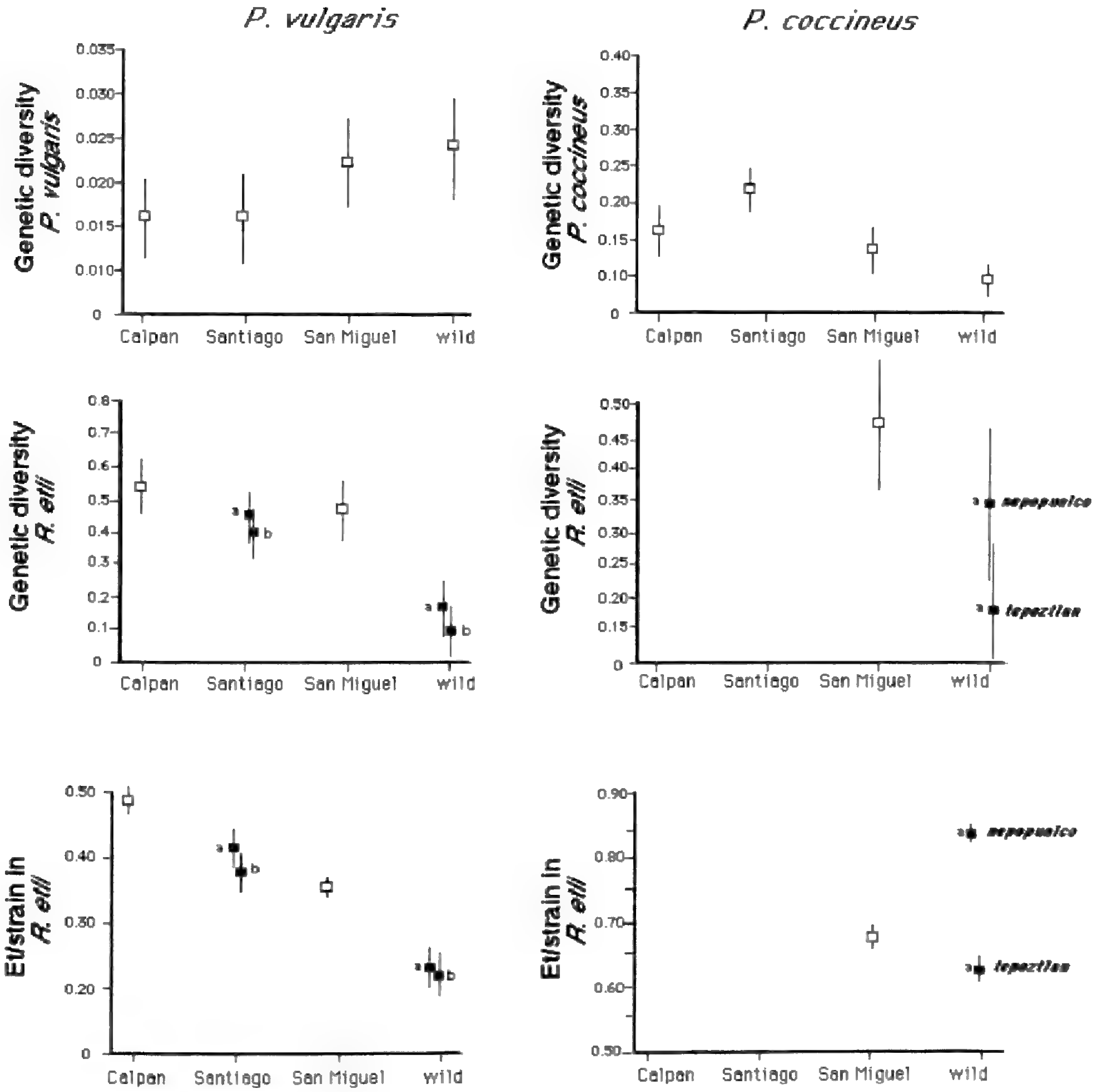

FIGURE 2.—Genetic diversity of beans and associated rhizobia in four sites in Mexico. The first column shows the genetic diversity of *Phaseolus vulgaris* and the genetic variation of their associated *Rhizobium etli* ; the second column shows the genetic diversity of *P. coccineus* and associated *R. etli* (see text). The rhizobia associated with *P. coccineus* in Calpan, Puebla and in Santiago, Morelos are not represented in the figure due to the small sample size. Open squares show the data of 1994; filled squares show the data from Souza *et al.* 1994; [a] is for the 1987 studies; and [b] is for the 1988 studies. The bars represent one standard error.

TABLE 4.—Relative genetic differentiation in *Rhizobium etli* in Puebla and Morelos.

Site	N strains[a]	*H R. etli*[b]	G_{pp}[c]	G_{ps}[d]
Calpan, Puebla	123	0.545		0.101
plot 1	54	0.463	0.052	
plot 2	33	0.466	0.014	
plot 3	36	0.540	0.009	
Santiago, Morelos[e] (1988)	190	0.407	0.58	
San Miguel, Puebla	229	0.508		0.142
plot 10	95	0.498	0.379	
plot 11	74	0.440	0.555	
plot 12	60	0.371	0.482	
Wild *P. vulgaris*, Morelos[e]	33	0.118	0.53	
Total: Puebla	351	0.579	G_{st}[f] = 0.09	
Total: Morelos[e]	223	0.487	G_{st}[f] = 0.55	

[a] Total number of isolated and identified strains

[b] *H R. etli*: A measure of the genetic variation in *Rhizobium*, the virtual expected heterozygosity (Souza *et al.* 1994).

[c] Relative genetic differentiation among plants within a plot ($G_{pp} = H_{plot} \cdot H_{plant} / H_{plot}$).

[d] Relative genetic differentiation among plots within a site ($G_{ps} = H_{site} \cdot H_{plot} / H_{site}$)

[e] Based on data from Souza et al. 1994: G_{ps} not obtained for Morelos samples.

[f] Relative genetic differentiation among sites within each state ($G_{st} = H_{total} \cdot H_{site} / H_{total}$)

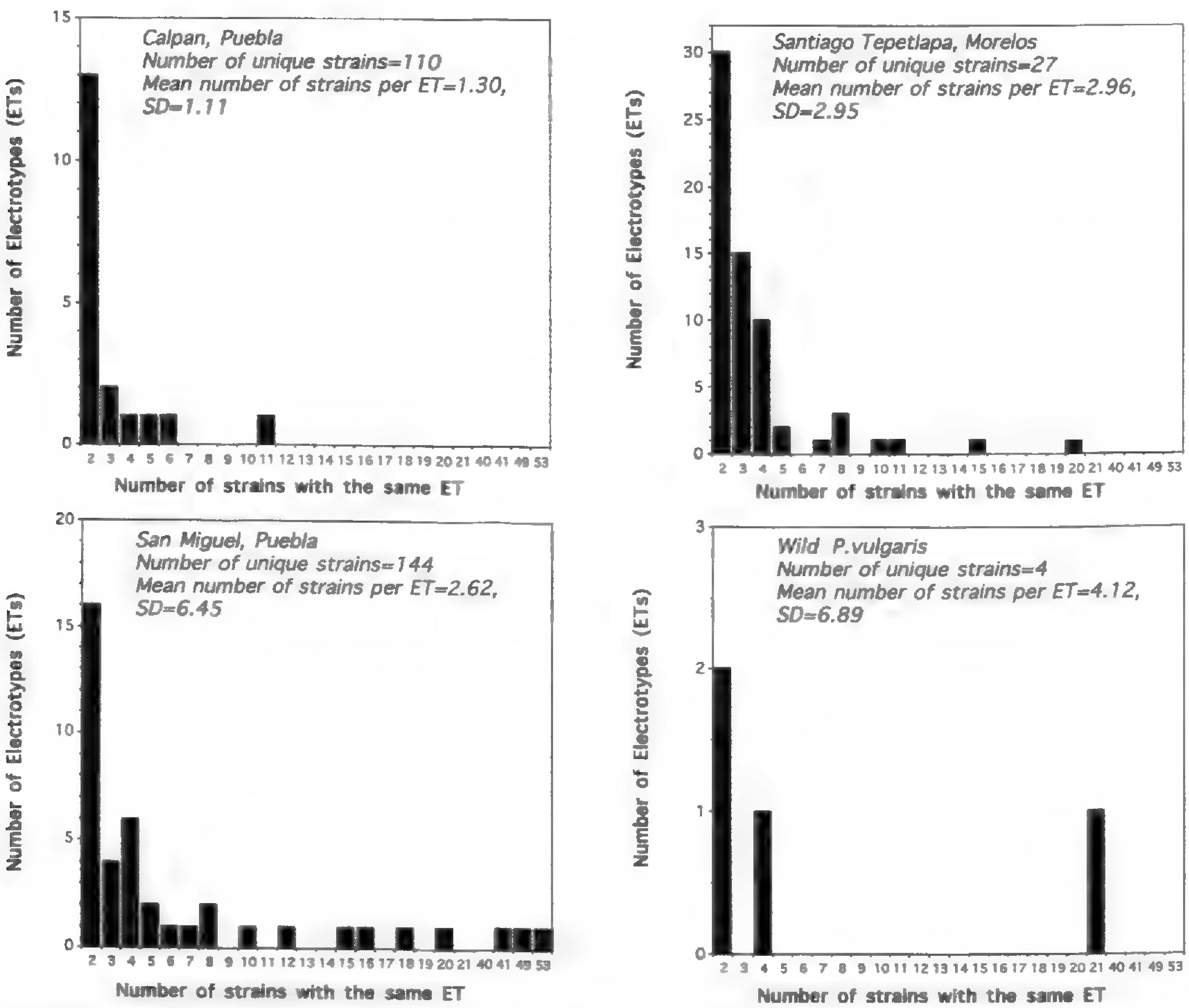

FIGURE 3.—Distribution of the frequencies of strains with the same genotype (ET) in the study sites.

Distribution of the strains and degree of dominance: In Figure 3 we show the distribution of strains with the same ET (electrotype) for four contrasting populations of rhizobia. We detect a gradient of ecological dominance, which appears to depend on the degree of agricultural management. In Calpan, the most technified site, the community of *R. etli* presents the lowest ecological dominance, with many ETs represented by just one or few strains in each, so the average number of strains per ET is 1.30. Both communities with simpler agricultural technology, Santiago Tepetlapa and San Miguel, have intermediate dominance levels, with most ETs being unique or with few strains, but some ETs are represented by several strains, and the average number of strains per ET is 2.96 and 2.62, respectively. The wild *P. vulgaris* site is the extreme of the gradient, with a strong ecological dominance, as most of the collected strains belong to a single ET, and, in consequence, the average number of strains per ET is the highest (4.12)..

Genetic differentiation at different hierarchical levels: The genetic levels of differentiation are described by the G_{st} analogs at the different levels, shown in Table 4. In Calpan, the G_{pp} indicates there is very little genetic differentiation of the bacterial isolates among plants in a given plot (G_{pp} range 0.009-0.052), and thus we found in each plant most of the rhizobia variation described for the entire plot. In contrast, in San Miguel the G_{pp} was substantially larger, ranging from 0.379 to 0.555, indicating a large degree of genetic differentiation of the bacterial isolates among plants. This means that each plant had a lower proportion of the rhizobia genetic variation found in the whole plot. This pattern was also found in the cultivated rhizobia from Santiago, (G_{pp} = 0.58) and in the wild *P. vulgaris* (G_{pp} = 0.53) where most of the variation is found between plants. At a higher level, in both communities in Puebla we found that each plot had most of the genetic variation present in that site (Calpan G_{ps} = 0.101, San Miguel G_{ps} = 0.142), meaning that there was little bacterial genetic differentiation among the plots in a given site. At the site level within each state, the G_{st} indicates that each site in Puebla represented most of the genetic variation, and very little genetic differentiation was found between sites (G_{st} = 0.09), while the sites sampled in 1987 in Morelos were quite different (G_{st} = 0.55). On the other hand, we have not found a single shared strain between the two sites in Puebla, although *P. coccineus* and *P. vulgaris* in San Miguel shared 5 ETs. In Morelos, very few strains were shared among neighboring sites (Souza *et al.* 1994). This may be due in part to the lack of mobility of this bacteria, but also to a lack of adaptation to new environments.

DISCUSSION

The main findings of our research are: 1) San Miguel is a Nahuatl community that has maintained its agricultural tradition and its rich and diverse bean germ plasm for generations. In recent years, women have played an important role in preserving this tradition. In Calpan, on the other hand, the seed stock of the community has suffered increasing pressure from the market; local varieties of beans have been replaced by commercial varieties that are smaller and less diverse than the beans in San Miguel. 2) The genetic diversity of *R. etli* associated with cultivated beans, both *P. vulgaris* and *P. coccineus*, is high in all the communities studied, while it is lower for the *Rhizobium* associated with wild beans. 3) The population structure of *R. etli* is different in all the populations studied. The most fertile and intensively managed plots are similar, while the least managed plots resemble the wild site of *P. vulgaris*; the genetic structure of *Rhizobium* seems to be associated with agricultural practices, bean genetic diversity, and soil conditions.

The people, the beans and the environment.—One of the objectives of this research was to assess the role women play in these communities as managers of their natural resources and germ plasm, and therefore, to evaluate their participation in the conservation and management of the genetic diversity of beans and the nitrogen-fixing bacteria *Rhizobium etli*.

Women in San Miguel appreciate the heterogeneity in their crops, as was expressed by a woman in an interview: *"Me gusta que mi canasta esté pinta"* ("I like a mottled basket."), referring to the diversity of color and size of her corn and bean seeds (for instance, tortillas are brownish in San Miguel due to a mixture of grains of different colors). In the interviews we observed that women in San Miguel take more variables into account when they select their seeds for the next cycle. This selection for heterogeneity is confirmed by the morphological and genetic analysis of the beans, where the maintenance of a mixture of genotypes is evident. The beans in San Miguel are also larger and heavier than the commercial seeds from Calpan. A higher diversity of beans, such as we found in San Miguel, has been observed elsewhere in areas where local landraces are maintained (Brush 1986; Altieri and Merrick 1987; Martin and Adams 1987). While genetic diversity is directly related to ancient agricultural traditions and may be explained as a response to a complex and competitive ecological environment, it may also associated with low productivity (Jennings and Cock 1978). This is only partially true for San Miguel, where bean productivity per hectare is lower than in Calpan and is, in fact, one of the lowest in the state of Puebla (INEGI 1994), but where yield per plant is significantly higher. This paradox is explained by the fact that people in San Miguel cultivate beans varieties that grow as vines. These plants can grow so heavy that they can crush the maize plants that provide their support. The women in San Miguel choose only a certain number of maize plants to support their beans and do not have more than a few hundred plants per hectare. In contrast, bean varieties cultivated in Calpan are free-standing and can be grown as a monoculture, with densities as high as 25,000 plants per hectare.

The bean plants in San Miguel also may be better symbionts with rhizobia than the beans in Calpan, as indicated by the number of active nodules per plant (red nodules evidence active nitrogen fixation) and the dry weight of nodules/gm of dry root (Table 2). In San Miguel the average number of nodules per plant was 229, while in Calpan it was only 122. However, these results need to be replicated in the greenhouse by controlled inoculation of different seeds.

In addition to the rich bean germ plasm, the botanical research indicates that in spite of the region´s semi-arid climate and eroded soils, San Miguel has a higher plant diversity within its fields than Calpan, which is explained in part by the Nahuatl agricultural practices that promote the growth of useful weedy species, including medicinal herbs used by healers in the community. While most women in San Miguel collect plants and fuel wood from their plots and immediate surroundings, women in Calpan buy fuel and medicinal plants at the market; when they do collect plants, they do not gather them in the agricultural plots.

Agricultural techniques.—Agricultural traditions differ in the two communities. Plots in San Miguel are seldom hand-weeded and fertilized. This may lead to a certain degree of nutrient competition among the various plants growing together in the plots by reducing the amount of resources available to the bean plants. Bean plants from Calpan, where fields are managed intensively and fertilized, obtain more nutrients. Peasants in San Miguel, however, obtain other benefits from the presence of a tolerable level of weeds in their fields (Bye 1981). In San Miguel, 11-21 species of weeds are found in the plots and most of these are used for medicinal and culinary purposes, while in Calpan only six-eight species are found in association with the beans. Weed communities may also enhance biological insect pest control (Altieri *et al.* 1977), organic matter accumulation, and soil conservation (Chacon and Gliessman 1982). The higher number and weight of the active nodules in plants from San Miguel may be due to both the differences in beans varieties and the low levels of agrochemicals, since large amounts of ammonia and nitrates in the soil inhibit the nodulation process (Long 1989).

Even though the common beans in San Miguel are much more diverse morphologically than the beans in Calpan, *P. vulgaris* genetic structure is similar in the four sampled sites. These results suggest that the morphological diversity may be due to the expression of a few genes that are not scored in the multiloci electrophoresis. In that case, even if the mating system of the species reduces heterozygosity (Escalante *et al.* 1994), the selection criteria for seeds in San Miguel may be favoring morphological diversity by selecting diverse bean lines that coexist in a cultivar.

The genetic erosion of crops is common all over the world at the sites of domestication. The replacement of local landraces by commercial varieties usually implies the loss of all or most of the old cultivars and their genetic diversity. Although yields may rise through this substitution, an increase in management costs and a reliance on purchased inputs, like fertilizers and seeds, is common (Brush 1986; Altieri and Merrick 1987).

Rhizobium *genetic structures and diversity.*—In San Miguel, the community with minimal tilling, the ecological dominance is high, as three ETs (electrotypes) represent more than 50% of the total population. Nodulation is also high, but environmental pressures appear to reduce the genetic diversity (measured as the ratio of ETs to strains), and increase the differentiation from plant to plant within a plot. The abundance of some well-adapted ETs (i.e., ecological dominance), suggests both adaptation to the local soil conditions and adaptation to the local bean varieties (Souza 1990). This hypothesis is reinforced by the number of nodules per plant and the ratio of strains per ET. In contrast, in Calpan the soil conditions are good and the technologically modified agriculture may increase the movement of strains within a plot, and in consequence reduce local adaptation of the strains. In this site, the ecological dominance is the lowest, and both the ratio of ETs to strains and the genetic diversity are high, but nodulation efficiency is lower than in San Miguel. In Santiago the ecological dominance and low nodulation efficiency may be explained by the low calcium concentration (Lodeiro *et al.* 1995). Furthermore, in Santiago there appears to be a low degree of migration of strains from other sites (Souza *et al.* 1995), which limits the genetic diversity within each site and increases the genetic differentiation. In the wild site of Tepoztlan, the ecological dominance was the highest, as one ET represented most of the strains. This site had also the lowest genetic diversity and high levels of genetic differentiation (Souza *et al.* 1994).

Agricultural practices may have indirectly changed the genetic structure of the nitrogen fixing bacteria *R. etli*. The bacteria associated with cultivated plants have higher levels of genetic variation than those associated with wild plants. This result may seem paradoxical, as it is well known that most domesticated organisms have lower levels of genetic variation than their wild relatives (Doebley 1989). Greater genetic diversity in *Rhizobium* may be due solely to agricultural practices: there may be more bacteria in the soil in cultivated plots than in the wild sites, and thus the plants may be able to sample from a larger pool of genotypes. On the other hand, the greater genetic diversity may reflect changes in the plant specificity due to domestication. If this is the case, the roots of the cultivated plants can be colonized by a genetically wider pool of bacteria than the wild beans. We suspect that a change in specificity is a more likely explanation (see also Souza *et al.* 1994). Future experiments on the specificity of both beans and rhizobia will test this hypothesis. These results suggest that the genetic structure of *Rhizobium* depends not only on the number of different strains found in a site, but also on the biology of the host plant and on the agronomic practices of each community.

Ethnomicrobiology, an emerging field.—The process of plant domestication, as well as introduction of crops to novel environments, may have an impact on both the introduced and the native rhizobia (Souza 1990). The extent of this effect has not been evaluated (Martínez-Romero and Caballero Mellado 1996). In this study we observed that rhizobia performance is much better in San Miguel than in Calpan. The efficiency of the interaction between *R. etli* and the local races of beans in San Miguel may be due to seed selection, crop management, and the adaptation of the *R. etli* and the local beans to alkaline soils and unpredictable rains. The introduction of nitrogen by way of fertilizers and the use of novel and homogeneous bean varieties may be changing the genetic structure of the native rhizobia and their interaction with beans. Such changes could be affecting other microbes associated with crops. The direct and indirect effects of traditional human activities on the microbiota are overlooked, yet potentially important aspects of ethnobiology. We suggest that the interdisciplinary study of the biological, ecological, and cultural aspects of the interactions between microbes and humans constitutes the field of ethnomicrobiology.

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ARCHAEOLOGICAL EVIDENCE OF ABORIGINAL CULTIGEN USE IN LATE NINETEENTH AND EARLY TWENTIETH CENTURY DEATH VALLEY, CALIFORNIA

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ABSTRACT.—During archaeological test excavations in two rockshelters in Death Valley, California, two storage features were unearthed which were found to contain numerous perishable artifacts and foodstuffs. In addition to seed remains of indigenous species, including mesquite and piñon, several seeds of introduced cultigens were recovered from within the features, including melon, squash, and beans. The feature containing the greatest number of domesticate seeds appears to date to the late nineteenth and/or early twentieth century and represents the first reported archaeological evidence of Shoshoni horticulture in the southwestern Great Basin.

RESUMEN.—Durante excavaciones arqueológicas preliminares en dos refugios de roca en el Valle de la Muerte, en California, se descubrieron dos almacenamientos que resultaron contener numerosos artefactos y alimentos perecederos. Además de restos de semillas de especies nativas, incluyendo mezquite y piñón, se encontraron dentro de los vestigios varias semillas de cultivos introducidos, incluyendo melón, calabaza y frijol. El almacenamiento que contenía el mayor número de semillas domesticadas parece datar de finales del siglo diecinueve y/o principios del siglo veinte, y representa la primera evidencia arqueológica reportada de horticultura shoshoni en el suroeste de la Gran Cuenca.

RÉSUMÉ.—Des reconnaissances archéologiques conduites dans deux abris rocheux de la Vallée de la Mort en Californie ont permis de mettre au jour deux structures d'entreposage contenant plusieurs objets et denrées périssables. Outre des vestiges de graines d'espèces indigènes, incluant des graines de prosope et de pignon, plusieurs graines de cultigènes introduits ont été repérés dans les structures, provenant entre autres de melon, de courge et de haricot. La structure contenant le nombre le plus élevé de graines domestiquées semble dater de la fin du 19^{e} et/ou début 20^{e} siècle et représente la premièr évidence archéologique consignée d'horticulture shoshone dans la partie sud-ouest du Grand Bassin.

During the summer of 1992, archaeological test excavations were undertaken at two rockshelters (CA-Iny-272) in Breakfast Canyon, Death Valley National Park, California. The work was carried out by archaeologists from the Cultural Resource Facility (CRF) at the California State University, Bakersfield, under the supervision of the author. The CA-Iny-272 site is located on the north side of an east/west trending wash forming a northern side branch of Breakfast Canyon approximately 2.4 km (1.5 mi) southeast of Furnace Creek Ranch in central Death Valley (Figure 1). Fluvial activity in Breakfast Canyon resulting from winter storms earlier that year had resulted in the undercutting and collapse of the cultural deposit in one of

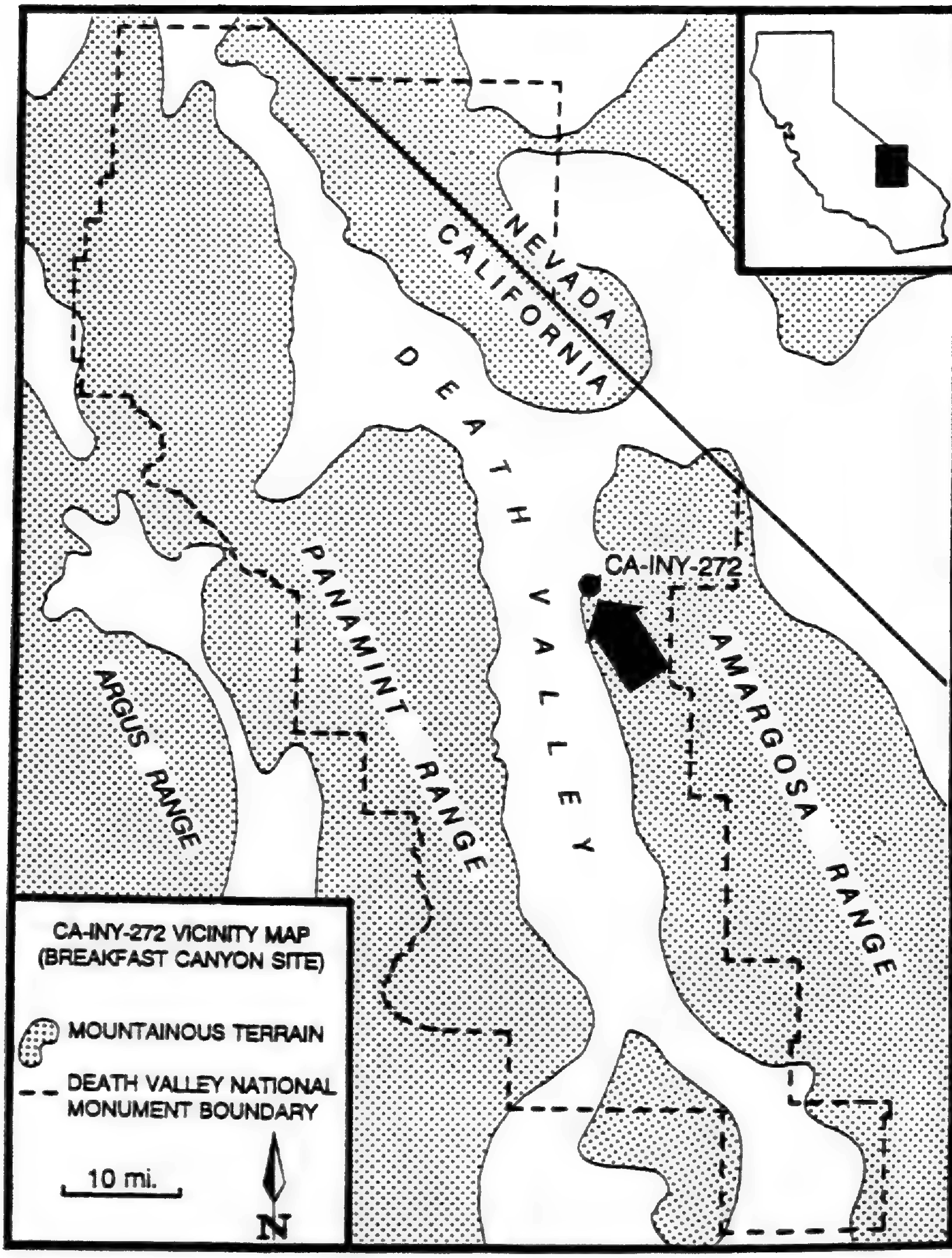

FIGURE 1.—CA-Iny-272 vicinity map including former Death Valley National Monument boundaries (Death Valley became a National Park in 1992)

the rockshelters. This event exposed numerous pieces of basketry and a clear stratum of organic material that caught the attention of several visitors who were hiking through the canyon. The high visibility of the archaeological deposit coupled with Breakfast Canyon's increasing recreational use made it imperative to determine the extent and nature of the cultural materials within the shelters before further disturbances occurred. At the request of the National Park Service, the CRF archaeologists set forth to evaluate the site and to salvage information from the exposed cultural feature.

The archaeological excavations in the rockshelters resulted in the discovery of two complete food storage features that contained numerous basketry fragments, cordage, historic artifacts, and various food items, including pods of honey mesquite (*Prosopis glandulosa* Torr. var. *torreyana* [L. Benson] M. C. Johnston), piñon (*Pinus monophylla* Torr. and Frem.) nuts, and cultigens. Apart from the discovery of various cultigen seeds in a rock crevice in Butte Valley made by William Wallace in the 1950s (W. Wallace, personal communication, 1995), the Breakfast Canyon project is the first instance where horticultural products have been found in an archaeological context in Death Valley. The Breakfast Canyon investigations provided a unique opportunity to glimpse traditional Shoshoni food storage customs both prior to and following the introduction of horticultural practices. This paper provides both a description of the storage features and the evidence of horticultural products found within these features and a discussion of the implications of this study for understanding horticultural practices in the southwestern Great Basin.

SITE AND FEATURE DESCRIPTIONS

The Breakfast Canyon site consists of two small rockshelters (A and B) that occur 1.5 to 3 m above the base of the wash. Both are solution cavities in mudstone that overlay consolidated alluvial deposits. Shelter A, the largest of the two, is the westernmost shelter and is approximately 15 m wide and a maximum of 3 m deep. Ceiling height varies from 1.5 to 2 m (Figure 2). It was the eastern half of Shelter A where the outer margin of a storage feature was exposed when a portion of the

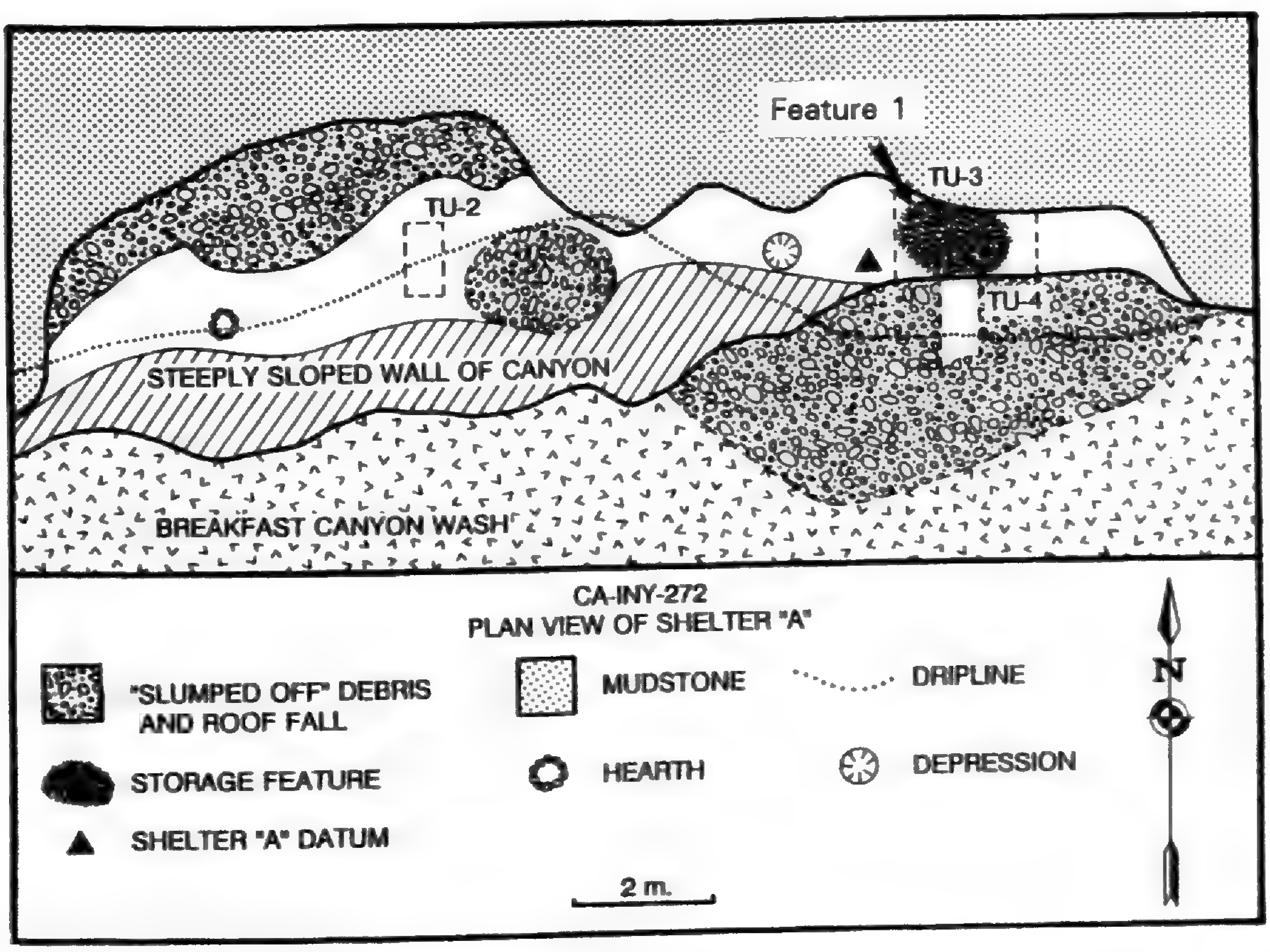

FIGURE 2. —Map of Shelter A showing the location of excavation units and the storage feature (Feature 1)

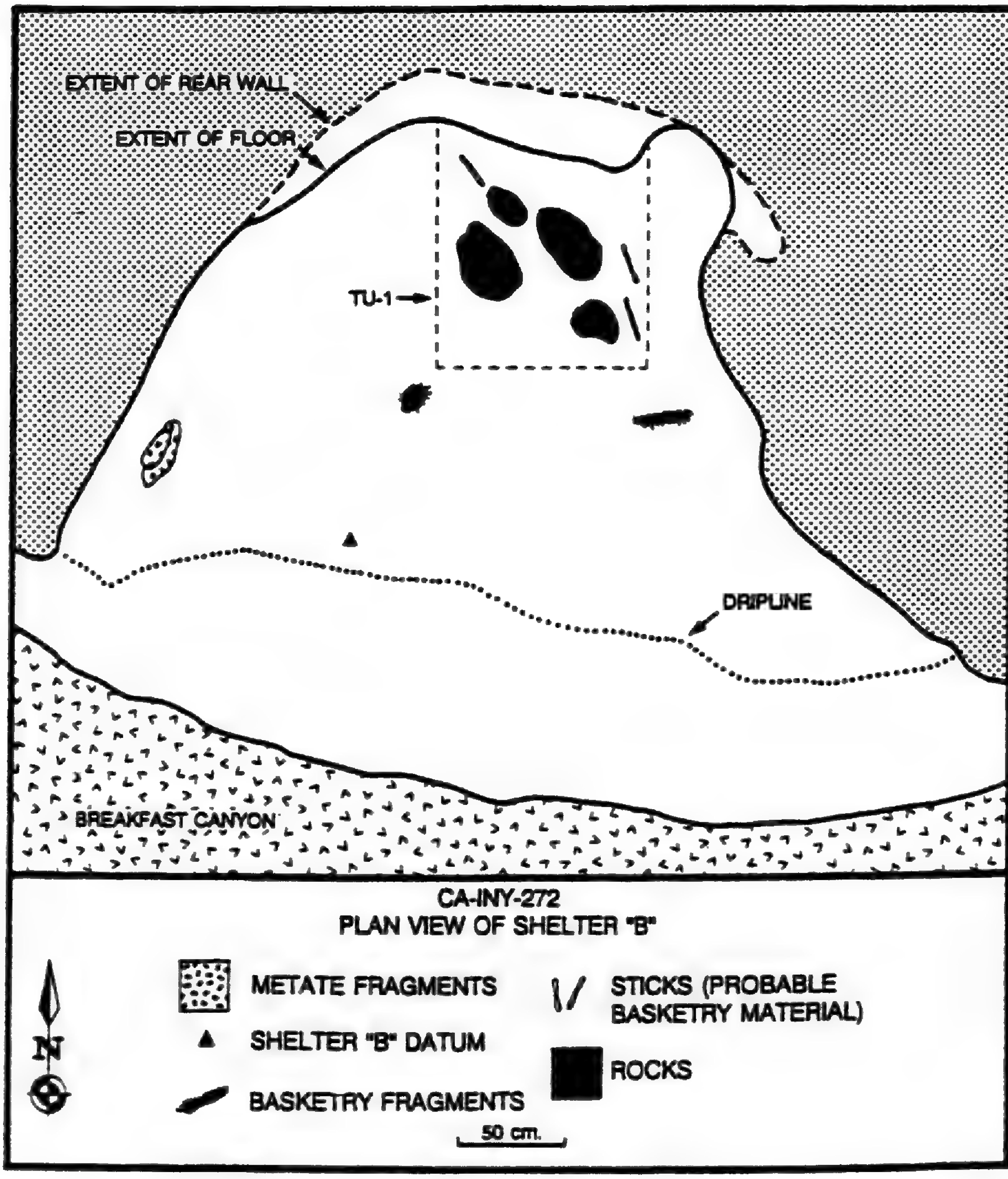

FIGURE 3. —Map of Shelter B showing the location of the one excavation unit (TU-1) where the historic cache pit was discovered (Feature 2)

cultural deposit collapsed. Shelter B, 26 m east of Shelter A, is much smaller, measuring 4 m in width and 2.5 m in depth (Figure 3). Two metate fragments and basketry were evident on the floor of the interior of this shelter prior to excavation.

Feature 1, the partially exposed storage pit in Shelter A, was further delineated through the excavation of a 2 x 1 m test unit (TU-3). The fully exposed feature was roughly circular and approximately 1 m in diameter and 70 cm in depth. Based on the discovery of an upper and lower component to the feature, it appeared that there were two distinct episodes in the use of the pit. This was later confirmed by radiocarbon analysis of floral materials (*Scirpus* sp. fragments) from each component. The upper component provided a "modern" ^{14}C date of 100 ± 70 B.P.

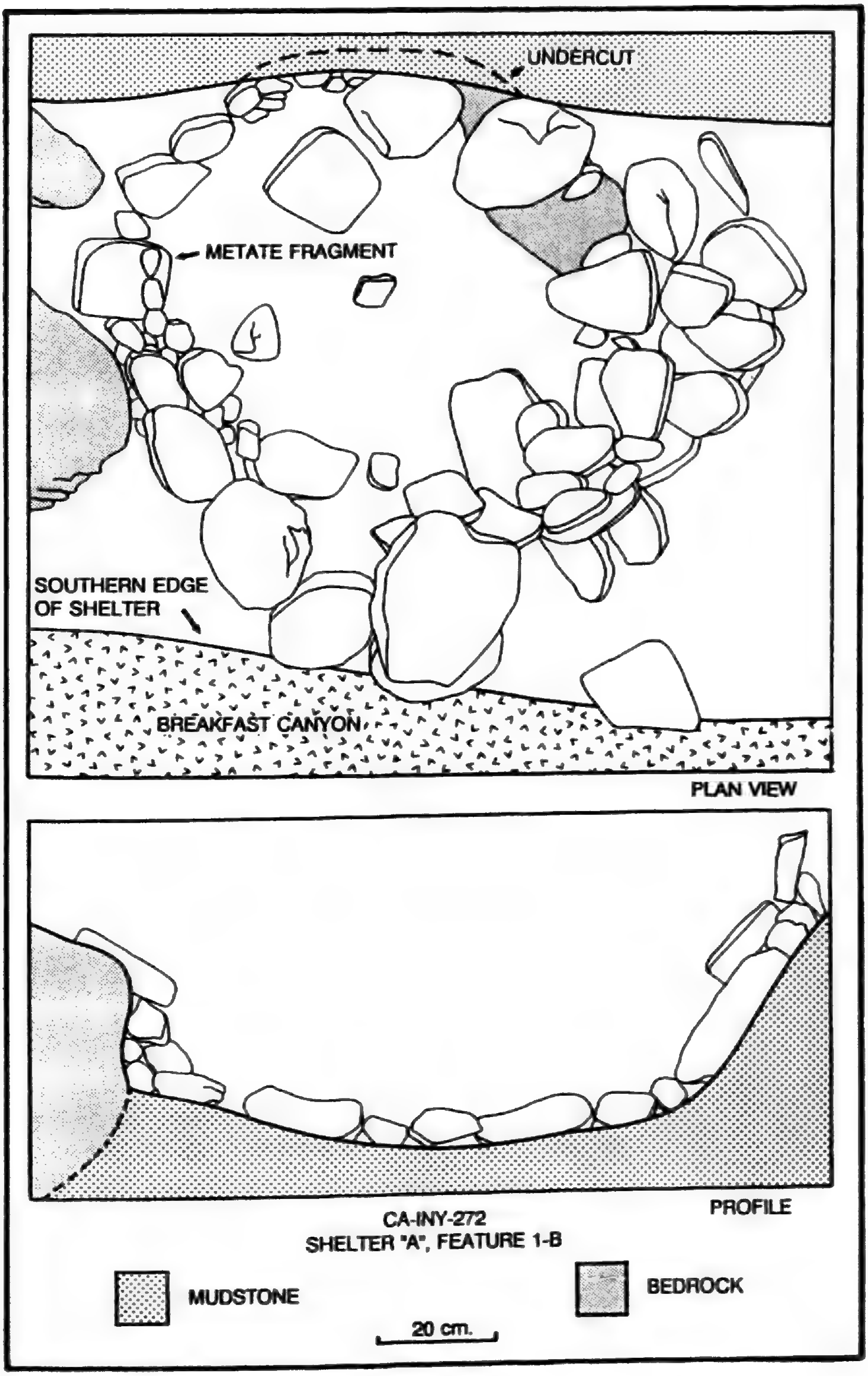

FIGURE 4. —Storage pit (Feature 1, lower component) from TU-3, Shelter A, CA-Iny-272

FIGURE 5. —Upper component of Feature 1, Shelter A (Photo by S. Valdez)

(Beta-54375), while the lower component dated to 340 ± 60 B.P. (Beta-54376).[1] Both components contained perishable artifacts and seeds, but only one domesticate, a squash/pumpkin (*Cucurbita* sp.) seed recovered from the upper component of Feature 1. The upper component of Feature 1 also contained two human coprolites, one of which contained piñon nut hulls and the other mesquite seeds, but neither contained identifiable cultigens. The earliest component of the storage pit was rock-and-clay lined (Figure 4), while the latest component was only grass-lined (Figure 5).

Feature 2, the storage pit in Shelter B, was demarcated on the surface of the rockshelter floor by several large rocks that suggested a deflated or partially removed cairn. A 1 x 1 m excavation unit (TU-1) bisected the storage pit which appeared to be slightly oval and estimated to be 1.5 x 1 m (Figure 6). Unlike Feature 1, there appears to have been only one episode of use of this pit. This feature contained numerous historic artifacts, including machine-made cotton cloth, cotton string, paper, a "silver" tablespoon, and a sardine can lid/base. Based on the age of the spoon (ca. 1891) and the sardine can fragment (post-1870), the feature appears to date to the late nineteenth/early twentieth century. The presence of an Old World date palm (*Phoenix dactylifera*) fruit seed from within the feature may suggest an even later date, given that fruit-producing date palms did not flourish in Death Valley until 1926 or 1927 (Gower 1970). This feature contained the greatest diversity of floral materials, including mesquite, piñon, cactus fruit, and various seeds from domesticated plants. The diversity of artifacts from within this storage feature was equally great. The inventory of cultural objects includes twined and coiled basketry, tule mats, a moccasin fragment, a bone chuckwalla hook barb,

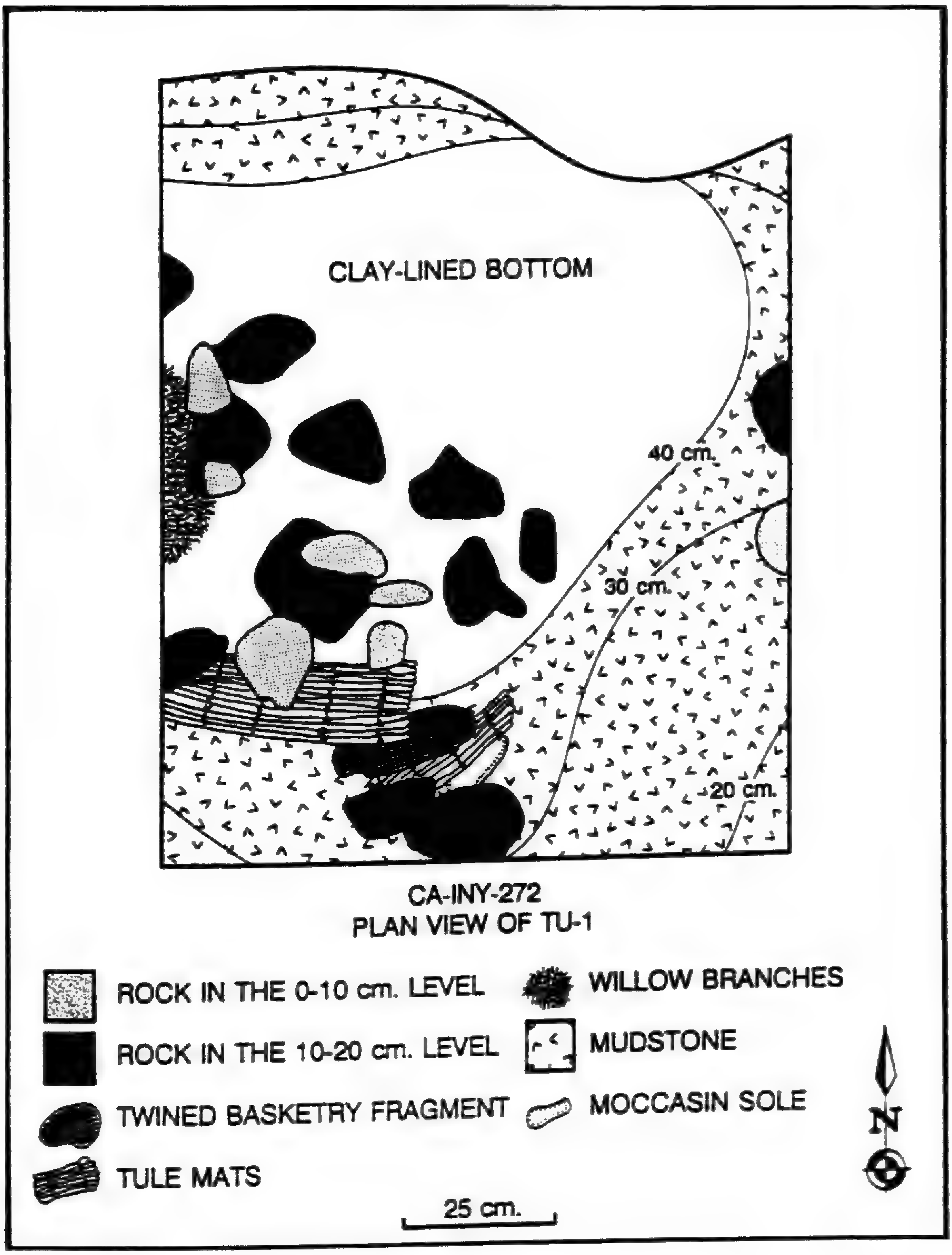

FIGURE 6. —Plan view of storage feature (Feature 2) from Shelter B, CA-Iny-272

and a Cottonwood Triangular projectile point with adhering mastic. A more complete description of the Breakfast Canyon site and artifacts can be found in Yohe and Valdez (1996).

FLORAL REMAINS

A large percentage of the contents of the storage features at CA-Iny-272 consisted of plant materials, much of which is believed to have functioned as padding or lining of the storage features. These specimens were mostly in the form of fragments of wood, stems, and bark. Seeds and a small number of dried fruits comprised the remainder of the plant remains.

Table 1.—Identification of plant remains from CA-Iny-272

Shelter	*Taxon*	*Part*	*NISP*[1]
A, B	*Atriplex* sp.	wood	4
A, B	*Salix* sp.	wood	3
A, B	Asteraceae	wood	2
A, B	*Pluchea sericea*	wood	5
B	Monocot	stem	1
A, B	Cyperaceae, *Scirpus*-type	stems	84
A	Cyperaceae	stems	18
B	Poaceae (cf. *Phragmites*)	stems	6
B	Poaceae (Panicoid)	stem	1
B	Poaceae (Festucoid)	stems	—
B	Fabaceae	bark	73
B	cf. Liliaceae (*Yucca*?)	stem	1
B	*Opuntia* sp.	pad	3
B	Cactaceae	fruit	29

[1] Number of identified specimens

Woody materials and grasses.—A sample of floral material consisting of sorted plant fragments (n = 221) from both Features 1 and 2 was sent to PaleoResearch Laboratories in Denver, Colorado, for specific taxonomic identification through both microscopic morphological examination and analysis of phytoliths (Table 1). Common woody materials of the Shelter A feature (TU-3) include wood from saltbush (*Atriplex* sp.), arrowweed (*Pluchea sericea* [Nutt.] Colville), and willow (*Salix* sp.). The non-wood constituent of the pit lining was identified as a *Scirpus*-type sedge, as well as two other members of the Cyperaceae (Puseman and Scott-Cummings 1996).

Shelter B (TU-1) contained wood from *Atriplex*, possible arrowweed (*Pluchea sericea*), willow (*Salix* sp.), and a member of the Compositae (Asteraceae) family. Also identified were grass (Poaceae) stems with festucoid phytoliths, *Scirpus*-type stems, *Phragmites* sp. (reedgrass) stems, bean plant (Fabaceae) stems, and a possible Liliaceae (yucca?) stem. The presence of the legume stem is consistent with the presence of two tepary beans (*Phaseolus acutifolius* Gray) found within the storage feature.

All the plant materials incorporated into the features from both Shelters A and B would have been available either in the immediate vicinity of the shelters or at nearby springs, with the exception of the one possible yucca specimen. No member of the Liliaceae is indigenous to or currently found in Death Valley (Norris n.d.), but this family is commonplace (especially species of *Yucca*) in the Mojave Desert both south and west of the valley. Bulrush (*Scirpus olneyi* Gray) and willow (*Salix* sp.) probably would have been available at either nearby Travertine Springs or at the base of Furnace Creek Wash (the present location of Furnace Creek Ranch).

Seeds of domesticates.—A variety of cultigen remains were recovered from the Breakfast Canyon Shelters, all but one specimen coming from Feature 2 in Shelter B (Table 2). The most common domesticates were squashes and melons (*Cucurbita* spp., *Citrullus vulgaris* Schrad., *Cucumis* sp., all of which are non-local), especially citron melon (*Citrullus vulgaris* var. *citroides* Bailey). One specimen of *Cucumis* was found in Feature 2, but it is not possible, based on seed characteristics alone, to differentiate between cantaloupe (*Cucumis melo* L.) and cucumber (*C. sativa*). Given the fact that cantaloupe ("musk melons") are known to have been cultivated by the Timbisha Shoshoni of Death Valley in historic times, it is likely that the seeds represent this plant. Four cucurbit seeds from Feature 2 could be either squash or pumpkin of three species (*Cucurbita maxima* Duch., *C. pepo* L., and *C. moschata*). Two other domesticates identified were tepary bean (*Phaseolus acutifolius*) and sorghum (*Sorghum bicolor* [L.] Moench.), the latter having been introduced from the Old World. The only domesticate found in Shelter A was a *Cucurbita* seed found in the upper component of Feature 1.

Table 2.—Seeds identified from Shelter B, CA-Iny-272

Common Name	Taxon	NISP[1]	Reported Use[2]
watermelon	*Cituillus vulgaris*	3	food
citron	*C. vulgaris* var. *citroides*	3	food
squash	*Cucurbita* sp.	4	food
cantaloupe?	*Cucumis* sp.	1	food
tepary bean	*Phaseolus acutifolius*	2	food
sorghum	*Sorghum bicolor*	1	food
date	*Phoenix dactylifera*	1	food
beaked spike rush	*Eleocharis rostellata*	1	none
phacelia	*Phacelia* spp.	3	medicinal
golden carpet	*Gilmania luteola*	1	none
blazing star	*Mentzelia* sp.	1	food
American tule	*Scirpus* sp.	1	food, utilitarian
rigid spine flower	*Chorizanthe rigida*	1	none

[1] Number of identified specimens
[2] Based on Fowler (1986), Irwin (1980), Steward (1941), and Zigmond (1981)

As discussed above, a seed from an Old World date palm was recovered from Feature 2 in Shelter B. Date palms are presently abundant at Furnace Creek Ranch, but little information is available about when the first palms were brought to Death Valley. Date palms were first introduced to Furnace Creek in 1921. The first fruit-producing Deglet Noor date trees were brought to the valley between 1924 and 1925. Gower (1970:141) stated that these trees produced fruit within one or two years. If the date pit from Shelter B was obtained in one of the Furnace Creek groves, then the minimum date for use of this shelter would be 1926 or 1927. It is also possible that dates were brought into Death Valley in earlier years as a dried commodity for the workers at the Harmony Borax Works or the occupants of Furnace Creek Ranch after the closure of the borax plant.

Seeds of native plants.—Mesquite (*Prosopis glandulosa*) was the most common seed recovered from either of the two storage features (Table 3). Pods were less common than seeds, perhaps the result of differential preservation in favor of the harder seeds. There was also evidence of bruchid beetle infestation, a small beetle that frequently inhabits mesquite fruits (Kingslover *et al.* 1977). Mesquite was of particular importance to the Shoshone of Death Valley (Timbisha) as well as the Panamint Shoshone (Fowler 1995). Other archaeological evidence for storage of mesquite in either storage features or rock shelters in Death Valley was reported by Hunt (1960).

Table 3.—Vertical distribution of mesquite and piñon remains[1] by weight

Level (cm)	*Mesquite (gm)*	*Piñon (gm)*		
	feature 1	*feature 2*	*feature 1*	*feature 2*
0 - 10	8.33	2.41	15.30	0.34
10 - 20	12.07		8.25	—
20 - 30	4.59	4.89[2]	1.93	—
30 - 40	4.88	4.07	0.44	0.95
40 - 73	13.22	—	0.17	—
TOTALS	43.29	11.37	26.09	1.29

[1] Refers to whole seeds, hulls, and/or pods
[2] For 10-30 cm interval

Piñon nuts were the second most commonly recovered seed type from both storage features. The hulls of piñon nuts were most frequent in the upper half of Feature 1 and least frequent in Feature 2 (Table 3). Piñon nuts were also a very important food resource for local populations (as well as in the Great Basin as a whole [see Fowler 1986]) and would have been available for harvest in the late summer/early fall months. The smaller numbers of pine nuts in Feature 2 is interesting in light of the abundant cultigen specimens recovered from the same feature. This may be the result of a sampling error or may be indicative of a behavioral shift to less dependence on piñon resulting from the adoption of horticultural practices.

Other seeds of aboriginal economic importance from the features include blazing star (*Mentzelia* sp.) and phacelia (*Phacelia* sp.), both of which occur in small numbers. The Kawaiisu ground the seeds of *Mentzelia* into a peanut butter-like paste (Zigmond 1981). The Koso Shoshone collected mentzelia stalks which were placed on large flat rocks and stomped to separate the seeds for easy collection (Irwin 1980).

HORTICULTURE IN DEATH VALLEY

According to Steward (1938), wild seeds were not planted nor tended by the Panamint Shoshoni, but cultigens were introduced to the area in the 1870s, and became increasingly important by the 1890s. As described by Steward (1938:89):

> The plants and pattern of cultivation seems to have been borrowed almost completely from neighboring Southern Paiute. Few Death Valley people had farms.... Before shovels were introduced, plain digging sticks were used for planting. Each species or variety was planted in a different row. Work, including irrigation, was performed by both sexes. Because of short winters, crops were planted in February and harvested in July.... Plots were family owned. This conformed to the principle of use ownership and con-

flicted with no native patterns. Plants, even those ready for harvest, were usually destroyed at the owner's death, as among Ash Meadows Southern Paiute, and the field lay fallow for a year or two, when any relative resumed cultivation.

Wallace (1980) has suggested that horticulture may have entered Death Valley earlier than the 1870s, being introduced to the Panamint Shoshoni by Mojave Indians as early as the 1840s. Wallace (1980) notes that a Furnace Creek informant of Driver (1937) stated that his grandfather visited the Colorado River Valley and returned with seeds of several domesticates. A Colorado River Valley connection is further supported by the similarity between the Mohave word for muskmelon (***kamito***) and the term used by the Death Valley Shoshoni (***kamitu***) (Wallace 1980).

Irrespective of the exact timing, it is clear that the adoption of horticultural techniques during the 19th century added variety to the diets of the people of Death Valley. Domesticated plants reported to have been cultivated by the Shoshoni include: corn, squashes, pumpkins, two types of beans, muskmelons (cantaloupe), watermelons, wheat, sunflowers, tomatoes, potatoes, grapes, and peaches (Nelson 1891; Coville 1892; Steward 1938, 1941). The greatest diversity of domesticates are reported to have been produced by small garden plots in Grapevine Canyon in northern Death Valley (Steward 1941). However, a Furnace Creek village informant remembered planting only corn, beans, and pumpkins (Driver 1937:65). Since watermelon, squash, beans, and muskmelon are all represented within Feature 2 at Breakfast Canyon, the variety of domesticated plants raised at Furnace Creek may have been greater than recalled by Driver's informant.

The occurrence of sorghum (also known as broom millet) in Feature 2 was unexpected as it is not usually considered among the major European-introduced cultigens in post-contact North America. Of the nearly 20 species of the genus *Sorghum*, only one is a native to the New World (Gould 1981). There is no clear record of cultivation of this grass by Native Americans in western North America with the exception of the Tarahumara Indians of northern Mexico, whose use of "millet" was very limited (Pennington 1983). The rare occurrence of sorghum at Breakfast Canyon may indicate experimentation with this grain rather than common use. Its presence does, however, underscore the presence of a wide range of cultigens available to and cultivated by the native peoples of Death Valley.

The location and types of gardens in Death Valley have been explicated to some degree in the ethnographic record. Established gardens were reported by the latter part of the 19th century at several localities in Death Valley in addition to Furnace Creek and Grapevine Canyon. These include Warm Springs, Saratoga Springs, and Hungry Bill's Ranch (Fowler 1995). Ditch irrigation was used with these plots which could reach an acre in size. For a more comprehensive discussion of Death Valley horticulture, see Wallace (1980) and Fowler (1995).

DISCUSSION

Archaeological storage features are fairly common to rockshelters in the region surrounding Death Valley (Clewlow, Wallmann, and Clewlow 1995; Hildebrand 1972; McCown 1964; Meighan 1953), and several possess characteristics similar to those noted at CA-Iny-272.[2] At Coville Rockshelter, between Saline and Death Valleys, Meighan (1953) recorded six storage features, both grass- and slab-lined. Floral remains recovered from the rockshelter include piñon, desert peach (*Prunus andersonii* Gray), buckwheat (*Eriogonum* sp.), cactus (*Opuntia* sp.), and yucca (*Yucca* sp.). McCown (1964) reports on the discovery and excavation of storage features that contained fragments of newpapers dating to the 1870s in lava blisters approximately three miles south of Little Lake in Rose Valley. One storage feature in "Lava Cave 1" contained piñon nuts and acorns (*Quercus* sp.). Hildebrand (1972) reports on the excavation of four rock-lined cache pits at Chapman Shelter 1 in the Coso Range, where piñon (*Pinus* sp.) hulls were found in two of the pits. Resurrection Shelter (CA-Iny-2844), originally recorded by the author in 1985, produced a remarkable rock-lined storage pit during excavations by Clewlow, Wallmann, and Clewlow (1995). This feature was very similar to Feature 1 at Breakfast Canyon in terms of its size, construction, and artifact assemblage. A paleobotanical analysis by Gummerman and Klug (1995) from this feature included the identification of blazing star (*Mentzelia* sp.), sage (*Salvia* sp.), wolfberry (*Lycium cooperi* Gray), mormon tea (*Ephedra* sp.), needlegrass (*Stipa* sp.), and Indian rice grass (*Oryzopsis hymenoides* [R. & S.] Ricker).

Several of the native species of economic value noted above, with the exception of mesquite,[3] were also encountered in small numbers at CA-Iny-272. *Mentzelia* also has been recovered from archaeological deposits in open air sites in Coso Mountains, Rose Valley, and Owens Valley (Bettinger 1989; Gummerman and Klug 1995).[4] Cultigens, however, have proved to be far rarer in occurrence. McCown (1964) reports discovering a "small corn cob" in a storage pit within a lava blister just south of Rose Valley, approximately 110 km west of Death Valley.[5] In 1955, William Wallace recovered a corn meal sack, a sown pocket from a man's coat, and two coffee cans full of seeds cached in a rock crevice in Butte Valley, an offshoot of southern Death Valley (approximately 80 km south of Breakfast Canyon). The coffee tins and cloth packets contained seeds of cantaloupe, squashes (*Cucurbita mixta* Pang., *C. maxima*, and *C. pepo*), citron, and the native tansy mustard (*Descurania pinnata* [Walt.]) (W. Wallace, personal communication, 1995). Also found with this material were five small ears of maize identified as belonging to the "Mais Blando race of northern Mexico" or "the Pima-Papago race" (W. Wallace, personal communication, 1995 [*per* H. C. Cutler]). Several kernels of maize also found in the cache were described as a late prehistoric corn common to the Southwest after A.D. 1100 (W. Wallace, personal communication, 1995).

The location of the Breakfast Canyon storage features and their contents may have both significant land-use and seasonal implications. All of the seeds known to have been stored in the features are late summer/early fall resources. Most probably are from areas west of the shelters. The closest large groves of piñon pine trees are currently 16-25 km west of the site in the Panamint Range. Honey mesquite trees are found today within one mile west of the site. Evidence of storage of these resources on the eastern side of the valley suggests that this area may have been a focal point of subsistence activities (i.e., use of stored foods) during the lean winter months, an hypothesis supported by the local ethnographic data.

Steward (1938) reported a small winter village at Furnace Creek (*Tümbica*) prior to the founding of the borax works in the 1880s. Following the establishment of Furnace Creek Ranch, Shoshoni from other areas wintered near the resort and moved to other areas during the summer (Steward 1938:92). Steward further noted that most subsistence activities were focused in the Panamint Range, with summer camps located at Wildrose Spring, Blackwater Spring, and the head of Death Valley Canyon. It is probable that prior to the Euroamerican appearance in the valley, summer (seed gathering) and fall (piñon) camps were in the Panamints, perhaps with brief summer excursions to Furnace Creek to collect mesquite pods.[6] Some mesquite may have been cached in some of the closest rockshelters to the Furnace Creek groves, which would have included CA-Iny-272. Piñon nuts would have also been added to the storage features as people moved from piñon camps in the late fall to the winter village at Furnace Creek. With the appearance of horticulture in the region in the mid- to late-nineteenth century, seeds from the fall harvest of domesticated plants may have been stored with the cached foods (as seen in Shelter B) for the following year's planting. Driver (1937:65) noted that at Furnace Creek, Timbisha Shoshoni would store surplus corn, wheat, and squash in pits, but would also save seeds for planting the following year. The nature of the cultigen remains from Breakfast Canyon, consisting predominantly of seeds rather than dried fruit flesh, would suggest seed storage rather than the caching of the domesticates as foodstuffs.

The rockshelters in Breakfast Canyon have yielded the first detailed archaeological data confirming the ethnographic/ethnohistoric record of aboriginal cultigen production in Death Valley. These data tend to support the notion that horticulture was introduced in the later half of the nineteenth century. Horticulture may have diffused from both the east and the south, coming to the Shoshoni in Death Valley from the Southern Paiute in southwestern Nevada and perhaps the Mohave from the Colorado River area. Although there is some suggestion that the Owens Valley Paiute practiced incipient agriculture using two indigenous crops (yellow grass nut [*Cyperus esculentus* L.] and wild-hyacinth [*Dichelostemma pulchella* Salisb.]) (Lawton *et al.* 1976), there is no indication from the ethnographic record or historical accounts that introduced cultigens were planted and harvested by these people. In Death Valley, seeds from the late summer/early fall harvest appear to have been stored with traditional food items (piñon, mesquite pods) for use the following year. As noted by Fowler (1995), the addition of garden horticulture to the typical Mojavean foraging strategy produced a subsistence system that would benefit it practitioners during those periods when traditional resources may have been in short supply. It also would have served to add markedly to the variety of foods items available to the Timbisha.

Much remains to be learned about the exact timing of the horticultural incursion into Death Valley. It is hoped that future archaeological investigators will develop research strategies that will focus on this important issue, since the answers to many questions are likely to exist in one or several of the countless rockshelters and caves that populate the numerous canyons in the ranges that encompass Death Valley.

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NOTES

[1]The actual, unadjusted dates for these samples is 10±70 (Beta-54375) and 180±60 (Beta-54376). The dates in the text have been adjusted for $^{13}C/^{12}C$, but because of recent variations in atmospheric ^{14}C known as the post-Sixteenth century de Vries effects, the assignment of a calendar date can be problematic (see Taylor 1987:35-38). The calibrated age range for the 340±60 rcy BP date is A.D. 1440-1665. The "modern" sample (Beta-54375), however, is calibrated to (at 2 sigma) A.D. 1690-1735, or 1815-1925 (D. Hood, personal communication, 1997). Most importantly for the issues discussed in this paper, the upper sample (based on these two individual measurements) dates to a later time than the lower component of the storage feature.

[2]For a comprehensive discussion of rock-lined storage features in the Great Basin and Southwest, see Wilke and McDonald 1989.

[3]Mesquite remains, especially from caches, have been uncommonly recovered from archaeological sites in the Mojave Desert and surrounding areas. Hunt (1960) reports a mesquite cache in two separate storage features in Death Valley, one near Bennett Wells, the other between Tule Springs and Shorty's Well. At China Ranch south of Death Valley a small, mud-lined pit in Robinson Cave (CA-Iny-982) contained both honey and screwbean mesquite (*Prosopis glandulosa* and *P. pubescens*) (Schroth 1987). Chuckwalla Cave in the Moapa Valley of Nevada also yielded caches of both mesquite species from rock crevices (Shutler 1961). Further south, in the Mecca Hills of the Salton Basin of California, Swenson (1984) describes a cache of *P. glandulosa* from an *olla* discovered in a crevice.

[4]Other indigenous floral species of aboriginal economic significance noted in the above storage features have been recovered from several open air sites in this region. An interesting exception is the fairly common occurrence of seeds of the tansy mustard (*Descurania pinnata* [Walt.]) (Gummerman and Klug 1995) in flotation samples from sites in the Coso region west of Death Valley.

[5]Also found in this storage feature were grain sacks containing "four oat seeds and three barley kernels" (McCown 1964:6). It is assumed that these grains were not intentionally

stored in the features, but were mere remnants inadvertently left in the bottom of the grain sacks stored here. Approximatley 20 grain sacks were recovered from this storage pit, along with numerous pieces of Euroamerican textiles.

[6]According to Fowler (1995), the Timbisha Shoshone of Death Valley also used mesquite earlier in the season, beginning in spring when the pods were green and flat. The pods were roasted over hot stones in a pit. The final product of this process was tart and not enjoyed by everyone (Fowler 1995:102).

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NEWS AND COMMENTS

NANCY TURNER NAMED RECIPIENT OF 1997 SCHULTES AWARD

ST. LOUIS AND WASHINGTON, D.C., JUNE 5, 1997

Professor Nancy J. Turner of the School of Environmental Studies at the University of Victoria, B.C., is the recipient of the 1997 Richard Evans Schultes Award, presented annually by The Healing Forest Conservancy. The award recognized the scientist, practitioner, or organization that has made an outstanding contribution to ethnobotany or to indigenous peoples issues related to ethnobotany. Specific recognition is given Dr. Turner for her leadership in partnering with First Nations peoples to bring ethnobotanical knowledge to the forefront in discussions on management of the ancient, temperate forests of the Pacific Northwest with the government of Canada. Turner's impressive scholarly corpus includes almost 30 books, monographs, or chapters. She has inspired many devoted students to enter the field of ethnobotany. The award honors the name of Richard Evans Schultes, the Harvard ethnobotanist widely recognized as one of the most distinguished figures in the field. The International Nominating Committee for the award is chaired by Michael J. Balick, Philecology Curator of Economic Botany and Director of the New York Botanical Garden's Institute of Economic Botany. Each Schultes Award features a $5000 cash prize donated by Shaman Pharmaceuticals, Inc. and The Leland Fikes Foundation. Nominations for the 1998 Richard Evans Schultes Award are open until May 1, 1998. Submit nominations to Katy Moran, Director, The Healing Forest Conservancy, 3521 S Street, N.W., Washington, D.C. 20007 (moranhfc@aol.com).

NORTH AMERICAN INDIGENOUS WOMAN TO RECEIVE CONSERVATION AWARD

SALT LAKE CITY
SEPTEMBER 10, 1997

Mary Thomas, Elder of the Secwepemc (Shuswap Interior Salish) Nation of central British Columbia, Canada has been named as the Indigenous Conservationist of the Year 1997 by the Seacology Foundation. The award ceremony was held Monday, September 22, 1997 at Sundance.

"Mary has devoted her life to the conservation and perpetuation both of her own indigenous culture and language and of the lands and waters of her traditional homeland," states Dr. Nancy Turner of the University of Victoria, B.C. She has received local recognition and many community awards for her work as an educator, elder, medicine and plant specialist, conservationist, and authority on the Secwepemc culture and language. In 1992 she founded the Salmon River Watershed Coalition as a means to provide community support and action to monitor and restore the Salmon River, one of the major salmon spawning rivers of the British Columbia interior.

Mary Thomas was born in Salmon Arm, British Columbia. As a young child, she attended the Kamloops Indian Residential School, which was an unhappy experience for her and one she does not like to remember. Much happier memories for her were the times she spent with her grandmothers, aunts, and parents, together with her brother and sisters, traveling up into the mountains, digging wild root vegetables, picking berries, harvesting Indian-hemp for cordage making, and learning all of the cultural traditions and environmental and conservation knowledge of her people.

> "This place brings back memories. When you're a little girl, and families were still intact and still practiced a lot of the natural way—our people survived many, many years. And this place reminds me of when I was a little girl and we used to come up here. Children were brought up to be so close to Mother Nature, to appreciate it, what you're seeing here now. I can remember as a little girl running, hopping, skipping, jumping through all these beautiful flowers—I think that's one of the happy memories I have. And we did take part in the gathering of food. When the food, especially the potatoes—that was one of the diets through the winter, and they had to collect a lot of that. What they did was they collected the avalanche lily [*Erythronium grandiflorum*] and spring beauty [*Claytonia lanceolata*], ***scwicw*** and ***sqwaqwinna***, down in the bottom. When that was completely finished then our people came up to the plateau. They hunted up here. They picked huckleberries. They gathered more avalanche lilies and spring beauties, and those were brought down to the valley and stored for the winter. And not only that—you can tell the difference in the air. The children were taught to respect Mother Nature and to appreciate it, and when you breathe in this cool air and you can imagine yourself sleeping out here in open air—we just had a little lean-to, and you're breathing in this beautiful mountain air. And when you're breathing, even now you can smell the air has that ***melanllp*** [subalpine fir, *Abies lasiocarpa*] smell, from the beautiful boughs, the trees. And every time you smell that beautiful smell of Mother Nature's creation, you appreciate it, you love it, you're a part of it—you become a part of it. So I think those are the happy memories I can really appreciate today, because we very seldom come to these areas where there's a lot of beautiful flowers yet. Hopefully we can preserve and maintain this for the generations to come."

The Seacology Foundation, based in Springville, Utah, seeks to preserve Earth's ecosystems and cultures. The Seacology Indigenous Conservationist of the Year award is funded annually by Seacology President Ken Murdock, founder of Nature's Way Products, Inc., a natural pharmaceutical manufacturer in Springville, Utah. Mary Thomas is the sixth recipient of the annual award.

Thanks to Nancy J. Turner for the background information.

SOCIETY OF ETHNOBIOLOGY ANNUAL MEETING

UNIVERSITY OF NEVADA, RENO
APRIL 15-19, 1998

This year's conference is sponsored by the Department of Anthropology and the Historic Preservation Program, University of Nevada, Reno, and the Quaternary Sciences Center, Desert Research Institute.

This year's conference theme is: **Seeking and Saving Common Ground: Interfacing Ethnobiology and Conservation Biology**. Sessions are scheduled for Thursday, April 16 and Friday, April 17, with field trips Saturday, April 18 to the Carson Sink, Hidden Cave, and Stillwater Marsh and to Pyramid and Winnemucca Lakes.

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DENNIS MICHAEL WARREN

Mike Warren died suddenly at his home in Ara, Nigeria December 28, 1997. Dr. Warren was well known and highly regarded for his dedication in defense of indigenous knowledge systems and the communities that sustain them. Dr. Warren studied at Stanford University, then received his Ph.D. from Indiana University in 1974. After a stint as a Peace Corps Volunteer in West Africa, he adopted Nigeria as his home. He helped found the Center for Indigenous Knowledge and Agriculture and Rural Development (CIKARD) and at the time of his death served as professor of anthropology at Iowa State University.

A memorial service and celebration of the life of Dennis Michael Warren will be held Sunday, March 8 at Iowa State University. A memorial fund has been established to honor Mike's commitment to introducing students to West Africa and to the study of indigenous knowledge. Department of Anthropology, 319 Curtiss Hall, Iowa State University, Ames, IA 50011-1050. For further details, contact Norma H. Wolff, Department of Anthropology, 319 Curtiss Hall, Iowa State University, Ames, IA 50011-1050 or email nhwolff@iastate.edu.

BOOK REVIEWS

Ethnoveterinary Research and Development. C.M McCorkle, E. Mathias, and T. W. Schillhorn van Veen (editors). Southampton Row, London: Intermediate Technology Publications. Pp. vi; 338 (including 24 tables, 14 illustrations, 1 appendix and 14 pages of index). £17.95. ISBN 1-85339-326-6 (paperback).

General contents.—Ethnoveterinary Research and Development tackles the difficult task of describing a program that synthesizes indigenous and Western veterinary techniques. As eloquently stated in the introduction of this text, "...policies that refuse recognition to or are overly controlling of localized and privatized practitioners who can deliver alternative or techno-blended treatments and husbandry strategies will deprive the very public who most require such services" (p. 21). It seems sensible to adopt some of the wisdom and experience of local practitioners who have successfully raised and cared for their animals. Moreover, cultural sensitivity may facilitate cooperation from local policy makers. Natives from developing countries may choose to interact with scientists who are realistically aware of their socioeconomic and agro-ecological environment. Some chapters (e.g., chapters 3 and 11) helped the readers to realize the psychological and economical demands that are placed on natives who wish to make the transition from traditional to modern technology and the need to develop a plan that will allow them to do so. Chapter 3 described how Western veterinary knowledge caused conflict between the generations (youth and elders) and their respective world views, while chapter 11 noted how the high cost of drugs and services have forced Samburu pastoralists (who are now seeking wage labor) to rely on borrowed and inexperienced women, boys and girls for some of their responsibilities. These chapters provide a compelling vision of modern, non-Western animal health care. The reader is left to consider the potential benefits of the influence of Western knowledge, methods and equipment (to man and beast alike).

Other chapters (e.g., chapters 6, 7, and 10) are largely anecdotal, admittedly difficult to substantiate, and unlikely to have modern application. Nonetheless, they provide interesting historical information. In Chapter 6, the prayers, chants and "secret restorative roots" of Native Americans are not of use to the modern health care provider if the details are lacking. Also, one needs to ask whether Native Americans' commitment to horses will allow them to collaborate with Western veterinarians or must this knowledge be maintained as a cultural secret. In Chapter 7, medicinal bouquets used by French shepherds (the data presented appear quite dated) reference a 1989 survey not yet completed. Is the reader to assume that the work is still not done? In Chapter 10, on traditional castration of bulls in Ethiopia, one wonders whether Maskal-day celebrations would seem less meaningful to Ethiopians if they used Burdizzo pincers to castrate the bulls?

Chapters such as 12, 13, and 15 show how people in many cultures are constantly seeking ways to prevent disease in their animals. This is good because disease prevention is an often overlooked and under-utilized technique for the natural promotion of animal health. Chapter 12 contains a unique reference to animal training for disease prevention in North Africa and India (p. 129). Chapters 13 and 15 emphasize beliefs people have about the spiritual and natural causes of illness as well as the different types of health care strategies employed. It seems true that while technological practitioners employ sophisticated methods to improve on animal health care and production, some village-level poultry farmers yield very good results while requiring very little technological investment.

Several chapters (e.g., Chapters 5, 14, and 16) not only cited the spiritual and emotional conditions linked to various animal diseases, but also outlined several types of traditional treatments or remedies. However, we question the utility of describing treatments with no evidence of contemporary clinical validity. Chapter 14 is filled with prescriptions (recipes) for traditional therapies in which validations of (or speculation about) effectiveness are lacking. Having attended the horrific death of a dog treated with "pennyroyal oil" as a holistic flea remedy has made one reviewer (WVB) shy from recommending any alternative therapy not validated in some way. For example, it is difficult to believe a 5 cm incision in the ear will aid in treating tympany, as described on p. 150, and it would be questionable, in my opinion, to recommend an osmotic laxative for diarrhea, to withhold colostrum to prevent parasite infestation, or to sprinkle black pepper into a sick animal's eyes for "some ailments" (pp. 150-152).

Highlights of the book.— Overall this book is a delightful overture to a still esoteric discipline. It provides a fascinating introduction and insight to "alternative, holistic, nontraditional therapies." The book provides a pan-global overview of facts, myths, and legends likely common knowledge in their respective circles but not widely disseminated. The subject matter certainly increases the level of awareness of "big picture" management of animal (perhaps including human) health and welfare—a must as we move into the 21st century with its increasing demands on our shared but limited global resources.

The authors of this book discuss various veterinary issues encountered in different cultures. They unequivocally point out the importance of "techno-blending" to address health management issues. As an example, the description in chapter 3 (p. 41) of the curious Nilotic ritual of distributing the spinal cord of bulls during ritual sacrifice is intriguing with the current knowledge of Bovine Spongiform Encephalopathy and lessons learned from the transmission of Ebola virus during ritualistic body preparation ceremonies.

The book provokes many questions about other factors a researcher may consider. How many interactions did the local people have with modern veterinarians throughout each study? Did they chose traditional veterinarian services out of preference, lack of confidence in modern treatments, lack of information about modern treatments, fear of reprisal from traditional healers, or inaccessibility to modern programs?

Critique.—Unfortunately, the way the book is written limits its accessibility to people who have the time and energy to wade through its uneven style and content. This book would appeal to a wider audience if the chapters were presented in a more clear, concise, and standardized manner. The continuity could have been improved dramatically if the editors had exercise more active control over the writing style. The inclusion of notes in the chapter titles is a further distraction to the reader. Many of these would be more appropriately included in the text.

Photographs and illustrations are lacking. Additional photographs would help to visualize the complexities of a given situation and enhance the reader's appreciation of the conditions and environments described in the text. Some authors did a better job of providing both the indigenous name and Western name for given ailment and treatment. This information could have been standardized in a table in each chapter. Each author could have provided a paragraph about their professional affiliation, when and why they did their research, and so forth.

Most importantly, the rationale for the book's organization is not readily apparent. Parts I and II both appear to be case study reports. Why were they separated? Part III appears to deal with "materials and methods." However, it is not until chapter 19 that the reader finds specific methodologies for ethnoveterinary research and development. Are the methodologies presented in chapters 19 and 20 meant to suggest standard procedures for collecting data or to show different approaches to data collection. In our opinion, chapter 23 should have been chapter 1, as it is a poignant opening for the book.

Recommended Audience.—Although the organization of the book is weak, it provide a great deal of information, and could be a valuable tool for health professionals. As a teaching tool, this compilation would be excellent to stimulate discussion of how people in non-technological societies have learned to care for the animals on which they depend for physical and psychological nourishment. There is fodder for a great deal of productive research awaiting the astute reader of this text. However, one important step that remains is to separate folk veterinary myth from effective folk veterinary practice. From the perspective of a culture psychologist, the question that came to mind most often was, "What cultural and scientific understanding do we need in order to incorporate effective traditional practices into contemporary veterinary training?" From a veterinary perspective, the question that came to mind most often was, "Does it work?" What evidence is there that these things described have cultural, psychological, or physical value to animal or human health?". We deeply appreciate the concept on which this book was predicated. The information provided, and in some cases, the information lacking here, will spur research that may systematically advance the state of ethnoveterinary knowledge and practice.

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Healing with Plants in the American and Mexican West. Margarita Artschwager Kay. Tucson: The University of Arizona Press, 1996. $19.95 (paperback), $50.00 (clothbound). Pp. xvii; 315. ISBN 0-8165-1646-4 (paperback), 0-8165-1645-6 (clothbound).

The general population, seemingly insatiable for information about herbal medicines and alternative health therapies, indiscriminately devours the many new publications on medicinal plants. Are readers looking for clues to send them on the journey of "self-healing" the "natural" way? The writers of many of these books seem well attuned to this large and vulnerable market, and quite prepared to exploit it. Refreshingly, this is not so for *Healing with Plants in the American and Mexican West*.

Margarita Kay's book is informative, thoughtfully written, and highly readable. She covers a wide range of traditional medicinal plants found in the western United States and western Mexico. Although a list of plants and their medicinal uses constitutes a significant portion of Kay's book, what sets this publication apart from its many competitors is the care devoted to contextualizing the significance of these plants for the peoples who use them. Kay combines ethnographic information with data from hundreds of personal interviews she conducted with people familiar with plant remedies. The ethnomedicinal information is presented as part of an exploration of the evolution of the Mexican American domestic pharmacopoeia. The result is an impressive assemblage of the historical and cultural information on plants of this region, combined with their medicinal applications.

Healing with Plants in the American and Mexican West is divided into two main parts, the first providing the historical, cultural, and botanical backgrounds and the second consisting of medicinal plant listings. Part 1 is divided into four chapters: 1) "Ethnohistory" sets a cultural and historical context for the significance of plants to cultures of this region; 2) "Plants, Their Names, and Their Actions" discusses the importance of plant names (both common and scientific), and provides a general overview of phytochemicals related to pharmacological action of the plants; 3) "Illnesses Treated With Plants" acknowledges the complexity inherent in "translating" disease perceptions from one culture to another and thus the importance of examining lay vocabularies for clues to cultural perceptions of and responses to disease. General procedures for preparing plant medicines and conditions treated with plants are also discussed; 4) "Healing Illnesses of Women and Children" explores concerns and afflictions more specific to women and children, indicates plants used in treating these, and outlines reasons that information on this topic is generally less often discussed.

In Part 2, the 100 most commonly reported medicinal plants for this region are listed, complete with plant descriptions, historical and modern medicinal uses, and a brief summary of their known phytochemistry, including reported toxicities. Parts 1 and 2 are followed by two brief appendices concerning safety of medicinal plants and pharmacologically active phytochemicals, authors notes, a bibliographic essay, an extensive reference list, and an index (by plant name and medical condition). A map showing the locations of culture groups in the American and Mexican West, a table of medicinal plant genera (by culture), and 29 plant drawings interspersed throughout the text are thoughtful inclusions.

Overall this book is excellent, with the exception of weaknesses in the phytochemistry, largely due to generalizations or brevity. However, the majority of the phytochemical information that is provided is secondary to the historical and modern uses described, and does contribute an adequate introduction to and some relevant information about this aspect of medicinal plants.

Healing with Plants in the American and Mexican West presents information from a variety of sources in an interesting, scholarly fashion, and in a convenient and readily usable form. It is not meant as a tool for prescription nor self-treatment, but rather as a means to acquaint the reader with a range of ethnomedicinal information, issues, and practice. This book will be of value to anyone interested in the plants and peoples of this region. Kay's thoughtful presentation makes it a pleasure to read, no matter what the incentive. Recommended.

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Wild Plants of the Pueblo Province. Exploring Ancient and Enduring Uses. W. W. Dunmire and G.D. Tierney. Santa Fe: Museum of New Mexico Press, Albuquerque, 1995. Pp. xii; 292. . $29.92 (hardbound), $19.95 (paperbound). ISBN 0-89013-282-8 (hardbound), 0-89013272-0 (laminated cloth).

The Pueblo Province is situated in New Mexico. It extends over the area of the Rio Grande Valley from Taos to Isleta, the mountain ranges on either side of the valley, the Rio Pueblo and San Jose river drainages west of the Rio Grande, and moves over the continental divide to include Zuni territory, a region of North America where diverse cultural relationships with plants remain largely intact.

The book was originally conceived by the authors as a guide to some of the common trail side plants of Bandelier National Monuments and the Pajarito Plateau and their prehistoric and recent uses by Indians living in this area. It includes many beautiful photographs. Altogether, there are approximately 90 color and 20 black-and-white photos.

The book begins with an eight-page prologue—a "How to Use this Book"—and includes a map of locations and recommendations to visitors that they respect the people and the land. The remainder of the publication is divided into nine chapters, each of which concludes with a "Suggested Reading" list which relates to the contents of that chapter.

Chapter 1 discusses the enormous natural diversity of the region. Chapter 2 reviews the history of the Pueblo peoples, tracing their beginnings from hunters to foragers and from collectors to cultivators. Following this, the book discusses the impact of contact and colonization on the peoples of the region. Chapter 4 highlights the modern Pueblo peoples and Chapter 5 discusses plants as living artifacts.

Chapters 1-5 describe the people living in this region, making reference to traditional plant use. When a plant is cited in the text, the local name of the plant, as well as a page number referring to the location of a photograph of that species, is located in the margin.

Chapter 6 describes nearly 300 plants and their uses. These are arranged by growth form: trees, shrubs, grass-like plants, and herbaceous plants, then by plant family in phylogenetic order. Each description includes the common and scientific name of the species or group of species. The distinguishing features are described for each plant and accompanied by a line drawing, and, for most, a color photograph of the entire plant. In the description, the reader is referred to the different monuments and parks where the plants can be seen and identified from public trails. This chapter starts with a brief description of the parks, their location and contact addresses.

Chapter 7, entitled "Ethnobotany in New Mexico," consists largely of an historical introduction to ethnobotany and the related sciences and would have been better placed at the beginning of the book.

Recent modifications to the landscapes of the Pueblo province are discussed in Chapter 8 with a summary of the major factors which have shaped the landscape of the area.

In Chapter 9, the authors identify other places to visit in the region and introduce the reader to other interesting visits to museums, monuments and parks which offer additional information on the Indians of New Mexico.

Finally, there is a table (pp 254-266) which compiles all the species whose uses are known in the New Mexico Pueblo Province in present day or in the past. This list is based on a comprehensive review of the technical literature as well as information collected personally by the authors.

The publication includes a bibliography (pp 267-278), as well as photo credits, an index and information about the authors.

This book contains a great deal of information about the uses of plants by the people of the Pueblo Province, much of it collected from modern peoples by the authors. The text is easily readable for a non-specialist public, the photographs are beautiful and useful. This book would be useful for an ethnobotanist, botanist, students, and people interested in traditional uses of plants and the knowledge of American Indigenous peoples.

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Plantas Medicinales en el Sur Andino del Perú. 2 Vols. C. Roersch. Koeltz Scientific Books, Koenigstein, Germany and Champaign, Illinois, 1994. Pp. xiv; 1188. US$177.00 (paper). ISBN (Germany) 3-87429-369-67-2; (USA) 1-878762-67-2.

This publication is another manifestation of the surge of serious interest in the medicinal plants of non-industrial societies. The healing power of their flora has found an international respectability that, back in the 1960s, could not have been imagined. South America's Andes has a rich inventory of *materia medica,* as would be expected from a land of pre-Columbian civilizations. The geographical scope of this work is restricted to the most traditional part of the Andes, the Departments of Cusco, Puno, and Apurímac in southern Peru. Just as the people of that area are themselves primarily descendants of the Incas, so most medicinal plants form the bases for remedies that predate the Spanish Conquest. Eighteen percent of the plants on this list were introduced beginning in A.D. 1532, which is uncannily also indicative of the extent of European traits in peasant livelihood.

The two-volume work is organized into a thematic section and an herbal section. In the former, we first read a discussion of the development project in traditional medicine which led to the establishment in Cusco of the Centro de Medicina Andina. Social activists in the Catholic Church and foreign donors, especially from The Netherlands, understood the need to recover traditional medicinal knowledge as a valid counterweight to the monopolistic claims of the modern medical establishment to successful curing. For almost a decade, the author was closely associated with this project whose work included plant collections from valleys, forests, and *punas*; recording of an impressive 2,940 medicinal recipes; bioassays; and yearly conferences to exchange knowledge. Trained in organic chemistry and pharmacology, the author is particularly concerned with the active principles in these remedies. Not all remedies have an active principle; sympathetic magic forms an element of Andean folk medicine too. The thematic section also contains a chapter on the aims and methods of science in order to show how folk medicine of the Andean tradition differs from drugs developed by laboratory experimentation. The author then launches into folk taxonomy and how the peasant mind conceptualizes useful plants. Scholars of folk classification will find this chapter instructive in defining universals derived elsewhere.

Two-thirds of this treatise is devoted to plant-by-plant entries arranged alphabetically by their most common name. Since no botanical key is included with which to identify the plant, it becomes imperative to know its commonest name. Alas, Quechua, the language in which most names occur, has had several orthographies, which can complicate retrieval. Line drawings (some clear, others less so) of stems, leaves, and flowers have value in identification, but they are available for only 31 percent of the entries. Botanists and others in Linnean straitjackets risk being frustrated that these plants are not grouped by family. Instead a folk perspective prevails in which a named plant may correspond to a number of related species or even to species in different genera.

For each of the 509 descriptions in the herbal section, succinct and well-documented information is provided on: other common names; the scientific binomial; habitat; categorization of plant into "hot, "temperate," or "cold;" parts of plant used; illness(es) for which plant is indicated; and mode of application. Somewhat more discursive comments then follow on its ethnobotany, phytochemistry, and toxicology. A summarizing evaluation for each plant attempts to capture the essence of its relative importance, preferential uses, and apparent therapeutic value or dangers.

Not given much attention in these individual entries or elsewhere in the book are the ethnographic, historic, and folkloric dimensions of Andean medicinal plants. This deprives the work of a larger contextual significance, for many of these plants have long cultural associations. Another caveat is that certain plants, especially those known as contraceptives, abortifacients, aphrodisiacs and hallucinogens, are omitted. Inexplicably, coca (*Erythroxylum* spp.), whose numerous alkaloids and sacred status have always made it the leading panacea of traditional Andean medicine, does not have an herbal entry. ***Wanarpu*** (*Jatropha* spp.), whose aphrodisiacal power was known to the Incas as it is today, is absent. One looks in vain to find the famous ***willka*** (or ***vilca***) (*Piptadenia macrocarpa*). Known and used in this region as a purgative, it becomes in larger doses an hallucinogen of great cultural-historical continuity. Some other plants, such as manioc (*Manihot esculenta*), with no substantive medicinal use, nevertheless receive an entry. The criteria for exclusion or inclusion are not provided; thus it is fair to wonder if Western and Catholic bias entered into these expurgations.

The most serious disquisition prepared so far on the medicinal plants of southern highland Peru, its positive achievements are substantial. It serves as a cardinal corrective to the many popularized accounts on Andean folk medicine in Spanish that over the years have mixed fact with sometimes the wildest fancy. By screening the many claims to healing power, author Roersch has sets the record straight on that copious list. For many plants, he evaluates the phytochemical properties by winnowing the fugitive and disparate literature which in this book amounts to 499 references. That documentation, combined with years of field experience in working with plants and people in the Andes, has created a sound knowledge base. However the treatment is not definitive, nor is the work trenchantly analytical. Many questions about the relationships of Andean culture and these plants are not probed, much less raised. Summaries are called "conclusions."

This book represents an exemplary international cooperative effort: a Dutch author writing in Spanish and a German publisher who also distributes in the USA. In this case, the publisher did not provide copy editing which would have tightened up certain paragraphs, insisted on complete references, and caught the typographical errors which crept onto the printed page. Three chapter summaries are provided in English and there is also a 14-page synopsis for those who read Dutch. In published form this thesis, filed at the Catholic University of Nijmegen, becomes much more accessible than would a manuscript dissertation available only in The Netherlands. There is only one hitch: the people who need it most would not be able to afford the price.

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La Zoologie des Montagnais. Daniel Clément. Peeters, Louvain-Paris, 1995. Pp. xiv; 569. 1260 B. fr. (ca. CA$ 49)(paperback). ISBN 2-87723-099-6 (Éditions Peeters-France). ISBN 90-6831-686-9 (Éditions Peeters-Louvain-Paris).

Clément's book—a modified version of his Ph.D. thesis—has two aims: to give a substantial account of the zoological knowledge of the Montagnais (Innu) of Northern Québec, and to contribute to the debate on the nature of traditional systems of classification and their relation to Western/scientific taxonomy. (He has already published a shorter account of Montagnais ethnobioloy—see *Journal of Ethnobiology* 15:1-44).

The first chapter precisely deals with the latter point. The author's main hypothesis is that Montagnais zoology "shares with science more similarities than differences" (61), since they "observe, compare, and classify animals and have developed their own concepts to cope with this reality" (5). This, he exemplifies by showing the gross correspondence between the four major classes of the native taxonomy and the categories of Western science (58). Thus, from the very beginning the author takes side as a partisan of a "universalistic" conception of ethnobiology, as opposed to the "ethnoscience" approach, which insists more on the linguistic and cosmological aspects of animal nomenclature and classification. Most of the chapter reviews the different theories of modern science, and outlines a history of ethnobiology. It ends with a detailed description of the author's field methodology and his corpus of data.

Chapter 3 deals with anatomical knowledge. Particularly detailed, and well-illustrated, it contains four divisions, following the main life-forms (***aueshishat*** "four-legged," ***nameshat*** "water-dwellers," ***missipat*** "waterfowl," and ***manitûshat*** "harmful animals, insects"). Both external and internal parts are described with remarkable precision by his informants, and this nomenclature is thoroughly analyzed from a linguistic point of view (e.g. the ***uîshinaiat/uîtuia*** complex which, in different mammals, describes testicles and/or foreskin glands and/or anal glands [pp 90 ff]). Extensive references to native texts also show that cultural practices regarding animals (like meat-carving) have notable impact on the nomenclature, particularly internal parts, while functional discourse is limited to digestion, breathing, locomotion, and reproduction, as could be expected (pg 130). A polemical aspect of this chapter refers to the ***manitûshat*** category, which Clément translates as "harmful animals," and which includes frogs, lice, snakes, mosquitoes, and flies. As the author recognizes (pg 120), the proper translation is "malignant spirit" and this points to an important feature of Montagnais' (and others') animal taxonomy: namely the intrusion of the supernatural. This dimension is deliberately minimized by the author in favor of a purely "naturalistic" treatment of native knowledge.

The following four chapters are concerned with animal behavior, that is: "Sound, senses and motion" (Chapter 3), "Habitat and food" (Chapter 4), "Seasonality and animals" (Chapter 5), and "Reproduction" (Chapter 6). It is, of course, impossible to summarize the enormous amount of information included, covering more than 200 pages, which reveals the consultants' amazing familiarity with the patterns of feeding, moving, mating, and caring for the young. The author's analysis also includes references to the Montagnais lore, like one tale from the

Wolverine cycle, which synthesizes in a pleasant and didactic way the native view of animal locomotion.

Contrary to the highly empirical content of these chapters, Chapters 7 ("Identification and nomenclature") contains an extensive theoretical section in which Clément is concerned with the correspondence between the native success at identifying species and the total number of species found in the territory. Results of these tests seem rather inconclusive (pg. 390). On the other hand, by studying the components of animal-names among the Montagnais, he demonstrates that nomenclature follows very systematic patterns, the most frequent being the qualification of a superior taxon by an attribute selected from a relatively limited set: morphology, size, or color (pp 404-410).

Chapter 8 ("Classification") deals with the principles according to which the Montagnais separate animals into various categories and the result of such activity. According to one's basic assumptions regarding the nature of classifications, his analysis will be judged satisfactory or unconvincing. For, on the one hand, the author does present us with a rare feat: an integrated taxonomy of the animal kingdom, with an (unnamed) "unique beginner" splitting in two ("edible"/"non-edible"), the edible animals being divided between "those which have meat" (***aueshishat***) and those which have flesh" (***nameshat***), and so on to the last species. But there is a basic flaw: this is not a general-purpose classification, but a largely monothetic classification, based on one animal use: food. The author starts with a long and rather puzzling discussion on the notion of species among the Montagnais. This serious methodological shortcoming comes on top of another, regarding the notion of species, when the author unsuccessfully tries to convince the reader that the Montagnais share the biological concept of species as in-breeding groups (pp 416 ff).

In summary, and in spite of the reserves expressed at the theoretical-methodological level, Daniel Clément's book constitutes an invaluable source of empirical materials regarding the animal knowledge of the Montagnais. Furthermore, these data were collected at the very moment the traditional hunting economy is giving way to generalized sedentism. As such, it is a must for any student of the relationships between aboriginal peoples and animals in the Northern woodlands and it should be present in the library of anyone concerned with the biology and cultural anthropology of North America.

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NOTICE TO AUTHORS

The *Journal of Ethnobiology*'s revised "Guidelines for Authors" appears in Issue 16(1) on pp. 124–127. If you need a copy of these Guidelines you may request a copy from the Editor. Careful scrutiny of recent issues of the *Journal* should provide appropriate stylistic models for any manuscript you may wish to submit.

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BOOK REVIEWS

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