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COVER ILLUSTRATION: Mari Elena Cruz Hernández of San Juan Mixtepec, Oaxaca, Mexico (see "Ethnobiotica," this issue) is collecting cones of *Pinus teocote* which she will use to represent the family's chickens in prayers for a fruitful year. This ceremony is conducted on the summit of a mountain near town during the Fiesta of the Holy Cross, May 3 each year. Families climb to the summit, leave offerings at a dry well there that is the door to the house of ***nguzii***, the Zapotec god of lightning, petitioning the release of the rains.

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CONTENTS

ETHNOBIOTICA

Those of us who have worked with Native American or First Nations communities in North American are in the habit of honoring the elders as repositories of a precious heritage of environmental knowledge and wisdom. The unfortunate truth is that the younger generations rarely have had the opportunity to master the intricacies of this traditional knowledge nor to learn through practice the value of that knowledge. Witness reports in this issue of the *Journal of Ethnobiology*: Estabrook's requiem for a peasant agricultural system in Portugal and Florey and Wolff's account of the suppression of traditional healing ritual and associated use of plant medicines on Seram, eastern Indonesia. However, this is not everywhere the case. I have been heartened by my recent experience in Oaxaca, Mexico where the initial phase of my Zapotec ethnobiology is nearly done. The village of San Juan Mixtepec is the focus of this study. It appears to be a rather average Mexican peasant town, still heavily dependent on subsistence agriculture, planting the famous Mesoamerican staples, corns, beans, and squash. The setting is typically dramatic: perched on a ledge of the Sierra Madre del Sur with pine forest at its back; a sweep of arid subtropical woodland and cultivated lands below. Yet like many rural communities in Oaxaca, it is losing population; the young people leave seeking cash employment or in pursuit of education. Still the community retains a powerful hold on its children. Virtually all are proud to speak Zapotec as their first language.

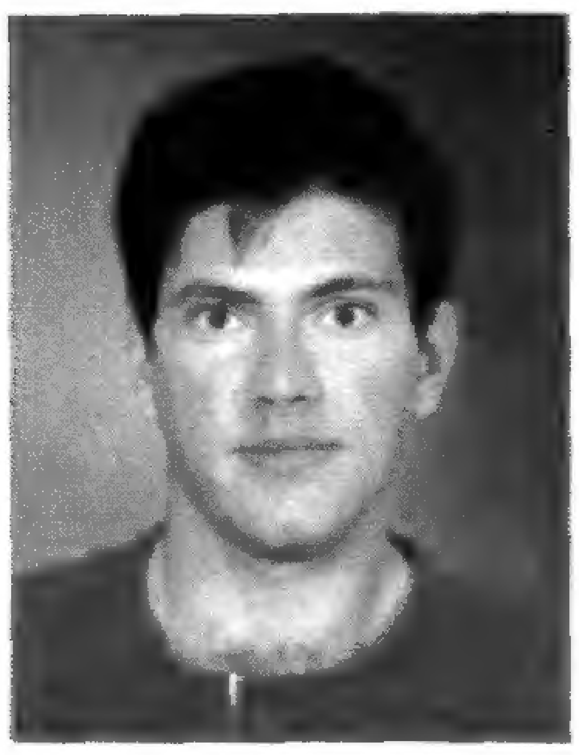
San Juan has its elders, of course, several in their 90s. But what most impressed me is the children. Let me introduce you to one, Mari Elena, who turned 13 last August. She's a fourth grader in the village primary school; the youngest of five daughters of Rosalía Hernández and Cándido Cruz. Her next older sister, Justina, just graduated from the local secondary school and has left to go live with another sister in the city of Tehuántepec, helping her in her business. Justina served as my assistant last year, helping with plant collections, as had the eldest daughter, Inez Vírgen. Inez now lives in a coastal town, but her daughter, Lilia, who is seven, has stayed behind, largely in the care of Mari Elena, her aunt.

This past summer with the onset of the rains and the initial weeding of their milpas, Mari Elena got the idea to bring me bags of plants each evening, recounting their names and uses, for which she received a few pesos. I warned her that I only wanted different plants; no duplicates. For two weeks running nearly every evening came the soft knock on my door. Mari Elena with one or more of her younger kin, each clutching a bag of plants. I dropped what I was doing, dumped the plants out on the patio, and did a "rapid environmental assessment" on the spot, one plant at a time: ***Zhaw lE guizh ri?*** "What is this plant called?" Then, ***Par ne rquina?*** "What is it used for?" I could identify maybe half the plants to genus and/or species; the rest were just leaves. Day by day the total mounted, reaching 686 the night before my departure for the states. Toward the end there was some duplication as other children tried to get a piece of the action. Once I had four children contending for my attention. When her turn came Lilia would blurt out the name of her plant, on occasion gently corrected by Mari Elena. Analyzing the resulting list showed that Mari Elena and Lilia used 369 distinct names for 471 plants specimens and made virtually no errors. Based on this rather casual experiment, I believe it is fair to estimate Lilia's repertoire of distinct plant names at over 300; Mari Elena's at over 500! I doubt they are unusual in this regard amongst their peers. Ironically, Mari Elena is two years behind where she should be in school. Her father reports that she is unhappy there. I am certain her teachers have no inkling of her intellectual gifts nor of her passion for plants. At least Mari Elena has not let school interfere with her botanical education.

Could it be that children are born to learn plant names? Only if they are deprived of the opportunity does this gift wither and go unfulfilled.

Eugene Hunn

AUTHOR PROFILES



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George Frederick Estabrook graduated in 1964 from Dartmouth College, where he studied botany with Karl Wilson and mathematics with John G. Kemeney. He was one of Stanislaw Ulam's last graduate students at the University of Colorado, where he applied combinatorial mathematics to the study of evolution. In 1970, he joined the faculty of the University of Michigan, where he is now Research Scientist in the University Herbarium and Professor of Botany in the Biology Department. He became involved in the Portuguese speaking world through participation in the ambitious project to computerize the Brazilian flora 1975-1979. In the early 1980s he worked with ecologists and agronomists in Italy and Portugal, where he observed a relationship between plant ecology and human culture in rural subsistence economies. He returned to Portugal for several months during 1987, 1991, and 1994 to study subsistence agriculture, and spent the academic year 1997/8 as a Visiting Professor in the Anthropology Department of the University of Coimbra, Portugal, to study the relationship between culture and technology in traditional agriculture.

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Journal of Ethnobiology 18(1):1-13 Summer 1998

FOLK TAXONOMY AND CULTURAL SIGNIFICANCE OF "ABEIA" (INSECTA, HYMENOPTERA) TO THE PANKARARÉ, NORTHEASTERN BAHIA STATE, BRAZIL

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ABSTRACT.— This paper focuses on the ethnotaxonomy and significance of bees and wasps to the Pankararé Indians living in a semi-arid zone of the Northeast of the State of Bahia, Brazil. The survey was conducted with the Pankararé from Brejo do Burgo village. Data were obtained by using ethnoscientific methods and through open interviews with natives and a native specialist in ethnoapiculture. A total of 23 folk species were recorded within the folk category "*abeia*," the label used for both Apidae and Vespidae. Considering the ethnotaxonomic aspects, "abeias" are classified in two groups as "fierce bees" and "mild bees". They are also sub-divided into three intermediate taxa depending upon whether or not they sting and, if so, if they can sting repeatedly. Eleven folk species are sources of medicine. Wild honey is the main raw material used in the treatment of illnesses and as food. Honey is also an important source of income for the Pankararé. These insects play significant roles in the social, economical, and cultural life of this group.

RESUMO.— Este artigo focaliza a etnotaxonomia e importância de abelhas e vespas para os índios Pankararé, grupo residente em uma região do semi-árido do Nordeste do Estado da Bahia, Brasil. O estudo foi realizado com os Pankararé da aldeia Brejo do Burgo. Os dados foram obtidos seguindo-se métodos da etnociência, mediante entrevistas abertas com nativos e especialista em etnoapicultura. Um total de 23 etnoespécies foram registradas e "abeia" é o rótulo usado para apídeos e vespídeos. Considerando aspectos etnotaxonômicos, as "abeias" são classificadas em "abeias-brabas" e "abeias-mansas". Elas também são divididas em três famílias folk dependendo da posse do ferrão. Onze etnoespécies são fontes de remédio e o mel silvestre é a principal matéria-prima utilizada no tratamento das enfermidades e como alimento. Mel é também uma importante fonte de insumos para os Pankararé. Observou-se que esses insetos desempenham significativos papéis na vida social, econômica e cultural desse grupo indígena.

RÉSUMÉ. — Cet article porte sur l'ethnotaxinomie et l'importance des abeilles et des guêpes pour les Indiens pankararé qui habitent une région semi-aride du nord-est de l'État de Bahia au Brésil. L'étude a été réalisée dans le village pankararé de Brejo do Burgo. Les données ont été obtenues au moyen de méthodes ethnoscientifiques et d'entrevues semi-dirigées menées auprès des autochtones et d'un spécialiste autochtone en ethnoapiculture. L'enquête a révélé vingt-trois espèces d'"*abeia*", la catégorie vernaculaire utilisée pour désigner à la fois les apidés et les vespidés. Cette catégorie comporte deux groupes nommés respectivement "*abeia-braba*" et "*abeia-mansa*". Le taxon "*abeia*" est également subdivisé en trois taxons de niveau intermédiaire définis en fonction des espèces qui piquent ou non et, le cas échéant, si elles le font de façon répétée. Onze espèces vernaculaires servent à préparer des médicaments. Le miel sauvage est la principale matière première utilisée dans le traitement des maladies et comme aliment. Le miel constitue également une source de revenus importante pour les Pankararé. Les abeilles et les guêpes jouent un rôle significatif dans la vie sociale, économique et culturelle de ce groupe amérindien.

INTRODUCTION

Amerindian peoples possess an ethnobiological knowledge accumulated over hundreds of years of interaction with nature. This is shown by the diversity of relationships that Indians maintain with animals and plants in the localities where they live. Insects have played important roles in the social, economic, and cultural systems of many traditional, non-industrial peoples (Gudger 1925; Weiss 1947; Coimbra 1985; Posey 1979, 1986, 1987; Ramos-Elorduy 1987; Ribeiro and Kenhíri 1987; Dufour 1987; Ratcliffe 1988; Ramos-Elorduy and Pino 1988; Starr and Wille 1988; Camargo and Posey 1990; Setz 1991; Hunn 1997). Social insects, in particular, have had outstanding significance due to their social nature and behavioral patterns (Posey 1986). The study on the perception, knowledge, and uses of insects by human societies is the subject matter of ethnoentomology, a branch of ethnozoology (Posey 1987).

The Brazilian Northeast is characterized by a widespread semi-arid climate with a deciduous, woody vegetation dominated by thorny cacti and bromeliad species that comprise what is traditionally called *caatinga* ('white forest' in the Tupi language). In this geographical area human populations have adapted to very severe drought periods ranging from five-nine months annually. Today, there are 23 Brazilian indigenous groups living in the semi-arid zone or in transitional areas (ANAI 1981). Most are subject to powerful acculturative pressure from white society (Ribeiro 1987). Despite this cultural richness, the vast majority of ethnobiological surveys have been traditionally conducted with indigenous tribes and *caboclos* ('peasants') in the Amazon basin and surroundings. Studies of northeast Brazilian indigenous ethnobiology are generally limited to ethnobotany (Bandeira 1972; Mota 1987). The only available reference on ethnozoology is a brief survey of the Pankararé (Bandeira 1993).

In this semi-arid environment, bee species, in particular, stand out from the rest of the entomofauna because of their ecological performance as important pollinate agents of the ***caatinga*** flowers (Machado 1990). They also supply honey and other products that are sources of food, medicine and income for local inhabitants, who are obligated to adapt to great periods of drought. Althought studies have been carried out on bees in this ecosystem, especially *Apis mellifera* (Castro 1994;

Martins 1990; Aguiar 1995; Martins and Aguilar 1992; Ducke 1907), there are no surveys about bee ethnobiology and ethnotaxonomy.

Posey (1987) argues that traditional knowledge about ecology and biological diversity can generate new ideas to the complement Western scientific knowledge of these phenomena. In that spirit, I record here the ethnotaxonomic aspects of social insects of the order Hymenoptera (excluding ants) and their importance to the Pankararé Indians from the northeastern region of Brazil.

THE COMMUNITY

Studies on the Pankararé began in the 1970s and they resulted in the recognition of this group as an indigenous community. According to Pinto (1991), the Pankararé seem to be descendants of the Gê Indians. However, the Pankararé are now highly acculturated through mixing with peoples of different cultural and linguistic groups.

The Pankararé are an undifferentiated linguistic unit restricted to the northeastern portion of the State of Bahia, Brazil. Most of the Pankararé (900 individuals) live at Brejo do Burgo village which is situated at the edges of the Raso da Catarina Ecological Station (Figure 1). This is the driest region of Bahia State with a mean annual temperatura of about 27° C and rainfall about 400 mm per year (CEI 1994).

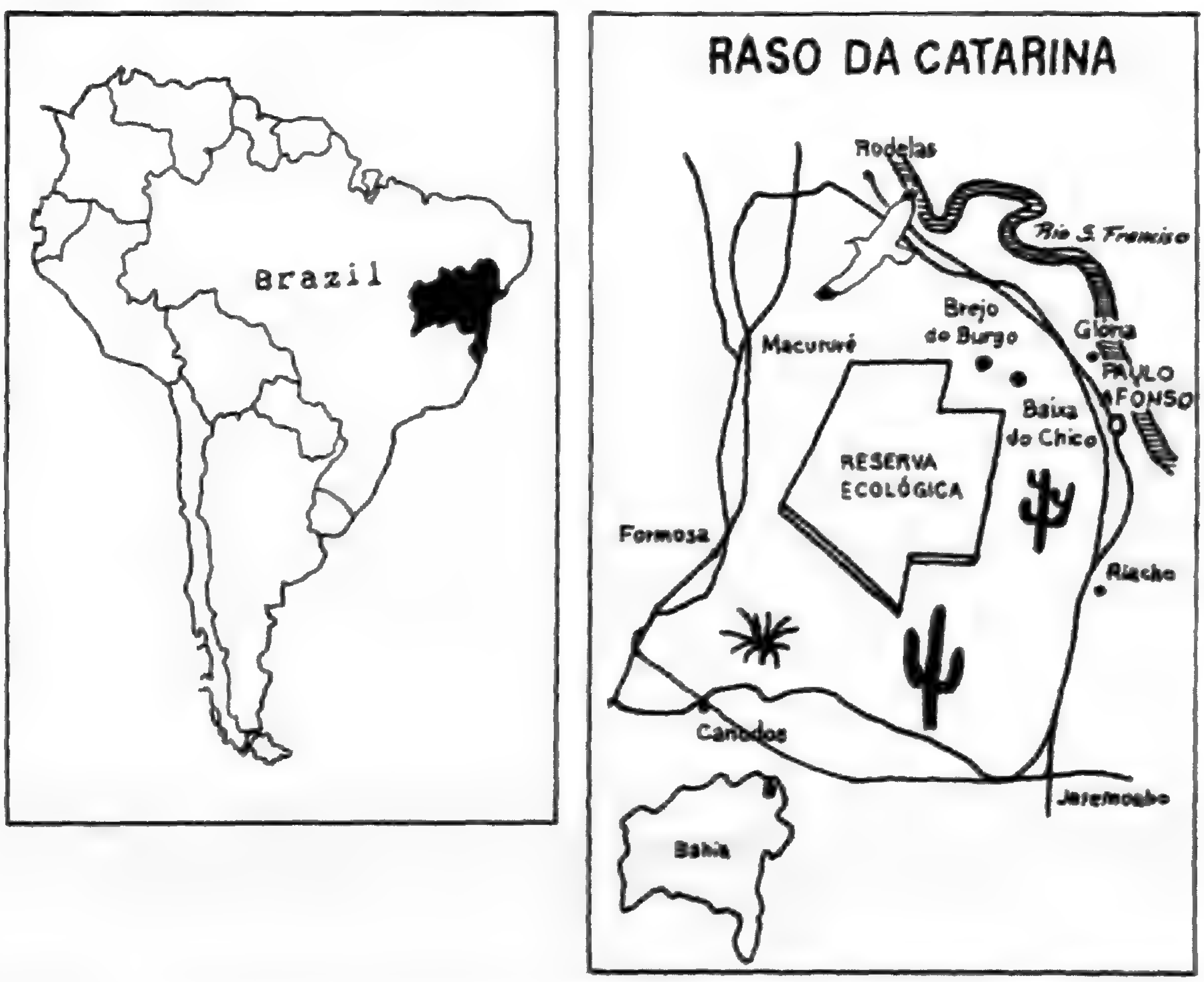

FIGURE 1.—Map showing location of the Brejo do Burgo village where the study was undertaken.

Information on geology is found in Almeida and Figueiroa (1984). Their territory is a predominantly ***caatinga*** area.

People are distributed in small familial agricultural groups around Brejo do Burgo village. The main crops are maize, bean, and manioc, cultivated both for home consumption and for market exchange. This activity is conducted in the rainy months (April to August) due to more propitious conditions of the soil and water availability. The main protein sources are goat, pig, and chicken meat. However, they complement their dietary needs with game, honey, and wild fruits (***imbú*** [*Spondias tuberosa*, Anacardiaceae]; ***murici*** [*Byrsonima gardneriana*, Malpighiaceae]; ***licuri*** [*Syagrus coronata*, Arecaceae]; and ***castanha-de-caju*** [*Anacardium occidentale*, Anacardiaceae]) (Maia 1992). Young people have been migrating to the larger cities for remunerative employment. Data concerning educational and political issues were not collected for this study.

METHODS

The observations reported here are based on fieldwork performed during monthly visits of about three days each from July to November 1995 with Indians of the Brejo do Burgo village. Fourteen individuals (nine men and five women) 18-67 years old were interviewed. Males proved to be more knowledgeable about folk names and behavioral traits of each specimen than the females. This is presumably because the men hunt game and collect wild honey. Only one native specialist in ethnoapiculture has been questioned, who was the major consultant (Afonso Pankararé, 42 years old). Interviews were conducted in Portuguese since the Pankararé are bilingual in this language. Consultants were all literate to some degree; they made their living by farming livestock (goats and pigs), and by planting corn, manioc, beans, watermelon, and cantaloup, which are marketable products. In addition, they harvest honey for their own use or for sale. Unfortunately, linguistic data were not collected in the indigenous language. However, most terms are Portuguese and, with few exceptions, are used by both the Pankararé and other rural peoples throughout Brazil.

Data were obtained through open interviews and by noting folk taxonomic features and uses of bees and wasps reported by the Pankararé. The "emic" approach focuses on the native people; the way they organize, perceive, use, and manage their natural resources, without imposing the researcher's Western categories (Sturtevant 1964; Posey 1986).

Insects were collected at their nests or as they were visiting flowers by using entomological nets, and then were preserved in 70% alcohol. The indigenous consultants identified them before and after they were captured. Specimens were shown to the Indians in order to ask about folk names, basic uses, whether they were kept for honey or not, their behavior and presence in mythology, folklore or ceremonial. They were later mounted on pins at the Laboratory of Entomology of Feira de Santana State University, and then sent to experts to be identified. Specimens other than eusocial Apidae and Polistinae Vespidae were also collected. Altogether, thirty specimens were collected.

Wasps species were identified by Dr. Oton Marques, of the Agricultural School of Bahia Federal University; bee species were identified by Dr. Marina Siqueira, Department of Biology of Feira de Santana State University. Though specimens of ***manduri, mané-de-abreu, mandassaia,*** and ***exuí*** were not found during fieldwork, their scientific names are tentatively given here based on the Brazilian insect folk names catalogued (Lenko and Papavero 1979; Buzzi 1994). Vouchers were deposited at the laboratory cited above.

RESULTS AND DISCUSSION

The present study on the Pankararé ethnoapiculture has revealed important aspects of their traditional entomological knowledge. At least 23 categories of insects are classified as ***abeias*** ("bees") by the Pankararé Indians, who put together under this label those hymenopterans that produce and store honey (eusocial, melliferous bees and wasps). The word "bee" appears here in quotes in order to contrast it with "bee," as normally used, since this latter term properly designates only the superfamily Apoidea, excluding wasps. All "bees" are believed to be enchanted living organisms and are protected from human exploitation by guardian spirits of plants and animals called ***encantados***. As Bandeira (1993) notes, the Pankararé have a very accurate ethnotaxonomy of "bees." The precision of their description addresses morphological and adaptative details. For example, the local specialist says that these insects carry pollen (***saburá***) on their legs. It is known that Apidae evolved the curbicula or pollen basket, a derived structural modification of the hind tibia which is used to transport pollen, wax, resin, and other substances. The Pankararé also know from which plants "bees" have taken pollen by observing the color and taste of honeys. As the informants say:

> "... here is the ***saburá*** (pollen). It is from this little yellow mass that honey is made. It comes from the juice of the flower ... Bee does not make honey with other thing. All bees make honey from the juice [that is, the pollen] of the flower. Larvae food is ***saburá***".

All human groups answer to the biological diversity in their environments by grouping plants and animals taxonomically in labeled subordinate or superordinate categories (Brown and Chase 1981). Following Berlin's principles of categorization (Berlin 1992), the term ***abeia*** or "bee" is at the life-form rank. In contrast to what has been noted in most other ethnobiological classification systems, the most inclusive taxon – the kingdom rank – is named and labeled ***animali*** ('animal'), thus "bees" and the rest of the faunal categories fit beneath this label. The life form taxon *abeia* is, in turn, divided into two intermediate categories. If a "bee" shows an aggressive defensive behavior it is labeled a "fierce bee" (***abeia braba*** in Portuguese). This category includes the honeybee *Apis mellifera*, seven species of social vespids of the Epiponini tribe (carton nest species), and one species of the Meliponinae locally named ***arapuá*** (*Trigona spinipes*). If not aggressive, they are referred to as "mild bee" species (***abeia mansa***). These are all meliponines (stingless bees). This distinction implies the manner by which the Indians deal with wasps and bees. They burn green wood near a nest or hive of the fierce species to keep away or to kill the adults. Then they harvest the honey, wax, and larvae.

It is worth noting that these insects are classified in three intermediate taxa

TABLE 1.— Pankararé taxonomic classification of wasps and bees (Insecta: Hymenoptera) placed in the "bee" life form, showing intermediate categories of folk families according to their aggressive behavior.

Intermediates	Folk genera and species (scientific species)	fierce	mild
Exu's line (Vespidae, Polistinae, Epiponini)			
	cangota (*Polybia occidentalis*)	X	
	caraquile (*Polybia paulista*)	X	
	exu-de-cachorro (*Protopolybia exigua exigua*)	X	
	exu-preto (*Polybia ignobilis*)	X	
	exu-verdadeiro (*Brachygastra lecheguana*)	X	
	exuí (*Polybia* sp.)	X	
	tarantantã (*Polybia sericea*)	X	
Oropa's line (Apidae, Apinae)			
	oropa (*Apis mellifera scutellata*)	X	
Arapuá's line (Apidae, Meliponinae)			
	abeia-branca-do-fundinho-branco (*Frieseomellita silvestrii*)		X
	abeia-branca-do-fundinho-vermeio (*Frieseomellita silvestrii*)		X
	arapuá-macho (*Trigona spinipes*)	X	
	arapuá-fêmea (*Trigona spinipes*)	X	
	cupira-boca-de-barro (*Partamona cupira*)		X
	cupira-boca-de-berruga (*Partamona cupira*)		X
	mandassaia (*Melipona quadrifasciata* ?)		X
	manduri (*Melipona rufiventris* ?)		X
	mané-de-abreu (*Frieseomelitta varia* ?)		X
	mosquito-preto (*Plebeia mosquito*)		X
	mosquito-remela (*Friesella schrottkyi*)		X
	mosquito-verdadeiro (*Tetragona angustula*)		X
	papa-terra (*Cephalotrigona capitata* ?)		X
	trombeta (*Plebeia* sp.)		X
	uruçu (*Melipona scutellaris*)		X

depending upon the presence or absence and the loss or retention of the sting (Table 1). The Pankararé put all Epiponini wasps in the "line" or folk family (intermediate taxon) of those "bees" that retain their stinger. They state that some kinds of fierce "bees" can use their stings more than twenty times. This folk family is usually designated as "***exu***'s line", where ***exu*** is a polysemic taxon that occupies both this intermediate position and the generic rank. The honeybee (*Apis mellifera scutellata)* by itself comprises "***oropa***'s line" because it loses its stinger after one use. As one informant (Afonso Panakararé) stated:

> "***Exu-verdadeiro***, ***cangota***, ***tarantantã***, ***caraquile***, ***exu-preto***, and ***exuí*** have all the same bite, the same sting, and the same line. They can bite you more than one time.... The sting of an ***oropa*** is different, more simple. If one bites you it leaves its sting on you and it cannot bite you any more because an other sting is not born."

The third folk intermediate grouping is formed by 15 folk species of stingless "bee," it is referred to as "***arapuá***'s line". The first two lines include the "fierce bees"; the last is equivalent to the mild ones. Though ***arapuá*** is identified as aggressive it lacks a sting.

Drones and workers are not distinguished but a "master bee" (***abeia mestra***) is. Consultants recognize that all "bees" have a master living inside the nest; it is distinguished from the others by its larger size. This is presumably the queen.

The material and cultural significance of "bee" resources along with the stinging behavior of some types may explain the fine recognition of categories within these folk families. The indigenous classification of social hymenopterans in lines shows an impressive one-to-one correspondence to the scientific families of Western taxonomy (see Table 1). The taxa included are distinguished by morphological and behavioral criteria, such as shape and size, color pattern, nesting behavior, hive structure, arrangement of honey in combs, honey production, fierceness, etc.

In contrast, the social vespids with open nests, the "true" wasps (*Polistes* and *Apoica* spp.), are set apart as ***maribondo***. Since these wasps do not produce honey the Pankararé do not harvest them for food, but instead use their nests as medicine to treat dizziness, asthma, and stroke. As the Pankararé say, "***maribondo-chapéu*** (*Apoica pallens*) and ***maribondo-caboclo*** (*Polistes canadensis canadensis*) are not 'bees' because they do not produce honey." Hymenopteran specimens other than the Apidae and Polistinae (Vespidae), such as potter wasps, carpenter bees, ground-nesting, solitary bees, and wasps were all classified as "beetles," and some specimens lack folk names. The ethnotaxonomy of these insects has not been completely analyzed and will not be discussed here.

Pankararé nomenclature and Berlin's general principles.— The construction of specific names in folk systematics is regularly binominal with the folk generic name modified by an adjective which often designates some obvious morphological character. Monominal specific names are also found in folk taxonomies, but when they occur they are polysemous with respect to the superordinate generic. The distinction between a prototypical, polysemously named folk specific taxon and its superordinate generic may be made explicit by the use of a marking attributive that may be rendered as 'real', 'original', 'best looking', or 'true' (Berlin 1992:90-96). Two examples of prototypical folk specific taxa have appeared in the Pankararé ethnotaxonomy. ***Exu-verdadeiro*** ('true exu' *Brachygastra lecheguana*) is a short-bodied and dark-colored social wasp, with yellow transverse bands on the tip of the abdomen. This folk species is probably the prototype due to its powerful sting and the quantity of honey which it stores. Two others folk species included in the ***exu*** folk genus are ***exu-de-cachorro*** ('dog's exu' *Protopolybia exigua exigua*) and ***exu-preto*** ('black exu' *Polybia ignobilis*). Their nests are made of cow dung and are considered to be medicinal (Table 2). The other prototypical folk specific is described as ***mosquito-verdadeiro*** ('true mosquito', *Tetragona angustula*) and, according to Atenor Pankararé (55 years old), this typical form is said to produce more honey than its neighbors, ***mosquito-remela*** ('gummy mosquito', *Friesella schrottkyi*) and ***mosquito-preto*** ('black mosquito', *Plebeia mosquito*). Some informants stated that ***mosquito-verdadeiro*** makes about one liter of honey whereas ***mosquito-preto*** only produces half that. These tiny stingless bees are attracted to human perspiration and they usually nest in small hollow logs. Their honey is taken as medicine.

Naming by binary contrast is a common linguistic feature where a primary lexeme is modified to form two secondary lexemes according to an obvious semantic dimension. Three sets of specific taxa are formed by this process in the Pankararé entomological classification system. The folk specific taxa included in folk generic ***abeia-branca*** are clearly marked by binary contrast in which the color pattern of the abdomen is the main semantic dimension. While ***abeia-branca-do-fundinho-branco*** ('white-tailed white bee') has its abdomen colored white, the contrasting specific taxon, namely ***abeia-branca-do-fundinho-vermelho*** ('red-tailed white bee'), has its abdomen marked red. The hive entrance of both types is said to be made of wax.[1] Taxonomically, the two kinds of ***abeia-branca*** are likely to represent varieties of a single scientific species, *Frieseomellita silvestrii*.

The same can be said for ***cupira*** (*Partamona cupira*), though no specimens were examined by the specialist. The distinction between ***cupira-boca-de-berruga*** ('wart-mouth cupira') and ***cupira-boca-de-barro*** ('clay-mouth cupira') alludes to the material which is used to build their hive entrance. The former folk species opens a little hole in the tree in which it lives, which is lined with wax, whereas the latter goes inside a termite nest and uses clay to construct its hive entrance. The third generic taxon illustrating binary contrast at the folk specific rank is ***arapuá***. The distinctive semantic dimension used to separate the two types of ***arapuá*** is the quantity of honey produced by each, in combination with the size of the hive entrance. ***Arapuá-macho*** ('male arapuá') is thought to produce more honey than ***arapuá-fêmea*** ('female arapuá'), and its hive entrance is the longer of the two. Nests of both folk species are made of cow dung and vegetable matter. Their honey is considered to be tasteful. These two folk species correspond to only one scientific species, *Trigona spinipes*. Apparently, the ***arapuá-macho*** hive is older and so its entrance is longer than that of ***arapuá-fêmea***. Consultants say that ***cupira*** resembles ***arapuá*** but it is slightly longer and brighter than the latter. Thus, the 23 categories of "bees" recognized by the Pankararé include monotypic folk genera, polysemous generics, as well as binomially and monomially named folk specifics.

The cultural significance of "bees" for the Pankararé.— The knowledge of an elaborate ethnotaxonomy of social insects indicates the high cultural significance of eusocial bees and wasps for the Pankararé. The Indians interact with these animals in many different ways, using them as food and medicine, consuming wild honey in religious festivities, and utilizing beeswax to make tools, such as bullets, or to stopper pots. Not only is their honey eaten, but also their larvae and pupae. The Pankararé roast *Apis mellifera scutellata* and *Polybia sericea* larvae in their combs, then extract them with small sticks to be eaten alone or mixed with manioc flour. The Pankararé go primarily to the ***caatinga*** to search for those "bees" whose honey is of higher quality, such as ***oropa*** and some stingless bees. Informants assert the quality of honey depends on the quality of the tree in which the hive was made, the age of the hive, and the flowering season. Honey-producing wasps, by contrast, produce little honey which is of low quality, but their larvae are very nutritious. When harvesting their honey they can eat larvae and pupae locally or take them home for their children and wives. Although used as a food source, "fierce bees" are not kept by the Pankararé as is done in other communities (e.g., Hunn 1977). It is interesting to note that these resources are readily available to men because they harvest wild hives. In addition to larvae consumption, the pollen sacks (***fio azedo***) of ***abeia-branca*** are used medicinally against influenza.

Pankararé sell honey in the market in Paulo Afonso, generating cash to buy foodstuffs such as sugar, flour, and salt. This activity is conducted in the driest months of the year when low agricultural production coincides with a higher honey productivity. Honey is also important when hunting in the ***caatinga*** woods, where "water and food are available only for those who know how to achieve these resources" (Bandeira 1993). The importance of insects as food is indicated by the number of calories which is obtained by the ingestion of bee larvae (here concerning Apidae only). This is greater than that of their honey, which is considered a high energy food. Honey produces 4.053 kcal/kg against 4.756 kcal/kg for the pupae (Ramos-Elorduy and Pino 1990).

Bees and their products have been noted as important for their healing powers by ancient and modern medical sciences and in many different human societies

TABLE 2.— "Bees" used as medicine by the Pankararé Indians from Northeastern Brazil, related to raw materials, usage, and indications. Also included true wasp medicine.

Pankararé name	Scientific name	Raw materials	Usage	Indications
abeia-branca	*Freiseomellita silvestrii*	"fio azedo" (pollen pot)	eaten	influenza
arapuá	*Trigona spinipes*	honey	eaten	diabetes
cupira	*Partamona cupira*	honey	eaten	throat inflammation
exu-de-cachorro	*Protopolybia exigua exigua*	nest	inhaled	evil eye
mandassaia	*Melipona quadrifasciata ?*	honey	eaten	snake bites
maribondo-chapéu	*Apoica pallens*	nest	inhaled	dizziness, asthma, stroke
mosquito-preto	*Plebeia mosquito*	honey	eaten	throatache
			massaged	"sapinho" (oral micoses)
oropa	*Apis mellifera scutellata*	honey	eaten	diabetes, bronchites, tuberculosis, hoarseness, verminousis
		wax	inhaled	headache, dizziness
papa-terra	*Cephalotrigona capitata ?*	honey	eaten	snake bites
tarantantã	*Polybia sericea*	nest	inhaled	"mal do tempo" (stroke ?)
trombeta		wax	inhaled	"mal do tempo"
		wax	eaten	diabetes
uruçu	*Melipona scutellaris*	honey	eaten	snake bites, rabid dog bites, impotence

(Ioirich 1986; Weiss 1947). In Pankararé medicinal usage, 11 "bees" provide 13 raw materials used to prepare remedies to treat or prevent 16 illnesses (Table 2). Honey is the main resource recommended in cases of diabetes, bronchitis, oral micoses, sore throat, intestinal worms, and impotence. It is considered also an powerful antidote against bites of snakes and rabid dogs bites. The multiple uses of stingless bee honey as medicine is justified by its chemical diversity (Pamplona 1992). The bactericidal properties of bee products, whether pollen or bee glandular secretions added when honey is dehydrated (Cortopassi-Laurino and Gally 1993), are well known. In Pankararé ethnoentomology, two species of social wasps of the Polistinae have been used as medicines. A bath of the smoke from burning nests of ***tarantatã*** (*Polybia sericea*) and ***exu-de-cachorro*** (*Protopolybia exigua exigua)* are thought to be useful in treating evil eye and strokes. At least one resource is traditionally used in ethnoveterinary medicine. A piece of an ***arapuá*** nest is dissoved in water, which is then used to bathe dogs with fleas or scabies. Indeed, insect products are reputed to have immunological, analgesic, diuretic, anesthetic, antirheumatic, and even aphrodisiac properties. Understanding the traditional modes of use of medicinal insects and studying their active principles in laboratories may suggest prototypes for new drugs, such as the established commercial products Melitin, Oftalmosept, Apinen, Apicosan, and Apimoset (Ramos-Elorduy and Pino 1988). Wasps have also played important roles in folk beliefs (Starr and Wille 1988; Posey 1987; Lenko and Papavero 1979).

Conservation of the apifauna of the Brazilian caatinga. — The ***caatinga*** environment is characterized by prolonged seasonal drought. However, it supports a singular biodiversity in fauna and flora, exuberant in times of rain. Nevertheless, this Brazilian ecosystem has been seriously deforested during centuries of unrestrained exploitation for wood extraction and cattle pasture. This has decreased the vegetal covering and consequently the number of "bee" species. Although the ***encantados*** are feared because they severely punish those who misuse game uselessly, this taboo has weakened among young Indians just because their beliefs have been left behind. Many of them have become acculturated when studying in towns, and a significant fraction of the Pankararé population, as well as those of other northeast Brazilian peoples, have migrated south to the rapidly growing cities in search of better living conditions. This is a serious problem, considering the overexploitation of native resources, mainly by ***posseiros*** ('white, non-indigenous settlers'). Traditional folk knowledge of biological diversity and ecological relationships of the semi-arid zone diminish as the indigenous population declines.

Honeybees and stingless bees are in danger of extinction in some areas of the world. Harvesting their hives has resulted in the elimination of many colonies (Roubik 1989). Consultants report that the number of stingless bee colonies is declining and that these insects are becoming rare. In addition, the Pankararé believe that *Apis mellifera* has influenced the reduction of some Meliponinae. They say that this introduced species arrived at Raso da Catarina Ecological Station about 30 years ago, and that it has since displaced the less aggressive indigenous species, appropriating their sources of nourishment. Despite its good taste, abundant honey, and economic value, *Apis mellifera* is not kept by the Pankararé. One alternative for stingless bee conservation is to encourage beekeeping by native people in a way that respects the local indigenous cultures. Thus, indigenous bee species would be preserved and the lives of the local people improved. As observed in Brejo do Burgo village, there is some husbandry of bees of the native species *Melipona scutellaris*, which is reared near houses in natural tree cavities or hollow logs or in artificial hives (***cortiços***), which are installed under the eaves of the house or tied on the branches of a tree. This activity is not common and needs to be better understood as a potential conservation strategy.

CONCLUSIONS

I report here results of the first ethnoentomological study of the folk taxonomy and cultural importance of social insects among the Pankararé. These insects are significant as medicines and in the economy of this tribe. Nests and honey are utilized as food and medicine, beeswax is used to stopper pots or to make bullets. Their ethnotaxonomy shows that honey-producing bees and wasps are classed together in the life form ***abeia*** or "bee," which is divided into three intermediate taxa according to whether they sting or not and, if so, if they can sting repeatedly. Prototypical folk species and binary contrast sets are named, but further study is necessary to clarify the folk taxonomic treatment of hymenoptera other than the Apidae and Vespidae.

Due to processes of acculturation that have affected the younger generation and pressures on the ***caatinga*** environment, the entomological resources of the Pankararé have been overexploited. Native stingless bee colonies may survive if conservation programs that encourage beekeeping are developed in accord with both folk and scientific techniques. This survey was concerned not only to record the ethnoentomology of social insects in this one traditional society of northeastern Brazil, but also to call attention to threats to the habitat of these people and thus to the cultural diversity of this region.

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NOTES

[1] As the specialist consultant could not be found at the moment of collecting specimens of ***abeia-branca***, those collections were shown to other consultants. However, they were unable to distinguish to which folk variety they belonged. So, the specimens were assigned only the folk generic name.

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Wild Plants and Native Peoples of the Four Corners. William W. Dunmire and Gail D. Tierney. Museum of New Mexico Press, Santa Fe, 1997. Pp. 313. $22.50 (paper). ISBN: 0-89013-319-0.

Wild Plants and Native Peoples of the Four Corners is the second book by Dunmire and Tierney to explore native plant uses in the American Southwest. (*Wild Plants of the Pueblo Province* was published in 1994 and reviewed in the *Journal of Ethnobiology* 17:290-291). The intended audiences are those with no formal training in botany and anthropology, but it should prove a handy reference for trained ethnobiologists as well. Dunmire and Tierney present a good balance of linking prehistoric evidence of plant-people relationships with that of contemporary cultures and a welcome change from books that so often emphasize only one or the other. They focus first on the reconstructed and present-day flora(s) of five parks within the U.S. National Park System — Chaco Canyon, Aztec Ruins, Mesa Verde, Hovenweep, and Canyon de Chelly — and the peoples who inhabited these areas in the past. This information is tied to the present via the Hopi, who represent a direct cultural link with pre-Puebloan people, and by the relatively recently arrived Navajo, Ute Mountain Ute, and Jicarilla Apache.

The first ten chapters cover various aspects of Four Corners ethnobotany: the land, the earliest people, ancestral Puebloans, the four featured contemporary tribes, weedy gardens (agriculture, including semi-domesticates), wild plant use (arranged by food and beverage, medicine, construction and fuel, implements and ceremonial objects, baskets and cordage, textile, paint and dyes), and Four Corners ethnobotany (research methodology). Each chapter has its own list of suggested readings and, when reference is made to a plant treated in depth later in the text, it and its page number are noted in the margin. The bulk of the text (Chapter 11) is devoted to two- to four-page profiles of fifty of the wild plants that were, and continue to be, common and the most culturally important to the native peoples of the Four Corners region. Six trees, 18 shrubs, 24 herbs and two grasses are featured, arranged phylogenetically within each lifeform. Their natural history and past and present uses are summarized, and line drawings and color photographs are included for easy field identification. An annotated list of 515 useful plants provides helpful summary data organized by major use categories, with tribe(s) and reference(s) indicated.

Aside from occasional ambiguous wording and one case of poor editing (i.e., the wild plant use categories in the chapter by that title do not match exactly those found in the annotated list), my biggest concern is with the chapter entitled "Four Corners Ethnobotany." It sets out to inform the reader on how ethnobotanical research is done. While it does an admirable job of addressing various aspects of archaeobotany, palynology, dendrology, and such, it falls short in its coverage of modern ethnographic, linguistic, and ecological techniques. All in all, however, *Wild Plants and Native Peoples of the Four Corners* will be a valuable addition to the library of anyone who needs a practical readable reference to this corner of the world.

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MAINTENANCE OF FERTILITY OF SHALE SOILS IN A TRADITIONAL AGRICULTURAL SYSTEM IN CENTRAL INTERIOR PORTUGAL

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ABSTRACT.—The traditional techniques practiced by subsistence farmers dwelling in the shale foothills of the Serra da Estrela mountains in central interior Portugal have created and maintained fertile soil on this intrinsically marginal land for the past 400 years or more. To describe and explain these techniques, data were recorded for an area at 600 m above sea level at the headwaters of the Pracais river in the county of Pampilhosa da Serra, district of Coimbra. The 23 remaining residents of a group of three villages here provided ethnographic insights. In the summer temperatures may reach 40° C and it rarely rains, but in the winter temperatures often fall near zero (though rarely below) and about 2 m of rain fall. The rain has cut deep, steep-sided valleys into the shale from which soil is readily washed. The clay soil that forms from this ancient shale is not fertile. Church records show that people have inhabited the Pracais valley for at least four centuries, but probably longer. During this time, they have built hundreds of kilometers of stone retaining walls to facilitate cultivation and irrigation, and to control erosion. To create and maintain fertility they cut brush from the heathlands that cover the ridgetops above the valleys, mix it with goat excrement, and bury it in the soil of the cultivated terraces. The rate at which organic matter is added to soil was measured to be about 12 metric tons dry weight per hectare per year. Chemical analyses of vegetation from heathland species, and of their mixture with goat excrement, determined that this rate was slightly more than adequate to replace the nitrogen, phosphorus and potassium removed from the soil with the annual corn harvest. Annual primary productivity in the heathlands was measured to be about 210 g dry matter per square meter. Vegetation harvested from about 6 to 8 hectares of heathland is required to maintain the fertility of one hectare of cultivated terrace. Thus, the nearby heathlands are as much a part of the economic resources of the village as are the sheds, houses, and cultivated terraces.

RESUMO.—Este estudo descreve processos de manutenção da fertilidade do solo através de técnicas tradicionais, empregues por agricultores em regime de subsistência, que vivem nas encostas da Serra da Estrela, no interior Centro de Portugal. Os dados foram recolhidos essencialmente no grupo de aldeias, junto do rio Praçais, na freguesia de Cabril, concelho de Pampilhosa da Serra, distrito de Coimbra. A pluviosidade anual no local atinge de metro e meio a dois metros e um quarto, principalmente entre os meses de Outubro e Março. Os vales escarpados são susceptíveis de uma intensa erosão, em direcção ao leito do rio, sob acção das chuvas. Raramente chove nos meses de Julho e Agosto, e as temperaturas atingem os 30 centígrados. Os registos paroquiais indicam que a população habita esta zona há pelo menos 4 sèculos, mas muito provavelmente, há mais tempo. Ao longo dos anos, as populações foram erigindo centenas de quilômetros de muros de pedra para suporte da terra, ao longo do vale do Praçais. Destinam-se a segurar o solo para possibilitar o seu cultivo e irrigação e para evitar a erosão. O solo argiloso que é arrastado pelo leito do rio é constituido principlamente por minerais de ilite, e é praticamente infértil. A fertilidade é produzida e mantida, em primeiro lugar, pela adição de matéria orgánica, constituida por mato cortado nas charnecas que ocupam os cumes dos vales, misturado com excrementos de cabra, e enterrada no solo dos terracos de cultivo. Através de observação directa e inquérito aos agricultores, medindo as reas e pesando e medindo os montes da mistura, foi possível calcular que a taxa de adição de matéria orgánica no solo era cerca de 12 toneladas de matéria seca, por hectare, por ano. Análises químicas de amostras da vegetação empregue, obtidas na zona, bem como da sua mistura com os excrementos de cabra, permitiram verificar que esta taxa de adição é ligeiramente superio à necessaria para a substituição do azoto, fôsforo e potássio removidos do solo pelo cultivo anual de milho. A productividade primária nas charnecas, onde o mato cresce, foi determinada com sendo, aproximadamente, de 230g de matéria seca por metro quadrado, por ano. Cerca de um terço destas zonas altas , terreno baldio ou pedregoso. Assim, são necessarios cerca de 8 hectares de terreno com mato para manter a fertilidade de um hectare de terreno cultivável, nos terraços. Isto demonstra claramente a importância das charnecas e matagais circundantes nos recursos econômicos essenciais à tradicional agricultura de subsistência desta região.

RÉSUMÉ. — Les agriculteurs de subsistance des collines basses de la Serra da Estrala, au centre du Portugal, ont aménagé il y a quatre cents ou plus et réussi, depuis, à conserver des sols fertiles dans une région schisteuse intrinsèquement marginale. Pour décrire et expliquer les techniques traditionnelles utilisées, nous avons rassemblé des données dans une zone à 600 m au-dessus du niveau de la mer située en amont de la rivière Pracais, dans le comté de Pampilhosa da Serra, dans le district de Coimbra. Les vingt-trois derniers habitants d'un groupe de trois villages ont fourni des informations ethnographiques précieuses. Durant l'été, la température peut atteindre 40°C et il pleut rarement, mais en hiver, le mercure descend souvent à zéro, rarement au-dessous, et il tombe environ 2000 mm de pluie. La pluie a creusé dans le schiste des vallées profondes à flancs escarpés et la terre est facilement emportée. Le sol argileux qui compose cet ancien schiste n'est pas fertile. Les registres paroissiaux montrent que la vallée de la Pracais est habitée depuis au moins quatre cents ans. Durant cette période, les habitants ont construit des centaines de kilomètres de murs de soutènement en pierre pour faciliter l'agriculture et l'irrigation, et contrôler l'érosion. Pour enrichir le sol et le conserver fertile, ils coupent les brousailles pris dans les landes qui se trouvent sur les crêtes surplombant les vallées, y ajoutent du fumier de chèvre et enterrent le tout dans le sol des terrasses cultivées. Environ 12 tonnes métriques (poids sec) de matière organique sont ajoutées par hectare par année. L'analyse chimique des espèces végétales des landes et du mélange obtenu avec le fumier de chèvre montre que cette quantité est légèrement plus qu'adéquate pour remplacer l'azote, le phosphore et le potassium retirés du sol avec la récolte annuelle de maïs. La productivité primaire des landes a été évaluée à environ 210 g de matière sèche par mètre carré. De six à huit hectares de landes fournissent assez de matière végétale pour maintenir un hectare de terrasse cultivée fertile. Ainsi, les landes voisines font autant partie des ressources économiques du village que les bâtiments, les maisons et les terrasses cultivées.

INTRODUCTION

Fossil fuels, such as coal and oil, are used extensively to manufacture inputs to modern agriculture, while pre-fossil fuel agriculture, here termed "traditional," is principally solar powered. The study of traditional agriculture, where it has supported a population for hundreds of years, can reveal how aspects of its culture and technology overcome ecological, environmental, and social problems to meet the material and emotional needs of its practitioners. The cultural aspects of traditional agriculture include the practices by which the technology is learned, transmitted to subsequent generations, and made resilient against short term vicissitudes of environment or against invasion by inappropriate technology. As part of culture, these practices are celebrated as life-sustaining activities that create and strengthen among individuals ties that form a self- consciously bound community. With this understanding, we can participate more effectively in directing and appreciating our own modern agricultural technology and culture.

Often, agriculture becomes established in areas that are naturally fertile; but the people described here have practiced traditional agriculture where soils are naturally sparse and infertile. Thus, collecting and holding soil, and creating and maintaining its fertility, were important and unusual aspects of their technology. This study combines the methods of cultural anthropology, history, quantitative field ecology, and chemical laboratory analyses to provide both scientific and cultural explanations for the traditional practices of these people to create and restore the fertility of their cultivated soil.

ETHNOGRAPHIC SETTING

To the west and south of the Serra da Estrela, Portugal's highest range of mountains, the large stream, Rio Pracais, descends its steep-sided, twisting, deep valley about 15 km to the town of Pampilhosa da Sera, where it joins the Unha river in the Tejo river drainage (Figure 1). At its headwaters lie three villages: Sobralinho, Malho, and Sanguasuga, called collectively Ribeiros, which means streams. Ribeiros is in the parish of Cabril, about 40° 6′ N, 7° 56′ W (Greenwich), at ca. 700 m elevation, with ridge tops 100 m to 250 m above. Downstream from Ribeiros, the valley of the main stream soon becomes so deep and steep that agricultural development has occurred mostly along tributaries. On a tributary about 6 km downstream is the village of Pracais. Two kilometers further, over the ridge, along the next major tributary lie the three villages of Piscanseco. The whole Pracais drainage lies within the county (Concelho) of Pampilhosa da Sera, in the state (Distrito) of Coimbra, Portugal.

METHODS

I first visited the Pracais valley in 1980, when I was taken to the villages of Piscanseco by an adult who was born and raised there. It was apparent that the only agriculture then practiced was based on pre-fossil fuel technology. Families owned the land they worked and worked on their own account, primarily for subsistence.

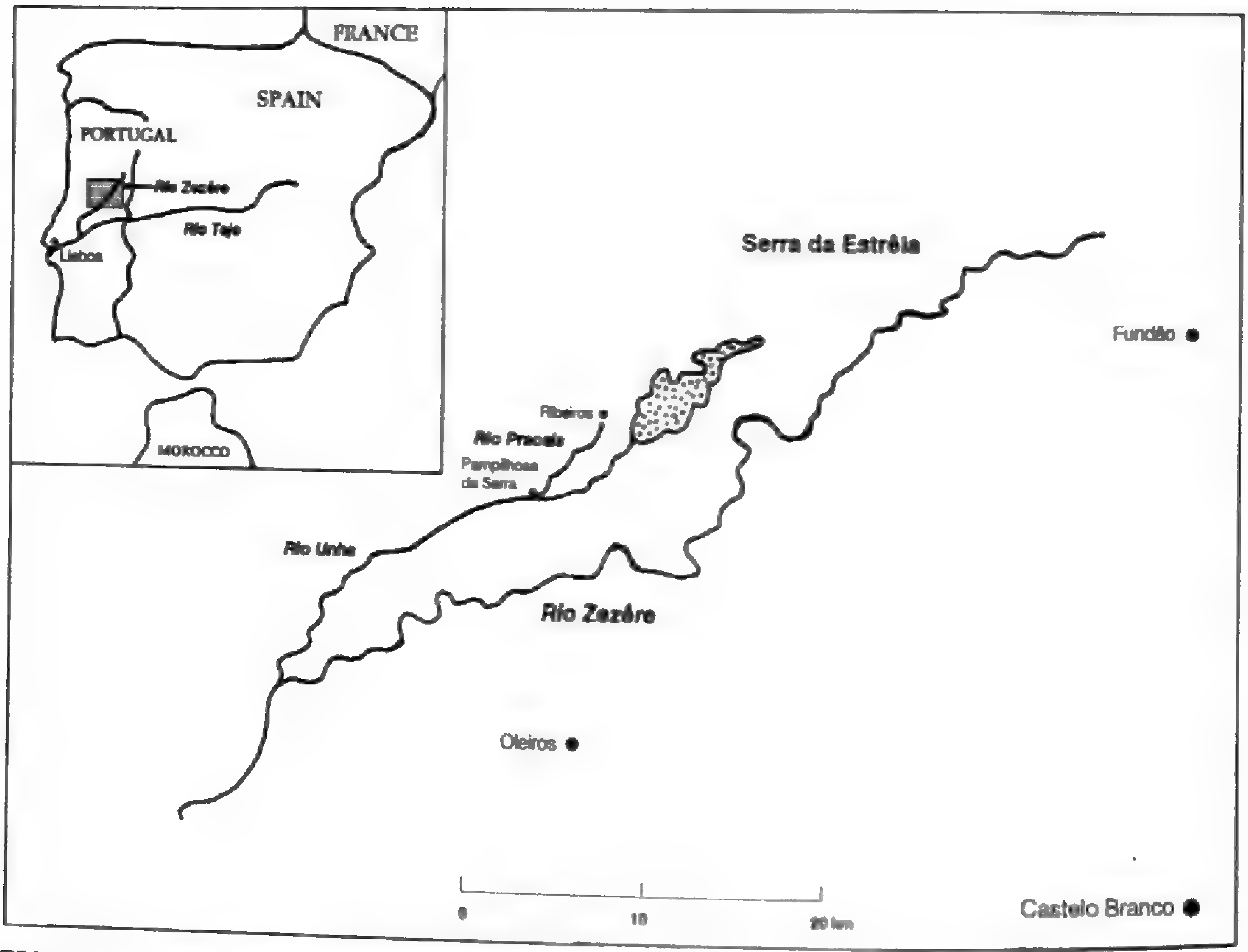

FIGURE 1.— Location of Rio Pracais and the Ribeiros village group within Portugal.

I returned to the Pracais valley briefly in 1983 and 1984, and subsequently lived in Ribeiros from August through December 1987 to study the agricultural technology practiced there. I spent six equally spaced weeks during this time in Lisboa to work with the Laboratorio Quimica Agricola Rebelo da Silva (LQARS), the Portuguese Agricultural Ministry's chemical laboratory, to analyse samples, or in Oeiras at the Herbarium of the National Agronomy Station to identify plants, or at the University of Coimbra to examine the Archives and weigh plant material. I returned to the Pracais valley briefly in July 1993.

In addition to personal observation of the weather in Ribeiros, I estimated the general climate in recent years by examining the records of the Portuguese National Meteorological Service at the Instituto Superior de Agronomia in Lisboa, where records from locations near Ribeiros were available for some years beginning in the early 1960s. Monthly rainfall data were available for the towns of Vidual, Cabril, and Fejao, all within 10 km of Ribeiros. Monthly average daily temperature maxima and minima, total monthly evaporation, and hours of sunshine were available only for the more distant and larger small cities. Fundao (34 km east) was chosen as representative because of similar altitude and terrain.

During this time, I observed and measured the terrain, which has been extensively modified by the construction of tens of kilometers of terraces. These are an integral part of the agricultural technology because most of the annual crops are cultivated in soil they retain. I observed the forests and heathlands, which play important roles in this subsistence economy. I observed the cultivated crops, including the timing and technology practiced by the people who cultivate them.

Much information was gathered by interacting directly with the permanent residents themselves. Two married couples provided me food and shelter, and introduced me to some of the other residents of Ribeiros. This endorsement by my native hosts was essential for other residents to speak freely with me. Estabrook (1994) presents a detailed description of interview and observation methods used to gather data directly from residents.

I used two approaches to estimate the number of residents in Ribeiros in 1900 and 1940. Church records in the archive of the University of Coimbra and civil records in the town of Pampilhosa da Serra indicate baptisms in towns in the Pracais valley, including Ribeiros. Numbers of hearths and numbers of people were estimated for 1900 and 1940 using national census counts from 1890 and 1930 of people per hearth and baptisms per hearth for the nearby towns of Cabril and Pampilhosa da Serra, because Ribeiros was too small to be reported. The ratios from these two towns were applied to the available baptism counts for Ribeiros. I also estimated the number of people in Ribeiros in 1940 from the number I observed in 1987 and the fraction of terraces I observed to be under cultivation in 1987.

An important aspect of the technology by which people create and maintain soil fertility is by adding large amounts of organic matter to the soil. I observed how people collect this organic matter as brush from the heathlands, enrich it with goat excrement, and allow it to begin decomposition, before they add it to the soil at specific times. Corn (*Zea mays* L.) is a major crop, which is harvested in October. I was able to observe and measure this harvest. I estimated the amount in dry metric tons per hectare of organic matter that people added to the soil to restore fertility after they harvested this corn crop. People carry baskets of organic matter to the plot where soon it will be spread out and mixed with the soil. They empty baskets into a pile against the wall at the uphill side of the plot. With the cooperation of their carriers, I weighed several baskets using a hand-held, spring-loaded scale. The number of baskets emptied to make a pile, together with the volume of the pile, was used to estimate the weight of a cubic meter of organic matter. I sealed a sample of organic matter in a plastic bag and later, in a laboratory in Coimbra, weighed, dried, and reweighed it to determine percent dry weight. Farmers made four piles during my stay. For each, I measured the volume of the pile and the area of the plot over which it would be spread.

Just before its harvest in October, I measured corn yield in the irrigated streamside plot known to be cultivated using traditional practices. The number of ears on all stalks in three areas of four m^2 each were counted. Also counted were the numbers of grains on several ears. Later in Coimbra, I weighed 100 grains. From these data, yield in kg of dry seed per hectares was calculated. The residents allow the seeds to dry thoroughly on the stalks before harvest so that they may be more easily removed from the ears and milled into flour for bread. Barber and Olson (1968) used chemical analysis to estimate the amounts of plant nutrients contained in corn plants producing 10,000 kg of dry grain grown in Wisconsin. They report 200 kg N, 42 kg P, and 205 kg K. Recognizing that corn plants in Ribeiros may differ somewhat from this composition, these removal rates per 10,000 kg dry grain, together with the yield estimated for the plot in Ribeiros, were used to estimate the rate at which nutrients are removed from the soil in that plot per corn harvest per hectare.

I homogenized many samples of *estrume* (as the residents call their mixture of heathland plants and goat excrement) and analyzed it by chromatography at

LQARS to determine g/kg of nitrogen, phosphorus, potassium, calcium, magnesium, and sulphur. In all four plots, estimates of the amounts of nitrogen, phosphorous and potassium removed from the soil with the corn harvest were compared to the amounts added to the soil in organic matter. Vegetation samples of the nine principal plant species in the heathlands were also analysed in the same way. Comparing these measurements with those for estrume provides clear evidence of the contribution of goats to estrume (as shown in Table 3, below).

The area presently and formerly used by the residents is essentially the entire upper drainage basin (Figure 2). Fifty-five soil samples were taken from 23 sites throughout this area, including uncultivated clay, heathland, irrigated streamside and terraced plots, and unirrigated terraced plots (see Table 4, below). Some of the plots were still actively cultivated, though others had been abandoned for from two to 20+ years. Soil sample sites were chosen in order to measure and compare the nature of various local soils of interest to this study. The uncultivated clay represents soil before residents invest in it. The one or two cm of soil over the rock outcrops from which the heathlands grow may have been a source of soil to pioneering cultivators. Actively cultivated plots have received hundreds of years of annual influxes of organic matter, and when irrigated have remained wet all year long. Recently abandoned plots may reflect the cultivator's intent to abandon. Long abandoned plots may show the restorative effect of fallow. Measurements of soil samples from each area of interest will be presented and discussed below.

At most sites, about 10 soil cores, each about two cm in diameter and of lengths depending on site from superficial to 40 cm, were taken from within about a two square meter area. In cultivated plots, about the top 10 cm are disturbed when organic matter is added or new crops are planted, so the 5-6 cm section was usu-

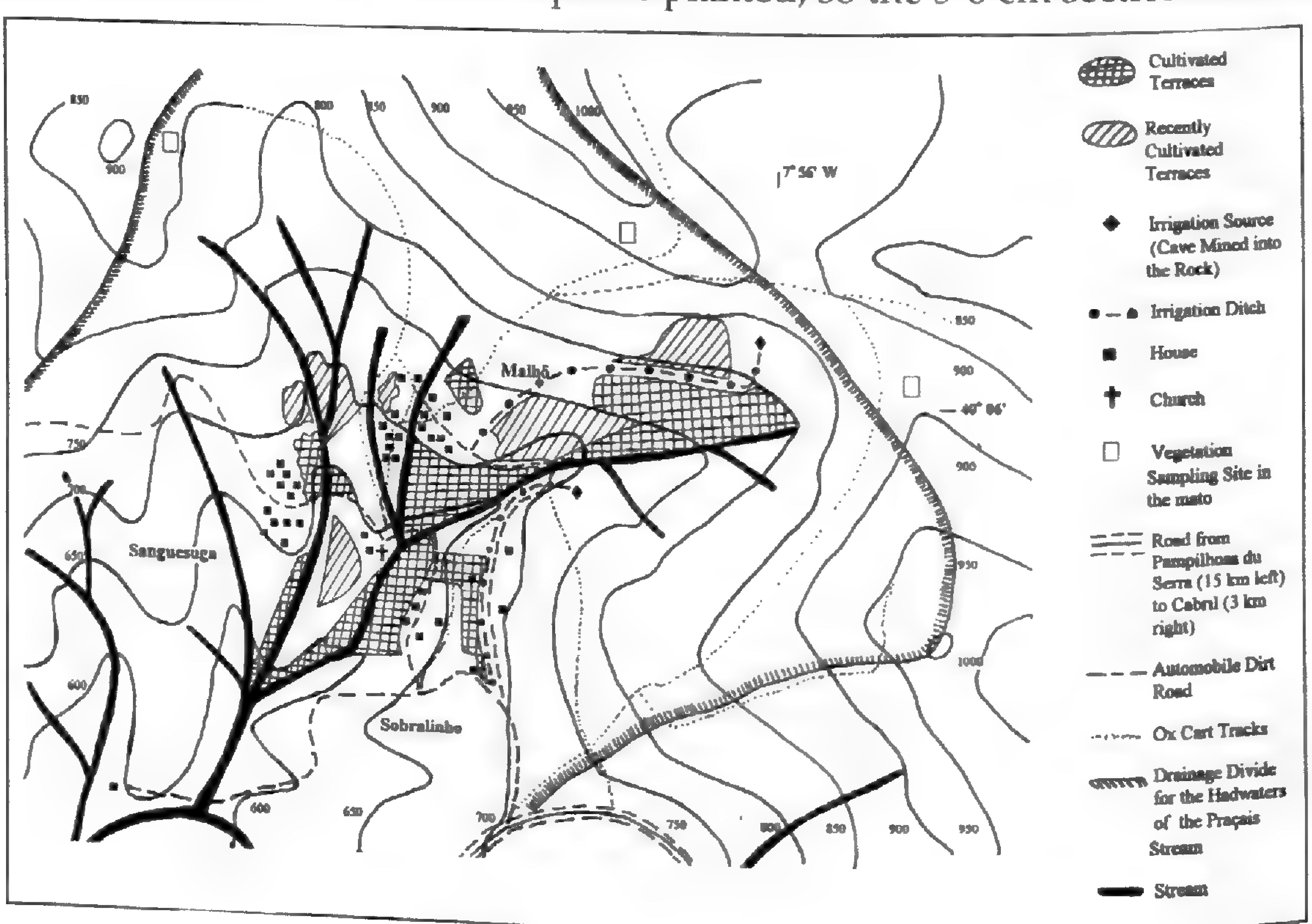

FIGURE 2.— The location of the Ribeiros village group and related features within the head waters of Rio Pracais.

ally taken from these disturbed strata, along with a section at 20-21 cm just below the actively disturbed depth. In a few cultivated plots the soil was deep enough to allow a section from 40 cm. Within a plot, sections from the same depth were then combined and homogenized to make a single soil sample. Values for N, P, and K may be affected by periodic additions by farmers of organic matter to cultivated plots, as described above. Samples from such plots were taken about two weeks before the corn was harvested in early October. Soil samples were analysed at LQARS for particle size, water holding capacity, organic matter, total nitrogen, carbon to nitrogen ratio, extractable phosphorus and potassium, pH (both in water and in dilute KCl), and cation exchange capacity

Because people collect large amounts of vegetation from the heathlands to add to the soil in their cultivated terraces to restore its fertility, the heathlands are an important resource for their agricultural technology. To estimate the ratio of area of heathland needed to support area of cultivated terrace, I measured the rate of growth of vegetation in the heathlands. I cut, removed, dried and weighed all the vegetation from sample plots in two distinct areas. In one area that people said had been cut to near ground level 4 years earlier, which is the regeneration interval allowed before they clear-cut vegetation again from the same place, I clearcut plots covering two square meters. In the other area, which had burned over in a local fire eight years earlier, I clearcut plots covering six m^2. Because the purpose of this vegetation sampling was to produce an estimate of the rate of primary productivity in the heathlands that is as accurate as possible, all the vegetation from plots of the same age was pooled to avoid pseudo-replication. Dividing previously estimated rates per unit area at which people add organic matter to soil to restore fertility after a corn harvest by rates per unit area at which vegetation grows in the heathlands estimates the ratio of area of heathland needed to support area of cultivated terrace.

RESULTS

Climate. — Monthly temperature, rainfall and evaporation data are presented in Table 1. Lows at or below freezing occur in a dozen or so days spread over the months from November through April with average lows in the single digits C and average highs in the teens. Rains typically begin in September or October, becoming strong in November, intense in December, strong again in January and February, moderate in March, taper through April and May to sparse in June, and absent in July and August. Typical annual rainfall in Vidual, Cabril and Fejao (all within 10 km of Ribeiros and about the same altitude) is from 1.5 to 2.2 m of which about 80% falls from November through February. Direct sun and drying of the air occur infrequently during these months, as shown by the sun hours and evaporation potential in nearby Fundao. By April it is drier, sunnier, warmer, and freezing is improbable. June, July, and August are very hot and dry, with highs sometimes near 40° C. The timing and amount of rains are quite variable from year to year, and to a lesser degree from place to place. Occasionally, rains will start late, or annual rainfall will barely exceed 1000 mm. Some aspects of the agricultural practices anticipate this uncertainty.

Terrain and terraces. — The Pracais flows sw away from Portalinha Pass (900 m), which is 1.5 km ne from the church (600 m) shown by the cross in Figure 2. The principal cirque has a radius of about 1 km for its northeastern half, but the divides narrow to about 1 km apart 2 km downstream from the church. Many streams flow out of this cirque, joining in and below Ribeiros as the divides begin to narrow. A lesser ridge, from northwest of the pass, slopes SW to the middle cluster of residences and divides the cirque into two lesser cirques: one faces west below Portalinha pass and carries the main stream; the other faces south below a high ridge and carries one of its many tributaries. The beds of these two streams are 1 to 2 m deep and so difficult to cross that they divide the lower basin into the three small villages mentioned above: Malho on the small ridge between them; Sobralinho on the NW facing slopes south of the main stream; and Sanguasuga, now completely uninhabited, on a South-facing promontory West of this tributary, which joins the main stream 300m below.

These slopes have been developed into productive, cultivated plots in a variety of ways. In the past, rye (*Secale cereale* L.) was cultivated during the winter in distant, unterraced, heathland plots without irrigation. Perhaps because of their distance from the residence cluster, these plots have been abandoned. Formerly most and presently all cultivated soil is held behind stone walls. These are built high enough to hold soil at a depth sufficient to grow crops and to create a level terrace wide enough to stand on to cultivate. Walls also protect soil from erosion and facilitate irrigation.

Approximately 40 km of retaining walls are in the area represented by the map in Figure 2. They have been built in three basic styles. North of the main stream, beginning several hundred meters east of Malho, continuing downstream through the villages and below, are wider, sloping, cultivated plots behind streamside walls, each an ownership parcel 10 to 30+ m long. Below Malho on the northwest facing slopes of Sobralinho, there are similar plots south of this stream as well. A second style occurs on the south facing slopes north of, and farther from, this main stream. These consist of series of nearly level cultivated terraces, behind retaining walls from 1.5 to 2.2 m tall. The gullies of streamlets that run southward or westward have frequently been breached by masonry walls and backfilled to produce yet a third kind of cultivated terrace.

TABLE 1. — Data to estimate weather in Ribeiros

		‡	J	F	M	A	M	J	J	A	S	O	N	D
Cabril	1965	*r*	241	128	194	12	18	3	0	0	131	261	274	175
Vidual	1978	*r*	214	328	89	195	109	77	0	1	38	76	68	568
Fejao	1978	*r*	256	324	123	171	94	83	0	0	36	76	84	660
Fundao	1968	*M*	13	12	14	16	21	24	30	30	24	24	14	11
Fundao	1968	*m*	1	5	6	7	10	14	16	16	13	11	7	5
Fundao	1968	*x*	-4	-2	0	0	3	10	10	12	7	8	3	-3
Fundao	1966	*h*	59	66	291	206	340	348	371	346	243	172	154	195
Fundao	1966	*e*	54	54	146	112	204	185	287	265	229	90	62	70

‡ r = rainfall in mm; M = monthly average of daily maximum temperature in Centigrade; m = same for daily minimum; x = extreme lowest temperature during the month; h = total numbers of hours of sunshine; e = total monthly evaporation potential in mm.

Forest and Heathland. — On the north facing slope south of the main stream and east of Sobralinho were formerly chestnut groves (*Castanea sativa* Mill.), managed for chestnuts and for wood for lintels and bridges. These trees were cut in the 1950's and 60's for sale to the hardwood furniture industry. A few regenerating stumps remain. The area was replanted in maritime pine (*Pinus pinaster* Aiton). Oaks (*Quercus* sp, perhaps *Q. suber* L. or *Q. ilex* L. among others) used to grow on the steep, south-facing hillsides. These supplied firewood, oxcarts, floorboards, toolhandles, etc., but are now replanted also in maritime pine. Above the steep upper slopes, where the ridge tops level, are heathlands. (The names of the nine principal species of heathland plants are given in Table 3 below.)

Crops. — Rye, corn, potatoes (*Solanum tuberosum* L.), beans (*Phaseolus vulgaris* L.), and collard (*Brassica oleracea* L.) are staple annuals. Perennial woody fruit-bearing plants include fig (*Ficus carica* L.), olive (*Olea europaea* L.), apple (*Pyrus malus* L.), quince (*Cydonia oblongata* Mill.), raspberry (*Rubus* sp), walnut (*Juglans regia* L.), chestnut (*Castanea sativa* Mill.), and marginally grape (*Vitis vinifera* L.). Rye is planted (now in terraces) at the beginning of the rainy season, grows vegetatively through the cool wet winter, flowers in the warmer spring, and the dry seed is harvested in late spring. The fact that rye is no longer cultivated in the heathlands may explain why the 1940 population estimated from terraces is more than that estimated below from baptisms.

The variety of collard, called *cove* in Portuguese, grows in the cool wet winter. It is planted in late summer as seed in a small, crowded, irrigated patch, and at the beginning of the rains, is transplanted at 0.5 m intervals. During the cool, wet winter, it grows to a height of two m and produces broad, thick leaves, which are eaten all winter long as a source of fresh vegetable, yielding vitamin C and fiber. Its inclusion in the diet contributes to the health and longevity of these robust people.

Corn is planted in the spring in irrigated plots. With adequate irrigation, it thrives in the hot summer. Ears are not harvested until late September before the rains start but after the grain had dried. *Cove* is often transplanted into the plot where corn grew in the spring and summer, and occupies it during the fall and winter. By contrast, rye cannot be grown to seed in plots where corn is to be grown because it does not mature in time for corn to be planted. Rye is sometimes planted in corn plots to help hold the soil in the torrential rains of winter, but is fed to goats before it flowers, so that corn can be planted.

Corn is planted two seeds per hill about 40 cm apart in all directions. When the stalks are about a 0.5 m high, the corn is thinned. From hills with two surviving stalks, one is removed and fed to goats. A few bean seeds are then planted around the base of the remaining stalk. During the summer, as the bean vines climb the corn stalks, the lower corn leaves are removed and fed to goats. Beans are harvested by pulling up the corn stalks after the ears have been removed, at which time the bean seeds are dry. Most organic matter that goats cannot or will not eat is buried in the soil. By contrast, corn stalks are pulled out by their roots and burned.

Sometimes beans are planted without corn, which, as the cultivators explain, gives the plot a rest. Non-climbing varieties are used for this. Pumpkin (*Cucurbita* *pepo* L.) is often planted along the upper wall in these plots. Potatoes are planted earlier in the spring than corn but, later in the spring, need irrigation to flourish. Their harvest is able to begin in May, providing an early staple, and continues through the early summer. Potatoes are harvested too late to allow corn to follow them, but beans can be planted. During the warm seasons, in irrigated kitchen gardens near the dwellings, an array of vegetables is grown, including lettuce (*Lactuca sativa* L.), onion (*Allium cepa* L.), carrot (*Daucus carota* L.), tomato (*Lycopersicon esculentum* Mill.), and garlic (*Allium sativum* L.).

Demographic history. — An inscription on a building in Pamilhosa da Serra states that King Dinis awarded the surrounding area as a fief to one of his nobles in 1308, but the earliest written record of habitation by a specific person that I found is a baptismal record from 1667. Records of parish rituals associated with birth, death, and marriage in the Pracais valley are nearly continuous since that date, and clearly indicate that the valley was well populated long before the mid 17th century. I have no direct evidence of the agricultural technology employed in the 16th and 17th centuries, but it is clear that the soil was naturally infertile, having weathered from the same ancient shales, and that the steep hillsides were then equally prone to soil erosion. Thus, it seems plausible that terraces were already in use to retain soil of sufficient depth and to control erosion.

I estimated the Ribeiros population in 1900 and in 1940 from baptisms to be about 131 and 260 people respectively. In 1987, 23 people lived in Ribeiros and cultivated only about 1/12 of the area of the terraces, the rest being left uncultivated. Residents confirm that in the 1940s every terrace was cultivated. Assuming a constant ratio of people to terraces, I estimate about 276 people in 1940, close to the estimate based on baptisms.

Residents tell me that the first road capable of carrying a motorized vehicle was built by hand in 1942, preliminary to the construction of the power dam near Cabril, and that most people there had never seen a motorized vehicle before that time. Thus it seems plausible that in 1940 the Ribeiros traditional, pre-fossil fuel agricultural technology was intact and capable of supporting 250+ inhabitants.

In 1987 Ribeiros still had at least 23 permanent residents, who told be they had been born there, or had come there to be married, and still remained. All were over 60 except for three young adults. Two were sons of a family that no longer farmed. They left the village daily with their father to labor for wages. The last was a farmer's daughter who worked with her parents. Four married couples and five single women still actively raised crops for much of their livelihood. The remaining five-six people lived mostly on pensions or savings but planted a few crops. There were no children nor single elderly men.

Addition of Organic Matter to Soil. — The principle means for maintaining soil fertility is to add organic matter to the soil. This organic matter consists mostly of brush, cut from the heathlands. Every active cultivator kept at least a few goats. Three or four days a week, a cultivator will take his or her goats, and often another's too, up to the heathlands. While the goats are grazing, the cultivator harvests brush. A heavy sickle is used to cut the bushes about 2 cm above the ground. An area of one or more m^2 is clear cut leaving nothing but stubble. Formerly the brush har-

FIGURE 3.— A bundle of brush about to be carried from the heathland where it was cut, down to a goat shelter in the village below. Photograph by the author.

vest might have been transported to the villages by ox cart, but now there are no more oxen, so it is piled into a bundle, tied with a single loop of rope, hoisted onto the head and carried down the hillside and back to the village (Figure 3). Often a piece of cloth protects the head and neck from thorns and prickles, with which this brush is replete. Typically, the brush bundle will be as large as can be reasonably carried; in the case of one strong farmer about 65 years old, a bundle he was carrying down the steep path back to the village weighed 42 kg.

Not all of the stone buildings are residences; some serve for storage on their main floor, and house goats at night in the basement. The brush is carried to these buildings and spread on the basement floor, to be enriched by goat excrement. I did not observe the inclusion of any other organic wastes with this brush. Enriched brush is removed about every two weeks and piled outdoors nearby (see Figure 4). Now called *estrume,* it will eventually be transported to the cultivated plots where it will be dug into the soil with large hoes, though formerly it might have been plowed into the soil with cow- or ox-drawn plows. Other organic wastes, including human, pig, and chicken excrement, were dug directly into the soil of nearby kitchen gardens.

Data to determine the rate at which farmers added estrume to cultivated plots following a corn harvest are given in Table 2. Eleven baskets of about 20 kg each (220 kg) of wet estrume made a pile of about 1.33 m^3. About one thirds of the wet weight of estrume is water. Thus dry weight of one cubic meter of estrume is estimated to be about 110 kg. This estimate was used to calculate dry weight.

TABLE 2. — Rate at which estrume is added to plots cultivated in corn.

Location/type	D	V	W	P	R
Sobralinho terrace; farmer not interviewed	2.6 x 1.4 x 0.7	2.5	275	220	12.5
Lower streamside traditional, corn yield estimate plot "d," Table 4.	3.5 x 1.0 x 1.6	5.6	615	440	14.0
Upper streamside traditional, followed with forage rye	2.8 x 1.0 x 2.0	5.6	615	470	13.1
Sobralinho terrace, same farmer as above, followed with fallow	1.8 x 1.1 x 1.4	2.8	336	505	6.7

D = dimensions of compost pile in meters; **V** = volume in cubic meters; **W** = dry weight in kg; **P** = plot size in square meters; **R** = rate in metric tons per hectare.

FIGURE 4.— A pile of brush that has been removed from the floor of a goat shelter, ready to be buried in the soil of cultivated terraces. Photograph by the author.

Nutrient replacement rate. — Corn yield in a cultivated plot was estimated to be 5,800 kg dry seed per hectare. Applying the rates of Barber and Olsen (1968), an estimated 116 kg N, 24 kg P, and 119 kg K are removed from the soil by the corn plants harvested from each hectare. Table 3 presents the concentration in g dry weight per kg of some agriculturally important elements present in estrume and in the various species of heathland bushes. These data can be used to estimate the rate at which estrume would need to be added to the soil each corn harvest to replace the nutrients removed by the corn in that harvest. Because 1.44% of estrume is nitrogen, 8.6 dry metric tons would be needed to replace the nitrogen removed from the soil in one corn harvest. Because 0.36% of estrume is phosphorous, about 6.8 metric tons of estrume are needed, and similarly about 9.0 metric tons for potassium. By comparing the values in Table 3 for vegetation sampled directly from

TABLE 3. —Dry gm / kg of elements in vegetation and estrume samples. Scientific names according to Franco (1971, 1984).

	N	P	K	Ca	Mg	S
Estrume	14.4	3.8	13.2	4.6	2.9	1.7
Calluna vulgaris (L.) Hull	5.8	1.0	1.7	2.4	1.0	1.0
Erica umbellata L.	9.0	0.6	1.2	1.6	0.9	0.7
Halimium ocymoides (Lam.) Willk. In Willk. & Lange	5.9	0.8	1.6	2.1	1.3	0.8
Lithodora diffusa (Lag.) I. M. Johnson	6.3	1.0	1.8	2.4	1.2	0.9
Erica cinerea L.	6.4	1.6	4.2	2.9	0.9	1.0
Chamaespartium tridentatum (L.) P. Gibbs	4.8	1.0	2.6	1.8	0.9	0.8
Ulex minor Roth	6.4	1.4	2.1	3.8	1.0	0.6
Genista triacanthos Brot.	12.4	1.0	3.4	1.3	0.9	0.9
Erica arborea L.	8.6	0.6	2.0	1.0	0.8	0.6

TABLE 4. —Analyses of soil samples representing plots of interest.

	F-W=A	O	N	P	K	pH	cxc	x
a. Uncultivated clay	27-11=16	0.9	1.0	2	70	4.8	9.5	2.4
b. Shallow soil from heathlands	31-11=20	7.9	3.1	39	174	4.7	14.5	3.8
c. Terrace irrigated Cultivated	34-12=22	7.5	3.6	366	378	4.9	20.0	6.4
Same plot 20 cm	32-12=20	5.2	2.7	188	126	4.7	17.7	4.3
Same plot 40 cm	31-10=21	5.2	1.7	34	96	4.5	13.6	3.3
d. Streamside irrigated Cultivated	36-12=24	6.2	4.3	89	169	5.7	23.4	12.2
e. Streamside irrigated abandoned 2 yr	35-17=18	8.8	4.5	206	142	4.7	21.7	7.0
f. Streamside irrigated abandoned 4 yr	33-15=18	8.8	4.8	53	126	4.4	12.7	4.2
g. Streamside irrigated abandoned 20+ yr	36-17=19	9.3	5.3	39	196	4.6	16.4	4.7
h. Terrace irrigated abandoned 9 yr	27-12=15	6.2	2.8	50	126	4.3	9.2	3.1
i. Terrace unirrigated abandoned 30? yr	33-14=19	7.3	3.8	14	215	5.0	22.3	6.9

F = field capacity; **W** = permanent wilting point; **A** = available water; **O** = organic matter; (F, W, A, O in %); **N** = total nitrogen (in g/kg); **P** = phosphorus; **K** = potassium; (P, K extractable in mg/kg). **pH** = titrated in water; **cxc** = cation exchange capacity; **x** = exchangeable Ca, Mg, K, and Na; (cxc, x in cmol(+)/kg). Sample at 5 cm depth unless otherwise noted.

the plants with values for estrume, the effect of the goats is easily seen. They approximately double the nitrogen, triple the phosphorous, and increase potassium several fold. Residents said that when they were young, the village was full of people, every terrace was cultivated, and there were hundreds of goats. There were about 25 goats in Ribeiros when I was there. Using the same 12:1 ratio of total to cultivated terraces cited above, indicates a goat population in 1940 of about 300, which would have been needed to maintain fertility in all the cultivated terraces.

Soil analyses. — Table 4 presents values for 10 measurements of each of nine typical samples from plots that represent the various situations of interest to this study, as described above. These data are available on request.

How much heathland is needed? — As noted above, soil fertility in cultivated plots is maintained in large part by adding to soil heathland brush enriched with goat dung. The rate at which brush grows limits the rate at which it can be harvested to replenish cultivated soil. Harvesting brush yielded 1.25 dry kg/m^2 in areas last harvested four years earlier, and 3.3 dry kg/ m^2 in areas that had been burned eight years earlier. This gives average annual productions of 312 and 410 dry gm/ m^2. Since burning the vegetation produces ashes that enhance plant growth, while removal of vegetation to make estrume does not, the higher of the two estimates of the regeneration rate of harvested brush is somewhat too high. Furthermore, these experimental harvests were taken from areas of heathland where brush grows well. As much as one third of the heathland is outcrop, boulders, or cart tracks, where little vegetation grows. Thus, assuming 12 metric tons of brush are required annually for each hectare cultivated, approximately six hectares of heathland are needed to grow the brush to replenish the soil in that cultivated hectare.

DISCUSSION

The climate and weather patterns, with very hot dry summers and cold, rainy, overcast winters, the steep crumbly terrain so difficult to even walk over, and the inherently infertile soil raise the question of why people should ever have settled the Pracais valley, and why they did not starve before they developed the agricultural technology that has nourished them for the past half millennium. Acquiring the data to answer this convincingly was beyond the scope of the present study, but other authors have suggested patterns that may apply here. Underdown (1985) points to a tendency for more marginal land to be owned and occupied by families who farm it themselves for subsistence, perhaps to avoid the exploitation following the concentration of wealth typical of economies built on fertile, easily farmed soils. Thirteenth and fourteenth century plagues killed about 40% of the population, mostly in concentrated urban areas. People may have sought unoccupied, and hence marginal, lands to escape this threat of death. Reduced populations made it difficult for the exploiting class to separate people from the land, so subsistence agriculture prospered, commercial agriculture waned, and urban centers experienced a shortage of grain (Oliveira Marques 1977).

The use of brush as a source of organic matter for soil enrichment in northern interior Portugal is probably quite old and widespread. It is explicitly discussed by Lacerda Lobo (1787) in his prize winning essay about the maintenance of soil fertility in the absence of animals. Bella (1805) writing about Portuguese agriculture states (p 154) that those who intend to grow more for themselves depend on brush to fertilize their cultivated land. Motta Prego (1897), in one of his many novels written near the turn of the 20th century to encourage young adults in northern Portugal to become or remain farmers, describes the cries of the ox-cart drivers as they return in the evening from the hill tops with their loads of cut brush.

Comparison in Table 4 of the soil in an organically enriched plot with the uncultivated clay of plot "a" clearly shows the contribution of increased organic matter. But the abundant organic matter in the cultivated soil of Ribeiros does more than provide nitrogen, phosphorous, and other nutrients. According to Magdoff (1992), organic matter facilitates the penetration and retention of water during irrigation, which is important for keeping crops supplied with water during the dry season. It facilitates the penetration of water during rains, which increases absorption and reduces surface erosion. It glues the soil together to help resist erosion during the heavy rains of winter. Organic matter increases the soil's capacity to hold and release ions, which is important for soil-root interactions, and it maintains the ecosystem of microbial and fungal life, which mediates the passage of nutrients to plants.

Plot "b" in Table 4, a heathland plot, is high in organic matter but, because it does not benefit so much from goat excrement, decomposes slowly and erodes rapidly. A comparison with other cultivated plots in Table 4 further shows how goats contribute. A few goats are milked, and occasionally one is eaten, but perhaps their most important contribution is to the maintenance of soil fertility. This has an importance beyond simply adding more nutrients. Goat excrement increases nitrogen and other nutrients and decomposes carbon more efficiently relative to the carbon in the brush. Griffin (1972) suggests that the species that make up the community of decomposers are largely determined by the ratio of carbon to nitrogen and other nutrients. Thus goats may also alter the species composition of the decomposing community in favor of those that thrive at higher nutrient levels.

One might ask why nitrogenous wastes of the other domesticated animals, such as chickens and pigs, not to mention human wastes, are not added to the brush with the goat excrement. As noted above, these types of excrement are buried instead in kitchen gardens. Perhaps it is to minimize the transmission of disease. Their wastes do not represent outside inputs. By contrast, goats, like the brush itself, gather nutrients from many km^2 and concentrate them in nearby cultivated soil. Sheep, cows, and sometimes pigs render this concentrating service in other agro-ecosystems. Here the terrain is steep and the rock is crumbly; the light, agile, sure-footed goat, unlike other domestic animals, ranges safely throughout the whole area. In addition there is very little grass but mostly forbs and shrubs, which goats eat more readily than these other animals.

Farmers often treat their goats affectionately, as if they were pets. No effort is made to herd or restrain the goats. They willingly follow farmers, who refer to their brush gathering activities as providing food and bedding for their goats, but the goats neither eat it (much) nor sleep on it. Farmers know that the brush is to maintain the fertility of their soil, but will still explain brush gathering in terms of goat care. Estabrook (1994) discusses this and several other explanatory anomalies in the tradition of these farmers. Perhaps 30% of the total time spent on economic activities by a farmer is invested in goats, harvesting and hauling brush, and making and hauling estrume. People say that in the past, brush was brought down in ox-carts. A few years ago someone was killed when he lost control of an ox-cart and now people say that they are too old to manage oxen safely. Oxen consume a great deal of food. There is virtually no pasture in this terrain, so ox food has to be grown. Thus oxen must be kept at work to amortize their operating costs. The need for ox food in the past results in an overestimate of population based on cultivated area. I saw no oxen resident in Ribeiros, but one farmer said he borrowed an ox from the nearby village of Vidual to plow. Several broad paths lead from residential areas up into the brush meadows and stop. These paths often crossed outcropped bedrock, where wheel ruts, worn by ox-carts into the soft shale, could be seen, evidence of the importance of oxen in the past.

Bearing in mind that corn yields may vary from plot to plot, that estrume and corn constituents may vary from our estimates, and that cove, beans, or winter rye may also be grown during the rest of the year (except when farmers fallow, which I suspect is not a traditional practice but evidence of the demise of traditional agriculture), it is apparent that farmers are approximately replacing with estrume the nutrients removed from the soil by the plants they harvest.

It is not surprising that the rate of soil replenishment by the addition of organic matter is sufficient to replace the nutrients removed and to maintain water holding capacity and tilth. After all, people have been raising crops in this soil for hundreds of years. The mechanisms suggested by the data are of interest. Azevedo and Ricardo (1973) suggest that the clay is weathered from precambrian shale, perhaps in its second or third soil cycle. From sample "a" in Table 4 it is clear that the native clay is low in plant nutrients, intrinsically acid, low in cation exchange capacity, and with few exchangeable cations. The addition of organic matter raises available water capacity somewhat, substantially increases nutrient levels, has little effect on pH, and substantially increases cation exchange capacity and availability, as shown by comparison with other samples in Table 4. It is possible that the cultivator of plot "c" added commercial phosphate or potassium fertilizer to the soil there because these values are conspicuously high, compared to plot "d," the other cultivated plot of Table 4. Plot "d" — in which I estimated corn yield and rate of addition of organic matter — was cultivated by a 67 year old man and his wife, who were my hosts. Trucks selling fertilizer do pass through the village. One frail lady in her 80s explained to me that she used fertilizer because she was too weak to carry brush any more, making it clear that people understand that brush does replenish soil nutrients, and that they proudly work on behalf of their own family even if they are its only remaining aged member. Plot "c" was in beans following potato, so rate of organic matter addition could not be measured because none was brought to that terrace during the five months I was there. However its 74 year old male cultivator did collect copious quantities of brush for his goats' bed, making it clear that people did understand that organic matter was not just to replenish nutrients.

Another natural question also beyond the scope of this study is why a culture, with its attendant technology, that was thriving with hundreds of practitioners in the villages of the Pracais valley in 1940 has dwindled to a few practitioners in 1987 and to virtually none in 1997. Caldas (1981), Serrao (1982) and Brettell (1986) state that in the 1930s traditional agricultural technology was still practiced in most villages in northern interior Portugal but emigration, especially of men, had begun. Roads and motor vehicles may have reached some villages by this time, facilitating government (exploiter class) tactics, such as taxation and conscription, that separate people from the land and force participation in the cash economy. Under the dictatorship of Salazar, suppression and exploitation of the lower classes was apparently so intense that it was clearly preferable to emigrate into menial laborer positions in other countries, lead frugal lives, and send money home to Portugal. In spite of harsh government laws prohibiting emigration, by the 1960s the exodus was rampant, contributing to the demise of depopulated villages, especially after a generation is born and raised in exile, where the invisible transmission of their culturally informed technology does not occur.

Since the 1970's, many emigrants have returned to their native villages to retire. They bring pensions and savings with which to create demand for food, brought by trucks into the villages and exchanged for cash. The residents of the village of Pracais are now nearly all retirees who live in original dwellings but no longer practice subsistence agriculture. By 1987 in the Piscansecos, many young inheritors had converted the dwellings of their deceased ancestors to vacation homes with running water, disregarding traditional mores for water sharing and human waste management. This led to overt hostilities from the older, permanent residents, decimating the cultural basis of their technology. Although aging, many of the permanent residents of Ribeiros still practiced aspects of their culturally informed subsistence agriculture and depended on it in large part for their livelihood. My glimpses of this way of life suggested that it depends on three generation households in which people of all ages had useful roles to play. The attraction of young people away from their culture and land seems to be an integral part of the process by which this culture dissolved. A few young Portuguese desire to return to the culture and land of their grandparents, but Portuguese society in the late twentieth century, under first the dictatorship and then the revolution, seems to have lost access to its the culturally informed traditional agricultural technology. Some rural parishes have avoided demographic demise by undergoing the transition to modern commercial agriculture. Pearson *et al.* (1987) and Bentley (1992) discuss the transition of agriculture in Northwest Portugal to modern technology.

Of the land cultivated in Ribeiros in 1940, less than 10% was under cultivation at the time of this study. However, the centuries of investment in the building of retaining walls, and in the creation of the organically rich soil behind them, does not rapidly deteriorate when terraces are abandoned. Rarely were walls in need of repair, and then mostly where they were actively driven or walked over/behind, or where water had been allowed to escape from ditches that had been built to carry it safely away. Most walls holding long abandoned terraces were in good shape. Especially where vegetation cover has grown thick, soil has remained in abandoned terraces. As shown in Table 4, this soil maintains its high level of organic matter and much of its available water capacity and nutrient levels. In fact, except for plot "e" where goats are occasionally corralled, the abandoned plots show little of the beneficial effects of fallowing, so important in other agricultural systems.

If traditional technology and willing labor were available, many abandoned terraces could be brought back into cultivation with minimal preparation. After ten years or more, woody plants begin to establish, often beginning with wild black raspberry (*Rubus*), which is ubiquitous. Broom (*Cytisus*) and sargaso (*Cistus*) and eventually walnut, chestnut, and oak follow. Owners often plant olive or apple trees on their terraces in partial abandonment, hoping to get some harvest with minimal care. In this region, some apple and olive trees are grown productively when cultivated appropriately, usually not in terraces but on less steep hillsides. Pine has been planted in abandoned terraces and managed for turpentine and firewood. Whether planted or natural, trees are difficult to remove from a terrace to return it to annual crops. In some parts of the Pracais valley the pine and oak forests nearly obscure the ancient terraces on which they are now growing.

Very damaging to the continuance of traditional agricultural methods here is the practice of replacing the heathlands on the upland ridges with eucalyptus. Eucalyptus trees grow rapidly, producing a crop of marketable poles in a few years, but draw large quantities of water from the ground, so that the irrigation springs below yield less water and dry earlier in the summer. In addition, chemicals produced by eucalyptus retard the growth of other plants. In 50 years they have depleted the soil and no longer regenerate well, leaving stumps that are hard to remove from terrain that has become truly unproductive. Some who advocate replacing heathlands with eucalyptus trees do not fully appreciate how important heathlands are to the fertility and water supply of the cultivated terraces below them.

Forest fires have burned frequently and destructively through out Iberia in the past two decades. Damaso (1992) suggests that fires are set during the dry season by people with selfish interests. Oak and pine forests take longer to regenerate after a fire, but heathlands begin to regenerate the next season, and may be somewhat fire adapted. In 1991, a forest fire swept through the upper Pracais valley, burning the heathlands and destroying the trees. When I returned to Ribeiros in 1993, after two years of no brush with which to restore soil fertility most of the residents had gone to live with relatives elsewhere. They are unlikely to practice cultivation again.

Subsistence agriculture with pre-fossil fuel technology has largely ceased as a way of life in Portugal. In the region studied, traditional technology and culture seem to have sustained an expanding population for hundreds of years, with minimal spatially or temporally external inputs. The invasion of extrinsic social and economic influences seem more likely to explain its discontinuance; traditional subsistence agriculture did not fail technically nor deplete its local resources.

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BOOK REVIEW

People, Plants, and Landscapes: Studies in Paleoethnobotany. Kristen J. Gremillion, editor. University of Alabama Press, Tuscaloosa. 1997. Pp. xviii; 271. $29.95 (paperback). ISBN: 0-8173-0827-x.

One of the more inexplicable aspects of archaeology this century is that, despite growing recognition of the importance to human societies of plant resources, surprisingly little emphasis has been placed on the recovery and interpretation of those remains by archaeologists. There have been notable exceptions, of course, as represented by the work of Braidwood, Yarnell, Flannery, Watson, and others, and by the 1970s, paleoethnobotanical studies were regularly being conducted by a small number of practitioners across North America to produce an unprecedented wealth of information on prehistoric plant use. Yet full acceptance of paleoethnobotany as a vital component of archaeology has been surprisingly slow, and in some respects, it has been ghettoized. Despite its immense potential to contribute information pertinent to both Big Questions (e.g., where and when were plants first domesticated?) and those of more local significance (e.g., what plants were eaten at this site?), the recovery and analysis of samples for paleoethnobotanical sampling are still not routinely practiced at most archaeological sites.

This well-edited volume offers a strong challenge to this situation by demonstrating how clearly paleoethnobotany can illuminate aspects of past settlement, subsistence, and economic practices otherwise inaccessible. No less importantly, it offers new ways of thinking about the relationships that have existed between people and the dynamic landscapes they occupied, with each influencing the other.

The collection is derived from a Society of American Archaeology symposium in honor of Richard Yarnell, a pioneer in this field, who in 1992 received the society's Fryxell Award for Interdisciplinary Research. Most of the contributors are former students or colleagues of Yarnell. United under the banner of human ecology, the authors explore two central themes: first, the process by which paleoethnobotany has evolved into a multidisciplinary entity, armed with formidable tools (e.g., electron microscopy, accelerator dating); and second, the development of a set of robust explanatory tools that include the integration of ecological and evolutionary theory. This approach gives this collection a coherence seldom found in *festschrifts*; indeed as Bruce Smith notes in the foreword, "There is much in this book that would please Yarnell far more than any glowing praise for him."

In both her well-crafted preface and introduction, Gremillion sketches the development of paleoethnobotany in North America, and how it has gradually shifted from description to explanation, with impetus provided by Julian Steward, Leslie White, and others. This short essay identifies several major themes in the history of the discipline, and thus provides a firm base for the chapters that follow.

The first part of the collection, "The Archaeological Record of Plant Domestication and Utilization," explores the evidence for the development of food production primarily in eastern North America, which is now viewed as an independent center of plant domestication. Patty Jo Watson begins with a succinct summary of the development of modern paleoethnobotany in the Near East, Eastern Woodlands, and Southwest, which has "proceeded at different rates and along different trajectories" in each region. Kristen Gremillion re-examines a collection of plant remains originally recovered in Kentucky in the 1930s, using crop morphology and site chronology to explain increases in seed size of sumpweed, chenopodium, and other species through domestication. An amazing collection of five charred bags of seeds stored in an Arkansas rock shelter (also excavated in the 1930s) is investigated by Gayle Fritz, whose analysis of cucurbits, sunflower, and sumpweed from the cache indicates that plant husbandry was already well developed by 3000 years ago. Additional evidence for the indigenous development of *Cucurbita pepo* is further explored by Wesley Cowan's study of seed morphology in archaeobotanical samples from Kentucky. The final paper in this section is by Gary Crawford, whose study of the ecological processes of domestication in Jomon Japan provides new insights into human influences on local landscape development.

The second part of the book, "Plant Resources, Human Communities, and

Anthropogenic Landscapes," focuses on the cultural and ecological contexts of plant domestication and management. Margaret Scarry and Vincas Steponaitis examine changes in agricultural strategies associated with the rise the late prehistoric Moundville (Alabama) polity; paleoethnobotanical evidence there suggests that crop production strategies, such as communal fields, may have served as a type of risk management, while also influencing local landscape development. The application of evolutionary ecology models to understanding the transition from foraging to farming is detailed by Bruce Winterhalder and Carol Goland, who evaluate diet breadth, risk analysis, and production efficiency. Their study complements Paul Gardner's predictive modeling of nut productivity and harvesting for Eastern Woodlands foragers, whose response to processing costs and periodicity of mast yields may have prepared them for post-foraging food production. The remaining two chapters utilize historical sources to explore the relationship of people to plants at very different scales. Gregory Waselkov relates a shift in Creek and Seminole agricultural field location to the development of the 18th century market economy, while Julia Hammett offers a sweeping survey of North American aboriginal plant management strategies, correlated to the geographic distribution of economically important plant families and agricultural intensification during the late Holocene.

What shortcomings the volume has are minor. All but one of the chapters focus on eastern North America, leaving Crawford's valuable study on plant domestication and anthropogenesis in Jomon Japan geographically isolated and not as well integrated into the collection as it should be. In fact, a different organizational scheme might have reduced the sometimes awkward feel of seemingly dissimilar chapters bound together within Parts 1and 2, although each addresses the general issues used to define each part. There is also considerable difference in the length of chapters, leaving one wishing for a little more from Watson (13 pages) and a little less from Winterhalder and Goland (38 pages). Still, these are more preferential than problematic points. The volume is well illustrated and indexed, and the use of historical maps and paintings in two final chapters is particularly informative.

This collection ultimately works well at two complementary levels, the first concerned with what we now know about past use of plant resources, and the second with how we know what we know. It therefore serves as a valuable resource for both students and scholars interested in the dynamic nature of past human-environment interactions, and complements other recent volumes, particularly Hastorf and Popper's Current Paleoethnobotany (1988).

Paleoethnobotany has become an indispensable component of contemporary archaeology, yet many remain unaware of its potential. In a letter cited by Gremillion (p. 23), William Webb wrote to botanist Volney Jones in 1935: "I have stirred through Indian beds and shoveled out bushels of 'trash' which in my ignorance I regarded as valueless. I now know that I have probably destroyed a large body of valuable information." This volume reminds us of how valuable that information may be.

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Of Marshes and Maize: Preceramic Agricultural Settlements in the Cienega Valley, Southeastern Arizona. Bruce Huckell. University of Arizona Press, Tucson. Anthropological Papers of the University of Arizona No. 59. 1995. Pp. xvii; 166. $13.95 (paper). ISBN: 0-8165-1582-4.

Bruce Huckell's monograph reports the results of his research on aceramic sites in Matty Canyon Wash and integrates those findings with the information of other studies to generate a model of the subsistence-settlement system of southeastern Arizona's late preceramic populations. Those readers who have kept abreast of the discussions and debates on early southwestern agriculture presented over the past ten years will find Huckell's work a capstone argument for models which recognize early maize production as the crucial factor explaining the transformation from mobile to sedentary settlement. Those who have not will find the book provides clear guidance through the maze (pun intended) of claims and counter claims proposed by competing models that suggest early maize production had minimal impact on the cultural character of populations of the day. Huckell's work was undertaken with the expectation of acquiring new information from one site (Donaldson, AZ:EE:2:137) that had been tested and studied twenty-five years earlier and another (Los Ojitos, AZ:EE:2:137) newly exposed by erosion some distance downstream. Prior reports on the results of archaeological survey and testing operations, geomorphological research, and palynological studies in the Cienega Creek Basin long before Huckell's excavations were initiated had provided substantial evidence that Late Archaic populations in this area created sedentary communities on the local floodplains, where they cultivated maize. This evidence was not widely acknowledged nor appreciated, however, and Huckell's decision to recover additional data and to study the Donaldson site in the context of more recently acquired information and new frames of reference was a sound one.

Fully a quarter of the text is devoted to analyses of the floral, faunal and human remains recovered at the two sites. These are presented as chapters of the monograph, rather than appendices, and are clearly integral to the development of Huckell's conclusions. For example, Lisa Huckell's analysis of the plant macroremains from seven pits and two pithouses at the Donaldson site provide convincing evidence that "a system of maize agriculture combined with gathering of wild plant resources...was maintained by these people, who resided in an optimal area in which to successfully blend these economic strategies" (p. 97). In addition, the analysis of the vertebrate bone data suggests that the procurement strategy of Donaldson's residents, like that of later Hohokam sites, was focused on larger mammals because the increased search time, travel distance and transport costs was offset by a greater payoff in protein, hides, sinew, and bone for tools.

All in all, the ethnobiological studies provide strong support for Huckell's reconstruction of the subsistence-settlement system of the occupants of the Late Archaic sites of the Cienega Basin and his regional model of foraging, farming and sedentism in southeastern Arizona. Thus I find the monograph well constructed, well done and generally praiseworthy. However, I think Huckell overdoes it when, at the beginning of the final chapter, he asserts:

> "The 1983 investigations at the Donaldson Site and Los Ojitos... have fundamentally changed our understanding of the settlement and subsistence strategies of societies in southeastern Arizona in the mid to late first millennium before Christ... Of particular importance is the evidence of how agriculture became integrally woven into the fabric of these societies. By at least 500 B. C., the basic elements of the mixed farming-foraging economy that typified the next 2000 years of southwestern prehistory were clearly present." (p. 117)

For one thing, the only new evidence for subsistence strategy provided by his excavations is the demonstration that maize was a significant aspect of the diet. Prior information had clearly indicated maize was grown, and the two structures Huckell recovered (as he realizes) are not more definitive evidence of sedentism than existed previously. Further, if the faunal materials Huckell recovered were the sole body of evidence for a reconstruction of the animal procurement strategy, his contention that large mammals were favored over leporids would not be tenable. Eddy's excavations produced 75% of the artiodactyl remains known for the site while Huckell's yielded 63% of the leporid bones.

For another, there is actually no clear evidence that agriculture was "firmly woven into the fabric" of Cienega Phase population culture (or cultures). The evidence informs us only that subsistence-settlement systems at Donaldson and a number of Cienega Phase sites were characterized by production and consumption of food plants and non-mobile residency. Extension of this knowledge to reconstruction of the character of Cienega Phase societies requires the debatable assumption that the cultural importance of maize production is properly measured by its ubiquity in secondary trash deposits.

Finally, the idea that food production is an adequate archaeological index of agriculture is anthropologically naive. Anthropologically speaking, agriculture is a type of economy in which food production is a crucial element in the interactive relationships of social, political, and religious subsystems as well as a behavior pattern that is structurally significant for the ways members of a society maintain their standard of living. All groups who produce food do not participate in agricultural economies, and all who do participate in them do not necessarily cultivate the food they consume. Huckell's book does not reveal the warp and woof of the fabric of Cienega Phase society. The subsistence-settlement system may be no more than a pattern painted on its surface.

I believe Huckell's appreciation of the value and necessity of recognizing the archaeological distinctions between San Pedro Phase and Cienega Phase assemblages is fully justified, but I find his re-labeling of the period from about 1500 B. C. to the time of the arrival of pottery in the first millennium untenable. Sites on the Colorado Plateau and other parts of the northern southwest are labeled "Late Archaic" if they yield no evidence (macroremains) of maize cultivation and "Basketmaker II" if they do. Basketmaker II sites, however, are contemporary with the sites in southeastern Arizona and the Mogollon Highlands that are labeled "Late Archaic" because they contain evidence of maize cultivation. There's not much question that this awkward situation should be corrected. But Huckell proposes to leave the term "Late Archaic" in place for the period of time prior to the arrival of maize in the southwest and label the period of time subsequent to that date and prior to the use of pottery as the "Early Agricultural Period."

I consider this unwise. The Early Agricultural Period label is far less temporally controlled than we should prefer. The timing of the introduction of maize to the southwest is presently a matter of debate. Similarly, the true antiquity of the earliest southwestern pottery is difficult to pin down. Further, as he defines it, the Early Agricultural Period label suggests that prehistoric populations who added food production to their inventory of cultural behaviors thereby revolutionized their cultural systems and adopted a distinctive economic adaptation, irrespective of the way those behaviors were related to the particulars of the population's history or to its cultural institutions. Huckell is not alone in assuming that archaeological evidence for maize production identifies an adaptive behavior that must have had significant impact on the cultural ecology and economy of any ancient group. But, to my knowledge, that assumption has not been convincingly tested. Until it is, the label he proposes reflects a particular form of cultural evolutionist bias rather than the sort of general cultural condition appropriately signified by the labels we apply to horizons of culture history.

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INCANTATIONS AND HERBAL MEDICINES: ALUNE ETHNOMEDICAL KNOWLEDGE IN A CONTEXT OF CHANGE

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ABSTRACT.—An analysis of healing practices among the Alune people of Seram Island, eastern Indonesia, reveals that in the pre-Christian era, healers treated illnesses and midwifery concerns with herbal medicines made from a wide range of plant, animal, and mineral matter. If a patient failed to respond to herbal medicines, the illness was considered to have arisen in ancestral reprisal for the misdeeds of the patient or to have derived from the destructive magic of sorcerers. In such cases treatment required divination of the source of the problem followed by the recitation of curative incantations in conjunction with (non-medicinal) aids. Conversion to Christianity early in the twentieth century led to the suppression of many pre-Christian practices, including traditional health care practices, and abruptly interrupted transmission of such knowledge. Concomitant with social changes, language shift to the regional Malay variety, Ambonese Malay, is also occurring. A contrast can be drawn between Alune villages which have, until very recently, been protected from rapid sociopolitical and linguistic changes by their relative remoteness in mountain locations, and villages which have relocated to sites nearer to the coast and have been subject to more intense processes of change. We compare the situation in two sites reflecting these different patterns. In both the inland location of Lohiasapalewa and the relocated coastal village of Lohiatala, the use of herbal medicines is associated with the pre-Christian era and transmission of this knowledge has greatly diminished. In Lohiasapalewa a very few elderly people covertly utilize curative incantations while villagers born following religious change have had restricted access to ancestral practices. As a result, use of curative incantations appears to have almost completely ceased at this site. A contrasting outcome is noted in Lohiatala where, in the absence of transmission of Alune practices and in response to the contemporary environment, younger people have transformed the form and function of incantations by seeking and utilizing such knowledge from the wider Moluccan community.

RESUMEN.— Un análisis de las prácticas curativas entre los alune de la Isla de Seram, Indonesia oriental, revela que antes de la era cristiana los curanderos trataba enfermedades y partos con medicinas herbarias compuestas de un rango amplio de materiales de plantas, animales y minerales. Si el paciente no respondió a las medicinas herbarias, la enfermedad se consideró una represalía para fechorías de la paciente o derivada de la magia destructiva de hechiceros. En tales casos, el tratamiento se exigió la divinación del origen del problema, sequido por la recitación de conjuros curativos junto con auxilios no medicinales. La conversión a la cristianidad temprano por el siglo xx llevó a la supresión de muchas prácticas pre-cristianas, incluso a prácticas curativas tradicionales, y interumpió bruscamente la transmisión de tal conocimiento. Junto con los cambios sociales, también está sucediendo el cambio de idiomas hacia la variedad regional de malay, el malay ambonense. Se puede sacar un contraste entre los pueblos alune que hasta recientement han sido protegido de los cambios sociopolíticos y lingüísticos rápidos por su lejanidad en ubicaciones montañosas, y los pueblos que fueron reubicados a sitios más cercanos a la costa y que han sido sometido a los procesos de cambio más intensos. Comparamos las situaciones de dos sitios que reflejan estos padrones diferentes. En tanto la localidad del interior de Lohiasapalewa y el pueblo costero reubicado de Lohiatala, el uso de medicinas herbarias se relaciona con la era pre-cristiana, y la transmisión de este conocimiento ha disminuido bastante. En Lohiasapalewa, unos pocos ancianos utilizan furtivamente conjuros curativos, mientras que los poblanos que nacieron después de los cambios religiosos han tenido acceso restringido a las prácticas ancestrales. Como consequencia, el uso de conjuros curativos parece haber cesado casi completamente en este lugar. Un resultado contrastante se nota en Lohiatala, donde en la ausencia de la transmisión de prácticas alunenses y en respuesta al ambiente actual, los más jóvenes han transformado la forma y la función de los conjuros por buscar y utilizar tal conocimiento de la más amplia comunidad molucana.

RÉSUMÉ. — Une analyse des pratiques thérapeutiques des Alune de Seram, en Indonésie orientale, montre qu'avant l'arrivée du christianisme, les guérisseurs traitaient les maladies générales et les troubles obstétricaux au moyen de médicaments à base de plantes qui étaient fabriqués à partir d'une grande variété de produits naturels. Si un patient n'était pas réceptif à un traitement par les plantes, la maladie était considérée comme la répression d'un comportement individuel ou était attribuée à la sorcellerie maléfique. Dans de tels cas, le traitement exigeait une action divinatoire pour révéler la source du problème, suivie d'incantations curatives récitées de concert avec l'emploi de produits naturels. La conversion au christianisme au début du XXe siècle entraîna la disparition des pratiques thérapeutiques traditionnelles et mit fin brusquement à la transmission d'un tel savoir. Parallèlement à ces changements sociaux, on assiste également à un déplacement de langage vers une variété régionale de malais, le malais ambonais. On peut contraster les villages alune qui, jusqu'à tout récemment, ont été à l'abri des changements linguistiques et sociopolitiques soudains à cause de leur éloignement relatif dans des emplacements montagneux et les villages qui ont été réinstallés plus près de la côte s'exposant à un processus de changement plus intense. Cette étude compare la situation de deux sites qui reflètent ces deux modèles et examine dans quelle mesure le savoir linguistique et ethnoécologique peut être modifié à travers un processus de déplacement linguistique et de changement social. Dans la communauté intérieure de Lohiasapalewa, la connaissance et l'utilisation des incantations curatives semblent être disparues. Tandis que les gens plus âgés se souviennent et peuvent utiliser secrètement ces incantations, les villageois nés après les changements religieux n'ont qu'un accès limité aux pratiques ancestrales. La situation apparaît différente à Lohiatala, un village qui a été réinstallé dans un environnement côtier. Ici, en l'absence de transmission des pratiques alune et en réponse à l'environnement actuel, les jeunes gens ont transformé la forme et la fonction des incantations en cherchant et en utilisant le savoir de la communauté moluques élargie.

INTRODUCTION

Alune is an Austronesian language spoken in 26 villages in west Seram, in the eastern Indonesian province of Maluku. During this century, and particularly during the last 50 years, rapid sociocultural and economic changes resulting from increased contact with non-Alune peoples have occurred in the majority of these villages. During this period extensive changes have also occurred in health care practices.

The Alune assert that there are primarily two sources for illness - those which are attributed to a physical cause and those which result from the malevolent action of humans or supernatural beings practicing destructive magic. In earlier times, Alune healing practices involved either the use of herbal medicines made from plants and other matter or the recitation of incantations in conjunction with (non-medicinal) aids made of animal, plant or mineral matter. Illnesses attributed to a physical cause could be treated by herbal medicines or, in some cases, by the recitation of incantations. Similarly, midwifery practices drew on the use of herbal medicines and the recitation of incantations. However, illnesses resulting from the practice of destructive magic were amenable only to treatment by incantations following the divination of the source of the illness.

Contemporary Alune society is overtly Christian, with conversion to Calvinist Protestantism having occurred throughout this century. In the pre-Christian era, Alune cosmology focused on placating ancestral and local nature spirits, such as Tuale, the sun god, Dabike, the moon goddess, and spirits of the earth (***tapele***)[1] and sky (***lanite***). The goodwill of the spirit world was regarded as necessary for ensuring the health and vitality of the living and the productivity of the environment. This goodwill could be achieved and maintained, in part, through the chanting of incantations to invoke the spirits of ancestors or deities who could mediate on behalf of human beings. Religious change has resulted in the active suppression by missionaries and ministers of pre-Christian practices, including those relating to health care. Treatment of illness and injury today largely involves prayer, either as the sole healing tool or in combination with Western medicines which are administered by a regional health practitioner (known in Ambonese Malay as ***mantri***.). However, research undertaken in two Alune villages revealed a substratum of knowledge about both herbal medicines and incantations. There is evidence that some pre-Christian healing practices retain a role in present-day Alune society, although the distribution of such knowledge among members of the community and patterns of use have clearly changed.

We will first describe the two research sites and our research methodology. We will then discuss healing practices using herbal medicines, describing the illnesses amenable to such treatment, the ingredients, and the forms of treatment. We also discuss the use of herbal medicines in midwifery practices. Third, we consider healing practices involving incantations, describing the healers, sources of knowledge, illnesses treated, and methods of treatment. Finally, we examine the processes of change, analysing the role of several factors in changing health care practices and in changes in the transmission and distribution of knowledge.

RESEARCH SITES

Research was undertaken in two Alune villages, Lohiasapalewa and Lohiatala. Lohiasapalewa is located in the central mountain range of West Seram, at an altitude of approximately 650 m in sub-montane rainforest. The complete territory (***tapel lalei***) owned and occupied by the village comprises primary forest at varying altitudes, secondary forest at varying stages of regrowth, bamboo thickets, planted groveland, garden land, dry rice fields, sago swamps, grassland, and the settlement site of the village (cf. Ellen 1993a). By far the largest portion of village territory is primary and mature secondary forest.

Lohiasapalewa is some 30 km from the north coast of Seram. Its nearest neighbors are the Alune villages of Riring, Manusa Manue, and Buria. At various times during this century, Alune villages have come under pressure to relocate from the mountains to the coast. The primary purpose of such relocation has been "pacification" — first by the Dutch colonial authorities and later by the Indonesian government — in order to make the villages more accessible to government authority and thus to enable the government to exercise greater control. While a considerable number of Alune villages succumbed to the pressure and relocated to either the north or the south coast, the villagers of Lohiasapalewa have successfully resisted all attempts to impose relocation upon them. In the 1950s and early 1960s a guerrilla conflict was fought in Central Maluku between the ***Republik Maluku Selatan*** (RMS) separatist movement and the Indonesian military forces. Fear of the forces on both sides of the conflict caused the villagers to abandon their houses throughout the thirteen years of this conflict, however they rejected government pressure to move to the coast and remained in the forest within their village territory. The villagers also resisted an attempt by local government authorities to relocate the village in 1970. The relative isolation of their location has meant that all generations of villagers in Lohiasapalewa remain Alune speakers and further means that limited knowledge of a few pre-Christian practices has been retained. In 1998, Lohiasapalewa had a population of 244 in 32 households.

The present-day villages of Lohiatala and Lohiasapalewa were formerly one village, located on the site of Lohiasapalewa. According to local history (Makerawe and Nikolebu 1988), in 1817 conflict within Lohiasapalewa led to the departure of a breakaway group which formed a new village, Lohiatala, in a large tract of forest approximately 20 km to the south. The historical relationship between the two villages is denoted by their retention of the name Lohia. The addition of the name of the major river in each region, the Tala and the Sapalewa, marks their contemporary separation. A significant bond remains between Lohiasapalewa and its daughter village, though there is now little contact between the villages, and the majority of villagers have not visited the other site. Unlike Lohiasapalewa, the villagers of Lohiatala were unable to resist the government's efforts to relocate them during the RMS conflict. In 1952 they were moved en masse to the south coast of Seram, where they dwelt in the non-Alune village of Hatusua for thirteen years. The present-day village of Lohiatala was established in 1964 following the restoration of peace. It is located approximately six km inland from the south coast of western Seram, on the southern border of Lohiatala's land and some 20 km from its former mountain location. Its nearest neighbor is the non-Alune village of

Waihatu, comprised of people from Lombok and Java who moved to Seram as part of the central government's ***transmigrasi*** program which aims to relocate populations to reduce pressures on the more overcrowded Indonesian islands. Further south are the non-Alune villages of Waesamu and Hatusua. Bordering Lohiatala's territory to the north are the Alune villages of Rumberu and Rumbatu. In 1992 Lohiatala had a population of 728 in 110 households.

Unlike Lohiasapalewa, which is located within sub-montane rainforest, the people of Lohiatala occupy lowland territory largely comprising secondary forest at varying stages of regrowth, planted groveland, garden land, sago swamps, grassland, and the settlement site of the village. While dry rice fields were planted in this location, the practice has been abandoned in recent years due to introduced pests from transmigrant wet rice fields. Lohiatala's former village site largely consists of lowland primary forest, mature secondary forest, bamboo thickets, planted groveland, and grassland. Products are still harvested from this site, particularly by older villagers.

In contrast to Lohiasapalewa, Lohiatala has undergone dramatic sociocultural and linguistic changes since the 1950s. The process of language shift to Ambonese Malay is well advanced in Lohiatala, and there are clear generational differences in knowledge and use of the Alune language and Alune practices (Florey 1991, 1993, 1997).

METHODOLOGY

The initial goal of research conducted by Florey in the lowland village of Lohiatala was the study of language shift and language obsolescence (Florey 1990). During the course of learning and analysing the Alune language and its changing patterns of use in Lohiatala, information concerning plant lore and pre-Christian sociocultural practices emerged. Although the recording of Alune plant names and their uses was not undertaken systematically during this period, information learned in the course of fieldwork provided an initial database on which later ethnobotanical research could build.

The investigation of incantations and their practice proved both more difficult and more intriguing by comparison. Information was initially gleaned, often inadvertently, through discussions with members of the community. While comments alluding to the role of incantations in pre-Christian life were quite frequent, direct requests for information were always met with a denial of any personal knowledge of them, often accompanied by a referral to other members of the community said to be more knowledgeable. Apparent contradictions emerged from early discussions. As Boulan-Smit (1992) noted for the Alune community of Manusa, many older Lohiatala consultants strongly rejected the notion that incantations were still used in the village and echoed a belief in God in place of the use of incantations and pre-Christian healing methods. However another perspective was expressed by an elderly man who stated that there are people in Lohiatala who still know how to use incantations: "They don't trust in God, but trust instead in their incantations." Statements such as the following were common:

> "Yes, if we use that [incantations], we are not human, we can't choose between one thing and another. But because God works with us, we behave

in certain ways and must throw that [knowledge] away. If not, we will be ruined, ruined!"

However, after working in Lohiatala for approximately five months, an elderly villager expressed his willingness to discuss the use of curative incantations. During one research session, six incantations were recorded and a description was given of the way the incantations were used in conjunction with aids such as oil, water, or mineral lime. These data formed the basis for future exchanges of knowledge with other villagers. Florey found she was, in effect, able to trade this knowledge for further information concerning incantations. Towards the end of that field season, two principal research consultants and the family with whom Florey lived provided several incantations as gifts. In these ways, a corpus of 13 curative incantations was compiled, together with 15 incantations concerning topics beyond the scope of the present paper (such as hunting, harvest increase, and destructive medicine).

In 1992 research moved to the highland village of Lohiasapalewa. The purpose of the move was to base research in a site that was linguistically more conservative in order to compare language use in two quite different locations. Once established in this village, it became apparent that this was also a promising location in which to carry out extensive ethnobiological work. In order to undertake these specialized studies, two additional researchers became involved.[2] Ethnozoological work began in 1993, and Wolff commenced botanical work in 1994.

Botanical research began by checking with the principal research assistant, Mr. Wempi Manakane, the lexical database of botanical terms previously recorded in Lohiatala and Lohiasapalewa. We made a work plan each evening for the following day based on information already gathered and targeting the information we were still seeking. Information concerning herbal medicines is now largely restricted to a small number of older villagers in Lohiasapalewa. Such knowledge has been acquired by only a very few younger villagers in Lohiasapalewa who continue to value the ways of their elders. Hence our work plan entailed determining the location of people with specialist knowledge and the location of specific plants. We worked with these people around the village settlement, in nearby gardens, and at locations further afield in primary and secondary forest. Manakane arranged visits to villagers in their gardens and accompanied Wolff and Florey to field sites.

Lohiasapalewa is subject to heavy rainfall throughout the year, concentrated in the afternoon and evening. Therefore we set out for our planned research location shortly after sunrise and usually worked at the site(s) until early afternoon. For each plant, Wolff collected relevant samples, photographed the plant in situ, and recorded data such as leaf measurement, plant height, plant width, descriptions of flowers and fruits, and agricultural practices. Florey recorded Alune names and descriptive terminology for the plant, with respect to its morphology, stages of growth, agricultural practices, etc. Data were also recorded in Ambonese Malay and Indonesian when known. Extensive ethnographic notes were taken, including known uses of each plant and its importance in Alune life. We discussed agricultural practices, garden site selection and layout, and preservation techniques for harvested crops with villagers in situ. We urged healers to discuss and demonstrate the use of plants for medicinal purposes. We took photographs as appropriate.

Plant samples were processed after returning from the field site by labeling each sample and pressing and/or preserving it in silica gel. Field notes were systematically organized. Ethnographic data were collated and cross-checked with relevant community members. For example, data concerning plants used in midwifery practices were discussed and verified with women with the inherited right to Alune midwifery knowledge. All linguistic data were checked with several Alune speakers.

Work also continued in the village, gathering information from people with specialized healing knowledge. Florey worked extensively with an elderly Lohiasapalewa man who had retained the knowledge and practice of healing incantations. Due to the sensitivity of this information, the work was undertaken in private. Incantations recorded previously in Lohiatala could not be cross-checked there because of the demise of the elderly consultants. Therefore, these data were checked with the Lohiasapalewa consultant, who also contributed eleven additional healing incantations and descriptions of their use.

Following the field research period, the collected data (plant samples, photographs, notes) formed the basis for plant identification by Wolff. Sources for identification included collections held in the Herbarium Bogoriense, the Smithsonian Institution Herbarium, and relevant published materials. As the plants were identified, the Latin names were incorporated into a larger database collating linguistic, botanical, and ethnographic information for each plant. This corpus forms the basis for the present paper.

HERBAL MEDICINES: TREATMENT OF AILMENTS WITH A PHYSICAL CAUSE

A wide range of common illnesses and injuries are known and named in Alune. An important contrast is drawn by the Alune between common illnesses which are perceived to have a physical cause, and ailments which are considered to result from the malevolent action of humans or supernatural beings practicing destructive magic. Ailments in the former category indicate the everyday health concerns of the community. They include: bleeding from wounds, burns, colds and influenza, cough and sore throat, diarrhea, ear infection, eye infection, fever, goiter, headache, head lice and dandruff, infected wounds, intestinal parasites, jaundice, muscular pain, sprains, broken bones, nausea, poisoning and snake bite, skin complaints (ichtyosis, scabies, irritant reactions to plants or insects, fungal infections), smallpox, toothache, and urinary tract infection. Appendix 1 describes in detail the preparation of medicines for the treatment of these diseases.

Women with the inherited right to practice midwifery address issues of conception, contraception, and delivery as well as treating a range of post-partum conditions. Treatments are provided for the following conditions: to prevent conception, to regulate menstruation, to end unwanted pregnancies, to assist conception of a male or female child (as per the parents' expressed desire), to speed a slow or difficult labor, to cleanse and/or strengthen a woman following birth, to remove post-partum blood clots, to heal a post-partum swollen belly, and to treat engorged breasts. Appendix 2 describes in detail the preparation of medicines used by midwives. Where available, Alune names for ailments and gynecological or obstetric conditions are noted alongside headings in the appendices. The appendices also provide the Alune name, English name and Latin identification (when known) of plants, and their medicinal application.

Ingredients used in healing and midwifery practices.—The ailments listed above which are diagnosed as having a physical cause, and the conditions which fall within a midwife's care, can be treated with medicines made from plant, animal, or mineral matter found in the village territory. All herbal medicines minimally contain plant material and may also contain other ingredients. Sixty-two plants were identified as ingredients in medicines used to treat ailments which are diagnosed as having a physical cause, and a further 15 plants were identified as ingredients in medicines used in midwifery practices. Villagers in Lohiasapalewa asserted that, in earlier times, plants which could be used for healing (***ai 'watai***) were planted near the garden hut in each newly-established garden. This practice has diminished with increased access to Western medicines

In addition to plant materials, twelve plant by-products and non-plant ingredients used in medicines have been identified (see Table 1). In contrast to the extensive use of plant material in healing, very few medicinal recipes were recorded which use animal products. These animal products are mineral lime, turtle shell, egg, and honey. The lime is most commonly extracted from freshwater mussel shells (***lopon inai***) which are dried, baked, and pounded.

Preparation and application of medicines.—The application of herbal medicines varies according to the nature of the ailment and the ingredients used in the medicine. The medicine may be applied as a poultice or compress, rubbed on as a massage ointment, drunk as a potion, or infused. Very few treatments require eating specific foodstuffs; however, the ***banana tema 'watnabane*** (*Musa fehi*) is eaten as a treatment for jaundice and for bladder infections.

While an illness or injury may be treated by several different preparations, certain generalizations can be drawn about the treatment of particular illnesses or injuries. Bleeding is staunched with the application of a poultice made from one of a number of plants, primarily grasses which are readily available in the village residential area, as well as in gardens and secondary forest in which villagers may be working or hunting. Nausea is treated through the external application of stimulants: tobacco (*Nicotiana tabacum*), betel nut palm (*Areca catechu*), clove (*Syzygium aromaticum*). Oily substances are applied to treat irritant reactions to certain plants and animals: coconut oil (derived from *Cocos nucifera*), candlenut (*Aleurites moluccana*). Burns are treated with the application of gluey poultices. Colds and influenza are treated by rubbing the head with medicinal shampoos. Medicines for malaria tend to consist of bitter-tasting drinks. Urinary tract infections are cured by plants which color the urine a bright yellow.

Medicinal properties.—Most of the plants used for healing are held to have only one medicinal property. However, from our corpus eight plants serve multiple purposes and indicate their wider utility in healing (see Table 2).

CURATIVE INCANTATIONS

Despite the wide range of plant, animal, and mineral matter known and available as ingredients in herbal medicines, and the extensive range of illnesses and injuries which they can treat, the Alune acknowledge that there are ailments which remain resistant to a medicinal cure. If an injury or disease attributed to a physical cause persisted despite the application of herbal medicines, community members with special healing powers were called upon to divine the source of the ailment, which might then be rediagnosed as having been caused by destructive magic. Some such ailments were diagnosed as deriving from ancestral spirits in reprisal for the behaviour of an individual who had contravened social norms by committing, for example, adultery (***soune***) or theft (***mleane***). Ancestral ***spirits (nitu matale)*** might also exact retribution for the contravention of custom: for example, through a marriage between two people who were too closely related according to customary law, or through failure to keep a promise made to a dying person. Alternatively, illness might be diagnosed as arising from the malevolent acts of humans, or from evil beings (***lita***) who could harm and potentially kill humans by "sending" an illness or injury to a chosen victim.

In cases where ailments or injuries were rediagnosed as having been caused by destructive magic, incantations were employed to attempt to cure the patient. The recitation of incantations was usually accompanied by the use of plant or animal products, however the latter were regarded as an aid in the application of incantations and were not held to be herbal medicines. Similar practices have been widely reported throughout the Austronesian region (cf. Bolton 1994, Ellen 1993b, Errington 1986, Glick 1967, Ooy 1994, Taylor 1988). The use of incantations in Alune healing practices reflects attempts to understand, predict, and control the physical and spiritual environment.[3]

The healers and their sources of knowledge.—Healers with knowledge of curative incantations are known in Alune as ***ma'aleru*** 'one who heals', which derives from the verb ***lerue*** 'to heal by blowing an incantation over someone'. Healers must possess both the appropriate linguistic knowledge to perform the incantations together with a knowledge of the products (plant, animal, and mineral) which are aids accompanying the recitation of incantations. The ***ma'aleru*** could derive knowledge from several sources. Incantations were occasionally given as a gift and, very rarely, could be bought from a practitioner. The practice of selling incantations or giving them as gifts was uncommon because incantations were considered to be a source of wealth, and knowledge which is given away is lost to the former owner (cf. Valeri 1990).

More commonly, incantations were learned from parents or inherited from ancestors. However, while younger family members could study healing from their elders, they were unable to utilize the knowledge fully during their parents' lifetimes. Historically, each person or family owned their own healing incantations. Transmission could occur through a dream, as in the case of one young man in Lohiatala, who received his knowledge of healing incantations from his wife's (deceased) grandparents. This man asserted that it is potentially dangerous to receive knowledge directly from other people, but that to receive the information in a dream parallels the way that biblical personages received divine inspiration. In his dream, transmission occurred at Lohiatala's former village site. Another young man in this village also received his healing knowledge from a dream. He dreamt he had a book with healing charms and woke and found this was real. Once he had learnt the incantations the book disappeared. Some knowledge of incantations was received from non-human sources. According to Alune historical mythology narrated in Lohiasapalewa, the common palm civet (***lau, ti'luline***) gave healers some of their knowledge of healing, and they are prohibited from eating this animal.

There are two categories of practitioners of midwifery in Alune society: the ***biane*** 'midwife', and the ***ma'selu***, literally 'one who sees', a healer who assisted after childbirth by inspecting the newborn child and repairing physical problems, such as straightening crooked limbs. The ***ma'selu*** also carried out the task of ritually washing a woman and her newborn child before they left the birthing hut (***luma posone***) and returned to their house. The ***ma'selu*** then carried the baby home to his or her waiting family. Alune midwifery knowledge was derived from the cuscus (***marele***), however there are no prohibitions on eating this animal.

Ailments treated by curative incantations.—The corpus of incantations contains cures for the following ailments: bleeding, breathing difficulties, centipede bite, stomach ailment, fever (including fever caused by being caught in rain which occurs while the sun is shining), a convulsive disease (possibly epilepsy), and headache. Commonly, stomach ailments are thought to be caused by eating or stealing crops protected by an incantation (***'wate*** — known in Ambonese Malay as ***matakau***). Healers use incantations to treat wounds caused by a machete if divination reveals that the weapon was strengthened by a charm. In some cases the physical manifestation of the illness caused by sorcery is non-specific, but is amenable to treatment by incantations if the healer can divine the source. Midwives may use incantations during a prolonged and difficult labor if the childbirth problems are considered to derive from sorcery.

Divination.—The first stage in healing an illness presumed to have been caused by sorcery is determining the source of the ailment, a task which is undertaken by ***ma'aleru*** and ***ma'selu*** (cf. Ellen 1993b and Bolton 1994 for a discussion of divination in healing among the Nuaulu of south Seram). One man asserted:

> "Previously, we used sorcery [to cause illness]. We would seek the source [of an illness] by using a length of wood. Probably the person was ill because of an evil spirit or because s/he sinned or whatever. Before we could heal the person, we would seek the source of the illness. I'd place a piece of wood in my hand. If the wood broke that would mean there was a problem and later the patient would tell the healer what s/he'd done to lead to the use of sorcery. Then the healer would be able to heal."

The process of divination is known in Alune as ***'nau***. A ***ma'aleru*** uses various aids to assist this process. For example, as described above, a length of midrib from the sago palm which is used to build walls (***punale***), a length of stem from the ***nipa'we*** plant (*Hornstedtia* sp.), or a coconut fruit is held in the hand and squeezed. If it breaks, this indicates the ailment has been caused by sorcery. Some healers may also go into a trance (*'basa*) and call upon a spirit to reveal the source of the illness. One man explained that his uncle had used a large white stone to call his personal spirit to assist in divination. He stated:

> "In earlier times they worshipped, they didn't yet know about the Lord. They didn't know ..., the sun and the moon spirits they certainly knew, but about the Lord they didn't know, they worshipped [spirits]. Tall trees, large rocks, they had to worship [them]. Tradition meant that they worshipped that, only that. Then they worshipped their spirits or devils, they had to work that way because they trusted in rocks. Certainly their spirit came, and shortly it would reveal [the source of the problem], say this and this, like that."

Ingredients used as aids in the application of curative incantations.—Once the source of the problem and the nature of the ailment has been revealed the process of healing can commence. The specific pattern of application of curative incantations varies according to the ailment to be treated. The cure is very rarely effected by mere recitation of an incantation. In virtually all cases plant matter, plant by-products, and non-plant matter (such as water) are used as an aid to accompany the recitation of curative incantations.

Various parts of a plant may be used to aid the application of curative incantations, including the leaf, root, fruit, shell, rhizome, and sepals. The list of plants in Table 3 indicates the key role of ginger (*Zingiber officinale*) and the ingredients of a betel quid in the application of curative incantations. Where ***se'u putile*** or ***se'u ta'unui*** (*Z. officinale, Z. zerumbet*) are not available, they can be substituted with the plants ***'wata muri*** (*Costus speciosus*), ***'wata muri 'berele*** (*Tapeinochilus ananassae*), or ***toune*** (*Alpinia* sp.) (all members of the Zingiberaceae). The plant by-products and non-plant matter in Table 4 may also be used in conjunction with curative incantations:

Application of curative incantations.—Healers apply an incantation by "blowing" it over the patient. The whispering of the words protects ownership of the incantation by ensuring that it cannot be overheard and thus learned and later utilized by others present. Healers assert that an incantation is not efficacious if heard. The following sections exemplify some of the applications of incantations and the use of some plant, animal, or mineral matter in conjunction with curative incantations. Incantations are often addressed to the spirit who is considered to have brought the ailment.

Use of betel quid. The components of a betel quid (leaf of a betel vine, fruit of the areca palm, and mineral lime) can be used to treat a headache. The healer chews a betel quid and gives it to the patient to chew. The skin of a young fruit of the areca palm is brushed across the head of the patient and the healer massages the head of the patient four times, pressing across the forehead and down from scalp to forehead. The healer recites the following incantation:

ntua 'ete ntua 'ete,	Old man biter, old man biter,
esi-'ete leu ulu buai	its bite returns to his head,
au 'ete leu ulu buai	my bite returns to his head.

mata bina 'ete, *esi-'ete leu ulu buai* *au 'ete leu ulu buai*	Old woman biter, its bite returns to her head, my bite returns to his head.
esi-'ete 'uru mise *satu lupa mo batu napane* *batu 'wale*	Its bite is strong and powerful like the sandstone and the solid slippery stones.

Use of mineral lime. Lime can be used in conjunction with curative incantations to treat several ailments. One incantation is used by a healer to staunch heavy bleeding from a wound: the first line is repeated four times. As the incantation is recited mineral lime is rubbed around the wound:

e-hmolile leta, lala'we leta	As the flow of water in the gutter ceases, so the bleeding ceases.
ile lala'we leta talu, soli'ele *noma*	The blood completely ceases flowing and remains that way.

Use of chilli pepper (*Capsicum frutescens*). In staunching bleeding from a wound, one practitioner wraps ginger and eight chilli peppers in a leaf, heats the bundle on the fire and applies it as a poultice on the wound while reciting the following incantation:

'wamlua peilu *lala'we seli la'wai*	As the ant [...][4] so blood is renewed in the wound.
lala'we sa seli *la'wai 'loto'ele lupa lane salati*	The blood rises and is renewed, the wound closes up as the rack above the hearth (is enclosed by soot).
mutu 'au sela 'wate	The wound is healthy [...].
'loto'ele lupa lane salati	[It] closes up as the rack above the hearth (is enclosed by soot).
mutu 'au soli'e	The wound remains healthy.

Use of heat. In order to treat ailments which exhibit symptoms of heat such as fever or burns, heat is an ingredient in the cure. A smouldering log is placed near the patient while the incantation is recited four times. The fire is then extinguished with cold water, and the log is thrown into a nearby river or stream:

auwe tetu 'wele *e-muti soli'ele, mata soli'ele*	The fire falls on the water, it remains cold, remains dead.
au muti musute *mata soli'ele muti soli'ele*	The fire is cooled of its heat, it remains dead, remains cold.
au dulu soli'ele	The fire continues to diminish.
soli'ele bei X	It stays away from [name of patient].
nanai muti sa'a 'wele mutine	His/her body is cool like cold water.

Use of water. The following curative incantation is used to treat breathing difficulties, manifested either by illnesses such as asthma or when someone is thought to be dying. The healer blows the incantation over a container of water, then drinks a little before brushing the remainder over the patient's body:

manu nusa inai	The birds of the mother island (Seram)
e-mei betu'we ile lalei	are coming to awaken his/her soul.
betu banu lupa manu nusa inai	Arising and beginning to lean like the birds of the mother island.
na'wai i-leu soli'e	His/her breath keeps returning.
betu banu lupa manu nusa inai	Arising and beginning to lean like the birds of the mother island.
na'wai i-leu soli'e	His/her breath keeps returning,
betu banu soli'e	[s/he] continues to arise and lean.

Use of the ***sonatene*** plant, *Codiaeum variegatum*. This plant is used in conjunction with a curative incantation to treat fever. Two pieces are cut from the tip of the plant, brushed on the patient from the head down to the legs, then the plant is thrown far away in a westerly direction (i.e. the direction of the sunset):

ntua 'era'eni	Old man illness,
e-tati musute bei mlete mosole	he lowers the heat from high up in the forest.
e-tati musute bei X meije	He lowers the heat from [name of patient].
e-dulu soli'e	It keeps descending.
e-leta soli'e	It is completely healed.

Healing by exorcism (***hela'e***). In cases of persistent illnesses in young children, the ***biane*** may heal by performing an exorcism (cf. Prentice 1981 concerning exorcism among the Timugon Murut of Sabah). As an incantation is recited, the spirit causing the illness is "pulled" from the child's body and drawn into the healer's body through a deep body massage. The movement of the malevolent spirit into the healer's body is visible through her shivering and trance-like state. The accompanying chill in the ***biane***'s body is said to result from her body heat transferring to and healing the child. The ***biane***, an adult with stronger powers than the malevolent spirit, can then expel the illness from her own body.

PROCESSES OF CHANGE: FACTORS AFFECTING HEALING PRACTICES

A number of factors are implicated in the process of changing health care practices among the Alune. Perhaps the greatest effect has been wrought by conversion to Christianity, which began in western Seram early in the twentieth century, occurring first in the more accessible coastal regions (for example, in 1902 in the transplanted coastal village of Murnaten) and later in the inland villages (1925 in Lohiatala's former village site, 1935 in Lohiasapalewa). Christianity was brought to Lohiatala by a man named Marten Supulatu, who was related to people in Lohiatala (including the traditional midwife). He had spent time in the coastal villages of Hatusua and Waesamu and was converted to Christianity there before going as a missionary to Lohiatala[5].

The Alune language appears to have been feared by missionaries, and speaking Alune was strongly discouraged as it was seen as a vehicle for the promulgation of pre-Christian beliefs. On occasion, use of Alune resulted in physical punishment. Conversations recorded with villagers in Lohiasapalewa and Lohiatala provide plentiful evidence that pre-Christian sociocultural beliefs and practices were also actively suppressed by the church. Such knowledge has become devalued over time by villagers, and they have ceased transmitting indigenous practices to later generations (cf. Florey n.d.). Although some young people express an interest in learning pre-Christian skills, older people are refusing to teach them in order that such knowledge is forgotten. One man asserted:

> "Yes, all of it will be lost. Because now we trust in the Lord Jesus ... but if we [live as we did formerly] we would no longer know Jesus."

With conversion to Christianity, Alune healers participated in religious ceremonies held to symbolize the abandonment of their knowledge. In 1979 the minister in Lohiatala held a village-wide ceremony at the time of the laying of the foundation of the new church. Each family was required to contribute a coin over which they prayed in their home with the minister and the church committee. The families took an oath that they would no longer use incantations, and understood that God would punish them with death within three days if the oath were broken. All families then gathered in the old church building while the coins were secretly buried by the minister and his committee beneath the foundations of the new (permanent) church.

However not all members of the community were prepared to abandon their knowledge. Several elderly men resisted, but later events forced their compliance. One such event concerned a man whose wife was gravely ill. He was told to destroy his knowledge of incantations or she would die. He agreed to the process, and went to the church at midnight to pray with the minister. The minister had stated that a gun would be fired following the prayer as a sign that the man had abandoned his non-Christian practices. A bullet was loaded but the gun would not fire. The prayers were then repeated, but again the gun would not fire. The minister accused the man of concealing knowledge. His son told the story as follows:

> "So the minister prayed. After praying he put in a bullet and fired. It didn't make a sound. They prayed again. He [i.e. the minister] said, 'Father, it's not finished.' Father said, 'It is.' However, there was more. Father finished [disposing of his knowledge] again. He fired a second time (father himself fired the gun), but the gun again didn't make a sound. They said, 'Hey, mother is ill, she's at home dying.' If father didn't dispose of all his knowledge mother would die. Finally father disposed of it all. Finally after the third time it was disposed of. The minister prayed again and the gun fired: it was over. Therefore it was okay. It was immediately forgotten, even if he does it again, even if father still remembers he can't use his knowledge again."

In a similar event another man later disposed of his knowledge by burning the red cloth worn during rituals which 'contained' the knowledge. This event took place at the church with a visiting minister from the neighboring island of Nusa Laut. The cloth took three attempts before it would burn.

The Alune are clearly aware that this knowledge remains accessible to former practitioners. One consultant acknowledged, for example, that there are people in Lohiatala who retain traditional knowledge but choose not to use it any more:

> "That's true, there are still those who know but are no longer allowed [to use their knowledge]."

Traditional midwifery healing knowledge has also been suppressed by the church as a facet of pre-Christian practices. However, this knowledge was not disposed of in the above-mentioned ceremony in Lohiatala. Instead, the minister made a pact with the oldest midwife that Alune midwifery practices would cease in that village upon her death.

The villagers of Lohiasapalewa underwent similar ceremonies to dispose of their traditional healing skills, including midwifery practices. Despite these overt displays of abandoning non-Christian beliefs, it is apparent that some incantations continue to play an important role in contemporary life in some Alune villages. A Lohiatala man explained the need to retain the knowledge and use of incantations, both for healing and for self defence. He cited the case of one young man who is in the army and has been taught incantations by his father both to protect and to heal himself. However, he noted:

> "That doesn't mean you can disregard the Lord. The Lord comes first, then this [knowledge of incantations], comes later."

Language shift from Alune to Ambonese Malay has also contributed to the demise of healing incantations in Alune. Linguistic skill is a key element in the performance of curative incantations. Efficacy depends, at least in part, on accurate recitation. Valeri (1985:3) similarly discusses the "paramount importance" to the Huaulu of Seram of exact recital of magical charms. For older members of the Lohiatala community where language shift to Ambonese Malay is progressing rapidly, fluency in Alune is an essential component of healing practices. They assert, therefore, that younger people are unable to learn pre-Christian healing skills because they are not Alune speakers. Middle-aged members of the Lohiatala community, who speak a non-standard variety of Alune (cf. Florey 1997), discussed the dangers involved in reciting incantations imperfectly. One man in this age group had inherited healing skills from his father. Although an Alune speaker, he was not prepared to become a practitioner because of his awareness of non-standard features in his use of this language.

Both language shift and the suppression of pre-Christian practices are clearly implicated in the loss of traditional healing methods, including the use of herbal medicines and the recitiation of incantations. However, the process of loss has been compounded by lifestyle changes which have reduced opportunities for young people to be exposed to the skills possessed by their parents and ancestors. Time constraints imposed by contemporary village life, including involvement in church and state projects undertaken in the village, are greatly reducing time available for horticultural practices in both Lohiasapalewa and Lohiatala. Villagers in both sites now rely to a much lesser extent on the harvesting of forest resources and to a much greater extent on the planting of a limited range of cultivated plants (Wolff and Florey n.d.). Children are therefore spending less time in the forest with their parents and are not learning about plant and animal resources or the wide range of traditional uses of plant species indigenous to this environment. This situation is exacerbated by the time which younger Alune villagers spend away from the village for purposes of education and employment. In Lohiatala, the move to their lowland village site has further reduced access to traditional plant resources because of the different ecology of the new site. A considerable number of the forest resources which were exploited in the mountain village are not found in the coastal zone and the majority of villagers of all ages in Lohiatala have a very limited knowledge of the ecology of interior Seram which characterises the traditional Alune world of their ancestors.

CONTEMPORARY HEALING PRACTICES

In both Lohiatala and Lohiasapalewa today, illness and injury are treated first by prayer, usually intoned in the home alongside the patient and his or her family by a church elder, or, in more serious cases, by the minister with all deacons and deaconesses. Where available and affordable, Western medicines may form a part of the healing treatment. When ailments remain resistant to prayer and Western medicine, some Alune in both sites will call upon elderly villagers to prepare an appropriate herbal medicine. If these strategies all fail, villagers may ask a ***ma'aleru*** to divine the source of the illness and to heal with incantations. Due to the suppression of these practices by the church, the work of ***ma'aleru*** and ***ma'selu*** is carefully concealed from the non-Alune ministers appointed to Alune villages and from Alune villagers whose beliefs in Christian precepts are more complete.

A comparison of contemporary healing practices in the two sites reveals some interesting differences. People in Lohiatala who were born after 1950 were raised either in the non-Alune village of Hatusua or in the relocated coastal village site of Lohiatala. Their knowledge of pre-Christian practices has been affected by three processes: interrupted transmission brought about through the suppression of such knowledge following conversion to Christianity, lack of knowledge of traditional plant resources, and language shift to Ambonese Malay. In Lohiasapalewa, transmission of knowledge to younger people has been affected by the first two processes but to a much lesser degree by language shift because the Alune language is still spoken by all generations.

In Lohiasapalewa, several consultants born between 1920 and 1940 were willing to discuss pre-Christian Alune healing practices and, in the case of one elderly man and one woman, to recite curative incantations. One of the villagers who recited incantations, and the few villagers willing to discuss the use of incantations, requested secrecy during these discussions. Only the elderly man who had spurned the public process of disposing of pre-Christian knowledge appeared unperturbed by the possibility that others may know he was revealing this information. His lack of concern was not shared by other members of the household in which recording took place. Although they had consented to and arranged the meeting, they carefully concealed its purpose.

No villager born in Lohiasapalewa after 1940 was willing to discuss pre-Christian practices of any kind, including healing practices. Questions seeking such information were invariably met with a commentary on the use of Christian practices in place of all practices during the "period of darkness" which preceded conversion. The process of conversion to Christianity began in 1935 in Lohiasapalewa: villagers who were adults at that time appear to have been the last in this site to have transmitted knowledge of curative incantations to younger villagers. Despite having the linguistic skills necessary for the recitation of incantations, it appears that the success of conversion to Christianity in Lohiasapalewa has been such that younger people have no knowledge of curative incantations.

In Lohiatala, consultants who were willing to discuss pre-Christian Alune healing practices and recite incantations were born between 1910 and 1930. As noted earlier, these recitations of incantations followed a fieldwork period of approximately five months during which personal knowledge of healing practices was denied by all villagers. Once closer relationships had been established with consultants in this generation, they appeared proud to display their knowledge and, during our discussions, did not exhibit the same caution noted in Lohiasapalewa.

Villagers born in Lohiatala between 1930 and 1950 were, like their counterparts in Lohiasapalewa, unwilling to recite incantations. However, unlike the Lohiasapalewa middle-aged group, Lohiatala villagers were willing to discuss pre-Christian practices. These discussions were placed within two contexts. One group of villagers denied any personal knowledge of Alune healing practices but cited specific people within the village who were known to be ***ma'aleru***, ***biane***, or ***ma'selu*** and usually gave descriptions of the ways in which healers had treated various ailments. A second group couched their discussion in the framework of present-day Christian practices or the use of Western medicine. It is interesting to note that conversion to Christianity began in 1925 in Lohiatala. Transmission of Alune healing practices appears to have been interrupted by that process, and, as in Lohiasapalewa, villagers who were adults at the time of conversion seem to be the last to have transmitted knowledge of curative incantations.

Lohiatala villagers born after 1950 in their refugee site of Hatusua or in the relocated village of Lohiatala were, like those in their grandparents' generation, willing to recite incantations and to discuss patterns of use. However the structure and function of incantations used by this age group differs dramatically to those used by their grandparents. Incantations tend to be destructive rather than curative, they are usually recited in Malay or other non-Alune languages, and the incantations are often written rather than memorised. Further, recitation of incantations by this generation is usually not accompanied by the use of aids made from plant or animal matter. In clear contrast to the healing practices of older Alune people, it is the words themselves in incantations owned by younger people which hold the power and carry the ability to heal.

Parental knowledge is not the source for incantations recited by young Alune people in Lohiatala. The language of the incantations and the functions for which they are used strongly suggest the influence of the world beyond the immediate

Alune environment. Unlike their parents and grandparents, who were raised in the relative isolation and protection of the mountain village, young people in Lohiatala are confronted by the apparent hostility of a non-Alune world. They have reacted to the environment in which they now live by learning and utilizing pan-Moluccan knowledge of incantations.

CONCLUDING REMARKS

An analysis of health care practices in the Alune villages of Lohiasapalewa and Lohiatala reveals that, in the pre-Christian era, healers (***ma'aleru***, ***biane***, and ***ma'selu***) began the process of treating ailments and midwifery concerns with herbal medicines made from a wide range of matter, including plants, plant by-products, animal by-products, and minerals. If the patient failed to respond to herbal medicines, the illness was considered to have arisen from ancestral reprisal for the misdeeds of the patient or to have derived from the destructive magic of sorcerers. In such cases treatment first required the divination of the source of the problem followed by the recitation of curative incantations in conjunction with aids made of plant, animal, or mineral matter.

Conversion to Christianity in both sites led to the suppression of the Alune language and pre-Christian health care practices, and abruptly interrupted transmission of such knowledge. Herbal medicines are now rarely used and the knowledge of ingredients and methods of preparation is in decline. Villagers rely largely on the healing power of prayer and, where available, Western medicines. While older people in Lohiatala and Lohiasapalewa remember and may covertly utilize curative incantations, villagers born following religious change have had restricted access to ancestral practices. In Lohiasapalewa, knowledge and use of curative incantations appears to have almost completely ceased. In Lohiatala, in the absence of transmission of Alune practices and in response to the contemporary environment, younger people have transformed the form and function of incantations by seeking knowledge from the wider Moluccan community.

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NOTES

1. A glossary of Alune terms and English translations is provided in Appendix 3.

2. A description of Alune ethnobiology (Florey, Healey, and Wolff, with Manakane) is in preparation.

3. This paper focuses on incantations used in what Taylor (1988:426) terms "curative medicine". A more complete analysis of Alune incantations, which are very extensive in number and function, is given in Florey (1998).

4. Parentheses indicate verbs for which a translation is not known either to the linguist or to contemporary Alune speakers. The difficulty of interpreting some of the lexemes used in incantations is also addressed by Taylor (1988) and Fox (1975).

5. Social change and the impact of Calvinism in Seram is also discussed in Grzimek (1991, 1996).

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APPENDIX 1: PLANTS USED IN TREATMENT OF ILLNESSES

Bleeding (***nasu*** "to bleed from the nose").

'amu lebu leaf of betel vine (*Piper* sp., Piperaceae). Medicinal use: the leaf is chewed, mixed with mineral lime, and placed on a wound to staunch bleeding. This leaf is considered more efficacious than certain grasses in staunching bleeding.

'wah'nalu inai buffalo grass (*Digitaria* sp., Poaceae). Medicinal use: the grass is chewed, mixed with mineral lime, and placed on a wound to staunch bleeding.

osane (*Dicranopteris* sp., Gleicheniaceae). Medicinal use: the leaf is chewed, mixed with mineral lime, and placed on a wound to staunch bleeding.

palate kind of tall grass (Poaceae). Medicinal use: the grass is chewed, mixed with mineral lime, and placed on a wound to staunch bleeding.

palise common snakeweed (*Stachytarpheta jamaicensis = S. dichotoma* Vahl, Verbenaceae). Medicinal use: to treat bleeding wounds, the bitter-tasting leaves are chewed, placed on a wound, and held in place until bleeding ceases. The leaf poultice causes intense stinging. Other leaf poultices are considered more effective cures for bleeding.

si'wa mau kind of ***si'wa'we*** fern (*Selaginella* sp., Selaginellaceae). Medicinal use: can be used to staunch bleeding. The leaves are chewed and placed on a bleeding wound, which causes intense stinging but quickly staunches the bleeding.

Blood pressure.

samu labu sea trumpet (*Cordia subcordata* Lam., Ehretiaceae [Boraginaceae]). Medicinal uses: treatment of high blood pressure.

Burns (***popa'e***).

lutune Malay apple (*Syzygium malaccense* (L.) Merr. & Perry, Myrtaceae). Medicinal use: in treatment of burns, the young leaves are chewed and then spat on the burn. The poultice has a gluey quality and sticks until dry.

me'u abile kind of thorny creeper. Medicinal use: in treatment of burns, the bitter-tasting leaves are chewed and then spat on the burn. The poultice has a gluey quality and sticks until dry.

Colds & influenza (***nobale***).

labale Spanish thyme (*Coleus (= Plectranthus) amboinicus* (Lour.) Sprengel, Lamiaceae). Medicinal use: in treatment of influenza or colds, leaves of planted variety are cleaned and mixed with water, then crushed in the hand before being rubbed on head of patient.

buna 'o'laene hibiscus (*Hibiscus rosa-sinensis* L., Malvaceae). Medicinal use: in treatment of influenza or colds, the leaves are rubbed in water then squeezed in the hands until frothy. They are then rubbed on the crown of the head until the head feels warm.

me'u 'waetute kind of vine (Apocynaceae). Medicinal use: colds or influenza treated by soaking the leaves in warm water and then rubbing the head of a sick child to ease his or her breathing.

Cough (***'buse***) & sore throat.

ai tosile kind of tree (*Boehmeria* sp., Urticaceae ?): very small fruit, inedible. Medicinal use: the root is scraped clean, then grated and squeezed through a cloth. The fluid is mixed in a glass with warm water, then drunk to treat bronchitis or a dry cough. It is asserted that when the child defecates one can see in the feces the remains of something which was caught in the throat and is causing the cough.

'mulene kind of plant (*Wollastonia (=Wedelia) biflora* (L.) DC., Asteraceae). Medicinal use: in treatment of coughs, the leaves are boiled in two glasses of water until the water reduces to one glass. The water is then drunk by the patient. Alternatively, the plant can be eaten mixed with gnetum (*Gnetum gnemon* L., Gnetaceae) leaves.

musi, lemone orange, lemon (*Citrus* spp., Rutaceae). Medicinal uses: 1) Citrus juice is mixed with sugar and salt and drunk early in the morning to treat cough. 2) To treat sore throat, mineral lime is rubbed on cut half of fruit which is then placed in the ashes until juice boils and then rubbed on chest and throat.

ma'inu tuae anai (e)si='wele honey. Medicinal use: mixed with egg and palm wine and drunk as a medicine to treat cough and sore chest.

Diarrhea (***lale 'lusute***).

ete buai kind of fibrous plant, caesar weed (*Urena lobata* L., Malvaceae). Medicinal use: in treatment of diarrhea, the fruit is cleaned then boiled in two glasses of water until it reduces to one glass. It is then drunk by the patient.

ni'wel (e)si=lamuti root of coconut palm (*Cocos nucifera* L., Arecaceae). Medicinal use: to treat diarrhea the young root of the red variety of coconut palm is cut, boiled with two glasses of water until ca. one glass has evaporated, then root is discarded and cooled water is drunk. Children are treated with one spoonful of the medicine. A further dose can be given if required.

papai papaya tree (*Carica papaya* L. Caricaceae). Medicinal use: dry seeds are chewed then spat out as a treatment for diarrhea.

sala' opoi young seed of the salak (*Salacca edulis* Mal. [= *S. zalacca* [Gaertner] Voss], Arecaceae). Medicinal use: in treatment of diarrhea, the young white seed is peeled, scraped, and the fluid is then squeezed out through a cloth. The fluid is then drunk by the patient, who is also given a lot of water to drink.

Ear infection (***sonale***).

'amu la'a leaf of betel vine (*Piper betle* L., Piperaceae). Medicinal use: in treatment of infective discharge from ear, the leaf is chewed and the saliva mixed with fluid extracted from the leaf is dripped into the ear together with one or two drops of tea tree oil (derived from *Melaleuca quinquenervia*, Myrtaceae). The ear is plugged with a piece of clean cloth.

'amu mala'a leaf of betel vine (*Piper betle* L., Piperaceae). Medicinal use: in treatment of infective discharge from ear, the leaves are pounded and the fluid is squeezed out and mixed with mineral lime then inserted into the ear.

Eye infection (***mata 'erale***).

bawane members of the onion family (*Allium* sp., Alliaceae). Medicinal use: in treatment of sore eyes, a cut piece of onion is rubbed underneath the eye to cause the eye to water.

Fever (***lalelune***) & malaria.

ai lite kind of tree. Medicinal use: the bitter-tasting sap is boiled and drunk to lower fever or treat malaria.

jarak loini (Euphorbiaceae). A recently introduced plant for which there is no Alune term (and which therefore is referred to by a combination of the Malay term and the Alune word for leaf). Medicinal use: in treatment of fever, the leaf is heated over coals then pounded to soften, placed on torso and covered with a cloth.

lasete langsat (*Lansium domesticum* Jack, Meliaceae) Medicinal use: a piece of bark is peeled from the tree, cleaned, and boiled. Approximately half a glass of the bitter-tasting water is drunk as often as required to treat malaria. Symptoms are said to improve in two to three days.

me'u 'wamate kind of ground vine (Commelinaceae). Medicinal use: in treatment of fever, the plant is stripped of its root and dried leaves, then cleaned and boiled in two glasses of water. It is reduced to one glass then drunk by the patient.

Goiter (***mo'a posile***).

tapana parasitic creeper (Loranthaceae). Medicinal use: this plant is said to cure goiter.

Headache (***ulu 'erale***).

'weiye culilaban (*Cinnamomum culitlawan* (L.) Kosterm., Lauraceae). Medicinal use: the bark of the tree is peeled, then chewed to soften and applied to the forehead or temples to treat headache. The bark sticks firmly and can only be removed once dry.

usue kind of plant (*Laportea* sp., Urticaceae). Stem and underside of leaf cause extreme itching, burning sensation, and blistering of skin. Medicinal use: wiped across forehead to treat headache.

Head lice (***utu***), dandruff (***sobule***)

alale kind of plant (*Elatostema* sp., Urticaceae). Grows to about 1 m with small fruit and thin stem. Medicinal uses: 1) Stem is pounded with a rock and rubbed on wet hair. It foams like a shampoo and is used to treat dandruff or head lice. 2) Stem is cut and pounded to extract the sap which is used as conditioner to make curly hair manageable and easier to comb.

hlia kind of plant. Medicinal use: leaves are pounded and wrapped on hair to treat head lice.

Infected wound (***hauni***).

pia sago (*Metroxylon sagu* Rottb., Arecaceae). Medicinal use: cold sago gelatin is applied to infected wounds in order to draw out pus. The wound is cleaned, then sago gelatin is applied and left on overnight. If necessary a second application is used.

soi buai (e)si=matai fused sepals on fruit of the betel nut palm (*Areca catechu* L., Arecaceae)). Medicinal use: this part of the fruit is baked until burnt, then ash is squeezed over navel of newborn baby once umbilical cord is cut and tied. The medicine is applied daily until the navel is dry to prevent infection.

Intestinal parasites (***tilatine***).

samu labu sea trumpet (*Cordia subcordata* Lam., Ehretiaceae [Boraginaceae]). Medicinal uses: roots are dried on smoking rack, one quarter glass of scraping is mixed with warm water, then drunk for treatment of intestinal parasites.

Jaundice.

tema 'watnabane kind of banana (*Musa fehi*, Musaceae). Medicinal use: people are fed this fruit as a treatment for jaundice.

Muscular pain, bruising, sprains, broken bones.

unine tumeric (*Curcuma domestica* [= *C. longa* L.], Zingiberaceae). Medicinal use: to replenish the strength of a man or woman who has been doing hard physical labor, the root is grated, boiled with coconut milk, palm sugar, ground pepper, coriander, cumin, and tamarind, then drunk on several consecutive mornings.

'wapa kind of plant (*Crinum* sp., Amaryllidaceae). Medicinal use: in treatment of muscle pain or sprains, a plaster or compress is made from the stem of the plant. The outer stem is peeled and a thin strip of the inner pith (which has layered skin like an onion) is heated to soften and applied to the sore part of the body. It is left in place for one or two days.

'welamau lemongrass (*Cymbopogon citratus* (DC.) Stapf, Poaceae). Medicinal use: in treatment of sprains or cracked bones, the base of the stem is pounded, mixed with coconut, wrapped in a leaf and heated among coals on the hearth until the fluid boils. Once the mixture has cooled it is put on the injured limb and wrapped in cloth. This is repeated until the injury has healed.

'welamau musi citronella grass (*Cymbopogon nardus* (L.) Rendle, Poaceae). Medicinal use: as a massage oil, which is extracted from the pounded stem and leaves.

ma'otu luma pagoda flower (*Clerodendrum* sp., Verbenaceae). Medicinal use: to treat sprains or bodily aches following falls or to speed the healing of broken bones, the midrib of the leaf is heated to soften, pounded until fine and easy to compress, rubbed with coconut oil, then the entire leaf is applied as compress and covered with a cloth. The compress is applied at night and removed in the morning. This forms a very strong-smelling ointment. Only the variety with the reddish midrib is used medicinally.

maralane (e)si=tu'une deer fetus. Medicinal use: to strengthen the body, the fetus is added to distilled palm wine. To prepare, the fetus is washed twice in distilled wine, which is later discarded. Prepared fetus is added to container of palm wine which is drunk sparingly as needed.

maralane (e)si=tamu Achilles' tendon of deer. Medicinal use: to strengthen the body, the tendon is added to distilled palm wine. To prepare, the Achilles' tendon is washed twice in distilled wine, which is later discarded. Prepared Achilles' tendon is added to container of palm wine which is drunk sparingly as needed.

mayana kind of plant (*Plectranthus scutellarioides* (L.) R. Br., Lamiaceae). Medicinal use: to treat swelling in limb, a leaf is rolled between hands until soft, then mixed with mineral lime and rubbed on the wound. The plant can be repeatedly applied until swelling reduces.

minyak kayu putih tea tree oil (derived from *Melaleuca quinquenervia* (Cav.) S. T. Blake, Myrtaceae). This is a commercially purchased product for which there is no Alune term (and therefore it is referred to by the Malay term). Medicinal use: to treat bruising following a fall, a young child's head and entire body is firmly massaged with the oil.

mou tapele kind of vine (*Aglaonema commutatum* Schott, Araceae). Medicinal use: to treat muscular pain and sprains, young leaves are heated over a fire to soften them, then coconut oil is rubbed on the leaf and the leaf is applied to the sore muscle or sprain as a compress. It is said to feel cool and fresh. The epidermal layer is also used as a compress for sprains: it is removed, cleaned and grated then put on the sprain and wrapped with cloth.

popole cluster fig (*Ficus racemosa* L., Moraceae). Medicinal use: young leaves of the red variety of cluster fig are used to treat body pains. The leaves are boiled in coconut milk until the milk has completely evaporated. The sore part of the body is wrapped with the leaf and then covered with cloth.

usue kind of plant (*Laportea* sp., Urticaceae): stem and underside of leaf causes extreme itching, burning sensation, and blistering of skin. Medicinal use: rubbed on limbs to treat muscle pain.

Nausea (***iba***).

ai inai aini clove tree (*Syzygium aromaticum* (L.) Merr., Myrtaceae). Medicinal use: stomach is rubbed with clove to treat nausea.

pa'u tobacco (*Nicotiana tabacum* L., Solanaceae). Medicinal use: stomach is rubbed with tobacco to treat nausea.

soi betel nut palm (*Areca catechu* L., Arecaceae). Medicinal use: seed is chewed as a treatment for nausea (including morning sickness).

soi 'berele betel nut palm (*Areca catechu* L., Arecaceae): fourth and final stage of growth of the fruit. Medicinal use: stomach is rubbed with this fruit to treat nausea.

Poisoning (***male***) & snake bite.

ai sa'ale kind of plant, said to be a kind of cluster fig (*Ficus racemosa* L., Moraceae). Medicinal use: a cure for poisoning. The fruit of the tree is eaten to extract the liquid, which constitutes the cure, and the skin is spat out.

'wata muri crepe ginger (*Costus speciosus* (Koenig) Sm., Costaceae [Zingiberaceae]). Medicinal use: the stem of the plant is used either to treat or prevent snake bite. It is pounded then rubbed over the body which deters snakes from biting. If bitten, the pounded stem can be rubbed on the wound.

tema amine kind of banana (*Musa acuminata* Colla, Musaceae). Medicinal use: sap taken from a small plant is drunk to treat bite of death adder (*Acanthophis* sp.). The medicine is said to cure through inducing vomiting.

Skin complaints (***ndu'ane, busale***).

ai inai clove tree (*Syzygium aromaticum* (L.) Merr., Myrtaceae). Medicinal use: as a cure for scabies, the skin is rubbed with a mixture of clove, shallot, ginger, Chinese chive, and the components of a betel quid (sirih leaves, fruit of the areca palm, mineral lime).

ai tetu ndu'ane kind of tree (*Rhynchoglossum obliquum*, Gesneriaceae). Medicinal use: leaves are rubbed on the skin to treat scabies (***ndu'ane***). Its name literally means "the tree with scabies leaves."

bawan lala'we shallot shallot (*Allium cepa* L. (*aggregatum* group), Alliaceae). Medicinal use: as a cure for scabies, the skin is rubbed with a mixture of clove, shallot, ginger, Chinese chive, and the components of a betel quid (sirih leaves, fruit of the areca palm, mineral lime).

'amu leaf of betel vine (*Piper* sp., Piperaceae). Medicinal use: as a cure for scabies, the skin is rubbed with a mixture of clove, shallot, ginger, Chinese chive, and the components of a betel quid (sirih leaves, fruit of the areca palm, mineral lime).

'apul tubui shoot tip of the autumn pumpkin vine (*Cucurbita pepo* L., Cucurbitaceae). Medicinal use: form of treatment for early stages of skin disease (ichtyosis, tinea). The affected part of the body is scraped until it becomes a bleeding wound. A mixture of mineral lime and shoot tips from a pumpkin plant is then applied.

'ucai loini Chinese chive (*Allium tuberosum* Rotter ex Sprengel, Alliaceae). Medicinal use: as a cure for scabies, the skin is rubbed with a mixture of clove, shallot, ginger, Chinese chive, and the components of a betel quid (sirih leaves, fruit of the areca palm, mineral lime).

leite coconut oil (derived from *Cocos nucifera*). Medicinal use: a) As a cure for itching and blistering of the skin caused by contact with the hairy caterpillar (Lepidoptera), the skin is rubbed with coconut oil. b) As a cure for itching caused by spines on stem of giant bamboo, the skin can be rubbed with coconut oil.

milu candlenut (*Aleurites moluccana* (L.) Willd., Euphorbiaceae). Medicinal use: as a cure for itching caused by spines on stem of giant bamboo, the skin can be rubbed with oil from the candlenut.

popole putile cluster fig (*Ficus racemosa* L., Moraceae). Medicinal use: ichtyosis may be treated in its early stage. The affected part of the body is scraped until it becomes a bleeding wound. The sap from the base of a petiole is dripped on to the wound. This treatment cannot be used if disease is too extensive as it would create too large a wound.

se'u tinai rhizome of ginger (*Zingiber officinale* Roscoe, Zingiberaceae). Medicinal use: as a cure for scabies, the skin is rubbed with a mixture of clove, shallot, ginger, Chinese chive, and the components of a betel quid (sirih leaves, fruit of the areca palm, mineral lime).

soi betel nut palm (*Areca catechu* L., Arecaceae). Medicinal use: a) As a cure for scabies, the skin is rubbed with a mixture of clove, shallot, ginger, Chinese chive, and the components of a betel quid (sirih leaves, fruit of the areca palm, mineral lime). b) As a cure for itching and blistering of the skin caused by contact with the hairy caterpillar (Lepidoptera), the skin is rubbed with chewed fruit of the areca palm. c) As a cure for itching caused by spines on stem of giant bamboo, the skin can be rubbed with chewed fruit of the areca palm.

totlaine kind of plant. Medicinal use: in treatment of fungal infections (known in Ambonese Malay as ***mata ikan***) which cause painful sores under fingernails. Outer bark is scraped away, then the inner bark is scraped and put on the wound. The bark has a gluey consistency, and sticks more effectively as it dries.

usue kind of plant (*Laportea* sp., Urticaceae). Stem and underside of leaf of this plant cause extreme itching, burning sensation, and blistering of skin. Medicinal use: used to treat the severe itching, hives and paraesthaesiae caused by contact with the ***hlatene loini mayaune*** (*Laportea* sp., Urticaceae). The reaction may be minimised if the affected part of the body is immediately rubbed with leaves from this plant.

Smallpox (***uwane***).

lotine kind of plant (*Eurycles amboinensis* (= *Proiphys amboinensis* [L.] Herbert), Amaryllidaceae). Medicinal use: treatment of smallpox, which reached epidemic proportions in Lohiasapalewa in earlier times. A plaster or compress is made from the leaves and placed on the wounds. The leaf is heated to soften, rubbed with coconut oil, then applied to the wound and left in place for one or two days to draw pus from the wound. This plant is always replanted in new gardens to ensure its availability.

Toothache (***nise 'erale***).

tapua 'otote creeping oxalis (*Oxalis corniculata* L. Oxalidaceae). Medicinal use: in treatment of nerve pain in teeth, or soreness from erupting teeth in a young child. The leaves are washed, then placed in warm water to soften (for approximately 20 minutes). Then the plant is discarded and the patient gargles several times with the water.

tolun nise ma'erale nipple fruit (*Solanum mammosum* L., Solanaceae). Medicinal use: the name of the plant (literally "the sore tooth eggplant") derives from its use as a treatment for toothache. A clay pot is heated on fire and seeds from this plant are then baked in the pot. One end of a strawlike petiole from a papaya tree is placed over the burnt seed and the smoke is inhaled onto the sore tooth. It is asserted that the pest which is causing the toothache will fall out and into the pot.

Urinary tract infection (***tili senete***).

palate kind of tall grass (Poaceae). Medicinal use: the leaves of the grass are tied around the waist as a treatment for urinary tract infections, and left in place until cured.

putune alang-alang (*Imperata cylindrica* (L.) Beauv., Poaceae). Medicinal use: the root is used to treat urinary tract infections. The root is pounded until soft, then boiled in two glasses of water until reduced to one glass. The liquid is mixed with 2-3 spoons of honey and drunk.

seae ta'unui spiny fruited pick-a-back (*Phyllanthus urinaria*, Euphorbiaceae). Medicinal use: leaf is used to treat stomach ailments, and kidney and bladder problems, such as blood in the urine.

tema 'watnabane kind of banana (*Musa fehi*, Musaceae). Medicinal use: fruit is used as a medicine to cleanse the bladder and make urine very yellow.

APPENDIX 2: PLANTS USED BY MIDWIVES

Childbirth & postpartum treatment.

ai 'opi robusta coffee (*Coffea canephora* Pierre, Rubiaceae). Medicinal use: strong coffee is given to a woman in labor to speed a slow delivery. Coffee is also drunk post-partum to cleanse the uterus.

ba'u'upe infusion or sauna: made from leaves of clove, nutmeg, lemongrass, papaya, and citrus. Medicinal use: encourages sweating and speeds the healing process in someone recovering from an illness or following a difficult childbirth which has left the mother pale and weak. Leaves are boiled together in a pot until the water is reddish and the pot is then placed inside an enclosure made from matting; the patient inhales the fragrant steam and bathes in the water. Patient remains within the sauna for as long as possible: she may emerge to cool down, then re-enter. The sauna may be used over a period of several weeks, though it is considered dangerous to use it more than once a week. The water from the sauna may be drunk to assist in a particularly difficult childbirth. Older people insist that this water must not be carelessly disposed of, but be treated with respect. An alternative kind of sauna can be made by heating stones until red hot, then placing them under a bed base made of sago leaf midribs. The patient is enclosed with matting and water is poured over stones.

boro kind of plant (*Colocasia* sp., Araceae). Medicinal use: the leaf is used as a treatment for a protracted and difficult labor. Water or cold tea is poured into the center of the leaf and the patient drinks the fluid directly from the leaf. If the placenta is slow in being expelled, the leaf is tapped once on the head of the woman, then brushed the length of the front of the body before being thrown away.

unine tumeric (*Curcuma domestica* (= *C. longa* L.), Zingiberaceae). Medicinal use: to replenish the strength of a woman who has just given birth, the rhizome is grated, boiled with coconut milk, palm sugar, ground pepper, coriander, cumin, and tamarind, then drunk on several consecutive mornings.

lahlate nutgrass (*Cyperus rotundus* L., Cyperaceae). Medicinal uses: used in a steam bath as a post-partum treatment; the leaves of the grass are boiled together with clove leaves, nutmeg leaves, lemongrass, and citrus tree leaves, then placed inside a sauna made of matting. The woman squats over the infusion for about five minutes to cleanse herself and regain strength.

musi munine makrut lime (*Citrus hystrix*, Rutaceae). Medicinal use: the fruit is used as a post-partum treatment for swollen belly; up to 10 fruits are cut in two and baked on the coals of a fire until the juice boils. Lime is rubbed on a plate, then the juice is squeezed on to the plate and mixed with mineral lime until smooth. The paste is then rubbed on the belly below the navel.

me'u 'a'ale kind of thorny creeping vine (*Smilax* sp., Smilacaceae). Medicinal use: the leaf is used as a post-partum treatment for swollen belly. The soft, young leaves are boiled in two glasses of water until reduced to one glass, then drunk.

minyak kayu putih tea tree oil (derived from *Melaleuca quinquenervia* (Cav.) S. T. Blake, Myrtaceae). This is a commercially purchased product for which there is no Alune term (and therefore it is referred to by the Malay term). Medicinal use: 2-3 drops of oil are added to warm water to cleanse a woman who has just given birth. A cloth rinsed with the water is used to massage her belly to remove blood clots.

popole cluster fig (*Ficus racemosa* L., Moraceae). Medicinal use: young leaves of the red variety of cluster fig are used to treat women who have just given birth. The leaves are boiled in coconut milk until the milk has completely evaporated. The lower body is wrapped with the leaves and then covered with cloth.

Conception (***mluti***).

ai tetu bina white kyllinga (*Cyperus kyllingia* ?, Cyperaceae). Medicinal use: this plant is used by women who desire a female child. The leaf is tied over the belly of the woman and left in place until it dries and falls. Its name means "the tree which drops females." The plant is said to be effective during the first three months of pregnancy.

seae ta'unui spiny fruited pick-a-back (*Phyllanthus urinaria*, Euphorbiaceae). Medicinal use: this plant is used by women who desire a male child. The topmost leaf is discarded, and the second leaf is said to provide the male child. The leaf is tied over the belly of the woman and left in place until it dries and falls. This plant has small round green fruit which people say resemble testicles. Its alternate name, ***ai tetu mo'wai***, literally means "the tree which drops males." The plant is said to be effective during the first three months of pregnancy.

Contraception and abortion.

'ampala opoi immature pineapple (*Ananas comosus* (L.) Merr., Bromeliaceae). Medicinal use: abortifacient. The skin is peeled from a young fruit, which is then grated and squeezed to extract its juice. The juice is boiled with two glasses of water until it reduces to one glass, then is mixed with ash from the hearth and drunk to induce abortion. This abortificent is used only within the first two months of pregnancy: after that time a) abortion is considered dangerous to the mother and b) the fetus is considered human.

lahlate nutgrass (*Cyperus rotundus* L., Cyperaceae). Medicinal uses: leaves are cut and dried for one day, then boiled, and the water is drunk to induce abortion. This is not preferred as an abortificent as it is said to damage the uterus and cause infertility.

putune alang-alang (*Imperata cylindrica* (L.) Beauv., Poaceae). Medicinal use: the plant is used as a contraceptive or abortifacient. Alang-alang and ***tapana*** (*Loranthus* sp., Loranthaceae) are pounded and boiled together in two glasses of water until reduced to one glass, then drunk. Midwives advise women to drink the mixture two weeks after menstruation to prevent conception. The mixture is used to space children in a family.

seae ta'unui spiny fruited pick-a-back (*Phyllanthus urinaria*, Euphorbiaceae). Medicinal use: leaf of plant is used as an abortifacient. Ten leaves are boiled in water until approximately one glass of water remains, and then drunk to induce abortion.

tapana (Loranthaceae). Medicinal use: the plant is used as a contraceptive or abortifacient. Alang-alang (*Imperata cylindrica* (L.) Beauv., Poaceae) and tapana are pounded and boiled together in two glasses of water until reduced to one glass, then drunk. Midwives advise women to drink the mixture two weeks after menstruation to prevent conception. The mixture is used to space children in a family. It is said that this plant can make men impotent, and can make young women who have not yet had a child infertile.

Breastfeeding.

'bue lala'we rice bean (*Vigna umbellata* (Thunb.) Ohwi & Ohashi, Fabaceae). Medicinal use: treatment to help the flow of milk from engorged breasts (***laesa***). The leaves are washed, rubbed to soften, mixed with mineral lime and rubbed on breast. The treatment is repeated several times if necessary.

APPENDIX 3: GLOSSARY OF ALUNE TERMS

ai 'watai	a plant which can be used as a medicine; a plant which has healing properties
biane	midwife
hela'e	to exorcise; to remove an evil spirit from a person through the use of incantations
'basa	to be possessed: to go into a trance in order to determine the cause of an illness or the source of a problem
'era	to be ill, be in pain
'nau	the process of divination: to try to find the source of an illness or problem using a variety of aids
'nipa'we	kind of plant (*Hornstedtia* sp., Zingiberaceae), used as a tool in divination
'wate	protection charm
lanite	sky
lau	common palm civet, principally arboreal. Healers who use incantations may not eat this animal because it is asserted that the civet cat gave them some of their knowledge of healing
lepate mlerude	a healing register spoken prior to treating certain injuries with incantations
lerue	to heal by 'blowing' an incantation over someone

lita	evil spirit, devil
lopon inai	mineral lime. Mussel shells are a common source of mineral lime which is used in a betel quid: the shells are dried, baked, and pounded to extract the chalk
luma posone	birthing hut
ma'aleru	one who heals by reciting incantations
ma'amlea	thief
ma'selu	a healer who assisted after childbirth by inspecting the newborn child and repairing physical problems, such as straightening crooked limbs. Literally: "one who sees"
marele	cuscus (generic), Phalangeridae. Cuscus are linked with myths and rituals related to life-giving and preserving, including the origin of Alune midwifery knowledge
mleane	theft
ni'wel (e)si=buai	fruit of the coconut palm (*Cocos nucifera* L., Arecaceae), used as a tool in divination
nitu matale	spirit of the dead, ancestor
nulu	to massage, rub (body, not head)
ose'e	to massage, rub one's temples
punale	the midrib (leaf petiole-rachis) of the sago palm which is used to build walls; used as a tool in divination
soune	to commit adultery
tapele	earth
tapel lalei	territory: the complete territory owned and occupied by a village, including primary and secondary forest, groveland, gardens, and settlement sites
ti'luline	common palm civet, terrestrial. Healers who use incantations may not eat this animal because it is asserted that the civet cat gave them some of their knowledge of healing

BOOK REVIEW

Population Dynamics of a Philippine Rain Forest People: The San Ildefonso Agta. J. D. Early and T. N. Headland. University Press of Florida, Gainesville. 1998. Pp. 208. $39.95 (cloth). ISBN: 0-8130-1555-3.

This book is based on over 40 years of demographic and ethnographic work among the San Ildefonso Agta. The quality of the publication certainly reflects the authors' profound intimacy with the study population. In just over 200 pages that include 80 tables, figures, maps, and black-and-white photographs, Early and Headland meticulously craft an outstanding book, a must-read for anyone interested in tropical rain forest peoples. It makes a superb addition to any demography, ecological anthropology, or geography course syllabus.

The 12 chapters are divided among six themes. In Part 1 they introduce the study population and provide the essential ethnographic data. In Part 2 they discuss how historical forces have shaped the trajectory of the Agta in general, and the San Ildefonso population specifically. Their discussion of methods in Part 3 is a high point of the book and could very well serve as a blueprint for future studies in demographic anthropology. In Parts 4 and 5 they present and discuss their data, while in Part 6 they attempt to shed comparative light on the population dynamics of the San Ildefonso Agta.

Many rainforest peoples have experienced extreme cultural changes as they have come into contact with the industrialized world. The San Ildefonso Agta are no exception. The text encapsulates this cultural transition quantitatively, through the lens of demographic anthropology. Early and Headland follow the Agta through three arbitrarily delimited yet highly salient stages: the Forager Phase (1950-1964), the Transition Phase (1965-1979), and the Peasant Phase (1980-1994). By analyzing the four principal demographic variables — fertility, mortality, in-migration, and out-migration — the authors successfully identify the principal cause of acculturation among the Agta: hypergyny. Recently, women from the foraging group have been marrying lowland, Agta peasant men which has dramatically accelerated the growth of the acculturating population while subtracting from the foraging population. Such "cultural migration" is an enormous threat to the San Ildefonso Agta foragers and could ultimately lead to the assimilation of the Agta into the national Filipino ethnic matrix.

Although the quality of the analysis throughout the text is at times brilliant and the explanation of methodology superb, several of the authors' conclusions mar what is otherwise an outstanding text. Most importantly, the discussion of rampant acculturation among the Agta is not grounded in a clear definition of the peasantry, and, because the authors are content with understanding culture as a non-dynamic system, the discussion of acculturation, the peasantry, and Agta "cultural maintenance" seems somewhat shallow. Also, in their presentation of "Characteristics of the Agta Population," Early and Headland momentarily digress to a brief evaluation of the impact of high mortality on individual consciousness and the self (p. 126). In a text so dedicated to quantitative description and analysis, such a digression seems out of place.

Despite these minor problems, the text is a great success. Readability, close attention to methods, and the quantitative support of qualitative ideas are the book's chief resources. The authors' conclusions and analysis in the final, comparative chapter also have very practical consequences. They contribute to our understanding of landless peasants and their role in global tropical deforestation. The text's final paragraphs emphasize the importance of missionary work in the survival of foraging populations, which may strike a sour note with some, but few will deny the book's important contributions to the field of demographic anthropology.

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CLASSIFICATION AND NOMENCLATURE IN WITSUWIT'EN ETHNOBOTANY: A PRELIMINARY EXAMINATION

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ABSTRACT. — The Witsuwit'en are Athapaskan speaking peoples of northwestern British Columbia, Canada. They were traditionally foragers who harvested salmon, game animals and a diversity of plant foods. Witsuwit'en plant classification includes a large number of generics or basic terms. Folk specifics are poorly developed. There are also major plant classes, or "life forms", and intermediate groupings. "Life forms" include 'tree', 'plant', 'berry', 'flower', 'moss', 'fungus' and perhaps 'grass'. The first two satisfy criteria proposed by Berlin and Brown in being morphologically defined, transitive, and containing relatively large contrast sets. The remainder are cross-cutting ('berry'), utilitarian ('berry', 'flower'), or empty ('moss', 'mushroom', 'flower'), showing similarities to "life forms" reported for other northwestern North American peoples. Several intermediate groupings are proposed, defined either by morphology or utility, including such types as 'willows', 'spines', and 'poisonous plants'. Utility seems to be important in perception and grouping of plants, and may be directly or indirectly coded in plant names. A number of Witsuwit'en plant names are loan-words from Gitksan, a Tsimshianic language spoken to the north and west.

RESUMEN. — Los witsuwit'en son gente de lengua atabascana del noroeste de la Columbia Británica en Canadá. Tradicionalmente eran pescadores de salmón, cazadores y recolectores de diversos alimentos vegetales. La clasificación witsuwit'en de plantas incluye un gran número de términos genéricos o básicos que se designan por lexemas primarios simples o no productivos, o en ocasiones por frases descriptivas. Hay también clases mayores de plantas, o "formas de vida", y agrupaciones intermedias. Solamente una forma genérica descrita hasta ahora, ***tl'oɣ***, 'pasto', parece estar dividida en categorías indígenas específicas. Las "formas de vida" incluyen 'árbol', 'planta', 'baya', 'flor', 'musgo', 'hongo' y tal vez 'pasto'. Las primeras dos satisfacen los criterios propuestos por Berlin y Brown en cuanto a ser definidas morfologicamente, ser transitivas, y contener juegos de contraste relativamente grandes. Las restantes son categorías entrecruzadas ('bayas'), son utilitarias ('bayas', 'flores'), o están vacías ('musgo', 'hongo', 'flor'), mostrando semejanzas con las "formas de vida" reportadas entre otros pueblos del noroeste de Norteamérica. Se proponen varias agrupaciones intermedias, definidas ya sea por su morfología o por su utilidad, incluyendo tipos tales como los 'sauces', las 'espinas', y las 'plantas venenosas'. La utilidad parece ser importante en la percepción y agrupación de las plantas, y puede ser codificada directa o indirectamente en los nombres botánicos. Cierto número de nombres witsuwit'en de plantas son préstamos del gitksan, una lengua tsimshiánica hablada hacia el norte y occidente.

RÉSUMÉ. — Les Witsuwit'en sont des Athapasquans du nord-ouest de la Colombie britannique au Canada. Ils vivaient traditionnellement de chasse au gros et au petit gibier, de pêche au saumon et de cueillette de plantes alimentaires. La classification witsuwit'en des plantes comprend un nombre élevé de taxons de base ou génériques qui sont désignés par des lexèmes primaires simples (non analysables) ou stériles (analysables mais non productifs), ou quelquefois des phrases descriptives. Il y a également des classes majeures de plantes ou formes du vivant, et des catégories intermédiaires. Un seul générique décrit jusqu'à présent, ***tl'oɣ*** 'herbe', semble être subdivisé en taxons spécifiques. Les "formes du vivant" sont les suivantes: 'arbre', 'plante', 'baie', 'fleur', 'mousses', 'champignon' et peut-être 'herbe'. Les deux premières sont conformes aux caractéristiques de ces catégories telles qu'établies par Berlin et Brown : elles sont définies à partir de critères morphologiques, elles sont transitives et se subdivisent en ensembles contrastés relativement larges. Les autres chevauchent d'autres catégories ('baie'), sont de nature utilitaire ('baie', 'fleur'), ou sont vides ('mousses', 'champignon', 'fleur'), montrant des similitudes avec les 'formes du vivant' rapportées pour d'autres peuples du nord-ouest de l'Amérique du Nord. Certaines catégories intermédiaires sont proposées, définies à partir de critères morphologiques ou utilitaires, comme les 'saules', 'les plantes à piquants' et 'les plantes vénéneuses'. Les facteurs utilitaires semblent jouer un rôle important dans la perception et la catégorisation des plantes et les noms de plantes peuvent refléter directement ou indirectement cet état. Un certain nombre de noms de plantes witsuwit'en sont des emprunts du Gitksan, une langue tsimshiane parlée au nord et à l'ouest.

INTRODUCTION

The Witsuwit'en, an Athapaskan[1] speaking group of northwestern British Columbia (Figure 1), are traditional foragers in a largely forested environment transitional between the coastal rain forest and the boreal forest. Their traditional subsistence emphasized fishing for anadromous salmon, lake fishing, and hunting for large and small game, supplemented with collection of a wide variety of berries, and a few kinds of tree cambium, root vegetables, and greens. The Witsuwit'en presently live largely in two modern villages along the Bulkley River, and are integrated into the contemporary Canadian cash economy, although various foraging activities still take place (Gottesfeld 1994, 1995).

Virtually all modern Witsuwit'en speak at least some English and essentially all people under about 40 years of age are monolingual English speakers. In Moricetown, the community with the largest number of Witsuwit'en speakers, only 10-15% of the community of roughly 1200 can be classed as native speakers. Witsuwit'en is spoken in daily conversation primarily by elders over about 65 years of age; this group of people may have limited fluency in English. In public venues, Witsuwit'en is encountered chiefly in the feasthall. All songs are in

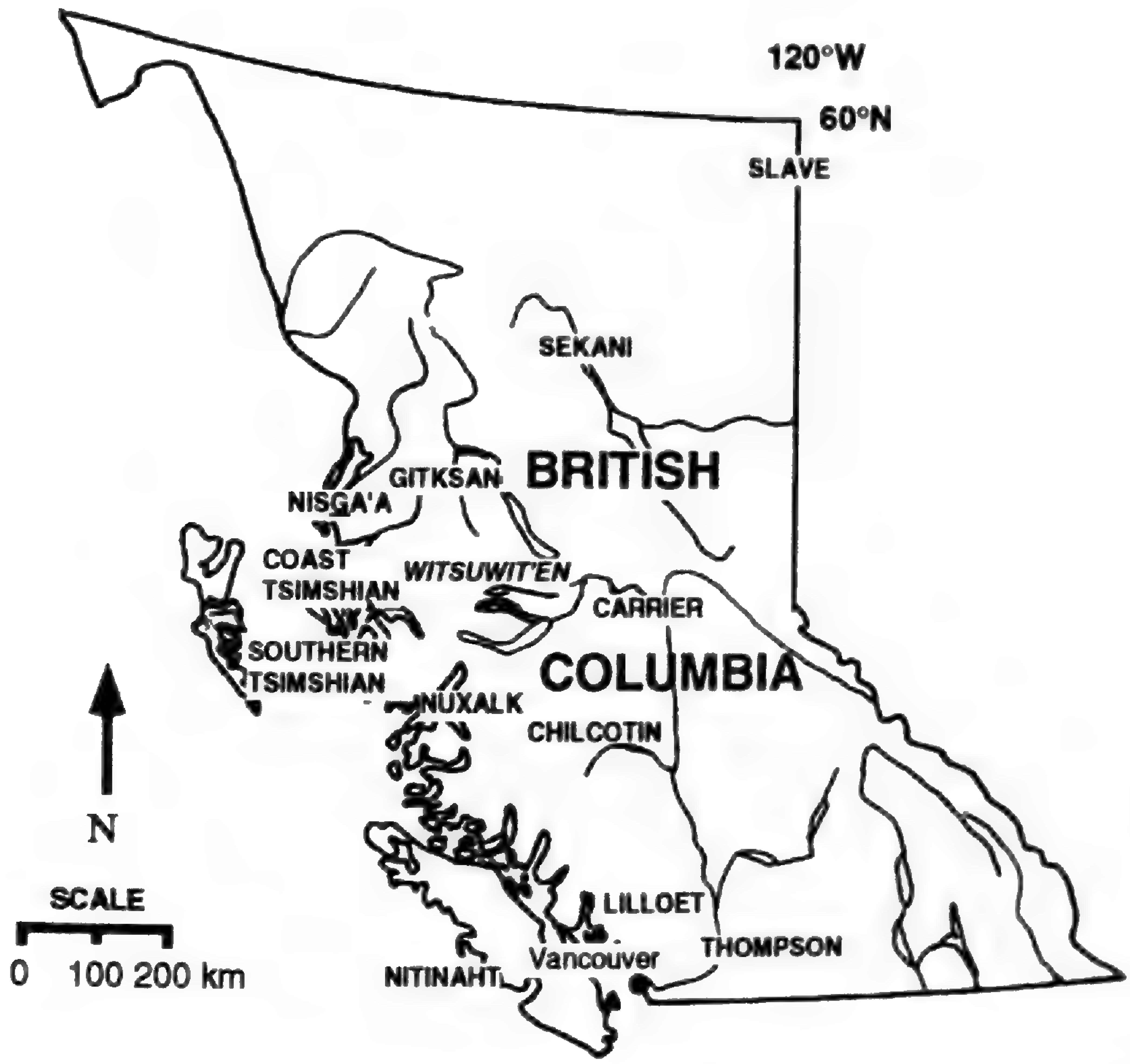

FIGURE 1. — Map showing the general areas of different British Columbia indigenous languages mentioned in the text. Languages not mentioned in our analysis are not indicated on the map.

Witsuwit'en, and formal speeches are preferably given in Witsuwit'en. Data for this study were collected primarily from speakers born before 1930, for whom Witsuwit'en was the preferred language. Some younger speakers were also consulted regarding proper translation into English of certain terms.

Methods. — The data for this analysis of plant classification and nomenclature were collected by Johnson-Gottesfeld during ethnobotanical, ethnomedical, and ecological fieldwork among the Witsuwit'en in the period 1986-1996. The data were gathered in a series of unstructured interviews regarding plant uses, identification, and naming, and during several field trips to gather medicinal plants. Plant information was elicited at times by bringing fresh specimens to elders and inquiring what specific plants were called. Information was also collected by reference to a loose-leaf notebook of color photos of local plants and plant parts such as berries, stems, petioles, or rootstocks. Other plant data were volunteered spontaneously. Confirmation of identity of spontaneously described plants was by reference to fresh plant material collected to confirm postulated identifications, and to "case" specimens (Bye 1986) of known identity (e.g., a dried plant rhizome carried as a charm), or by freehand sketches and verbal descriptions, later verified by showing a plant or specimen to an elder to confirm the identification. Voucher specimens are deposited in the herbarium of the Royal British Columbia Museum in Victoria; a duplicate set is held in the Herbarium of the University of Alberta.

Interviews were conducted in Witsuwit'en with a bilingual translator,[2] or in English, with use of Witsuwit'en plant names and other botanical terms. Plant names and taxonomic questions were explored with 19 different consultants, all fluent, native speakers of Witsuwit'en. Eighteen of these were over 60 years of age when interviewed, and all of the consultants who contributed substantial linguistic data had lived on the land at least in their childhood.

Linguistic research was independently carried out by Sharon Hargus with fieldwork from 1988-present, and she was consulted during the data gathering phase to check the correctness of linguistic data. Some of her recent fieldwork has included re-elicitation of plant terms originally collected by Priscilla Kari (now Russell) in the mid 1970s and confirmation of the referents of these terms with specimens or photographs in plant manuals. Linguistic analyses presented in this paper are her work.

Classification. — Ethnobiological classifications have been the subject of many papers and much theoretical debate. According to Berlin (1992; Berlin *et al.* 1973), ethnobiological classifications are taxonomic and hierarchical in organization, consisting of up to six different levels or ranks. The most inclusive is what he terms the "unique beginner" (e.g., 'plant'), unnamed in most cultures, ranging through "life form" (e.g., 'tree'), "intermediate" taxa (e.g., 'evergreen'), folk generics (e.g., 'pine'), folk specifics ('lodgepole pine'), and folk varieties.

Not all cultures have all of the "universal" ethnobiological taxonomic ranks represented in their classifications. In particular, Berlin (1992), Waddy (1982), and Hunn and French (1984) have argued that foraging peoples tend to lack folk specifics and may have fewer recognized life form categories, or no life forms (Brown 1985). Most generics are reported to be included in one or another life form, but many are not clustered within intermediate taxa. Similarly, few generics are reported to be further sub-divided.

It has been argued that a classification which usually develops only two levels is perhaps not most fruitfully conceptualized as "hierarchical" (Morris 1984; Ellen 1993; Randall 1976, 1987).[3] However, it is not our purpose to debate this theoretical point here. Although alternative terms for ethnobiological taxa have been proposed by Bulmer (1974) and Atran (1990), Berlin's terms for the different ranks of folk biological classification are those generally used in the literature, and we have chosen to employ them in this study. Our use of these terms does not mean that we accept *a priori* Berlin's conclusions about the nature of ethnobiological classification, and our usage of "life form" does not conform entirely to his criteria, as will be discussed below.

Generics are what Berlin (1992) calls the basic units, the most salient and perceptually distinct "kinds" of plants or animals, in any ethnobotanical taxonomy. Berlin (1992) and Atran (1990) have commented that folk generics are usually equivalent to scientific species in a local context. However, the distinction between generics may be more on the order of differences between scientific genera, because many genera will be monotypic in any local environment. In some instances, the generics may be partitioned into folk specifics, which are recognized as being special cases of the generic which differ in one or a few characters. In relatively few instances, folk species are further broken down into superficially recognized but similar varieties. This usually occurs with distinctive cultivars or color phases of cultivars, and does not typically occur with wild plant species.

Major plant categories in ethnobotanical classification have been called life forms (Atran 1985, 1990; Berlin *et al.* 1973; Berlin 1992; Brown 1977, 1984). Life forms are understood by these authors to be broad groupings of plant kinds based on morphological characters, typically designated by monomorphemic words (called by Berlin [1992] simple primary lexemes), and containing contrast sets of subordinate named generics. Atran (1990) maintains that life forms are natural, rather than artificial, categories which divide up the botanical domain without overlap (although Berlin 1992 notes that not all generics appear to be affiliated with these broad groupings). There has been considerable debate in the literature over the validity and universality of such plant groupings in cultural context (Hunn 1982; Randall 1976, 1987; Randall and Hunn 1984; Morris 1984; Taller de Tradición Oral and Beaucage 1987; Turner 1974, 1987) and what the nature of broad plant groupings is in various cultures whose ethnobotanical classification has been investigated.

Intermediates were originally conceptualized by Berlin *et al.* (1973) as covert groupings of generics between the ranks of life form and generic; they were believed to be rare. Subsequent work has revealed that intermediates are more widespread than previously believed, and that they might sometimes be overtly labeled (Berlin 1992). Studies by Turner (1989) and Taller de Tradición and Beaucage (1987) reveal that for some groups, there might be a relatively large number of intermediates of varying inclusivity, and, according to Turner, with variable bases for inclusion, ranging from strictly morphological to utilitarian or even symbolic. Atran (1985, 1990) rejects non-morphologically based intermediates, but allows for the existence of "covert family fragments", morphologically based intermediates which cross-cut the life form category, postulating that the modern botanical Family is derived from these. Brown (1977) has rejected unlabeled ethnobiological classes, while Taylor (1990) explores the relationship of botanical terminology to classification among the Tobelo, and concludes that unlabeled classes can be recognized by the use of terms which pertain only to the members of the postulated class. An example from our study area would be the existence of the term ***ʔ'l*** 'conifer leaf or needle', which implies the class "evergreen needle bearing tree/shrub."[4]

WITSUWIT'EN CLASSIFICATION

Witsuwit'en classification includes general plant classes of the "life form" rank, a number of generics, at least some intermediate groupings, and possibly one polytypic generic divided into several species. The generic level is the only level encountered in general use; major plant classes or "life forms" and intermediates are more implicit than commonly referred to in discourse about plants. As is typical of most folk botanical classifications, Witsuwit'en generics in general match

TABLE 1.— Witsuwit'en Basic Level Terms: Generics and "Empty" Life Forms

Plant Species	English Name	Witsuwit'en Name	Life form
Abies lasiocarpa (Hook.) Nutt.	subalpine fir	**ts'o tsən, ho'oqs**	**dəcən**
Acer glabrum Torr. ssp. *douglasii* (Hook.)Wesmael	Douglas maple	**ʔaç, ʔaç cən**	**dəcən**
Achillea millefolium L.	yarrow	**bəʔəl yez wəni**	
Agrostis tenuis Sibth.	red top	**tl'oɣ**	**tl'oɣʔ**
Alectoria or *Bryoria* spp.	"black tree moss"	**dəχ ɣe**	
Allium cernuum Roth	nodding onion	**tl'oɣ həłtsən**	
		cət'an həłtsən	**tl'oɣ?**
Alnus crispa (Ait.) Pursh	'mountain alder'	**wəze**	**dəcən**
Alnus incana (L.) Moench	alder	**q'əs**	**dəcən**
Amelanchier alnifolium Nutt.	saskatoon berry	**łəɣəχ**	**dəcən, miʔ**
Apocynum androsaemifolium L.	spreading dogbane	**leχ, c'əndeqł**	
Aquilegia formosa Fisch.	red columbine	**ləsuc**	
Aralia nudicaulis L.	wild sarsparilla	**sɢənistl'ɛs**	
Arctostaphylos uva-ursi (L.) Spreng.	kinnikinnik	**dəniç**	**c'ət'an, miʔ**
Arnica cordifolia Hook. and ?*Taraxacum officinale* Weber	heart-leaved arnica; dandelion?	**ditnic kwə'n**	
Betula papyrifera Marsh.	paper birch	**q'əy**	**dəcən**
Carex sp.	sedge	**tl'oɣ tɛl,**	**tl'oɣ?**
Chrysanthemum leucanthemum L.	ox-eye daisy	**c'ət'an tsəyʔ**	
Cicuta douglasii? (DC) Coult. & Rose	water hemlock?	**wəɣen co, wənɣeni co, honɣeni co**	
Cirsium arvense (L.) Scop.	Canada thistle	**wəle yinət'əyh**	
Cornus canadensis L.	bunchberry	**dəniç yez, cəniç t'an, ɢuziç miʔ**	**c'ət'an, miʔ**
Cornus stolonifera Michx.	red-osier dogwood	**qaq dəlq'ə'n, q'ɛntsec**	**dəcən**
Corylus cornuta Marsh.	beaked hazelnut	**tsaləc qɛkwə'n**	**dəcən**
Crataegus douglasii? Lindl. #	?black hawthorne	**xwəs miʔ**	**dəcən, miʔ**
Cypripedium montanum Dougl.	mountain lady slipper	**dəltsɛ ɣil, cəlqɛ ɣiz**	
Delphinium glauca # S. Wats.	tall larkspur	**dəni zic ɢus**	
Dryopteris expansa (K.B. Presl) Fraser-Jenkins & Jermy	spiny woodfern	**dəyi'n**	
Epilobium angustifolium L.	fireweed	**χas**	**c'ət'an**
Equisetum arvense L., *E. pratense* Ehrb.	horsetail	**χəχ deʔ, χəχ c'ət'an**	**tl'oɣ**
Fragaria virginiana Duchesne	wild strawberry	**yən tədəlq'ə'n**	**c'ət'an, miʔ**
Fritillaria camschatcensis (L.) Ker-Gawl	riceroot lily	**c'ənqał, c'ənqatl**	
Geum macrophyllum Willd.	large-leaved avens	**həlq'ət bən**	
Heracleum lanatum Michx.	cow parsnip	**ɢus**	**c'ət'an**
Inonotus obliquus (Pers.: Fr.) Pilat	cinder conk	**dəc'əc'əsts'oʔ, tl'eç tsɛ**	
Juniperus communis L.	common juniper	**detsan qɛ gət, detsan ʔanqət, detsan cən, detsan ʔəl**	
krumholz *Abies lasiocarpa* and/or *Tsuga mertensiana* (Bong.) Carr	'mountain juniper' timberline subalpine fir and mountain hemlock	**ts'əχ**	**dəcən**

TABLE 1.— (continued)

Plant Species	English Name	Witsuwit'en Name	Life form
Lathrys nevadensis Wats.	peavine	***qənesdəs***	
Ledum groenlandicum Oeder	Labrador tea	***lədi məsgic***	
Lonicera involucrata (Rich.) Banks	black twinberry	***səs miʔ cən***	***dəcən, miʔ***
Lupinus sp. (*arcticus*?)	lupine	***dzəɬ q'ət tl'oɣ***	
Lycodium selago L.?*	fir clubmoss?	***hatəc***	
Lysichiton americanum Hult+n & St. John	skunk cabbage	***c'ət'an co***	
Mentha arvensis L.?	field mint?	***c'ət'an ts'oltsən***	
Nuphar polysepalum Engelm. and *Calla palustris* L.	yellow pond lily	***χɛɬ t'ats, dəlkw'aχ neɬdəc*** (leaves) ***wəɣuɬ*** (root)	
Oplopanax horridum (Smith) Miq.	devil's club	***xwəs, xwəs co*** (also ***kwəs, kwəs co***)	
Picea engelmanii x glauca	spruce	***ts'o***	***dəcən***
Picea mariana (Mill.) Britt., Sterns & Pogg	black spruce	***nedus, ts'o, ts'o dəz***??	***dəcən***
Pinus contorta Dougl.	lodgepole pine	***cəndu***	***dəcən***
Plantago major L.	broad-leaved plantain	***dəlkw'aχ neɬdəc***	
Poaceae, indet.	grass sp.	***tl'oɣ lədi***	***tl'oɣ***
Populus tremuloides Michx.	trembling aspen	***t'əɣəs***	***dəcən***
Populus balsamifera L. ssp. *trichocarpa* (Torr. & Gray) Hult.	black cottonwood	***ts'əy***	***dəcən***
Prunus ?pensylvanica L.	'red cherry'	***snəw***	***dəcən, miʔ***
Prunus pensylvanica•	bird cherry	***smits'oq***	***dəcən, miʔ***
Pyrola sp. or *Moneses uniflora* (L.) Gray	wintergreen or single delight, 'beaver ear'	***tsa dzəq***	
Pyrus fusca Raf.	Pacific crabapple	***məlqs***	***dəcən, miʔ***
Ribes oxyacanthoides L.	northern gooseberry	***c'əndewəzgi, kw'əndewəzgi***	***miʔ***
Ribes triste? Pall.	'wild red currant'	***q'ay dətəgi***	***miʔ***
Ribes ?lacustre (Pers.) Poir	'wild black currant'	***dəlkw'aχ miʔ***	***miʔ***
Rosa acicularis Lindl.	prickly rose	***tseɬ ɣil***	***c'ət'an, miʔ***
Rubus idaeus L.	red raspberry	***bəyoɬɢəkw***	***miʔ***
Rubus parviflorus Nutt.	thimbleberry	***dəq dinqay*** (berry), ***misq'oʔ t'an*** (bush)	***c'ət'an, miʔ***
Rubus spectabilis Pursh	salmonberry	***məsɢəle'n***	***miʔ***
Salix spp.	willow	***q'ɛndliç***	***dəcən***
Sambucus racemosa L.	red elderberry	***luts***	***dəcən***
Sedum divergens Wats.	stonecrop	***tsɛ miʔ***	***miʔ***
Shepherdia canadensis (L.) Nutt.	soapberry	***nəwəs***	***miʔ***
*Sium suave?*Walt. #	water parsnip? "wild carrot"	***sasco, tsasco***	
Smilacina racemosa (L.) Desf.	large flowered false Solomon's seal	***ɬəc tsəkw miʔ***	
Sorbus scopulina Greene	mountain ash	***dəcən həltsən, cənec'əɬ, məsdzi tsawəsdi, honq'ɛχ ts'əcən***	***dəcən***
Sphagnum magellanicum Brid. (part)	sphagnum moss	***yin, yən tl'aχ yəl, yin yəl ?***	

TABLE 1.— (continued)

Plant Species	English Name	Witsuwit'en Name	Life form
Spirea douglasii Hook. ssp. *menziesii* (Hook.) Calder & Taylor	pink spirea	***ts'ədəziç***	***dəcən***
Streptopus roseus Michx.	rosy twisted stalk	***tsəlto miʔ***	
Symphoricarpos albus (L.) Blake	snowberry	***c'ətsəft miʔ***	***dəcən, miʔ***
Thuja plicata Donn. ex D. Don	western red cedar	***səmɢən, hɛt'əl***	***dəcən***
Tsuga heterophylla (Raf.) Sarg.	western hemlock	***məsdzu***	***dəcən***
Typha latifolia L.	cattail	***tl'oɣ zi, tl'oɣ c'əziç***	***tl'oɣ?***
Urtica dioica L.	stinging nettle	***hoɬts'ec***	
Vaccinium caespitosum Michx.	low-bush blueberry	***yəntəmiʔ***	***miʔ***
Vaccinium membranaceum Dougl.	black huckleberry	***dəgi***	***miʔ***
Vaccinium ovalifolium Smith	high-bush blueberry	***dindze***	***miʔ***
Vaccinium oxycoccus L.	bog cranberry	***miʔo***	***miʔ***
Veratrum viride Ait.	Indian hellebore	***qunye***	***c'ət'an***
Viburnum edule (Michx.) Raf.	high-bush cranberry	***tsaɬtsɛ***	***miʔ***
unidentified fern? or synonym for skunk cabbage?, from swamp		***dəmuh t'an***	***c'ət'an***
fern spp.	lady fern, spiny woodfern	***tsəɬ ʔaχ stan, ts'ətl'aχ stan***	
fungi, in general	mushroom, fungus	***c'ebedzəq, c'əɣebedzəq, c'ebedzəq***	
puffball sp.	puffball	***dəni zic cac'əsɢəkw***	
white lichen, probably a reindeer moss (*Cladonia* or *Cladina* spp.)	"caribou eat this"	***c'agu***	
water plant, unidentified••	'streaming'	***tɛχ dləz***	
flower, in general	'flower', wildflower	***c'əndec***	***c'əndec***
mosses, in general	moss	***yin***	***yin***

* from Jenness 1943, reelicited from Pat Namox in 1996; identification from photograph, uncertain

identification from Kari (1978)

• may be an identification error as the Gitksan term refers to *P. virginiana* L. var. *melanocarpa* (Dougl.) Walp., chokecherry, which has dark fruit, in contrast to the red fruit of **snəw**

•• from the description, maybe a species of submerged *Potamogeton*

well with scientific species, while relatively inconspicuous plants such as mosses, lichens and fungi (fungal fruiting bodies) are underdifferentiated, with only a few Witsuwit'en terms for the many kinds in the local biota.

Generics. — Because the focus of the ethnobotanical study was on the utilization of plant resources, Johnson-Gottesfeld did not attempt to collect a complete inventory of all plants distinguished and named by the Witsuwit'en. She obtained terms for 75 basic level categories, that is, folk generics (see Table 1), and three terms which are "empty" life forms that appear to be undifferentiated residual classes (discussed below under *Major plant classes* and *Intermediates*). Seventy-one of the basic level categories are treated as folk generics which are not further subdivided. Further research by Hargus has added 16 terms for basic level classes and several variant names for plants already documented, for a total of 91 named basic level plant classes.

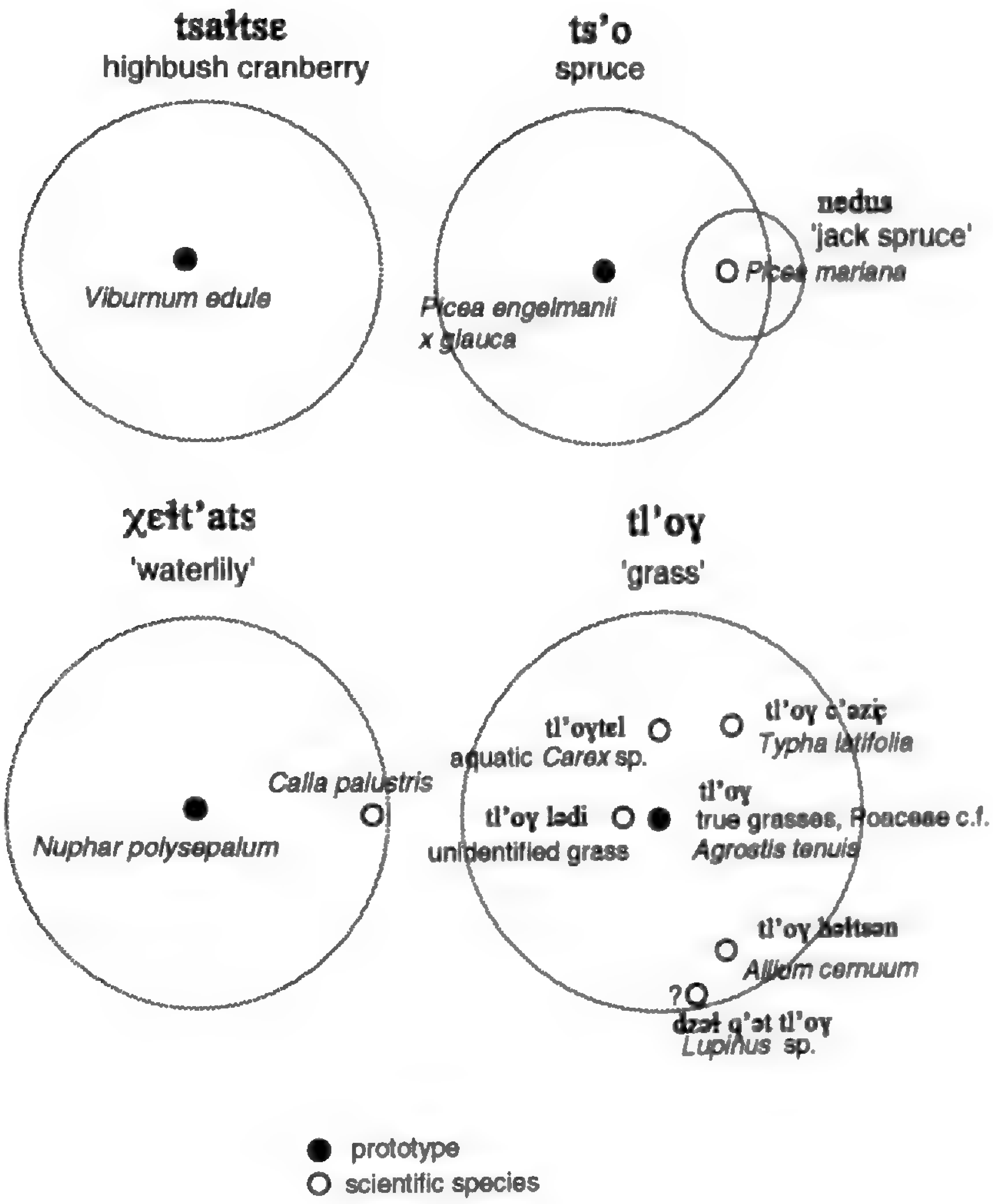

FIGURE 2. — Diagrams of several Witsuwit'en generics, showing a range of relationships of between Witsuwit'en generics and scientific species and genera. The bounds of Witsuwit'en generics are indicated by gray outlines. The prototypical scientific species is indicated by a solid black circle. Any other scientific species included in the Witsuwit'en generic are indicated with hollow circles. The generic *tl'o^ß* also contains named Witsuwit'en subdivisions or specifics. Witsuwit'en names are given in boldface type, and scientific names in italics.

Most of the generics appear to correspond in their ranges to single biological species, but several may cover more than one scientific species (Figure 2). Of those generics whose range of reference is adequately known, 33 generics represented monotypic genera in the local flora, and 24 generics represented single biological species in polytypic genera (see species of *Rubus, Ribes, Vaccinium, Alnus,* and *Cornus* in Table 1).[5] ***ts'o*** is an example of a generic which can refer to more than one species of a locally polytypic genus; it can refer to black spruce (*Picea mariana* (Mill.) Britt., Sterns & Pogg.) as well as the more common and widespread hybrid white spruce *Picea engelmannii x glauca*. Some groupings diverge further from botanical classification: ***χεɬ t'ats*** can refer to the shallow water aquatic plant *Calla palustris* L. (in the Araceae) as well as the yellow pond lily *Nuphar polysepalum* Engelm. (in the Nymphaeaceae), a medicinal plant. The consultant suggested in English that calla was a 'baby water lily'.

The only class which appears to be a polytypic generic with four named species is ***tl'oγ*** 'grass'. The terms for nodding onion, sedge, cattail and a species of grass are all hyponyms of ***tl'oγ***; i.e., ***tl'oγ*** modified by a second term (see Figure 2).

There are two other examples of possible folk specifics which we tentatively treat as coordinate taxa (Hunn and French 1984) at the generic level. While the term for bunchberry (***dəniç yez***, lit. 'small kinnikinnik') suggests that it is a species of ***dəniç*** 'kinnikinnik', we interpret these terms as two forms at the same level of classification with a relationship indicated by a diminutive, as has been reported in Sahaptin (Hunn and French 1984) and Slave (Rice 1989). No consultant described bunchberry — also called ***cəniç t'an*** (lit. 'marten plant') and ***ɢuziç miʔ*** (lit. 'gray jay berries') — as a "kind of ***dəniç***" or suggested any special relationship between them, although speakers clearly know the literal meanings of such terms. Since we did not specifically elicit speakers' views on such relationships, our interpretation must be seen as tentative. Consider ***ts'o tsən*** 'subalpine fir' (*Abies lasiocarpa* [Hook.] Nutt.): Hargus has heard ***ts'o tsən*** spontaneously translated by its literal meaning 'stinking, smelly spruce', suggesting that subalpine fir might be treated as a type of ***ts'o*** 'spruce' (*Picea* spp.). However, no consultant indicated any relationship between the two nor explained how ***ts'o tsən*** might differ from some "typical" ***ts'o***.

Although the 91 generics and specifics do not constitute a complete inventory of the flora known to the Witsuwit'en, they do exhibit the pattern reported for a number of other foraging peoples (Berlin 1992; Hunn and French 1984; Randall and Hunn 1984; Brown 1985) with around 2% polytypic generics.

The majority of plants recognized and named by the Witsuwit'en are large, salient in the environment, and of ecological importance or utility. In order to partially correct for the bias in the ethnobotanical fieldwork caused by the research focus on use of plants, during 1992 fieldwork Johnson-Gottesfeld attempted to elicit names of several plants that she had no indication were used by the Witsuwit'en. She was unable to obtain names for four plants, three of which are quite conspicuous and common. Two were flowering specimens of common herbs, Indian paintbrush (*Castilleja miniata* Dougl.) and a purple flowered aster (*Aster ?ciliolatus* Lindl.), and the third was a branch of a very common shrub, pink spirea (*Spiraea douglasii* Hook. ssp. *menziesii* [Hook.] Calder & Taylor), with flowers and fruits.[6] Two elders commented that "in the old days" they would have had words for everything, including terms for the flowers, but they did not currently know any term for the aster and Indian paintbrush besides ***c'əndec*** 'flower'.

Major Plant Classes or "Life Forms".—Broad groupings of plant classes in Witsuwit'en are relatively difficult to identify without specialized elicitation sessions, as folk generics are the terms commonly employed. We will here provisionally employ the term "life form" for broad groupings of Witsuwit'en plant types which Johnson-Gottesfeld inferred during her field work (Table 2), although the groups we report here do not uniformly conform to the definitions of life form given by Berlin (1992), Atran (1985, 1990), or Brown (1977) in that they may be based in part on utilitarian criteria, are not always mutually exclusive, and may be "empty," that is, contain few or no named subordinate generics. This is similar to the situation described by

TABLE 2.— Witsuwit'en Major Plant Classes or "Life Forms"

Witsuwit'en Plant Class	Approximate English Gloss	Empty?
dəcən	'tree', large woody plant	no
c'ət'an	'plant', small shrubs and herbs	no
miʔ, nət'ay	'berry', shrubs or low plants with berries; focused on edible fruits; not exclusive of ***dəcən*** or ***c'ət'an***	no
c'əndec	'flower', herbs with conspicuous flowers	yes
ʔtl'oɣ	'grass', graminoid plants	yes
yin	'moss', including true mosses	yes
c'ebedzəq, c'əɣebedzəq	'mushroom', fruiting bodies of fungi including 'mushrooms' and bracket fungi	yes

Turner (1974, 1987) for several other Indian groups in British Columbia. The following list of broad taxa of "life-form" rank, or major plant classes, must be considered preliminary until more detailed investigation is carried out.

A class of large woody plants, ***dəcən***, is recognized. These include plants which have woody stems and vary from as tall as a person to forest canopy height. This includes both "trees" in the conventional English sense, and woody multiple-stemmed shrubs. ***dəcən*** are utilized for firewood, construction, and carving. Their bark provides resources for dye, cordage and medicines. ***dəcən*** also means 'bush, forest, woods' and 'stick, wood(en), (deciduous) branch'. A common type of medicinal decoction of mixed barks is called ***dəcən yuʔ*** 'bush medicine'.

Other major plant categories are less clearly defined. Smaller shrubs, large herbs (including at least one fern), and low growing herbaceous or semi-herbaceous perennials can be referred to with the term ***c'ət'an*** 'plant, leaf' (as in ***χas t'an*** 'fireweed plant'). Members of ***dəcən*** cannot be referred to by this term. Fireweed, strawberries, thimbleberries, prickly rose bushes, and Indian hellebore are all ***c'ət'an*** (***c'ə-*** unspecified possessor + ***t'an*** 'bush, leaf'). A rose bush, for example, would be referred to as ***tseɬ ɣil t'an*** (***tseɬ ɣil*** 'rosehip' + ***t'an*** 'bush, leaf). We infer that there is a plant class ***c'ət'an*** which includes all such plants, although we have not attempted to elicit such a classification in the field.

Herbs with conspicuous flowers are lumped together as ***c'əndec*** 'flower', and are not usually subdivided by the modern Witsuwit'en. Forms with conspicuous flowers which have a use, however, are referred to by a specific name, such as red columbine (*Aquilegia formosa* Fisch.) ***ləsuc*** (lit. 'sugar'), or yarrow (*Achillea millaefolium* L.) ***bəʔəl yez wəni*** (lit. 'it has small conifer branches'). In addition, several common flowering herbs which are not used do have names (see Table 1); whether these various individually named flowering herbs are seen as subtypes of ***c'əndec*** was not investigated in the field. The term ***c'əndec*** also refers to the flower as a plant organ: "you don't pick the leaves of ***lədi məsgic*** [Labrador tea] when the ***c'əndec*** [flower] is on it." ***ç'əndec*** as a "life form" then is a residual category or "empty" life form (Hunn 1982; Hunn and French 1984; Turner 1987).

The term for grass may also be applied at the "life-form" level, and/or it may be an intermediate taxon or an unaffiliated folk generic with several folk species. If it is to be considered a "life form," then it is a "monogeneric life form" (*sensu* Atran 1985), in that it contains just one, or perhaps two generics, but exhibits a distinctive morphology and special role in the local "economy of nature", or an "empty life form" (*sensu* Turner 1987) in that it does not include a contrast set of named generics. Several different graminoid plants were shown to Witsuwit'en elders to elicit names. Red top *(Agrostis tenuis)*, a true grass, was labeled ***tl'oɣ***. Sedge *(Carex* sp.) was labeled ***tl'oɣ tɛl*** (lit. 'wide grass'). A larger grass (as yet undetermined) was called ***tl'oɣ lədiʔ*** (lit. 'grass tea'). The names of the large aquatic graminoid cattail (*Typha latifolia* L.) are ***tl'oɣ zi*** (lit. 'large, dark grass') and ***tl'oɣ c'əziç***,. Another plant which appears to be classed as a 'grass' is nodding onion (*Allium cernuum* Roth), called ***tl'oɣ həɬtsən*** (lit. 'stinking grass'). It has linear grass-like leaves, but is somewhat succulent, with showy flowers and a conspicuous smell. It is, incidentally, the only grass-like plant which was used by people for food. It can also be called ***c'ət'an həɬtsən*** (lit. 'stinking leaves'), indicating a marginal position in ***tl'oɣ***. A last possible 'grass' is lupine (*Lupinus* sp.), called ***dzəɬ q'ət tl'oɣ*** (lit. 'grass on the mountain'), though its dissimilarity in habitus might suggest that it is 'grass' only in the very general sense of being non-woody.

Horsetails *(Equisetum* spp.) may be marginally included in the 'grass' life form. *Equisetum arvense* L. was unnamed by one consultant, who said he guessed it could be called (in English) "grass." Two other speakers consulted called it ***χəχ c'ət'an*** (lit. 'goose leaves') or ***χəχ deʔ*** (lit. 'goose food').

There is a sense that ***tl'oɣ*** 'grass' may contain a connotation of uselessness, except for hay (and apparently 'stinkgrass', nodding onion). One elder contrasted a sedge specimen with other plants which had potential medicinal uses by saying "that's just ***tl'oɣ*** " (i.e., useless, neither a medicine nor harmful) (LJG interview notes 7/31/92).

When directly asked what term she would use for "all the low growing green plants I showed you" (including several graminoid specimens, horsetail, aster, and yarrow), one elder answered ***q'ay nəyeχ*** (lit. 'new growth'). Johnson-Gottesfeld had just asked about the Witsuwit'en term for 'tree' and intended to inquire about a term for 'herb' (or the 'grerb' of Brown 1977) in contrast to 'tree'. However, since we never encountered such a term or concept spontaneously, we are hesitant to conclude that this term can be accepted as a general 'herb' life form concept or term.

Evidence for 'berry' (***miʔ*** or ***nət'ay***)[7] as a "life form" or major plant category is suggested by the spontaneous listings in interviews of a number of plants which bear edible berries. Such forms include trees or large shrubs, smaller shrubs, and perennials which grow low to the ground (including the succulent *Sedum divergens* Wats. whose leaves are classed as a berry). As Turner (1987) found in her Thompson and Lillooet material, this classification cross-cuts other "life form" classes in that some members are doubly categorized (see Table 3). For example, saskatoons were listed spontaneously as ***dəcən*** (large woody plants) as well as ***miʔ*** (berries). This may be because saskatoons were formerly prized for their hard straight wood for arrow shafts, an important pre-contact trade item, as well as being one of the most important berries for food. For other berries, such as rose hips, strawberries, or thimbleberries, when the focus is on the plant, as opposed to the fruit, they are referred to as ***c'ət'an***.

In addition, some forms of conspicuous berry bearing plants are perhaps only peripherally categorized as 'berries' because the fruit is not edible. Examples include black twinberry (*Lonicera involucrata* [Rich.] Banks) and common snowberry

TABLE 3.— Witsuwit'en 'Berries'

Scientific Name (English name)	Witsuwit'en Name	Other "Life Form"*
Amelanchier alnifolia (saskatoon)	**ɬəyəχ**	**dəcən**
Arctostaphylos uva-ursi (kinnikinnik)	**dəniç**	
Cornus canadensis (bunchberry)	**dəniç yez, cəniç t'an**	**c'ət'an**
Crataegus douglasii? (thornberry')	**xwəs miʔ**	
Fragaria virginiana (wild strawberry)	**yən tədəlq'ə'n**	**c'ət'an**
Lonicera involucrata ('bearberry'#, black twinberry)	**səs miʔ**	**dəcən**
Prunus pensylvanica ('wild red cherry', pin cherry)	**snəw**	**dəcən**
Prunus pensylvanica ? ('wild cherry', bird cherry?)	**smits'oq**	**dəcən**
Pyrus fusca (Pacific crabapple)	**məlqs**	**dəcən**
Ribes lacustre? (swamp gooseberry)	**dəlkw'aχ miʔ**	
Ribes oxyacanthoides (northern gooseberry)	**c'əndewəzgi**	
Ribes triste? ('wild red currant')	**q'ay dətəgi**	
Rosa acicularis (prickly rose)	**tseɬ γil**	**c'ət'an**
Rubus idaeus (red raspberry)	**bəyoɬɢəkw**	
Rubus parviflorus (thimbleberry)	**dəq dinqay, misq'oʔ**	**c'ət'an**
Rubus spectabilis (salmonberry) (red elderberry)	**məsɢəle'n**	
Sedum divergens ('stoneberry', stonecrop)	**tsɛ miʔ**	
Shepherdia canadensis (soapberry)	**nəwəs**	
Smilacina racemosa ('dog penis berry'•, "sugarberry," false Solomon's seal berries)	**ɬəc tsəkw miʔ**	
Symphoricarpos albus (grouseberry'#, common snowberry)	**c'ətsət miʔ**	**dəcən**
Vaccinium caespitosum ('low bush blueberry')	**yəntəmiʔ**	
Vaccinium membranaceum (black huckleberry)	**dəgi**	
Vaccinium ovalifolium ('highbush blueberry', oval-leaved blueberry)	**dindze**	
Vaccinium oxycoccus (bog cranberry)	**miʔo**	
Viburnum edule (highbush cranberry)	**tsaɬtsɛ**	

* other "life form" listed only where the use of the "life form" term with the berry name has been recorded; this information was not specifically elicited in the field

marginal members of **miʔ** or perhaps contrasted with true **miʔ** by animal names; have fruits which are considered inedible with stems which are used for medicinal bark collection

• an edible species with an animal anatomic name; said to resemble a dog's genitals in appearance

(*Symphoricarpos albus* [L.] Blake). These plants, discussed in more detail below, appear to be peripheral to the **miʔ / nət'ay** category, and are classed primarily as **dəcən**.

Two "empty" life forms round out the classification of plants *(sensu lato)* by the Witsuwit'en. These are ***yin*** 'moss' and ***c'əyebedzəq*** or ***c'ebedzəq*** 'fungus' (hereafter referred to as ***c'ebedzəq***). Moss was collected for diapers, and this moss is called ***yin yəl*** (lit. 'white moss') or ***yən tl'aχ yəl*** (lit. 'white under ground'). The preferred moss is pale in color and very long. At times several "feather mosses" of the forest floor may be used, although a very pale type of sphagnum moss (*Sphagnum magellanicum* Brid.), which grows in swamps (Johnson-Gottesfeld and Vitt 1996) is generally considered to be the real diaper moss. This sphagnum appears to be the prototype of the "life form." The term ***c'ebedzəq***, which may contain the root ***dzəq*** 'outer ear', refers to both mushrooms and bracket fungi. Cinder conk, a bracket fungus of unusual form (*Inonotus obliquus* [Pers.: Fr.] Pilat), is called ***tl'ẹ tsɛ*** or ***dəc'əc'əsts'oʔ***. Whether this is considered a type of ***c'ebedzəq*** is not clear.

In common with other Northwest Coast groups, the set of major plant classes or "life forms" proposed for the Witsuwit'en is not congruent with the set of "ubiquitously occurring life forms" analyzed by Cecil Brown (1977, 1984). Vines, for example, are rare in northwestern North America, and are not particularly salient nor taxonomically diverse, whereas mosses, lichens and fungi are conspicuous, varied and abundant. Unsurprisingly, vine is not recognized as a life form by groups in this geographic region (Turner 1987), whereas empty classes denoting "moss" and "mushroom" are found among the Gitksan[8] and may be characteristic of other groups in similar climatic regimes (Turner 1987:77).[9] Clément (1990) describes a broad Montagnais bryoid taxon with numerous named types from the boreal forest region of northeastern North America. Atran (1985, 1990) recognizes that life forms have ecological relevance, and indeed are still retained in scientific ecology. He comments that life forms occupy distinctive roles in "the economy of nature."

In addition, characters other than morphology or plant habitus seem to be factors in generating broad groupings of plants, as will be discussed below under utilitarian factors. A "berry" taxon is reported by Turner (1987:72) for a number of northwest North American Native languages, by Randall and Hunn (1984:340) for the Sahaptin, by Compton (1993) for Southern Tsimshian, as well as for the Witsuwit'en and the Gitksan (Johnson 1997). Clément (1990) also reports a similar edible fruit taxon for the Montagnais. The prominence of berry bearing plants and their economic and cultural importance should perhaps not make it surprising that they should be recognized as a "life form" by various cultures of northwestern and northern North America.

The phenomenon of "empty" life forms subsuming less salient or utilized non-woody vegetation seems to be common to various northwest and northern North American groups. A "flower" class is reported by Clément (1990) for the Montagnais, and Johnson (1997), Turner (1987), Hunn (1982), and Randall and Hunn (1984) have recorded the presence of such a group for various northwest North American groups. "Grass" is similarly a class which is commonly recognized, but usually not extensively subdivided among many non-grain growing peoples, including the Lillooet of British Columbia (Turner 1987) and the Ka'apor of Brazil (Balée 1989).

Intermediates. — Without detailed systematic investigation of Witsuwit'en plant classification, the existence of intermediate plant groupings cannot be discussed in detail. Several possible intermediates may be present in Witsuwit'en plant classification (Figure 3). Some of these postulated intermediates are lexically labeled, while others are covert. Prickly plants or "thistles", ***xwəs*** or ***kwəs*** (hereafter ***xwəs***), are spoken of as a group. These include devil's club (*Oplopanax horridum* [Smith] Miq.), the prototype ***xwəsco*** (or simply ***xwəs***), prickly rose (*Rosa acicularis* Lindl.), stinging nettle (*Urtica dioica* L.), the introduced weedy Canada thistle (*Cirsium arvense* [L.] Scop.), and perhaps **xwəs mi?**, tentatively identified as *Crataegus douglasii* Lindl. "We call all those thistles, rosebush, and so on, they're all **xwəs**" (LJG interview notes 10/29/86). These plants are referred to in conversation as types of **xwəs**:

> "the **xwəs** with the pink flower... **tseɬ γil**" [prickly rose]
>
> "there is a **xwəs** that makes you itch. It's a green 'grass' on the hillside" [in reference to **hoɬts'ec** 'stinging nettles']. (LJG interview notes 10/14/87)

tl'oγ 'grass', discussed above, may be an intermediate taxon rather than a "life form." We have here diagrammed it (Figure 3) as including **tl'oγ** , the focal generic, as well as **χəχ c'ət'an** 'horsetail' as a second generic.

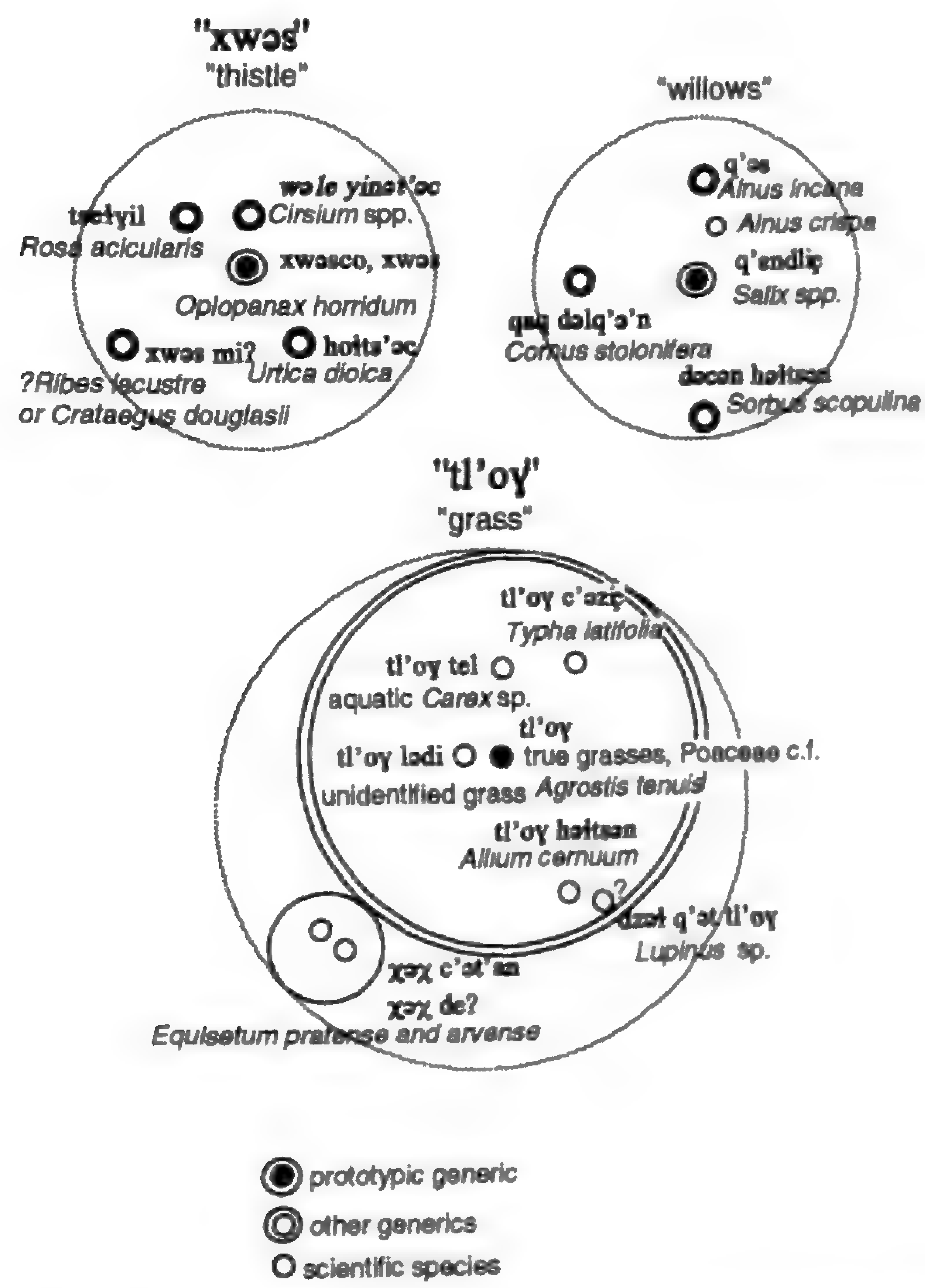

FIGURE 3. — Three Witsuwit'en intermediates, showing constituent generics and scientific species. The "thistle" and "grass" groups are overtly labeled in Witsuwit'en, while "willows" appears to be covert. The outline of the intermediate is shown in gray, while the included generics are shown with a black outline. The prototype of the intermediate is indicated by a solid black circle. Other scientific species are indicated with hollow circles. Witsuwit'en names are given in boldface type, and scientific names in italics.

A third potential intermediate is 'willow'. The English terms 'alder' and 'willow' may be used interchangeably by Witsuwit'en speakers to refer to species of *Alnus* and *Salix*, suggesting that they are perceived as similar. Witsuwit'en speakers take care to distinguish several shrubs with generally similar ecological habitats and habit, including alders (*Alnus incana* [L.] Moench and *A. crispa* [Ait.] Pursh), willows (*Salix* spp.), "red willow" or red-osier dogwood (*Cornus stolonifera* Michx.) and perhaps mountain ash (*Sorbus scopulina* Greene). The 'willow' intermediate may be a functional grouping in that all of these shrubs of similar stature are utilized for bark resources in the dormant season when they are leafless. As their properties and uses are not interchangeable, it is necessary to carefully observe and contrast their stem and bark characters to avoid collecting the wrong type of bark. Alder *(Alnus incana)* **q'əs** is distinguished by its inner bark which turns red when peeled (and was used as a dye); 'mountain alder' (*Alnus crispa*) **wəze** inner bark does not turn red. It is noteworthy primarily for the difficulty of walking through thickets of it on the mountainside. Willow (*Salix* spp., **q'ɛndliç**) inner bark **q'ɛltay** remains white and is strong (it was used for cordage). When red-osier *(Cornus stolonifera)* is discussed for medicine, it is generally referred to as **qaq dəlq'ə'n** (lit. 'red surface'). Some speakers also refer to red-osier as **q'ɛntsec**, similar to the term for willow, or **q'ɛndliç**, when discussing its use in basketry. One elder also took care to contrast mountain ash *(Sorbus scopulina)* from 'willow' (i.e., *Salix* spp.) by bark characters. This is another plant whose bark is medicinal. It differs from 'willow' by the glossiness of the bark and by its strong, distinctive smell.

Other possible intermediate groupings include a 'kinnikinnik and relatives' group, containing kinnikinnik, **dəniç**, and bunchberry, **dəniç yez**, and possibly 'wintergreens' (*Pyrola* spp., *Orthilia [Pyrola] secunda* [L.] House, and *Chimaphila umbellata* [L.] Barton). These are relatively similar low growing ground plants which retain green leaves all year, though they contrast in that only the first two produce edible fruits. As discussed above, at least bunchberry seems to be named in coordinate fashion to kinnikinnik, and Kari (1978) suggests that a species of *Pyrola* (not determined) is also called **dəniç yez**.

Two other intermediates were spontaneously mentioned by one consultant, who was describing which flowering herbs were designated by the terms **ditnic kwə'n** and **ɬəc tsəkw mi?**. Andy George (SH interview notes 6/96) mused that **ditnic kwə'n** really named a whole "family" of flowering herbs, not just dandelion and heart-leaved arnica. For this speaker, the prototype of the group was "sunflower" (probably heart-leaved arnica): "sunflower is the real one." The second grouping included *Smilacina racemosa* (L.) Desf. and other similar herbs in the lily family which produce similar appearing berries "Lily-of-the-valley too, eh. As long as they're in that family." This appears to be a metaphoric expression of group membership in English, rather than a translation of a common Witsuwit'en speech form. The use of the term "family" or other terms for kin relationships has not been observed in Witsuwit'en discussion of plant names, although **yez**, 'little', 'woman's child' is used to indicate affiliation as discussed above.

The last proposed intermediate is a possible "poisonous plants" grouping.[10] Two plants were spontaneously volunteered as poisonous after a discussion of some medicinal plants and Labrador tea: **dəni zic ɢus** (lit. 'corpse's cow parsnip')

(*Delphinium glauca* S. Wats.) and **wənyeni co** or **honyeni co** (lit. 'big killer'), This may be water hemlock (*Cicuta douglasii* [DC.] Coult.& Rose). Water hemlock is known locally for livestock poisoning. The Indian hellebore plant, **qunye**, is always mentioned as poisonous as well, and might be affiliated with such a grouping.

More systematic data collection would clarify the existence and membership of these and other intermediate groups among the Witsuwit'en. The Witsuwit'en intermediate taxa proposed in the present study are based on similar habitus, possession of spines or stinging hairs, and possibly on recognition of human and animal toxicity. Data from Turner (1989) suggests that there might be a number of such intermediate plant groupings, which would serve to order the plant domain for Witsuwit'en native speakers, as the groupings she has documented do for a variety of other Native groups in British Columbia.

Turner (1989) finds evidence of a large number of intermediate plant groupings based on a variety of morphological and utilitarian criteria. A 'spiny' group is reported by Turner (1989), Turner *et al.* (1983) for the Nitinaht, Lillooet, and Chilcotin, other British Columbia Native groups. The Chilcotin use a cognate (**kwes**) of the Witsuwit'en term **xwəs** to designate this group, which for the Chilcotin includes a species of prickly pear *(Opuntia)* but does not include devil's club (Turner 1989:98). Turner (1989:76) has also found evidence of a kinnikinnik and relatives grouping among the Thompson, which included kinnikinnik, wintergreens, false box, and twinflower. The Gitksan also seem to have such a group: the term for kinnikinnik is **sgantimi'yt**,[11] while prince's pine *(Chimaphila umbellata)*, a relative of the wintergreens, and false box are both called **hissgantimi'yt** (lit. 'resembling kinnikinnik') (Johnson 1997).

LINGUISTIC ANALYSIS OF WITSUWIT'EN PLANT TERMS

Our linguistic analysis is based on a corpus of 108 distinct Witsuwit'en names for life forms, intermediates and folk generics.[12] The following types of words are found among this portion of the Witsuwit'en lexicon: nominal roots, prefixed nominal roots, noun compounds, deverbal nouns, other noun phrases, loans, and unanalyzable polysyllables. Many Witsuwit'en plant terms have a literal meaning (or "descriptive force," Hunn 1996) in addition to reference to a particular plant or plant group. Such plant names may describe appearance, scent, uses, or properties of the plant, or make metaphoric allusion to body parts or secretions.

According to Berlin (1992, Berlin *et al.* 1973), a generic is usually denoted linguistically by a single morpheme (a simple primary lexeme, i.e., one which is not analyzable, e.g., 'pine' or 'maple'). In our corpus, the majority, that is, 5 of 8 "life-form" terms are either monomorphemic nominal roots (e.g., **yin** 'sphagnum moss') or prefixed roots (e.g., **dəcən** 'large woody plant', < **də-** 'wooden' + **cən** 'wood, handle, frame'; **c'ət'an** 'plant, leaf', < **c'ə-** unspecified possessor + **t'an** 'plant, leaf'). Our clearest intermediate term, **xwəs** 'spiny plant', is also a monomorphemic nominal root. However, Berlin's prediction is false for the Witsuwit'en folk generics in our corpus: only 15 of the 99 folk generic names in our corpus are monomorphemic roots (n = 9) (e.g., **ts'o** 'spruce') or prefixed nominal roots (n = 6) (e.g., **dəyi'n** 'spiny woodfern').[13]

Compounds form the largest subclass of analyzable, non-loan plant terms (24 of 108 in the total corpus; 24 of 99 folk generics). Compounds are not employed above the folk-generic level of classification. Examples include ***tsaləc qɛkwə'n*** 'beaked hazelnut' (lit. 'squirrel's box'), ***dəni zic ɢus*** 'tall larkspur' (lit. 'corpse's cow parsnip'), and ***tseɬ ɣil*** 'prickly rose' (lit. 'ax pack'). The next largest classes in our corpus (16 of 108 terms) are deverbal nouns (i.e., nouns derived from verb phrases) and other types of noun phrases (16 of 108 terms). All but one of the deverbal terms are folk generics (e.g., ***qaq dəlq'ə'n*** 'red osier', lit. 'surface is red'); among the life forms, only ***nət'ay*** 'berry', lit. 'it is ripening', is deverbal. Non-deverbal noun phrases are nouns modified either by (a) a prenominal postpositional phrase (n = 3, e.g., ***dzəɬ q'ət tl'oɣ*** 'lupine': ***dzəɬ*** 'mountain,' ***q'ət*** 'on', ***tl'oɣ*** 'grass'), (b) a postnominal adjective (n = 10, e.g., ***ts'o tsən*** 'balsam': ***ts'o*** 'spruce', ***tsən*** 'smelly'), or (c) what we have tentatively identified as a prenominal adverb (n = 2, e.g., ***dəχ ɣe*** "black tree moss": ***dəχ*** 'above', ***ɣe*** 'hair').

Fourteen of the 108 plant terms in our corpus are unanalyzable polysyllables; e.g., ***tsaɬtse*** 'high bush cranberry', ***c'agu*** 'white lichen', ***qunye*** 'Indian hellebore'. While a few of these may have one or more identifiable morphemes (e.g., ***cən***— 'wood, handle, frame', as in ***cəndu*** 'lodgepole pine'), it is not possible to provide a literal translation or morphological analysis of these terms at this time. Such terms are possibly originally deverbal; alternatively, they could be loans from other languages.

The majority of plant terms in our corpus (62 of 108 terms; 61 of 99 folk generics) have a literal meaning (descriptive force) in addition to referring to a member of the plant classes we have identified. These literal meanings are either 'descriptive', naming some characteristic shape, smell, color, location, or other property, or 'functional', referring to a use of the plant. Some plants are also named in a metaphoric manner or by allusion to animals. Nearly all plant terms with literal meanings are found at the folk generic level, the sole exception being the deverbal life form ***nət'ay*** 'berry' (lit. 'it is ripening').

Two monomorphemic folk generic terms are polysemous, describing some aspect of the appearance of the plant: ***ts'əx*** 'hat', 'mountain juniper'; ***ɬəɣəχ*** 'together', 'saskatoon' (the berries grow in clusters). Most noun phrase generics are descriptive: e.g., noun + adjective, ***tl'oɣ tɛl*** 'sedge' (lit. 'wide grass'); noun + adjective, ***xwəs co*** 'devil's club' (lit. 'big thorns'); postpositional phrase + noun, ***yəntəmiʔ*** 'low bush blueberry' (lit. 'berry among the land'). Deverbal descriptive terms include ***hoɬts'ec*** 'nettles' (lit. 'it stings'), ***wəle yinət'əç*** 'Canada thistle' (lit. 'it sneaks into hands'), ***yən tədəlq'ə'n*** 'strawberry' (lit. 'red among the land'), ***bəʔəl yez wəni*** 'yarrow' (lit. 'it has little conifer branches'), and ***dəcən həɬtsən*** 'mountain ash' (lit. 'stinking wood') (Mountain ash has a very characteristic bitter almond odor when the bark is cut).

Some descriptive plant terms refer metaphorically to body parts, corpses, or bodily secretions: ***dəχ ɣe*** 'black tree moss' (lit. 'hair above'), ***ts'əlto miʔ*** 'rosy twisted stalk' (lit. 'tears berry'), ***dəni zic cac'əsɢəkw*** 'puffball' (lit. 'corpse's navel'), ***ɬəc tsəkw miʔ*** 'false Solomon's seal' (lit. 'dog penis berry'), ***cəlqɛ ɣiz*** 'mountain lady slipper' (lit. 'boy's testicles') (in allusion to the bulbous sac-like form of the flowers), ***tsa dzəq***[14] 'wintergreen, single delight' (lit. 'beaver ear') (in reference to the shape of the leaf). Folk generics which seem to be named more for function than for some inherent characteristic include deverbal ***həlq'ət bən*** (lit. 'swelling preventative'), as well as the polysemous roots ***ʔaç*** (***cən***) 'Douglas maple' (lit. 'snowshoe (wood)') and ***ts'əy*** 'boat', 'cottonwood'.

Plant names which allude to animals suggest associations of the animal to the plant, ecologically or as food, or types of metaphoric association; e.g., beaked hazelnut, ***tsaləc qɛkwə'n*** (lit. 'squirrel's box'). (Red squirrels [*Tamiasciurus hudsonicus*] harvest large quantities of hazelnuts and store them for winter provisions.) Similarly, the name for yellow pond lily leaves, ***dəlkw'aχ neɬdəc*** (lit. 'frog blanket'), indicates an ecological association with wetland habitat, and horsetail, ***χəχ deʔ*** (lit. 'goose food'), alludes to an ecological and trophic association with geese. Other plant names which incorporate animal names may do so to indicate the non-edibility or medicinal properties of plants so named. Examples include ***səs miʔ*** 'black twinberry' (lit. 'black bear's berry') and ***c'ətsət miʔ*** 'snowberry' (lit. 'ruffed grouse's berry'), both berry bearing shrubs whose fruits are not eaten, but whose bark is used for medicine, and ***detsan qɛ gət*** (lit. 'crow's old shoe') or ***detsan ʔəl*** (lit. 'crow's conifer needles') 'common juniper', an important medicinal plant.[15] Other names of this general form are applied to berries which are not important food sources (and may be considered inedible); e.g., ***dəlkw'aχ miʔ*** 'wild black currant' (lit. 'frog's berry'), not locally considered edible; 'bunchberry' ***cəniç miʔ*** (lit. 'fisher's berry')/ ***ɢuziç miʔ*** (lit. 'gray jay's berry').[16] Another way of indicating inedibility may be by association with corpses: tall larkspur is ***dəni zic ɢus*** (lit. 'corpse's cow parsnip'); this is one of the plants specifically mentioned as poisonous and which is not to be eaten or used for medicine.

Seventeen of the 108 plant names in our corpus are analyzed as loanwords from other languages. Source languages include Gitksan, Carrier, Cree, and French. Roughly two thirds of these loans (12 of 17) are borrowed from Gitksan, a Tsimshianic language spoken immediately north and west of the Witsuwit'en. Three plant names are very likely borrowed from Carrier, an Athapaskan language spoken to the south and east of Witsuwit'en. The remaining 2 loans come from French and Cree.

Speakers of Gitksan and Witsuwit'en have had long contact (Rigsby and Kari 1987, Mills 1994) . For many of the plant names which are shared by Witsuwit'en and Gitksan (Table 4), linguistic and/or biogeographic reasons can be given for positing a direction of borrowing. However, for other names, the language of origin is not immediately obvious. Witsuwit'en plant terms for cedar/cedar bark, fireweed, berry (in general), crabapple, a variant term for subalpine fir, and possibly hemlock/hemlock cambium are Gitksan in origin.[17] The names for red cedar (***səmɢən***) and cedar bark (***hɛt'əɬ***), and perhaps the uses as well, were most likely learned from the Gitksan. Red cedar does not grow in areas occupied by Athapaskan speakers except for the now extinct Tsetsaut and the northwestern corner of the territory of the Witsuwit'en, while it is very abundant in the territory occupied by Tsimshianic speakers, including the Gitksan. ***ɢan*** is the standard term for 'wood, tree' in Gitksan, Nisga'a, and Coast Tsimshian, while in Witsuwit'en this term occurs only in ***səmɢən*** 'red cedar' (<Gitksan ***sim gan***) and in the personal name ***ɬoʔ əmɢən*** (Gitksan morphemes translated as 'timber avalanche'). (As noted above, ***dəcən*** is the usual Witsuwit'en term for 'wood, stick, tree'.)

The terms for 'fireweed' in Gitksan (***haast***), Witsuwit'en (***χas t'an***), and Carrier (***xas***) all have a phonological similarity which is not likely due to chance. The

TABLE 4.— Witsuwit'en Botanical Terms Shared with Gitksan

Latin Name (English Name)	Witsuwit'en Name	Gitksan Name
Abies lasiocarpa (subalpine fir)	**ho?oqs**	**ho'oxs**
Apocynum androsimaefolium (spreading dogbane)	**leχ**	**sganlekx**
Aralia nudicaulis (wild sarsaparilla)	**sGənistl'ɛs**	*
Epilobium angustifolium (fireweed)	**χas**	**haast**
krumholz forms of *Abies lasiocarpa* and perhaps *Tsuga mertensiana / Juniperus communis* ("mountain juniper" / common juniper)	**ts'əχ**	**ts'eex**
Lycopodium selago ? (fir clubmoss)	**hatəc**	**xaadax**
Nuphar polysepalum (yellow pond lily)	**χɛɬ t'ats**	**gahldaats**
Prunus pensylvanica ('red wild cherry')	**snəw**	**snaw**
Prunus pensylvanica / Prunus virginiana (bird cherry / chokecherry)	**smits'oq**	**mi ts'ook**
Pyrus fusca (Pacific crabapple)	**məlqs**	**milkst**
Sambucus racemosa (red elderberry)	**luts**	**sganloots'**
Thuja plicata (western redcedar)	**səmGən**	**sim gan**
Vaccinium oxycoccus (bog cranberry)	**mi?o**	**mi'oot**
cedar, cedar bark / cedar bark	**hɛt'əl**	**hat'a'l**
pine cambium	**q'əniç**	**gan hix, ganix**

Botanical nomenclature after Hulten (1968).
Term from Jenness (1943); reelicited 1996 by S. Hargus
* Term not collected in Gitksan, but Witsuwit'en consultant stated the term to be in the "Hazelton language" (field notes, July 1992) (the root **sgan** is a Gitksan term meaning 'plant'). An unrelated Gitksan term **maa'ytwhl smex** has been recorded by Johnson-Gottesfeld for *Aralia nudicaulis.*

Gitksan term has cognates in other Tsimshianic languages (Nisga'a, Tsimshian **haast**) whereas the names in Sekani (**kahgụ̀s**, **kahgọ̀s**, and Dena'ina (**niɬdghuligi**, **tl'ik' desq'a**, **ts'ik' desq'a**, **ch'deshtleq'a**) are completely different from the Witsuwit'en, suggesting that the Witsuwit'en and Carrier terms originate in the Tsimshianic languages.

In Witsuwit'en there are two words for 'berry', **mi?** and **nət'ay** (lit. 'it's ripening'). **nət'ay** is less common as the spontaneous translation of 'berry', and **mi?** alone is used in proper nouns (berry names). Central Carrier also uses a related word, **mai**, for 'berry'. Apparently, both Witsuwit'en and Carrier terms were borrowed from Gitksan **maa'y**, cognates of which are also used in Nisga'a and Tsimshian.

Witsuwit'en **məsdzu** 'hemlock cambium' appears to be derived from the Gitksan terms **maas** 'bark' and **xsuu'u** 'hemlock cambium'. All Witsuwit'en speakers who discussed hemlock 'cambium' as a food mentioned that it was learned about or obtained in trade from Gitksan or Tsimshian people, and one elder stated that the name **məsdzu** was from Gitksan.

Like other Canadian Athapaskan languages, there are numerous loan nouns from French into Witsuwit'en in non-plant names. Only two such loans occur in plant names. Labrador tea **lədi məsgic** is a compound consisting of two loan words: French *le t+* 'the tea' and Cree *maske:k* 'swamp, muskeg' (Ellis 1983). This suggests that its use as a beverage may have been learned from early French and M+tis fur traders, possibly through the Babines or Stuart Lake Carrier. The Witsuwit'en name for *Aquilegia formosa* (red columbine) is ***ləsuc*** (<French *le sucre*, 'sugar'); ***ləsuc*** also means 'sugar' and is therefore polysemous in Witsuwit'en.

While linguists agree that Carrier and Witsuwit'en are separate Athapaskan languages, exactly how closely related they are is a matter of debate. Story (1984) groups Witsuwit'en and Carrier into an Athapaskan subfamily, Babine-Carrier, of relatively shallow time depth (approximately 300 years.). On the other hand, Kari and Hargus (1989) view Witsuwit'en and Carrier as no more closely related than other adjacent northern Athapaskan languages spoken in the interior of Alaska (which are known to have been neighbors for considerably more than 300 years). Of the 108 plant terms in our corpus, 31 are shared with Carrier. The phonological similarity of these shared terms could be due either to borrowing or to inheritance from a common ancestor, either Proto-Athapaskan or a more immediate ancestor. Nine of these shared terms have widespread cognates in the Athapaskan family and are clearly inherited from Proto-Athapaskan (PA); e.g., 'alder' (Witsuwit'en ***q'əs***, Carrier ***k'əs***), 'spruce' (W. ***ts'o***, Carrier ***ts'u***), and 'kinnikinnik' (***dəniç*** in both languages). Fifteen of the 31 shared terms have at least one morpheme that can be reconstructed for PA. With some terms, Carrier and Witsuwet'en have undergone the same semantic shift, e.g., PA ****dəge*** 'berry' > W. ***dəgi*** 'black huckleberry', C. ***dəǰe*** 'huckleberry'; PA****da'ŋ***(ə), ****də'ŋ*** (ə) 'spring season' > W. ***χəχ deʔ***, C. ***xohdaiʔ*** 'horsetail' (species). The remaining seven of 31 plant terms shared with Carrier are of uncertain etymology: e.g., 'highbush cranberry' W. ***tsaɬtsɛ***, C. ***tsaɬtse tsən***. We hypothesize that three of the latter set are borrowings from Carrier into Witsuwit'en: 'juniper' ***detsan ʔanqət***, cf. C. ***datsan ʔangət***; W. 'cattail' ***tl'oɣ c'əziç***, cf. C. ***tl'oɣaziɬ***; 'red-osier dogwood'; W. ***q'ɛntsec***, cf. C. ***k'entsi***, since these plants are all known in Witsuwit'en by more than one name (see below and Table 1). However, we suspect that more than these three terms shared by Witsuwit'en and Carrier are loans from one language into the other. The matter requires a survey of other Athapaskan and non-Athapaskan languages in the area.

Nine generics were labeled by more than one term. Some of these we consider true synonyms, as they were consistently referred to by more than one name by the same speaker, e.g., red-osier dogwood (two distinct terms and several variants of the first term), mountain-ash (four terms encountered), bunchberry (three terms collected), and cinder conk (two unrelated terms used). A variation in naming which can be used for contrast is shown for devil's club, which is usually referred to as ***xwəs***, the unmarked prototype of the "***xwəs***" class, but can be distinguished as ***xwəsco*** (lit. 'big thorn'). Other terms appear to reflect idiolectal variation, with only one term used per speaker, e.g., 'mountain lady slipper' ***dəltsɛ ɣil, cəlqɛ ɣiz***, 'cattail' ***tl'oɣ zi, tl'oɣ c'əziç***.

COMPARATIVE ANALYSIS

Changes in lifestyle and language retention may affect the retention of botanical lexicon and knowledge of the indigenous classification system (Berlin 1992, Waddy 1982). The strong bias toward economic plants, and the poor awareness of non-economic plants evident in Johnson-Gottesfeld's research is probably a result of these factors, as well as a consequence of her research emphasis on plants as resources. Hargus's linguistic research has increased the proportion of names for unutilized plants in our corpus.

The degree to which this emphasis on naming and classification of plants of potential utility would have been present in the aboriginal system prior to contact cannot be determined at this point. Johnson-Gottesfeld has found that among the Gitksan — neighbors to the north and west of the Witsuwit'en with similarities in environment, culture, and history — only those plants of high salience and ecological importance or utility tend to be named. The Gitksan also underdifferentiate groups like mosses, fungi, and graminoids, subsuming them in classes which may be analyzed as "empty life forms." Likewise, Sahaptin (Hunn 1982) and Chewa (Morris 1984) fail to recognize or name many species which are not utilized or otherwise salient.

Relationship of "Life Forms" to Partonomy. — Clément (1995) has analyzed life forms for the Montagnais in terms of 'partons' (plant organs) which are in turn related to utilitarian factors. Such a life form will contain a core of plants with the diagnostic parton and others related by prototype-extension to this core. The Montagnais life form 'tree' ***(mishtukuat)*** is designated by the same term as 'wood' (except that 'tree' is animate and 'wood' inanimate in gender). 'Tall shrubs' ***(shak̃ua)*** are woody plants which possess 'double bark', useful in medicine; eight of 12 forms so classed have this 'double bark', an outer bark layer and an inner layer, often considered to be medicinally efficacious. Members of the small shrub class ***(atishŋa)*** typically possess edible fruits. Low herbs ***(mashkushua)*** include a subgroup called 'leaves' ***(nŋpŋsha)***, which have leaves useful for medicinal purposes, and another subgroup called 'root' ***(ushk̃tĩpŋ)***,with medicinal roots. (The remainder of this heterogeneous class is considered to be residual.)

Witsuwit'en "life forms" can also be analyzed in terms of relationship of diagnostic and useful partons. **ðəcən** implies both woodiness and medicinal properties of the bark. ***ŋiʔ/nət'ay*** 'berry' is roughly equivalent to the small shrub class of the Montagnais, except that it is cross-cutting for the Witsuwit'en, overlapping both **dəcən** and **c'ət'an**. **c'ət'an** could be said to be named with reference to partonymy also, as this term can be glossed 'leaf' as well as 'plant'. However, this Witsuwit'en grouping lacks a strong utilitarian component. The empty class **c'əndec** 'flower' is obviously conceived with reference to the plant parton 'flower'; for the Witsuwit'en it is negatively associated with utility and is clearly a residual class.

Utilitarian Factors. — Brown (1977, 1985, 1995), Berlin (1992, Berlin *et al.* 1973), and Atran (1985, 1990) consistently argue for divorcing ethnobiological taxonomy from utilitarian characteristics of biological species. They argue instead that "general purpose" (more or less purely morphological or perceptually based classifications of biota) taxonomies can be meaningfully elucidated in human cultures as separate from various "special purpose" classifications based on the use of species for food, medicine, or in symbolic systems. Others argue that though "general purpose" taxonomies may be elicited, they may not reflect what is most culturally relevant or significant (Randall 1976, 1987; Morris 1984; Hunn 1982).

> ...although we can accept that there is no necessary one-to-one relationship between utility and nomenclature, nevertheless it is important to recognize

> that functional criteria are intrinsically linked to taxonomic ordering. As I have tried to indicate above, many Chewa life-form categories cannot be understood in purely morphological terms, and functional categories ... also have a taxonomic relevance.... a true understanding of the nature of folk classifications, both in a culturally specific context and in terms of the evolution — the 'encoding sequence' — of life form categories, demands that we incorporate into the analysis functional criteria. As anthropologists we should be concerned with systematically exploring the relationship between folk classifications and other aspects of cultural life. To view folk taxonomies simply as taxonomies, abstracted from utilitarian, ecological and cultural concerns, limits our understanding of how human groups related [sic] to the natural world (Morris 1984:58-59).

> ...Brown arbitrarily restricts his [life form] analysis to a small set of folk biological concepts prejudged to be universal.... Consequently, we are left in ignorance of the welter of utilitarian and ecologically defined suprageneric taxa which most peoples rely on to organize their knowledge of the natural world.... Sahaptin conversation is full of reference to such general classes of plants as *xnit* 'foods which are dug' and *tmaanit* 'foods which are picked' (Hunn 1982:839).

The argument has involved both the presumed actual structures involved in storage and retrieval of relevant information regarding plant identity, and issues such as what is legitimately a taxonomy (cf. Wierzbicka 1984) versus other types of classification. Issues such as transitivity (Waddy 1982; Randall 1976, 1987) and whether classification of "living kinds" differs in fundamental ways from that of cultural artifacts (Atran 1985, 1990) are central:

> This intrusion of practical considerations into the referential meaning of life forms is also anomalous from the taxonomic perspective in that it divides species that exhibit strong morphological resemblances while uniting others that are morphologically dissimilar (Hunn 1982:838).

> Berlin suggests that a life-form generally contains a fairly large number of named subdivisions. However, the internal differentiation of a taxon may not correlate with the salience that taxon has in local thinking.... A second difficulty with the concept of "life form" is that some taxonomic categories of this general order do not in fact coincide neatly with obviously distinctive groups of fauna or flora.... Here the polysemous nature of terms applied in many languages to certain taxa which would appear to constitute legitimate "life forms"...suggests that these taxa may be defined as much by cultural evaluation (technological utilization, dietary and culinary status, economic and ritual significance) as by their objective biological characteristics (Bulmer 1974:23).

Atran (1990) suggests that children spontaneously form natural object concepts — including life forms and folk generics — by an innate cognitive process, regardless of the potential uses of plants and animals. Thus ethnobiological classification is fundamentally independent of utilitarian factors.

Although this is an appealing argument, we suggest that utility of plants may well be incorporated into classification schemes for plants, and that categories such as "foods" or "economic plants" cannot be separated from a general classification of plants. Johnson-Gottesfeld's experience suggests that in families which engage directly in subsistence activities, children learn the economic and utilitarian aspects of plants as soon as they become aware of the plant world. Johns (1990) suggests that there is a period of time after weaning when young children are particularly receptive to learning new foods, and are most likely to sample different plants in their environment. This leads to a peak in accidental poisonings of young toddlers, but might also make children of this age very impressionable regarding the potential edibility of plants in the environment, if they are in contact with the plant world and are among adults who regularly harvest plants for food.

It is true that not all types of use are likely to be learned equally early, nor, indeed, by all members of a given society (cf. the study of Tzeltal children's ethnobotanical knowledge by Stross 1973, cited in Berlin 1992). Medicinal uses of plants may be learned much later, and may involve specialization of skills and knowledge. However, important edible and poisonous plants are likely to be learned by children, concurrently with their use or avoidance, as soon as they are mobile and can talk.

Bulmer (1974:12-13) explores the relationship between obvious utility and plants and animals named by the Kalam of New Guinea:

> "The recognition of both the objective and subjective importance of ecology to human communities throws light on the problem of classification and naming of apparently useless animals and plants. If one sees individual plant and animal categories solely in their direct relationships to man, there are many which appear irrelevant, neither utilised nor noxious. However if the relationships between different kinds of plants and animals are recognised as relevant, then a great range of additional forms will very usefully be identified and classified....
>
> My final introductory point is that it is this ecological perspective which requires systems of classification to recognise basic categories, reflecting discontinuities in nature "in the round", multidimensionally, systematically relating morphological discontinuities with discontinuities in behaviour, as well as direct cultural significance."

Some features of the naming of edible or cultivated plants versus non-utilized or wild plants by Amazonian peoples can also be interpreted as coding utility within the plant taxonomy. In many cultures, cultivated plants *are excluded from the life forms* in which their non-cultivated congeners are included, clearly showing a utilitarian component (in a negative sense) to for the Ka'apor "life-forms" (Balée 1989).

The Ka'apor label folk generics which are wild or unutilized with an animal name coupled to the name of a cultivated form (Bal+e 1989). This indirect coding of disutility by use of animal names may be seen in the Witsuwit'en names for black twinberry and snowberry discussed previously. The Chewa of Malawi use animal names to signal the inedible or dubious status of mushrooms (Morris 1984). Turner (1975) reports that in Nuxalkmc (Bella Coola), the literal translation of devil's club (with inedible berries and a rhizome that may be used medicinally) is 'grizzly bear's highbush cranberry'. Gitksan terms for several non-edible berries also contain animal names: ***sgan maa'ya gaak*** 'raven's berry plant' is the name for black twinberry, used for medicine; ***maa'ytwhl smex*** (lit. 'bear's berry') refers to *Aralia nudicaulis*, with inedible berries that may be used medicinally (Johnson 1997). ***ŋaa'ya smex*** (lit. 'bear's berry') or ***maa'y litisxw*** (lit. 'blue grouse's berry') are alternative names for queen's cup (*Clintonia uniflora*), regarded as poisonous (Johnson 1997). The term ***mi' ganaa'w***, 'frog berry' for the edible cloudberry *Rubus chamaemorus* is an exception.

An intriguing feature of northwestern North American plant classification is the direct coding of utility in some tree species. In Gitksan, the names of many tree species mean "good for____" (Johnson 1997). Cottonwood (*Populus balsamifera* L. ssp. *trichocarpa* [Torr. & Gray] Hult.) is ***am m'al***, lit. 'good for canoe'. Western red cedar is either ***sim gan***, lit. 'real wood', 'tree', or ***am hat'a'l***, lit. 'good for cedar bark'. In Witsuwit'en, cottonwood is ***ts'əy***, polysemous with 'canoe', and maple (*Acer glabrum* Torr. ssp. *douglasii* [Hook.] Wesmael) is **ʔaç**, polysemous with 'snowshoe', or **ʔaç cən** (lit. 'snowshoe wood'). Turner (1987) reports several such examples from Lillooet including terms for 'ocean spray' (*Holodiscus discolor* [Pursh] Maxim.), lit. 'digging stick plant', and 'bitter cherry' (*Prunus emarginata* [Dougl.] Walp.), lit. 'bitter cherry bark', important for imbricated designs in Salish coil basketry.

Shallowness of hierarchy. — The uneven development of "life form" classes, coupled with the irregular presence of intermediate taxa and the rarity of folk specifics indicates a shallow and weakly developed hierarchic structure in Witsuwit'en ethnobotanical classification. As mentioned above, this situation has been reported for other folk biological classification systems such as Sahaptin (Hunn and French 1984). Turner (1987:77), describing the overall ethnobotanical classification systems of the Thompson and Lillooet, was moved to remark:

> "A number of the major categories are at least partially defined by utilitarian, rather than solely morphological features. These categories are not necessarily mutually exclusive. Most are residual, having a few highly salient named terminal taxa and many recognizably distinct, but unnamed, members. Most of the named taxa have, or had in the past, a high level of cultural significance, particularly as foods, [technological] materials or medicines."

Had she confined her analysis to taxa which did not overlap and were based only on morphological and perceptual differences, she would have missed much of the structuring of the botanical domain by speakers of these languages. Although loose hierarchy is apparent in the taxonomies of these groups, the structure is much more fluid and less systematic than the classic hierarchical structure idealized by Berlin *et al.* (1973). In a later paper investigating intermediate level groupings, Turner (1989:71) comments:

> "Hunn (1982), Randall (1976) and other researchers...have presented data

that contradict or at least render less certain the contentions of Berlin and his colleagues that ranked, hierarchical folk biological classifications systems based on perception of overall morphological similarities are universal and are the only valid framework for folk taxonomies. Classes based on utilitarian features, and relationships through affiliation, association and "sphere of influence" rather than stringent hierarchical inclusion are perceived by many researchers to play a significant role in folk biotaxonomies...data presented in this study supports the views of Hunn (1976, 1982) and others that relationships based on affiliation and utility are important components of plant classification systems."

In Witsuwit'en ethnobotanical classification, hierarchy is weakly developed, and relationships between taxa based on inclusive relationships are poorly developed. Only one polytypic folk generic has been described to date. The postulated major life forms may overlap, as ***miʔ*** with ***dəcən*** and ***c'ət'an***. Intermediate groups appear to exist, but their relationship to "life forms" is not yet clear. Prototypy seems applicable to five of the postulated seven intermediate groups described. The "coordination" model of Hunn and French (1984) may better describe the ethnobotanical classification of the Witsuwit'en than hierarchical relations, in that folk generics may be seen to form clusters or groups based on affiliation rather than inclusion.

SUMMARY AND CONCLUSIONS

Although this study is not exhaustive, plants named by the Witsuwit'en appear to be primarily those of high utility and/or of ecological and perceptual salience. We have collected the names of 91 plant classes which cover the low to mid elevation flora of the Bulkley River drainage, where the Witsuwit'en with whom we have worked primarily have lived and carried out traditional hunting, trapping, fishing, berry picking, and other subsistence activities. There are certainly more than 91 vascular plant species in the Bulkley Valley and surrounding area. A preliminary estimate of the vascular plant flora of the Bulkley River drainage, including high elevation sites, is 900-1000 species (Jim Pojar, British Columbia Forest Service, personal communication 1997); compared to 85 Witsuwit'en named vascular plant classes. Although many types of low salience and economic importance are probably subsumed in 'grass' and 'flower', some vascular plant species are simply unnamed, at least by the modern Witsuwit'en. This is similar to the pattern reported for other foraging peoples such as the Sahaptin (Hunn 1982) of the Columbia Plateau, who name 213 vascular taxa of the approximately 2000 vascular plant species which occur in their traditional territory, or roughly 10%.

Plants which are named include all tree species (in the English sense), most large shrubs, plants which produce edible fruit, plants which are used for medicine, plants which are eaten, plants which have technological uses, and poisonous plants. Underdifferentiation is characteristic of vascular plant groups like grasses, sedges and rushes, small herbaceous plants, and flowering herbs. Mosses and fungi are also underdifferentiated, having generally low salience and utility, and are subsumed in two "empty" life forms. One folk class of moss, ***yən tl'aχ yəl*** or more commonly ***yin*** (*yəl*), 'diaper moss', is differentiated because of its functional importance. Fungi in general are lumped as ***c'ebedzəq***. A single type of technological and medicinal use is called either ***dəc'əc'əsts'o?*** 'burl' or ***tl'eçtsɛ*** 'fire carrying fungus', and the uncanny puffballs are called ***dəni zic cac'əsɢəkw*** (lit. 'corpse's navel'). Whether they are considered types of ***c'ebedzəq*** has not been determined. Similarly, the position of ***dəχ ɣe***, 'black tree moss', conspicuous arboreal hairlike lichens used as tinder, with reference to more inclusive classes has not been determined.

As noted, Witsuwit'en major plant classes or "life forms" include utilitarian factors in their definition. In this respect they are similar to those of the Thompson and Lillooet (Turner 1987) and other Northwest North American Indian groups. "Empty" or "monogeneric life forms" are found among the major plant categories, i.e., 'grass', 'moss', 'mushroom', and 'flower'. Hierarchical organization is shallow, and higher level classes may cross-cut one another, a situation also reported by Hunn (1982), Randall and Hunn (1984) and Turner (1987, 1989).

Our findings regarding Witsuwit'en plant classification may be influenced by selective loss of detail of less salient or economically important plants as a corollary of extensive changes in life style and culture contact in the past 100 years. Berlin (1992) and Waddy (1982) suggest that the low level of specific taxa could be caused by this type of cultural erosion, though Hunn (1982) argues cogently that this is unlikely for the Sahaptin. Memory ethnography introduces some biases; elders sometimes report that they don't know or can't remember the name of a specific plant, or what plant was used for a particular purpose, but that their grandmother would have known. It is possible, for example, that more wildflowers once had specific names. However, Morris (1984) in a traditional Malawian population, reports that conspicuous flowers without uses are neither named nor apparently recognized, so this may not be an artifact of information loss. Variability of plant knowledge within the culture combined with sampling bias also influences reported patterns of naming and classification (c.f. Gardner 1976; Hays 1974; Ellen 1993; Berlin 1992). Sometimes errors in plant reference can be detected which derive from learning of plant names and uses only from hearsay, without having had the experience of gathering the plants in question. Such inaccuracies cannot be corrected if no elders remain who have been shown the correct plants or gathered them themselves.

The nomenclatural patterns of the Witsuwit'en seem consistent with those of other foraging peoples with respect to the low level of folk specific differentiation. This is true even with polytypic genera such as *Rubus* and *Vaccinium*. One noteworthy feature of the Witsuwit'en plant lexicon is the relatively high proportion of terms, 58%, with some sort of descriptive meaning in addition to their referential function.

A significant number of Witsuwit'en plant terms are shared with the neighboring Tsimshianic language Gitksan. Most of these terms appear to have been borrowed into Witsuwit'en from Gitksan, but at least three terms appear to have gone in the opposite direction. Borrowed plant names exhibit no clear biogeographic pattern, except for cedar/cedar bark, red elderberry, and crabapple, which are predominantly coastal. Turner (1974) reports a similar occurrence of loanwords of Bella Bella origin in Bella Coola (Nuxalk) plant names.

As plant foods were trade items among these groups and also prominent in the feast hall, it is likely that the occurrence of plant loanwords reflects the shared heritage of trade and mutual feasting in the Northwest Coast area.

The significance of postulated loan words between Carrier and Witsuwit'en is not entirely clear; possibly long-distance trade relations have also encouraged exchange of plant knowledge and terms between these two groups. Shared term include a number of common trees and shrubs used for medicinal purposes, plus some terms for herbaceous plants which may be used medicinally or not.

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NOTES

[1]Witsuwit'en is a dialect of the Babine/Witsuwit'en language, which is spoken in the Bulkley Valley, Babine Lake, Takla Landing, Burns Lake, and François Lake areas of northwestern and north central British Columbia (Kari and Hargus 1989). Wet'suwet'en is the local spelling of the name, and is the spelling which Johnson-Gottesfeld has used in previous publications. The Witsuwit'en language is distinct from Carrier, a contiguous language

spoken to the east and south (Kari 1975; Story 1984).

[2]Translators for this research were Doris Rosso and Cecile LaPalme.

[3]Ellen (1993) discusses in detail the characteristics of a true taxonomy which is a hierarchical structure organized by relations of class inclusion. Ellen rejects the universality of true taxonomy in ethnobiological classification, and argues that, for the Nuaulu at least, attempts to force their classification of biological forms into a taxonomic model distorts the characteristics of that system. We have therefore chosen to use the more neutral terms "classification" and "class" in this paper rather than "taxonomy" and "taxon," except where true taxonomic classification is meant.

[4]Witsuwit'en words are transcribed using standard phonetic symbols as indicated below, with the exception of [g], which represents a voiceless unaspirated palatal stop.

Consonants:	labial	alveolar	palatal	labiovelar	uvular	laryngeal
voiceless unaspirated stops /affricates	**b**	**d** **dz dl**	**g**	**gw**	**ɢ**	
voiceless aspirated stops /affricates	**p**	**t** **ts tɬ**	**c**	**kw**	**q**	
glottalized stops /affricates		**t'** **ts' tɬ'**	**c'**	**kw'**	**q'**	**ʔ**
voiceless fricatives		**s ɬ**		**xw**	**χ**	**h**
voiced fricatives		**z l**	**y**	**w**	**ɣ**	
nasals	**m**	**n**				

Vowels:	front	central	back
high	**i**		**u**
mid	**e**	**ə**	**o**
low	**ɛ**	**a**	

[5]A possible exception is black spruce. For most modern Witsuwit'en, both *Picea mariana* and *Picea glauca* x *engelmanii* are called ***ts'o***. However, a distinct term for black or 'swamp' spruce has also been collected: ***nedus***. Its relationship to ***ts'o*** could be that of a folk specific, or they could be two generics, one of which is in the process of being subsumed in the other. The two species of *Sorbus* present in the local flora are very similar and can be used interchangeably; they are not distinguished by Witsuwit'en people. Similarly, the horsetails *Equisetum arvense* and *E. pratense* are not distinguished. Other exceptions include the use of single terms to refer to members of the genera *Salix* and *Carex*.

[6]Priscilla Kari (1978) does report a name for the *Spiraea*, and Pat Namox also identified it to Sharon Hargus in 1996, suggesting that it was named. Ethnobotanical knowledge is clearly variable among the Witsuwit'en as it is among other peoples.

[7]Although these terms are synonymous, they do not have exactly the same distribution in Witsuwit'en. Both can be used as common nouns, but only ***miʔ*** occurs in proper nouns (berry names). ***miʔ*** can also refer to berry-like things (e.g., ***lemiʔ*** 'fingers (collectively)', ***qɛlemiʔ*** 'toes (collectively)', ***tsaɬmiʔ*** 'small, hard feces', ***ye beɣ ts'əmiʔ*** 'fruit' (lit. 'overseas berries'). ***nət'ay*** is not attested with this kind of semantic extension.

[8]While not all languages encode a "vine" life form, vine is one of the five classes used in Brown's analysis of cross-linguistic patterns of life form occurrence; mushroom, flower, moss, and berry plant are not included in his list.

[9]Atran (1985:300) comments that:

> ...occasionally mushrooms, as for the Brou, and possibly mosses, as in the case of the Batak of Sumatra, also assume life-form status. This may owe more to the distinctive role they are perceived to play in the economy of nature than to their readily visible external morphology (i.e., habitus), for the non-flowering plants (exclusive of the ferns, perhaps) may be generally construed as "residual" categories with no clearly defined morphological aspect...Ray's (1682) *Musci*...those small and often hidden plants that lack phenomenal resolution for human beings.

The last comment perhaps accounts for the fact that the "moss" and "mushrooms" life forms are often "empty" or monogeneric, as they are for the Witsuwit'en.

[10] ***ntsəyʔ*** 'it is bad' is offered as a translation of "it's poisonous." We have been unsuccessful at eliciting any other Witsuwit'en terms for "poison" or "poisonous."

[11] Gitksan words are transcribed in the Gitksan practical orthography. Gitksan words discussed in this paper are from Johnson (1997) and have been reviewed by linguist Bruce Rigsby (University of Queensland). Carrier names discussed below are from Morice (1932) and Antoine *et al.* (1974). Sekani data are from Kaska Tribal Council (1997). Dena'ina data are from Kari (1987, 1994). Ahtna data are from Kari (1990). Coast Tsimshian data are from Dunn (1978). Both Carrier and Sekani terms have been retranscribed here using standard phonetic symbols. Other transcription systems have not been altered, and are described in the references cited.

[12] We count names as distinct if they contain distinct morphemes. Thus ***qaq dəlq'ə'n*** and ***q'ɛntsec*** are tallied as different names of *Cornus stolonifera*, whereas we consider ***detsan qɛ get***, ***detsan ʔəl***, and ***detsan cən*** variations of the same name, since they all contain ***detsan*** 'crow, raven' as the first part of a compound. We do not count as distinct names which differ in minor phonological ways, such as ***sasco˟ tsasco*** 'wild carrot' or ***c'eγebedzəq˟ c'ebedzəq*** 'mushroom, fungus'.

[13] We follow the usual practice in Athabaskan linguistics in analyzing ***dəyi'n*** (and other words like it) as a prefixed root. Although this instance of ***də-*** lacks a meaning of its own and cannot be separated from the root ***yi'n***, there is a handful of other animate nouns in Witsuwit'en which occur with ***də-***, suggesting that it is a separate grammatical element, a prefix: ***dəni*** 'man, person; bull moose', ***dət'ay*** 'duck', ***dəq'ay*** 'cutthroat trout, rainbow trout', ***dəguh*** 'mosquito', ***dəyəq*** 'canyon', ***dəq'a'n*** 'woodchuck, gopher', ***dəbiç*** 'sheep'.

[14] The Cree word for *Pyrola* sp. also means 'beaver's ear' (Chalifoux with Anderson 1977). This may be an instance of loan translation between Algonquian and Athapaskan languages.

[15] The association of crow or raven with juniper appears widespread among Athapaskan languages; the Kaska term for common juniper, an important medicinal plant in that area as well, is ***nosgą̂ al'*** (lit. 'raven's boughs') (Kaska Tribal Council 1997).

[16] Bunchberry is also named by association with kinnikinnik as ***dəniç yez***, as discussed above.

[17] Some shared plant names appear to have been borrowed from Witsuwit'en into Gitksan. (1) Consider Gitskan ***gahldaats***: Witsuwet'en ***χεłt'ats*** 'yellow pond lily rootstock', Central Carrier ***xełt'az***, Sekani ***teh t'aze, teh t'azè?***, Ahtna ***xelt'aats'i*** and Dena'ina ***qalt'ats'a*** 'yellow pond lily rootstock' all appear to contain reflexes of a Proto-Athapaskan stem ****/t'a'ts'*** 'cut'. Furthermore, the Coast Tsimshian name ***onxł*** (Dunn 1978) is not a cognate of the Gitksan name. (2) The resemblance between the Witsuwit'en term ***ts'əχ*** "mountain juniper" and the Gitksan term ***ts'eex***, for an ecotype of common juniper, also appears not to be coincidental. Similar forms are found in Nisga'a (McNeary 1976) and Sekani (***ts'əx***), though the Dena'ina forms (***chegenza, chuni ela, chint'uyn***, and ***shint'una***) are unrelated. We see the Witsuwit'en term as Athapaskan in origin, derived from Proto-Athapaskan ****c'əχd*** 'hat'. (3) The Gitksan term ***ganix, gan hix*** 'pine cambium' also appears to have been borrowed from Witsuwit'en ***q'əniç***. Cognates in other Athapaskan languages include Carrier ***k'enih***, Sekani ***k'eni***, and Ahtna ***k'iił*** 'watery sap', 'birch sap', 'cottonwood sap'. There is no Coast Tsimshian term reported for pine cambium to compare with the Gitksan form, as it is not harvestable for food on the coast. The phonological resemblance to the Witsuwit'en term and identity of meaning strongly suggest borrowing from Witsuwit'en into Gitksan given the widespread distribution of the term in other Athapaskan languages and its lack in Coast Tsimshian (despite the fact that the Gitksan term can be semantically analysed in Gitksan as 'tree fat'[Rigsby, personal communication]).

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AN ETHNOBOTANICAL ACCOUNT OF THE VEGETATION COMMUNITIES OF THE WOLA REGION, SOUTHERN HIGHLANDS PROVINCE, PAPUA NEW GUINEA

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ABSTRACT.—The vegetation communities distinguished by the Wola people of the Southern Highlands Province of Papua New Guinea are the subject of this paper, which complements a previous one on their botanical taxonomic scheme (*Journal of Ethnobiology* 15:201-235). The Wola identify nine vegetation types, with a further four sub-types, ranging from climax montane forest to seral communities of grassland. The composition of these communities is investigated, supported by data on plant species present, collected in a series of quadrat surveys (detailed in Appendix). The number of species in each community is found to range from 18 to 174. The Wola describe the vegetational communities on disturbed land as comprising an anthropogenic series of varying composition and species richness that is compared to the unaltered forest community. This paper is organized around this presumed ecological succession. While there is a broad correspondence between the local and scientific recognition of these ecological zones, which the quantitative data reinforce, the differences in these knowledge traditions should not be overlooked. Wola perceptions are outlined so far as apprehensible. Attitudes to human induced changes in vegetation cover are also explored, and found to be equivocal.

RESUMEN. — Las comunidades vegetacionales distinguidas por la gente wola de la Provincia de las Tierras Altas del Sur en Papúa Nueva Guinea son el tema de este trabajo, que complementa un artículo previo acerca de su esquema taxonómico botánico (*Journal of Ethnobiology* 15:201-235). Los wola identifican nueve tipos de vegetación, con cuatro subtipos adicionales, que van desde bosque clímax de montaña hasta comunidades secundarias de pastizal. Investigamos la composición de estas comunidades, con el apoyo de datos acerca de las especies de plantas presentes, recabados en una serie de encuestas de cuadrante. Encontramos que la composición de especies en las comunidades varía de 18 a 174. Los wola hablan de las comunidades vegetacionales establecidas en tierras perturbadas abarcando una serie antropogénica de variable composición y riqueza de especies que se relaciona con la comunidad de bosque no alterado, y nuestro trabajo está organizado alrededor de esta supuesta sucesión ecológica. Si bien a grandes rasgos hay una correspondencia entre la identificación local y la identificación científica de estas zonas ecológicas, que es reforzada por los datos cuantitativos, no deben dejarse a un lado las diferencias entre estas tradiciones de conocimiento, y esbozamos las percepciones wola en la medida que son aprehensibles. Exploramos también las actitudes hacia los cambios en la cubierta vegetal inducidos por los seres humanos, y encontramos que son equívocas.

RÉSUMÉ. — Cet article traite des zones de végétation distinguées par les Wola, un peuple habitant les Southern Highlands de la Papouasie-Nouvelle-Guinée. Il complète un article précédent sur le système classificatoire wola des plantes (*Journal of Ethnobiology* 15:201-235). Les Wola identifient neuf types de végétation, plus quatre autre sous-types, en partant de la zone forestière montagneuse climacique jusqu'aux zones sérielles herbacées. La composition de ces zones est examinée avec des données sur les espèces végétales présentes inventoriées au moyen d'une série de levés de terrain par lots circonscrits (détails en annexe). Le nombre d'espèces dans les zones varie de 18 à 174. Les Wola parlent des zones de végétation sur les terres perturbées comme étant constituées d'une série anthropogénique de composition variée et très riche en espèces qu'on rapporte à la zone forestière non modifiée et nous avons organisé notre article conformément à cette succession écologique présumée. Bien qu'il y ait une correspondance générale entre l'identification locale et l'identification scientifique de ces zones écologiques, ce que les données quantitatives viennent appuyer, les différences entre ces traditions de connaissances ne doivent pas être négligées et les perceptions des Wola sont mises en évidence en autant qu'elles ont pu être dévoilées. Les attitudes à l'égard des changements du couvert végétal d'origine humaine sont aussi examinées et apparaissent équivoques.

The indigenous classification of biological communities has so far received considerably less attention than folk systematics. The understanding that people like the Wola of the Papua New Guinea highlands have of their plant resources predictably extends well beyond naming the flora that occurs in their region, and then ordering these plants according to their folk botanical classification. It is necessary to go beyond a discussion of taxonomic schemes, interesting as these are, to explore more fully people's understanding of plant associations and ecology — which they achieve in part using their classifications — in order to achieve a fuller understanding of their perceptions of their natural environment and how these inform their interactions with it. In a previous paper (Sillitoe 1995a) I made a start in cataloguing the plants that occur in the Wola area and describing how Wola classify them. This is the first step towards an appreciation of their knowledge of their region's vegetation and their relation with and influence upon it.

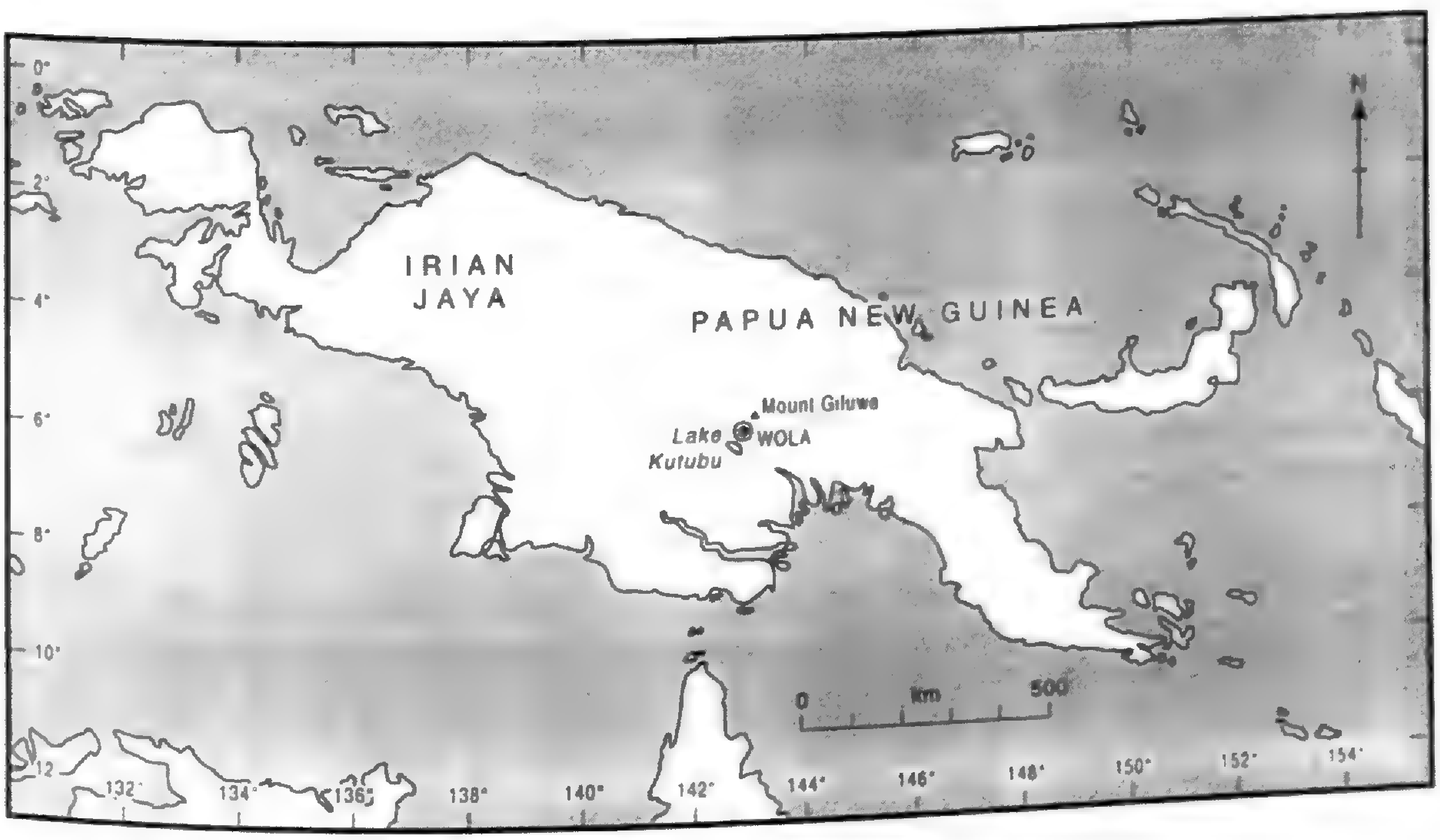
The next step involves documenting the different plant communities and habitats recognized by the Wola. To that end, I investigate here the composition and structure of these associations. (For further information on the various vegetational communities described here, and a finer botanical classification of the different communities, see Robbins and Pullen 1965; Paijmans 1976:84-97; Johns 1976, 1982). The Wola recognize several different vegetational communities, comprising varying populations of plants and animals, both named and unnamed. Their awareness of these communities and understanding of their dynamics influence their attempts to manage their natural resources and their consequent impact upon the environment. This knowledge informs their cultivation strategies, although it is more evident in their practices than in their verbalized accounts. This presents certain epistemological problems in documenting their appreciation of the mark they make on the plant world (Sillitoe 1995b).

The taxonomic schemes of people only reflect part of their understanding of the natural world. Environmental knowledge is transferred between generations, in other ways too, such as in terms of vegetation communities. This information among Highlanders is not codified but diffuse, communicated piecemeal through experience, and has a marked practical aspect. When asked to justify their naming of a vegetation community they are likely to look perplexed. They are not used to being asked how they distinguish these communities, and do not readily cite, for example, certain plants in specified proportions as diagnostic. Their awareness of vegetation community structure has accumulated over years of experience, of seeing these communities and hearing comments from others about them. Placing indigenous and scientific perspectives of vegetation ecology side by side helps us to achieve a more rounded understanding of the environmental impact of human activities, relating both to the effect people think they have on nature as agents and what we as outside observers make of their practices. The objective is not to assess the veracity of local ideas against ecological ones — both are relative — but to enrich our overall understanding of environmental appreciations within cultural context.

THE WOLA REGION

Wola speakers occupy five valleys in the Southern Highlands of Papua New Guinea ne of Lake Kutubu, between 6° 0'/20' S and 143° 15'/45' E (Map 1). The majority of the population lives at 1600-2000 m asl. The topography is mountainous, rugged and precipitous, with turbulent rivers flowing along the valley floors. The Wola live along the valley sides, leaving the intervening watersheds largely unpopulated. In the valleys, where they have cultivated extensively, there are areas of dense cane grass interspersed with the grassy clearings of fallowed or recently abandoned gardens and the brown earth and dark green foliage of current ones. Lower montane rainforest occurs on the mountains and in the unpopulated parts of river valleys.

The region's climate is of the 'Lower Montane Humid' type (according to the scheme of McAlpine *et al.* 1983:160). It is characterized by high rainfall — annual average 3011 mm — cool temperatures, due to the moderating effect of altitude — mean daily temperature 18°C — and the absence of soil moisture droughts. Varia-



MAP 1. — Map of the island of New Guinea showing the location of Wolaland

tions in topography and altitude give rise to numerous micro-climates locally. The weather is generally equable, many days featuring sunny mornings and rainy afternoons. There are no notable seasons sufficient to influence crop cultivation, although the Wola distinguish two seasons called ***ebenjip*** and ***bulenjip***, which equate with the Southern Hemisphere's summer and winter (Sillitoe 1994). The same climatic conditions largely prevail throughout the year, although unpredictable perturbations can occur, such as overly dry or wet weather, which can adversely affect crop yields.

The substrate environment comprises sedimentary rocks largely, mainly limestone, with igneous rocks of more recent volcanic origin on its margins. In the recent geological past the region was uplifted, then folded and faulted. Frequent earth tremors indicate that these earth movements continue today. The relatively recent occurrence of this folding accounts for the landscape's sharp relief, and was responsible for its current north-west/south-east axis. Contemporary geomorphological processes are changing the region rapidly, maintaining its youthful and raw topography; weathering proceeds apace, erosion is constant, and the occasional large-scale earth movement can dramatically change the local landscape (Löffler 1977).

Soils of the inceptisol and andisol order dominate the region. Soils of other orders (entisols, ultisols, mollisols, and histosols) cover small areas in comparison and are relatively insignificant (USDA 1975; Bleeker 1983). The soils are derived from sedimentary parent materials, variably affected by volcanic ash (from dominated by it, to no evident effects), with some alluvial redeposition. Some are affected by high water content leading to changes in their morphology. Older alluvial soils consist of redeposited volcanic ash; recent ones are of eroded bedrock and redeposited clayey soil. Sandy soils are very localized, occurring largely where occasional sandstone beds outcrop at the surface. Shallow soils too are very limited. Any of these soils may be subject to wet conditions and become a gley, and if the wet conditions are particularly severe and prolonged, peaty soils of high organic matter may develop.

The youth of the soils, combined with several rejuvenating episodes of volcanic ash fall, results in fairly productive soils, with appropriate management. Land-use history depends largely upon horticultural use. Dotted across the landscape are neat gardens. The Wola practice a sedentary variation of shifting cultivation, and subsist on a predominantly vegetable diet in which sweet potato is the staple. Their agricultural practices result in two broad classes of garden: those cleared and planted once with a wide variety of crops (the classic swidden regime), and those planted two or more times, sometimes over and over again for decades, with brief spells in grass fallow. These support a narrower range of crops, largely sweet potato. Gardens range in size from small plots adjacent to homesteads (av. 90 m^2), through taro gardens (av. 495 m^2), to large cultivations of mainly sweet potato (av. 1150 m^2).

The Wola live in squat houses scattered along the sides of their valleys, in areas of extensive cane grassland, the watersheds between being heavily forested. They do not depend on hunting and gathering to supply them with food to any extent, and today make considerably less use of local raw materials to produce things than prior to European contact. They keep pig herds of considerable size.

They hand these creatures, together with other items of wealth such as sea-shells and cosmetic oil, around to one another in an unending series of ceremonial exchanges, which mark all important social events. These transactions are a significant force for the maintenance of order in their fiercely egalitarian, acephalous society. Local social organization also features territorial groups of kin called ***semg'nk*** and ***semonda*** ('small' and 'large families'), which structure access to land. Their supernatural conceptions centre on beliefs in the ability of their ancestors' spirits to cause sickness and death, in various other forest spirit forces, and in others' powers of sorcery and "poison."

METHODOLOGY

The following accounts of vegetational ecology are structured around successions identified and named by the Wola. They distinguish eight major vegetational communities, as follows:

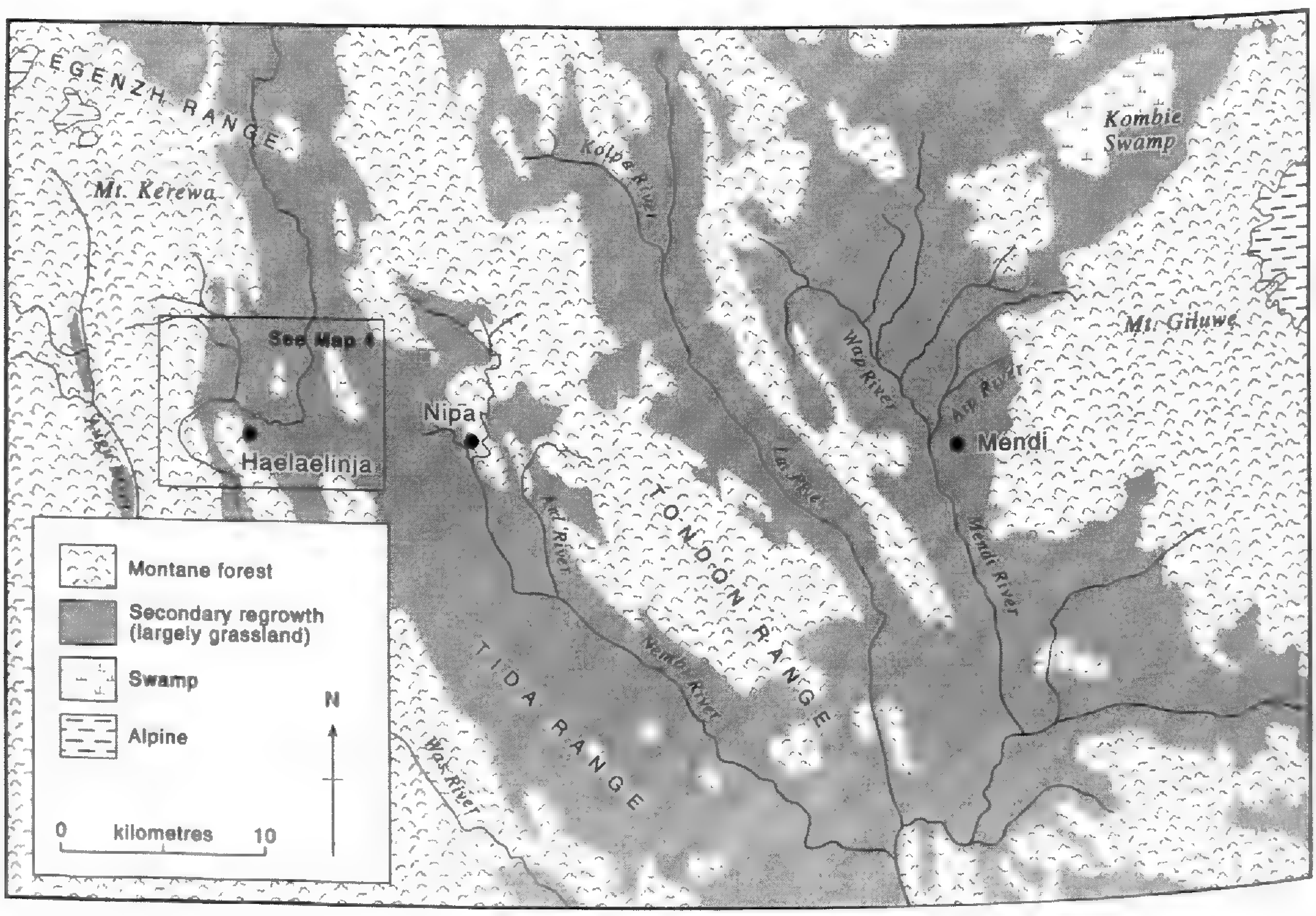
iyshabuw	lower montane rainforest
pa	wetland vegetation
haenbora	rocky vegetation
yom	alpine vegetation
way bway	cultivated vegetation, comprising two locales:
em	gardens
aend bort (or ***aendtay***)	houseyard environs
mokombai	recently abandoned garden successions, including:
taengbiyp	pioneer herbaceous regrowth
bol	later coarse grass regrowth
gaimb	cane grass regrowth
obael	secondary forest regrowth

They distinguish a ninth named community—***pletbok*** 'thicket'—which may occur at locales within some of the above vegetational successions (notably ***iyshabuw, yom, gaimb,*** and ***obael***), that relates more to density of plant growth than species composition or land use.

The method adopted in this investigation of the composition of these plant communities distinguished by the Wola was firstly to gain some idea of their discriminations. On visits to different locales people described successions, relating the plant associations as they saw them. The ethnographer learnt of the different named successions over a period of several years while engaged in research into agricultural practices and environmental issues, the names of vegetation communities coming up in various contexts, often during visits to specific locales. People identified the vegetational communities and related their distinctive composition and discriminatory features, often on site. The knowledge accumulated gradually, the ethnographer becoming increasingly aware of the diagnostic floristic features of communities according to the Wola, following repeated discussions with many people. In this way information was accumulated on the indicator species and floristic structure which the Wola look for in discriminating between named successions.

There followed a series of quadrat surveys to gather quantifiable data on the composition of the various successions (Kershaw 1973; Kent and Coker 1992). These data were recorded in detail in tables, covering each of the different vegetational communities. These tables are arranged according to Wola categories of growth form (woody plants, vines, tree ferns, etc.), and alphabetically by botanical families within each of these categories. They include the Wola name for the plants, together with their species and genera identifications. Space limitations here prevent inclusion of the baseline data for each site. However, that information is available at http://www.dur.ac.uk/~dan0ps/veg.html. Botanical identifications have been substantiated by vouchers, annotated reference specimens being deposited at several herbaria (see Sillitoe 1995a), upon which determinations depended, together with some use of available monographic keys. I relied heavily upon my Wola assistants' knowledge of their region's flora in making discriminations.

The dimensions of the areas surveyed varied according to the size of the vegetation comprising the communities. Where the vegetation included some very large plants (***iyshabuw*** 'montane forest', ***obael*** 'secondary woodland', and ***gaimb*** 'cane grassland'), 10x10 m quadrats were marked out using surveyor's tape, and all of the plants occurring in the demarcated area were counted, excluding fungi and mosses. Where the plants were smaller (***em*** 'gardens', ***mokombai*** 'abandoned gardens', ***haenbora*** 'rockland', and ***pa*** 'swampland' communities), 1 m square portable frames were used, thrown at random in the locations surveyed, and all plants that grew within the area delimited by the squares counted. (The complete original data sets may be requested from the author via e-mail.) When the frames tipped sideways or caught in shrubbery in dense vegetation, we moved plant stems where possible to even them up, or if they were too robust for this, undid one corner of the frame to encompass them. The larger 100 m^2 sites, like those in the



MAP 2. — Map of the vegetation of Wolaland.

forest, were selected at random, using two random numbers per site, to determine compass direction and distance in paced meters from the last site surveyed to the next one. The survey starting points were selected by pointing blindfold at a map of the region.[1] This work was conducted in the Was (Wage) river valley in the region of the locality of Haelaelinja (Map 2).

VEGETATION COMMUNITIES DISTINGUISHED BY THE WOLA PEOPLE

Iyshabuw** 'montane rainforest'.* — The lower montane forest or ***iyshabuw (< ***abuw*** 'wood') is not what one might expect rainforests to be like from popular accounts: dense green walls of thick jungle vegetation. In places it is sometimes of unexpectedly open aspect, with the sky visible through the canopy overhead. It is difficult to evoke the feel of this forest. It is grand; cathedral-like, it inspires humility. It can overawe, particularly those unfamiliar with it, by its size and extent. It is easy to lose one's bearings here. It sometimes worries the Wola too, who may project their fears in the shape of forest-dwelling demon spirits. We recorded at total of 174 plant species in 2500 m^2 of this habitat (Table 1).

The Wola say that the southern beech (*Nothofagus* spp.) predominates in the ***iyshabuw*** forest, with many gigantic mature trees and a considerable scattering of younger ones, plus the occasional dead or dying tree with bare stag-headed crown. The quadrat survey data support their assertions; 12.1% of the large trees in the montane rainforest plots surveyed were *Nothofagus* beech (174 species recorded in 2500 m^2 surveyed). A prominent canopy tree in these highland forests, the beech reaches maximum heights of ±30 m, with branches giving a nearly level or domed canopy (Ash 1982). Beech populations, gregarious and non-allelopathic, characteristically form extensive single genus, even single species stands, which is fairly unusual for tropical forests. A shallow rooting tree, it can be unstable, and in high winds my Wola friends always become very anxious in the forest, fearing tree falls. Its upper altitudinal limit extends somewhat beyond that of cultivation. The montane Wola environment suits *Nothofagus* beech, which favors cloudy regions where precipitation is continuously high. Seedlings require an open tree canopy if they are to complete successfully and grow into mature trees. The proportion of

TABLE 1. — ***Iyshabuw*** rainforest summary composition.

Growth Form	*Families*	*Species*	*Mean % of Species per Quadrat*
Trees	41	109	30%
Tree Ferns	7	15	40%
Ferns	2	2	18%
Screw-pines	1	4	37%
Vines	18	22	36%
Cane Grasses	1	1	4%
Large Herbs	2	6	57%
Grasses and Herbs	10	15	26%
Totals (in 2500 m^2)	82	174	

Nothofagus seedlings and saplings to those of other trees that may grow into the canopy is, at 6.9%, almost one half of the ratio of mature beech trees to other canopy trees, suggesting that proportionately more beeches than other tree species may survive to become forest giants.

The growth rate of young plants increases markedly with the creation of gaps in the canopy through senescence or tree fall, as the Wola are aware. They sometimes create spaces by felling trees to encourage the growth of selected saplings, such as those that yield edible nuts or fruits. These occur with natural dieback too, sometimes of several trees and even entire patches of forest, associated with a combination of unfavorable weather and pathogenic attack (Kalkman and Vink 1970). The beech is not a colonizing genus, regeneration scarcely extending beyond the canopy of *Nothofagus* stands (Walker 1966), which is interpreted as evidence that today's stands are relics of once more widespread beech forests upon which other genera have encroached (Ash 1982).[2] In the Wola region it is common for discrete patches of beech forest to occur surrounded by multi-genera forest (Robbins and Pullen 1965; Kalkman and Vink 1970; Walker 1966). According to Ash (1982), beeches overall comprise between 10% and 20% of the canopy trees in lower montane forest, which complies with the quadrat survey findings reported here.

While beech is dominant, other trees may occur in considerable numbers, rivalling the beech in places, giving a mixed aspect to large tracts of forest (see Table 12).[3] They include oaks (*Lithocarpus* and *Castanopsis*), like the southern beech, members of the Fagaceae, and have retained similar ecological habitat compatibilities. Wola point out that *Lithocarpus* oaks are particularly common in heavily disturbed forested pockets on lower valley slopes. Other trees here include figs (*Ficus*), colas (*Sterculia*), white magnolias (*Galbulimima*), gamboges (*Garcinia*), and elaeocarps (*Elaeocarpus*), among others. The trees form a ca. 80% canopy cover at about 30 m, with some emergents above it, and sometimes with a secondary or diffuse layer at ±20 m, all competing for a share of the light. Our Wola consultants say that it is difficult to identify any clear stratification in the forest because of the overlapping crowns in the various layers. The trees are also shallow rooting on the whole like *Nothofagus*, with most of their roots fairly evenly distributed in the top 20-30 cm of the soil (Edwards and Grubb 1977, 1982). The ground cover is frequently heavy, often restricting visibility, and varies from dense stands of saplings and shrubs (including species of Melastomaceae, *Phyllanthus, Pipturus, Cyrtandra, Piper, Symplocos,* and *Daphniphyllum*), to impenetrable tangles of slender-stemmed climbing bamboo (*Racemobambos congesta*), which men sometimes cut down and wrap around their heads like foliage wigs. There are also masses of fleshy leafed herbs, notably gingerworts (Zingiberaceae, Urticaceae) and ferns, both tree ferns (Cyatheaceae) and in places numerous low clump ferns (*Cyclosorus*), which the Wola also favor, picking fronds for personal decoration, a sign that they have been in the forest (Table 1).

The forest has a wet aspect, dripping much of the time, frequently enveloped in low cloud and subject almost daily to considerable rainfall. The wetness is one of the most tiresome aspects of forest travel because it renders everything slippery underfoot. Mosses (*Frullania, Meteorium, Bazzania, Dicranoloma,* and *Lepidozia*) thrive in this environment, and thick mats festoon trees and shrubs; men also use these on occasion for wig-like decoration. A springy bed of mosses, which together with a thick layer of rotting vegetation and fallen leaves, covers the ground, forming a raw or partially decomposed litter through which surface roots run. The forest floor is criss-crossed with surface and stilt roots and fallen timbers. With the uneven ground, pitted by hollows and crevices, and the standing vegetation, traveling is awkward off the established paths, and progress slow.

The trees also support a variety of climbing plants, from woody lianas (*Alyxia, Cayratia,* and *Dimorphanthera*) to palms (*Rattan*) and pandan vines (*Freycinetia*), all twining strongly around their trunks, growing into canopy gaps to the light overhead. Trees act as hosts for many epiphytic plants too, all of which thrive in the humid atmosphere of the forest. They range from bryophytes on trunks, to vascular epiphytes and ferns on branches, to sooty moulds on leaves. On the crown branches of some trees there is a peat-like accumulation comprising the remains of epiphytes and litter which forms a substrate for larger epiphytic plants, and occasionally for some tree species which are more often found growing on the ground. These include *Schefflera, Pittosporum, Timonius,* and *Gardenia*. One way the Wola explain that these trees germinate in the crowns of larger trees is by birds depositing seeds there in their droppings. They name the red-capped flowerpecker (*Dicaeum geelvinkianum*) it ***mondiytiylkaelenj*** (literally, '***mondiyt***-shrub' + 'seed') for the fact that it propagates this shrub by distributing its sticky seed via its droppings. Older and larger trees predictably support more climbers and epiphytes. Epiphytic orchids (*Dendrobium*), together with some other flowering herbs, add a splash of color to the dank grey-green background. Sometimes people pick them and push them into their hair as ornamentation.

A feature of the forest familiar to the Wola is the similarity and continuity of its structural form and floristic composition through a range of stands. Obvious environmental variations occur, which are sometimes remarked upon by the Wola, as for instance, in wet or waterlogged pockets, on bare steep slopes, and along watercourses. Landslides and slips, if extensive, can also change the floristic community, although the most pervasive interference and consequent modification of successions results from the actions of human beings. While the forest is predominantly primary, human activity has disturbed considerable tracts (Flenley 1969). In some places the interference is minimal, a hunter perhaps having felled a tree or cleared some undergrowth. In other places the disturbance is extensive, a man having maybe established a clearing to allow the sun access to nut-bearing screw-pines (*Pandanus julianettii*). These areas may become quite large, developing into pandan groves. Wild pandans elsewhere in the forest grow singly, here and there. Nearer to settlements people have considerably disturbed the forest and altered its floristic composition, with fewer beech and more faster growing, softer-wooded species evident.

Forest wildlife is diverse, though less conspicuously vocal than at lower elevations. Some forest birds are highly valued for their plumes, which are wealth in ceremonial exchanges. Common mammals include cuscuses, opossums, and tree kangaroos. A wide variety of rodents, including giant rats, also occurs, as does the rare spiny egg-laying echidna of remote forested regions. Birds are numerous, including the large flightless cassowary, various small flycatchers, colorful parrots and lories, soft-hued pigeons, numerous honeyeaters, and New Guinea's renowned birds of paradise. Reptile and insect populations are also numerous and varied. But hunting is not a regular pursuit.

The forest supplies other edible products, notably fungi, which people collect irregularly. It is also the source of raw materials used in the production of artifacts. But Wola attitudes to the resource-rich forest are ambivalent. They enjoy it, but are sometimes wary of it; they value it but are piecemeal destroying it. They do not readily speak expansively about the forest, beyond saying that it is a large and sometimes dangerous place, a place to hunt and a source of raw materials. But their fear of forest demons expresses something of their deeper attitudes and ambivalence. It is possible to lose your way in unfamiliar regions. Accidents are more likely in the forest, where shallow rooted trees blow over in high winds. One may fall on the frequently broken and slippery terrain and injure oneself. Fatalities occur. The Wola explain the misfortunes that may befall people there as caused by demon spirit creatures called ***saem*** and ***iybtit***, which inhabit forests at higher and lower altitudes respectively.

These dangerous spirits may strike those who are reckless or thoughtless. Thus, the deep forest is not somewhere to go lightly. This could be interpreted as promoting a regard for the forest, perhaps even a degree of environmental awareness, intimating disquiet over forest destruction. Moreover, one should beware indiscriminately damaging the forest, as one may offend a demon. However, this demon complex does not reflect a conscious recognition of the need for forest conservation. The forest is too vast for the Wola to conceive of its destruction, as it may take days to walk through it. It is plausible to interpret their demon beliefs as paradoxically endorsing such action, in that by destroying the forest they are exerting some control over frontier areas, driving demons from their homeland by depriving them of a place to live. Where there is no rain forest, there are no demons. However, the idea of destroying all their forest would be unthinkable to the Wola. The ambivalence they feel is captured in their demon fears.

Pa *'swamp vegetation'*. — Wetland communities, varying in size, occur throughout forests and grasslands, They occur on poorly-drained sites called ***suw pa*** ('bog place'). Depending on the depth of the water table, these areas vary from spongy damp swards to waterlogged swamps. Water-loving grasses (e.g., *Leersia, Ischaemum, Isachne, Panicum*), which dominate swards, and herbs such as sedges (*Cyperus, Kyllinga*), horsetails (*Equisetum*), and water-parsley (*Oenanthe*), grow in low tussocks. A scattering of wild sugar (*Saccharum robustum*), clumps of cane grass (*Miscanthus, Coix*), and the occasional tree or dwarf shrub, such as water-gums (*Syzygium*), icacinads (*Rhyticaryum*), and she-oaks (*Casuarina*) occur, particularly on the swamp margins (see Table 2, 11;. 34 species were recorded in 50 m^2 of this habitat).

The presence of hydrophytes is indicative of locations with gleyed soils, which the Wola favor for taro cultivation, for which they are well suited. These ***ma em*** 'taro gardens' may support a range of crops in addition to taro, though taro tends to predominate, particularly in mature gardens (Table 3, 11; 47 species were recorded in 32 m^2 of this habitat). Other crops are most often planted on drier hillocks and around tree stumps, including various cucurbits and leafy greens, such as crucifers and acanths (Sillitoe 1983). The weeds that colonize these sites are similar to those found in other gardens (described below).

Swamp forest occurs in some waterlogged locales, generally of limited extent

TABLE 2. — ***Pa*** swampland summary composition.

Growth Form	*Families*	*Species*	*Mean % of Species per Quadrat*
Trees	1	1	2%
Tree Ferns	2	2	2%
Vines	1	1	2%
Cane Grasses	3	3	3%
Grasses and Herbs	11	25	18%
Crops	2	2	43%
Totals (in 50 m²)	20	34	

(Johns 1980). Conifers are common here (indicator species include *Dacrydium, Podocarpus*), together with a range of other trees (*Glochidion, Maesa, Homolanthus*), giving a variable canopy beneath which occurs a dense layer of shrubby vegetation. The forest floor is fairly open with pools of water separated by irregular hummocks. Botanists have suggested that these conifer-dominated swamp forests may have arisen due to extreme frosts killing off broadleaved trees (Robbins and Pullen 1965), or they may represent an early stage in mixed montane swamp forest development (Johns 1980). The wildlife populations supported by any wetland area depends on and reflects the surrounding vegetational community, plentiful if forest, more meagre if grassland.

Haenbora *'rocky vegetation'*. — Rocky locations that support some plant life are called ***haenbora.*** These occupy limited areas of thin skeletal soil found throughout the Wola region. They vary in extent, but are generally small. The vegetation consists of hardy plants capable of colonizing thin regolith (see Table 4, 11; 18 species were recorded in 10 m^2 of this habitat), notably mosses initially (*Frullania, Meteorium*), followed when a suitable soil-like deposit has accumulated, by some ferns (e.g., *Pteridium, Cyclosorus*), hardy orchids (*Spathoglottis*), stunted grasses (*Imperata, Miscanthus*), and the occasional dwarfed sapling (*Dodonaea, Ficus, Acalypha*). These locales are of no horticultural use, although they are sometimes disturbed by, for example, when people burn off nearby cultivated areas. These rocky sites may be

TABLE 3. — ***Ma em*** taro garden summary composition.

Growth Form	*Families*	*Species*	*Mean % of Species per Quadrat*
Trees	9	12	15%
Tree Ferns	1	1	19%
Cane Grasses	1	1	19%
Large Herbs	1	1	50%
Grasses and Herbs	11	20	24%
Crops	9	12	19%
Totals (in 32 m²)	32	47	

TABLE 4. — ***Haenbora*** rockland summary composition.

Growth Form	*Families*	*Species*	*Mean % of Species per Quadrat*
Trees	2	2	30%
Tree Ferns	2	2	45%
Ferns	1	1	10%
Vines	2	2	15%
Cane Grasses	1	1	40%
Large Herbs	1	1	10%
Grasses and Herbs	6	9	54%
Totals (in 10 m^2)	15	18	

used for burials, which people fear as places frequented by ancestral ghosts, making them doubly unsuitable for cultivation or other human use.

Yom *'alpine vegetation'*. — Alpine heath and grassland vegetation, called ***yom***, occurs on the high volcanic summits that flank Wolaland to the east and west. It is of little concern to the Wola, with few resources of use to them. One exception is the hardy pandan called ***dalep*** or ***tuwmok*** (*Pandanus brosimos*). Some men collect their nuts in season. Alpine areas are considered dangerous places because of forest demons, and best avoided. The flora is a tussock grassland (of e.g., *Danthonia, Poa, Deschampsia, Festuca*), with small heath-like shrubs (*Rhododendron, Coprosma, Styphelia*), low herbs (*Ranunculus, Gentiana, Lycopodium*), and gaunt, stunted tree ferns (*Cyathea*). The festucoid composition of mountain grasslands contrasts with the panicoid one of lower regions. The flora, with its gentians, buttercups, and fuschias is reminiscent of New Zealand (Robbins 1961). Mires are common, with hummock plants and shrubs (*Gleichenia, Trochocarpa, Astelia*) prominent in stagnant acid bogs and sedges and grasses (*Carex, Brachyposium*) in fens with moving water.

At high altitudes the forest adjoining these alpine grasslands may be of a quite different aspect to that lower down, although still called ***iyshabuw***. Cloud envelops it daily, influencing its floristic composition. It is a single-tree-layered forest (*Rhododendron, Rapanea*), of stunted and crooked aspect, with a low (10 m) canopy, except for some emergent trees (*Papuacedrus, Schefflera, Dacrycarpus, Saurauia, Podocarpus*). Mosses and liverworts are also common, festooning lower branches, exposed roots, and crooked trunks; they may even cover the tangled roots and decaying forest debris on the forest floor in a thick, wet, spongy carpet. Sprawling shrubs are also common (*Vaccinium, Coprosma, Dimorphanthera*). A dynamic transition zone exists between forest and high altitude grassland, creeping shrubs colonizing grassy areas by vegetative propagation, while grasses encroach on shrubbery after its occasional destruction in fires (Gillison 1969, 1970). These regions are of no horticultural significance, being beyond the altitudinal range of crop plants.

Pletbok *'thickets'*. — Thickets, particularly of fern, are common in this high-montane cloud forest. The Wola refer to these areas as ***pletbok***, a term for any dense and impenetrable stand of vegetation that requires the cutting of a path through it. Although ***pletbok*** thickets are common at higher altitudes, they are not restricted to these locales, also occurring in rain forest and mature secondary successions at lower elevations. They are usually of restricted occurrence. They commonly comprise a tangle of ferns (*Dicranopteris*), climbing bamboo vine (*Racemobambos*), sword grass clumps (*Miscanthus*), together with low bushy saplings. People tend to avoid thickets, as they are difficult to penetrate, though they may harbor game or occur on a site being cleared for cultivation.

Way bway *'cultivated communities, gardens and homesteads'*. — The Wola call their gardens collectively ***em***, distinguishing several kinds. Here they cultivate a wide range of crops (Sillitoe 1983). Newly established gardens, particularly those adjacent to homesteads, feature a wide range of intercropped plants (see Table 5, 11; in two plots, each 42 m^2, we recorded 54 and 55 species [77 total], of which 20 and 9 were cultivated, respectively).

Longer established plots have less crop variety, sweet potato vines (*Ipomoea*) predominating over large areas, interspersed with some pumpkin (*Cucurbita*), sugar cane (*Saccharum*), green leafy vegetables and shoots (*Rungia, Setaria*), and other crops (see Table 6, 11; in two plots, each 42 m^2, we recorded 52 and 28 species [54 total], of which 12 and 6 were cultivated, respectively).The occurrence of crops in sweet potato gardens does not differ greatly with the time they have been under cultivation, as shown by a comparison of data from gardens cleared once, two-four times, and five or more times (Table 7).

All of these gardens support large numbers of sweet potato plants, usually cultivated in mounds. There is an evident increase in sweet potato plants per unit area as gardens age, from 16 to 18 to 21 plants per m^2, but the range of crops cultivated does not change noticeably. This suggests that no dramatic changes occur in garden fertility over time, corroborating people's assertions that sweet potato tuber yields vary little between gardens of differing ages. The Wola cultivate a range of other crops in small fertile strips along downslope fence lines, in surface dips, and so on.

A range of cultivated plants also occurs in houseyards, called ***aend bort*** (literally, 'at house'), and to a lesser extent around adjacent ***howma*** ceremonial grounds. People cultivate long-term crops around the edges of these clearings, such as bamboo (*Nastus*), palm lilies (*Cordyline*), bananas (*Musa*), screw-pines (*Pandanus*), and

TABLE 5. — ***Em*** garden (planted once) summary composition.

Growth Form	*Families*	*Species*	*Mean % of Species per Quadrat*
Trees	8	12	6%
Tree Ferns	2	3	15%
Cane Grasses	1	2	4%
Large Herbs	1	1	7%
Grasses and Herbs	19	39	27%
Crops	14	20	19%
Totals (in 84 m^2)	45	77	

TABLE 6. — ***Em garden*** (planted twice or more) summary composition.

Growth Form	*Families*	*Species*	*Mean % of Species per Quadrat*
Trees	6	7	5%
Tree Ferns	1	1	2%
Cane Grasses	2	2	4%
Grasses and Herbs	18	33	29%
Crops	8	11	19%
Totals	35	54	

TABLE 7. — Comparison of productivity of gardens cleared once, two-four times, and five or more times by mean number of plants per m^2.

	Mixed vegetable gardens	Sweet potato gardens: planted once	planted 2-4 times	planted >5 times
Sweet potato	0.36	15.80	17.90	20.70
Leafy vegetables and shoots	10.02	0.91	1.38	0.12
Pulses	0.57	0.07	0.10	0.10
Crucifers	1.86	0.27	0.04	0.14
Cucurbits	0.57		0.02	
Aroids	0.14		0.02	

ornamental plants for body decoration (*Acalypta, Laportea, Graptophyllum*). They may also cultivate on occasion plants that supply useful materials, such as hoop-pines (*Araucaria*), she-oaks (*Casuarina*), spurges (*Euphorbia*), bead ashes (*Elaeocarpus*), and marants (*Cominisia*).

Some wild plants that invade garden sites are edible too, and on occasion people cultivate them (e.g., *Commelina, Oenanthe, Solanum*). Others are not utilized directly by the Wola, although they may protect soils against erosion (Sillitoe 1993). Different associations of weedy plants are related more to the natural vegetation adjacent to sites, and hence to seed supply, than to any other factor.

Mokombai *'recent regrowth'*. — Recently abandoned, gardens, called ***em mokombai*** ('immature-regrowth garden'), pass rapidly through a series of overlapping plant successions before either tree or sword grass regrowth become established. These communities are botanically varied, changing quickly. Recently abandoned garden sites are irritating to traverse, colonized by herbaceous plants which rely on spiky and sticky burrs to disperse their seeds, called generically ***kobkob*** by the Wola (e.g., *Bidens pilosus, Adenostemma lavenia, Cynoglossum javanicum*).

Abandoned gardens are invaded by pioneer grasses (e.g., *Arthaxon, Paspalum, Ischaemum, Setaria, Isachne*) and herbs (*Crassocephalum, Polygonum, Viola*, and *Rubus*, among others). These flourish at the expense of the few remaining crop plants, finally displacing them (see Table 8, 11; 47 species were recorded in 50 m^2 of this habitat). The Wola may refer to this early ***mokombai*** phase as ***taengbiyp*** after one of the grasses that characterizes it.

TABLE 8. — ***Mokombai taengbiyp*** summary composition.

Growth Form	Families	Species	Mean % of Species per Quadrat
Trees	4	4	2%
Tree Ferns	3	4	6%
Ferns	1	1	4%
Cane Grasses	1	1	8%
Grasses and Herbs	15	31	24%
Crops	5	6	22%
Totals (in 50 m^2)	29	47	

Certain crops, like sweet potato, highland pitpit (*Setaria*), bananas, sugar cane, and the coleus dye plant (*Plectranthus*), compete successfully with the invading weeds and maintain their position on the site for some time. Eventually, robust and vigorous grasses (notably *Ischaemum*, but also *Paspalum, Arthraxon*, and *Isachne*) take over, possibly with swamp grass (*Leersia hexandra*) in wet depressions, replacing both any remaining crop plants and many of the early weed colonizers (see Table 9, 11; 50 species were recorded in 50 m^2 of this habitat). Wola commonly refer to this later ***mokombai*** phase as ***bol***, after the coarse *Ischaemum* grass that is predominant.

Some garden fallows never advance beyond one or another of these stages of regrowth, as people may pull up the herbaceous regrowth or coarse grasses and re-cultivate the sites. If natural regeneration proceeds, saplings, cane grass, or both invade (see Walker 1966 for a schematic representation of various possible sequences). Perennial short grassland like that in the Eastern Highlands is uncommon, probably because of the higher year round rainfall (Henty 1982), although small patches of ephemeral kunai grass (*Imperata*) occur, which the Wola call **senz** after that species, and which they exploit for house thatch. In the drier eastern regions of the New Guinea highlands, burning is more frequent and destructive, helping maintain a more extensive continuous cover of short grasses; it is not necessarily more mature than a cane grass cover nor an indication of earlier settlement and longer disturbance (Robbins 1960).

TABLE 9. — ***Mokombai bol*** summary composition.

Growth Form	Families	Species	Mean % of Species per Quadrat
Trees	3	3	4%
Tree Ferns	1	2	8%
Ferns	1	1	2%
Vines	2	2	3%
Cane Grasses	1	1	6%
Grasses and Herbs	20	38	22%
Crops	3	3	9%
Totals (in 50 m^2)	31	50	

Gaimb** 'cane grassland'*. — In the long-term one of two major floristic successions will establish themselves on abandoned cultivation sites: cane grass or secondary forest. The Wola call communities dominated by sword or cane grass (*Miscanthus floridulus*) ***gaimb after that predominant species. Cane grassland, like secondary forest, occurs predominantly as garden regrowth, although it sometimes colonizes sites disturbed and deforested for other reasons. *Miscanthus* is an erect cane-like grass with robust culms. It grows in dense clumps. Its lanceolate leaves, two-three cm wide, have finely serrated margins and taper to sharp points. Its inflorescence is a large, open panicle (Henty 1969). It produces large amounts of fluffy wind-borne seed, well adapted to colonize disturbed locales at a distance. It is prolific, even when cut right back. Eradicating it when clearing a new garden, for example, demands levering out the rootstock clump.

Dense stands of *Miscanthus floridulus*, 2-3 m high, cover large areas in valley basins. The quadrat survey data indicate up to 30 large clumps per 100 m^2 where it predominates. It may comprise 90% or more of the ground cover.[4] The cane forms a dense ***pletbok*** 'thicket' which is frequently impenetrable without a bush knife to cut a path. Thick brakes of fern (*Dicranopteris*) also occur in some locations among the cane, and clumps of low fern (Thelypteridaceae) are common where the cane is less dense. The cane is more open near homesteads where the rooting of pigs expose earth around the cane clumps. Even here a fair layer of leaf and cane stem litter builds up, supporting local assertions that under cane grass fallow a good layer of high organic dark topsoil suitable for recultivation soon accumulates. *Miscanthus* appears less readily to colonize sites close to the forest edge or other shaded places, which seem to reduce its competitive ability (Walker 1966).

Other grasses that occasionally occur amongst the *Miscanthus* include Job's Tears (*Coix lachryma-jobi*), wild sugar (*Saccharum robustum*), particularly along stream banks, and an "elephant grass" (*Pennisetum macrostachyum*) on wooded margins. Where the cane is more open and the soil not turned over too frequently by rooting pigs, low grasses (*Isachne, Paspalum, Ischaemum, Sacciolepsis, Setaria*) and various herbaceous plants (various Compositae, *Desmodium, Selaginella, Oenanthe, Plectrantus, Rubus, Viola*) may form a ground cover (see Table 10, 11; 148 species were recorded in 2000 m+ of this habitat).

Cane grassland is second only in extent to montane forest and has gradually replaced forest as the human population has expanded. Though cane grassland appears monotonous, floristic analysis suggests that it is a surprisingly species-rich succession (Figure 1). When established, cane grassland supports a few scattered trees, notably lower-statured, soft-wooded species such as nettles (*Pipturus*), ochnas (*Schuurmansia*), silkwoods (*Cryptocarya*), dillenias (*Saurauia*), and woolly cedars (*Trema*), with she-oaks (*Casuarina*), figs (*Ficus*), switchsorrels (*Dodonea*), parchment barks (*Pittosporum*), umbrella trees (*Schefflera*), and others. Stands of cultivated screw-pines (*Pandanus*) are also common, remaining from previous gardens. They sometimes grow in rows with palm lilies (*Cordyline*), marking old fence lines. The graceful tree fern (Cyathaceae) is common too, producing a distinctive vegetational succession. Wola do not distinguish this succession as a separate community, beyond speaking of them as ***henk***, the Wola life-form term for tree ferns.

A *Miscanthus* succession generally replaces shorter grasses if a site is left undisturbed, the tall cane out-competing even vigorous and persistent *kunai* grass

TABLE 10. — ***Gaimb*** cane grassland summary composition.

Growth Form	*Families*	*Species*	*Mean % of Species per Quadrat*
Trees	30	66	20%
Tree Ferns	7	12	33%
Ferns	3	3	33%
Screw-pines	1	1	35%
Vines	16	18	17%
Cane Grasses	1	2	68%
Large Herbs	2	5	23%
Grasses and Herbs	21	38	33%
Crops	3	3	45%
Totals (in 2000 m^2)	84	148	

TABLE 11. — ***Obael*** secondary forest summary composition.

Growth Form	*Families*	*Species*	*Mean % of Species per Quadrat*
Trees	29	64	19%
Tree Ferns	7	13	34%
Ferns	4	4	40%
Screw-pines	1	1	5%
Vines	14	15	12%
Cane Grasses	1	3	40%
Large Herbs	2	6	17%
Grasses and Herbs	19	36	34%
Crops	4	4	33%
Totals (in 2000 m^2)	81	146	

(*Imperata conferta*). The conditions that promote *Miscanthus* in competition over *Imperata* are an absence of extensive burning, which the wet Southern Highland's climate generally assures, and the presence of foraging pigs (Walker 1966). Not all grassland successional changes are due to human interference. Earth movements can disturb plant communities, sometimes permanently if drainage is altered. It has been suggested that some cane grassland was established during the Pleistocene glaciation, glacial evidence, such as moraines, existing on high volcanic peaks (Walker and Flenley 1979). However, Wola attribute such changes primarily to their activities, as the major disturbers of vegetation.

Human activity has undoubtedly extended the area under grassland. Grasslands occur where neither climate nor soil would preclude the growth of forest. Forest-grassland boundaries frequently occur independently of changes in soil types, having no apparent relationship with them. This is taken as evidence that grassland is largely anthropogenic (Robbins 1960; Henty 1982). Repeated cultivation, shortened fallow cycles, grass fires, and other disturbances encourage cane grass following forest clearance. Environmental factors that assist seedling death, such as soil-plant nutrient imbalances and sub-optimal drainage conditions, also contribute. Wola acknowledge that they themselves are agents of the forest's destruction. Once in digging a ditch to enclose a garden in cane grassland, gnarled bits of beech root and tree stump were uncovered, which were readily explained as evidence that the area was once forest.

Obael *'secondary forest'*. — The alternative long-term floristic succession to cane grass following the clearance of any area for cultivation is secondary forest. When plots cleared for gardens in the rainforest are abandoned they rapidly regenerate into patches of secondary forest , which the Wola call ***em obael*** ('mature-regrowth garden'). Tree regrowth occurs too in pockets throughout the cane grassland zone. It has a markedly different floristic composition to montane forest. It is altogether of a softer aspect and less formidable.

The ***obael*** secondary forest has a considerably lower canopy than the ***iyshabuw*** montane forest at 10-20 m and comprises fast growing soft-wooded trees primarily, such as various spurges (Euphorbiaceae), pipers (Piperaceae), nettles (*Pipturus*), figs (*Ficus* spp.), umbrella trees (*Schefflera*), dillenias (*Saurauia*), silkwoods (*Cryptocarya*), woolly cedars (*Trema*), and switchsorrels (*Dodonaea*) (see Figure 1; 146 species were recorded in 2000 m^2 of this habitat). Tree ferns (Cyatheaceae) are also common, often occurring as an understory tree (Table 11). Clumps of cane grasses (*Miscanthus, Coix*) are common too. When these exceed a certain number, the regrowth becomes more akin to cane grassland; there is no sharp distinction between these two vegetational communities, nor any others that pass from one to another. They gradually merge, as the Wola acknowledge, with no abrupt change.

The ground cover is on the whole considerably less dense under secondary woodland than primary forest, consisting of various coarse and creeping grasses (*Paspalum, Setaria, Ischaemum*), and a range of herbs and shrubs (Compositae, *Desmodium, Impatiens, Oenanthe, Plectranthus, Polygonum, Selaginella*), sometimes growing to waist height. Ferns are also common, notably in sprays across the forest floor (Thelypteridaceae) and sometimes in tangles (*Pteridium, Dicranopteris*); tall leafy herbs, notably gingers (Zingiberaceae), are frequently seen. The wildlife inhabiting secondary forest depends on its location. When surrounded by montane forest, where wildlife is abundant, it is likewise plentiful. But when situated island-like in a sea of cane grassland, where wildlife is limited, it is sparse. However, the fruits of some trees growing in these wooded islands are popular with birds and attract them here in considerable numbers when ripe.

Areas of secondary forest rarely develop into mature wooded stands. People with rights to the land usually clear them again for gardens before they reach this stage, or otherwise hinder their development by collecting firewood and raw materials. Near homesteads, they are sometimes disturbed by pigs rooting for food, which leaves patches of churned sod and vegetation across them. Nonetheless, if left undisturbed, the Wola maintain that ***iyshabuw*** forest would eventually establish itself in these areas. Some men told me that if they abandoned their valleys, montane rainforest would eventually replace both ***obael*** secondary forest and ***gaimb*** cane grassland, to cover them just as it had before their ancestors cleared it. They spoke of the primary forest 'hitting and eating' (***luw nokor***, literally, 'hit will eat') these long-term secondary successions and 'making them rotten' (***kor ma sokor***, literally, 'rotten cause become'). They pointed out locations where secondary woodland and cane grass abut the forest and explained how with human-beings absent the montane forest would slowly advance down the valley sides; they cited the Augu valley as a place where this has occurred in living memory, for with the abandonment of gardens there (following the establishment of administrative centers elsewhere, prompting people to move to be closer to them), the forest is engulfing the ***obael*** woodland and ***gaimb*** grassland down to the edge of the Augu river.

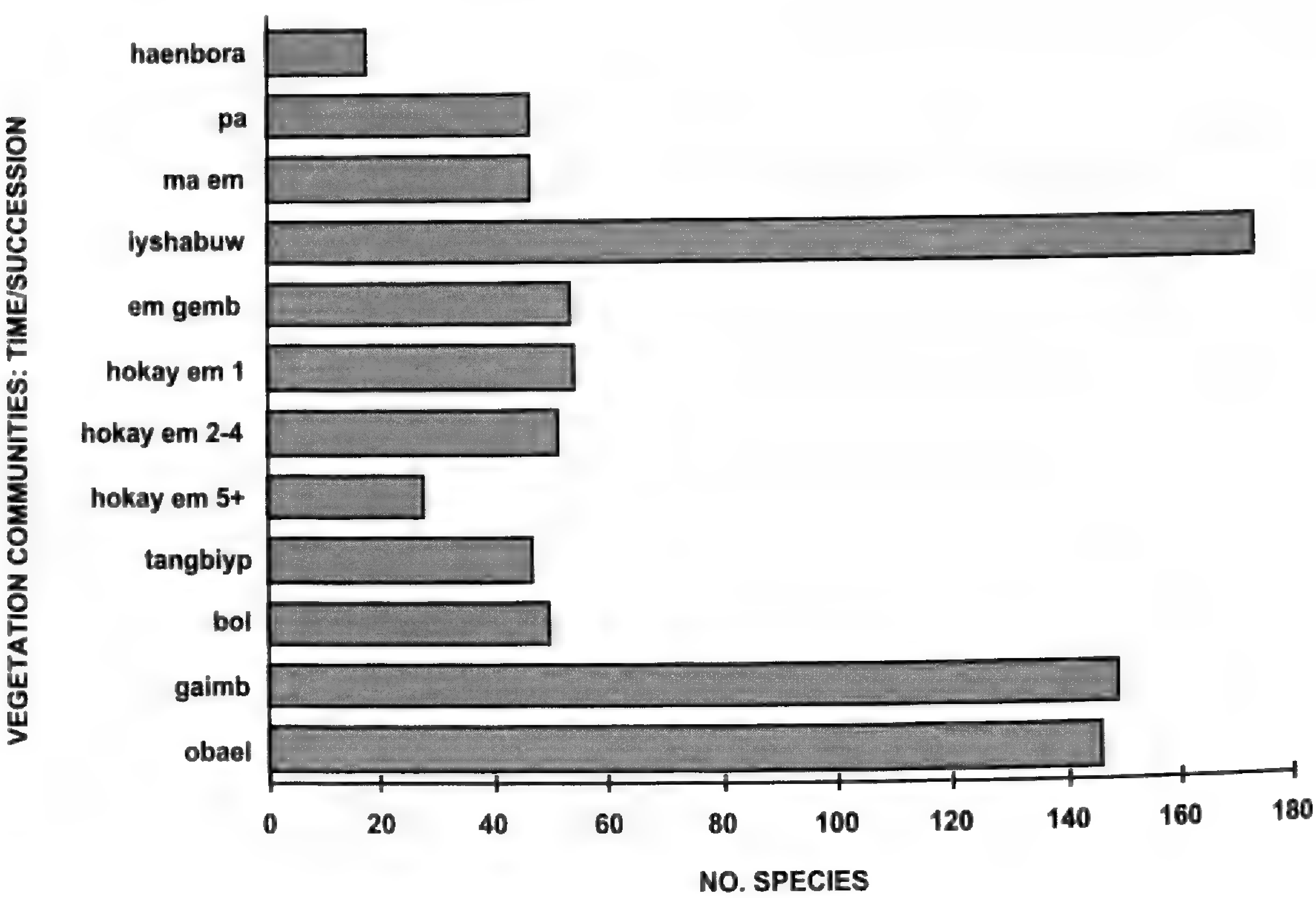
VEGETATIONAL SUCCESSIONS AND CHANGE

Changes in vegetational composition with human interference, in which the foregoing seral communities feature prominently, do not necessarily spell irreversible degradation, with permanent reduction in species diversity and biomass, at least not in the long run. While there is piecemeal destruction of forest to establish new gardens, this may be interpreted as the start of a long term chain involving garden and houseyard sites, which may pass through a series of successions upon abandonment to become cane grass and/or secondary forest regrowth, even mature forest if left long enough, although more likely they are disturbed again at some time relatively early in their progression towards maturity. The different plant communities recognized by the Wola relate to a presumed floristic successional pattern, a development relationship existing between the various anthropogenic communities and the unaltered forest and other communities (Figure 1). These data also belie the assumption that secondary successions are floristically degenerate, mature ones approaching primary forest in species richness; the Shannon and equitability indices support this conclusion (Table 12). While humans have contributed to deforestation and the spread of ecological disclimax vegetation, their activities do not necessarily result in a one-way change nor long term degradation, at least according to Wola experience and perceptions.

The assumption that a floristic succession characterizes changes in vegetation communities informs Wola thinking, who maintain that over time disturbed land passes through a series of named successions; this assumption also implicitly informs the structure of this paper. A statistical assessment of similarity between the vegetational communities distinguished further supports the postulated successional.[5] The cluster dendrogram sequence (Figure 2) groups together the various sites under cultivation, together with those under early abandoned vegetation, as similar in composition, in contrast to primary forest and advanced secondary successions under trees and cane grass, with bogland and rocky outcrop communities separated as quite different (a multidimensional scaling analysis mapped the distances similarly).

It is more difficult to appreciate Wola perceptions of the changes which their activities cause to vegetation communities, although the species richness and similarity evidence hints at their views and lends them some credence. Apparently, they do not think of themselves as irrevocably destroying virgin plant associations. The different plant communities which they distinguish and name are broad, relatively ill-defined categories. While they cite certain plants as indicator species of different communities, even naming some of them after these predominant plants (like ***gaimb*** for cane grassland and ***bol*** for coarse grass regrowth), they do not justify their identification of communities in terms of certain proportions of specified plants occurring there. This approach to community definition characterizes ecological science. It is used in this paper to achieve a more precise characterization of plant communities as identified by the Wola. While there is some broad correspondence, local and scientific ideas of botanical and ecological zones over-

FIGURE 1. — Species richness and characteristic taxa of climax and seral communities, according to relative time-succession order.



Checklist of taxa characteristic of each community in the development sequence	
Haenbora	*Eulalia, Imperata, Spathoglottis, Pteridium*
Pa	***Leersia****, Panicum, Oenanthe, Isachne, Ischaemum, Cyperus, Kyllinga*
Ma em	***Colocasia****, Crassocephalum, Nasturtium, Amaranthus, Viola*
Iyshabuw	***Nothofagus****, Ficus, Garcinia, Saurauia, Lithocarpus, Castanopsis, Elaeocarpus, Dicksonia, Alpinia, Cyclosorus, Racemobambos, Freycinetia, Polystichum, Phyllanthus, Cyrtandra, Cyphlophus.*
Em gemb	*Various crops, Setaria, Oenanthe, Bidens, Paspalum, Polygonum*
Hokay em 1	***Ipomoea****, some crops, Bidens, Centella, Cynoglossum, Polygonum*
Hokay em 2-4	***Ipomoea****, Adenostemma, Crassocephalum, Isachne, Polygala, Viola*
Hokay em 5+	***Ipomoea****, Arthraxon, Paspalum, Polygonum, Bidens*
Taengbiyp	***Arthraxon****, Adenostemma, Rubus, Cynoglossum, Paspalum, Viola*
Bol	***Ischaemum****, Isachne, Pouzolzia, Paspalum, Polygala, Polygonum*
Gaimb	***Miscanthus****, Blumea, Centella, Cyathea, Cyclosorus, Desmodium, Plectranthus, Schuurmansia, Selaginella, Oenanthe, Bidens*
Obael	*Trema, Piper, Cryptocarya, Dodonea, Saurauia, Pipturus, Pittosporum, Desmodium, Garnotia, Impatiens, Miscanthus, Paspalum, Plectranthus, Polygonum, Selaginella, Sphaerostephanos*

TABLE 12. — Shannon (H') and equitability (E) indices for vegetation communities (for definitions see Note 3).

	H'	E
Iyshabuw *'primary forest'*	3.80	0.74
Pa *'swampland'*	1.70	0.48
Ma em *'taro garden'*	2.83	0.74
Haenbora *'rockland'*	0.56	0.19
Em gemb *'houseyard garden'*	3.15	0.79
Em *garden (planted 1x)*	2.70	0.67
Em *garden (planted 2-4x)*	2.67	0.68
Em *garden (planted 5x or more)*	1.96	0.59
Mokombai taengbiyp *recent regrowth*	2.68	0.70
Mokombai bol *recent regrowth*	1.29	0.33
Gaimb *'cane grassland'*	3.77	0.75
Obael *'secondary forest'*	3.42	0.69

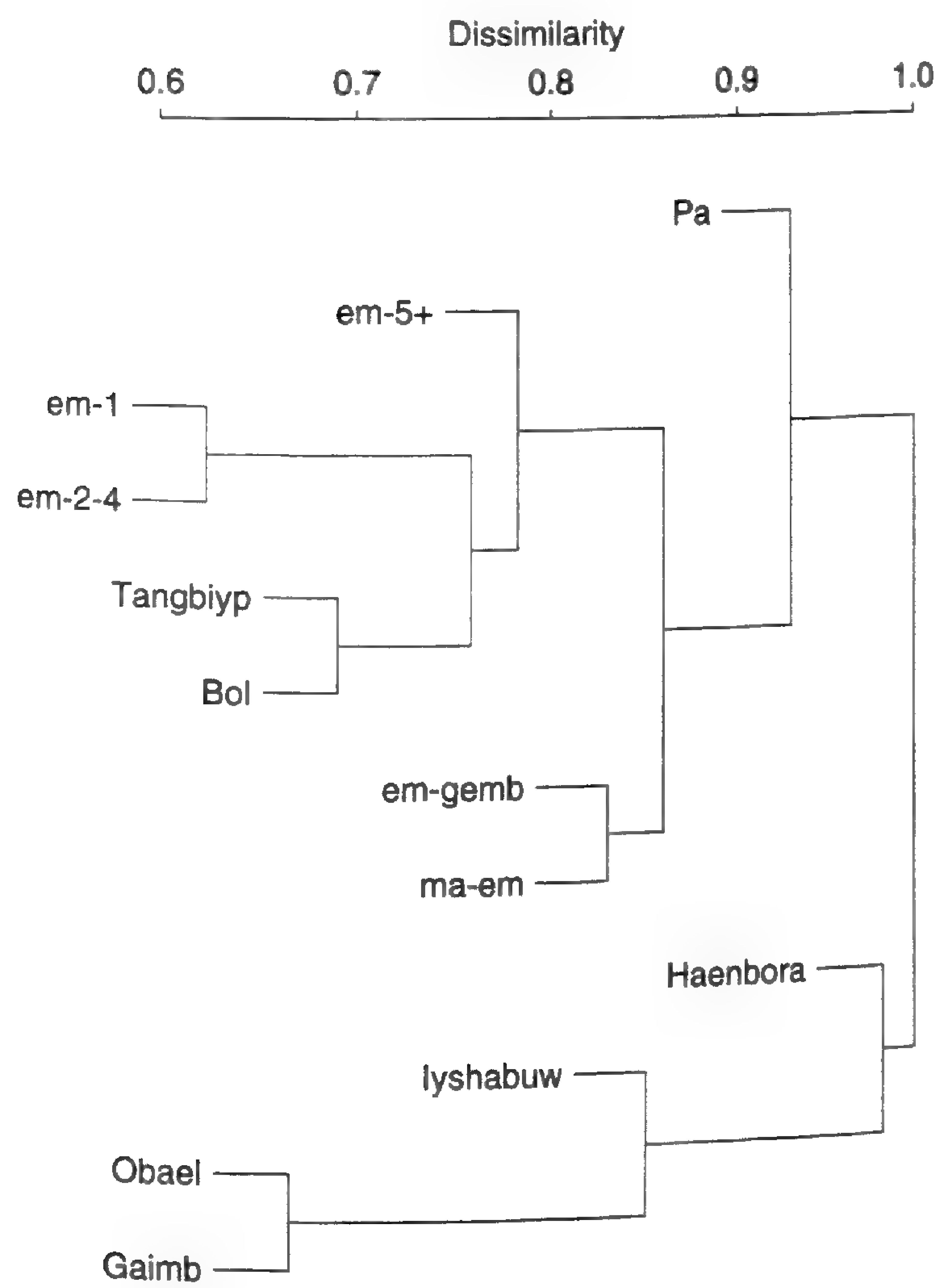
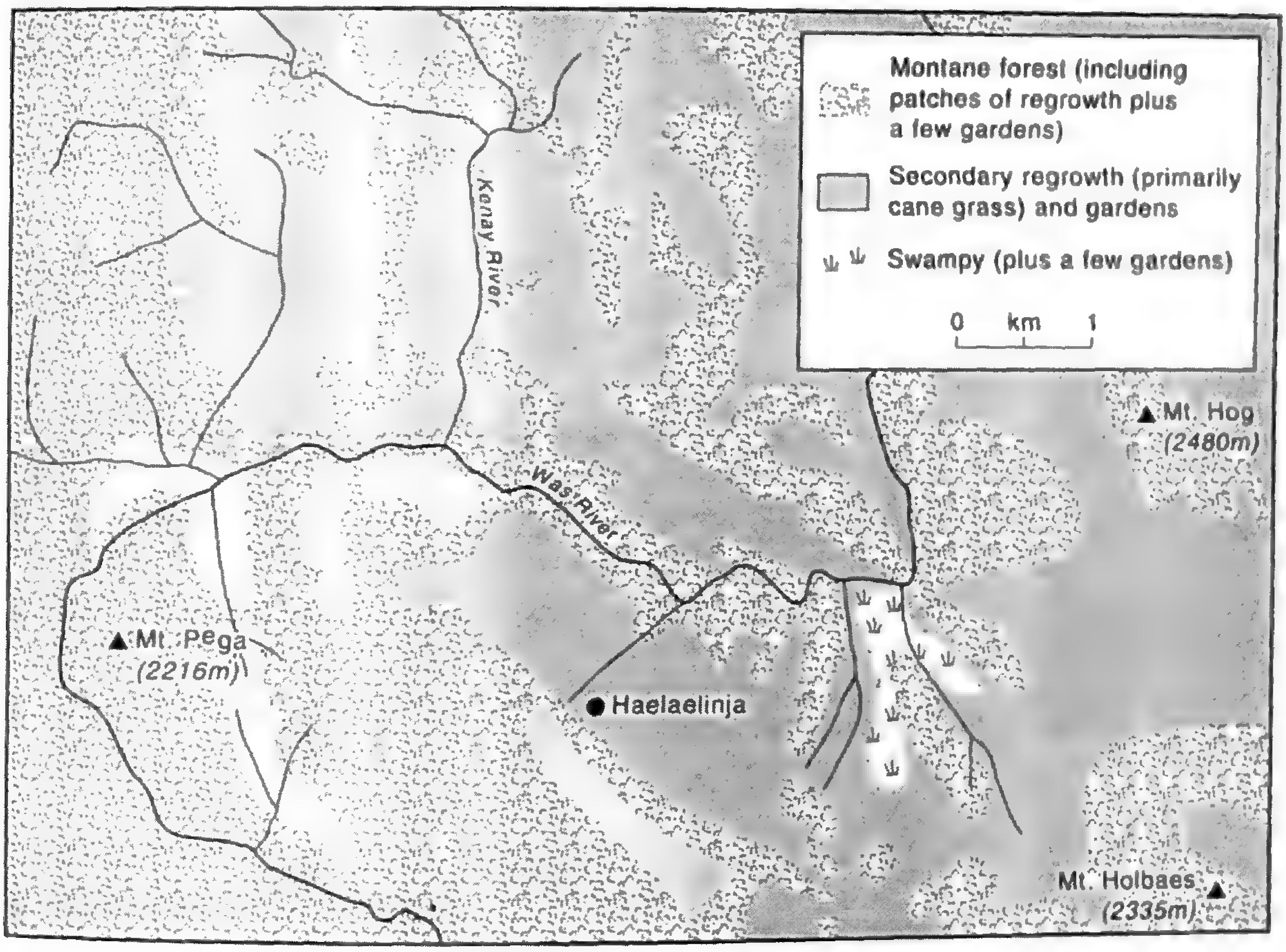


FIGURE 2. — Dendrogram of similarity measures.

lapping substantially (as noted repeatedly by ethnographers for other ethnoscientific domains), we should not allow this to obscure differences. The Wola acquire and apply this knowledge in a more informal and practical way. They know it without needing to identify consciously and count plants. Their categories are also open to negotiation and are not precise. The seral communities pass one into another, as do different virgin communities, with no discontinuous breaks. If people are asked to justify their identification of communities they may disagree, particularly if in a transition phase, for example where soft wooded ***obael*** trees and ***gaimb*** sword grass occur in large numbers, or where a patch of heavily disturbed albeit uncultivated ***iyshabuw*** montane forest supports many plants characteristic of ***obael*** secondary forest.

The ***iyshabuw*** lower montane forest and ***gaimb*** cane grass regrowth are the two vegetational communities that predominate across the Wola region, covering over ninety eight per cent of the area (Map 2). The other communities are small in comparison. These statistics may under–represent the area covered by some of these smaller communities,[6] being calculated from large scale maps and aerial photographs,[7] supplemented by my own limited observations. Detailed work in more restricted areas indicates nonetheless that these overall figures are of the correct order. A sizeable swampy area to the east of the locale of Haelaelinja in the Was valley, covers for example about 0.6 km^2 which, while a noticeable part of the local territory on which it occurs, is too small to show up in a survey of all Wolaland and makes no difference to the percentage given for this vegetational community for the entire region, comprising only 0.02% of it (Map 3).[8] Detailed data on areas under cultivation on the territories of two neighbouring ***semonda*** communities in the Haelaelinja region (population of approximately 300 persons) indicate that they only cover small areas too, 1% of these communities' territories. The local territories in the Was valley region also include considerably larger areas of lower montane rainforest than average, other territories elsewhere have more grassland, swamp, and so on. In his study of LANDSAT imagery for example, Radcliffe (1986:28-29) found that only 39% (125.4 km^2) of the Upper Mendi region is under rainforest, whereas 15% (45.7 km^2) of it is under wetland vegetation,[9] and cane grassland comprises the balance, covering 46% (144.6 km^2) of the area. In summary, while closer study of more limited areas reveals predictable variation between territories across Wolaland, the broad picture is one of forest and cane grassland communities predominating, with patches of other vegetational communities dotted about them.

Whatever the exact developmental relationship between vegetational successions and the long-term extent of montane forest regeneration, Wola subsistence gardening does not appear to be overly destructive of the forest environment, at least in the short-run. Their region has large areas of forest intact regardless of their apparent lack of any manifest conservation ethic; some 52% of their region is under primary forest (the percentage rising to over 80% on less heavily populated territories). And comparison of aerial photographs taken over part of their region by the U.S.A.F. in 1948 with more recent ones suggests that no marked increase has occurred in forest destruction over the last forty years or so. During this time more efficient steel tools have become available, making clearance somewhat easier, and administrative control extended over the area, with the introduction of health services resulting in a spurt of population growth (Radcliffe 1986:29). The dra-



MAP 3. — Map of the vegetation of Aenda and Ebay *semonda* territory.

matic increase in rates of labor migration out of the region over the last decade, on the other hand, suggests that pressure on forest resources is not increasing markedly, and may even decline.

The Wola destroy montane forest, steady population expansion obliging them to clear new land, but they are not indifferent in doing so. Their belief in the presence of demons reveals a tension. Clearance has been gradual and restrained. When they destroy forest to establish new gardens, they usually do so on the fringes of the forest, eating slowly into it from already settled areas. Human activity has already interfered with the forest here, in collecting firewood, raw materials, and so on. It is not where demons reside, they lurk in remoter and less disturbed forested regions. Over many generations, each nibbling away at the forest edges, destruction of large forested areas has occurred. But extensive forested tracts have survived, considering the substantial population density and the great period of time for which agriculture has been practised in the New Guinea Highlands.

The demographic position of the Wola is a critical parameter. Their population density, at some $18/km^2$, is relatively low compared to some of the more densely settled regions of the central cordillera of New Guinea — the Enga have around $50/km^2$, and the Chimbu and Dani over $100/km^2$. The lower population density compared to some other highland regions contributes to large tracts of the Wola montane habitat being relatively well preserved. But it is not just the demographic differences between densely settled central highlanders and the less densely settled Wola that accounts for differences in their regions' vegetational communities. There is more at issue than numbers of people. Cultural factors, such as cultivation practices, even beliefs in demons, may also play a part, as the Maring data suggest (Rappaport 1968; Clarke 1971; Healey 1990). The Maring, who have a slightly higher mean population density than the Wola, have about one-third of their region under anthropogenic vegetation, a substantial part of which is advanced secondary forest and woodland. It appears that the Maring environment and agricultural practices have less profoundly altered vegetation cover and not so significantly deflected successions from reverting back to montane forest. The Wola seem to engender more extensive, longer term transformation of vegetation from forest to stabilized cane grassland.

The Wola cultivate areas under secondary woodland or cane grass far more often than they farm virgin forest sites; for example, only 8% of 293 gardens surveyed in the Was valley were on sites under primary forest before cultivation. It is both supernaturally safer and physically easier to clear secondary regrowth. Also, having only stone tools for most of their history, would have restrained Wola forest clearance. Though over many centuries their ancestors cleared large areas in their main valleys. The natural resource base should not be overlooked. The soil resources of this montane environment are critical, supporting an intensive cultivation regime, which on some sites amounts to a semi-continuous system (Floyd *et al.* 1988). At the population densities involved in the Highlands, other less fertile soils would have led to far more forest destruction, under the resulting extensive shifting agricultural regime. The Wola are not innate conservationists, nor are they wanton destroyers of forest, as depicted by opponents of shifting cultivation (FAO-SIDA 1974; Watters 1971). Their relationship with natural vegetation is more elusive and indeterminate.

NOTES

[1]I particularly thank Wenja Muwiy, Ind Kuwliy and Mayka Haebay for their help in this work, and also Wenja Neleb, for I depended heavily on their knowledge of the plants growing in their region.

[2]Palynological evidence supports this view, indicating that *Nothofagus*, an ancient genus, migrated rapidly to higher elevations in Papua New Guinea as the climate warmed during the Pleistocene, establishing extensive beech forests which other genera then gradually invaded to give today's mixed montane forest (Walker 1970; Hope 1976).

[3]The Shannon index of diversity $H' = \sum_{i=1}^{s} p_i \log_e p_i$ where s = number of species and p_i = proportion of total sample belonging to the ith species. The index of equitability E is calculated from $E = H' / \log_e s$.

[4]The clumps themselves comprise large numbers of individual cane stems, on average 70 green and 43 dead stems per clump, ranging from 20 to 156 green and 12 to 123 dry stems (n=20 clumps, selected by random stone throws).

[5]The cluster analysis uses the following equation as a measure of similarity:

$$(1 / n_{ij}) \sum_{k=1}^{n_{ij}} (\mid x_{ik} - x_{jk} \mid) / (x_{ik} - x_{jk})$$

This is a variation on the "Canberra" metric (Digby and Kempton 1987), proposed by D. Wooff, which takes into account not just presence or absence of species but also their relative frequencies. I am grateful to D. Wooff of Durham University's Mathematical Sciences Department for assistance with this similarity measure.

[6]Notably they will omit small-sized areas under some of these less extensive vegetational communities which, occurring in one of the two major communities, are 'lost' because below the minimal size represented at the gross scale of this reconnaissance.

[7]C.S.I.R.O. (1965) Forest Types map; Radcliffe (1986:28); Papua New Guinea 1:100,000 topographic maps; and R.A.A.F. (1959) 1:35,000 aerial photographs.

[8]This swampy area occurs on the territory of a *semonda* neighboring those documented in the right hand column of Table 1 and hence is omitted from the table.

[9]The region surveyed included within it the large Kombie swamp.

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RECENT DOCTORAL DISSERTATIONS OF INTEREST TO ETHNOBIOLOGISTS XV

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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: 1-800-521-3042; 1-800-343-5299 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: 1-800-521-3042; desde Canada 1-800-343-5299).

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: 1-800-521-3042; de Canada 1-800-343-5299).

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This is the fifteenth 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 Sciences, Folklore, Geography, Health Science, Home Economics, Language, Linguistics, Palaeobotany, Paleoecology, Paleozoology, 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 1996-August 1997 and Volume B (Sciences and Engineering): September 1996-August 1997 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.

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ABSTRACTS OF PRESENTATIONS

at the 21st Annual Conference of the Society of Ethnobiology
University of Nevada, Reno
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NOTE: Abstracts are arranged in three categories: The papers in the Plenary Session are in the order of speaking. Contributed Papers and Posters are arranged alphabetically.

PLENARY SESSION

Introduction and results of survey of membership of Society of Ethnobiology and Society of Conservation Biology: *Elaine JOYAL*, Arizona State University, Tempe.

Why ethnobotany is a distant cousin of conservation biology: *Richard I. FORD, University of Michigan, Ann Arbor.*

Several of the pioneers of ethnobotany had an idea of conservation of plant resources as part of their conception of the uses of ethnobotany. They lacked, however, the theoretical construct that would allow them to center ethnobotany into the modern field of conservation biology. In the absence of the ecosystem concept and TEK (traditional ecological knowledge), they proposed what was most familiar to them as botanists and that was the garden. Both Harshberger and Gilmore envisioned ethnobotanical gardens as spaces to teach about plants as well as to do research on plant varieties, especially agricultural species. The thoughts about plant diversity by these early ethnobotanists will be discussed.

Ethnobiology, conservation biology, and cultural ecology: *E. N. ANDERSON, University of California, Riverside.*

Connecting ethnobiology and conservation biology requires a theoretical foundation in cultural ecology. In particular, we need a double theory of motivation: first, a theory of the actual motives involved in human use and management of the environment; second, a theory of motivated cognition, to explain why people know or believe what they do about this. Current theories, based on economic and political considerations, are valuable but inadequate. A more adequate theory is outlined.

Ethnobotany, politics, and conservation in British Columbia, Canada: *Nancy J. TURNER, University of Victoria.*

First Peoples in British Columbia are participating in land management and environmental decision-making in a variety of ways, particularly in the areas of forest practices, fisheries, establishment of parks and protected areas, and environmental and social impact assessments. Ongoing treaty negotiations incorporate many issues of resource use and management. Several key examples of the role of ethnobotany in these activities are presented in relation to: the Scientific Panel for Sustainable Forest Practices in Clayoquot Sound; Gwaii Haanas National Park Reserve; Kitlope Valley protected area; and Traditional Use Studies throughout the province.

Ethnobiology and conservation biology in Mexico: *Robert BYE, Universidad Nacional Autónoma de México.*

Ethnobotany (e.g., biological basis of plant-human interactions and relationships over evolutionary time and socio-geographic space) has been associated with conservation biology programs in Mexico due to the Mexican philosophy of reciprocation in ethnobotanical studies. Not until recently has conservation biology been formally recognized as a legitimate component of academic and community-based projects. Not only has species preservation (*ex situ* as well as *in situ*) and habitat protection (e.g., preservation, restoration) been carried out, but the recognition and promotion of traditional knowledge and practices are recognized as integral parts of conservation. The cultural context is seen as important in determining various values, identifying benefits, and implementing decisions. Given Mexico's long history of plant-human interaction, all conservation programs must involve the human component (rather than apply the "wilderness" concept) - conservation is utilization within limits. Today, social development in rural areas and human rights are becoming associated with ethnobotanical endeavors and are seen as important components of conservation programs. Examples of programs in Mexico of non-governmental organizations (e.g., Model Forest - Chihuahua; Fundación Ecológica de Cuixmala; Institute of Sonora; Conservación y Manejo de las Materias Primas de Uso Artesanal (AMACUP)), governmental para-governmental programs (e.g., Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO); Instituto Nacional Indigenista (INI); Instituto Nacional de la Nutrición (INNSZ); Secretaría de Medio Ambiente Recursos Naturales y Pesca (SEMARNAP)), and university projects (e.g., International Cooperative Biodiversity Group; McKnight Project; farmer participation in *in situ* conservation in milpas; etc.) will illustrate various points.

Kincentric ecology: Indigenous perceptions of the human/nature relationship: *Enrique SALMON, The Baca Institute of Ethnobotany.*

Indigenous people view themselves as part of an extended ecological family. It is an awareness that life surrounding them is kin. They are affected by and, in turn, affect their environment. The interactions that result from this "kincentric ecology" enhance and preserve the ecosystem. An indigenous perception of the human relationship to the natural world will be offered. It will illustrate the influences indigenous people have on the natural environment. The Raramuri example of *iwmgara* will serve to enhance understanding of the human/nature relationship which is necessary in order to fully comprehend the distinct intricacies of kincentric ecology.

Bridging traditional ecological knowledge and Western science: Restoration ecology and conservation biology in the indigenous context: *Dennis MARTINEZ.*

Traditional indigenous attitudes of kinship with the natural world, kincentric ecology, are still relevant to modern conservation concerns. Ethnography and ethnohistory provide essential tools which can assist in the conceptual reconstruction of precontact ecosystem structure and composition. This ethnoecology of cultural landscapes offers valuable clues to baseline ecosystem conditions, i.e., what to restore to. The last known natural state of high biodiversity resulting from indigenous management can guide conservation biologists in designing reserves and restoring the quality of habitats within those reserves. Western science provides the quantitative tools with which to evaluate this indigenous model by measuring the enhanced function of restored ecosystems.

Comcaac communities in conservation collaborations for ironwood and reptiles: When do cross-cultural coalitions work? *Gary Paul NABHAN, Arizona-Sonora Desert Museum.*

The Comcaac or Seri communities of Sonora, Mexico have been actively involved with ethnobiology and conservation projects for decades, some of which have provided tangible benefits to their communities, some of which have not. This report highlights two efforts which have included the Comcaac communities of Punta Chueca and Desemboque as partners in biological as well as cultural conservation: the Ironwood Alliance, and the Seri Ethnoherpetology Conservation and Education (SEEC) Project, which included an effort to captive-breed chuckwallas endemic to the Sea of Cortez area. The Ironwood Alliance, with 70 Seri signatories, successfully petitioned the Mexican government to list ironwood (*Olneya tesota*) as a species with special protection status, and to grant the Arte Seri crafts cooperative a collective trademark for ironwood and stone animal carvings. In addition, it launched a consumer awareness campaign about fake Seri carvings, confirmed that Seri harvesting of ironwood is sustainable, and worked to make ironwood a national priority for conservation and sustainable harvesting. Today, because conservation biologists helped them find new niches in the marketplace, the number of Comcaac artisans is increasing once again, and their products have diversified to use many raw materials in addition to ironwood. More recently, SEEC has involved dozens of Seris and non-Seris working hand in hand to construct a captive-breeding exhibit and ethnobiology trail in Punta Chueca, and to record songs and stories about reptiles for use in Seri schools. We have identified several ingredients essential to the success of cross-cultural interactions which have cultural and biological conservation as goals: 1) involve community leaders in initial brainstorming so that objectives, process, and structure emerge from their concerns: 2) focus on protecting traditional resources for which access has declined; 3) generate modest new sources of income for the community; 4) use coalitions to help reassert indigenous rights to manage, use, and conserve resources in political arenas where the communities cannot leverage support on their own; and 5) base project management on long cross-cultural friendships where trust already exists.

CONTRIBUTED PAPERS

ACUCA, Donato V. [see HUNN, Eugene]

The spirit of the driftwood: The importance of driftwood to humans: *Karen ADAMS, Gila River Indian Community.*

Recent analysis of driftwood brought to a "catcher beach" on Afognak Island in the Gulf of Alaska has revealed a diversity of woods carried by ocean currents. Much of this wood has probably originated in British Columbian and Alaskan rivers, though some may have traveled longer and from farther distances in the Japanese current. Ethnographic accounts suggest the importance of driftwood to humans as construction timbers, fuelwood, for tools and for mask-making. People could identify driftwood types while still afloat in the ocean, and once logs were beached, human ownership marks were honored. The relatively recent arrival of Sitka spruce forests to this region within the last 500 years suggests the importance of driftwood to ancient groups that occupied this relatively treeless area for the last 6,000 years.

Blowing in the Wind? The Dispersal of Cotton Pollen in the Safford Valley, Arizona: *Richard V. N. AHLSTROM, SWCA, Inc. and Linda Scott CUMMINGS, Paleo Research.*

In 1993, archaeologists from SWCA Environmental Consultants collected pollen samples from prehistoric rock features located on Pleistocene terraces overlooking the Gila River. Analysis by Paleo Research Laboratories revealed cotton pollen in several features, a surprising result given the arid setting. Was the pollen blown up from modern fields on the valley floor? To eliminate this possibility, surface pollen samples were collected in transects extending from the valley floor's edge to the uppermost terrace. Contrary to expectation, cotton pollen was found in most samples, supporting the interpretation of wind transport. This finding encourages caution when interpreting pollen samples from agricultural features.

The Formal and the Expedient: Lower Pecos Pit Hearth Tool Kits: *Charlotte K. BANISTER, University of Nebraska, Lincoln.*

In the Lower Pecos of Texas, the pit roasting of agave *(Agave lecheguilla)*, sotol *(Dasylirion sp.)*, and yucca *(Yucca sp.)* has been practiced since the early Archaic. Utilized flakes are commonly associated with the archaeological remains of pit cooking, but are seldom treated with any serious consideration in the archaeological literature. Changes in the style, raw material, and use wear patterns of these expedient tools may give us information about changes in plant processing through history. Studies of this kind may also give us a new way to look at Archaic tool kits in the Lower Pecos.

Pitcooked Balsamroot: The Bite Is in the Bark: *Kelly BANNISTER, University of British Columbia and Sandra PEACOCK, University of Victoria.*

For several years, we have been investigating the nutritional and medicinal properties of Secwepemc plant resources. Recently, our interest in the overlap between "food" and "medicine" was piqued by a comparison of the chemical nature and antimicrobial properties of balsamroot *(Balsamorhiza sagitatta)*, "the medicine," with pitcooked samples of balsamroot, "the food." We examine both chemical conversion and chemical stability of nutritional and medicinal agents in pitcooked balsamroot. As pitcooked balsamroot was formerly eaten in large quantities as a source of carbohydrate, we ponder the implications of our findings for Native diet and health.

Ahjumawi Fish Traps: The Social Implications of Intensive Sucker Exploitation in Northern California: *Frank E. BAYHAM, California State University, Chico and Antoinette MARTINEZ, University of California, Berkeley.*

The archaeofaunal record of northeastern California documents an increase in the prehistoric use of non-anadromous fishes, particularly suckers *(Catostomus sp.)*, around A.D. 1000. Relatively little is known about the social dynamics associated with this resource shift. A series of fish traps in the Ahjumawi Lava Springs State Park and the local ethnographic record allow us to consider the extent to which capture strategies and Native modifications to spawning pools may have served as a type of ecosystem management. Here we examine the social implications of this phenomenon as it relates to the allocation of labor in extraction, tool production, processing and distribution, as well as its implication for gender equity.

BEAR, Robert [see EISELT, Sunday]

Indigenous Management of Yellow Glacier Lily (*Erythronium grandiflorum*) and Blue Camas (*Camassia spp.*), Two Important Root Vegetables of the Pacific Northwest: *Brenda BECKWITH and Dawn LOEWEN, University of Victoria (both).*

Two significant food plants of First Nations in British Columbia are the liliaceous species *Erythronium grandiflorum* (yellow glacier lily; south-central interior of British Columbia), and *Camassia spp.* (blue camas; southern Vancouver Island and adjacent Gulf Islands). Both species were actively managed in various ways to increase the vitality of populations and productivity of the bulbs. Management strategies included selective harvesting, tilling, weeding, sowing, and burning. New experimental results are presented for glacier lily to confirm that the traditional replanting of "bulb-appendages" would have promoted vegetative reproduction. A proposed restoration project in Victoria, B.C., will include prescribed burning to study the fire ecology of camas.

BRANDT, Betsy [see JOYAL, Elaine]

Amerindian Classification of Oaks: *Cecil BROWN, Northern Illinois University.*

Eighty Amerindian languages and dialects are surveyed for systems of classifying and naming oak trees. Systems may or may not show generic oak terms (GOTs), e.g., English oak, or binomial oak terms (BOTs), e.g., English *white oak*. GOTs and BOTs tend more strongly to be present in folk taxonomies of small-scale farmers than in those of hunter-gatherers. However these features appear typically to develop for agrarian groups only when marginal agriculture is replaced with more intensive farming.

Roasting of Agavaceous Plants in Northwestern Mexico: *Agave* Species in Southern Sonora: *Robert BYE, Universidad Nacional Autónoma de México and Rigoberto LOPÉZ, Universidad de Sonora.*

Members of the genus *Agave* (e.g., maguey) and related plants (e.g., *Dasylirion*) have been important sources of food and beverage for native peoples in arid and semiarid zones of central and northern Mega-Mexico. Much attention has been given to the system of maguey roasting pits in the Southwestern USA, especially from the archaeological and botanical viewpoints. Although northern Mexico has had cultural and historical relations with this part of the USA, there is little comparable information. Recent archaeological studies in northwestern Mexico suggest that this system was equally important. After a brief introduction to general examples of products of Agavaceae involving pit baking, a summary will be presented of a maguey pit baking workshop conducted as part of a cultural rescue project in southern Sonora at the request of the local Mayo Indian community and related to the conservation and immediate benefit program of the International Cooperative Biodiversity Group (a collaborative effort of the Universidad Nacional Autónoma de México and University of Arizona). The dense crowns and leaf bases of the magueys *Agave shrevei*, *A. angustifolia*, and *A.* af. *rhodacantha* have been used in the past to produce a sweet carbohydrate food during the dry season prior to the flowering of the plants. The decapitation of the plant months prior to harvesting promotes suckering so that the populations propagate vegetatively and increase. The recent decline in the abundance of the magueys has been attributed to abandonment of pit roasting practices. Prepared maguey "hearts" are placed in previously heated, rock-lined pits along with various layers of branches. The best tasting results are said to be obtained by baking the "hearts" with certain resinous plants (e.g., *Bursera*). The roasting pits are located along the upper banks of arroyos and rivers or near houses. Most of the activities are carried out by men.

BYE, Robert [see LINARES, Edelmira]

CANNON, William J. [see FOWLER, Catherine S.]

CERVANTES, Luis [see LINARES, Edelmira]

Putting Informal Knowledge of Nature to Conservation Purposes when Societies Are Developed or Developing: *Raymond CHIPENIUK, Frost Centre, Trent University, Ottawa.*

Throughout the world now, most individuals grow up without a traditional knowledge of nature. But neither do they absorb a correct or substantial appreciation of the concepts of Western science. Nevertheless, they experience nature personally and develop an informal understanding of it. This paper identifies some of the factors involved in putting informal knowledge of nature to conservation purposes when societies are developed or developing, as in Canada.

"Rich Forest": Traditional Knowledge, Inventory and Restoration of Culturally Important Plants and Habitats in the Atleo River Watershed: *Juliet CRAIG, Long Beach Model Forest/University of Victoria and Robin SMITH, Trent University.*

In 1995, the Scientific Panel for Sustainable Forest Practices in Clayoquot Sound recognized the valuable role of First Nations' knowledge and perspectives in working towards sustainable forest practices in British Columbia. "The Rich Forest" project, funded by the Long Beach Model Forest, was designed to follow up on the recommendations of the Scientific Panel by conducting an ethnobotany project with the Ahousaht First Nation focusing on the Atleo River watershed. A description of the research project is provided, along with reflections on how this project demonstrates the intersection of ethnobotany and conservation in practice.

When Presence is Enough: *Linda Scott CUMMINGS, Paleo Research.*

Pollen and phytolith analysis can borrow from macrofloral and faunal analysis when the question involves presence of specific remains to answer specific questions. Presence of remains may be interpreted, but absence is not significant. Identification of garden areas, and other activity areas, often hinges on recovery of specific remains. Even in tropical areas where preservation is not expected to be good, presence of starch granules, phytoliths, and fragments of pollen can provide valuable interpretations. Examples from Easter Island and various other places are used as examples of rare remains providing valuable and interpretable results.

CUMMINGS, Linda Scott [see AHLSTROM, Richard V.N].

The Correlations Between Health and the Environment in Western Apache Culture: *Sean Michael DALEY, University of Arizona and Christine MAKOSKY, Arizona State University.*

This study looks at the interaction between the Western Apache of Arizona, their environment, and the connection between the environment and their conceptions of health and illness. Topics analyzed include Western Apache animal and plant taboos and their correlation to illness and Western Apache medicinal and protective uses of animals and plants. Data included in this study was collected through interviews with Western Apaches and secondary sources. Results will be used by biomedical healthcare practitioners on Western Apache reservations in a training manual.

***Mursik* Production in Trans-Nzoia District, Kenya: A Traditional Method of Treating Milk for Preservation and Palatability:** *Christoffel DEN BIGGELAAR, Michigan State University and William MUREITHI, Moi University, Kenya.*

Milk treatment using trees is an age-old practice of pastoral communities in Kenya. Due to economic, political and environmental pressures, pastoralists have become settled farmers and turned to crop cultivation as their main means of survival. However, they have continued to keep some cows and to treat their milk using traditional practices, incorporating the desired tree species into their farming system. This paper will present information as to how species are identified and selected, how the trees are managed, management problems associated with the trees, and how farmers evaluate the results of continuing experimentation with trees used for *mursik* production.

Use of Traditional Concepts of Biota in Conservation Efforts in Palau: *Cynthia DURGAN, Adolph M. GREENBERG, and W. Hardy ESHBAUGH, Miami University (all).*

Endangered species including sea turtles and dugongs are hunted in the Republic of Palau in Micronesia. Food fish catches are dropping. Development threatens mangrove and forest habitats of birds and fruit bats. Utilizing legends and citing traditions of resource protection, educators, government agencies, and nonprofits seek to raise public support for conservation. Invasive weeds and imported plant diseases represent threats against which traditional values and concepts of biota may be more difficult to enlist.

At the Water's Edge: Fishing, Practices and Gear Selectivity in the Prehistoric Northern Great Basin as Evidenced by Archaeological Fish Remains and Modern Fishing Experiments: *Sunday EISELT, University of Michigan, Ann Arbor; Robert BEAR; and Ruth GREENSPAN, Heritage Research Associates.*

The reassessment of ethnographic fishing practices and archaeological fish remains have prompted new interpretations about the role of marshes in Great Basin aboriginal settlement. The contribution of fish to prehistoric diets is difficult to assess, however, since fish captured by aboriginal mass capture techniques are small, numerous and similar to natural die-off assemblages. This paper includes the results of mass capture fishing conducted in northeastern California using basketry and netting. The results of gear selectivity and fish size gradients are compared to archaeological materials from several open-air sites in southeastern Oregon and early Holocene human paleofecal remains from central Nevada.

EISELT, Sunday [see FOWLER, Catherine S.]

Ethnobotanical Education Grows in the Garden: Examples of Student-Supported Ethnobotanical Garden Projects: *Marja ELOHEIMO, The Evergreen State College/University of Washington.*

Student involvement in the development, maintenance and utilization of ethnobotanical gardens can enhance the teaching of ethnobotany. Three student-supported ethnobotanical gardens at varying sites—a historical museum, a Tribal center and a college campus location— are described. These projects have been incorporated into ethnobotany and ethnoecology courses at The Evergreen State College in Olympia, Washington. Through them, student learning and community contribution have occurred in a number of areas including plant identification, plant ecology, plant salvaging, native plant gardening, ecological restoration, traditional and contemporary plant use, cross-cultural collaboration and reciprocity, and environmental education.

ESHBAUGH, W. Hardy [see DURGAN, Cynthia]

ESHBAUGH, W. Hardy [see LAMONT, Susan]

FLASTER, Trish [see KINDSCHER, Kelly]

Plant and Place Names Among the Keo of Eastern Indonesia: *Gregory FORTH, University of Alberta.*

Among the Keo people of eastern Indonesia, plants, especially trees, serve a variety of ritual, symbolic and linguistic ends. Like other landscape features, particular plants and trees provide a means of defining and designating places, most notably villages and other culturally bounded spaces, and are further used to name clans. Plant nomenclature is also prominent in Keo personal naming, especially of women. The paper considers how these various instances of botanical names are connected, and how such connections between plants and people may be mediated by a particular social structure.

Pit Roasting *Valeriana edulis*, a Root Food of the Surprise Valley Paiute: *Catherine S. FOWLER, University of Nevada, Reno; Lucile HOUSLEY and William J. CANNON, Bureau of Land Management, Lakeview; B. Sunday EISELT, University of Michigan, Ann Arbor; and Kimberly GUPTA, University of Nevada, Reno.*

Valeriana edulis was used in several areas of the northern Great Basin and the Columbia Plateau as a root food. Members of the genus (and species) are known for containing various sedative-like substances, and are used in several areas of the world as medicines rather than foods. In June, 1997, we simulated a pit roasting of *V. edulis* with Surprise Valley Paiute to learn more about the food properties of the plant. We were also curious as to whether the pit roasting altered in any way the active compounds in the plant. This paper reports on the ethnographic background of uses of the plant, as well as the pit roasting procedures.

Whence Corn Pollen at Archaeological Sites? An Experimental Study of Maize Ear Washes: *Phil GEIB, Navajo Nation Archaeology and Susan SMITH, Northern Arizona University.*

Adequate interpretation of pollen data from prehistoric sites is contingent upon understanding how pollen becomes deposited in the archaeological record. As a continuation of a study intended to help bridge the inferential gap between pollen from archaeological contexts and behavioral inference, we analyzed a series of pollen washes from maize husks, silks, and kernels. Our analysis quantifies a drastic reduction in maize pollen from the outer husks to the inner husks, with no pollen occurring on kernels. We describe the results of this experiment and discuss implications regarding the interpretation of corn pollen from archaeological samples.

GREENBERG, Adolph M. [see DURGAN, Cynthia]

GREENBERG, Adolph M. [see LAMONT, Susan]

GREENSPAN, Ruth [see EISELT, Sunday]

GUPTA, Kimberly [see Fowler, Catherine S.]

HALLETT, Douglas [see LEPOFSKY, Dana]

The Saints of Tobacco in Mazatec Prayer: *Kathleen HARRISON, Sonoma State University.*

The Mazatec people of northeastern Oaxaca, Mexico, grow *Nicotiana tabacum*, which they employ in prayer and healing ceremonies. Each variety of tobacco is perceived as a distinct holy character—Catholic saint—with whom people speak. The specially-prepared tobacco mixtures, which may include multiple varieties, are not smoked; rather they are used externally on the body, to demarcate a protected space, or as a quid when invoking the saints' assistance. Slides and stories of fieldwork among the Mazatecs illustrate this reverential practice.

HENRIKSON, Suzann [see YOHE, Robert]

Lithic Soils—Supermarkets or 7 - 11s? Shallow-Soiled Grocery Stores of the Intermountain West: *Lucile A. HOUSLEY, Bureau of Land Management, Lakeview.*

Plant resources are not scattered randomly across the landscape of the arid West, but they can be found in discrete areas related to soils and soil moisture availability. The seemingly bare, rocky areas of low sagebrush are of great interest to archaeologists, ethnographers and land managers as lithic soils support a great diversity of geophytic roots and other cultural plants collected by indigenous peoples. This report explores the knowledge of these resources in order to help preserve and protect these plant communities and encourage indigenous peoples to maintain past lifeways.

HOUSLEY, Lucile [see FOWLER, Catherine S.]

Mixtepec Zapotec Bird Classification: *Eugene HUNN, University of Washington and Donato V. ACUCA.*

Contemporary Zapotec speakers of San Juan Mixtepec, Miahuatlán, Oaxaca, Mexico recognize and name approximately 100 bird taxa, of which 70 are of folk generic rank. The terminology is applied to a local avifauna of 175+ species. The effects of taxonomic salience, size, ecological factors, and cultural salience are assessed to account for naming patterns. The system is then compared with Zapotec vocabularies for the Sierra Juárez, Mitla, and Juchitán, and with Fray Juan de Córdova's 16th century Zapotec vocabulary. Finally, these Zapotec classifications are compared with that of the Tenejapa Tzeltal.

HURLBURT, Dana [see KINDSCHER, Kelly]

A Traveler's Path: Ethnoecology of Athapaskan Speakers in Northwestern Canada: *Leslie Main JOHNSON, University of Alberta.*

A preliminary examination of landscape terms in Witsuwit'en and in Kaska suggests that Athapaskan speakers of northwestern Canada organize their perception of landscape from the perspective of people who travel on the land. Terms for topographic features such as river, creek, creek side, mountain, slope, hill, lake, swamp, meadow, open grassy area, wooded area, grove, avalanche track, glacier, cliff, and rubble field; and ice textures, sand, trail, various types of animal trails, bedding areas, and licks are found in these languages. Toponyms reveal how a place looks from the vantage of the traveler and what its characteristics are.

Basketry Ecology Among the White Mountain Apache of Arizona: *Elaine JOYAL and Betsy BRANDT, Arizona State University (both).*

Apache Indians are well known basket makers. We consulted published references and conducted *de-novo* interviews to determine which plants were, and are still, used for basketry by the White Mountain Apache of Arizona. Apache basket types and purposes, the plants used for each, and gathering practices are summarized. Changes in material preferences and harvest methods between older and younger weavers, and the transfer of traditional knowledge from tribal elders to the next generation of weavers, are used to explore the broader implications of basketry ecology.

***Echinacea angustifolia*: The Prime Crop of a Kansas Medicinal Plant Industry:** *Kelly KINDSCHER and Dana HURLBURT, University of Kansas, Lawrence; and Trish FLASTER, Botanical Liaisons.*

We are exploring the possibilities of a medicinal plant industry for Kansas with "seed" money from the Kansas Department of Commerce. Among the many promising candidates for Kansas-grown and processed medicinals, *Echinacea angustifolia* is foremost because of its local abundance, long history of wild harvest in Kansas, and strong market demand (*Echinacea* led the nation in medicinal herb sales, the last three years). Our demographic data on density, reproductive success and survival show moderate levels of wild harvest (as practiced by experienced "rooters") appear to allow for sustainable harvest. In addition, local climatic conditions are suitable for a Kansas-grown supply.

Building a Database for Great Basin Ethnobotany: *Glenda KING, Idaho State Historical Society.*

Scholars reviewing the status of ethnobotany in western North America frequently comment on the lack of comprehensive approaches to the subject and the need for cross-cultural comparisons and regional syntheses. A database for plant use by indigenous hunting and gathering people of the Great Basin was assembled using ethnographic and ethnobotanical studies that have occurred over a span of 100 years. While the gathered data vary in specificity and reliability, their assemblage provides for easy access and facilitates comparisons, overviews, and development of avenues for investigation on indigenous plant use in the Great Basin.

Recent Changes in the Ethnobotany of Standing Rock Indian Reservation: *Shelly KRAFT-MICHELS.*

Plant use among the Lakota has been greatly reduced and in some cases, completely eliminated by the damming of the Missouri River by Oahe Dam. The Missouri River Basin Investigation report stated that timber, game, and wild plants were resources basic to survival of the Indians of Standing Rock Reservation. It was determined that at least twenty-six plants were reduced or eliminated from the reservation resulting in loss of traditional ecological knowledge and traditional Indian culture. This loss created socioeconomic setbacks for the Lakota forcing them to become more dependent on welfare or a wage-earning economy off the reservation.

The Effects of Ecotourism on Subsistence Agriculture in a Rural Amazonian Village: *Susan LAMONT, W. H. ESHBAUGH and Adolph GREENBERG, Miami University (all).*

Few studies have documented the effects of ecotourism on resource use strategies of local human populations. Plant use was studied in three rural villages in the Peruvian Amazon, one of which is located adjacent to an ecotourism operation. Data from surveys of agricultural fields and home gardens and household interviews suggest a decreased reliance on subsistence agriculture in this village, resulting in fewer and smaller fields, less species diversity and a shorter swidden-fallow cycle. Home gardens contained fewer species overall and more species were used for crafts.

Mule Deer and Seasonality at Black Rock Shelter: *Anastasia T. LEIGH, California State University, Chico/Summit Envirosolutions.*

Cementum increment analysis is an increasingly common method conducted on archaeological samples of mammal teeth to investigate scheduling of seasonal events or seasonality of site occupation. This research examines application of the method to mule/black-tailed deer (*Odocoileus hemionus*) from northern California. A modern control sample and an archaeological sample of deer teeth are analyzed. Using the control sample as a baseline, the archaeological sample is interpreted in terms of deer ecology and available ethnographic data from the region.

Documenting the History of Prescribed Burning Among the Sto:lo of the Fraser Valley, British Columbia: *Dana LEPOFSKY and Douglas HALLETT, Simon Fraser University; Kevin WASHBROOK and Sonny McHALSIE, Aboriginal Title and Rights, Sto:lo Nation; and Ken LERTZMAN and Rolf MATHEWES, Simon Fraser University.*

This research documents prescribed burning practices among the Sto:lo of the Fraser Valley during the historic and prehistoric periods. Interviews with elders indicate the widespread use of controlled fires in the historic period to encourage the growth of berries and other useful plants, particularly in the subalpine. We are documenting prehistoric burning practices through the dating and identification of soil charcoal and analysis of pollen and charcoal from the lake sediments. Our investigation of sites identified by elders as having been burned historically indicates that prescribed burning leaves evidence in the paleoecological record that can be used to reconstruct a long history of this management practice. Documenting the history and ecology of controlled burning in ecosystems previously presumed to be "wild," has important implications for modern resource management and conservation.

LERTZMAN, Ken [see LEPOFSKY, Dana]

Complementary Plants in Some Chocolate Preparations of Mexico: *Edelmira LINARES and Robert BYE,Universidad Nacional Autónoma de México; Luis CERVANTES, Jardín Historica Ethnobotánico; and Beatriz RENDON, Universidad Nacional Autónoma de México.*

Cacao (*Theobroma cacao*) as a prehispanic domesticate played important commercial, social and dietary roles among various Mesoamerican cultures. Its adoption by European societies changed its importance in Mexico as well as the form and context of its consumption. Nonetheless, some traditional ingredients still complement the cacao seeds in such chocolate preparations as "popo," chilate," "tejate," and "tascalate." The respective wild and cultivated indigenous complements for these beverages include fruits of *Gonolobus niger*, seeds of *T. bicolor*, flowers of *Quararibea funebris*, and seeds of *Bixa orellana* (among others) all of which add culturally appreciated organoleptic properties.

LOEWEN, Dawn [see BECKWITH, Brenda]

LÓPEZ, Rigoberto [see BYE, Robert]

McHALSIE, Sonny [see LEPOFSKY, Dana]

MAKOSKY, Christine [see DALEY, Sean Michael]

MATHEWES, Rolf [see LEPOFSKY, Dana]

Little Known Western Fiber Plants: Habitat Restorations, Native Revivals of Traditional Skills and Museum Collection Research: *Margaret MATHEWSON, University of Oregon.*

This paper explores some little known Western basketry and cordage fiber plants and their use. Current revivals in the use of these plants among California and Oregon native basket makers are discussed as well as efforts to save a number of threatened plant gathering locations. Contemporary native people are using museums and archives in increasing numbers to pull together "lost" ancient traditions. Many museum collections contain objects of questionable origin. Plant species identification may be used in determining the possible origins of undocumented museum pieces. Early ethnobotanical collections, modern field collection and replication projects are used to determine plant species. Examination of diagnostic features of plant fibers in documented pieces is used for comparison.

MARTINEZ, Antoinette [see BAYHAM, Frank E.]

Transformations of Attitudes Towards the Forest Among an Eastern Indonesian People: *Andrea K. MOLNAR, Northern Illinois University.*

The paper addresses issues connected with the consequences of agricultural modernization among the Hoga Sara of Flores Island eastern Indonesia. Pressures to implement an agribusiness project had important consequences on ways the Hoga Sara conceptualize their relationship to the forest. In the past, and in spite of conversion to Catholicism, this relationship was expressed in terms of the indigenous religious ideology. At the present, however, economic forces are impacting both on traditional religious ideas and on the Hoga Sara conceptualization of their relationship and attitudes towards the forest.

MUREITHI, William [see DEN BIGGELAAR, Christoffel

NEWMAN, Margaret E. [see YOHE, Robert]

Wetland Biodiversity, Human Ecology, and Conservation Strategies: *George NICHOLAS, Simon Fraser University/Secwepemc Education Institute.*

Wetlands have figured prominently in human affairs throughout the last million years, and continue to be important to many traditional societies. While people did not live within swamps, bogs, or marshes, such settings have a demonstrated importance as a resource base, and also satisfied other needs (e.g., sacred places). This paper: (a) reviews the range of land use associated with wetland settings worldwide during the Pleistocene and Holocene periods; (b) discusses ecological factors that explain aspects of this association; (c) identifies the variety of wetland types and resources exploited; and (d) investigates several conservation strategies that combine cultural and natural management values.

The Zooarchaeology of Wildlife Management: *Christopher O'BRIEN, U.S. Forest Service, Lassen National Forest/CSUC.*

Specialists concerned with modem game management are increasingly turning to archaeological data for an understanding of diachronic variability in game populations. Measures of human predation and ecological change serve not only as templates against which current methods of wildlife exploitation are evaluated but also frame the philosophical debate over natural resource use. Implications of zooarchaeological data for wildlife management policies are discussed and several case studies are considered. Attention is focused on evaluating recent proposals in elk management policies in Yellowstone National Park which have been prompted by interpretations of regional archaeological data. The argument is advanced that while zooarchaeological data provide valuable information relevant to wildlife management, such data have been applied uncritically in the case of the Yellowstone elk herds.

Traditional Tongan Cures for Morning Sickness and Their Mutagenic/Toxicological Evaluations: *Melinda OSTRAFF, University of Victoria.*

Every year millions of women become pregnant, and more than sixty percent of them will develop some form of morning sickness. And yet drugs like Thalidomide, Benedectin and other possible potent teratogens administered for pre-partum nausea have severely limited any medical intervention. In Tonga, women have been treated for morning sickness for hundreds of years. One of the treatments is called *vai haka*, which is made from the boiled bark of several trees. *Vai haka* was tested for mutagenic and teratogenic effects. Data from the Ames TA-98 mutagenic bioassay clearly indicate that *vai haka* is not mutagenic with or without S-9 activation. Bioassays with pregnant mice produced no significant teratogenic or developmental anomalies.

PEACOCK, Sandra [see BANNISTER, Kelly]

Concepts and Cures of Intestinal Worms in Dominica, West Indies: *Marsha QUINLAN, University of Missouri, Columbia.*

In rural Dominican ethnophysiology, worms reside in the "worm bag," a human organ above the stomach. Gone unchecked, worms can grow in size and number, spreading out of the worm bag and into other organs. A study of "bush medicine" in one village revealed four plants commonly used to control intestinal worms. These were: *Ambrosia hispada* (Asteraceae), *Aristolochia trilobata* (Aristolochiaceae), *Chenopodium ambrosioides* (Chenopodiaceae), and *Portulaca oleracea* (Portulacaceae). The acquisition, administration, perceived action, and biomedical properties of these herbs are discussed.

Historic Conflicts Between Conservationists and Native Americans in Yosemite: *David RAYMOND, University of California, Santa Cruz.*

After Yosemite Valley was made a park in 1864, the indigenous Yosemite Miwok clashed with park authorities over their rights to gather food in the park and over their demand for compensation for the land. These same officials suppressed Miwok environmental management practices, but recognized that they were superior to their own. Native Americans and national parks (and the conservation movement) have generally pursued two different paths to the preservation of nature. Now, with conservationists and ethnobiologists and Native people seeking ways to work more closely together, it is important to remember some of this often difficult history.

RENDON, Beatriz [see LINARES, Edelmira]

Indigenous Focused Ethnobotanical Curriculum of the Baca Institute of Ethnobotany: *Enrique SALMON, Baca Institute of Ethnobotany.*

The Baca Institute of Ethnobotany offers specialized programs for Native American communities, schools, and individuals. The curriculum utilizes a collaboration of Western science and traditional approaches to indigenous botanical, conservation, and agricultural knowledge. The students who attend our programs are introduced to the field of ethnobotany and engage in botanical studies, chemistry, traditional knowledge of plants, and history. The course provides intensive instruction in modern techniques of ethnobotany and focuses on the mutual interactions between humans and plants. The course culminates in the construction of a field guide that encourages the students to use their talents.

Ethnobotany: Ayurvedic System of Medicine: *G.K. SHARMA, University of Tennessee at Martin.*

Ayurveda is a holistic system of medicine which represents an ancient practice of therapies in many parts of Asia. There are over 2,000 single drug prescriptions used in the Ayurvedic system of medicine, and almost 85 percent of these are of plant origin.

Ethnomedicinal flora of the Ayurvedic system of medicine was studied in one of the remotest parts of the Indo-Tibetan Himalayas. Since time immemorial, the plants of the Himalayas have richly contributed to the indigenous systems of medicine. The herbal remedies documented in the remote, precarious, and enigmatic Himalayan ecosystem may suggest new ways to combat dreaded killer diseases and improve human health.

The Hard and the Soft: Tikuna Ethno-ecology of Agricultural Intensification: *Nicholas SHORR, Indiana University.*

Considering the pivotal nature of the intensification of swidden and its increasing ubiquity in the contemporary age, we have far too few examinations of gardeners' own understanding of this process and its challenges. Campo Alegre (Tikuna; Upper Solimoes) is one of the largest indigenous swidden communities on record in Amazonia. A series of conversations, triads and pile-sorts revealed a primary dichotomizing criteria common to three central agro-ecological domains—trees, soils and weeds—: "Hard" vs. "Soft." In each domain, this contrast was strongly associated with a) relative fallow maturity; and b) effects on work-experience. An emic model of intensification is presented.

Guilá Naquitz Reconsidered: *Bruce SMITH, Smithsonian Institution.*

Two central questions are considered regarding the *Cucurbita* materials from Guilá Naquitz cave in Oaxaca. First - what is the actual age of the squash seeds and peduncles recovered from preceramic zones of this cave? Thirty-seven AMS and standard radiocarbon dates are employed to address the related issues of the stratigraphic integrity of the cave and the age of the squash remains. Second - are the *Cucurbita* materials from the cave domesticated? To address this question, morphological attributes of peduncles and seeds from Guilá Naquitz are compared with specimens of 13 past and present-day taxa of wild *Cucurbita* gourds.

SMITH, Robin [see CRAIG, Juliet]

SMITH, Susan [see GEIB, Phil]

The Ethnobiology and Distribution of White Root (*Carex barbarae*): *Michelle STEVENS, University of California, Davis.*

This ethnoecological study was designed to assess traditional resource management of white root, a sedge harvested by California Indians for basketweaving. White root is a riparian understory plant, diminished to less than 5 percent of its original range. Elimination of traditional gathering sites and difficulty of access result in this being one of the most ethnobotanically scarce plants in the state. In this study, I evaluate the distribution of *Carex barbarae* and of the people who use it for basketweaving, comparing and contrasting taxonomic and cultural world views.

Fields of Stone: Lithosol Meadow Ecology Along the Upper Klamath River of Southern Oregon and Northern California: *Donn TODT, Ashland Parks Department.*

Lithosol meadows are visually, physiographically and floristically distinct from their surrounding terrain. Geophytes, strong components of lithosol meadows, once provided, and in some cases still provide, a harvest of Native American "root-foods." Ecological description of these plant associations has pertinent applications for cultural resource management and conservation biology. This paper delineates the basic physical and floristic components of lithosol meadows along the Upper Klamath River of southern Oregon and northern California. Ecological and biogeographical features of these meadows are described, salient cultural attributes are suggested, and management concerns are addressed.

Pit-Hearth Food Processing, Cereal Imperialism and the Transition from Thrifty to Non-Thrifty Genotype: *LuAnn WANDSNIDER, University of Nebraska.*

Recent work in the area of diet and nutrition, on the one hand, and the archaeology of pit-hearth food processing, on the other, suggests we may be ever closer to understanding the presence of two gross genotypes, thrifty and non-thrifty, in the human genome. This paper focuses on the transition from diets high in fructose to those high in other sugars (glucose and lactose), with implications for human physiology as we understand it, population expansion, and contemporary health problems seen in Native peoples. As it happens, pit-hearth food processing is an important means for preparing complex carbohydrates that reduce to fructose. Thus, archaeologically, we are in a good position to monitor the appearance and effects of a "Cereal Imperialism."

WASHBROOK, Kevin [see LEPOFSKY, Dana]

Archaeobotanical Evidence for Resource Intensification in Prehistoric California: A Prelude to Indigenous Agriculture?: *Eric WOHLGEMUTH, University of California, Davis/Far Western Anthropology.*

Plant macrofossil data from central California archaeological sites show patterned changes through time. Early Period assemblages are not dominated by any particular taxon. Middle Period plant remains tend to be dominated by acorn, and small seed assemblages are restricted. Late Period sites are distinguished by a striking increase in small seeds as well as abundant acorn. These data are consistent with implications of resource intensification models, and suggest trends to development of indigenous native California domesticates. The implications are explored for models of California and Near Eastern prehistory.

Prehistoric Phyllopod Exploitation on the Snake River Plain: *Robert YOHE, Idaho* State Historical Society; *Suzann HENRIKSON, Shoshone District, Bureau of Land Management; and Margaret E. NEWMAN, University of Calgary.*

Phyllopods of the genera *Triops, Lepidurus, and Branchinecta* are common inhabitants of many ephemeral lakes in the American West. Tadpole shrimp *(Triops* sp., *Lepidurus* sp.) are known to have been a food source in Mexico, and fairy shrimp *(Branchinecta)* were eaten by the aboriginal occupants of the Great Basin. Although it seems likely that prehistoric peoples would have exploited such a seemingly valuable resource, archaeological evidence for phyllopod use thus far has been lacking. An attempt to extract protein residues from certain artifacts found at ephemeral lake sites in southern Idaho, as well as the exploration of other avenues of indirect evidence, has recently been undertaken in an attempt to establish the validity of prehistoric freshwater shrimp exploitation.

POSTER SESSION

Ethnobotany in Medicinal Plant Conservation: ICBG-Mexico: *Robert BYE, Edelmira LINARES, Myrna MENDOZA, and Gustavo MORALES, Universidad Nacional Autónoma de México (all).*

Supported by the International Cooperative Biodiversity Group, ethnobotanical work is being carried out on medicinal plants in the arid and semiarid regions of Mexico with the objective of: 1) conserving the biological diversity, 2) discovering biologically active substances of local, national and international interest, and 3) promoting economically sustainable activities for the communities based upon local biodiversity. Market surveys, community-based investigations, immediate benefit programs and long term benefit sharing permit the advancement of ethnobotanical research as well as promote community participation in the rescue and maintenance of ethnobotanical knowledge and practices.

Domestication of Chia *(Salvia hispanica)*: *Joseph CAHILL, University of California, Riverside.*

Chia *(Salvia hispanica)*, a crop of the ancient Aztecs, has several varieties that exist in cultivation today. Morphological differences in these varieties have been loosely correlated with Aztec culinary, medicinal, and religious uses as well as cultivation techniques. The botanical literature agrees on widespread cultivation, but not all sources consider the species domesticated. Research presented focuses on quantifying and comparing potential domesticated characteristics. The objectives include determining domesticated status and understanding the role of plant plasticity in defining domesticated traits for chia.

Ecological Characteristic of Anthropogenic Forests in Guyana: *Catherine COTTON, Roehampton Institute, London, and Clair OZANNE.*

In recent years, traditional forest management (including agroforestry or swidden-fallow agriculture) has been advocated as a possible solution to balancing economic development with rainforest conservation. However, to date, relatively little is understood about the management practices involved or their ecological implications. Focusing on the Makushi village of Surama in Central Guyana, this project aims to combine detailed ecological mapping with ethnobiological knowledge, to provide both practical information for Guyanese foresters, and a crucial platform on which to base further economic and ecological analysis of traditional forest management systems.

JOYAL, Elaine [see PLOTKIN, Nicole]

Medicinal Plants Used by Native American Cultures in the Coastal Plain East of the Mississippi River and South of North Carolina: *Heidi K. LAMOREAUX, University of Georgia.*

A poster was prepared by: 1) determining which Native American tribes inhabited the Coastal Plain through map overlay; 2) searching online databases to determine the names and uses of medicinal plants for each tribe included in the study; 3) listing "Plant Species" on the y-axis of the poster, and "Medicinal Plant Uses," "Native American Tribes" and "Chinese Sister Genera" as columns on the x-axis of the poster; and 4) placing markers on the poster to show which medicinal uses, tribes, and sister genera are associated with each plant species.

LINARES, Edelmira [see BYE, Robert]

Human-Animal Transformation Imagery of Ancient Mesoamerican Ceramic Sculpture: *William LITZINGER, Prescott College.*

Among the cultures of ancient Mesoamerica a strong connection existed between artistic expression and religious imagery. Examples of ceramic sculpture have been examined which are thought to reveal the artist's attempt to transform the real world through symbolic connections. These ceramic sculptures are not static representations, but take the observer on a visionary journey linking one reality to another. Interpretation of the esoteric meanings found in the imagery of these sculptures remains speculative; however, human-animal transformation and a connection between life and death are evident.

Trees and the Maya: Four Millennia of Interactions: *William LITZINGER, Prescott College.*

Trees have been important elements in art and religious iconography since the beginnings of the Maya culture. A giant Ceiba tree grows at the center of the universe. Central trees are found growing today in nearly all traditional Maya towns and villages of the Yucatan Peninsula. These trees represent more than a physical manifestation of the cosmos. They are direct evidence that tree-image allegory is continuous in Maya thought. They also have important social and ecological roles. Socially, the trees are a focus for community events related to the traditional culture and are associated with the conservation of linguistic diversity and traditional knowledge. Ecologically, they represent most, or in some case the only, mature native trees growing in a given region. They are also critical-habitat for a rich diversity of epiphytic plants and associated animals. The future diversity of the forests of the Yucatan Peninsula will be significantly influenced by the trees now found growing in the anthropogenic refugia of traditional Mayan towns and villages.

Establishing an Ethnobotanical Garden Through Plant Salvaging: *Sheri LUBIN, The Evergreen State College.*

The Evergreen State College Longhouse Ethnobotanical Garden is located in southwestern Washington State. Using this garden as a model, establishment of ethnobotanical gardens in selected other areas of the United States will be discussed. Particular attention will be given to procedures for obtaining culturally significant plants through salvaging from areas designated for development.

MENDOZA, Myrna [see BYE, Robert]

MORALES, Gustavo [see BYE, Robert]

OZANNE, Clair [see COTTON, Catherine]

Arthritis Plants: Past and Present Uses by American Indians in Arizona: *Nicole PLOTKIN and Elaine JOYAL, Arizona State University (both).*

Arthritis is a chronic and debilitating disease for which Western medical treatment is inadequate. A literature search and interviews were combined to determine the plants utilized by American Indians in Arizona for the treatment of arthritis and its associated symptoms. Herbalists in Tuba City were interviewed regarding the plants they gather and sell for this purpose. Some herbalists expressed concerns about the need to travel farther to collect medicinal plants. Brine shrimp bioassays were conducted to determine the arthritis plants' bioactivity. Literature was reviewed for pharmacological data to identify the chemistry and activity of the most commonly used traditional plants.

RAYMOND, David (see Contributed Papers)

NEWS AND COMMENTS

THIRD MEXICAN ETHNOBIOLOGY CONGRESS, OAXACA, MEXICO, 1998

The III Congreso Mexicano de Etnobiología is scheduled 3-6 November 1998 in the city of Oaxaca, Oaxaca, Mexico. It is sponsored by the Asociación Etnobiológica Mexicana, A. C. and hosted by the Instituto Tecnológico Agropecuario de Oaxaca (ITAO). Workshops and excursions are scheduled to precede and follow the congress. For information contact Marco Antonio Vásquez Dávila at ITAO, Privada de Almendros 109, Col. Reforma 68050, Oaxaca, México [(951) 7-07-88 / 5-93-01] or Gladys Isabel Manzanero Medina, CIIDIR-IPN-Oaxaca, Calle Hornos No. 1003, Santa Cruz Xoxocotlán, Oaxaca, México, CP 71230 [(951) 7-06-10 ext. 2717, gmanzane@vmredipn.ipn.mx].

SOCIETY OF ETHNOBIOLOGY ANNUAL MEETING, OAXACA, MEXICO, 1999

The 22nd Annual Conference of the Society of Ethnobiology is scheduled March 10-13, 1999 in Oaxaca, Mexico. The venue is the Jardín Etnobotánico at the historic Centro Cultural Santo Domingo in the fascinating colonial city of Oaxaca. Symposium proposals and individual presentations are invited; priority will be given to the following topics: ethnobiology and community development, domestication and management of plants and animals, ethnoecology and conservation, ethnobiology in education and environmental tourism. For further information in the U.S. and Canada please contact Mollie S. Toll, Office of Archaeological Studies, Museum of New Mexico, Santa Fe, NM 87504-2087, tel (505) 827-6343, fax (505) 827-3904. In Mexico please contact Alejandro de Ávila, Jardín Etnobotánico, A.P. 367, Oaxaca, Oax. CP. 68000, tel & fax (951) 6 79 15.

PEOPLE AND PLANTS INITIATIVE WEBSITE www.kew.org.uk/peopleplants

Gary Martin writes to invite readers to consult their new "People and Plants Online" website at http:/www.kew.org.uk/peopleplants for up to date news and notes of applied ethnobiological projects around the world.

The website describes the warm reception received by the Malaysian translation of Gary's methodological handbook published in English as *Ethnobotany: A 'People and Plants' Conservation Manual* (Chapman and Hall, London, 1995). This project was sponsored by the World Wide Fund for Nature, UNESCO, and the Royal Botanic Gardens, Kew. See the *Journal of Ethnobiology* 16:140-142 for our review.

At the Desert's Green Edge. An Ethnobotany of the Gila River Pima. Amadeo M. Rea. University of Arizona Press, Tucson. 1997. Pp. xxvii, 430. $60.00 (hardcover). ISBN: 0-8165-1540-9.

"We didn't think of it as desert back then.... It was paradise, paradise." — a Pima elder. *At the Desert's Green Edge* is, to me, an ideal or "type" ethnobotany. Many words come to mind as I grapple with trying to convey to potential readers the essential nature of this book: monumental, detailed, compelling, fascinating, rich, thorough, authoritative, personal, poignant. It is all of these and more. It will at once serve as a reference book, an ecological and ethnobiological text book, and a story book. The book is full of rich detail about plants and their human relationships, and provides us with many ecological lessons and much ecological wisdom. It also tells us a story, a story of a healthy, functioning riverine ecosystem and how it was transformed and degraded over time into a dry wasteland. The story relates, with many fascinating historical notations and personal accounts, how the ecosystem held a people and their language and culture in a tight mutual embrace. It is a story told with gentle humor and deep appreciation, and sadness. It tells about a strong, happy, gentle, and generous people who were nourished by a diverse and healthy diet. They worked hard, and they enjoyed the "fruits" of the desert and the river that ran through it. Then, their lives were altered as newcomers came and wrought changes to their river. This story has an essential message, which reverberates through almost every North American environment and indigenous culture, and is captured in just one word: over-exploitation. The river died from overuse of resources. Trappers killed off the beaver in its upper reaches. Loggers and miners denuded the fragile semi-arid uplands of the forest cover that held back the waters from sporadic but torrential rainstorms. Ranchers' livestock overgrazed the native grasses and other plants. Farmers diverted the river to irrigate their crops. Today, where once you could hear the Redwing Blackbird calls reverberating over vast expanses of tule, willow, reed grass, and other moisture-loving plants, there is a disturbed, parched wasteland: ecological poverty.

And the people? Their humor and spirit have endured, but they have lost much of what they had because their culture and language are tied to the land. The river was their "economic backbone." Their cultural system actually increased the density and biological diversity of the ecosystems they inhabited. Now, their way of life has changed markedly. Their diet has changed, too, and generally not in a positive way. Obesity is a real problem, and these people now have the highest incidence of late onset diabetes of any population in the world. This book, with its carefully documented account of a people and their plants, is a monument to a past way of life and the knowledge system that supported it. It begins with a thoughtful Foreword by Rea's friend and colleague Gary Paul Nabhan, himself an award winning author and ethnobiologist. Each chapter is introduced with a relevant quotation that captures the message of the contents. After the Introductory part, the book is divided into two major parts: The Pima and their Country; and Gila Pima Plants. Part 1 is comprised of chapters on the Gila Pima people and culture, the Pima consultants whose knowledge Rea has incorporated in the book, the historic habitats and historic events that changed them, the Pima cultural ecosystem, the loss of the river, the habitats of today, dietary reconstruction, and Pima words for mapping the natural world. The Piman terms used throughout were checked by Piman linguistic consultant Culver Cassa, a biologist and ethnobiologist in his own right. Part 2 includes first an account of Piman folk generics, and then a systematic listing of formally named plant species, under the major Piman life form taxa: "plants growing in or on the water"; "plants standing in the river, emergents"; "grasses, grassy plants, forage plants, hay"; "bushes"; "trees"; "eaten greens"; "wild annuals"; "cactus-like plants"; "crops, planted things"; "planted fruit trees"; miscellaneous unaffiliated plants; and unassigned organisms that are not "things that grow up". Several appendices, a bibliography and index complete the opus. The plants are illustrated by Takashi Ijichi with *sumi-e*, Japanese ink paintings, which capture amazingly the essence of each plant with seemingly few carefully placed strokes. The species I was familiar with were instantly recognizable from these paintings, yet when I tried to identify the individual aspects of the illustration that distinguished one plant from another, I found that the strokes, textures, and shades of gray to black were so subtly blended that I could only marvel at the overall effect without ever being able to analyze the parts. The book is also illustrated with photographs, maps, and line drawings of plants with Piman names and botanical terminology. Amadeo Rea, ornithologist and ethnobiologist, is a founding member of the Society of Ethnobiology. Formerly a curator of birds and mammals at the San Diego Natural History Museum, he is currently a private consultant. He has worked on the Gila River Indian Reservation for over three decades, documenting with his Pima colleagues the rich knowledge and understanding of the plants and animals of their desert homeland. He is also author of a book on the disappearing Gila River ecosystem, *Once a River* (Rea 1983). Like all books of this magnitude, this one had a few minor flaws, which are irksome to a meticulous and careful author like Dr. Rea. For example, a series of flawed diacritical markings, correct in the page proofs, occurred on p. 88 in Figure 8.8, as a result of a printer's misreading (see Erratum, following this review). There is a mere scattering of other typographical errors but few others that would misinform the reader. It is not surprising that the book won the National Association of Academic Presses award for design as well as the 1998 Klinger Book Award from the Society for Economic Botany. This is a book that sets a standard that will be difficult to surpass.

Erratum: Rea, Amadeo M. 1997. *At the Desert's Green Edge*. p. 37, Figure 3.2: "Sand Tank Mountains" should read Santan Mountains. The Santan Mountains are north of the Sacaton Mountains, not west of Table Top Mountains as labeled. page 88, Figure 8.8.: ***chuudagr ch-ek ha'ichu vuushdag*** should read: ***chuudagĭ ch-eḍha'ichu vuushdag; akimel ch-ek ha'ichu keekam*** [sing.] should read: ***akimel ch-eḍ chuuchim*** [pl.]; ***iivagr*** should read: ***iivagĭ***.

LITERATURE CITED

REA, AMADEO M. 1983. Once a River: Bird Life and Habitat Changes on the Middle Gila. University of Arizona Press, Tucson.

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Indigenous Peoples and the Future of Amazonia. An Ecological Anthropology of an Endangered World. Leslie E. Sponsel, editor. University of Arizona Press, Tucson. 1995. Pp. ix; 312. $50.00 (cloth) ISBN:0-8165-1458-5.

The Amazon continues to be an area of intense debate over issues of environmental conservation, economic development, and cultural survival. This book is a review of traditional and changing adaptations of indigenous societies to Amazonian ecosystems. It focuses on indigenous adaptations to the challenges presented by the cultural and environmental impacts of Western society and the application of anthropological research to the needs, interests, priorities and rights of indigenous societies. The contributors are archaeologists, biological anthropologists, cultural ecologists and nutritionists. The text contains several figures and tables, but no photographs or illustrations.

The contents of the book are divided into a Foreword by Simeon Jiménez and Nelly Arvelo-Jiménez, an Introduction by the editor, followed by three main parts: "Environmental variation and adaptation," "Foraging, nutrition and health," and "Change, conservation and rights." Each part contains four to five chapters, the contents of which are summarized briefly by the editor at the beginning of each section. Each chapter includes an extensive bibliography. The index is exhaustive, including general subjects and specific features, names of localities and ethnic groups, or cited plants and animals.

Part 1, "Environmental variation and adaptation," examines the ways in which variation in the environment influence variation in culture, and vice versa. Chapter 1, "Judging the future by the past: The impact of environmental instability on prehistoric Amazon populations," by Betty Meggers, and Chapter 2, "The history of ecological interpretations of Amazonia: Does Roosevelt have it right?" by Robert Carneiro, focus on the temporal dimension of variation, the former emphasizing environmental changes in prehistory, and the latter changes in the course of cultural evolution. Chapter 3, "Disaggregating Amazonia: A strategy for understanding biological and cultural diversity," by Emilio Moran, discusses spatial variation in the environment, while Chapter 4, "Historical ecology of Amazonia," by William Balée, explores how the indigenous peoples changed their environment.

Part 2, which deals with foraging, nutrition and health, stresses the need for closer links between nutritional and medical anthropology and research on human ecology in Amazonia. Kenneth Good's chapter on the Yanomami of Venezuela illustrates that the Yanomami, who are primarily foragers and only secondarily farmers, adapt quite successfully in a tropical rain forest system. In the following chapter on the nutritional anthropometry of native Amazonians, Rebecca Holmes explores small stature as a reflection of the interplay of genetic and environmental factors. In Chapter 7, Darna Dufour examines the nutritional implications of bitter manioc use, specifically the process used to eliminate the toxicity of bitter manioc by the Tucanoans in the Vaupés region of Columbia. Dufour points out that the nutritional value of manioc is in part a function of the specific methods employed in processing. Due to sociocultural change, women may not have as much time to adequately process manioc, and the toxic residue that remains could lead to health problems. The section concludes with a chapter by Carlos Coimbra Jr. entitled

"Epidemiological factors and human adaptation in Amazonia," which examines the biomedical literature that indicates the existence of a multitude of parasitic and infectious diseases that, at least under traditional living conditions, are endemic at high levels amongst native Amazonians.

Part 3, "Change, conservation, and rights," offers a sample of case studies on ecological aspects of cultural change and economic development in Amazonia. Chapter 9 by Michael Baksh examines changes in Machiguenga quality of life with respect to nutrition, health, material goods, social relations, and life satisfaction and suggests that after two centuries of contact these peoples are experiencing a demographic rebound, partly as a result of Western medical assistance. Allyn Stearman discusses neotropical foraging adaptations and the effects of acculturation on sustainable resource use in Chapter 10, with a case study of the Yuqui of lowland Bolivia. Chapter 11, "Faunal resource use by the Chimane of Eastern Bolivia: Policy notes on a Biosphere Reserve," by Avecita Chicchón, describes patterns of land and resource use in forest, savanna, and river ecosystems by three different settlements of Chimane. She emphasizes that the needs of local people within and adjacent to protected areas must be considered by planners and administrators of protected areas. Chapter 12 is a study by Janet Chernela on sustainability in resource rights and conservation in the Awa Biosphere reserve in Columbia and Ecuador. It provides an illustration of the political component in human ecology and adaptation. The final chapter, written by the editor, Leslie Sponsel, concludes Part 3 and the book as a whole. It explores relationships among the world system, indigenous peoples, and ecological anthropology in the endangered Amazon. It reviews diverse aspects and factors such as deforestation, the frontier problems, paradigm shifts, political movements and environmentalists, and advocacy and human rights.

In summary, this book brings together much information on indigenous peoples of Amazonia. The text is useful for the anthropologist, ethnologist, sociologist, and anyone interested in Amazonia and Amazonian social and ecological conflicts. It will be equally at home in the libraries of universities and institutions as on the shelves of people dealing with such an exciting and controversial subject.

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Potions, Poisons, and Panaceas: An Ethnobotanical Study of Montserrat. David Eric Brussell. Southern Illinois University Press, Carbondale. 1998. Pp. viii, 176. $69.95 (cloth). ISBN 0-8093-1552-1.

This publication is another example of the growing interest in the ethnobotany of tropical cultures. However, while most ethnobotanical studies have focused on indigenous societies, this publication focuses on the Afro-Caribbean culture of Montserrat. This book provides an extensive survey of plant uses in numerous categories including: medicinal, poisons, plants associated with voodoo, construction, foods and dyes. The publication of this ethnobotanical survey is particularly relevant in light of the recent volcanic eruptions on the island, and the subsequent displacement of large numbers of citizens. Thus, there may not be an opportunity in the foreseeable future to collect more information of this type on Montserrat.

Potions, Poisons, and Panaceas is organized in two sections: background information and the list of plants and their uses. The background section has some weaknesses; however, the ethnobotanical section is extensive and interesting. There are 52 black and white photographs of plants, consultants, and landscape features as well as 24 color plates of plants and consultants.

The book begins with a literature review of botanical research on Montserrat and a discussion of the author's motivation and rationale for the study. There is some repetition in this section. For instance, Brussell discusses how tropical forests may contain many new products. This is no doubt important, but the author mentions this three times within just a few pages. A single strong statement at the beginning with references to the large body of literature on ethnobotanical research that has produced new products would suffice. The introduction also includes a cautionary notes section with a disclaimer against using the plants described by the author and a warning regarding the hazards of field work, such as contracting schistosomiasis and drinking untreated water. This section is not really necessary. Other problems in the introduction include broad statements with no citations. For example, Brussell states that many noteworthy medicines come from plants including the powerful anti-cancer drug etoposide. If readers are not familiar with ethnopharmacology, they probably would not know whether the drugs mentioned are derived from tropical plants or some other geographical location.

One of the more significant shortcomings of the background section is the brief (one short paragraph!) discussion of the recent volcanic eruptions and their impact on island ethnobotany. In many ways, the fact that this ethnobotanical knowledge may have been abruptly lost when the volcanic eruption began and the human population was displaced is what makes this publication so important. Instead of providing detailed information regarding the extent of damage from the eruptions on island flora, or how many people were displaced, the author directs the reader to the July 1997 issue of *National Geographic*. This is inadequate given the impact of the eruptions on island ethnobotany.

In the remainder of the background section, Brussell provides a description of Montserrat's climate, vegetation, and cultural history. Unfortunately, the entire background information section is only 14 pages long and leaves one with numerous questions concerning the study. For instance, what types of ethnographic methods were employed? The author mentions weekly interviews conducted at the public market in Plymouth, but he does not specify the number of weeks in total, or the number of people interviewed. Also, he briefly alludes to the abandonment of ethnobotanical practices, but provides no further details. Are the same factors that erode ethnobotanical knowledge in other cultural landscapes at work on Montserrat (besides volcanic eruptions)? Brussell also mentions the importance of voodoo in the ethnobotany of Montserrat, yet there is no background information provided regarding any religious/folklore beliefs. How extensive is the voodoo culture on Montserrat? It would be useful to readers unfamiliar with Afro-Caribbean religious beliefs to provide some information regarding this interesting cultural feature.

The second section of the publication, ethnobotanical uses and specific discussion, is extensive and interesting. A total of 282 culturally useful plants are reviewed. A botanical description is given for each plant, noting where it was observed and collected, and describing its uses. Both the botanical and common names are provided for all plants described, a most helpful feature. Many of the ethnobotanical descriptions are interesting and give insight into Montserrat folklore. But again, because there is so little detail provided regarding local culture and the extent of voodoo beliefs in Montserrat culture, many questions remained unanswered.

Potions, Poisons and Panaceas is important in that there may not be another opportunity to collect ethnobotanical data on Montserrat for the foreseeable future. However, the book could have been much stronger had the editors insisted on more background information, especially concerning Montserrat's culture. I came away wondering about the people and their culture. The book seems to have been written as if Montserrat's culture and environment exist in a vacuum. Instead, massive change is impacting the island and its people. Yet, the reader unfamiliar with the Caribbean would hardly know it after reading this book. Even with these shortcomings, the list of plants and their uses is extensive and irreplaceable given the recent environmental changes on the island. This book will be useful to researchers working in the Caribbean region and will make an important contribution to the ethnobotanist's library.

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NEW BOOKS FOR REVIEW

If you would like to review any of these books and would be able to have your review completed within four months after receiving the book, please contact:

Sandra Peacock, Book Review Editor
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Doctors for Democracy: Health Professionals in the Nepal Revolution. Vincanne Adams. University Press, Cambridge. 1998. Pp. xi; 251. $64.95 (hardback), $24.95 (paperback). ISBN 0-521-58486-8 (hardback); 0-521-58548-1 (paperback).

Mexican Rural Development and the Plumed Serpent. Betty Bernice Faust. Bergin & Garvey, Westport, CT. 1998. Pp. xxvii; 190. $59.95 (hardback). ISBN 0-89789-482-0.

Human Adaptation. G. A. Harrison and Howard Morphy, editors. Berg Publishers, Oxford. 1993, reprinted with new preface 1998. Pp. xvi;155. 14.99 £ (paperback). ISBN 1 85973-958-X.

Archaeological Obsidian Studies: Method and Theory. M. Steven Shackely, editor. Plenum Press, New York. 1998. Pp. xviii; 243. $49.50 (hardback). ISBN 0-306-45804-7.

Statistics for Anthropology. Lorena Madrigal. Cambridge University Press, Cambridge. 1998. Pp. xiv; 238. $64.95 (hardback), $24.95 (paperback). ISBN 0-521-57116-2 (hardback), ISBN 0-521-57786-1 (paperback).

The Origins of Agriculture in the Lowland Neotropics. Dolores R. Piperno and Deborah M. Pearsall. Academic Press, San Diego. 1998. Pp. xii, 400. $99.00 (hardback). ISBN 0 12-557180-1 (hardback).

Bodies and Persons: Comparative Perspectives from Africa and Melanesia. Michael Lambek and Andrew Strathern, editors. Cambridge: University Press, Cambridge. 1998. Pp. xiii; 298. $59.95 (hardback); $19.95 (paperback). ISBN 0-521-62194-1 (hardback), ISBN 0-521-62737-0 (paperback).

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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Information or commentary intended for the "News and Comments" section of the *Journal* should be sent in the same form as for articles to:

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CONTENTS