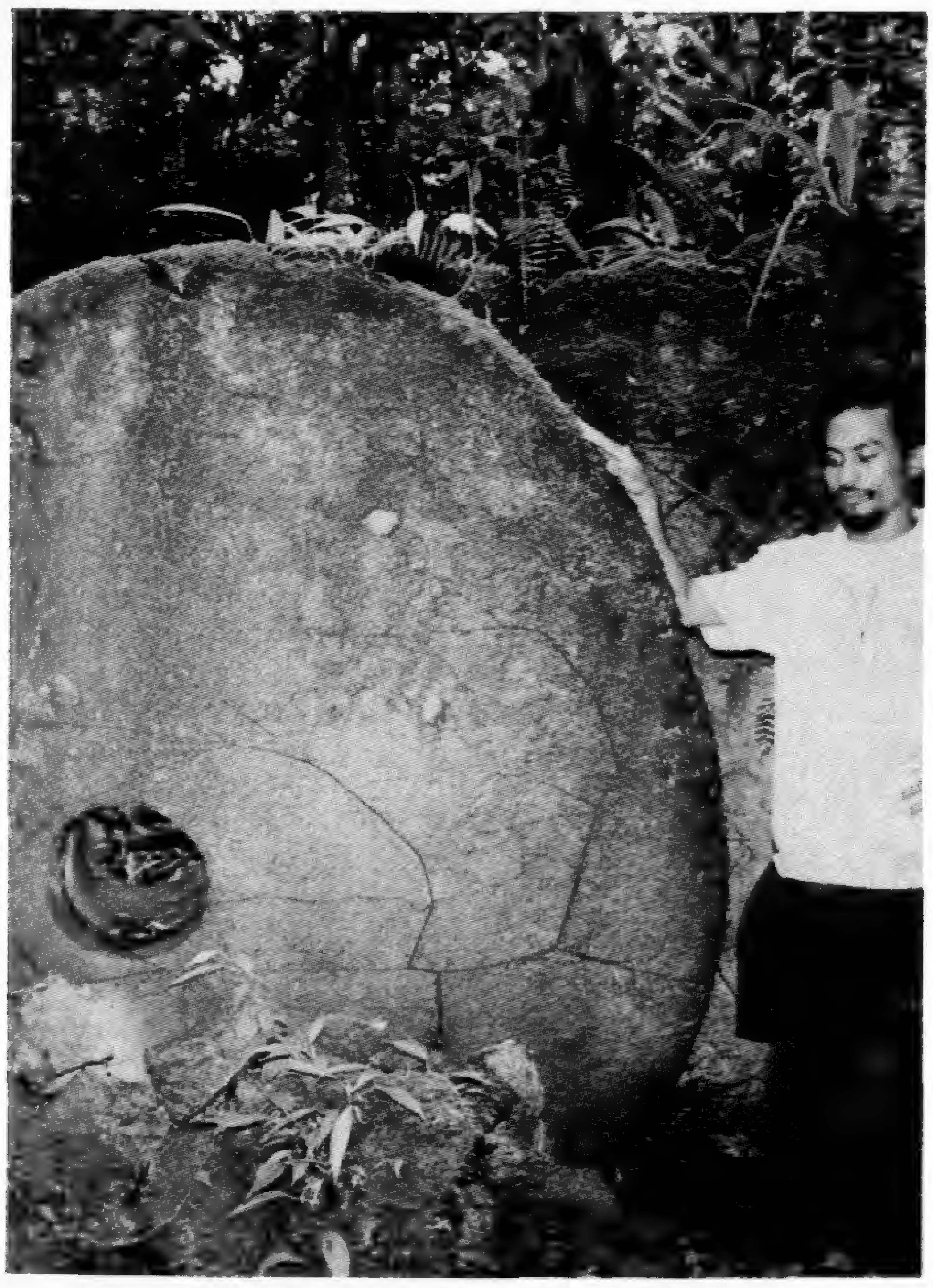
JOURNAL OF ETHNOBIOLOGY



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COVER ILLUSTRATION: Stone money disk (Fitzpatrick, this issue Figure 2).

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ETHNOBIOTICA

The 2003 annual meeting provided a wonderful opportunity to see old friends and meet new colleagues at the beginning of spring in Seattle.

For many of us, spring floods are a herald of change. Unusually high, they stand for destruction; as cyclical occurrences, they signify renewal. For example, 5000 years ago, the waters of the Tigris and Euphrates allowed Mesopotamian civilization to flourish. To this day, for people living in Iraq ("birthplace of civilization"), floods are more than just metaphors—the waters of the rivers and the sea have a direct impact on life.

Gulf War II began a few days before our meeting; juxtaposed against the conference theme, "Ethnobiology and Sustainability," I couldn't help thinking about the different faces of change—negative, positive, and cyclical. In lower Mesopotamia, the Marsh Arabs' traditional management of the marshes at the head of the Persian Gulf persisted for millennia, the epitome of sustainability. The draining of the marshes in the 1990s was disastrous for the people and the environment. Perhaps peace will now allow some part of this unique cultural habitat to be reestablished as a sustainable system.*

Naomi

"Three men making baskets, and one man cleaning a brace of pistols in front of native hut on Sunday." Nippur, Mesopotamia (modern Iraq), Ottoman Empire, 1899. Photograph by John Henry Haynes. (Courtesy University of Pennsylvania Museum, UPMAA neg. G5–6911)

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* For information and background:

UNEP. 2003. The Mesopotamian marshlands of the Tigris-Euphrates delta. United Nations Environment Programme. [Online: http://www.grid.unep.ch/activities/sustainable/tigris/marshlands/, March 22, 2003] (verified May 8, 2003).

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ALUNE ARACHNOPHAGY AND APPROACHES TO SPIDERS AMONG AN EASTERN INDONESIAN PEOPLE

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ABSTRACT.—Despite the close association between spiders and human communities, ethnobiologists and anthropologists have paid little attention to knowledge and use of spiders. This paper briefly reviews ethnographic information on human-spider interactions. We contend that spiders are intrinsically no less edible or otherwise useful than many other arthropods, and that the lack of reporting on spiders in the ethnobiological literature may reflect inattention on the part of observers rather than actual indigenous non-utilization of a potential resource. The paper then provides an example of ethnobiological knowledge and use of spiders among the Alune-speaking people of Seram Island, eastern Indonesia. Several Alune taxa of spiders are considered edible. While their contribution to the diet is undoubtedly minor, we suggest that spider eating is an element of a 'small foods' tradition of a mixed horticultural and foraging subsistence-oriented economy. Knowledge and use of spiders are components of Alune identity as forest-dwelling people, and of traditional patterns of livelihood that retain relevance in the contemporary context of widespread social unrest. The Alune example suggests the possible value of attention to spiders as dietary and medicinal items in the subsistence strategies of other indigenous cultures.

Key words: Alune, Seram, arachnids, entomophagy, ethnozoological classification.

RESUMEN.—A pesar de la estrecha asociación entre las comunidades de arañas y las humanas, los etnobiólogos y antropólogos han dedicado escasa atención al conocimiento y uso de las arañas. Este artículo revisa brevemente la información etnográfica sobre interacciones entre humanos y arañas. Sostenemos que las arañas no son intrínsecamente menos comestibles, o útiles en otros sentidos, que muchos otros artrópodos, y que la ausencia de información sobre las arañas en la bibliografía etnobiológica puede reflejar más una falta de atención por parte de los observadores que un desuso real por los indígenas de este recurso potencial. El artículo proporciona seguidamente un ejemplo de saber y utilización etnobiológica de las arañas por los hablantes Alune de la Isla de Seram, en el este de Indonesia. Varios taxones Alune de arañas se consideran comestibles. Si bien su contribución a la dieta es sin duda secundaria, sugerimos que la ingestión de arañas es un elemento más de una tradición de "pequeños alimentos" dentro de una economía mixta de horticultura y recolección orientada a la subsistencia. El conocimiento y el uso de las arañas son componentes de la identidad de los Alune como habitantes del bosque, y de unos patrones tradicionales de vida que mantienen su relevancia en el contexto actual de inestabilidad social generalizada. El ejemplo Alune sugiere la posible importancia del estudio de las arañas como elementos alimenticios y medicinales en las estrategias de subsistencia de otras culturas indígenas.

RÉSUMÉ.—En dépit du fait qu'araignées et êtres humains cohabitent, ethnobiologistes et anthropologues ont rarement étudié la conception qu'ont les indigènes de ces insectes et comment ils les utilisent. Cet article examine brièvement nos informations ethnographiques relatives aux interactions entre êtres humains et araignées. A notre avis, les araignées sont fondamentalement aussi comestibles et aussi utiles que beaucoup d'autres arthropodes. Le manque d'études ethnobiologiques consacrées à ce sujet est probablement dû plus à l'indifférence des observateurs qu'à l'absence véritable d'utilisation de ces insectes par les indigènes. Cet article présente ensuite un exemple d'exploitation et de connaissance ethnobiologiques des araignées par les habitants de langue Alune de L'île de Séram en Indonésie orientale. Plusieurs taxons d'araignées sur le territoire des Alune sont considérés comme comestibles. Leur contribution au régime alimentaire est certainement mineure. Nous suggérons cependant que du point de vue alimentaire, les araignées fait partie des "nourritures accessoires" traditionnelles d'une économie de subsistance mixte cueillette/horticulture. La connaissance et l'exploitation des araignées font partie de l'identité des Alune en tant qu'habitants de la forêt et des schémas traditionnels de moyens d'existence qui sont toujours importants dans le contexte contemporain d'une agitation sociale diffuse. L'exemple des Alune suggère que des études devraient être consacrées à la fonction alimentaire et médicinale des araignées dans les économies de subsistance d'autres cultures indigènes.

INTRODUCTION

Spiders often live in close association with humans, and are variously objects of interest, danger and aversion. Few ethnobiologists, however, have paid much serious attention to human knowledge of, and interactions with spiders. As a contribution towards an ethnographic understanding of human-spider relations, this paper documents the uses and ethnotaxonomy of spiders among the Alune people of Seram Island in Indonesia.

It is now widely recognized in the anthropological literature that insects have formed an important part of the diet of human communities in many parts of the globe. Academic attention to the consumption and other uses of insects has been subject to the filtering lenses of Judaeo-Christian traditions and European gastronomy, which, with a few celebrated exceptions (honey, crayfish and *escargots* come to mind), eschew the consumption of non-marine invertebrates and their products. The Biblical vision of John the Baptist living a wandering existence in the desert, subsisting on locusts and wild honey, is a symbolic representation of his separation from the established social order. His diet combines the sublime honey, a pure insect product of nature, with a notionally inedible insect, which is, furthermore, inimical to subsistence in the Middle East through its plague attacks on crops. European observers of the subsistence habits of other peoples have tended to assume that the consumption of insects is an indication of destitute circumstances, such as The Baptist voluntarily endured, rather than a matter of choice. As Sahlins (1972:2ff) has pointed out, this ethnocentric view contributed to the long delay in realizing that a hunter-gatherer existence was by no means as harsh as had been presumed.

There is abundant evidence that in various times and places, insects have achieved an important place in patterns of human exploitation of the environment (Bergier 1941; Bodenheimer 1951; Menzel and D'Aluisio 1998; Meyer-Rochow 1978/79; Posey 1986). Among horticultural people in particular, there is an often detailed knowledge of the biology and ecology of insects which are pests of crops (Posey 1986).

Insects and other terrestrial invertebrates figure widely in the everyday diet in many societies with subsistence-oriented economies (e.g., Bodenheimer 1951; Meyer-Rochow 1976; Posey 1986). In many instances, insects form an occasional or incidental part of the diet (e.g., Setz 1991), but are relished as side dishes (e.g., Ruddle 1973).

Insects are often consumed in particular by children and women, as among the Kapauku of Irian Jaya (Pospisil 1963), Aché of Paraguay (Hill and Hawkes 1983) and Tukanoa of Columbia (Dufour 1987). This restriction by age and gender itself is suggestive of the relatively low status generally assigned to most insect foods.

In other cases insects may be highly esteemed as feast food. In these instances, the particular species so regarded are usually only seasonally or periodically available, such as the bogong moths (*Agrotis infusa* Lepidoptera-Noctuidae) of highland southeast Australia (Flood 1980). Often, they are soft-bodied forms, especially the immature stages of growth, as in grubs of certain beetles, such as the 'sago beetles' (Curculionidae), which are widely consumed in Melanesia and Southeast Asia, and bruchid beetle larvae (Bruchidae) of Amazonia (e.g., Dufour 1987; Ellen 1993b; Ernst 1978; Ruddle et al. 1978).

Aside from the nutritional value of grubs, which are high in protein and fats (Dufour 1987; Ruddle et al. 1978:59), it is perhaps of significance that insects which feature as prestige foods are mostly pupating or burrowing forms, found in conveniently large numbers massed together either in the earth, encased in nests or cocoons, or in the moist pulpy interior of stems, fruit or rotting logs. The symbolic associations between such grubs and cultural representations of human sexuality have been explored by anthropologists (e.g., Ernst 1978; Gell 1975). And, of course, honey is also esteemed in many cultures for its qualities of taste, texture, and its symbolic properties (Levi-Strauss 1973; Posey 1983).

Various insects have been recorded to have other uses, including therapeutic and hallucinogenic applications (e.g., Britton 1984; Groark 1996) and as sources of poisons, as among the Kalahari 'Bushmen' (San), who use exudate from the larvae of the Chrysomelid beetle *Diamphidia simplex* as arrow poison (Silberbauer 1981:76, 207). In New Guinea the brilliantly colored shards and heads of scarab beetles (Scarabaeidae) are threaded on sticks as headdress decorations, valuables and trade items (e.g., Healey 1990:70, 135, 366; Meyer-Rochow 1978/79). Posey (1986) briefly reviews the place of insects in myth, folktales and ritual practice in 'tribal' cultures.

While there are numerous references in the literature to insects, there has been much less attention to knowledge, consumption and other uses of spiders. In some instances, this may be a product of the folk categories employed by ethnographers themselves. In scientific terms, 'insects' and 'spiders' are subcategories (along with crabs, centipedes and their allies) at different taxonomic levels within the phylum Arthropoda, the largest phylum in the animal kingdom—organisms characterized by a hard outer skin with flexible joints, bilateral symmetry and a segmented body with paired limbs. Spiders constitute a single order Araneae within the class Arachnida (which includes related orders of scorpions, mites and ticks, harvestmen, etc.). Insects, on the other hand, are classified into many orders, which in turn are distributed in several classes grouped into the superclass Hexapoda. There is clearly no close equivalence between the English-language categories of 'insect' and 'spider' and the scientific classification of these arthropods. For some, 'insects' and 'spiders' are distinct and roughly equivalent categories, while for others, the folk English category 'insect' may include 'spiders'. While the terms appear to be employed in a scientifically technical sense in many reports it may be that English-speaking investigators have actually failed to elucidate the boundaries of ethnotaxa glossed as 'insects'. In at least some cultures, besides the Alune case discussed further below, spiders nonetheless constitute distinctive recognized zoological and linguistic categories (see, e.g., Ellen 1993b on Nuaulu; Hunn 1977 on Tzeltal; Posey 1981 on Kayapo; Taylor 1990 on Tobelo; also, Healey elicited similar responses from Maring in 1974).

Spiders are commonly objects of mild unease to acute fear in Anglo-European culture. Arachnophobia is a recognized psychological disorder, and negative representations of spiders appear widely in European folktales, literature, film and children's stories. Spiders and their webs have a prominent place in the European iconography of horror.

Many cultures appear to share the ambivalent attitude towards spiders of Western European cultures. Spiders are widely regarded as objects of fear, aversion or as pests. The fact that many spiders have painful, poisonous, and even potentially lethal bites no doubt contributes to the common anxiety many people feel towards spiders.

However, most spiders are no less intrinsically edible or otherwise useful than many other arthropods and insects which are widely eaten in many subsistence-oriented societies. Hunn (1990:167ff) is the only source we have found which specifically notes that spiders are *not* eaten, in this case (along with most other invertebrates), by the Sahaptin Indians of the Columbia Plateau. There are very few explicit references in the ethnographic literature to the edibility of spiders, or to other uses to which they are put. The following section reviews the available record.

In the absence of clear attention to the issue of the utilization of spiders by human cultures we are led to ask: Does the lack of information on the use of spiders for food or other purposes reflect widespread non-utilization of this potential resource, or is it a consequence of inattention on the part of ethnobiologists to actual indigenous practices in relation to spiders?

ETHNOGRAPHIC RECORD OF USE OF SPIDERS

The negative attitudes to spiders outlined above is by no means universal. There are a few scattered reports in the literature of spiders being used for food, medicinal practices, as providing raw materials for items of technology, and as positive markers of social identity.

In his world survey of the use of insects as food, Bodenheimer (1951:65, 67–68) also briefly reviews the use of spiders as food and for medicinal or magical purposes, citing a number of sources from the eighteenth century onwards. Bodenheimer's data are fragmentary. The ethnicity or location of spider-users is not always clearly identified. Meyer-Rochow's more recent survey (1978/79) suffers from the same defects. Bodenheimer reserves greatest attention to cases of arachnophagy in Europe, perhaps out of a sense of the grotesque. It is clear from his account that instances of spider-eating attributed to particular individuals in eighteenth- and nineteenth-century France and Germany are "perversion[s] of taste" (Bodenheimer 1951:65), rather than common cultural practice. Several of these arachnophagists likened the taste of spiders to hazelnuts.

Table 1 summarizes results of our review of the available material that mentions the use of spiders as food and for other purposes. In a number of Melanesian cultures, spiders (mostly unidentified) are roasted in embers and eaten as snack foods (see Kapauku, Yopno, Pawaia, Maring, Kilimeri, New Caledonia in Table 1). The apparent prominence of spider use among peoples of Oceania relative to those of other regions may merely be an artifact of small sample size. The Khmer of Cambodia are reported to eat large tarantulas (Theraphosidae) deep-fried in oil and served on skewers. They are reputed to enhance virility (Menzel and D'Aluisio 1998). Similarly, the Yanomamo of Venezuela extract *Theraphosa leblondi* (Theraphosidae) tarantulas from their burrows to eat, roasting them on the fire (Menzel and D'Aluisio 1998). This species is the world's largest spider and contributes a substantial amount of meat to a meal. The reports in Table 1 attributed to Bodenheimer should be treated with some caution, as none of the sources he cites are by recent credible ethnographers. A more exhaustive search might yield further examples from other cultures, and in particular we would expect more cases from foraging peoples, particularly of tropical and subtropical America, Africa and Asia.

Spiders and their webs are also used for purposes other than food. Again, there is very little of substance in the literature beyond passing references. The Nuaulu of central Seram, who are culturally related to the Alune, use the compacted web masses of *Nephila* species (Araneidae) as bait in line-fishing for needlefish, a practice Ellen (1993b:203) considers they must have learnt from other people, as, like the Alune, the Nuaulu are traditionally an interior people. Speiser (1996 [1923]:241) reports the use of compacted web mass of unidentified spiders to construct purses and ritual masks in Malekula, Vanuatu. The Ngarinman of northwest Australia used spiders' web to fashion small purses (Healey, unpub. fieldnotes).

Spiders are reported to be used for medicinal purposes in a number of areas. Hunn (1977:310–312) notes that among the Tzeltal of Chiapas, Mexico, tarantulas (Mygalomorphae) are used in a cure for tumors, with the spiders induced to bite the affected area. Bodenheimer also reports the medicinal or magical use of spiders. De Walckenaer notes that "in Brazil certain [unidentified] spiders are believed to be strong aphrodisiacs . . . , and the same quality is ascribed to them in folk medicine throughout the world" (Bodenheimer 1951:68). In the Kamchatka

TABLE 1.—Sources on use of spiders.

Ethnolinguistic group/location	Source	Uses
Australasia/Pacific		
Anindilyakwa (N Australia)	Waddy (1988)	Clan totems
Amiyenggal, Larrakia, Malak Malak, Wadjigiyn, Werat, Wulna (N Australia)	Basedow (1907), Foelsche (1881–2), Healey (unpubl. field notes), Mackillop (1892–93), Spencer (1914)	Web of ?*Nephila* used as ligature to sever finger joint of young females, in at least some cases in accordance with mythical prescription
Ngarinman (NW Australia)	Healey (unpubl. field notes)	Web of unidentified species used to make purse
Kapauku (western New Guinea)	Pospisil (1963)	No details
Yopno (Morobe Province, Papua New Guinea)	Kocher Schmid (pers. comm.)	Unidentified species roasted and eaten by children
Pawaia (Eastern Highlands, Papua New Guinea)	Kocher Schmid (pers. comm.)	Unidentified species roasted and eaten by children
Maring (Western Highlands, Papua New Guinea)	Healey (unpub. field notes)	Various unidentified species, including ?*Nephila* sp. roasted and eaten, mostly by children
Kilimeri (West Sepik, Papua New Guinea)	Kocher Schmid (pers. comm.)	Funnel-web spiders (?) roasted and eaten by women
Malekula (Vanuatu)	Speiser (1996)	Web used to construct ritual masks
New Caledonia	Bergier (1941)	*Araneus edulis* eaten grilled on coals
Asia		
Thailand	Bodenheimer (1951)	Egg bags of spiders eaten
Khmer (Cambodia)	Menzel & D'Aluisio (1998)	Tarantulas (Theraphosidae) eaten deep fried
Nuaulu (Seram, Indonesia)	Ellen (1993)	Web of *Nephila* used as fishing lure
Kamchatka (E Russia)	Bodenheimer (1951)	Unident. species eaten by women to enhance fertility, ease labor
Africa		
San (South Africa)	Bodenheimer (1951)	Eaten. No details
Maniana (Gambia)	Bodenheimer (1951)	Eaten. No details
Merina (Madagascar)	Bergier (1941)	*Nephila madagascariensis* eaten fried in oil or fat
Cameroon (W Africa)	Zeitlyn (1993)	Unident. species provide divination in legal cases
Azande (Central Africa)	Evans-Pritchard (1937)	Unident. species manipulated in curing rites

TABLE 1.—Continued.

Ethnolinguistic group/location	Source	Uses
Americas		
Tzeltal (Chiapas, Mexico)	Hunn (1977)	Tarantulas (Mygalomorphae) used in cure for tumors
Guaharibos, Piaroa (Paraguay)	Bodenheimer (1951)	Tarantulas eaten
Brazil	Bodenheimer (1951)	Unident. species eaten as aphrodisiacs
Yanomamo (Venezuela)	Menzel & D'Aluisio (1998)	*Theraphosa leblondi* (Theraphosidae) tarantulas eaten
Europe		
France, Germany	Bodenheimer (1951)	Unident. species eaten (personal idiosyncrasy?)
England	Black (1883)	Unident. species used to relieve fever
S Italy	Lewis (1991)	*Lycosa* sp. associated with Tarantula cult

Peninsula of eastern Russia eating unidentified spiders is said to confer fertility on sterile women, and ease labor (Bodenheimer 1951:68).

The seventeenth-century English antiquarian, astrologer, and solicitor, Elias Ashmole, provides us with evidence of another medicinal use of spiders in his diary for 11 April 1681: "I tooke early in the Morning, good dose of Elixir, & hung 3 Spiders about my Neck & they drove my Ague away, Deo gratias" (Ashmole 1966:1680).[1] This was no Ashmolean idiosyncrasy; live spiders encased in a nutshell and worn about the neck were believed to relieve fever (Black 1883:59–60). One of Bodenheimer's possibly idiosyncratic German spider eaters spread them on bread in place of butter "as a purge" (Bodenheimer 1951:68).

Spiders may also serve positive symbolic uses. Among the Anindilyakwa of Groote Eylandt, northern Australia, spiders of any kind are among clan totems (Waddy 1988). Also in Australia, a number of related Aboriginal cultures of northwestern Northern Territory (see Table 1) traditionally used the web of a large orb spider (*Nephila* species, Araneidae) to tightly bind the top joint of the first finger of young girls. This cut the circulation and in time the top joint dropped off (Basedow 1907:8; Foelsche 1881–2:7; Mackillop 1892–93; Spencer 1914:10). This practice follows a tradition associated with a large earthquake in the creation period (Lindsay et al. 2001). It was believed that by driving the stump of the severed finger into the ground women would be able to quell earth tremors (Healey, unpub. fieldnotes 2001).

Spiders were employed in divination and curing in various African cultures. Zeitlyn (1993) discusses the use of spiders as infallible agents of divination in courts administered by traditional rulers in several Cameroonian societies. Among the Azande of central Africa, a spider was sometimes produced by sleight of hand in curing rites by 'witch doctors' who claimed the spider contains the sick person's blood (Evans-Pritchard 1937:236).

Lewis (1991) reviews the *Tarantismo* spider cult of southern Italy, where women are typically believed to be recruited to the cult by seeking a ritual cure after supposedly being bitten by a tarantula spider. Tarantulas of the genus *Lycosa* are regarded as the actual counterpart of a dangerous spirit which inflicts harm on humans.

These fragmentary accounts of the mystical and medicinal aspects of spider use suggest an association of spiders with dangerous states. These include rectifying reproductive dysfuntion in individuals by enhancing libido, conferring virility, and overcoming infertility; divining causes of social misfortune; and guarding against a repeat of mythical cataclysm. Even some of the reports of arachnophagy indicate that they are perceived primarily as medicines rather than as foods. It is tempting to speculate that this association of spiders with mystical dangers and bodily dysfunction may stem from a widespread cultural ambivalence towards spiders, perhaps stemming from the combination of the perceived delicacy of their webs and bodies and the remarkable strength of webs and the poisonous bite of at least some species.

What our review does indicate is that not only is the number of reported cases of use of spiders low, but the level of available detail is also generally limited. Our own material on the Alune is also limited in detail. It is offered here as a

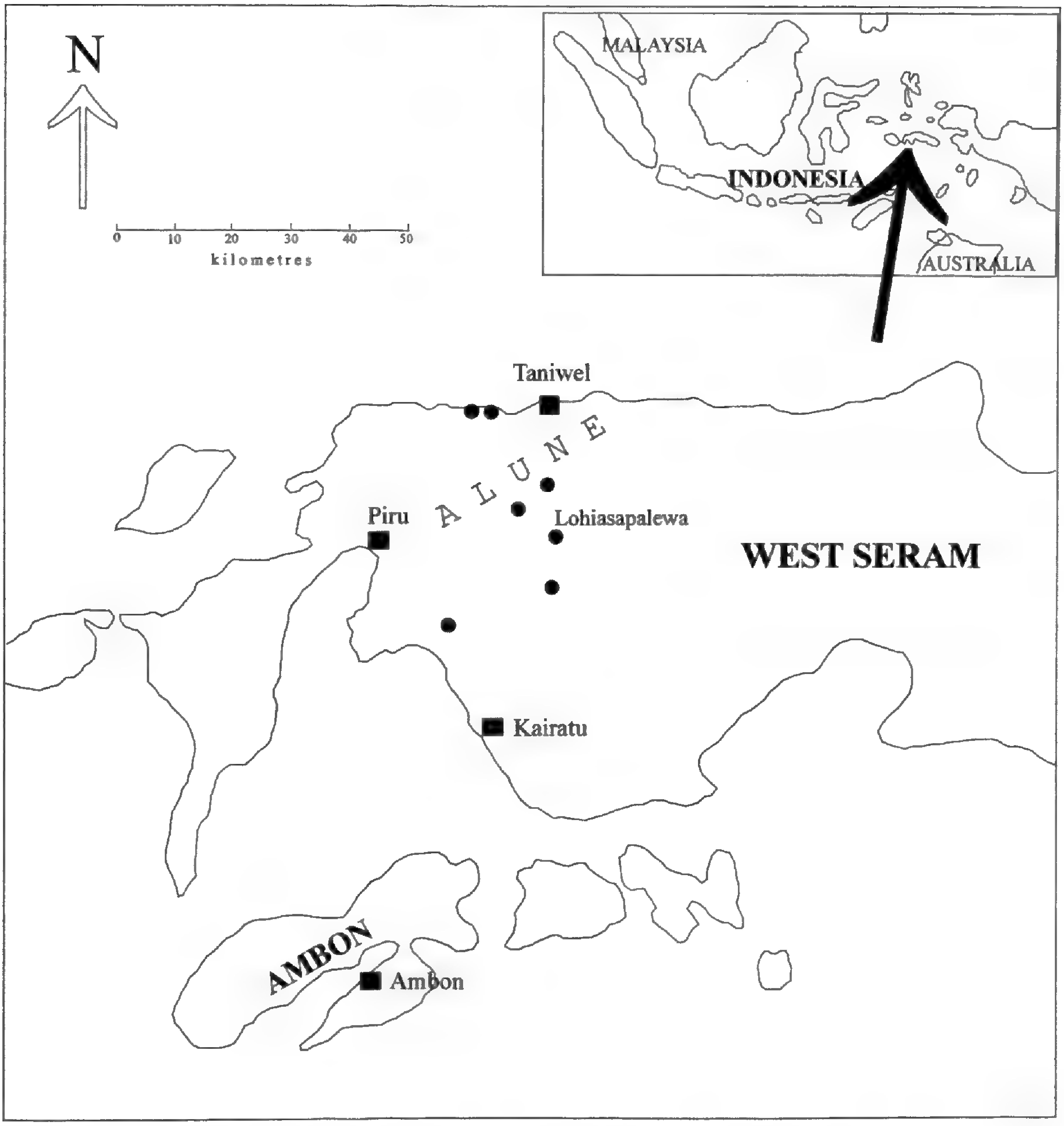

FIGURE 1.—Indonesia and West Seram. Alune villages are indicated by circles (not all shown), towns by squares.

preliminary contribution to a neglected area of human interaction with the biological environment.

THE ALUNE

The Alune are an Austronesian-speaking people living in twenty-five villages in north west Seram. Seram is one of the larger islands of central Maluku (the Moluccas or 'Spice Islands'), roughly midway between New Guinea and Sulawesi (Celebes) in eastern Indonesia (see Figure 1). The ancestral Alune domain is in the mountains of the interior of west Seram. The natural vegetation of this region is lowland and mid-montane rainforest. Large tracts of the rugged interior became depopulated when many Alune villages relocated to the narrow coastal belt in northwest and southwest Seram, as detailed below. As a consequence, much of the natural vegetation remains in the rugged interior, with earlier settlement and gardening sites reverting to heavy forest.

The Alune were traditionally one of a number of indigenous tribal populations of Seram living in autonomous village communities that maintained separate domains. The local community is composed of several localized intermarrying descent groups. Principal sources on traditional Alune social organization and religion include Ekris (1867), Jensen (1948), Jensen and Niggemeyer (1939), Sachse (1907), Stresemann (1923), and Tauern (1918). Alune social organization, ecology and subsistence are similar to that of the Nuaulu as described by Ellen (e.g., 1978; 1988).

Alune subsistence was based on a combination of shifting cultivation of hill rice (*Oryza sativa*) and other food crops, processing of sago starch (*Metroxylon* sp.) from scattered family- and lineage-owned stands within the rainforest, and extensive gathering and hunting (Wolff and Florey 1998). Consistent with the seasonal and geographic distribution of these activities, the typical settlement pattern was one of a loose cluster of hamlets and widely dispersed family garden houses and more temporary encampments in the forest at sago groves and hunting and gathering grounds. Often groves and foraging grounds coincided, allowing for a diversity of activities based at a camp site; in other parts of the domain they were more widely scattered.

Traditional Alune religion focused on the placation of ancestral and local nature spirits, whose goodwill was regarded as necessary for ensuring the health and vitality of the living, and the productivity of the environment. Virtually all Alune in inland villages are now adherents of the Protestant Church of Maluku. The church is a significant source of pressure for cultural change, with its official expectation that traditional beliefs and practices will be abandoned by its adherents. It also broadly subscribes to the ideology of 'development' espoused by the Indonesian government, which regards 'traditional culture', often glossed by the Indonesian term *adat,* as essentially 'backward' and an impediment to progress. In practice, however, traditional beliefs nonetheless remain strong in many Alune villages, albeit seldom openly articulated in the presence of church or government officials and other outsiders. There is still a strong belief in the presence of ancestral spirits which will punish failure of the living to abide by the customary norms of moral behavior, and belief in the efficacy of certain magical formulae and practices (Florey and Wolff 1998). All members of the local community are expected to share the same cosmological beliefs and ritual practices, and failure to do so is considered to invite ancestral anger and retribution. Paradoxically, the strength of commitment to the Protestant Church of Maluku is itself a product of a continuing principle of *adat,* which has seen those who have chosen to follow dissenting Christian churches excluded from the community (Florey and Healey 2002). In that sense, wholesale conversion of villages to the same variant of religious observance masks a continuation of *adat* belief and practice, which is suppressed in its outward expression, while at the same time re-affirmed as fundamental to the maintenance of social order.

The influence of the Dutch colonial government was for the most part confined to the suppression of hostilities and fostering conversion to Christianity.

From the early twentieth century a policy of encouraging resettlement of villages along the narrow coastal plain of north and south Seram served these interests well. However, a number of Alune villages resisted such moves, retaining occupation of their ancestral domains in the rugged interior. One such village was that of Lohiasapalewa, the site of fieldwork on which this paper is based.

The pace of change increased following Indonesian independence in 1945 and more effective state control over Alune domains. In response to pressures from the state, Alune settlement patterns have been modified with the establishment of nucleated villages and more relocations to the coastal belt.

Of particular relevance for the focus of this paper, post-colonial authority has influenced changes in the patterns of Alune subsistence practices and other interactions with the environment. But it has also periodically resulted in temporary reassertion of more traditional pursuits. Official encouragement of consolidation of residence in villages, combined with the demands of the church for regular participation in religious practice centered on the village church, have concentrated subsistence activities within easy reach of the village. Recent decades have seen an increase in small-scale production of tree cash-crops such as cloves (*Syzygium aromaticum*), cacao (*Theobroma cacao*), and coffee (*Coffea canepora*) planted in small scattered groves in old garden sites mostly close to the village.

As a consequence of political, religious and economic changes, extended residence in distant garden shelters or forest camps is less common than in the past, and gardens are more likely to be sited closer to the village. Although hill rice is still a preferred crop, cassava (*Manihot esculenta*) has increasingly supplanted it in the everyday diet. Furthermore, hunting and gathering in the forest, especially the more distant parts of village domains, is less common now than in the past.

Nonetheless, at least twice over the last fifty years, the Alune of Lohiasapalewa have fled the village to take refuge in the forest. In the 1950s and 1960s, many villagers sought refuge in the forest to evade the conflicts between the Indonesian military and guerrillas of the ill-fated separatist Republic of the South Moluccas, or RMS (*Republik Maluku Selatan*). Then again in 1970, Lohiasapalewa villagers fled to the forest to evade intense pressure from the local administrative officer to relocate the village to the coast.

There are unconfirmed reports that villagers have again taken refuge in the forest in early 1999, since the outbreak of sectarian violence between Muslims and Christians in Ambon city, which rapidly spread to many other parts of Maluku. Sporadic violence continues to the present (August 2002), and has included attacks on Alune villages in the coastal plains and raised more general fears of escalation of violence.

The significance for this paper of these retreats into the forest is that recent historical circumstances forced Lohiasapalewa villagers to revert to a subsistence economy centered on hunting and foraging in the forest. The present unrest further underscores the potential importance of the forest as a safe haven and source of subsistence foods. Thus, a close dependence on wild resources, including insects and spiders, is part of the shared experience of virtually all Alune today, and goes at least part of the way to explaining the retention of a considerable body of detailed ethnobiological knowledge. Changes in subsistence patterns are dealt with in more detail by Florey, Healey and Wolff with Manakane (in prep.) and Wolff and Florey (1998).

METHODOLOGY

The data on which this paper is based were collected over the course of several field trips to the inland Alune village of Lohiasapalewa in 1993–95. This research was part of a larger project on Alune ethnobiology and language change, involving collaboration between Florey, Healey, botanical consultant Dr. Xenia Wolff, and Alune subsistence farmer and expert on local natural history Mr Wempi Manakane. The research team drew upon the substantial linguistic and ethnographic knowledge of Alune gained by Florey over several fieldwork seasons in various Alune villages totaling over 24 months since 1988.

Alune knowledge of spiders was recorded in a number of different contexts. These included the following: focused discussion sessions on local fauna with individuals and small parties, mostly men, but sometimes also children and women; observations of spiders during excursions into different habitats in and around the village attended by Manakane and other Alune advisors and informants; examination and discussion of specimens of spiders and other invertebrates collected by Manakane and brought to Healey in evening work sessions, in which other adults of both sexes usually participated; chance observations of Alune behavior towards or talk concerning spiders.

No collections of specimens were made. However, we are building a photographic record of specimens. Most of the scientific identifications noted below were provided by Dr. Graham Brown of the Museums and Art Galleries of the Northern Territory, Darwin, Australia, based on photographs, as acknowledged in the text. Other identifications are our own tentative suggestions and should be treated with caution.

Ethnobiological knowledge is not evenly distributed within Alune communities, but varies with age, gender and personal interest. Despite his comparative youth, Mr Wempi Manakane, who was aged 25 years in 1995, is widely acknowledged by residents of Lohiasapalewa as a local expert in a broad range of traditional knowledge, including ethnobiological domains. The richness of the ethnobiological knowledge that he was able to convey to us, compared to that of many other villagers, certainly supports this reputation. He is also a highly articulate exegete of local knowledge, fluent and literate in Indonesian and the Ambonese Malay lingua franca. He has also adopted Florey's orthography for Alune and became fully literate in his own hitherto unwritten language. On a number of occasions, other Alune deferred to Manakane's opinion on various aspects of ethnobiological lore, or referred us to him as an appropriate person to consult. These referrals were not merely acknowledgement of the close working relations that developed between Manakane and us, as villagers also freely referred us to other recognized experts on diverse aspects of Alune culture and ecology.

Alune freely admit when they do not know the answer to questions, as indicated by their willingness to refer to other experts. Manakane himself is clearly conscious of the limits of his own ethnobiological knowledge, and referred us to others, or himself made enquiries of older people who are recognized as more knowledgeable in various areas of indigenous knowledge. He made these referrals both in our presence when other experts were also present, and independently by seeking out advisors when he had been unable to provide us with information we sought.

We made no systematic tests for consistency of identification of specimens or other details of ethnobiological information between informants. Indeed, we argue against the methodological value of rigorous testing of consistency of information or responses to elicitation stimuli as being contrary to naturalistic discourse. Consistent with the general methodological orientation outlined above, our focus has been on eliciting Alune identifications and knowledge of organisms in the meaningful contexts within which they are encountered in the course of everyday life. One context of encounter with organisms in the environment is not the same as another. Wherever possible, we allowed our Alune hosts, advisors, and informants to determine the contexts in which we encountered and recorded their ethnobiological knowledge, rather than seeking to impose an alien framework of our own. It was, for example, Manakane's idea to collect specimens of invertebrates and bring them to Healey in the evening as an aid to discussions.

Because we sought information contingently in contexts meaningful to Alune we have undoubtedly not encountered all possible contexts, and our compendium of information is therefore probably incomplete. However, we argue that the resulting record more closely represents the Alune world view than more formal elicitation techniques.

ALUNE ETHNOBIOLOGY OF SPIDERS

The Alune regard spiders as just another element of the diverse fauna of their region. Alune knowledge and exploitation of insects are extensive (Florey et al., in prep.). Spiders are classified separately from insects, but they are treated in very similar ways, and attract much the same character of attention.

Alune regard most spiders as eminently edible. Like other small invertebrates they are usually lightly roasted beside the fire. With an increasing orientation of the local economy to subsistence horticulture and cash cropping, and a residential focus on the village, rather than a more forest-oriented economy of foraging, hunting and cultivation, spiders no longer appear to be commonly eaten or otherwise exploited, even by children. Certainly, this was the view of several of our informants, but we cannot be sure that the various opportunistic snacks we observed being consumed around hearths did not contain the odd spider.

We have no data on the nutritional contribution of spiders and other invertebrates to the Alune diet. The only available study of Alune diet (Novotny et al. 1996) focused on adult women, and is compromised by apparently recording only household meals, and neglecting the possible nutritional significance of between-meal snacking. Our observations indicate that Alune consume sometimes considerable amounts of food as snacks away from the main residence. Snacks range from wild and cultivated fruits, nuts and vegetables to invertebrates and small vertebrates cooked in garden houses or at impromptu small fireplaces, especially by small bands of children.

The views of informants indicate that spiders were more commonly exploited in the past, but we have no evidence that this was other than on an opportunistic basis. It is therefore likely that spiders have only ever been a very minor component of the diet, and the nature of other human-spider interactions limited.

Nonetheless, in part because of the recent history of refuge in the forest, and the continuing interest in forest resources, many Alune preserve considerable knowledge of older patterns of exploitation of spiders and other invertebrates. Spiders form part of a wider pattern of close and intense interactions the Alune maintain with the natural environment. Exploitation of arthropods continues a long standing form of interaction with the environment in respect of that part of the diet that is based on a foraging component of the economy. Although recent social change has led to an increasing prominence of cassava and sago as the core component of main daily meals, there is a persistence of longer-established patterns of the foraging sector of the economy that yields considerable variety to the diet through frequent snacking, as an element of what we call a 'small food tradition'. This pattern of impromptu snacking, and the foraging behavior by which it is sustained, maintains a strong meaningful and subjective association with the forest as a core element of Alune perceptions of their ethnic identity as 'forest people'. This identity has been reinforced by their recurrent retreat into and dependence on the forest in periods of social upheaval. We do not mean to suggest that exploitation of spiders is itself definitive of Alune identity, but certainly this activity and the knowledge on which it is based are an integral part of a specifically Alune style of interaction with the environment at a subjective level.

The Arachnid fauna of Seram is poorly known. The abundance and species diversity of arthropods are high in central Seram (Stork and Brendell 1993). There are no good faunal surveys of the arachnid fauna of Seram that might be a guide to the number and identity of species that could be expected from the Lohiasapalewa area.

Ellen (1993b) records ten terminal categories applied to spiders by the Nuaulu, another Austronesian-speaking people of south-central Seram. These are assigned to seven biological species, although the actual number is likely to be considerably greater. This compares well with our own data for the Alune; we have recorded a total of eight terminal categories applied to spiders, each tentatively ascribed to separate biological species. This suggests that there may be few, if any, Alune categories that we have not yet discovered.

Alune class all spiders in a single category termed ***'wala'wa***.[2] The term is applied to a set of categories which are all regarded as morphologically similar. Possession of eight legs is a key characteristic. ***'wala'wa*** thus designates a well-defined natural category of organisms not further included in a higher order taxon. Despite the small number of terminal taxa making up the category, we consider ***'wala'wa*** can reasonably be designated as a 'life form', equivalent to other Alune life forms, such as ***manue***, 'birds'.

The label ***'wala'wa*** is cognate with the Nuaulu term ***wala-wala*** recorded by Ellen (1993b:201). Interestingly, however, the Nuaulu term is applied to spiders' webs and to certain web-spinning spiders, rather than to spiders in general. In Alune spiders' webs are designated by the noun classifier for fibrous matter, ***bueti***. Spiders' web is termed ***'wala'wa esi bueti*** ('spider its fibrous mass'). We have no record of any uses of spiders' webs. The Nuaulu equivalent of the Alune ***'wala'wa*** is ***kahunekete***, which contains ten named terminal categories (Ellen 1993b:200–204).

Nuaulu consider scorpions (Scorpionida) and harvestmen (Opiliones) to be closely related to spiders, and some of Ellen's informants suggested that harvestmen may be a kind of spider (Ellen 1993b:203). Alune opinion is much the same; at least some of our informants regard harvestmen somewhat ambiguously as possibly spiders, and certainly similar to spiders. While they are generally not included in the category ***'wala'wa***, they are discussed here because of their perceived close similarity.

Scorpions are more clearly classified in a separate category, as they are among the Nuaulu (Ellen 1993b:203). Alune liken them to freshwater crabs, as indicated by the term ***'li'we ta'umui*** (***'li'we*** is the general term for freshwater crabs, ***ta'umui*** means 'likeness' or 'resemblance', but also 'spirit of the dead/ghost'). Crabs are relished as food, but scorpions are not eaten.[3] The ambiguous meaning of the term for scorpions ('resembling a crab' and 'ghost crab') is perhaps appropriate for these venomous creatures.

Alune regard the named categories outlined below to be morphologically distinct. Taxa are thus distinguishable by perceptual criteria, although there are also behavioral and ecological characteristics which informants highlight. The eight terminal categories applied to spiders and one applied to harvestmen appeared to be used with some discrimination, having been offered as identifications of specimens which were also morphologically distinctive to us. However, as already noted, we are unable to assess the consistency with which these category names are applied in instances of identification of specimens. The number of biological species present is undoubtedly well in excess of the forms we have observed and the Alune terms may have fairly wide application. Ellen (1993b:203) has noted that Nuaulu categories appear to be "wide-ranging and overlapping." While our own data on identification and classification are insufficient to corroborate this conclusion in respect of spiders, our data on other biological domains indicate that Alune identifications of naturally-occurring specimens and classifying behavior is similar to that reported by Ellen (1993a, 1993b) for the Nuaulu.

Several spiders, such as *Nephila* sp(p)., are said by Alune informants to have a venomous or painful bite. However, while Alune handle dangerous spiders carefully they do so with confidence, and without apparent anxiety or squeamishness.

In what follows we briefly outline Alune knowledge of spiders and harvestmen by named terminal category within the higher order category of ***'wala'wa***. We also indicate uses and other cultural significance of spiders and harvestmen.

'wala'wa. The term applied to spiders collectively is also used as a label for a constituent terminal category. According to informants, the terminal category ***'wala'wa*** is applied to spiders described as of medium size, and which shelter in curled leaves suspended within their webs which resemble a wheel. These serve as the focal category of spiders in general, and ***'wala'wa*** as a terminal category probably is applied to a number of species of similar appearance and web-building. Focal ***'wala'wa*** make a nest around a curled leaf in which the eggs are laid. These spiders are common in vegetation about homesteads and gardens, and are edible. We obtained no photographic record of specimens and the species remain unidentified. We tentatively identify them as members of the leaf-curling spider group, family Araneidae.

'wala luma. This term means 'house spider', and is applied to huntsman spiders, Heteropodidae, found in houses. Several different species of Heteropodidae are represented in our photographic record, but unfortunately they have not been identified beyond family. Only one kind of these huntsmans (G. Brown, pers. com.) in the photographic record, a large grey spider encountered in houses, was identified as ***'wala luma*** (Figure 2). However, it is possible that identifications of ***'wala luma*** are based primarily on habitat, rather than morphological features, and this term may therefore apply to several similar species encountered in houses. Because ***'wala luma*** frequent houses and eat cockroaches and other objects of disgust they are considered inedible.

'wala metene. This term, meaning 'black spider', was applied to huntsman spiders found in fallow regrowth, a photograph of which has been ascribed to a second species of Heteropodidae. The large egg cases of this spider, lightly roasted by the fire, are regarded as delicious. These yield hundreds of tiny young when hatched.

'wala porole. This term was applied to another huntsman spider found in fallow regrowth. This has been identified as a third species of Heteropodidae (G. Brown, pers. com.). It is called *labalaba kuning* in Ambonese Malay. Both names mean 'yellow spider' and refer to the light brown color of this huntsman spider. This spider is edible.

'wala si'oli. This term is applied to the very large and common orb-weaving spiders, identified as *Nephila,* Araneidae (G. Brown, pers. com.) (Figure 3). The large females are highly distinctive and visible spiders, because of their size, glossy black and yellow bodies, and massive strong and sticky webs built across open spaces. Males are usually very small and seldom encountered with females except in the mating season (G. Brown, pers. com.), and it is not clear if Alune are aware of this extreme sexual dimorphism.

Alune provided no etymology of ***si'oli,*** but it can be translated loosely as 'it falls to the ground', from ***(e)si*** 'it' and ***'oli*** 'to slip and fall onto the ground (from a height)'. This is perhaps a reference to the spider's habit of constructing its webs high above the ground.

One can tell if other people have already passed by on a track as the webs will have been cleared away. This is the closest we have come to recording a functional use for spider web. Note that it is webs of the same genus that are used by the related Nuaulu as fishing lures.

While this spider is recognized to have a harmful bite, it is readily handled with care. It is considered edible, and spiders are roasted whole in the fire or steamed in bamboo tubes. *Nephila* species are also eaten in Madagascar and probably New Guinea (see Table 1).

'wala susu. This term was applied to distinctive hunting spiders encountered in undergrowth. We have no photographic record or identification of specimens, but they are possibly wolf spiders, Lycosidae. The translucent white color of these

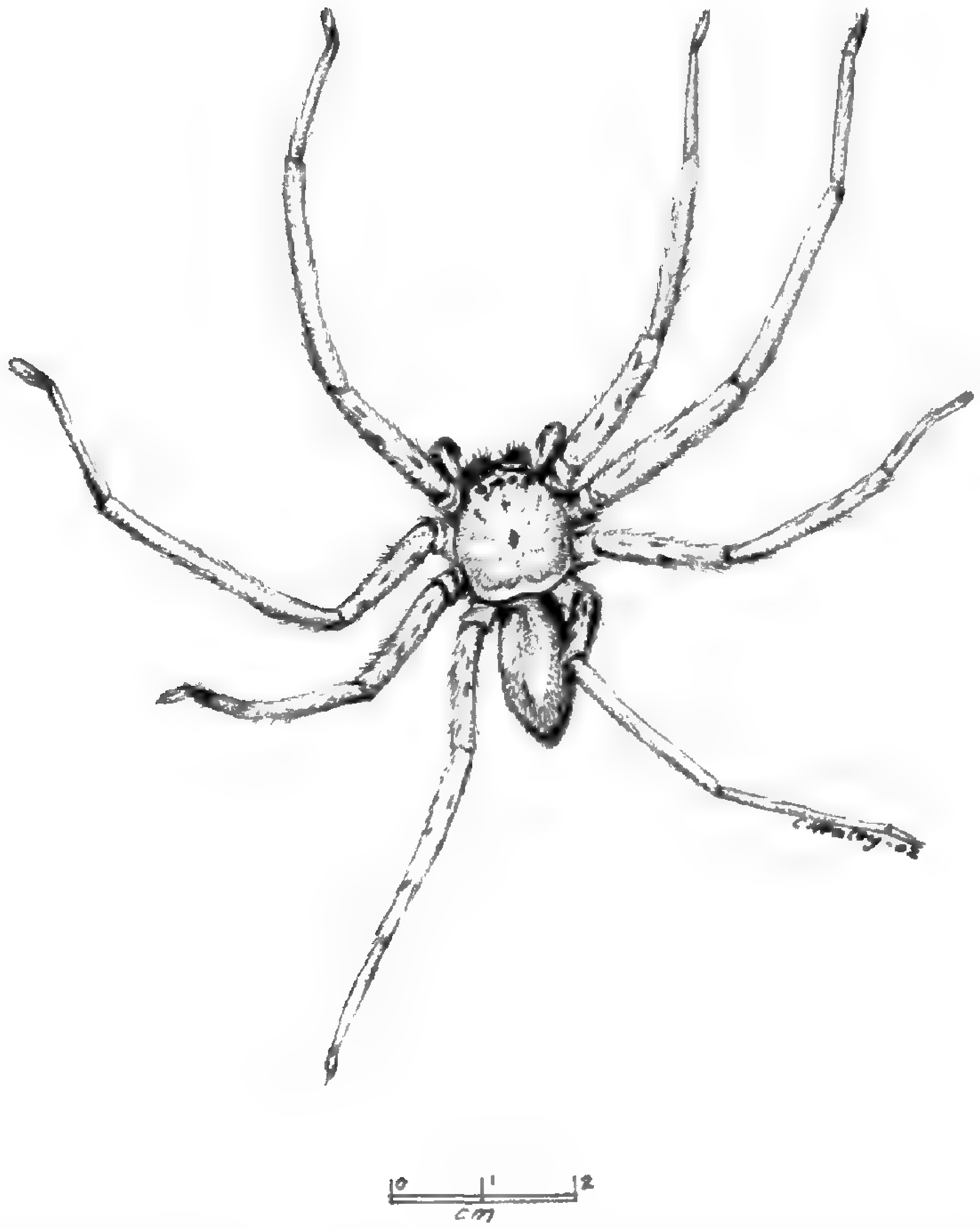

FIGURE 2.—***'wala'wa luma***, Heteropodidae. Huntsman spider. (Head and body length approx. 3 cm.; based on color transparency 94/4.23 20 June 1994 by C. Healey)

spiders is likened to breast milk, hence the specific name, ***susu*** meaning 'breast/milk'. ***'wala susu*** are edible.

'wala tasie. This term was applied to medium sized robust black spiders, probably *Araneus* species, Araneidae, found in leaf nests set in webs in scrubland. The spider is characterized by a hairy body and a painful bite. It is considered edible and has a rather pleasantly salty taste, hence its name: ***tasie*** meaning 'salty'. Members of the same genus are also eaten in New Caledonia (see Table 1).

'wala munine. This term was applied to medium sized dark wheel-web spinning spiders, possibly of the Family Araneidae (G. Brown, pers. com.). The spider is considered to be distinctive in having four clearly discernible eyes and in catching and eating other spiders and insects considerably larger than itself. It is likened to human sorcerers, ***munine***, hence its name, because it kills others of its kind. Also, like human sorcerers, it can see behind itself. It is considered inedible, presumably because of its association with sorcery.

Idori. This term is applied to harvestmen (G. Brown, pers. com.), which constitute the Order Opiliones (also referred to by the older name Phalangida). These are small, round-bodied arachnids with eight immensely long, very thin legs. These resemble spiders in their general form, except that the two body parts of head-thorax and abdomen separated by a distinct 'waist' in spiders are fused into a single body part. Harvestmen also lack fangs, and unlike most spiders, they do

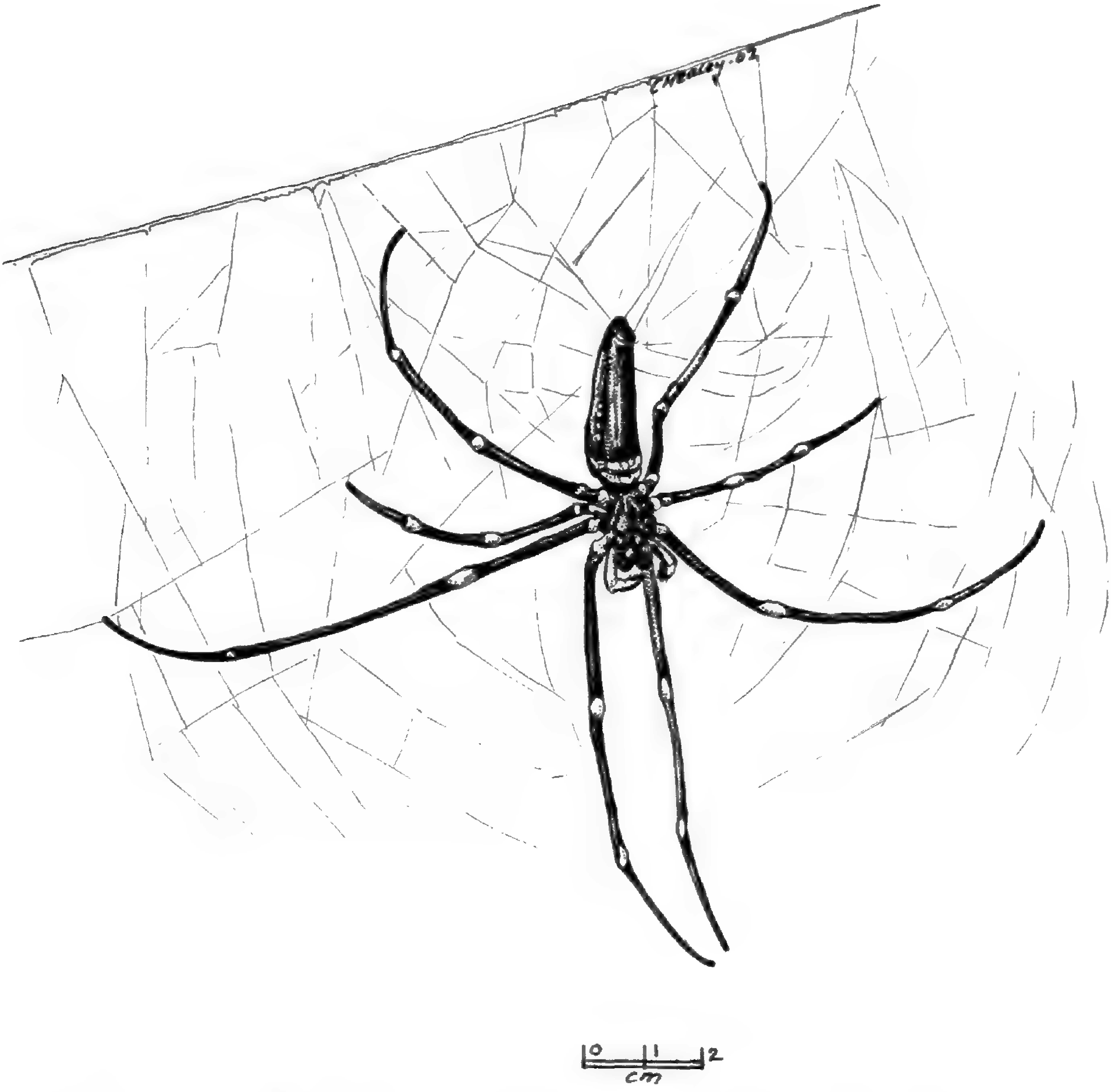

FIGURE 3.—***'wala'wa si 'oli***, *Nephila* sp. Orb-spinning spider (Head and body length approx. 3.5 cm.; based on color transparency 94/1.6 18 June 1994 by C. Healey)

not make webs. In discussing several live specimens brought by Manakane to Healey one evening, informants expressed uncertainty as to whether harvestmen should be classified as ***'wala'wa*** or in a category of their own. Manakane sought to resolve this issue by counting the number of legs, reasoning that if they possess eight legs they should be classed as ***'wala'wa***. The fragile specimens had all lost varying numbers of legs, and it was not possible to determine the normal complement. Manakane and others present therefore opted to cautiously ascribe ***idori*** to an unaffiliated category. This indicates a strong objectivist basis to classificatory behavior, at least in this instance.

Idori are found under leaves in undergrowth, always two or three or more together. They run quickly when disturbed. We were offered no etymology of ***idori***, but it can be translated as 'it falls over on the ground', from ***i*** 'he/she', and ***dori*** 'to fall over on the ground'. Perhaps this is a reference to the somewhat clumsy, gangling movements of harvestmen, and their tendency to be found close to the ground. A secondary meaning of ***dori*** is 'to live alone and unhappily', although this does not seem readily applicable to the sociable harvestmen. In the past harvestmen were used as a cure for bed-wetting at night in children who should have outgrown the behavior. A specimen was rubbed on the child's belly on being put to bed at night.[4] No objective, symbolic or metaphysical explanation was offered as a basis for this use. ***Idori*** are not considered edible.

CONCLUSION

All names for terminal categories of spiders and harvestmen are polymorphemic, with the exception of the focal category of leaf-curl spiders (***'wala'wa***). Three names refer to color or appearance (***'wala metene, 'wala parole, 'wala susu***), one to taste (***'wala tasie***), one to habitat (***'wala luma***). These names thus refer to objective criteria that distinguish categories. The last three names refer to aspects of behavior descriptively (***'wala si'oli, idori***) or metaphorically (***'wala munine***).

Six of the eight terminal taxa applied to spiders are regarded as edible. Ellen makes no mention of views of the edibility of spiders among the Nuaulu, although he records many other invertebrates as edible (1993a, 1993b). The other two categories are deemed to be inedible, because of their association with dirt or mystical danger. While the recorded number of Alune categories of spiders is very small, and probably applied widely to diverse biological species of spider, it is notable that the edibility of all spiders is unambiguously marked. Alune categories are designated as positively edible (even highly esteemed) or definitely inedible for clearly articulated reasons. Harvestmen are more neutrally inedible, but have a medicinal application.

Such marked definition of edibility is not a feature of all life forms in Alune ethnobiology. For example, while many insects are defined as edible, and others clearly proscribed, many more have neutral edibility, being neither considered worthy of eating nor specifically regarded as inedible. Similarly, as far as we are aware, all birds are considered edible but only a few are particularly esteemed as food. Even the smallest bird, which can be fairly easily killed with a lucky shot with bow and arrow or taken from the nest, yields more meat than a spider, but attracts less notice for its edibility.

Spiders are evidently an insignificant source of food, given their small size and the solitary habits of most species, which precludes collecting large quantities readily. Alune ascribe no remarkable edible qualities to spiders other than pleasant taste. Functionally, spiders on their own can never have assumed any significance in the Alune diet or adaptation to their rainforest habitat. Yet, taken in conjunction with a highly varied intake of other animal foods, from ant and spider eggs to deer and pigs, they form an integral part of the 'small food tradition' in a diversified subsistence economy of forest foraging, swidden cultivation, sago processing and hunting. The Alune example suggests the possible value of attention to spiders as dietary and medicinal items in the subsistence strategies of other indigenous cultures of similar economy.

NOTES

[1] We are grateful to Margaret Healey for this information on Ashmole's use of spiders.

[2] We adopt the orthographic convention of using an apostrophe to represent the glottal stop, which occurs in the Central Alune dialect spoken in Lohiasapalewa (Florey 2001).

[3] Lest it be assumed that scorpions are intrinsically inedible, we note that Menzel and D'Aluisio (1998) report that in Guangzhou province, China, scorpions are raised in homes and specially constructed basement 'farms' as wholesale business. They are added to soups and used in medicines.

[4] See Florey and Wolff (1998) for an overview of Alune ethnomedical concepts and practice.

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"HEAD OF SNAKE, WINGS OF BUTTERFLY, AND BODY OF CICADA": IMPRESSIONS OF THE LANTERN-FLY (HEMIPTERA: FULGORIDAE) IN THE VILLAGE OF PEDRA BRANCA, BAHIA STATE, BRAZIL

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To the memory of Darrell Addison Posey (1947–2001)

ABSTRACT.—Four aspects of the ethnoentomology of the lantern-fly (*Fulgora laternaria* L., 1767) were studied in Pedra Branca, Brazil. A total of 45 men and 41 women were consulted through open-ended interviews and their actions were observed in order to document the wisdom, beliefs, feelings, and behaviors related to the lantern-fly. People's perceptions of the external shape of the insect influence its ethnotaxonomy, and they may categorize it into five different ethnosemantic domains. Villagers are familiar with the habitat and food habits of the lantern-fly; they say it lives on the trunk of *Simarouba* sp. (Simaroubaceae) by feeding on sap with the aid of its 'sting'. The culturally constructed attitudes toward this insect are that it is a fearsome organism that should be exterminated whenever it is found because it makes 'deadly attacks' on plants and human beings. Local ideas about the origin of the lantern-fly, the metamorphosis process, as well as its transformation into another organism were also recorded. The insect inspires feelings of fear and aversion which create obstacles to developing an efficient strategy for the conservation of *Fulgora* species. Environmental education can play a significant role in changing these negative attitudes.

Key words: ethnoentomology, folk knowledge, Hemiptera, Fulgoridae, *Fulgora laternaria.*

RESUMO.—O artigo refere-se à etnoentomologia da jequitiranabóia (*Fulgora laternaria* L., 1767), baseando-se nas quatro dimensões conectivas que os seres humanos podem manter com o inseto. O trabalho de campo foi realizado no povoado de Pedra Branca entre os meses de fevereiro a maio de 2001. Foram consultados 45 homens e 41 mulheres através de entrevistas abertas e observações comportamentais, com o objetivo de registrar os conhecimentos, as crenças, os sentimentos e os comportamentos relacionados com o inseto. Os resultados demonstram que a percepção que os moradores têm da aparência externa do animal influencia em sua etnotaxonomia, uma vez que foi categorizado em cinco domínios etnossemânticos distintos. Os conhecimentos nativos referentes ao hábitat e à ecologia trófica da jequitiranabóia revelam que ela vive nos troncos de *Simarouba* sp. (Simaroubaceae), alimentando-se da seiva por meio do 'ferrão'. As atitudes culturalmente construídas com relação ao inseto colocam-no como um ser que deve ser exterminado ou temido sempre que encontrado devido à crença do 'ataque mortífero' a plantas e seres humanos. Impressões locais sobre a origem da jequitiranabóia, o processo de metamorfose, bem como de sua transformação em um outro organismo também foram registradas. Os sentimentos de medo e aversão ao inseto representariam obstáculos para a realização de uma estratégia eficaz de conservação das espécies de *Fulgora*. Daí, o papel significativo da educação ambiental para modificar essa visão.

RÉSUMÉ.—Ce rapport étudie quatre aspects de l'éthnoentomologie du fulgore porte-lanterne (*Fulgora laternaria* L., 1767) à Pedra Branca au Brésil entre les mois de février à mai de 2001. Les auteurs ont consulté 45 hommes et 41 femmes au total en utilisant un système de questions ouvertes. Ils on observé leur réactions pour documenter leurs connaissances, croyances, points de vues, et comportements relatifs au fulgore porte-lanterne. Les résultats montrent que les indigènes classifient l'insecte en cinq différents domaines ethnosémantiques, et fondent l'ethnotaxonomie sur leur interprétation de l'apparence extérieure de l'insecte. Ils connaissent l'hábitat et les habitudes alimentaires du fulgore porte-lanterne: ils disent que l'insecte vit sur le tronc du *Simarouba* sp. (Simaroubaceae), et se nourrit de la sève avec son 'dard'. Pour la culture locale, c'est un insecte redoutable à exterminer où qu'il soit, à cause de ses attaques mortelles contre les plantes et les êtres humains. Cet article document également les croyances locales relatives à l'origine du fulgore porte-lanterne, à son processus de métamorphose, et à sa transformation en un différent organisme. L'insecte inspire des sentiments de peur et de dégoût qui gênent la mise au point de vue d'une stratégie efficace pour la protection de l'espèce. Une éducation en matière d' environnement pourrait grandement modifier ces attitudes hostiles.

INTRODUCTION

Jequitiranabóia damned snake.
The reason for thy pains is in the name.
Death is what you shall expect, insect!
Bug without a delineated shape
First a cicada, then a snake, then a moth.
Worthless even as medicine.
Does nothing but wilt trees
And disturb the countryfolk.
Costa-Neto, 2001

Insects of the genus *Fulgora* L., 1767 are commonly known as lantern-flies and alligator-headed or peanut-headed insects. Folk beliefs about them abound, especially due to their unusual shape. Since the first European colonization of the New World, chroniclers, travelers, and natural historians have recorded native impressions of these strange insects (Hogue 1993). The species *Fulgora laternaria* L., 1767 (= *Laternaria phosphorea* L., 1764), for example, is supposed to bear a devastating poison that dries up those trees on which it feeds or rests, and also kills both men and animals (Carrera 1991; Costa Lima 1942; Fonseca 1926, 1932;

Janzen and Hogue 1983; Neiva and Penna 1916; Poulton 1928; Wied 1940). This belief is widespread from the Atlantic to the Andes, and is shared not only by the simple and superstitious but by persons of higher education (Poulton 1932). In the northeastern Brazilian State of Ceará the insect's folk name is synonymously used to describe a terrible person (Lenko and Papavero 1996) and is applied to any individual who has lost his good reputation. In Peru, the *chicharra machacui,* as it is locally known, is as dreaded as a serpent because people believe its sting is equally mortal (Dourojeanni 1965). In Costa Rica, peasants believe that the insect's huge, peanut-shaped head is full of poison. If someone is stung by the insect, he or she must have sexual intercourse within twenty-four hours. Otherwise, he or she will die (Ross 1994). According to Ross, urgency of treatment varies: one woman told him that a 'cure' would be necessary within 15 minutes, and that, for a man, a virgin would provide the best antidote. This legend is partly blamed for Costa Rica's soaring birthrate. It is not surprising that, in Colombia, the colloquial expression *picado por la machaca* (stung by the lantern-fly) is applied to a person who has a great sexual appetite (Anzola 2001). However, this seems to be more of a ruse invented by local men and used to their personal advantage than a valid folktale (Hogue 1993).

Due to their significance in legends, lantern-flies are represented in the graphic and plastic arts, as well as in the music of different South American countries. In 1987, on the occasion of the fiftieth anniversary of the Brazilian Society for Entomology (BSE), the Brazilian Post Office issued a set of two commemorative stamps. One of them depicted the species *F. servillei* Spinola, 1839 (actually *Fulgora laternaria*), which is the symbol of the BSE. Similarly, the Colombian Society for Entomology has the anecdotal periodical *La Machaca* as one of its newsletters. In the folkloric music of Ecuador and Colombia, the fast *cumbia* rhythm is said to reflect the emotions that follow from the insect's bite (Ross 1994). The insect is still regarded as a tourist attraction and has value as a souvenir (Hogue 1984). In 1964, a specimen was sold for nine dollars in Tingo Maria, Selva Central, Peru (Organização dos Estados Americanos 1987).

Fulgora spp. belong to the order Hemiptera, suborder Fulgoromorpha, superfamily Fulgoroidea, and family Fulgoridae (Bourgoin and Campbell 2002). Fulgorids may be distinguished by a combination of the second hind tarsomere with a row of apical spines and both apical and anal area of hind wings with cross veins (O'Brien and Wilson 1985). According to these authors, Fulgoridae is comprised of 108 genera and 543 species, which are distributed in the following geographical zones: nearctic (16 species), neotropical (242 species), Ethiopian (104 species), Oriental (180 species), and Australian (18 species). These numbers, however, need to be updated. The genus *Fulgora* ranges from southern Mexico to northern Argentina, and is represented by eight species (O'Brien 1989). The generic name probably owes its origin to the ancient Roman goddess Fulgora, who protected houses against lightning and terrible storms. *Fulgor* is the Latin word for lightning, brightness (Ross 1994).

Although fulgorids are notable for their size (some species are 7 mm in length, but some are 95 mm [O'Brien and Wilson 1985]), bizarre forms, brilliant colors, and wax secretions, there is very little scientific information about the biology and life cycle of the large neotropical members (Hogue et al. 1989). The exceptions are for those species reported to be of economic importance, such as *Phrictus diadema* (L.) Spinola, 1839 on cocoa trees (*Theobroma cacao* L.) in Brazil and *Pyrops candelaria* (L.) on longan (*Euphoria longana* Lam.) and mango (*Mangifera indica* L.) in Asia (O'Brien 1989). There are, however, some initiatives expanding our knowledge of their biology, such as the project "Biodiversity and Evolution of Fulgoromorpha: a Global Research Initiative," by Bourgoin and Hoch (1999).

The present work investigates the knowledge, beliefs, feelings, and behaviors that are related to the lantern-fly in the village of Pedra Branca, Bahia State. It is hoped that ethnoentomological knowledge will contribute to better scientific understanding of this group.

METHODOLOGY

Data presented here are part of a broader research project that aims to record the ethnoentomology of Pedra Branca's villagers. A former settlement of the Kiriri Indians that was established by the Portuguese pioneer Gabriel Soares de Souza in the sixteenth century, the village is located at the Middle Paraguaçu, west central region of Bahia State, northeastern Brazil (Paraíso 1985). It is inside the municipality of Santa Terezinha (which is also the capital), but it is about 13 km away from it. It is situated at the base of the Serra da Jibóia, a mountain range of about 225 km^2 of area whose peak elevation is 805 m above sea level. It lies between 12°46′ south latitude and 39°32′ west longitude (Juncá et al. 1999).

In 1991, the resident population in the county of Santa Terezinha was 8,851 individuals (Centro de Estatística e Informações 1994). The actual population in the village of Pedra Branca is nearly 400 persons (about 80 families according to the local Health Assistant), who depend on cassava cultivation (*Manihot esculenta* Crantz.) as their main economic activity. Livestock is also important, mainly cattle and goats.

This region, which is totally included in the Drought Polygon, has a semiarid climate with a mean annual temperature of 24.3°C and a mean annual rainfall of 582 mm. The rainy period lasts from November to January. The vegetation of the Serra da Jibóia includes *campo rupestre* savannas on the peaks; dense, ombrophilous Atlantic coastal forest in the valleys and on the slopes; semi-deciduous forest at the base; and arboreal Caatinga in the north. The soil is good for agricultural activities and not bad for livestock-raising (Centro de Estatística e Informações 1994).

Fieldwork was carried out over 64 days from February to May 2001 by one of the authors (EMCN), who also did the translations into English. Both open-ended interviews followed ethnoscientific principles (Posey 1986b; Sturtevant 1964). Informal observations of behavior related to lantern-flies were also recorded. Forty-five men and forty-one women, whose ages ranged from 13 to 108 years old, constituted the sample universe. This sample accounts for just those interviewees who provided information about the lantern-fly. Interviews were conducted in Portuguese since the villagers are Portuguese-speakers. Both individual and collective interviews were done to elicit native impressions on the insect, and people talked freely about other insects as well. Most of the interviews were recorded in microtapes; semi-literal transcriptions are deposited at the Laboratory of Ethnobiology of the Universidade Estadual de Feira de Santana (UEFS).

Data were analyzed by using the union model (Marques 1991), which involves considering all available information on the surveyed subject. Controls were performed both through consistency checking tests and reply validity tests, which make use of repeated inquiries in synchronic and diachronic conditions, respectively. One tests consistency by asking different people the same question within a very short time period. Reply validity is tested by asking the same question to the same person at different times. Two undergraduate volunteers, who have been in the village three times, helped the authors interview the subjects.

During the fieldwork period just one specimen of lantern-fly was collected by a villager, when it suddenly appeared in the village one night. This allowed us to conduct projective tests. These consisted in displaying both the photograph and the specimen itself to the informants in order to prompt them to talk about the insect. Their reactions and those of the rest of the members of the community (many of whom had never seen the insect before) were recorded during the interviews. The specimen, which was identified as *Fulgora laternaria* L. 1767,[1] was handled in accordance with the usual patterns for scientific collections and was deposited in the entomological collection at UEFS.

RESULTS AND DISCUSSION

The relationship between the Pedra Branca villagers and the insect has four dimensions: cognitive, ideological, affective, and ethological. With regard to the cognitive dimension, native knowledge about the lantern-fly's ethnotaxonomy, habitat, feeding ecology, and its transformation into another being were recorded. The way people behave toward it (ethological dimension) results from the way they perceive it (ideological dimension) and how they feel about it (affective dimension). All the interactive processes that occur between villagers and the lantern-fly (and the rest of the biotic elements from the surroundings as well) pass through these four dimensions. Despite being cryptic, nocturnal, solitary, silent, and rare, *Fulgora laternaria* stands out as one of the insects that has a cultural importance to these villagers. Its importance is not utilitarian, since this insect is neither a food nor a medicinal resource. Rather, it is 'good to think' in the Lévi-Straussian sense (Lévi-Strauss 1989). Some of the gender-based differences related to the ethnodiagnostic criteria (morphological, biological, and noxious criteria) which were attributed to the lantern-fly are shown in Table 1.

In the village of Pedra Branca, *Fulgora laternaria* is known by at least six different names. Twenty-five interviewees called it a *jitiranabóia;* eleven referred to it as a *jitirana;* nine treated it as a *cobra-de-asa;* eight referred to it as a *tiranabóia;* three termed it a *cobra-cega.* A single informant called it a *serra-velha.*

Several synonyms are found throughout Brazil. These are: *gitirana, jitirana, jaquiranabóia, jaquitiranabóia, jequitiranabóia, jiquitiranabóia, jaquitirana, jequitirana, jitiranabóia, tiranabóia, tirambóia, cobra-voadora, cobra-do-eucalipto, cobra-de-asa, cobra-do-ar, cobra-cigarra, serpente-voadora, gafanhoto-cobra, cigarra-doida, cigarra-cobra,* and *jacaré-namboya* (Becker 1976; Buzzi 1994; Cascudo 1972; Lenko and Papavero 1996). Ihering (1963), however, says that the term *jaquiranabóia* is the original term. Et-

TABLE 1.—Gender-based differences of the diagnostic criteria used to describe the lantern-fly (*Fulgora laternaria*) (Hemiptera, Fulgoridae) during open-ended interviews performed with 86 residents of the village of Pedra Branca.

	Gender			
Diagnostic criteria	Male (n = 41)	Percentage	Female (n = 45)	Percentage
Morphological criteria				
Head's conspicuousness	7	8.1	10	11.6
Absence of eyes	7	8.1	8	9.3
Absence of mouth	2	2.3	0	0
Presence of sting	13	15.1	7	8.1
Presence of eye spots	2	2.3	1	1.1
Presence of wax	1	1.1	0	0
Biological criteria				
Reproduction	1	1.1	0	0
Habitat (Serra da Jibóia)	8	9.3	9	10.4
Feeding habit	1	1.1	3	3.4
Host tree	8	9.3	2	2.3
Change to another being	2	2.3	0	0
Noxious criteria				
It kills/dries trees	13	15.1	22	25.5
It kills/dries people	12	13.9	15	17.4
It causes blindness	0	0	1	1.1
It is venomous*	12	13.9	19	22.0

* This noxious characteristic includes others like 'angry', 'bad', 'dangerous', 'harmful', and 'fierce'.

ymologically, the word *jaquirana* comes from the Tupi-Guarani language: ***ñakyrã*** means cicada (Sampaio 1995). In the 1926 issue of *Revista do Museu Paulista* the term *jakiranaboia* appears. According to Cruz (1935), it is a corruption of *andiranabóia,* which means a bat-like animal (*andirá*) with a snake body (*mboia*). Tastevin (1923) and Carrera (1991) corroborate the Tupi-Guarani origin for the word, which can be glossed as snake-like cicada (***yaki*** 'cicada', ***rana*** 'similar', ***mboya*** 'snake'). By using this folk name, indigenous peoples have recognized the resemblance between *Fulgora* species and cicadas. Both are jumping, free-feeding hemipterans. In folk biological classification systems, names that cross the boundaries of communities and extend to a larger region have gained great cultural significance (Berlin 1992).

In the nomenclature system of the Jibaro-Aguaruna Indians, the lantern-fly is known as ***manchi dapi*** (Guallart 1968). Among the Bororo Indians, the term ***aróe eporéu*** is the generic designation given to these insects; it means an insect similar in its external shape to a corpse wrapped up in mats (Albiseti and Venturelli 1962). The Xerente people call it ***anquecedarti,*** which means flying-snake (Posey 1986a). The Canela Indians who inhabit the south of Barra do Corda, Maranhão refer to it both as ***ka-no-iará*** and ***heganunui.*** Unfortunately, the etymology of these words has not been provided (Vanzolini 1956–58).

The Significance of the Insect's External Features for Naming and Folk Perception.—The abundance of terms currently used to designate the insects of the genus *Fulgora*

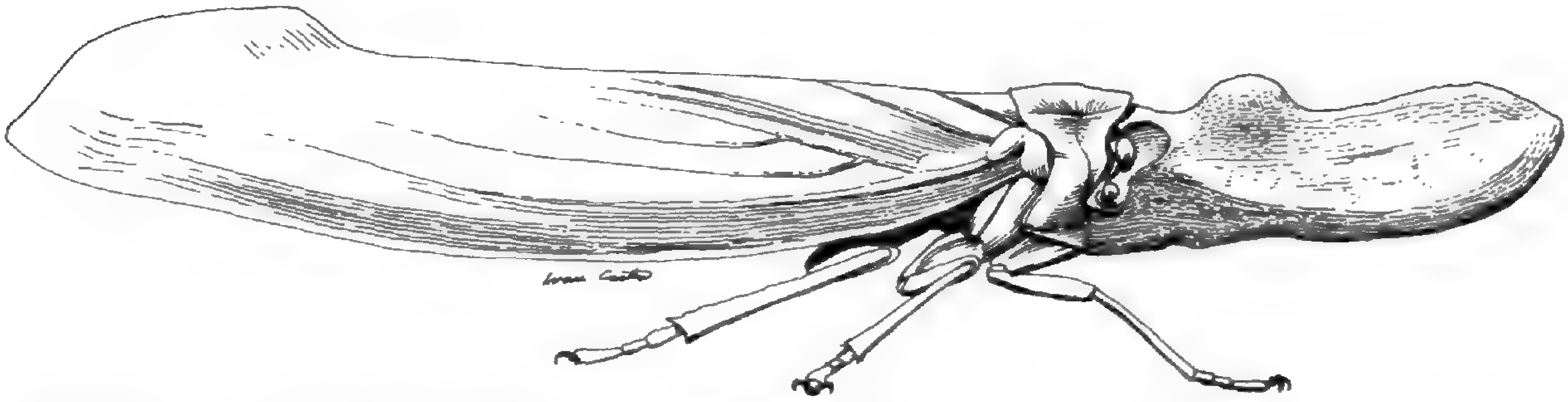

FIGURE 1.—Lateral view of *Fulgora* cf. *laternaria* L.; specimen is 50 mm long. (Drawing based on photograph of a specimen collected in the study area).

presumably results from their awesome appearance (Figure 1). When the informants talked about the insect, they mentioned the most prominent character—the head—whose shape reminded them that of a snake's or a cayman's head. A similarity to a chestnut was noted too, as can be seen in the following interviewees' assertions:

> The head is strange. It looks like a chestnut. (Mr. E., 62 years old)
>
> Its head looks like a cayman's head. (Mrs. E., 34 years old)
>
> The head is very ugly. It is like a snake. (Mrs. V., 58 years old)
>
> I am explaining that its head reminds [me] of an alligator's head. Have you ever seen it? It has a closed mouth and its head is spongy, very spongy, isn't it? It has nothing inside. And it is horrible. (Mrs. N., 38 years old)
>
> It looks like a moth, but its head is like a snake's. (Mr. P., 54 years old)

Much as people native to the region remark on the similarity of lantern-fly to snakes and crocodiles, scientifically-trained observers do, too. Gilmore (1986) comments on the insect's "swollen face, which is fantastically like a cayman's head, [and] even reproduces its protuberant eyes and sharpened teeth." Spix and Martius (1938) had already noticed this resemblance as they wrote the folk name *jacaré-mamboya,* the cayman-like snake. When Poulton (1932) described two specimens coming from the Brazilian Amazon, he reported that the entire visible surface of the insect in an attitude of rest (except the wings) reminded him of a cayman. As O'Brien and Wilson (1985) stated, members of *Fulgora* have a head that resembles a peanut (dorsal view) or the head of an alligator or cayman (lateral view). The scientific name given to *F. crocodilia* Brailovsky and Beutelspachen, 1978 from Mexico reveals the resemblance of this species to a cayman (Brailovsky and Beutelspachen 1978). A certain likeness with the head of snakes can be admitted, especially if the following features are taken into account: the lateral square maculae to the labial scales and pits of boids, and in some *Fulgora* species, a black spot between the false eye and nostril to the loreal fossa of arboreal pit vipers of the genus *Bothrops* (Hogue 1984). The insect has also been compared to a winged dragon (Cascudo 1972), and Hogue (1993) introduced the common name dragon-headed insect for *F. laternaria* based on the shape and mimetic pattern of the large head protuberance that he believed actually simulates the upturned head of a medium-sized, arboreal lizard.

According to Fonseca (1926), the structure of the cephalic appendix in this and other fulgorid genera of the Fulgorini tribe (*Phrictus* Spinola, 1839 and *Cathedra* Kirkaldy, 1903) is owed to the "extraordinary development of certain regions of its surface (vertex, front, faces, and so on), which extended forward like a bladder and constitute a gibbosity." Someone said the head is usually hollow, but there is a sac which is connected to the digestive system (Grassé 1952)—presumably sap can be stored there for later digestion.[2] It is believed that the frontal region's protuberance, which in some fulgorids is extended like a voluminous process similar to those of membracids' thoracic structures (Grassé 1952), is a defense against natural enemies (birds, lizards, and small mammals). However, there are no reports that confirm the protective advantage of this formation (Hagmann 1928). Birds, for example fly-catchers, are predators of other fulgorids, as shown by the analysis of stomach contents and photographs.[3]

Two folk species of lantern-fly seems to inhabit the region of the Serra da Jibóia. According to a single interviewee who provided that information, the true species of *jequitiranabóia* possesses a round head, whereas the false one is slender (Mr. T., 34 years old). Actually, one might hypothesize the existence of more than one species of *Fulgora* living sympatrically in this area, since three other species are found within the state of Bahia: *F. lampetis* Burm., 1845, *F. graciliceps* Blanchard, 1849, and *F. lucifera* Germar, 1821 (O'Brien 1989). Thus, further ethnotaxonomic studies are urgently needed. Perhaps accurate recording of trees on which eggs are laid would help.[4]

The 'sting' that everybody fears is nothing but the piercing-sucking stylet located in the middle line of the body and folded between the legs (Santos 1987). It is only when the insect is going to suck the phloem from plants that this long 'murderer dart' (Cruz 1935) is extended. Dukinfield Jones, who has spent many years in Brazil, corroborated the statement about the native superstitions by noting the insect had a poisoned spine or point at the end of its head that is capable of flying at a man's chest and inflicting a wound (Poulton 1928).

When people talk about the head, they always refer to the 'sting' as well. They think it is the vehicle the insect uses to 'inject the mortal poison':

> It has a sting in its belly. If it strikes a tree it dries up. It can be a jackfruit tree [*Artocarpus integrifolia* L.], it can be a coconut tree [*Cocus nucifera* L.], whatever. Even if it strikes a person he/she will die. (Mr. M., 57 years old)
>
> Its sting is beneath [the body]. In the moment it is going to sit on a person, then it stretches the sting out. (Mr. L., 41 years old)
>
> It has a mischievous sting. When it drives the sting against the tree it kills the plant. (Mrs. S., 82 years old)
>
> It is said that the danger is when it is furious. When it flies it extends the little beak ('sting') forward. Wherever that beak touches . . . Cause it is venomous . . . It is not fierce when it is calm. (G., 22 years old)
>
> It doesn't have a mouth but a sting. (Mr. E., 80 years old)

Another morphological characteristic that was emphasized by the informants refers to a presumed lack of eyes. Of 86 interviewees, 15 have called attention to the insect's blindness. One of the main reasons for the widespread panic when a lantern-fly is seen near the community is this supposed blindness. As stressed by Fonseca (1926), when the insect "flies in the middle of the living beings it slaughters lives without distinction of class." The following testimony describes the dread people feel about its zigzag flight: "That tiranabóia is like this. For example, people must have a lot of defense because . . . If it comes flying, where it . . . Because it is blind. It strikes. The tree dies. If a person, it is also said that [if] it strikes, [he/she] dies" (Mrs. E., 52 years old). However, the apparent blindness of the lantern-fly has been questioned by one of the informants: "People say it is blind. But what! Once I killed one and I saw two eyes like those of a cicada" (Mr. E., 62 years old).

Besides the head, the wings deserve some attention because of the eye spots: "It has marks like these on the wing. It looks like two eyes that we see when it flies" (Mr. E., 62 years old). On another occasion, this same informant said: "I know it is beautiful when the insect is flying because there are two eyes beneath the wings." One female informant compared the eye spots with those markings on the peacock's feathers. The literature records that *Fulgora laternaria* resembles an owl butterfly (genus *Caligo,* the 'witch' in the local perception) because the hind wings, shorter and wider than the fore wings, present large marks that look like the owl's eyes (Ihering 1968; Penny and Arias 1982). Such eye spots would seem to serve a startle or warning function as well (O'Brien 1989). As Ross (1994) states, false eyes are much more frightening when revealed unexpectedly, causing hesitation or delay, in a nervous predator's decision to attack.

Interviewees stressed the presence of 'ash' released by the insect. Fulgorids are known by their wax secretion, whose white filaments solidify in contact with the air and take the aspect of a substance resembling flakes of asbestos (Ihering 1968). Some species (e.g., *Cerogenes auricoma* Burmeister, 1835) produce elaborate trailing plumes of white wax from the abdomen. *Fulgora laternaria* do not develop this trailing plume, but the thin, white, powdery wax is often so abundant that it covers part of the insect's body. This helps the insect to look like the lichens or scars on the bark (Carrera 1956). In fact, fulgorids' primary defense is their ability to be homochromous with the substrate on which they live (Robinson 1982). The white powder that covers its body has been regarded as a strong emetic. The simple inhalation of it was enough to provoke vomiting (Burmeister 1952). This secreted wax is considered highly aphrodisiac in Colombia (Anzola 2001).

How the Lantern-fly Was Categorized.—The way the villagers of Pedra Branca perceive the *jequitiranabóia*'s external morphology plays a preponderant role in their ethnoentomological classification system. The shape of the head, the presence of eye spots on the hind wings, the presence of a 'sting', the wax production, and the presumed absence of mouth and eyes are all salient features that contribute to the imaginary construction of an animal potentially deadly to men, animals, and plants. Depending on the way informants perceived the lantern-fly it could be assigned to five distinct ethnosemantic domains. About 47% of the 86 interviewees classified it as a snake, 10% of them regarded it as a moth, 8% classified it as a cicada, 3% considered it as a beetle, and 1% thought about it as a grasshopper. This ethnocategorization appears in the local expression "It is a kind of." The other 32% of the respondents gave no information related to the insect's folk classification. Some examples of the informants' statements concerning the insect ethnotaxonomy are cited below:

> It is a beetle, but it has the shape of a snake. (E., 24 years old)
>
> It imitates a moth when its wings are folded. (Mr. A., 56 years old)
>
> It is a large insect resembling a moth. It has a caterpillar's face. (Mrs. M., 55 years old)
>
> A brave beetle. It is not a snake, but a beetle. (Mr. Q., 33 years old)
>
> It is a snake, isn't it? A winged-snake. (Mr. Z. P., 108 years old)
>
> It is a kind of grasshopper . . . (Mrs. L., 78 years old)
>
> People say it is a venomous snake and it is a kind of cicada. (Mr. D., 78 years old)

In Pedra Branca, the continual inclusion of *Fulgora laternaria* in the 'snake' domain and the strong aversion to it was observed through the projective tests. When a villager captured one specimen, he did not touch it and he was followed by a small group of curious people who wanted to see the weird creature more closely. On that occasion, they warned that a winged-snake should not be handled! One informant, who wondered about the presence of 'feet' (legs) as she was looking at a picture, questioned the insect's classification as a venomous snake: "Is this the winged-snake? Even on photograph I had no knowledge about it. A footed-winged snake? It resembles much more an insect, a thing. With leg and everything! Snake creeps" (Mrs. T., 68 years old).

As it was noted, 'snake' was the ethnosemantic domain used by the majority of the informants to classify the *jequitiranabóia.* Yet snake (the animal itself) can be also considered as a kind of insect, since the lexeme 'insect' includes other taxa beyond Insecta in the ethnobiological classification systems. For example, the Pankararé Indians from Brejo do Burgo village, northeastern Brazil, view snakes as 'insects' because they cause damage to people and domestic animals (Costa-Neto 1997). However, the boa (*Boa constrictor* L., 1768) is not considered an 'insect' because it is useful (they eat it as food). Costa-Neto (2000a) has explained the way human societies construct the ethnocategory 'insect' through the Entomo-projective Ambivalence Hypothesis: human beings tend to project attitudes and feelings of harmfulness, danger, irritability, repugnance, and disdain toward non-insect animals (e.g., toads, rats, scorpions, vultures, snakes, bats, lizards, earthworms, spiders, among others), by associating them with the culturally defined category 'insect'. The idea of ambivalence comes from sociology and relates to the attitudes that oscillate among diverse, and sometimes, antagonistic values. Projection results from the psychological processes by which a person attributes to another being the reasons for his/her own conflict and/or behavior. Accordingly, 'insects' can be seen as a representational category since they become metaphorical realizations of other beings or their qualities (Greene 1995). Nolan and Robbins (2001) state that the organization of ethnozoological semantic domains ('mammal', 'snake', 'bird', 'fish', 'insect', etc.) is influenced both by the emotive meaning and the culturally constructed attitudes toward these domains. Indeed, the way people perceive, identify, categorize, and classify the natural world changes the way they think, act, and feel in relation to the animals.

As Posey (1986b) points out, folk biological classification systems do not always fit in classificatory schemes that biology artificially attempts to organize. Thus, cognitive categories cannot be considered as universal and must be inferred through a methodological approach that allows the researcher 'to discover' the conceptual paradigms instead of impose them on the society under study (Posey 1987). For example, in their folk entomological classification system the Kayapó Indians from the Brazilian State of Pará categorize animals with shells and no flesh as equivalent to insects (Posey 1983). To the Ndumba, an ethnic group that lives in the highlands of New Papua Guinea, *tovendi* is an ethnocategory that refers to all insects and arachnids (Hays 1983). In some contexts, however, *tovendi* can be assigned to inedible animals (e.g., some types of toads), while in other contexts it can mean any creature considered disgusting (e.g., snakes).

Considering Berlin's principles of categorization (Berlin 1992), the term 'insect' and its similar (emic) equivalents usually represent the level of classification associated with a life-form category. This level of ethnobiological classification is, according to Berlin, the broadest classification of organisms in groups that are apparently easily recognized on the basis of innumerable morphologic characters. Studies of Brazilian ethnoentomology have shown, however, that in folk zoological classification systems the life-form 'insect' is identified and described based not only on morphologic and biological characters, but especially on the psycho-emotional criteria, which are very important when someone is naming the organisms. In other words, folk taxonomies are based not only on the knowledge of biological characteristics (cognitive dimension), but also on feelings (affective dimension), beliefs (ideological dimension), and behaviors (ethological dimension).

Traditional Knowledge Concerning the Lantern-fly's Ecological Aspects.—Informants' folk entomological knowledge based on habitat has revealed that *Fulgora laternaria* lives on the trunk of a tree species that appears to be more common in the Serra da Jibóia than in the other hills. According to two key informants, the *jequitiranabóia* "stays on the *pau-paraíba*" (*Simarouba* sp., Simaroubaceae). As one of them has said, "[One] can go anytime and find it. Sometimes, two or three are on the same wood" (Mr. E., 62 years old). The other has added: "Now, through the bushes, there is a wood that is said it is where it stays more. It is on that *pau-paraíba* (. . .). Who knows, sees and says: 'That is the *jitiranabóia* over there'" (Mr. Q., 64 years old). Eight other informants have confirmed the association between the insect and this tree. Because the insect is always seen on the trunk of this tree, people generally associate its emergence with spontaneous generation; that is, they think the insect is born naturally from the wood: "It comes from the *pau-paraíba*" (Mr. Q., 64 years old).

At the end of the nineteenth century along the Bahian south coast, lantern-fly was already known as *bicho do pau parahy'ba* because it frequented this tree

(Branner 1885). Bondar (1931) stressed that *F. laternaria* lives on *Simaba versicolor* St. Hilaire in Bahia State. Lantern-flies and several other species of Fulgoridae were observed and collected on trunks of *Simarouba amara* Aublet in Santarém, Pará, and in the region of Marmoré River, in Bolivia (Poulton 1932).

The preference for a given tree species has been proved by Johnson and Foster (in Hogue et al. 1989). In a study carried out in a period of five years at Santa Rosa National Park in Costa Rica these authors observed that 98 of 100 adult *F. laternaria* were seen on trunks of *Hymenaea* sp. (Fabaceae). This preference has a scientific explanation. Fulgoromorpha are generally closely associated with their host-plants that give them food, shelter, and protection against predators (Penny and Arias 1982). Different plants are known hosts to different species of *Fulgora*. It has been proposed that these plants serve as hosts to *Fulgora* spp. because they either produce and concentrate resins, oils, or bitter substances in their sap, possibly generating allelopathic chemicals: Simaroubaceae—*Simarouba amara* Aublet, *Simaba versicolor* St. Hilaire; Fabaceae—*Hymenaea oblongifolia* Lee and Langenheim, *H. coubaril* L., *Myroxylon balsamum* (L.) Harms; Rutaceae—*Zanthoxylum* sp.; Lecythidaceae—*Lecythis* sp.; Vochysiaceae—*Vochysia tucanorum* Martius; Bignoniaceae—*Jacaranda acutifolia* Humboldt and Bonpland; Apocynaceae—*Aspidosperma tambopatense* Gentry; Euphorbiaceae—*Hura crepitans* L.; Myrtaceae—*Eugenia oerstedeana* Berg., *Eucalyptus* sp. (Cruz 1935; Hogue 1984; Johnson and Foster 1986; Lenko and Papavero 1996; Poulton 1932).

Informants have also mentioned that the *jequitiranabóia* stays fixed to the tree when it dies: "In the place it sits, it stays. There it fixes the sting and does not get out. Then, it dies in that place" (Mrs. L., 66 years old). Another said: "The ancient ones told that the insect had a manner of sitting on green wood. It sat for a long time. Then, it weakened and died" (Mr. M., 68 years old). This fixation to the tree trunk due to its death has been reported also by Francisco Peres de Lima, in 1938 (Lenko and Papavero 1996).

Another fulgoroid species was collected on trunks of *Simarouba* sp. while we looked for *Fulgora* specimens at the upper slopes of the Serra da Jibóia. In those occasions, a key informant considered the insects as the lantern-fly's 'daughters'. (These are currently under taxonomic analysis.) Hogue (1984) recorded the presence of over 20 specimens of *Lystra lanata* (L., 1758) as he was examining *Simarouba amara* in the vicinity of Iquitos, Peru.

Informants also told us about the insect's origin. Individuals from older generations believe that the *jequitiranabóia* has come from the *sertão* (Brazilian arid midland): "There wasn't that kind of snake here. We only knew it through stories. Because they [people] say it is from the arid midland" (Mrs. E, 52 years old). According to another informant, the lantern-fly has come in the Serra da Jibóia because "it accompanied the herds of cattle that came from the *sertão*, from distant places" (Mrs. M., 62 years old). A third informant has stated that this insect has come from the South (of Bahia State?). The notion that this fulgorid comes from this arid environment was once used by the lexicographer Cândido de Figueiredo in his incongruous entry: "Venomous butterfly from the *sertão*" (Santos 1987).

Traditional and Scientific Knowledge of Jequitiranabóia*'s Feeding Habits.*—Villagers of Pedra Branca referred to the insect's feeding habits: "It feeds on the humidity of the wood" (Mr. E., 88 years old) because it "sucks from the plant" (Mrs. M., 30 years old). This "humidity" to which the informant referred can be interpreted as the sap, since fulgorids feed exclusively on trees and woody shrubs. They introduce their mouth apparatus ('sting' or 'beak') through the plant's bark and feed on phloem by turgor pressure (O'Brien and Wilson 1985). Apparently, the informants did not recognize the host tree (*pau-paraíba*) as being the source of food for *Fulgora laternaria.* Johnson and Foster (1986) reported that the phloem of *Simarouba amara* lies just below the smooth, thin outer bark. These authors stressed that this species possesses a phagostimulant on its trunk called simarolide, which is a quassinoid that probably is responsible for the insect's great attraction to this tree.

When hemipterans feed on phloem with an imbalance (for insects) of amino acids, they are able to obtain the food they need through symbiotic associations with microorganisms that live inside specialized cells known as mycetocytes (Chapman 1994). All Fulgoromorpha appear to have more than one type of mycetocyte microorganism and, in Fulgoridae, both yeasts and bacteria are present. Some species have as many as six different symbionts.

The Terrible Effects of its Sting.—The alleged 'deadly attack' on plants and human beings was the most cited and the best known of the *jequitiranabóia*'s behaviors. Since the insect is often perceived and categorized as a snake, people analogically confer on it the same fear they feel for the ophidians. Thus, the following testimonies were recorded:

> I have heard people talking about the *jitiranabóia.* That it is too venomous. I have heard my mother saying that the plant died whenever it was sat on. And there wasn't that snake here. (E., 24 years old)
>
> People fear it because it stings. It is like a snake. The poison that a snake carries it carries too. (Mrs. M., 55 years old)
>
> It is a dangerous snake. If it strikes a person it kills her. If it stings even wood the plant dies. (Mrs. E., 82 years old)

Although many informants mentioned the danger posed by the *jequitiranabóia,* there were individuals who questioned the risks attributed to having any dealings with it: "I don't know. If it was like that many [trees] have already died in the forest" (Mrs. G., 41 years old); "People say it is venomous, but F. (19 years old) took a look at the dictionary and found it is not" (Mrs. E., 52 years old). Carrera (1991) points out that the damages caused to the plants by its sting are insignificant and never result in death. Furthermore, these insects are too scarce to be harmful to trees (Ross 1994). Some fulgoroids, however, produce honeydew. This is a sweet, watery excrement that serves as the substrate for the growth of sooty mold. This blackens the leaf, decreases photosynthesis activity, decreases vigor, and often causes disfigurement of the host (Kessing and Mau 2001). Planthoppers also damage plants by ovipositing in plant tissues and by feeding in the phloem, sometimes spreading a variety of plant pathogens. At least three species of the Fulgoromorpha family Cixiidae are suspected vectors of the lethal yellowing of Canary Island date palms in Texas (Meyerdirk and Hart 1982). Considering our informants' testimonies, many of which have stated that trees passed away due to the injuries brought about by the lantern-fly, it could be deduced that this insect probably bears some kind of deleterious virus or bacteria. Maybe one can make a case for carrying out a phytosanitary investigation on those trees struck 'dead' by it.

On the other hand, Janzen has seen *Fulgora* ovipositing and feeding for years on the same trees in Costa Rica, students at La Selva in Costa Rica can point out trees that have had *Fulgora* on them for several years, and that is true also in Belize in Rio Bravo Conservation Area.[5]

When asked about the occurrence of possible cases of injury and/or death caused by the 'attack' of a *jequitiranabóia* to any member from the village of Pedra Branca, or elsewhere, the informants replied that no real incident has ever been registered. Even so, the belief persists:

> It is spoken that if someone is stung he will die. But nobody ever saw anyone die. (Mrs. E., 34 years old)
>
> Here, when a tree dies, then they say soon: "That tree over there has died because the *jitirana* has rested on." But people have not died here. (Mrs. V., 58 years old)
>
> I've never heard [about any case of death], but we feel as soon as we see some trees in the forest, all dried up, with wrinkled leaves, and completely lifeless without any reason. It's just been caused by the insect itself. (Mrs. P., 80+ years old)

In the mid-nineteenth century, the lantern-fly was thought to kill animals and trees. Branner (1885) recorded that along the Amazon, when a monkey suddenly came tumbling down dead from the forest canopy without any apparent cause, it was said that he had been struck by the fatal *jequitiranabóia*. Branner cited a Spanish-American newspaper published two years before, which reported that this insect was said to be destroying the cattle of Brazil in the grazing country of the southern provinces. The idea that *Fulgora* is very poisonous is so deep-rooted in common attitudes that even an entomologist from the Rio de Janeiro National Museum blamed contact with the animal when he felt bad (Lenko and Papavero 1996). Stories of dramatic and tragic encounters abound in the literature. Bates, an eminent British entomologist who collected insects for eleven years along the Amazon River in the nineteenth century, was once told that one of these 'dangerous' creatures suddenly emerged from the forest and attacked and killed eight of a nine-member boat crew (Bates 1943).

Apparently, the evil attributed to the insect is not a simple belief at all. According to Hagmann (1928), *Fulgora laternaria* may sting when carelessly handled. And incidental circumstances may render it toxic, as when it feeds on sandbox tree (*Hura crepitans* L., Euphorbiaceae) or other plants that produce toxic or noxious allelopathic compounds. Then, it extracts those chemicals and makes itself a bearer of fatal toxins (Orico 1975). It is known that certain insects sequester toxic secondary plant compounds and store them in their bodies, and in this way gain protection from predators and pathogens (Engel 2002). Fortunately, no case of death resulting from the attack of a *jequitiranabóia* has been found in the scientific literature.

If the insect is inoffensive, then what is the basis for such a terrifying tradition? Surely, the physical resemblance with ophidians is a reasonable explanation. But the origin for this fear may be also found in indigenous myths and legends. However, little if any information concerning its presence in native mythology is available. In an Amazonian legend about the Matintaperera, the lantern-fly is used as an instrument of torture (Lenko and Papavero 1996). Because of its anomalous morphology medicine men of many Amazonian tribes regard the insect as magically powerful and carry it (dead) in their amulet bags around their neck (O'Brien and Wilson 1985).

Some indigenous groups seem to consider the insects (or at least some of them) to be the tangible manifestation of ominous principles; these principles sometimes are attributable to the activity of some malevolent medicine men (Cesard et al. in press). To the Pälawan people, aggressive and poisonous animals such as ***älupjan*** (centipede), ***bäncanawa*** (scorpion), ***kätimamang kätimamang*** (bird-spider), and ***säli*** (snake) are said to be owned by malevolent non-human agents such as Länggam to whom they are totally obedient and friendly (Novelino 2002). The Munducuru Indians regard lice as the true materialization of the willingness of some animals to cause illnesses. The Yora/Yaminahua Indians of the Peruvian Amazon attribute a great number of illnesses to the malevolent spirits of noxious invertebrates such as wasps, which are blamed for gastrointestinal conditions, and a caustic millipede known as ***xaco***, which is associated with respiratory conditions. These Indians also blame urinary tract infections on termite spirits: "If one urinated on a termite mound, the termite would take vengeance and cause painful urination" (Shepard 1999). In fact, the belief in vengeful spirits of stinging insects is part of the Amerindian societies' folklore, which associates wasps and bees with a variety of mythical forces (Shepard 1999).

Different reasons for the consistent human aversion towards insects and other invertebrates, especially among many Westerners, have been proposed in the scientific literature (e.g., Kellert 1993). One suggests that people have an innate fear of potentially dangerous insects, which was generalized to include other animals. Another explanation is the association of invertebrates with illnesses and human habitation. A third is suggested by the notion of human alienation to creatures so different and distinct from our own species. To Laurent (1995), the general shape, the morpho-ethological aspects, and the negative sensations people attribute to the animals (e.g., disgust, revulsion) are reasons that explain man's aversion to the invertebrates, particularly to the insects. In general, more positive attitudes towards invertebrates can be found when these animals possess aesthetic, utilitarian, ecological or recreational values (Kellert 1993). In contrast, East Asian peoples have a more balanced perspective regarding insects, where most of them are considered to be aesthetically pleasing, good to eat, interesting pets, subjects of sport, enjoyable to listen to and useful in medicine (Pemberton 1999). Although a genetically inherited process cannot be ruled out, there are a number of theories which allude to cultural and social transmission of some common animal fears (Davey 1994; Matchett and Davey 1991).

Due to the socially constructed behaviors toward the *jequitiranabóia,* people of

Pedra Branca regard it as an organism that must be exterminated or dreaded whenever it is found. Such an affective representation, which occurs in the brain's limbic and neocortical organs (Soulé 1997), is done through images, stereotypes, and interpersonal myths. Since individuals are acting for 'rational' reasons (although scientifically incongruous), it can be said that the set of knowledge (= corpus) about the lantern-fly may be characterized as a kind of cognition that Anderson (1996) calls "hot cognition." According to him, the "hotter" the cognition of a given object is the better individuals will tend to think, know, speak, and act upon it. It is precisely because the lantern-fly represents a "potential danger" to human beings that it deserves some attention. That is why people generally know something about it, even though they have never seen the insect either *in situ* or *in vivo.* As Anderson (1996) emphasizes, emotional factors drive cognition.

Traditional Knowledge of the Lantern-fly's Reproduction.—With regard to the traditional knowledge related to the lantern-fly's reproductive behavior, we have just recorded information on the moulting process of the juveniles into adults. A key informant mentioned: "The daughters are black. Then, they transformed into large [insects] and change the color. Now, it changes its shape while it is growing. It is this same kind" (Mr. E., 62 years old). Another said: "The wood raises a beetle that originates it" (Mr. E., 88 years old). Although these informants know something about the metamorphosis process involving these insects, the 'daughters' actually were the adults of another fulgoroid species. At first sight we might think that such a classificatory relationship between two different species is a perceptive anomaly, but this parent-offspring relationship is based on a belief about ontogeny or origin which indicates a close similarity between them (Ellen 1985).

It is known that hemipterans develop through paurometaboly, which means their metamorphosis is gradual and inconspicuous (Kessing and Mau 2001). Apparently, Hagmann (1928) was the first scientist who described the nymph of *Fulgora laternaria.* He referred to it as a larva, very weird due to the shape of its long, cylindrical head (Figure 2). It resembles the adult in the possession of the inflated head structure but is wingless and much smaller.

There is little scientific knowledge about the *jequitiranabóia*'s reproduction and life history. Fonseca (1926) stated that "both sexes show the same color, design, and size, so that unless by the genitalia characters no superficial difference exists." The female has a reduced ovipositor, externally smaller that the male external genitalia (O'Brien and Wilson 1985). Literature records data concerning mating and oviposition, which occur on the host plants. Eggs are laid in masses on the surface of bark and glued together with a collateral fluid and covered with wax secreted from the abdomen (O'Brien and Wilson 1985). According to R. W. Hingston (in Hogue 1993:240), this structure is similar to a mantid egg case.

Local impressions of its transformation into another animal have been also recorded: "People say it turns into a *cobra-de-cipó* [maybe *Philodryas* sp., Colubridae]" (Mr. C., 32 years old). But this was a misconception, since the *jequitiranabóia* has been mistaken for the praying mantis (Mantodea). In the local classification system, mantids and phasmids are thought to arise from the branches and twigs of verbena (*Lantana camara* L., Verbenaceae) and change into snakes.

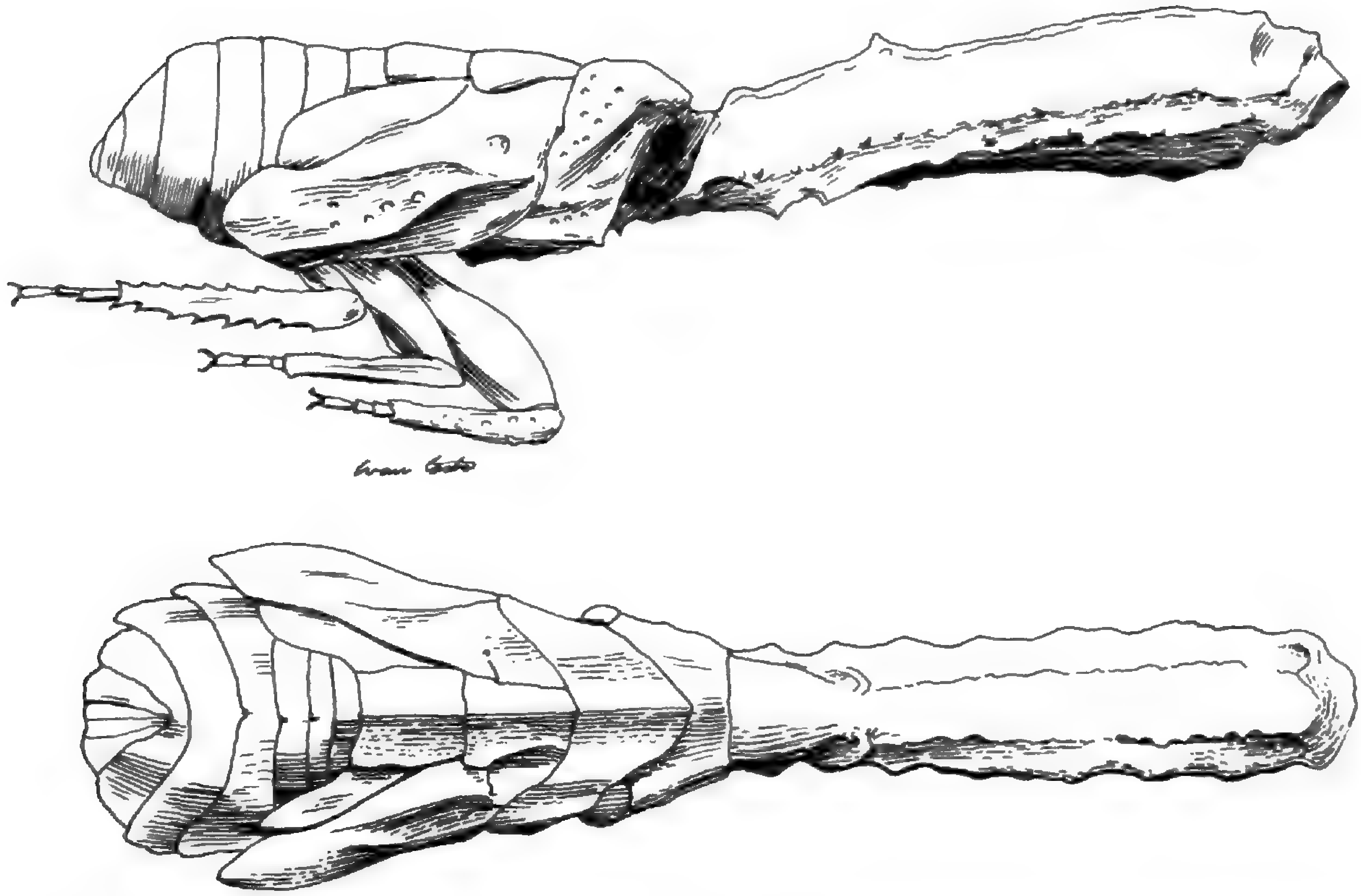

FIGURE 2.—Lateral and top views of the nymph of *Fulgora laternaria* L.; specimen is 68 mm long. (Redrawn from Hagmann 1928).

Other Behavioral Patterns.—Lantern-flies can drum their heads against the trunk of a tree if molested.[6] The informants have not commented on such behavior. The phenomenon of bioluminescence, which was first recorded by Nehemiah Grew in late 1681 and corroborated by Maria S. Merian's book *Metamorphosis Insectorom Surinamensium* published in 1705 (Ross 1994), was not mentioned by them, either. It is interesting to note that Grew erroneously attributed light produced by beetles of the genus *Pyrophorus* to *Fulgora.* Many discussions have followed since then. Ridout has studied that aspect with fast frozen specimens, and could not get a response using the chemical components of all known biological luminescence systems.[7] However, a luminescence in *Fulgora* may be observed and it is owed to the occasional, and generally deadly, appearance of pathogenic bacteria that develop on the abdomen and into the anterior intestinal caecum that is accommodated in the cephalic prolongation (Grassé 1952; Ihering 1968). The Amazonian peasants still believe that *F. laternaria* produces a type of prolonged sound in the evening similar to the whistle of a train. However, it is the cicada *Quesada gigas* Olivier, 1790 that produces this stridulation (Lenko and Papavero 1996).

When persistently and sufficiently molested, *Fulgora* species may emit a volatile, fetid defensive chemical released as a "skunk-like spray" (Janzen and Hogue 1983). However, no glands specifically for the production of noxious odors seem to exist in the insect's body. Hogue (1984) suggests that such volatiles could reside in the body's covering of wax. Additional information on its behavior is found in Fonseca (1926), who writes:

> They stay motionless, phlegmatic, for hours in one spot, by placing them-

> selves in a manner that their heads are always turned toward the top of the tree. I have never seen them at another position. They are neither brave nor noisy like cicadas. They let anyone get close to their immediate proximity and extend the hand to catch them. Then, they move slowly and cautiously to the other side of the trunk. When very bothered they leisurely rise over their legs, and by impelling the body with the former legs, they fly to another nearby tree, producing a muffled sound with the vibration of the wings during the flight.

Of Lantern-flies, Storms, and Electricity.—Fulgora laternaria's rare appearances in the village of Pedra Branca are linked to the storms and rains (what an amazing relationship with the Roman goddess Fulgora!), and invariably it is seen resting on electric poles. As informants say:

> In times of thunderstorms, of strong thunders, [in] the other day you can look [and] you find it on electric poles. (Mr. J., 78 years old)
>
> As soon as the electric light has come more than 50 [insects] have appeared on electric poles. (Mrs. M., 36 years old)
>
> It gets down from the 'Serra da Jibóia' when it is raining. (Mr. F., 40 years old)
>
> As soon as the light has come, people [the parents] didn't allow anybody to get out. They said: 'The snake is crazy! The snake is crazy!' (Mr. V., 36 years old)

The insects of the family Fulgoridae are luciphilous;[8] artificial light spots often attract them (Poulton 1932). Fonseca (1926) has noted that "sometimes these insects look for light, at night, landing on electric poles or entering through the windows wherever there is some clarity." After the introduction of electric energy in the village of Pedra Branca, people came into more regular contact with invertebrates. Dozens of different insects (e.g., moths, beetles, katydids) and their natural enemies, attracted by luminosity inside the houses, came in. In fact, the establishment of electricity caused great cultural changes. An informant mentioned that electricity was the reason they felt apprehensive about the insects. The electric poles were placed along the village's main street, so most of the trees that bordered it have been cut down in order to avoid harboring during the day the insects that were attracted to the lights at night.

Of the *jequitiranabóia*'s nocturnal activity, one key informant has said it 'walks' only at night (Mr. E., 62 years old). Hogue (1984) says that specimens of *Fulgora laternaria* typically rest during the day on the trunks of trees. They position themselves vertically with their anterior protuberance uppermost and elevated at an angle away from the substratum. As Johnson and Foster (1986) pointed out, the vertical position may be a conservative characteristic of the family Fulgoridae. Hogue (1984) sees in this posture a mimetic correspondence similar to that assumed by certain arboreal Iguanidae lizards. According to him, these insectivorous lizards probably are the lantern-fly's closest predators; thus, the insect tries to resemble them.

Conservation Status of Fulgora *spp.*—Considering the actual environmental situation in the region of the Serra da Jibóia, it could be thought that the local subpopulation of *Fulgora laternaria* might be particularly at risk of extinction. The two main anthropogenic causes of forest fragmentation and associated loss of entomofauna are the expansion of cattle-raising and the extraction of wood, which still occurs clandestinely. Conspicuous species, due to their associated ecological specializations, often live in closed or sedentary populations that are considered to be especially threatened by habitat fragmentation (van Hook 1997). Considering the conservation status of Brazilian primary forests, it is reasonable to expect that some species of *Fulgora* may be present in some red list of threatened animals in the near future. In Venezuela, *F. laternaria* is already listed as one.[9] In 1932, Poulton noted that this species was rarer than it was 20 years before. Gabriel Mejdalani,[10] a researcher from the Rio de Janeiro National Museum and specialist in leafhoppers (Hemiptera, Cicadellidae), believes that lantern-flies may be vulnerable since they inhabit "the interior of primary forests on the thickest trunks of the oldest trees." Actually, they are relatively rare because they exist in low population densities. To O'Brien, the conservation of *Fulgora* spp. is conditioned by the maintenance of forest preserves.[11]

It is widely known that public support for conservation continues to rest on emotional rather than intellectual motives, and has been garnered primarily by cute and cuddly vertebrates (van Hook 1997). As van Hook points out, humans most readily learn about, care about, and make sacrifices for animals that are visible, familiar, aesthetically appealing, and that demonstrate positive benefits to mankind. Innate fear of insects may also create obstacles to their conservation, especially when species are inconspicuous, unattractive, and economically unimportant (Kellert 1993). Thus, as a main contribution of the present research for the conservation of *F. laternaria* and their kin, we would suggest an environmental education program especially built on emotive basis in order to change, or at least diminish, people's feelings of fear and aversion towards fulgorids. It is hoped that the data now available will be incorporated into a curriculum by those researchers interested in biology conservation and ethnobiology as well.

CONCLUSION

The set of knowledge, beliefs, feelings, and behaviors that individuals from the village of Pedra Branca possess related to *Fulgora laternaria* shows that it has some cultural importance. Although people fear it, they think about it and put it in their oral literature. In general, local knowledge of its ethnotaxonomy, ecology, feeding habits, and behavior is in agreement with the scientific entomological knowledge. According to the ethnotaxonomic classification system, more than one species of *Fulgora* may live sympatrically in the area of the Serra da Jibóia. A further systematic taxonomic survey would clarify this point.

The way local people behave toward the *jequitiranabóia* results from their perceptions of and feelings about it. Because *F. laternaria* is categorized into different ethnosemantic domains, especially 'snake', the entomoprojective ambivalence hypothesis is reinforced. Although it is perceived as deadly poisonous, no actual case of injury or death has been recorded. Even so, the culturally constructed attitudes toward it make people kill it whenever they find one.

The subpopulation of *Fulgora laternaria* living in the area of the Serra da Jibóia might be at risk of extinction due to anthropogenic factors. Local people should be involved if we are to achieve an efficient strategy for the conservation of *Fulgora* and other species. Thus, folk entomological knowledge would not only assist researchers in their understanding on the ecological role played by insects, but also would help them to comprehend native cultures (Blake and Wagner 1987). Additionally, decision-makers would be able to apply proper conservation programs and management practices only if they recognized that the cultural perspective is to be taken into account in every debate focused on biological conservation policy (Costa-Neto 2000b).

NOTES

[1] Its taxonomic identification deserves more attention, since other three species inhabit the Atlantic rain forest in Bahia State.

[2] Dr. Lois O'Brien, Florida A & M University, Tallahassee, personal communication, 2001.

[3] Dr. Lois O'Brien, personal communication, 2001.

[4] Dr. Lois O'Brien, personal communication, 2001.

[5] Dr. Lois O'Brien, personal communication, 2001.

[6] *Fulgomorpha* Lists on the Web [on-line: http://flow.snv.jussieu.fr/introduction/fulgores_en.html] (verified December 17, 2002)

[7] Dr. Lois O'Brien, personal communication, 2001.

[8] Entomologists' most common way of collecting Fulgoridae is by hanging a night light or an ultraviolet light in front of a white sheet hung on a line between trees. Lois O'Brien, personal communication, 2002.

[9] Fundación Polar, Caracas [on-line: http://www.fpolar.org.ve/librorojo/insectos.htm] (verified January 13, 2003)

[10] Dr. Gabriel Mejdalani, Departamento de Entomologia, Museu Nacional, Rio de Janeiro, letter dated July 5, 2001.

[11] Dr. Lois O'Brien, personal communication, 2001.

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MARKETS AND THE USE OF WILD ANIMALS FOR TRADITIONAL MEDICINE: A CASE STUDY AMONG THE TSIMANE' AMERINDIANS OF THE BOLIVIAN RAIN FOREST

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ABSTRACT.—The use of animal parts for traditional medicine is growing in Africa and developed nations of Asia, and persists among African and Asian immigrants in developed nations. The practice undermines wildlife conservation. We contribute to studies of the use of wild animals for traditional medicine by: 1) focusing on an Amerindian society (Tsimane') in the rain forest of Bolivia, 2) using a large sample (n = 508) of households selected at random, and 3) using multivariate regressions to test hypotheses about how markets affect the use of wild animals for traditional medicine. We find that the average adult uses only a few wild animals and obtains only a few parts to treat only a few human ailments. Markets exert unclear effects on people's use of wild animals for traditional medicine. Some proxies of markets (e.g., wages) correlate with a lower probability of using animals for medicine, but other proxies (e.g., cash income) correlate with a higher probability. Animal abundance in the village, income, and prices for modern medicines correlate with a higher probability of using animals. In the Bolivian rain forest, the use of animals for traditional medicine does not threaten conservation as it does elsewhere in the world.

Key words: medicines, Amerindians, animals, Tsimane', Bolivia.

RESUMEN.—El uso de animales para medicina tradicional está creciendo en África y en los países desarrollados de Asia, y persiste entre los inmigrantes asiáticos y africanos que viven en países desarrollados. Esta práctica daña la conservación de la vida silvestre. Este artículo contribuye a la investigación sobre el uso de animales silvestres para medicina tradicional porque 1) estudia una sociedad amerindia (los Tsimane') en la selva tropical de Bolivia, 2) utiliza una gran muestra de hogares seleccionados al azar (n = 508), y 3) usa regresiones multivariables para comprobar hipótesis sobre el efecto del mercado en el uso de animales como medicina tradicional. Los resultados muestran que típicamente un adulto usa pocas partes de pocos animales silvestres para tratar pocas enfermedades humanas. El mercado ejerce un efecto ambiguo en el uso de animales para medicina tradicional. Algunos estimadores del mercado (e.g., el salario) se correlacionan con una menor probabilidad de usar animales para medicina, mientras que otros estimadores (e.g., los ingresos monetarios) se correlacionan con una mayor probabilidad. La abundancia de animales en la comunidad, los precios de las medicinas modernas, así como salarios correlacionan con una mayor probabilidad de usar animales. En la selva tropical de Bolivia, el uso de animales para medicina tradicional no representa una amenaza para la conservación, como ocurre en otras partes del mundo.

RÉSUMÉ.—L'utilisation de parties animales dans la fabrication de remèdes traditionnels augmente en Afrique et dans les pays en développement d'Asie, et persiste parmi les immigrants asiatiques et africains habitant dans les pays développés. Cette pratique porte atteinte aux efforts de protection de la faune sauvage. Pour cette étude nous avons suivi la démarche suivante: 1) travail centré sur une société amérindienne (les Tsimane') dans la forêt tropicale bolivienne, 2) utilisation d'un large échantillon de foyers sélectionnés au hasard (n = 508), et 3) utilisation de régressions à plusieurs variables pour vérifier les hypothèses concernant l'effet des marchés sur l'utilisation d'animaux sauvages dans la médecine traditionnelle. Les résultats montrent qu'un adulte moyen n'utilise que peu d'animaux sauvages, et seulement quelques parties de l'animal, pour quelques maladies seulement. Le marché exerce un effet incertain sur l'utilisation d'animaux dans la fabrication de remèdes traditionnels. Certains estimateurs du marché (ex: les salaires) correspondent à une probabilité inférieure, d'autres (ex: revenus en espèces) à une probabilité plus élevée. Dans les communautés où les animaux sont abondants, les salaires bas, et le prix des médicaments modernes élevés, la probabilité est plus grande. Dans la forêt tropicale de Bolivie, contrairement à d'autres régions du monde, l'utilisation de parties animales dans la fabrication de remèdes traditionnels ne représente pas une menace pour la conservation de la faune.

INTRODUCTION

Amerindian societies in the tropical rain forests use a wide range of native plants to treat human ailments (Reyes-García 2001), but there is limited evidence to suggest that they also use wild animals to treat human ailments. Costa-Neto and his colleagues have documented the widespread use of fish, insects, and terrestrial animals to treat human ailments among fishermen and town dwellers in the semi-arid regions of northeast Brazil (Costa-Neto 1998; Costa-Neto and Marques 2000; Costa-Neto and Oliveira 2000). As part of a broader study on social integration among the Kiriri Indians of the semi-arid zone of the state of Bahia, Brazil, Bandeira (1972) found that the Kiriri used only 13 animals for medicine. Alexiades (1999) found that the Esse Eja Indians in the tropical rain forest of southern Peru used about 50 animal species for medicine.

In a recent comparative study among four lowland Amerindian groups, Wilkie and Godoy (2001) show that as incomes increased, consumption of fish declined, but consumption of terrestrial game rose and then fell, overshadowed by the increasing consumption of meat from domesticated animals. At higher levels of income, Amerindians switched to domesticated animals for most of their animal proteins. Here we build on this prior line of research and ask: "How does integration into a cash market economy with a consequent rise in cash income among households of tropical lowland Amerindians affect their traditional use of wild animals to treat human ailments?"

The question of how integration into a market economy affects the use of wild animals for traditional medicine has implications for conservation policy. If integration into the cash market reduces the human use of wild animals for traditional medicine, game conservation will improve, but if greater participation in a cash market economy increases the use of wild animals for medicines, conservation will worsen.

Most studies of the use of wild animals for traditional medicine have been done in Asia or in Africa. Studies by Bolze et al. (1998), Servheen (1993, 1996), Callister and Bythewood (1997), Marshall (1998), Kritsky (1987), Mainka and Mills (1995), and Banks (1998) suggest that the expansion of markets induces people to make greater use of wild animals for traditional medicine and that the practice has spread in developed nations of Asia and the Pacific (e.g., Taiwan, Australia). But other research suggests that the increasing use of animals for traditional medicine can also take place without economic prosperity. For example, Kritsky (1987) says that the use of insects for traditional medicine in China increased during the Cultural Revolution. Based on an ethnozoological survey of the use of medicinal birds, Joseph (1990) concludes that the use of birds to treat human ailments increased in Madhya Pradesh, Central India, because people could not afford modern treatments.

To help explain the conflicting findings we draw on a supply-demand framework from microeconomics. To answer the query of how markets affect the use of animal parts, we use information from a relatively large sample of households (n = 508) and villages (n = 59) of Tsimane' Amerindians, a society of horticulturalists and foragers in the tropical rain forest of the Bolivian lowlands. In working with a large sample, we avoid inaccuracies from a small sample. We also avoid the bias of relying on traditional medical experts who may not know how the rest of the population uses wild animals.

Our goal is to estimate how various direct indicators of integration into a cash market economy—such as cash income, distance to the nearest town, and modern forms of human capital such as literacy and schooling—affect the probability that people will use wild animals for traditional medicine. We omit domesticated animals from the analysis because the policy debate in conservation centers on how the human use of wild animals for traditional medicine affects conservation (Brautigam et al. 1994; Huxtable 1992; Khoshoo 1997; Malik et al. 1996; Pui-Hay But 1995).

Animals and animal parts are heterogeneous commodities. Integration into the cash market economy can increase the demand for some animals but not for others, and it can increase the demand for some animal parts but not for other parts. We estimate the correlation of a household's cash income, wealth, and various other indicators of integration to the market, and the age, gender, and size of the household head with the household's use of wild animals for traditional medicine.

We recognize three different effects on the use of wild animal parts for traditional medicine resulting from a change in cash income. We call the animal part a "superior" good if a one-percent rise in cash income increases consumption of the animal part by more than one percent. We call the animal part "normal" if a one-percent rise in cash income increases the consumption of animal parts for traditional medicine by less than one percent. We call the animal part "inferior" if a one-percent rise in cash income reduces consumption of animal parts because people seek other treatments.

An increase in income could increase demand for parts of an animal, but it could also lower demand for parts of another animal, producing an unclear net effect on conservation. An animal part might be a normal good when people have low income, but it might become an inferior good when people have higher income.

Other factors besides income may change the use of wild animals for traditional medicine. A greater abundance of wild animals in a community might reduce the costs of extracting animals for traditional medicines; if their use is limited by cost, then it will rise with increased abundance. If people view modern and traditional medicines as substitutes for each other, then a rise in the price of modern medicines should cause an increase in the use of traditional medicine. If people use modern and traditional medicines together, then a rise in the price of modern medicines should cause a decrease in the use of both medicines. The last case is a theoretical possibility; we do not know of any empirical case supporting this point.

ETHNOGRAPHIC SETTING

The Tsimane' are a foraging and horticultural Amerindian society of approximately 7,000 people living in about 100 villages in the rain forests at the eastern foothills of the Bolivian Andes in the Ballivián and Yacuma provinces of the department of Beni (Ellis 1996; Godoy 2001; Government of Bolivia 1995; Huanca 2000; Reyes-García 2001). The Tsimane' are culturally and historically related to the Mosetene Amerindians, who form part of the Awaruna linguistic group (Reyes-García 2001). Tsimane' villages are spread over several parks and political jurisdictions, including the Pilón-Lajas Biosphere Reserve, the Parque Nacional Isiboro-Sécure, Territorio Multiétnico, and Territorio Uno.

Tsimane' villages are typically inhabited only by Tsimane'. The villages surveyed were in Territorio Uno (along the river Maniqui and along the dirt road linking the towns of San Borja and Yucumo), Territorio Multiétnico, and in the Pilón Lajas Biosphere Reserve. Transport in the region is along the river and by footpaths in the forests. Several logging roads cut across the Tsimane' territory. During the rainy season travel by roads is slower; at that time, logging roads and even public roads linking different towns in the department of Beni become impassable.

The Tsimane' territory spreads from the foothills of the Andes to the northeast, reaching the edges of the Moxos savanna (14°35′–15°30′ south latitude;

66°23′–67°10′ west longitude). Habitats in Tsimane′ territory range from wet to moist subtropical and gallery forest; some of their territory abuts savannas (Miranda 1995). Some Tsimane′ inhabit areas of tropical rain forest at the foothills of the Andes, about 500 meters above sea level. Other Tsimane′ communities are in moist forest in the savanna region at 150–250 meters above sea level. This type of forest is similar to Amazonian wet forest but is less diverse and lacks some of its typical species such as rubber (*Hevea brasiliensis* (Willd.ex Adr.Juss.) Muell.Arg.) or brazilnut (*Bertholletia excelsa* Humb. and Bonpl.). Drainage is deficient in the area owing to low variation in relief.

Part of the Tsimane′ habitat is made up of savanna, which is found in areas with alluvial soils. The floristic composition of the savanna changes with relief and flooding. In the plains, the main vegetative formation is flooded forest with relatively low tree diversity, probably because of low pH soils with limited availability of nutrients (Killeen et al. 1993). Poaceae and Cyperaceae (grasses and sedges) predominate on the savannas of lower altitude and are used as natural forage for cattle. Islands of forest occur with more frequency in the savannas of higher elevation (Killeen et al. 1993). The climate of the Tsimane′ area is moist, with a 4–5 month dry season (May to September). During one 15-month period of research, the average temperature was 26°C, ranging from a minimum of 10°C during May–June, when cold winds, locally called "Sur," arrive from the south, up to 42°C during August. The mean maximum temperature was 32°C, the mean minimum temperature was 20°C, and the average annual precipitation was 1,924 mm.

Tsimane′ show large variation in social, educational, and economic attributes. Some Tsimane′ in the upper Maniqui river are nomadic, live in small communities without schools, are monolingual in Tsimane′, and rely on shifting cultivation, hunting, fishing, plant foraging, and barter of forest products. Down the river Maniqui, close to the town of San Borja (pop. approx. 16,000), Tsimane′ are bilingual in Tsimane′ and Spanish, live in large settlements reachable by road, and are more likely to live in villages with schools (Reyes-García 2001). Besides subsistence agriculture and foraging, Tsimane′ in modern villages also work for wages and grow rice as a cash crop.

METHODS

The quantitative information for the analysis comes from a survey done between June and November 2000 among 508 households in 59 Tsimane′ villages in the department of Beni. During May and June 2000 we tested the survey in Tsimane′ communities close to the town of San Borja. The design and the administration of the survey drew on and were informed by a year of fieldwork by five researchers in two communities, one close (San Antonio) and one far (Yaranda) from the town of San Borja, during 1.5 years.

For the survey, we selected villages in the main Tsimane′ regions, including the Pilón-Lajas Reserve, Territorio Multiétnico, and Territorio Uno. In each region, we selected villages close and far from towns and villages in between. In each village, we first did a population census of all households, assigned a number to each household in the village, wrote each number on a piece of paper, and we then selected numbers at random from the folded pieces of paper to decide which households to interview. If the household chosen was absent, we picked another number. In each village, we surveyed between 12 and 15 households. Once we had selected a household, we flipped a coin to decide whether to interview the female or the male household head. According to the census of lowland Bolivian Indians, most indigenous households are nuclear (76%) or extended (22%) (Censo Indígena 1994–1995), so having one of the two household heads answer the questions of the survey captured one of the most important decision makers of the household. If the subject knew Spanish, we did the interviews in Spanish, but if the subject was a monolingual speaker of Tsimane' we used a translator.

From the household heads, we got information on the uses of wild animals for traditional medicine and on demographic and socioeconomic attributes of that person and that person's household. From village leaders we collected information on village-level attributes, such as prices, wages, and animal abundance. Table 1 contains a complete list of all the variables we used in the statistical analysis, including definitions, number of households answering each question, and the mean, standard deviation, maximum, and minimum values for each variable. The actual data used in the analysis can be found in an Excel format on the web page of the Center for International Development at Brandeis University, which also contains the data dictionary and details of the definition and construction of variables.[1]

We express household size in adult-equivalents, and use different consumption weights from the 1.5-year study of the two Tsimane' villages. As children, women, and men consume different amounts of food owing to differences in nutritional requirements, expressing the total size of the household in adult equivalents rather than in the number of persons captures with more accuracy the total effect of household needs. To capture competence in arithmetic and in literacy we relied on people's own assessment of skills in reading and in arithmetic. In the arithmetic test we asked people whether they knew how to add, subtract, multiply, and divide, and scored each positive answer as one point. To determine literacy, we asked subjects whether they knew how to read. We opted to ask rather than to test people about their competence in arithmetic and in literacy because objective tests create tensions in a cross-sectional study; those tests are more appropriate when done with a person who has been followed over time and with whom researchers enjoy rapport. We measured income by asking about the cash value the entire household had earned from the sale or from the exchange of all goods and services during the two weeks before the interview. We measured the consumption of bush meat and wild fish consumed during the two days before the day of the interview by asking household heads about the consumption of wildlife.

In each village, we asked village leader to assess the abundance of six common wild animals to obtain a subjective measure of animal availability; from this information we constructed an index of animal abundance. The six animals included the spider monkey (*Ateles chamek* Humbolt), the giant anteater (*Myrmecophaga tridactyla* L.), South American tapir (*Tapirus terrestris* L.), white-tailed deer (*Mazama americana* Erxleben), collared peccary (*Pecari tajacu* L.), and neotropical river otter, also known as *lobito de rio* (*Lutra longicaudis* Olfers). When asked about the abundance of animals, subjects could respond "none," "few," "average," "many," "animals have never been seen," or "animals used to exist in the past, but no longer available." The response for each animal was recoded as one if village leaders said there were "many" or "average," and as zero otherwise. The recoded responses for each animal were added to arrive at an index of animal abundance that ranged from zero to six.

We also asked village leaders about other village-level information, such as the price of modern medicines, the price of game, the number of traditional and modern health workers in the village, and the prevailing wages in the village. Researchers used a Global Positioning System receiver to measure the town-to-village distance in a straight line and decided for themselves whether or not the village had access to a road.

A one-time cross-sectional survey such as the one used here will produce a lower estimate of true use if respondents feel outsiders devalue traditional medicine. Open-ended, initial questions about what animal parts people used to treat human ailments might also miss the many insects that lowland Amerindians populations have been known to use for medicines (e.g., Costa-Neto 1998; Costa-Neto and Nogueira de Melo 1998; Costa-Neto and Oliveira 2000; Marques and Costa-Neto 1997).

To analyze the information we used univariate, bivariate, and multivariate analyses. We use univariate analysis to describe the types of animals used for medicine, the animal parts used, and the ailments treated (Table 2). We use bivariate analysis to compare the socioeconomic and demographic attributes of households that reported using and not using animals for medicine (Table 3). We use multivariate regressions to estimate the correlation of selected variables on the probability of using an animal for medicine. As we shall see, many of the results from the bivariate analysis gain strength and others become weaker once we control for the role of third variables.

A multiple regression is a statistical technique in which one predicts a dependent variable as a function of several explanatory variables. We chose to use one called a probit regression, a type of multiple regression appropriate when the dependent variable is categorical. In this study, the dependent variable took the value of one if the household head said the household had used an animal part to treat an ailment and it took the value of zero otherwise. Probit regression allows us to estimate the probability that the dependent variable will take the value of one when the explanatory variable increases by: [A] one unit above its mean value or [B] when the explanatory variable increases by a half standard deviation above its mean value. In both [A] and [B], all the other explanatory variables remain constant at their mean value.

We decided to report the results of the probit regression in two forms, [A] and [B], for two reasons. First, it is customary in some social sciences to report coefficients from probit regressions when the explanatory variable increases by one unit above its mean value. Second, since the units in which we measured explanatory variables are arbitrary and differ—e.g., income is measured in *bolivianos,* age is measured in years, distance is measured in kilometers—we decided to standardize their effect on the dichotomous variable by estimating probabilities when the explanatory variable increased by a half standard deviation.

We used a probit regression to estimate the effect of explanatory variables on

TABLE 1.—Definition and summary statistics of variables used in regression analysis.

Name	Definition	Obs	Mean	Std dvt	Min	Max
Dependent variable						
Household uses medicinal animal	Household uses medicinal animal: 0 = never; 1 = at least once in memory of household head	508	0.285	0.452	0	1
Explanatory variables: community level						
Price-medicine	Bolivianos (Bs)/box of general-purpose ointment[a]	508	4.11	1.53	2	10
Price-game	Average price (Bs/kg) for the following types of game: paca, collared peccary, and white-tailed deer. For scientific name of animals, see Table 2.	508	8.73	2.95	2.67	18.33
Distance	Distance to closest town in km using Geographic Positioning System receiver.	508	33.86	23.24	0	101
Caregivers	Number of health workers in village	508	0.18	0.38	0	1
Road	1 = village has year-round access by road; 0 = otherwise	508	0.492	0.500	0	1
Animal abundance	Estimated abundance of *lobito de rio* (*Lutra longicaudis*), giant anteater, Brazilian tapir, spider monkey, collared peccary, and white-tailed deer (arbitrary scale 0–6)	508	1.94	1.95	0	6
Wage	Value of daily wage, Bs/day, with food for unskilled worker in village	508	20.90	5.864	10	50
Explanatory variables: household level						
Wildlife	Weight in kg of game and fish brought into household/adult equivalent in last two days. Adult equivalent refers assigns a higher weight to adults than to children owing to greater nutritional requirements (see Deaton 1997)	508	1.905	3.500	0	54.369
Income	Bs/adult equivalent earned from sale, wage labor, and barter in last two weeks	508	47.22	70.85	0	546
Wealth	Value in Bs of 16 assets/adult equivalent. Assets included such things as chickens, rifles, fishnets	507	600.68	445.93	70.588	3429
Household size	Adult equivalents in the household; see under variable wildlife	508	4.0	1.9	0.62	12.13

TABLE 1.—Continued.

Name	Definition	Obs	Mean	Std dvt	Min	Max
Explanatory variables: personal level						
Education	Maximum education attained (in years)	508	0.89	1.64	0	13
Arithmetic	Self-assessed ability in arithmetic: 0 = none, 1 = a little, 2 = good	507	0.317	0.589	0	2
Reading	Self-assessed reading ability: 0 = illiterate, 1 = a little, 2 = reads well	508	0.338	0.611	0	2
Age	Age in years	504	36.5	14.5	13	125
Gender	Gender of subject: 1 = female; 0 = male	508	0.48	0.50	0	1

[a] 6.03 *bolivianos* = 1 US dollar at time of field work.

the probability of using an animal for medicine. The advantage of the probit regression over a linear probability model is that the probit regression keeps values of the dichotomous dependent variable between zero and one without arbitrarily setting them there, as is the case with a linear probability model. The probit model draws on maximum likelihood to estimate the effect of regression parameters on Z scores for specific units of observations (in this case households). It then draws on the cumulative density function from the standard normal distribution to get an estimate of $Pr(Y=1)$ conditional on changes in the underlying Z score. Two alternatives to probit models are logit and logistical models; since all three types of regression models produce similar results when estimating changes in the probability from changes around the mean value of explanatory variables, we decided to use the probit model. Aldrich and Nelson (1984) and Long (1997) provide details of how probit and logit regressions work.

Before using the probit regression we tested and rejected the assumption of constant variance in the error term at the 10% confidence level. We therefore use Huber-White robust standard errors. Robust standard errors are necessary when running a regression with heteroskedastic or non-constant error terms (Gujarati 1995). We did not have instrumental variables to control for possible biases from endogeneity or reverse causality. An instrumental variable is a variable that is highly correlated with the endogenous explanatory variable, but is uncorrelated with both the error term and with the dependent variable. Because we cannot establish the direction of causality in unambiguous ways, we speak of correlation when discussing the regression results. In the context of probit regressions, discussed later in this paper, a correlation refers to the probability of using a wild animal for medicine when the explanatory variable increases by one unit or by a half standard deviation above its mean value while holding constant all other explanatory variables at their mean value.

Since we did not collect repeated measures of people over time, we cannot control for unobserved fixed heterogeneity in endowments and preferences of people or biological attributes of villages (other than animal abundance) that could influence both the use of animals for medicine and the covariates used in

TABLE 2.—Animal part last used and ailments treated among Tsimane' Amerindians, Bolivia, 2000.

Animal	Parts	Human ailments treated
1. Brazilian tapir (*Tapirus terrestris*) (3)	fat (1)	cough (1)
	nail (1)	"bad wind" (1)
	liver (1)	general body pain (1)
2. brown agouti (*Dasyprocta variegata*) (1)	bile/gall bladder (1)	childbirth (1)
3. brown capuchin monkey (*Cebus apella*) (1)	bile/gall bladder (1)	eye infection (1)
4. collared peccary (*Tayassu tajacu*) (2)	fat (1)	cold (1)
5. common opossum (*Dipelphis* spp.) (6)	fat (6)	cut (1), fever (2), cold (2), leg pain (1)
6. giant anteater (*Mirmecophaga tridactyla*) (4)	nail (1)	general body pain (1)
	hair (2)	snake bite (1), urinary problem (2)
	liver (1)	heart pain (1)
7. jaguar (*Panthera onca*) (1)	fat (1)	cough (1)
8. kinkajou (*Potos flavus*) (1)	penis bone (1)	earache (1)
9. paca (53) (*Agouti paca*)	fat (1)	general body pain (1)
	bile/gall bladder (42)	stomach pain (1), leishmaniasis (5), snake bite (26), rheumatism (1), heart pain (1), pain in bones (2), liver pain (1), urinary (7), fever and stomach pain (1)
	teeth (8)	child birth (7), snake bite (1)
10. South American coati (*Nasua nasua*) (17)	fat (6)	cold (3), cough (2), leg pain (1)
	thorns (1)	cough (1)
	hair (2)	wounded foot (1)
	bile/gall bladder (1)	snake bite (1)
	penis bone (5)	earache (4), neck pain (1)
11. spider monkey (*Ateles chamek*) (8)	fat (2)	fever (1), cough (1)
	bile/gall bladder (5)	fever (1), cold (1), shoulder pain (2), sleeping problems (1)
	bone (1)	leishmaniasis (1)
12. stingray (*Potamotrygon* sp.) (13)	fat (10)	stomach pain (2), cold (3), cough (2), tuberculosis (1), pain in bones (1), leg pain (1)
	liver (3)	pain in bones (3), general body pain (1)
13. tortoise (*Geochelone* sp.) (3)	fat (3)	eye infection (1), rheumatism (2), headache (1)
14. white-tailed deer (*Mazama americana*) (2)	carcass (1)	cold (1)

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[a] In parentheses are the number of households reporting part or ailment. Sometimes number of households under animals parts used is less than the number of households for the animal because people could not recall the part of the animal they had used. The same applies to the number of ailments mentioned and the animal part; sometimes people mentioned an animal part, but could not recall for what ailment they had used it. Sometimes the number of ailments treated with a part exceeds the number of households under "parts"; this happens when households use one part to treat several ailments.

TABLE 3.—Comparison of mean values of explanatory variables between households that used and did not use animals for medicines, Tsimane' Amerindians, Bolivia, 2000.

	Medicinal use of animals by households that				Test of equality of mean	
	Did not use animals		Used animals			
Variable	Households	Mean	Households	Mean	Statistic	p value
Price medicine	363	4.01	145	4.37	$t = -2.36$	0.02
Price game	363	8.7	145	8.82	$t = -0.42$	0.68
Distance	363	32.75	145	36.64	$t = -1.08$	0.09
Caregivers	363	0.16	145	0.23	$t = 1.80$	0.07
Road	363	0.45	145	0.6	$\chi^2 = 10.69$	0
Animal abundance	363	1.77	145	2.38	$t = -3.21$	0
Wage	363	21.33	145	19.82	$t = 2.64$	0
Wildlife	363	1.6	145	2.67	$t = 3.13$	0
Income	363	41.46	145	61.65	$t = -2.92$	0
Wealth	363	589	144	628	$t = 0.88$	0.38
Household size	363	4	145	4.09	$t = 0.53$	0.6
Education	363	0.94	145	0.76	$t = 1.14$	0.25
Arithmetic	362	0.32	145	0.3	$t = 0.34$	0.73
Reading	363	0.34	145	0.34	$t = 0.02$	0.99
Age	361	35.78	143	38.43	$t = 1.85$	0.06
Female	363	0.49	145	0.44	$\chi^2 = 0.10$	0.32

the analysis. For example, some villages may contain greater biological diversity and may, therefore, have greater abundance of wild animals for traditional medicine, so people in those villages may be more likely to use wild animals for traditional medicine. If we had observations over time, we could control for fixed, unseen, attributes; since we collected information only at one time, unseen fixed attributes of communities, households, and people will bias our estimates in unknown directions.

We focus our discussion of the regression analysis on results that are statistically significant at the 90% confidence level or higher. We discuss explanatory variables at the community, household, and personal levels.

Table 1 lists the explanatory variables by level. Table 4 contains the regression results; we estimate the probability that a household will use a wild animal for medicine when an explanatory variable increases while all other explanatory variables remain constant at their mean value. In column A the explanatory variables increase by one unit and the probabilities reported are the resulting marginal probabilities. For example, we know from Table 1 that the average household size in the sample was 4.025 adult equivalents; if the household size increases by one adult, then the probability that a household will use an animal for traditional medicine increases by 3.6%; results are significant at the 95% confidence level. Note that 3.6% is the *marginal increase* in the probability. In column B the explanatory variable increases by a half standard deviation and we report the *overall probability* of using an animal for traditional medicine (30.1%). Since the mean predicted probability when all explanatory variables are held constant at their mean value is 26.7% (see bottom of Table 4), a half increase in the standard

TABLE 4.—Results of multivariate regressions. Probabilities of using wild animals as medicine among Tsimane' Amerindians, Bolivia, 2000.

Explanatory variable[3]	Probability of using animal[1] when explanatory variable increases by following above its mean value while holding constant all other variables: One unit [A][2]	1/2 standard deviation [B]
Price medicine	12.5*	28.5
Price game*	0.7	26.7
Distance*	−7.6**	22.5
Caregivers	7.7	28.0
Road	13.1***	29.9
Animal abundance	4.7***	31.4
Wage*	−20.7**	23.9
Wildlife	2.6	28.1
Income*	8.0**	29.8
Wealth*	4.7	28.1
Household size	3.6**	30.1
Education	−7.7***	20.7
Arithmetic	6.8	28.6
Reading	10.6	29.9
Age	0.1	27.5
Female	−2.4	26.0
Pseudo R^2	0.1	
Number of households	449	
Predicted probability at mean values of all Xs	26.7	
Probability from raw #s	145 users/508 total sample = 28.5	
Predicted probability when all Xs increase by 1/2 standard deviation	41.0	

[1] Dependent variable is binary, dichotomous categorical variable (1 = household used wild animal for medicine; 0 = otherwise).

[2] Column [A]: probit regression with robust standard errors. For units of each explanatory variable see second column of Table 1. Asterisks: *, **, and *** significant at the 90%, 95% and 99% confidence level.

[3] Explanatory variables with an asterisk (*) are in logarithms; 100 *bolivianos* added to income to avoid producing missing values when taking logarithms.

deviation of household size produces a change in the marginal probability in the use of medicinal plants of +3.37% (3.37% = 30.12%–26.75%), roughly comparable to the 3.6% of column A. The slight difference arises because the unit increase in column A (one adult) differs from the half standard deviation increase in column B (0.9 adult).

The last five rows of Table 4 contain information about the overall model. The pseudo R^2 is measure of goodness of fit of the model. The number of observations is 449, lower than the number of observations in Table 1 because of missing values that arose from taking the logarithm of the variable on wildlife consumption/adult equivalent. We re-estimated the probit models adding a constant (0.01) to households without wildlife consumption and found that the results did not change from those reported below in a significant way. The bottom three rows deserve a brief comment. The row called "predicted probabilities at mean values of all Xs" represents the overall probability (26.7%) of using an animal when all Xs are held constant at their mean value; the probability is estimated using the 449 observations used in the regression. The penultimate row represents the share of the households that used an animal for medicine and is derived by dividing the number of households that used animals (145) by the total sample (508). The last row contains the overall probability of using an animal when all explanatory variables increase simultaneously by a half standard deviation.

RESULTS

Few Tsimane' said they had used wild animals for traditional medicine. In response to the question "when was the last time you have used an animal to treat an ailment?" about three quarters of the household heads (71.4%) said they had never used an animal part to treat human ailments. In a companion study we show that the Tsimane' make widespread use of plant and plant products for many purposes, including the treatment of human illnesses (Reyes-García 2001). The same does not appear to be true with the use of animal parts.

Of the Tsimane' who said they had used a wild animal for traditional medicine, most said they had relied on only a few animals. The survey yielded a total of 14 animals used to treat human ailments (Table 2). All animals were mammals except for a stingray (*Potamotrygon* sp.) and a tortoise (*Geochelone* sp.). The mammals used belonged to five orders: Carnivora, Primates, Artiodactyla, Perissodactyla, and Rodentia. According to one source from Bolivia (Tarifa 1996), among the animals used for medicines by the Tsimane' five species are threatened or vulnerable to extinction: Brazilian tapir, spider monkey, giant anteater, collared peccary, and jaguar (*Pantera onca* L.). Of these, only the spider monkey appears in the IUCN list of vulnerable species. Although Tsimane' mentioned a total of 14 animals, four of them—paca (*Agouti paca* L.), South American coati (*Nasua nasua* L.), stingray, and spider monkey—accounted for 79.2% of all animals used. None of the Tsimane' surveyed mentioned more than one animal.

Again, this contrasts with the use of medicinal plants. Reyes-García (2001) found that Tsimane' used wild plants mostly for traditional medicine. She found that most medicinal plants had at least two unrelated medicinal uses. Out of the 169 medicinal plants registered during the longitudinal study in the two Tsimane' villages, Reyes-García found that only 27 medicinal plants had only one use, 58 had 2–3 unrelated uses, and 18 medicinal plants had at least four uses. The total number of wild animals (14) used for traditional medicine by the Tsimane' is similar to the total number of wild animals (13) used by the Kiriri Indians of Brazil (Bandeira 1972), but considerably lower than the total number of animals (50) used by the Esse Eja Indians of southern Peru (Alexiades 1999). Tsimane' used few animal parts to treat human ailment. Fat, bile, and gall bladders accounted for most of the animal parts used. Other parts included such things as teeth, livers, and bones. Tsimane' obtained fat for traditional medicine mostly from the South American coati, common opossum (*Dipelphis* sp.), tortoise, and stingray, and they obtained bile mostly from the paca and from the spider monkey.

The last column of Table 2 suggests that the Tsimane' use animal parts to treat many different human ailments. For example, the Tsimane' use the bile and gall blader from the paca to treat nine ailments. Although the Tsimane' mentioned many different types of ailments, they were most likely to have used an animal part to treat snake bites and, to a lesser extent, to treat coughs, colds, and urinary tract problems.

In Table 3 we compare the socioeconomic and demographic attributes of households that used animals for medicines and households that did not. A comparison of mean values between the two samples suggests that households that used animals for medicine lived in communities with higher price for modern medicines and were farther away from market towns. Those villages had more health care workers, animals in the commons, and lower wages, and were more likely to have access to a road. Household heads that used medicinal animals were slightly older and lived in households with more income and wealth than households that did not use animals for medicine.

The results of the multivariate regressions shown in Table 4 suggest that at the community level, animal abundance and greater access to roads correlated positively with a greater probability of using an animal for traditional medicine, but wages and distance to the nearest market town correlated negatively. A one percent increase over the sample mean of 33.85 km in the distance from the nearest market town correlated with a 7.6% ($p<0.05$) lower probability of using an animal for traditional medicine. Access to a road correlated with a 13.1% ($p<0.001$) higher probability of using an animal for traditional medicine. Last, a one percent increase in the village wage correlated with a 20.7% ($p<0.05$) lower probability of using a wild animal for traditional medicine.

We found support for the idea that animal abundance correlated positively with the probability of using a wild animal. A one-unit increase in the index of animal abundance around the village was associated with a 4.7% ($p<0.001$) higher probability of using wild animals for traditional medicine.

If we focus on the three following indicators of integration to the market—distance to the nearest town, access to roads, and wages—we find ambiguous results about how markets affect the use of wild animals for traditional medicine. If we equate integration to the market with proximity to market towns or with access to roads, we find that villages closer to towns and villages with access to roads were more likely to use wild animals for traditional medicine. The results suggest that markets correlate positively with increases in the demand for wild animals for traditional medicine. But if we equate integration to the market with wages, we find that Tsimane' living in villages with higher wages were less likely to use wild animals for traditional medicine.

Last, the sign of the coefficient for the price of modern medicine was positive, suggesting that modern medicines and wild animals for traditional medicines are substitutes. A doubling in the price of modern medicines increased the probability of relying on wild animals for traditional medicine by about 12.5% ($p<0.10$).

Two of the four household-level variables were significantly associated with the probability of using wild animals for traditional medicine. Household size correlated positively with a greater probability of using wild animals for traditional medicine. Each additional adult in the household above the 4.0 mean for the sample correlated with a 3.6% ($p<0.05$) greater probability of using a wild animal for traditional medicine. A one *boliviano* increase in income above the sample mean of 47.22 *bolivianos* correlated with a 8.0% ($p<0.05$) greater probability of using a wild animal for traditional medicine (6.03 *bolivianos* = 1 US dollar at the time of fieldwork). The result suggests that among the Tsimane' parts of wild animals used for traditional medicine may be normal goods—demand increases as incomes rise.

Last, the coefficients of personal-level variables suggest that only education correlated with a change in the probability of using wild animals for traditional medicine. An additional year of education above the sample mean of 0.886 years of education correlated with a 7.7% ($p<0.001$) lower probability of using wild animals for traditional medicine.

DISCUSSION

The central question motivating this article was: How does integration into a cash market economy with a consequent rise in cash income among households of tropical lowland Amerindians affect their traditional use of wild animals to treat human ailments? We made the point at the outset that relatively little was known about human uses of wild animals for medicines among indigenous people of the New World.

The picture of the Tsimane' that emerges from the survey is that of a tropical lowland Amerindian society in which the average household head uses only a few wild animals, to obtain only a few animal parts, to treat only a few human ailments. The finding is consistent with the low use of wild animals to treat human ailments reported by Bandeira (1972) among the Kiriri Indians of Brazil. The low use contrasts with the high use in northeast Brazil reported by Costa-Neto and his colleagues (e.g., Costa-Neto 1998; Costa-Neto and Marques 2000) and in southern Peru reported by Alexiades (1999). It also contrasts with the widespread use of wild plants to treat human ailments among the Tsimane' and other lowland Amerindian groups and with the well-documented importance of wild animals as a source of animal proteins among lowland Amerindians.

In answer to our central query of how integration into a cash market economy affects the use of wild animals to treat human ailment, a complex picture emerges. For example, we found that two proxies of a market economy—wages and schooling—correlated with a lower probability of using wild animals for traditional medicine. On the other hand, two indicators of participation in the market economy—proximity to market towns and access to roads—correlated with a higher probability of using wild animals for traditional medicine.

The findings must be read with caution owing to shortcomings in the information collected. Because we relied on a one-time cross-sectional survey, we could not control well for unseen, fixed attributes of households and people. We relied on the perception of village leaders about animal abundance rather than counting wild animals in the field. Last, we did not collect information on the actual quantity of wild animals used for traditional medicine, so we could not estimate the income elasticity of consumption—the percentage change in the consumption of wild animals for traditional medicine from a percentage change in income.

The low use of wild animals as medicines suggest that policies to enhance wildlife conservation among the Tsimane' should probably be targeted at reducing the use of wild animals as a source of food (whether by indigenous people or by outsiders) rather than at reducing the use of wild animals as a source of traditional medicine. Unlike some of the case studies of Asia and Africa reviewed earlier, among the Tsimane' the use of animals for medicine is not a significant threat to conservation.

If policy-makers decide they wish to improve the conservation of fauna by reducing the use of wild animals for medicine, then the results of this analysis hint at two possible policy options: wages and the price of modern medicines. We have presented evidence to suggest that higher wages from greater employment opportunities correlates with a lower probability that rural populations will use wild animals for traditional medicine because the opportunity cost of foraging rises. Policies geared at creating greater employment opportunities might have beneficial, direct effects on the conservation of wild animals for medicine. Similarly, we found that a doubling in the price of modern medicines correlated with an increase in the probability of using wild animals, suggesting that public health policies that deliver medicines and medical services to rural areas at lower prices will likely enhance the conservation of fauna in a direct way.

NOTE

[1] www.heller.brandeis.edu/sid/research/bolivia.asp

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THE GRAMMAR OF SNCHÍTSU'UMSHTSN (COEUR D'ALENE) PLANT NAMES

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ABSTRACT.—This paper analyzes 106 known plant names of Snchítsu'umshtsn (Coeur d'Alene), a Salishan language of northwestern North America whose ethnobotany has not been previously described. Grammatical analysis of plant names reveals semantic motivations, the structure of classification, and the position of Snchítsu'umshtsn among Salishan languages. A five-level botanical taxonomy correlates only partially with the levels defined by Berlin (1992) and Brown (1984). The morphological structure of plant names shows that classification is only part of the motivation for their construction. Many describe appearances and other sensory qualities that facilitate identification. Utilitarian concerns play a role, but not the dominant one. Snchítsu'umshtsn names are compared to those of other Interior and Coast Salish languages. A cline of decreasing cognate frequencies appears as one moves from Snchítsu'umshtsn in the east to the Coast Salish languages in the west. The 16 terms with cognates in at least six of the seven languages include names for eight trees (including six conifers), three berry bushes, one edible bulb and two edible taproots. Reasons for this distribution are discussed. We include a listing of plant terms with Salishan cognates, tables describing the morphological analysis of terms, and a table of cognate incidence in Salishan languages.

Key words: ethnobotany, categories, lexicon, plant names, Salish, Coeur d'Alene.

RESUMEN.—Este trabajo analiza 106 nombres de plantas en Snchítsu'umshtsn (Coeur d'Alene), una lengua Salish del noroeste de Norteamerica cuya etnobotánica no ha sido descrita. El análisis gramatical de los nombres de plantas revela los temas semánticos, la estructura de la clasificación, y la posición de Snchítsu'umshtsn entre las lenguas Salish. La taxonomía botánica, en cinco niveles, se correlaciona sólo parcialmente con los niveles definidos por Berlin (1992) y Brown (1984). La estructura morfológica de los nombres de las plantas muestra que la clasificación es sólo parte del motivo para su construcción. Muchos nombres describen la apariencia y otras cualidades sensoriales que pueden facilitar la identificación. Los conceptos referentes a la utilidad desempeñan un papel, pero no es el dominante. Los nombres Snchítsu'umshtsn se comparan a los de otros idiomas de los grupos Salish del Interior y Salish de la Costa. El numero de nombres semejantes decrece a medida que crece la distancia desde el Snchítsu'umshtsn, en el este, hacia las lenguas de la Costa en el oeste. Los 16 términos que tienen palabras semejantes en al menos seis de las siete de las lenguas Salish comprenden los nombres de ocho árboles (entre ellos seis coníferas), tres arbustos con bayas, un bulbo comestible y dos raíces comestibles. El trabajo discute las razones de esta distribución. Incluimos una lista de términos sobre plantas relacionados con términos semejantes en otras lenguas Salish, las tablas que describen el análisis morfológico de los términos, y una tabla de la incidencia de semejanza entre términos en los dialectos Salish.

RÉSUMÉ.—Cet article analyse 106 noms de plantes Snchítsu'umshtsn (Coeur d'Alene), une langue Salishan du nord-ouest de l'Amérique du Nord dont l'ethnobotanie n'a pas encore été étudiée. L'analyse grammaticale des noms de plantes révèle les nuances sémantiques, la structure de la classification, et la position du Snchítsu'umshtsn au sein des langues Salish. Une taxonomie botanique à cinq niveaux ne correspond que partiellement aux niveaux définis par Berlin (1992) et Brown (1984). La structure morphologique des noms de plantes indique que cette classification n'explique qu'en partie leur construction. Beaucoup de noms décrivent l'aspect et autres qualités sensorielles qui facilitent l'identification. Les considérations utilitaires jouent un rôle, mais elles ne sont pas déterminantes. Cet article compare les noms Snchítsu'umshtsn à ceux d'autres langues Salishan de l'intérieur et de la côte. Un cline où la fréquence des cognates diminue apparaît quand on passe des Snchítsu'umshtsn à l'est aux langues Salishan de la côte ouest. Les 16 termes avec cognates qu'on trouve dans au moins six des sept langues comprennent les noms des plantes suivantes: huit arbres (y compris six conifères), trois arbustes à petits fruits, un bulbe comestible, et deux racines pivotantes comestibles. Cet article examine les raisons de cette répartition. Sont également inclus dans cet article: une liste des noms de plantes avec les cognates Salishan, des tableaux de l'analyse morphologique des mots, et un tableau de l'incidence des cognates dans les langues Salishan.

INTRODUCTION

Previous researchers studying the ethnobotany of the Salishan languages of northwestern North America have used plant names to understand botanical classification, grammatical conventions of naming, and relationships among cognate languages. No previous studies have focused on the plant names or the ethnobotany of Snchítsu'umshtsn[1] (Coeur d'Alene), a language of the Interior Salish division of Salishan (Figure 1). This paper analyzes the grammar of plant names in Snchítsu'umshtsn. The grammatical analysis reveals new information on botanical classification and the relationship of this language to other Salishan languages. The analysis includes 106 names for plants at the genus and species level (Appendix 1). A few of these terms have not yet been correlated to taxa identified in English. A few terms for higher-level categories are also included, revealing a botanical taxonomy with five levels which correlate only partially with the ranks defined by Berlin (1992) and Brown (1984).

Though we describe the Snchítsu'umshtsn taxonomy, the emphasis in our analysis is not on discovering taxonomic principles, but rather on describing and analyzing the linguistic structure of plant names. We find that when a plant name has internal morphological structure, this often reflects perceptions of the plant that are specific to the language and culture. Our findings suggest that classification is only part of the motivation for the construction of plant names and that another important motivation is the description of appearances and other sensory qualities that are salient or that enable plants to be readily identified. Some plants

FIGURE 1.—Interior Salish speech community territories ca. 1850, principally after Elmendorf (1965).

are named in more than one way according to which structural part (leaves, trunk, etc.) is most salient at the time of speaking. Utilitarian concerns play a role in plant naming, but not the dominant one. We find that many terms have lost linguistic structure and original meanings have become partially or totally obscured. This is the case with nearly half (47) of the terms. We also record six names borrowed from English and French. We discuss our findings in relation to comparable data from other Interior and Coast Salishan languages and we describe the cline of decreasing cognate frequences in plant names as one moves from Snchítsu'umshtsn in the east to the Coast Salishan languages in the west.

Theoretical Approaches.—There are several perspectives from which one can analyze a language's botanical terminology, or more specifically, its names for plants. One approach is to look for universal hierarchies of categorization, called taxonomies. For example, Brown (1984:1) wrote, "For speakers of American English, white oaks, pin oaks, and post oaks are kinds of oak; oaks, walnuts, and maples are kinds of trees; and trees, vines, and bushes are kinds of plants. Such a system of inclusive relationships forms a *folk biological taxonomy*" [italics in original]. Berlin (1992) proposed a taxonomic framework of ranks, starting with the most inclusive category "kingdom" and descending through "life-form," "intermediate," "generic," "specific," and "varietal," but he noted that strictly taxonomic presentations of ethnobiological material have been questioned, first by Bright and Bright (1969) and later by others (Ellen 1986; Hunn 1976; Randall 1976). The shift of emphasis away from taxonomy received further support from Turner (1987, 1989).

A second approach is to investigate what the naming of plants reveals about ethnically distinctive classifications of the botanical world. For example, Bright and Bright (1969) found that many plant names of two northwestern California tribes—Yurok and Smith River—do not necessarily fall into any hierarchy. Instead, consultants often identified a plant as being "like such-and-such." They also reported that "where generic terms exist, they may also refer to a specific member of the class. . . . Thus Yurok *tepo'* refers to 'fir tree' or 'tree' in general" (1969:70). They concluded that "the aboriginal taxonomies of northwestern California can be represented more faithfully by a kind of 'sphere of influence' model," a conclusion echoed by Hunn (1985). Thus, one of the problems considered in this paper is the extent to which the structure of plant names reveals taxonomic categorization as opposed to other types, such as the identification of family resemblances, or functional (metonymic) relationships among plants. A second problem is to determine whether the structure of plant names is in fact intended to categorize by relating one kind to another, or simply to describe salient perceptual characteristics of plants.

Alternatively, plant names may be studied from a historical perspective in which cognates in neighboring languages are taken as evidence for common origins, borrowing, or language change. For example, Fowler (1972:109) found that plant names provided "ecological clues to early homeland situations." Examining plant name cognates among northern Uto-Aztecan languages, including those of the Numic, Tübatulabalic, Takic, and Hopic groups, she was able to conclude that their ancestors must have lived in a territory that was diverse in elevation and probably in or near desert zones. Based on the distribution of pinyon, prickly pear, ephedra, chia, lycium and cholla, as well as various animals, she could place the homeland area in the Sierra Nevada mountain range south of 36°30′ north latitude. Hinton (1994:87–90) followed a similar approach in her investigation into the origins of the Wintun people in Northern California. The areal ethnohistory approach using cognate distributions requires the examination of terms in all the members of a group of related languages together with data on the distributions of the named plants and animals. In this study we simply compare frequencies of cognate forms in other Salishan languages to determine closeness of relationship to Snchítsu'umshtsn.

Yet another approach to the study of plant nomenclatures examines their appearance in other domains of culture. For example, plant names may be used in the names of mythical persons, as in the Snchítsu'umshtsn story about Ylmíkhwm Asp'ukhweníchelt 'Chief Child of the Root,' who taught each of the animals how to live. The name of the mythical actor is composed of *ylmíxʷm* 'chief' and a-*s√p'éxʷenč*-ilt 'child of desert parsley (*Lomatium macrocarpum*)' (<ART-desert.parsley-offspring). In Snchítsu'umshtsn, mythical connections to plant names are uncommon.

Plant Names in Salishan Languages.—Comprehensive records of Salishan plant names are generally found in ethnobotanical studies, which usually include a great deal of associated cultural information on uses and cultural values of plants in addition to their Salishan names. Ethnobotanical studies of Salishan peoples are too numerous to review comprehensively here, so we will limit our survey to findings that are most pertinent to the present study of the linguistic structure and ethnic connections of Snchítsu'umshtsn plant names. The semantic implications of plant terms of Interior Salish languages are discussed in more detail in Palmer (1998b).

Turner (1974) found that in Stl'atl'imx (Lillooet), 52% of 137 plant names contained the suffix *-az'* or a form of the borrowed suffix *-lhp* (= *-ałp, -ełp*). She then argued that the distribution of the suffix demonstrated "the aboriginal existence of a definite category for at least 'vascular plants'" (1974:31). Turner (1987: 60) concluded, "It is notable that the names including this suffix pertain to a broad range of plants—mostly trees and shrubs, but also denoting some low herbaceous plants such as pine grass ["timbergrass"] and wild strawberry." There are a number of suffixes like this in Salishan languages, for example, Secwepemc *-úlex*^{w} ~ *-elex*^{w} 'on the ground' and *-áleq*^{w} 'log, tree, windfall, stick, branch', both of which have cognates in Snchítsu'umshtsn and neighboring languages. Typically, the suffix marks off a taxonomic class, but it is never realized as an independent superordinate term for the set of terms using the suffix, though a few such suffixes, such as Secwepemc *-úsaʔ* 'berry' may be realized as independent terms (Palmer 1998b:353). Palmer (1998b:354–355) has summarized some of Turner's findings that are pertinent to this study:

> For Fraser River Lillooet, Turner (1974) identified eight "life-form" categories, plus "other." The eight life forms are "trees" (divided into "with leaves" and "evergreens"), "berries," "flowers," "grasses" (and grass-like plants), "mosses," "mushrooms and fungi," "weeds," "roots (and underground parts, including poisonous types)." Of these, there are general terms for trees, evergreens, berries, flowers, grasses, mosses, and weeds. Trees "with leaves" and "roots . . ." are unnamed.

In the same paper, Palmer (1998b) concluded that Berlin's (1992) hierarchical framework of "kingdom," "life-form," "intermediate," "generic," "specific," and "varietal" categories was not well-suited for describing the Secwepemc (Shuswap) plant nomenclature. Turner (1987:55) also noted discrepancies between Berlin's framework and the plant categories of Nlaka'pamux[2] (Thompson) and Stl'atl'imx (Lillooet). Similarly, she concluded that Brown (1984) was wrong in considering "vine" to be one of the five universal life forms, as the category has low salience in Nlaka'pamux and does not appear to exist at all in Stl'atl'imx (Turner 1987: 74–75).

Concerning the internal morphological structure of plant names, Turner (1974:54) observed, "The majority of generic plant names in Haida, Bella Coola (Nuxalkmc), and Lillooet (Stl'atl'imx) can be analysed into component semantic units having meanings independent of their connotations as plant names or portions of plant names." She compared such terms to the "unitary complex lexemes" of Conklin (1969), exemplified in the English term 'Jack-in-the-pulpit.' Berlin et al. (1973) referred to such terms as "analyzable primary lexemes." Turner pointed out that "analysis of these generic names can give insights into the origin of the terms, the economic importance and innate characteristics of the plants themselves, and even some cultural traits of the group in which the names originated." Palmer (1998b:353) noted that Salishan plant nomenclatures have a structure in which some taxonomic sets are dominated by a substantive suffix that never stands independently to designate the set. Palmer and Nicodemus (1985:

343) proposed that terms using these classificatory suffixes be called "composite specific lexemes." They may be seen as a subtype of Conklin's "composite lexeme."

Salish terms of this type function much like Conklin's "composite lexemes."[3] For example, *t'ádaʔalq*^{w} 'white pine', from *t'édeʔ* 'canoe' + *-alq*^{w} 'tree/shrub, pole, log' could be regarded as structurally parallel to English 'tulip tree' or 'black oak', "in that the name is composed of a superordinate category 'name' modified by a delimiting attributive." That is, the suffix *-alq*^{w} would be regarded as modified by the root *t'édeʔ*. The reviewer may be correct, but it is difficult to know exactly how to interpret such terms. The term *t'ádaʔalq*^{w} might alternatively be read metonymically as 'canoe log' rather than taxonomically as 'canoe tree.' It seems best to avoid concluding that Salish plant names function taxonomically in exactly the same manner as those of English. Gross similarities in lexical morphology, and of the binomials in particular, may be misleading. Perhaps it is such a misreading of the communicative function of plant terms that leads ethnobotanists to posit "multiple life-form assignment" and "taxonomic anomalies," as discussed by Hunn (1998), who observed of Mixtepec Zapotec that "generic plant categories may bear alternative life-form prefixes or, quite commonly, multiple life-form prefixes, i.e., two or three such prefixes one before the other." For a parallel in Snchítsu'umshtsn, we need only look at the morphological analyses of terms (7a) √*marám-aɫp-alq*^{w} 'medicine-plant-tree' and (7b) *s-t-*√*marím-ɫp-ečt* 'NOM-attached-medicine-plant-whole.hand~branch' (see Appendix). Rather than compound life-form prefixes as in Mixtepec Zapotec, here we have compound suffixes, but the function may be the same, and that function is not necessarily taxonomic in the sense of distinguishing one species or genus from others belonging to a different life-form category.

Turner, Ignace and Compton examined the distribution of Secwepemc names for trees, looking for cognate forms in order to draw conclusions about historical linguistic connections. They found "a greater affinity in terms of shared cognates among Secwepemc and their Interior Salish neighbors to the south and east (Okanagan, Flathead, Moses-Columbian, and Coeur d'Alene" (Turner et al. 1998:395). Stl'atl'imx (Lillooet) and Nlaka'pamux (Thompson) were more closely affiliated with each other and both were more similar to the Coast Salish in their tree-naming.

SNCHÍTSU'UMSHTSN

Snchítsu'umshtsn is one of seven languages of the Interior Salish division. The others are Stl'atl'imx (Lillooet), Nlaka'pamux (Thompson), Secwepemc (Shuswap), Nsilxtsin (Okanagan-Colville), Nxaʔamxcín (Columbian), and Kalispel. Snchítsu'umshtsn shares 55% of its total vocabulary with its closest Salishan neighbor, Kalispel, which includes Spokane, Kalispel, and Flathead dialects. Snchítsu'umshtsn may have branched off eastward from other Interior Salish languages sometime between 2500 B.C. and A.D. 1 (Elmendorf 1965; Suttles and Elmendorf 1963). The Schítsu'umsh people were later flanked on the north and east by peoples speaking dialects of Kalispel. In general one finds the most cognate plant terms among the closest neighbors.

The territory occupied by the Schítsu'umsh in late prehistoric and early historic times extended over the drainage and headwaters of the Spokane River, with three clusters of permanent winter villages at Spokane River-Coeur d'Alene Lake, the Coeur d'Alene River, and the Saint Joe River, respectively. This territory contained rolling palouse prairie in the west, foothills, mountains, and valleys in the east. These features varied in altitude from sea level to 2000 m, creating an environment of exceptional diversity. Palmer (1998a:313) summarized some of the significant features of the botanical environment:

> In aboriginal times, the eastern palouse prairie was dominated by Idaho fescue and by blue bunch wheatgrass. . . . Chokecherry thickets surrounded by thickets of snowberry and wild rose provided cover and forage for white-tailed deer. . . . The steppe vegetation of the fescue—snowberry zone maintains one-third of its maximum growth throughout the winter. Some of this growth would have occurred in roots and forbs utilitized by the Indians in the spring and early summer.
>
> On the edge of the prairie, open stands of ponderosa pine provide patches of grazing land for black-tailed deer. In the foothills, the valleys of the Coeur d'Alene, Saint Joe, Saint Maries, Benewah, and Palouse send tongues of grassy camas meadows up to the foot of the Rockies themselves. These small meadows were favorite camping and root-digging grounds for parties on their way to hunt and fish in the mountains. Along creeks and rivers grow cottonwoods, chokecherries, hawthorns, nodding onions, and cow parsnips.

This is the environment in which the Schítsu'umsh foraged for perhaps 100 generations or more, eating the useful roots, berries, seeds, lichen, mushrooms, and cambium, using woods and fibers for building materials and tools, learning to avoid plants that were toxic or thorny, and appreciating those offering beautiful and interesting sensory qualities. They developed a botanical nomenclature that may once have included two or three hundred names.

Owing to a history of language loss that began well over 100 years ago, the 106 traditional Snchítsu'umshtsn names in this list are surely but a sample of all the plant names that once belonged to the language.[4] This seems likely because larger samples have been obtained from neighboring peoples.[5] For example, between 1971 and 1973, Palmer (1975) recorded over 150 plant names of the Secwepemc. At about the same time, Turner recorded over 260 Nlaka'pamux plant names (Turner et al. 1990). These numbers suggest that the botanical vocabulary of the Schítsu'umsh (and the Secwepemc) was larger in aboriginal times, probably comparable to that of the recorded Nlaka'pamux lexicon.

The first recorded contact with Europeans occurred in 1806 when three Schítsu'umsh were encountered by Lewis and Clark. Trading posts were established nearby in 1809 (Kullyspell House) and 1810 (Spokane House) (Frey 2001). Employees of the Hudson's Bay Company established farms in the Northwest by 1830, and by 1842 Schítsu'umsh were cultivating a superior strain of potatoes in the fertile soil of the Spokane Valley (Geyer 1846; Thwaites 1906:365–367). The first Catholic mission to the Schítsu'umsh was established by Father Nicolas Point in 1842. Some Indian families who resided on the mission grounds allowed their children to be boarded at the mission and trained in practical farming skills by the Catholic priests (Palmer 1998a, 2001). Time spent living and working at the mission would have deprived the children of opportunities to learn Snchítsu'umshtsn terms for native plants in the course of traditional hunting and gathering, and it would have introduced them to French and English terms for European domesticated plants.

The largest loss of language and botanical terms probably occurred after 1876, when the Schítsu'umsh settled on farms in the southern part of their aboriginal territory. In 1878 their children began to attend the mission boarding school at DeSmet, where speaking Snchítsu'umshtsn was prohibited and a massive loss of language ensued (Frey 2001; Palmer 2001). Today, only a very small number of tribal members still speak the aboriginal language fluently. Given this long history of contact with the overwhelming political and cultural forces of Euroamerican society, we are lucky that the remaining sample of Snchítsu'umshtsn plant names and botanical knowledge is so substantial.

METHODS AND SOURCES

Sources.—Those data that are previously unpublished were collected by the first author over the course of dozens of visits to the Coeur d'Alene reservation and Spokane, Washington, during the years 1978 to 1983. The purpose of the research was to study the ethnohistory of the Schítsu'umsh and to produce native language instructional materials. Due to the importance of native plants to historical and contemporary tribal members, ethnobotanical information frequently surfaced in the interviews and casual encounters. All of the consultants, with the exception of one non-Indian person who grew up in a Schítsu'umsh household, were native speakers of Snchítsu'umshtsn, or of Spokane or Kalispel dialects of Kalispel. A total of 15 persons were interviewed. Of these, 14 were knowledgeable tribal elders. Of these elders, ten were ethnically Schítsu'umsh, three were Spokane, and one was Kalispel. Several consultants are now deceased.

Some Spokane materials are included in this paper. While the focus of this study was Schítsu'umsh ethnohistory, interviews and informal discussions often took place in mixed groups of Snchítsu'umshtsn and Spokane speakers and some persons are of mixed ancestry. Furthermore, Schítsu'umsh and Spokanes have probably always had some knowledge of one another's languages and cultures, so it seems best not to try to separate Schítsu'umsh and Spokane ethnobotany too rigidly.

Full sources for each term are listed in "Ethnobotany of the Schítsu'umsh (Coeur d'Alene)," an unpublished paper by the authors. Documentation for Coeur d'Alene includes Nicodemus (1975a, 1975b), Reichard (1938, 1939), and Teit (1930). Cognates were drawn primarily from Boas (1890, 1925), Carlson and Flett (1989), Gibbs (1877), Giorda (1879), Kuipers (1975, 1983), Mattina (1987), Nater (1977, 1990), Palmer (1975), Thompson and Thompson (1996), various publications of Nancy J. Turner and associates, but especially Turner et al. (1980), Turner et al. (1983), Turner et al. (1990), and from Vogt (1940) and the following unpublished papers in possession of M. Dale Kinkade:

Jan van Eijk. 1978. Lillooet Stem List.
Tilly George. n.d. Classified Word List for the B.C. Indian Languages.
M. Dale Kinkade. 1964–1990. Columbian field notes.
———. 1987–91. Thompson class notes.
Larry Pierre and Martin Louie. 1973. Classified Word List for the Okanagan Language.
Sarah G. Thomason. 1990. Salish Dictionary.

Etymologies and Morphological Analyses.—Etymologies and morphological analyses are often problematic. An apparently obvious analysis of a root or substantive suffix may be etymologically invalid as revealed when a term is compared to its cognates in other languages. One can have confidence in a gloss when it is attested by native speakers. One can have confidence in an etymology only when the glossed meaning is attested by native speakers and the analysis is also supported by comparative evidence. Etymological and interpretive guesses are marked with a preceding question mark in Appendix 1. Guesses are generally made only where some known characteristic of the plant fits the interpretation of the root. Where one can have little confidence in an analysis of the linguistic root, a question mark appears in the morphological analysis. Full sources and reasons for analyses are presented in Palmer et al. (n.d.).

LINGUISTIC MORPHOLOGY OF SNCHÍTSU'UMSHTSN PLANT NAMES

We have divided the terms into simple and complex terms. The former category, which is by far the most numerous, refers to a kind of term that we designate *simple lexemes.* The set of "simple lexemes" intersects with the set defined by the previously discussed taxonomic notion of the "composite specific lexeme," for reasons that will be illustrated in the subsection on suffixes. The latter includes both *complex lexemes* and terms that are actually phrases. These categories will be defined more precisely below.

Simple Lexemes.—Simple lexemes comprise the vast majority of terms. By "simple lexeme" is meant a term that can be analyzed as a linguistic root plus, optionally, one or more prefixes and substantive suffixes. The designation excludes compound terms, complex verbal predications (even if they are single lexemes), and terms consisting of multiple words. A morphological analysis of 106 of the known plant terms in Snchítsu'umshtsn can be found in Appendix 1. The vast majority of terms, 97 of them, are simple lexemes by our definition. The term "simple lexeme" might be a bit misleading, because it includes not only terms such as (22) *e̲tqhwe'* 'edible blue camas', which is unanalyzable, but also terms that may have a number of prefixes and suffixes, such as (7b) *stmarímłpecht* 'subalpine fir (and/or grand fir)', which has the morphological structure shown below (phonetic spelling):

s-	*t-*	*marím*	*-əłp*	*-ečt*
NOM-	attached	medicine	plant	whole.hand~branch

This term also illustrates the difficulty of deciding what to count as a plant name. Term (7b) actually refers to the branches of the tree that has the morpho-

TABLE 1.—Frequency of affixes in simple lexemes.

Morphology	Affix	Frequency
Prefixes	s- NOMINALIZER	30
	n- 'in'	3
	č- 'on, distributed'	1
	t- 'on, attached'	1
Suffixes	*-iɫp, -eɫp, -ɫp* 'plant'[a]	19
	-alq^{w} 'tree, bush'	10
	-qn, -qí 'head'	6
	-t INHERENT	6
	-m MIDDLE	4
	-iye, -iyeʔ 'playingly'	3
	-mn INSTRUMENTAL	3
	-us 'face, eye'	2
	-əlš 'arc motion'	2
	-í ?	2
	-ul'mx^{w} 'ground, earth'	2
	other	16[b]
Reduplication[c]	augmentative	24
	intensifying	3

[a] The vowel is lowered before uvulars and pharyngeals.

[b] The following suffixes occurred once each: *-á, -astq* 'wild crop', *-ax̥n* 'arm', *-c'eʔ* 'skin, covering', *-ečt* 'arm, hand, branch', *-elp* (?), *-elps* 'throat, mane', *-enč* 'belly, bank', *-iɫk*^{w}*eʔ* 'in water', *-iʔɫ* 'source of', *-íẃəs* 'waist, between', *-n* NOM, *-p* INCH, *-ú, -umš* 'people', *-us* 'fire'.

[c] Augmentative reduplication copies the linguistic root or its first three segments. The semantics of the augmentative include "DISTRIBUTIVE, PLURAL, and CHARACTERISTIC" (Doak 1997:29). Intensifying reduplication copies only the first two segments of the root. It "implies an intensified condition" (1997: 28).

logical analysis listed in (7a) √*marím-aɫp-alq*^{w} 'subalpine fir (and/or grand fir)', with which it shares the linguistic root and a suffix (*marím-əɫp*). Terms such as (7b), which refer to plant parts or to important products of the plant, are often given by consultants as the name of the plant. In this instance, because the terms are related linguistically, they are counted as one, but analyses of both are presented in Appendix 1 and all affixes are listed in Table 1.

Linguistic roots. All the terms called simple lexemes must have a linguistic root or stem, but in 28 cases the meaning of the root or stem is unknown or not well substantiated.[6] The transcriptions of terms found in Teit (1930) often lacked the necessary precision for analysis. For 42 terms, the only meaning of the linguistic root is the conceptualization of the plant to which the term refers (Table 2).

For 29 terms (simple lexemes only) the meaning of the linguistic root is different from the referent plant itself (Table 3). Terms of this type with roots having meanings such as 'rustle', 'barb', and 'medicine' can be termed descriptive. Of the descriptive roots, the largest category (8 terms) is that referring to color or light. The senses include 'white', 'blue', 'pink' (2 terms), 'glow' (2 terms), 'dark', and 'paint'. Other senses include those of change or motion ('grow', 'revolve', 'rustle'), use ('medicine', 'good', 'gather', 'paint', 'canoe'), taste, smell, and texture ('sweet', 'rotten', 'foam'), danger ('barb', 'thorn', 'hurt'), plants or plant parts ('grass', 'leaf', 'barb', 'thorn'), and death ('ghost', 'corpse'). Senses of the remaining terms include 'straight' and 'wrap string'. Thus, it appears that utilitarian aspects of plants do

TABLE 2.—Meanings of linguistic roots as referent plant (simple lexemes only).[a]

4	Rocky Mountain juniper	65	pea
5	western red cedar	69	wild gooseberry
10	white-bark pine	70	mock orange
13	ponderosa pine	77	serviceberry
14	Douglas-fir	81	oceanspray
16	wapato	82	apples
18	skunk cabbage	83	plum
21	onion	84	bitter cherry
22	edible blue camas	85	chokecherry
24	Indian hellebore	86	peach
26	grass	88a	wild rose
28	barley	88b	wild rose
32	poison-ivy	89	wild rose
36	cous	90	wild raspberry
38	Indian celery, *Lomatium nudicaule*	91	blackcap
39	biscuitroot	96	cottonwood
48	pineapple weed	99	willow
52	hazelnut	100	willow
54	blue elderberry	101	wild tobacco
56	red willow	102	potato
61	kinnikinnick	107	black birch

[a] Numbers are keyed to item numbers in Appendix 1.

not dominate the senses of linguistic roots. Perceptual qualities are also important. In fact, it is often difficult to separate the two. For example, there is obvious utility in recognizing the shape of a thorn.

Prefixes. Simple lexemes have two types of prefix: the nominalizer *s*- and the spatial prefixes *č*- 'on, distributed', *t*- 'on, attached', and *n*- 'in'. Conspicuously missing from the spatial prefixes of these terms are *niʔ*- 'amidst', *cn*- 'under', and *čet*- 'on something broader than itself', all of which occur frequently in place names and anatomical terms (Palmer 1993; Palmer and Nicodemus 1985).[7] A total

TABLE 3.—Meanings of linguistic roots where meaning is other than referent plant (simple lexemes only).[a]

6	ghost	51	leaf
7	medicine	55	corpse/dead
8	pink	57	wrap string
12	canoe	60	foam
15	bow	63	sweet
20	raw	64	white
29	grass	67	hurt
27	grow	68	revolve
30	gather	71	rotten
34	good	75	paint
35	glow	79	thorn
37	glow	80	pink
44	dark	92	inverted concave object
46	barb	94	straight
50	blue	98	rustle

[a] Numbers are keyed to item numbers in Appendix 1.

of 30 of the 98 simple terms have the prefix *s-* (Table 1). Other terms whose linguistic roots begin with *s* may have the prefix as well, but there is no way of knowing. Why (77) *słaq* 'serviceberry' uses the *s-*, but a similar term, (85) *łáx̥ʷłəx̥ʷ* 'chokecherry', does not, is unknown, but it might involve free variation in assimilation of the initial consonant.

Prefixes with spatial meanings occur on only five names. The prefixes are *n-* 'in', *č-* 'on (distributed)', and *t-* 'on (attached)'. Thus, spatial constructs cannot be rated highly important in the construction of plant terms. Three terms have the prefix *n-* 'in'. Since the meaning of other elements in these constructions is unknown, it is not possible to clarify the semantic function of the *n-* prefix in plant names. Only one term has the prefix *t-* 'on (attached)'. Here, in term (7b) *stmarímłpečt* 'subalpine fir (and/or grand fir)', it seems to describe an attachment to a branch. The prefix *č-* 'on (distributed)' is also found in only one term, (75), analyzed as *s-č-√nir*$_{\text{(GLOT)}}$*-mn* 'sagebrush buttercup', which has a linguistic root referring to paint. The fact that these prefixes are so rare in plant names suggests that the architecture of the plants has little importance in naming.

Reduplication can also be regarded as a kind of affixation. Augmentative reduplication adds a new copy of the linguistic root (or the first three segments of it). It occurs in most instances as a prefix to the root, but sometimes as a suffix.[8] Examples include *√dúł-duł-p* (rustle-AUG.RDP-INC) 'poplar tree or trembling aspen' and *√łek'ʷ-łek'ʷ-t* (AUG.RDP-barb-INH) 'n. thistle, cactus'. According to Doak (1997:29), augmentative reduplication denotes actions or qualities that are distributive, plural, or characteristic. It occurs in a total of 24 of the simple terms. In five cases, the meaning of the root that is duplicated is the referent plant itself. Descriptive roots that are duplicated include those with meanings of 'rustle', 'stink', 'white', 'glow', 'good', 'dark', 'gather', 'thorn', 'straight', and 'corpse', a group which seems to have nothing much in common, either semantically or phonetically.

The intensive reduplication construction, which copies only the first two segments of the linguistic root, appears in three terms. The only one for which the meaning of the linguistic root is clear is (57) *t-ʕa-√ʕáx̥-c'eʔ*, where it means 'wrap string'. It is interesting that this must be a new term, as it refers to the domesticated cantaloupe.

Suffixes. The suffixes of Snchítsu'umshtsn plant terms have a variety of linguistic functions ranging from nominal classification as plant or tree (~bush), to anatomical topographical description, locative description, and some more abstract senses involving verbal aspect and linguistic voice. The most commonly occurring suffix (19 instances) is **-ałp* 'plant' (Table 1). It occurs with linguistic roots having both descriptive and referential meanings. The suffix should probably be regarded as a classifier that, in this language, contrasts with **-alqʷ* 'tree, bush'. There are 10 terms with **-alqʷ*. Term (61b) *álčałpalqʷ* 'kinnikinnick' has both suffixes: */√ʔí:lč-ałp-alqʷ/* (kinnikinnick-plant-tree~bush).[9] "Simple lexemes" that have substantive or classificatory suffixes *-ałp, -alqʷ*, and *-astq* 'berry' also fit the definition of the "composite specific lexeme" discussed in the introductory subsection on *Plant Names in Salishan Languages,* but those with substantive, but nonclassifying suffixes such as *-qn* 'head', *-us* 'face, eye', *-ax̥n* 'arm', *-c'eʔ* 'skin, covering', *-ečt* 'arm, hand, branch', *-elps* 'throat, mane', *-enč* 'belly, bank', *-íw̓əs* 'waist, between', *-əlš* 'arc motion', and *-iye/-iyeʔ* 'playingly', do not qualify as "composite *specific* lexemes." Simple lexemes with these suffixes may best be compared to the analyzable primary lexeme of Berlin et al. (1973) or the complex unitary lexeme of Conklin (1969), but the correspondence is imperfect, as terms of this type are usually descriptive, unlike the metaphorical example of "Jack-in-the-pulpit."

The next most common substantive suffix is *-qn* (~*-qí*) 'head', with six instances. Rather than a classifier, *-qn* seems to be used to locate a quality on the fruiting body of a plant or at the top of a tree. For the two terms that can be fully analyzed, the meanings seem to be *scratch on head~top* (48) 'pineapple weed', and *grass on head~top* (29) 'wheat'.

Also occurring with some frequency (6 terms) is the aspectual suffix *-t*, which denotes something inherent. Among the terms whose linguistic roots are known, it is suffixed to 'ghost', 'barb', 'stink', 'straight', and 'poison ivy' (suggesting that the linguistic root *p'uł* may have simply meant 'poison' before it acquired the meaning 'poison ivy'.)

The remaining suffixes cover a gamut of senses. Two of these appear to refer to motion or action: *-əlš* 'arc motion' and *-iye/-iyeʔ* 'playingly', perhaps referring to wavy or undulating leaves. Anatomical suffixes in addition to 'head' include *-us* 'face, eye', *-ax̥n* 'arm', *-c'eʔ* 'skin, covering', *-ečt* 'arm, hand, branch', *-elps* 'throat, mane', *-enč* 'belly, bank', and *-íw̓əs* 'waist, between'. None is used with any great frequency. The fact that anatomical suffixes occur only 14 times in 98 simple lexemes shows that anatomical topographical concepts were significant but not primary in plant naming. Locatives include *-ul'mx*^{w} 'ground, earth', *-iłk*^{w}*eʔ* 'in water', and *-iʔt* 'source of'.

Hunn (1985) has emphasized the importance of utilitarian concerns in plant classification. If utilitarian concerns were dominant, one would expect the majority of plant names to reflect important uses. One might expect a high frequency of instrumental suffixes and utilitarian looking linguistic roots. In fact, at the generic level, only six terms have roots with clearly utilitarian meanings. These are (7) 'medicine', (12) 'canoe', (15) 'bow', (30) 'gather', (34) 'good', and (75) 'paint'. One might also argue that (63) 'sweet' is utilitarian. The only clearly utilitarian suffixes are *-mn* 'used for' and *-astq* 'wild crop'. However, it is possible that some of the unanalyzable linguistic roots were once utilitarian markers. Names warning of unpleasant or dangerous qualities could also be regarded as utilitarian, as with (46) 'barb', (71) 'rotten', (79) '?thorn', and possibly (32) 'poison ivy', if *p'uł* does in fact derive from a former root meaning 'poison'.

At higher taxonomic levels, two terms appear to have utilitarian motivation: *syólalq*^{w} 'tree' is based on the root *yel* 'pitch', and *st'šastq* 'berries' is the same as the term for black huckleberry, which has the root *t'əš* 'sweet'. This small number of terms and affixes argues that utilitarian concerns are not the primary factor in Snchítsu'umshtsn plant naming, or in classification to the extent that it is reflected in naming. It may well be that utilitarian concerns govern the decision of whether or not to name, but they do not appear to govern the semantics or grammatical structure of plant names to any significant degree.

Substantive suffixes of Snchítsu'umshtsn are often truncated to a single vowel— *-e*, *-i*, or *-u*—usually (perhaps always) stressed in final position. When this happens, it is impossible to recover the meaning, as there are always several candidates for the original. There are four instances in these data.

Complex Terms.—Among the 106 Snchítsu'umshtsn plant names, only eight have structures that we have termed "complex." These include the compound descriptive lexemes such as (97) *dareɫdúɫduɫp* 'poplar (trembling aspen)' that compound two linguistic roots. The term is analyzable as *dar-eɫ-√dúɫ-duɫ-p* (containers.stand-CONN-rustle-AUG.RDP-INC). A bit more complex is the verbal predication (19) *hnt'apɫc'eʔencótn* 'pineapple', meaning 'what shoots self through inside', analyzable as *n-√t'ap-ɫc'eʔ-n-cút-n* (in-shoot-inside-TR-REFL-NOM). Term (58) *niʔšarusiʔutm* 'squash', is analyzable as *niʔ-√šar-us-iʔ-ut-m* (amidst-hang-fire-?-be.in.position-MDL) 'hang in fire.'[10] It is probably no coincidence that these are both domestic plants introduced by Europeans, though it is just possible that squash had some other source, since it originates in the New World.

Four of the terms have the structure of a phrase. The simplest of these is (49) *x̥al sgʷarpm* 'common dandelion' is translatable as 'lie.in.order bloom'. A similar term, but more complex, is (42) *x̥alńńnak'ʷaʔal'qs ha sgʷarpm* 'daisy' perhaps translatable as 'little blossoms that lie in rows on the ridge'. The phrasal term (93) *sngʷáŕus xʷe e tíɫteɫl'mxʷ* 'descendent of blackberry vine' (boysenberry) is the only recorded Snchítsu'umshtsn plant term that classifies using the principle of kinship, as suggested by the gloss 'descendent'.

COGNATE PLANT NAMES IN INTERIOR SALISH LANGUAGES

All the Interior Salish languages have plant names that are cognate with Snchítsu'umshtsn terms. Their distribution appears to be best described as a cline decreasing in frequency in rough order from Kalispel in the east to Stl'atl'imx (Lillooet) in the west (Table 4). The number of cognates drops off sharply with Stl'atl'imx, a phenomenon that has been noticed and discussed by Turner et al. (1998). There are 53 known cognate plant terms in Kalispel and 46 in Nsilxtsin (Okanagan-Colville). These correspond closely in their distribution. Nxaʔamxcín (Columbian) follows with 34 cognates. Of those, 33 also have cognates in either Okanagan-Colville or Kalispel or both. Of the northern Interior Salish languages, Secwepemc (Shuswap) has 25 cognates, Nlaka'pamux (Thompson) 29, and Stl'atl'imx (Lillooet) 13. Proto-Interior Salish forms have been reconstructed for 24 of these terms. Proto-Salishan forms can be reconstructed with confidence for nine and with less confidence for 13. Very few borrowings from Sahaptian languages are evident. Terms (36) *káʔus* 'cous, biscuitroot' and (38) *péqai 'Lomatium nudicaule'* are from Nez Perce. Another possibility is (78) *kʷela** 'red hawthorn' (cf. *kulakula*).[11] The Nez Perce term *k'ʷlawi* 'onion' was more likely borrowed from a Salish cognate of (20) *qʷəlíwəl'š* 'onion'.

Inspection of exactly which plants are named in the majority of Interior Salish languages may help us undersand the naming process. Terms which have cognates in all seven languages are as follows:

(4) *punɫp,* Rocky Mountain juniper
(11) *qʷoqʷoʔlíʔt,* lodgepole pine

(14) *c'áq'ałp,* Douglas-fir
(52) *q'ip'x^{w}eʔ,* hazelnut
(60) *sx̥úsm,* soapberry
(91) *məcúk^w,* blackcap
(101) *smiʔlx^w,* wild tobacco

Terms which have cognates in six of the seven languages, including Snchítsu'umshtsn include the following:

(7) *marámłpalq^w,* subalpine fir (and/or grand fir)
(8) *céq^{w}lš,* western larch
(13) *ýátq^{w}ełp,* ponderosa pine
(20) *q^{w}əlíwəl'š,* onion (*Allium* sp.)
(45) *smúk^{w}aʔcn*,* balsamroot
(54) *c'ék^{w}ək^w,* blue elderberry
(74) *sp'ít'em,* bitterroot
(81) *məcməcíʔełp,* oceanspray
(96) *mulš,* cottonwood

These two groups of high-frequency cognates (totaling 16 terms) include eight tree names, three berry bushes, one economically important bulb, and two economically important taproots. The trees, and oceanspray, have economic importance in providing materials for buildings and manufactured items and as sources of food and medicine. This group of high-frequency cognates suggests size, value in manufacturing dwellings and tools, subsistence value, and medicinal/ceremonial value (i.e., subalpine fir and wild tobacco) as features that promote the entrenchment, retention, and widespread distribution of names (though not necessarily their taxonomic construction). Food plants such as hazelnut, soapberry, and bitterroot were also important in trade (Teit 1930:112; Turner and Loewen 1998), as was wild tobacco, which was apparently not grown by the Snchítsu'umshtsn (Teit 1930:113). Balsamroot was utilized for its taproots, greens, and seeds.

Six terms—(22) edible blue camas, (33) cow parsnip, (70) mock orange, (84) bitter cherry, (88a) wild rose, and (26) grass—have cognates in five of the seven languages, including Snchítsu'umshtsn. These lower frequency terms contain no trees and one major food source (edible blue camas). Grass was economically important for the grazing of deer and horses. The hard wood of mock orange was used for making a number of small tools. Details can be found in the listing of plant terms (Appendix 1).

All these counts of cognates must be evaluated with some caution as plant names have been recorded more thoroughly in some languages than others. Stl'atl'imx (Lillooet), Nlaka'pamux (Thompson), and Secwepemc plant terms have received more study than Nxaʔamxcín, Kalispel, and Snchítsu'umshtsn.

SUMMARY AND CONCLUSIONS

The prototypical Snchítsu'umshtsn plant name consists of a linguistic root plus a substantive suffix. Typical examples are (13) *y'átq^{w}ełp, /s-$\sqrt{}$ʔetq^w-ałp/* (pon-

TABLE 4.—Cognates in Interior Salishan languages.[a]

#	Snchítsu'umtsn name	English or Latin name	PS	PI	LI	TH	SH	CV	CM	KA
1	*séčečt*	black tree lichen	·	·	·	·	·	·	x	·
2	*sicse:ciye*	lichen	·	·	·	·	·	·	·	·
3	*he st'edeʔ łe t'úxʷn*	horsetails	·	x	·	x	x	·	·	x
4	*punłp*	Rocky Mountain juniper	·	x	x	x	x	x	x	x
5	*k'ʷáysalqʷ*	western red-cedar	·	·	·	·	·	·	·	·
6	*sk'ʷust*	western red-cedar	·	·	·	·	·	·	·	·
7a	*marámłpalqʷ*	subalpine fir	x	x	x	·	x	x	x	x
8	*céqʷlš*	western larch	·	x	·	x	x	x	x	x
9	*šax̥šax̥t*	Engelmann spruce	·	·	·	·	·	·	·	·
10	*suwístč*	white-bark pine	·	·	·	·	·	·	·	·
11	*qʷoqʷoʔlíʔt*	lodgepole pine	·	x	x	x	x	x	x	x
12	*t'ádaʔalqʷ*	white pine	·	·	·	·	·	x	·	x
13	*y̓átqʷełp*	ponderosa pine	·	x	?	x	x	x	·	x
14	*c'áq'ałp**	Douglas-fir	x	x	x	x	x	x	x	x
15	*ʕacečn̥álqʷ**	yew	·	·	·	·	·	·	·	·
16	*sqígʷcs*	wapato	·	·	x	·	·	x	·	x
17	*qexʷqexʷəlšáiyeʔ**	skunk cabbage	·	·	·	·	·	·	·	·
18	*tímuʔ*	skunk cabbage	?	·	·	·	x	x	·	x
19	*hnt'apłc'eʔencótn*	pineapple	·	·	·	·	·	·	·	·
20	*qʷəlíwəl'š*	onion	·	x	x	x	x	x	·	x
21	*sisč*	onion	·	·	·	·	·	x	x	x
22	*ʔétx̥ʷeʔ*	edible blue camas	·	x	·	x	·	x	x	x
23	*č'áwəx̥**	tiger lily	?	·	·	x	·	·	·	x
24	*slaq'mn*	Indian hellebore	·	·	·	·	·	x	·	x
25	*sæc'sečíyə*	Indian hellebore	·	·	·	·	·	·	·	·
26	*st'édeʔ*	grass	·	x	·	·	x	x	x	x
27	*sq'iʔc'ul'mxʷ*	crab grass	·	·	·	·	·	·	·	·
28	*nors*	barley	·	·	·	·	·	·	·	·
29	*st'ádaʔqn*	wheat	·	·	·	·	·	·	·	·
30	*q'ʷósq'ʷəs**	cat-tail	·	·	·	·	·	x	x	x
31	*sqwaxt*	vine maple	·	·	·	·	·	·	·	·
32	*p'ułp'ułtúmš*	poison-ivy	·	·	·	·	·	·	·	·
33	*x̥ʷóx̥ʷłp*	cow parsnip	·	·	·	·	x	x	x	x
34	*x̥ásx̥əs*	Canby's lovage	·	x	·	x	·	x	·	x

TABLE 4.—Continued.

#	Snchítsu'umtsn name	English or Latin name	PS	PI	LI	TH	SH	CV	CM	KA
35	*p'exʷpuxʷ*	white camas	·	·	·	·	·	·	·	x
36	*káʔus*	cous (NP)	·	·	·	·	·	x	·	·
37	*sp'éxʷenč*	desert parsley	·	·	·	x	·	x	·	x
38	*péqai**	barestem lomatium (NP)	·	·	·	·	·	·	·	·
39	*píwye*	biscuitroot	·	·	·	·	·	·	·	x
40	*st'úqʷm**	wild caraway	·	·	·	·	·	x	x	x
41	*dmdmuʔqeyníʔ*	yarrow	·	·	·	·	·	·	·	·
42	*x̥alńńnak'ʷaʔal'qs ha sgʷarpm*	pussytoes, etc.	·	·	·	·	·	·	·	·
43	*p'up'uʔnełp*	northern wormwood	·	·	·	x	x	·	·	x
44	*qʷəl'qʷəl'mníłp*	big sagebrush	·	·	·	·	·	x	·	x
45	*smúkʷaʔcn**	balsamroot	·	·	·	x	x	x	x	x
46	*łek'ʷłuk'ʷt*	wild thistles	·	·	·	x	x	x	·	·
47	*maríupa**	wavy-leaved thistle	·	·	·	·	·	·	·	·
48	*ncl'cil'xʷqí*	pineapple weed	·	·	·	·	·	·	·	x
49	*x̥al sgʷarpm*	dandelion	·	·	·	·	·	·	·	·
50	*sqʷéyuʔ*	Oregon-grape	·	·	·	·	·	·	x	x
51	*spičłená:**	paper birch	·	·	·	·	·	·	·	x
52	*q'ip'xʷeʔ*	hazelnut	x	x	x	x	x	x	x	x
53	*sámpəqn**	black twinberry	·	·	·	·	·	·	·	·
54	*c'ékʷəkʷ*	blue elderberry	x	x	·	x	x	x	x	x
55	*təmtəmníʔełp*	snowberry	·	·	·	·	·	x	x	x
56	*stichtskhw*	red willow	·	·	·	·	·	x	x	x
57	*tʕaʕáx̥c'eʔ*	cantaloupe	·	·	·	·	·	·	·	·
58	*niʔšarusiʔutm*	squash	·	·	·	·	·	·	·	·
59	*sməx̥ʷnéłp**	silverberry	·	·	·	·	·	·	·	·
60	*sx̥ʷúsm*	soapberry	·	x	x	x	x	x	x	x
61	*ʔílč*	kinnikinnick	·	x	x	x	x	·	·	·
62	*st'eq'ln*	dwarf blueberry	x	·	·	·	·	·	·	·
63	*st'əšástq*	black huckleberry	·	·	·	·	·	x	·	x
64	*paqpaqáx̥n*	huckleberry	·	·	·	·	·	x	·	·
65	*lípowe:*	garden pea	·	·	·	·	·	·	·	·

TABLE 4.—Continued.

#	Snchítsu'umtsn name	English or Latin name	PS	PI	LI	TH	SH	CV	CM	KA
66	_snč'łmásməs_	frasera	·	·	·	·	·	·	·	·
67	_sc'érus_	golden currant	·	·	·	·	·	x	x	x
68	_yaŕčń_*	squaw currant	·	·	·	·	·	x	x	x
69	_ħnt'ít'ḿeʔlps_*	wild gooseberry	x	x	·	·	·	·	x	x
70	_wáx̥iʔłp_	mock orange	·	x	·	x	·	x	x	x
71	_naq'naq'tełp_	Canada mint	·	·	·	·	·	x	x	x
72	_łáq'mx^{w}_*	spring beauty	·	·	·	·	·	·	·	·
73	_sq^{w}étm_*	_Claytonia_ sp.	·	·	·	·	·	·	·	·
74	_sp'ít'em_	bitterroot	·	x	·	x	x	x	x	x
75	_sčnéʔrmn_	sagebrush buttercup	·	·	·	·	·	x	x	x
76	_stč'i:háyus_	buttercup	·	·	·	·	·	·	·	·
77	_słaq_	serviceberry	·	·	·	·	·	x	·	x
78	_k^{w}ela_*	red hawthorn	·	·	·	·	·	·	·	·
79	_sx̥^{w}úʔneč_*	black hawthorn	·	·	·	·	·	x	x	x
80	_scáq^{w}m_	wild strawberry	·	·	·	x	·	·	·	·
81	_məcməcíʔelp_	oceanspray	?	x	·	x	x	x	x	x
82	_sʔáplsalq^{w}_	apple	·	·	·	·	·	·	·	·
83	_plámsalq^{w}_	plum	·	·	·	·	·	·	·	·
84	pəčĺén*	bitter cherry	·	x	·	x	x	x	x	·
85	_łáx̥^{w}łəx̥^{w}_*	chokecherry	?	·	·	·	·	x	·	x
86	_píčus_	peach	·	·	·	·	·	·	·	·
87	_t'əšilépa_*	_Prunus_ sp.	·	·	·	·	·	·	·	·
88a	_sx^{w}á:yapaʔqn_*	wild rose	·	·	·	x	·	x	x	x
89	_qal'x̣elp_	wild rose	x	·	x	·	·	·	·	·
90	_hnhala:céʔ_	wild raspberry	·	·	·	·	·	·	·	x
91	_məcúk^{w}_	blackcap	x	x	x	x	x	x	x	x
92	_pólpolqn_	thimbleberry	·	·	·	·	·	x	x	x
93	_sng^{w}árus x^{w}e e tíł-teł-l'mx^{w}_	boysenberry	·	·	·	·	·	·	·	·
94	_tíłtełl'mx^{w}_	_Rubus_ sp.	·	·	·	·	·	·	·	·
95[a]	·	·	·	·	·	·	·	·	·	·
96	_mulš_	cottonwood	·	x	x	x	x	x	·	x
97	_darełdúłdułp_	trembling aspen	·	·	·	·	·	·	·	·

TABLE 4.—Continued.

#	Snchítsu'umtsn name	English or Latin name	PS	PI	LI	TH	SH	CV	CM	KA
98	*dúłdułp*	trembling aspen	.	.	.	.	.	.	.	.
99	*dél'ełp*	willow	.	.	.	.	.	.	.	.
100	*q'ólsalqʷ*	willow	.	x	.	x	x	.	.	x
101	*smiʔlxʷ*	wild tobacco	x	x	x	x	x	x	x	x
102	*pa:táq*	potato	.	.	.	.	.	.	.	.
103	*másməs*	edible valerian	.	.	.	.	.	.	.	.
104[a]	.	.	.	.	.	.	.	.	.	.
105	*pičelúsa**	a root	.	.	.	.	.	.	.	.
106	*sk'ʷax̥k'ʷax̥ełkʷaʔ*	a water plant	.	.	.	.	.	.	.	.
107	*tax̥tax̥iłp*	black birch	.	.	.	x	.	.	x	.
108	*t'eptptełp*	a berry	.	.	.	.	.	.	.	.

[a] Numbers are keyed to item numbers in Appendix 1. CM = Columbian (Nxaʔamxcín), CV = Okanagan-Colville (Nsilxtsin), LI = Lillooet (Stl'atl'imx), SH = Shuswəp (Secwepemc), KA = Kalispel (Spokan, Kalispel, and Flathead dialects), TH = Thompson (Nlaka'pamux), PI = Proto-Interior Salish, PS = Proto-Salish. Terms (95) and (104) omitted as they are Spokan.

derosa pine) and (63) *st'šastq, /s-√t'əš-astq/* (black huckleberry). As in these examples, there may also be a nominalizing prefix and/or one or more spatial prefixes and/or a stem-forming suffix, such as *-t* 'inherent'. Reduplications of the linguistic root are common. The plant names display a more limited set of spatial prefixes than are found in the domains of place names and anatomical terms.

A variety of substantive suffixes occur. The largest categories, involving 29 of the 103 simple lexemes, establish a division into terms with the suffixes *-ałp* 'plant' (19 terms) and those with *-alqʷ* 'tree~bush' (10 terms). However, the structure of one term—*álčałpalqʷ* 'kinnikinnick'—that combines the two suffixes suggests that *-ałp* 'plant' may be the more general classifier, having the sense of "green or leafy plants." It appears in the names of herbs (cow parsnip, Canada mint), small or low shrubs (snowberry, silverberry, big sagebrush, northern wormwood) as well as several larger shrubs or bushes (wild rose, mock orange, ocean spray, willow) and trees (Rocky Mountain juniper, ponderosa pine, Douglas-fir, cottonwood, black birch). The suffix *-alqʷ* specifies plants that take the form of a tree or a bush, more often the former, or perhaps it is simply applied to those for which the notion of pole is most salient. The corresponding suffix *-álek̲w* translates as 'wood' in Nsilxtsin (Okanagan-Colville) (Turner et al. 1998). This is one respect in which classification in Snchítsu'umshtsn may differ from other Salishan languages. In the Salishan languages having the 'plant' suffix, this is most often applied to various species of trees and shrubs, especially those with berries or other important cultural resources.

Fourteen of the simple lexemes in Snchítsu'umshtsn have anatomical suffixes, including seven instances of *-qn* (~*qí*) 'head', which, like English, has a metaphorical extension to 'top'. Non-hierarchical taxonomic relations are rare among the Snchítsu'umshtsn plant terms, but one instance of a plant as the descendant of blackberry vine occurs in a complex term. Only two terms have locative suffixes other than the anatomical suffixes, which can often be regarded as locative. Notably absent from the classificatory suffixes of Snchítsu'umshtsn is *-usaʔ* 'berry, face, eye, round thing', which can be found in neighboring Salishan languages (Palmer 1998b). Snchítsu'umshtsn does possess the related suffix *-us* 'face, eye', but it does not occur in the recorded plant names except as a pun in (86).

It appears that there is a term that stands for conifers in general, and that is term (13) *ýátqʷełp.* This term also has the more specific referent ponderosa pine. The general term for any tree is *syólalqʷ*, a term which suggests generalization of an earlier term limited to conifers (s-*yél-alqʷ* NOM-pitch-tree~log~pole). The general term for berries is *stšastq,* which is also the term for (63) black huckleberry. The general term for a bush or shrub is *eedel'.*

There seems to be no free lexeme that covers all trees, shrubs, and herbs, only the suffix *-ałp* (~ *-əłp, -łp*). This is a common pattern among Interior Salish languages (Turner 1987, 1988). The suffix is found in all the languages and used in many names (see, for example the tree names in Turner et al. 1998). In Stl'atl'imx (Lillooet) it coexists with a more common form *-az'*, which apparently has the same meaning (Ex. Stl'atl'imx *cáx̥-az' / c'q'ʷ-əłp* 'Engelmann spruce'). The 'log, pole' suffix (*-alqʷ*) occurs much less frequently in the Interior Salish tree names, but it is found in clearly recognizable form in all but Stl'atl'imx and Nlaka'pamux (Thompson). The latter has the possible cognate forms *-alx, -áyqʷ*, and *-yəqʷ*.

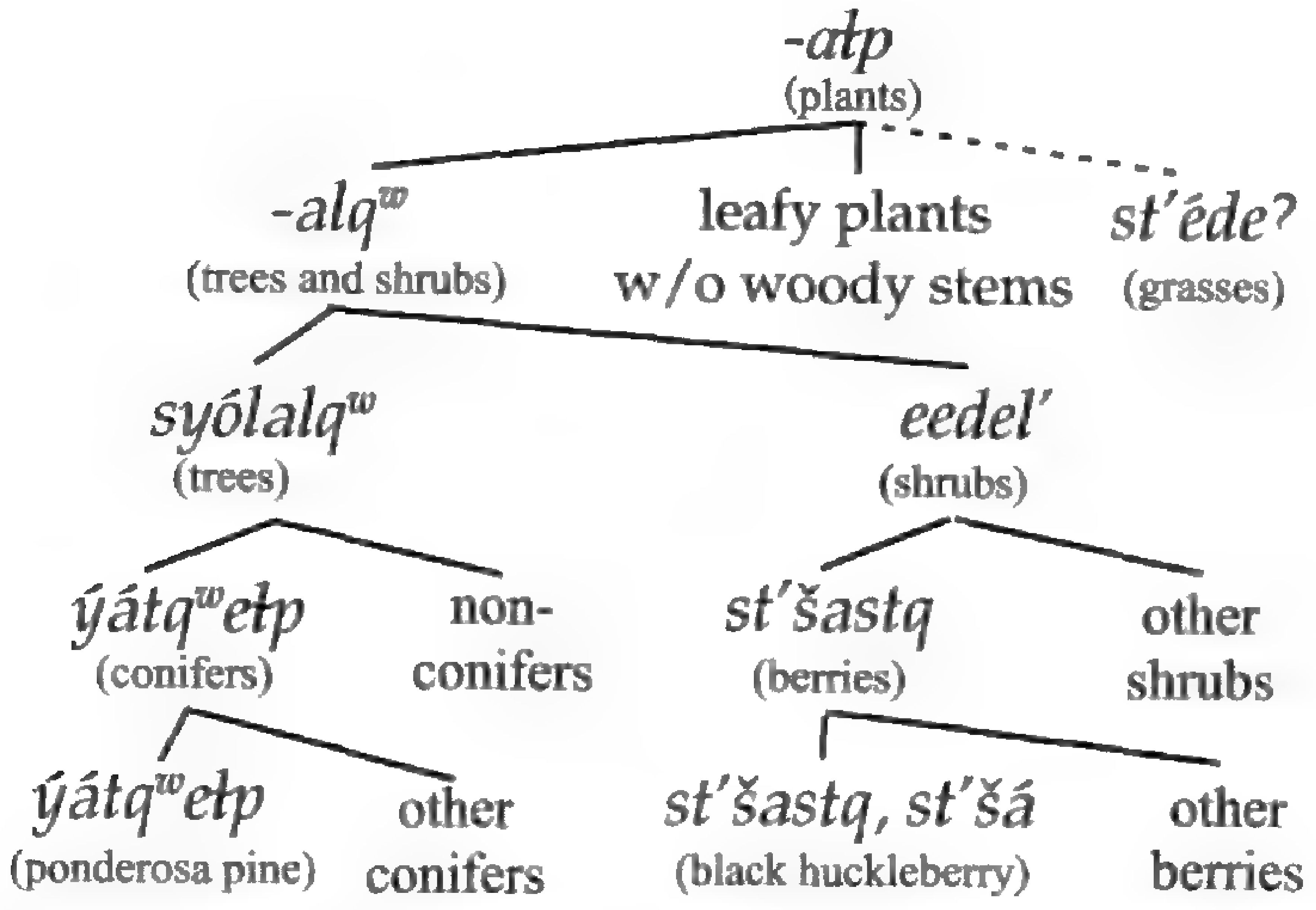

FIGURE 2.—Taxonomy of plant forms in Snchítsu'umshtsn. (Fungi and lichens not included. Dotted line indicates hypothetical inclusion.)

In Columbian the only tree name that has the *-alqʷ* suffix is 'jack pine'. Otherwise it is found on terms for 'fruit trees', 'bump into a tree', 'go under a log', 'peck at a tree', 'grave marker', 'train', 'twisted tree', 'a tree hit by lightning', 'logs', 'round like a pole', 'roll up one's sleeves', 'cradle of a scythe', 'tall', and others. It even occurs on words for 'short'. The suffix *-ałp* occurs on many tree and plant names, and comes closest in Columbian to being a suffix for 'tree'. However, it is also the suffix to indicate the plant on which particular berries grow, as opposed to the berries themselves. In a few cases it may not be divisible, that is, the root to which it is attached is not found elsewhere in the language, as in terms for 'juniper' and 'spruce'. It also occurs with 'tall sunflower', 'skunk cabbage', 'pine grass', 'wild lupine', 'sand bur plant', and three unidentified plants, and it is used for counting plants. This distribution suggests that the taxonomic diagram in Figure 2 must be evaluated with some caution, as the function of the *-ałp* and *-alqʷ* suffixes seems as much classificatory (differentiating by form or part within a genus or species) as taxonomic (differentiating by genus and species).

We have not explored the extensions of these terms with native speakers of Snchítsu'umshtsn in a systematic fashion, but given these facts and our understanding of the suffixes *-ałp* and *-alqʷ*, we can still posit a taxonomy something like that in Figure 2. This taxonomy agrees generally with the classification of plants implied by Okanagan mythology (Turner et al. 1980). There, the category of "bushes, flowers, and trees" subdivides into categories of "trees with leaves" and "trees without leaves." The chief of the latter is white pine and of the former, Rocky Mountain maple. In Snchítsu'umshtsn one can propose a taxonomic hierarchy of five levels, but the classifying suffixes (*-ałp* and *-alqʷ*) that partially structure the hierarchy appear in only a minority (29) of the terms, as described above.

Describing Fraser River Lillooet, Turner (1974) found eight life forms, including 'trees' (divided into 'with leaves' and 'evergreens'), 'berries', 'flowers', 'grasses (and grass-like plants)', 'mosses', 'mushrooms and fungi', 'weeds', and 'roots (and underground parts, including poisonous types)'. Only trees, evergreens, berries, flowers, grasses, mosses, and weeds are given general terms. Trees with leaves are unnamed, as are roots and underground parts. The Snchítsu'umshtsn classification depicted in Figure 2 appears to support Turner's observations in a general way. Trees are divided into conifers (evergreens) and non-conifers. There are general terms for trees, conifers, grasses, shrubs, and berries, but not, as in Fraser River Lillooet, for trees with leaves or for roots. In addition there are suffixes for plants in general, and for trees and shrubs as a single category. It is possible that Snchítsu'umshtsn also has or had general terms for mosses, mushrooms and fungi, and weeds, but we do not have the data to confirm it.

Most terms whose derivations are clear are descriptive constructions involving linguistic roots specifying some attribute of color or light (eight terms), taste, smell, shape, danger, motion, texture, or use. Two pertain to death and ghosts. Utilitarian concerns are present, but not primary. The infrequent usage of spatial prefixes ('in', 'on, attached', 'on, distributed', 'amidst', etc.) in descriptive terms suggests that conceptualizations of plant structure play little role in their naming. These findings are similar to those reported by Palmer (1998b) for Secwepemc, in which 45 of 144 recorded terms were descriptive. Of the 45 descriptive terms, 33 were based on the perceptual characteristics of appearance (30) and smell (3), with the remaining few terms classified as danger or irritation (6), usefulness (5), and behavioral (1). In general, the terms bear out Randall's (1976) observation that, rather than storing elaborate taxonomic hierarchies directly in memory, people typically store only the perceptual characteristics of classes. However, utilitarian concerns may be primary in the entrenchment and widespread distribution of a few names, that is, those with the greatest number of cognates in neighboring languages. The Snchítsu'umshtsn terms provide some support for Berlin's (1992: 21) generalization that "*names for plants and animals commonly allude metaphorically to some typical morphological, behavioral, ecological, or qualitative characteristic feature of their referents*" [italics in original], but this generalization is so inclusive as to be almost vacuous.

At least six of the terms may involve borrowings from European languages, three of these apparently from French, reflecting the influence of Father Point and other missionaries, and three from English, probably reflecting experiences subsequent to 1876. These include terms for barley, pea, and potato from French and apple, peach, and plum from English.[12] Terms for the crops wheat and alfalfa do not appear to be borrowings. Borrowings from English can provide an occasion for puns, as in the rendering of peaches in Snchítsu'umshtsn as *píč-us*, which can be construed as 'peach face'.

Interior Salish plant names that are cognate with Snchítsu'umshtsn forms are distributed along a cline of decreasing frequency from Kalispel in the east to Stl'atl'imx in the west, providing support for the conclusions of Turner et al. (1998). The 16 terms with cognates in at least six of the seven languages include names for eight trees (six of which are conifers), three berry bushes, one edible bulb and two edible taproots. At first glance, size, value in manufacturing, and subsistence value appear to be the major factors in their wide distribution, but other factors, such as trade and continuity of distribution on the landscape may be involved as well. Such utilitarian factors may motivate the creation and use of plant names, but they do not appear to govern the grammatical structure of plant names as categorizing symbols.

NOTES

[1] Snchítsu'umshtsn < *s-n-čícuʔumš-cn,* NOM-in-Coeur.d'Alene.people-mouth.or.language, i.e., 'Coeur d'Alene language'. The stem term Schítsu'umsh (Coeur d'Alene) has been translated by Lawrence Nicodemus as 'discovered people'. In the Coeur d'Alene community orthography, the stress is usually indicated with an underline, e.g., Schi̲tsu'umsh. Other names of ethnic groups are presented in their own community orthographies. We judged it to be an impossible task to resolve all the Salish orthographies into one.

Names of plants discussed in the text are presented in the Americanist orthography, which is discussed in the Appendix. The names may appear in analyzed form, as in the Appendix (second entries), or the unanalyzed form as they appear in Table 4, column 2. The use of the Americanist orthography was necessary to enable discussion of morphemes that are often only partially represented in the community orthography.

[2] Nlaka'pamux is a community spelling of */nłaʔkápməx/*.

[3] An anonymous reviewer made this suggestion.

[4] The list also contains two Spokane terms, bringing the total of plant names in Table 1 to 108.

[5] It is quite possible that plant names that are known to a few living speakers of Snchítsu'umshtsn have not yet been recorded.

[6] Terms 1, 2, 9, 11, 17, 23, 25, 31, 33, 40, 41, 43, 45, 47, 53, 59, 62, 72–74, 76, 78, 87, 94, 100, 103, 105, 106. See Appendix 1.

[7] The spatial prefix *niʔ-* 'amidst' occurred in (58), but it is omitted here because (58) is a complex term by our definition.

[8] The syllable lacking stress or having a reduced vowel is taken as the copy.

[9] Apparently, at least at the time the field work was conducted, the term *ilch* or the longer form indicating a bush *a̲lchałpalqw* could be used for either the wild cranberry or kinnikinnick. Nicodemus (1975a:111) has "ilch, n. red berries, knick-knick berries, wild cranberry." In (1975b:355) he has "wild cranberry, n. ilch" and "cranberry (wild), n. a̲lchałpalqw" (145).

[10] Ray Brinkman and Felix Aripa, personal communication, Language Preservation Program, Office of Education, Coeur d'Alene Tribe of Idaho, Plummer, Idaho, 2000.

[11] Possible Nez Perce cognates or borrowings supplied by a reviewer.

[12] Naomi F. Miller suggested that *nors* 'barley' might derive from French *orge*.

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APPENDIX 1.—SNCHÍTSU'UMSHTSN PLANT TERMS AND COGNATES

Plant terms in this appendix are divided into botanical groups (lichens, horsetails, conifers, and flowering plants, the last including monocotyledons and dicotyledons). Within these groups, they are alphabetized by botanical family, genus, and species names. Identification of botanical genus and species may be positive (no marker), probable (marked with following *), or possible (**). Each unique Snchítsu'umshtsn name (or Spokane name in two cases) is given a number. The data format for each numbered name is as follows:

scientific name (common English name)
(#) Snchítsu'umshtsn name in community orthography, (morphological analysis), (morpheme glosses)

Morphological analyses and morpheme glosses are not always possible. In the morphological analysis field, morphemes are separated by hyphens. Morphemes may be formed by reduplications (RDP), which generally operate on the roots by complete reduplication, reduplication of consonants with vowel reduction, or partial morpheme reduplications of either initial or final segments. Linguistic roots are prefixed with the √ symbol. In a reduplication, if the first instance were stressed, it would be labeled as the root and the RDP marker would follow. For an explanation of Snchítsu'umshtsn reduplication, see Doak (1997:27–29).

In the morpheme gloss field, the gloss for each morpheme is separated from its predecessor or follower by a hyphen. Alternative glosses of a single morpheme are separated by a tilde (~). The words of phrases are linked by periods. For example, the expression *on-RDP-wind~wrap.string.evenly-skin* has three morpheme glosses, if one does not count the reduplication. The gloss for the second morpheme has two alternatives: *wind* and the phrase *wrap.string.evenly.* The reduplication applies to the second morpheme, as will be evident from inspecting the phonetic form and the morphological analysis, which flags the linguistic root. Linguistic terms in glosses are abbreviated as follows: ART=article; AUG=augmentative; CONN=connective; CONT=continuative; DEM=demonstrative; DIM=diminutive; GLOT=glottalized; INC=inchoative; INH=inherent; INT=intensive; MDL=middle; NOM=nominative; POSS=possessive; PROX=proximate deictic; RDP=reduplication; REFL=reflexive; REM=remote deictic; TR=transitive; VB=verbal; VOL=volition.

The Snchítsu'umshtsn terms recorded in this study appear in three orthographies: a community orthography, a contemporary Americanist linguistic orthography (a modified version of the International Phonetic Alphabet), and the linguistic orthography used by James Teit (1930). Stress is marked where the information is available, but terms taken from documentary sources do not always indicate stress and stress could not always be determined in the field. Plant names are provided in the community orthography in the appendix for non-linguists. The contemporary linguistic orthography is used for precise phonetic description and for morphological analysis. Teit's orthography is used for terms that he recorded, but these are also presented in the other orthographies.

The Snchítsu'umshtsn community orthography used by Nicodemus (1975a, 1975b) is generally consistent, but it omits reduced vowels [ə] or [ɪ]. Consequently, there is some ambiguity in the proper placement of glottals, which are written as apostrophes, but this can usually be resolved by resort to morphological analysis with concomitant reference to the English glosses. In the appendix, phonetic forms and morphological analyses reconstructed from the community orthography are flagged with a star (*) after the word; the star before a word indicates a proto-form reconstructed by means of the comparative method of linguistics. The Nicodemus orthography underlines vowels to indicate stress. The "(" character is pharyngeal [ʕ]. When writing glottalized consonants and semivowels, apostrophes are placed before sonorants—*'l, 'm, 'n, 'w, 'y, '(* and *'(w*—but apostrophes follow the voiceless stop consonants *k', p', q', t'.* The phonemes are written *a, b, ch, ch', d, e, gw, h, i, j, k, k', kw, k'w, khw, l, ł, m, 'm, n, 'n, o, p, p', q, q', qw, q'w, qh, qhw, r, 'r, s, sh, t, t', ts, ts', u, w, 'w, y, 'y, (, (w, '(, '(w* This is also the sorting order, except that the parenthesis is ignored.

In the Americanist orthography the phonemes are written as follows: (voiceless stops and affricates) *p, t, c, č,* k^{w}, *q,* q^{w}, *ʔ*; (glottalized stops and affricates) *p', t', c', č',* k'^{w}, *q',* q'^{w}; (voiced stops and affricate) *b, d,* g^{w}, *j*; (voiceless continuants) *s, ł, š,* x^{w}, *x̥,* x̥^{w}, *h*; (resonants) *m, n, l, r, w, y, ʕ,* $ʕ^{w}$; (glottalized resonants) *ḿ, ń, l', ŕ, ẃ, ý, ʕ',* $ʕ^{w}$'; (vowels) *i, e, a, u, o, ə.* In order to facilitate comparisons to other languages and simplify the transcriptions, the Snchítsu'umshtsn mid-front vowel that is often written with epsilon ϵ is here written with *e;* the open ɔ is here written as *o.*

Teit's (1930) phonetic transcriptions may be unreliable. He seems to have often failed to distinguish glottalizations, labialization of consonants, rounding of vowels, and postvelar from velar consonants. Forms reconstructed from Teit's orthography, like those reconstructed from the community orthography, are flagged with a star (*) after the word. Teit used a straight apostrophe after the vowel to mark stress. His *ä* is [æ], which is usually written *e* in contemporary Salish orthography. His E is schwa [ə]. The alveolar and palatal affricates which Teit wrote as *ts* and *tc* are written as *ts* and *ch* in practical orthographies and *c* and *č* in the Americanist linguistic orthography. The palatal fricative which he wrote as *c* is *š* in the Americanist orthography.

Due to the fact that plant names and other information were collected in the course of ethnohistorical and ethnolinguistic studies not specifically focused on ethnobotany, identifications are based on the authors' prior knowledge of local species and no voucher specimens have been deposited for curation.

LICHENS

Bryoria fremontii (Tuck.) Brodo & D. Hawksw. (black tree lichen)
(1) *se̲ch'echt, séč'-ečt,* ?-hand~branch

?*Peltigera* sp. (lichen)
(2) *sitsseetsiye, √sic-sic-iyiʔ?*-AUG.RDP-playingly

HORSETAILS

Equisetaceae (horsetail family)

Equisetum spp. (horsetails, or scouring rushes)
(3) *he st'ede' łe t'u̲khwen, he st'edeʔ łe t'úxʷn,* POSS grass REM horsetail

CONIFERS

Cupressaceae (cypress family)

Juniperus scopulorum Sarg.* (Rocky Mountain juniper)
(4) *punłp, √pun-łp,* ?-plant

Thuja plicata Donn. (western red-cedar)
(5) *k'wa̲'ysalqw, √k'ʷ áýs-alqʷ, ?-tree*

Thuja plicata Donn.** (western red-cedar)
(6) *sk'ust, s-√k'ʷ us-t,* NOM-ghost-INH

Pinaceae (pine family)

Abies lasiocarpa (Hook.) Nutt., *A. grandis* (Dougl.) Lindl. (subalpine fir and/or grand fir)
(7a) *mara̲młpalqw, √marím-ałp-alqʷ*, medicine-plant-tree
(7b) *stmari̲młpecht, s-t-√marím-łp-ečt,* NOM-attached-medicine-plant-whole.hand~branch

Larix occidentalis Nutt. (western larch)
(8) *tse̱qwlsh, √céqʷ-lš,* pink-motion.in.horseshoe.curve

Picea engelmannii Parry *ex* Engelm. (Engelmann spruce)
(9) *shaqhshaqhtałp, šax̥-√šax̥-t-ałp,* AUG.RDP-?-INH-plant

Pinus albicaulis Engelm. (white-bark pine)
(10) *suwi̱stch*, suwístč**

Pinus contorta Dougl. *ex* Loud.* (lodgepole pine)
(11) *qoqo'li̱'t, qʷo-√qʷol'-íʔt,* INT.RDP-?-source[1]

Pinus monticola Dougl. *ex* D. Don (white pine)
(12) *t'a̱da'alqw, √t'édeʔ-alqʷ,* canoe-tree

Pinus ponderosa Dougl. *ex.* Loud.* (ponderosa pine, yellow pine)
(13) *'ya̱tqwełp, s-√étqʷ-ełp,* NOM-?-plant

Pseudotsuga menziesii (Mirb.) Franco var. *glauca* (Beissn.) Franco (Douglas-fir)
(14) *ts'a̱q'ałp, √ćaq́-ałp,* bunched~clumped-tree[2]

Taxus brevifolia Nutt. (yew)
(15) *(atsech'na̱lqw*, √ʕac-ičń̥-álqʷ,* tied-back-plant (bow-plant)

FLOWERING PLANTS—MONOCOTS

Alismataceae (water-plantain family)

Sagittaria latifolia Willd. (wapato, arrowleaf)
(16) *sqi̱gwts, s-√qígʷc,* NOM-wapato

Araceae (arum family)

Lysichiton americanum Hultén & St. John (skunk cabbage)
(17) *qekhwqekhwlshi̱ye', qexʷ-√qexʷ-əlš-íyeʔ,* AUG.RDP-?stink-arc.motion-playingly
(18) *ti̱mu', tímuʔ*

Bromeliaceae (bromeliad family)

Ananas comosa (L.) Merr. (pineapple)
(19) *hnt'apłts'e'entso̱tn, n-√t'ap-łc'eʔ-n-cút-n,* in-shoot-inside-TR-REFL-NOM; 'what shoots self through inside' Reichard (1938:222)

Liliaceae (lily family)

Allium sp. (onion)
(20) *qwli̱w'lsh, qʷəlíwəl'š,* raw

Allium sp., *A. douglasii* Hook.** (onion)
(21) *sisch, sisč*

Camassia quamash (Pursh) Greene (edible blue camas)
(22a) *e̱tqhwe', ʔétx̥ʷeʔ, ʔátx̥ʷeʔ*
(22b) *sqha̱'wlutqhwe*, s-√x̥íw-al-ʔitx̥ʷaʔ,* NOM-raw-CONN-cooked.camas

Lilium columbianum Hanson *in* Baker* (tiger lily or Columbia lily)
(23) *ch'a̱wqh*, č'áwəx̥**

Melanthiaceae (melanthium family)

Veratrum viride Ait. (Indian hellebore), very toxic
(24) *slaq'mn, s-√laq'-mn,* NOM-?-used for[3]
(25) *sits'sechi̱ye, √səc'seč-íyə,* ?-playingly

Poaceae or Gramineae (grass family)

A common Interior Salish form for grass resembles the Okanagan form *swupúla'xw* 'ground hair'. Nicodemus (1975a:81) lists the cognate form *gupu̱'lmkhw,* but he defines it as a verb: 'vt. It (ground) is covered with much grass'. Very likely it could have been nominalized with the s- prefix to *sgupu̱'lmkhw*. In Moses Columbian, *st'iyaʔ* is any tall grass, but short grasses are *suwpul'exʷ*, literally 'hair on the ground'.

grass (various kinds of forage, including grasses and the legumes alfalfa and clover)
(26) *st'e̱de', s-√t'édeʔ,* NOM-grass

Digitaria sp.** (crab grass)
(27) *sq'i'ts'u'lmkhw, s-√q'iʔc'-ul'mxʷ,* NOM-grow-on.the.ground

Hordeum vulgare L. (barley)
(28) *nors, nors,* possibly from Fr. *orge*

Triticum aestivum L. (wheat)
(29) *st'a̱da'qn, s-√t'ádaʔ-qn,* NOM-grass-head

Typhaceae (cat-tail family)

cat-tail, or bulrush (*Typha latifolia* L.)*
(30) *q'wo̱sq'ws*, √q'ʷés-q'ʷəs,* AUG.RDP-gather

FLOWERING PLANTS—DICOTS

Aceraceae (maple family)

Acer circinatum Pursh** (vine maple) or *Acer glabrum* Torr. (Rocky Mountain maple)
(31) *squaxt*

Anacardiaceae (sumac family)

Toxicodendron radicans (L.) Kuntze; syn. *Rhus radicans* L. (poison ivy)
(32) *p'ułp'ułtu̱msh, p'uł-√p'uł-t-úmš,* AUG.RDP-poison.ivy-INH-people

Apiaceae or Umbelliferae (celery family)

Heracleum lanatum Michx. (cow parsnip or Indian rhubarb)
(33) *qho̱qhlp, √x̥ʷóx̥ʷə-łp,* ?-plant

Ligusticum canbyi Coult. & Rose* (Canby’s lovage)
(34) *qha̱sqhs, √x̥ás-x̥əs,* good-AUG.RDP

Lomatium canbyi Coult. & Rose** (white camas)
(35) *p’e̱khwp’ukhw*[4] *√p’éxʷ-p’exʷ,* glow-AUG.RDP

Lomatium cous (Wats.) Coult. & Rose* (cous, or biscuitroot)
(36) *ka̱’us, káʔus*

Lomatium macrocarpum (Nutt.) Coult. & Rose (desert parsley)
(37) *sp’e̱khwench, s-√p’éxʷ-enč,* NOM-light~glow-belly~bank

Lomatium nudicaule (Pursh) Coult. & Rose** (barestem lomatium or Indian celery)
(38) *pe̱qai*, péqai*,* prob. equivalent to N.P. *péqiy* (*L. triternatum* (Pursh) Coult. & Rose var. *triternatum*)

Lomatium sp. (biscuitroot)
(39) *pi̱wye, píwye~piúweə*

Perideridia gairdneri (H. & A.) Mathias** (wild caraway or Indian carrot)
(40) *st’u̱qom*, s-√t’úqʷ-*m[5], NOM-?-MDL

Asteraceae or Compositae (aster or composite family)

Achillea millefolium L.** (yarrow)
(41) *dmdmu’qeyni̱’, dem-√dem-uʔ-qin-íʔ,* AUG.RDP-?old-?-head-NOM

Antennaria spp., *Erigeron* spp., *Aster* spp.** (pussytoes, fleabane, aster)
(42) *qhaln’n’nak’wa’a’lqs ha sgwarpm, x̥aln (n-√nek’ʷ -alqs)*DIM.GLOT *ha sgʷarpm,* lie.in.order (DIM.RDP-one-spur~ridge)DIM.GLOT POSS bloom

Artemisia frigida Willd.* (northern wormwood)
(43) *p’up’u’nełp, (p’u-√p’un -iłp)*DIM.GLOT, INT.RDP-?-plant

Artemisia tridentata Nutt. (big sagebrush)
(44) *qw’lqw’lmni̱łp,* qʷəl’-*√qʷəl’-mn-íłp,* AUG.RDP-dark-used.for-plant

Balsamorhiza sagittata (Pursh) Nutt.* (balsamroot or spring sunflower)
(45) *smu̱kwa’tsn*, smúkʷaʔcn**

Cirsium brevistylum Cronq. and other spp. (wild thistles) and other spiny plants, e.g., *Opuntia fragilis* (Nutt.) Haw. and *O. polyacantha* Haw. (prickly-pear cactus)
(46) *łek’włuk’wt, √łek’ʷ-łek’ʷ-t,* AUG.RDP-barb-INH

Cirsium undulatum (Nutt.) Spreng.* (wavy-leaved thistle)
(47) *mari̱upa*, maríupa**

Matricaria matricarioides (Less.) Porter* (pineapple weed)
(48) *hnts’ltsi’lkhwqi̱, n-cel’-√cel’xʷ-qi̱n,* in-AUG.RDP-?-head

Taraxacum officinale Weber** (common dandelion) or *Agoseris* sp.** (mountain dandelion)

(49) *qhal sgwarpm, x̥al sgʷarpm,* lie.in.order bloom

Berberidaceae (barberry family)

Mahonia aquifolium (Pursh) Nutt.; syn. *Berberis aquifolium* Pursh (Oregon-grape)
(50) *sqwe̱yu', s-√qʷéy-uʔ,* NOM-blue.or.green-?

Betulaceae (birch family)

Betula papyrifera Marsh.* (paper birch)
(51) *spichłena̱, s-√pičłen-álqʷ*,* NOM-?leaf-tree

Corylus cornuta Marsh.* (hazelnut)
(52) *q'ip'khwe', q'ip'xʷeʔ*

Cactaceae (cactus family). See (46).

Caprifoliaceae (honeysuckle family)

Lonicera involucrata (Rich.) Banks *ex* Spreng.* (black twinberry, or twinflower honeysuckle)
(53) *sa̱mpqn*, sámpqn**

Sambucus cerulea Raf.* (blue elderberry) and/or *S. racemosa* L.* (red elderberry)
(54) *ts'e̱kukw, ts'e̱k'ukw, c'ékʷəkʷ*

Symphoricarpos albus (L.) Blake (snowberry or waxberry)
(55) *tmtmni'ełp, √tmtmníʔ-ełp,* corpse-plant

Cornaceae (dogwood family)

Cornus stolonifera Michx. (red willow or red-osier dogwood)
(56a) *sti̱chtskhw, s-√tičcxʷ,* NOM-?
(56b) *stichtskhwe̱lp*[6]*, s-√tičcxʷ-élp,* NOM-?-?plant

Cucurbitaceae (cucumber family)

Cucumis melo L. (cantaloupe)
(57) *t(a(a̱qhts'e', t-ʕa-√ʕáx̥-c'eʔ,* on-INT.RDP-wind~wrap.string.evenly-skin

Cucurbita pepo L. (squash)
(58) *ni'sharusi'utm, niʔ-√šar-us-iʔ-ut-m,* amidst- hang-fire-?-be.in.position-MDL

Elaeagnaceae (oleaster family)

Elaeagnus commutata Bernh.** (silverberry)
(59) *smqhwne̱łp*, s-√məx̥ʷ-n-ełp*,* NOM-?snowbound-?NOM-plant

Shepherdia canadensis (L.) Nutt. (soapberry or soopolallie)
(60) *sqhu̱sm, s-√x̥ʷús-m,* NOM-foam-MDL

Ericaceae (heather family)

Arctostaphylos uva-ursi (L.) Spreng. (kinnikinnick)
(61a) *ilch, ʔílč*
(61b) *a̲lchałpalqw, √ʔí:lč-iłp-alqʷ*, wild.cranberry-plant-tree~bush

Vaccinium caespitosum Michx.* (dwarf blueberry)
(62) *st'eq'łn, s-√t'eq'ł-n**, NOM-?-NOM

Vaccinium membranaceum Dougl. *ex* Hook. (black huckleberry)
(63) *st'shastq, st'sha̲, s-√t'əš-ástq*, NOM-sweet-crop

Vaccinium sp. (huckleberry)
(64) *paqpaqa̲qhn, paq-√paq-áx̥n*, AUG.RDP-white-arm[7]

Fabaceae (pea family)

Pisum sativum L. (garden pea)
(65) *lipowee, lípowe:*, from the Fr. *le pois*

Gentianaceae (gentian family)

Frasera sp.** (frasera)
(66) *snch'łma̲sms*, s-nič'-ł-másməs**, NOM-cut-CONN-*másməs*. See also (103).

Grossulariaceae (gooseberry family)

Ribes aureum Pursh** (golden currant)
(67) *sts'erus, s-√c'ér-us**, NOM-hurt-face~eye

Ribes cereum Dougl.* (squaw currant)
(68) *ya̲rch'n*, √yár-čń**, revolve~round-back

Ribes sp.* (wild gooseberry)
(69) *hnt'i̲t"mel'ps, n-t'i-√t'eḿ-elps*, in-INT.RDP-?-throat~mane

Hydrangeaceae (hydrangea family)

Philadelphus lewisii (Pursh) Rydb.* (mock orange)
(70) *wa̲qhi'łp, √wex̥iʔ-łp*, ?-plant

Lamiaceae or Labiatae (mint family)

Mentha arvensis L., syn. *Mentha canadensis* L.** (Canada mint or field mint)
(71) *naq'naq'tełp, naq'-√naq'-t-ełp*, AUG.RDP-rotten-INH-plant

Portulacaceae (purslane family)

Claytonia lanceolata Pursh* (spring beauty)
(72) *ła̲q'mkhw*, łáq'mxʷ**

Claytonia sp.
(73) *sqwe̲tm*, s-√qʷét-m*, NOM-?-MDL

Lewisia rediviva Pursh (bitterroot)
(74) *sp'i̲t'em, s-√p'ít'-m*, NOM-?smooth,slick-MDL

Ranunculaceae (buttercup family)

Ranunculus glaberrimus Hook.* (sagebrush buttercup)
(75) *schne̱ŕmn, s-č-√nir*$_{\text{(GLOT)}}$*-mn*, NOM-on-paint$_{\text{(INC)}}$-used.for

Ranunculus sp. (buttercup)
(76) *stch'iiha̱yus, s-t-√č'i:háy-us*, NOM-attached-?-face~eye~fire[8]

Rosaceae (rose family)

Amelanchier alnifolia Nutt. (serviceberry or saskatoonberry)
(77) *słaq, s-√łaq*, NOM-serviceberry

Crataegus columbiana Howell* (red hawthorn or red thornberry)
(78) *kwela**, *kʷela**

Crataegus douglasii Lindl. (black hawthorn)
(79a) *sqhu̱'nech, s-√x̥ʷəʔneč**, NOM-?thorn
(79b) *sqhu'qhu'ni̱chełp, s-x̥ʷəʔ-√x̥ʷəʔníč-ełp̌**, NOM-AUG.RDP-?thorn-plant

Fragaria virginiana Duchesne, *F. vesca* L. (wild strawberry)
(80) *stsa̱qwm, s-√cáqʷ-m*, NOM-pink-MDL

Holodiscus discolor (Pursh) Maxim.* (oceanspray)
(81) *mtsmtsi̱'ełp, mc-√mec-iʔ-ełp*, AUG.RDP-?-NOM-plant

Malus sylvestris Mill. var. *domestica* (Borkh.) Mansf. (apple)
(82) *s'a̱plsalqw, sʔáplsalqʷ, s-√ʔápls-alqʷ*, NOM-apples-tree, from Eng.

Prunus domestica L. (plum)
(83) *pla̱msalq[w], √pláms-alqʷ*, plum-tree

Prunus emarginata (Dougl.) Walpers (bitter cherry)
(84) *pchłe̱n**, *pəčłén**

Prunus virginiana L. var. *demissa* (Nutt.) Torr. (chokecherry)
(85) *ła̱qhwłuqhw, √łáx̥ʷ-łəx̥ʷ*, ?-AUG.RDP

Prunus persica (L.) Batsch (peach)
(86a) *pi̱chus, píčus, √píč-us* peach-face (evidently a pun from folk etymology)
(86b) *spe̱chasalqw, s-péčas-alqʷ*, NOM-peaches-tree

Prunus sp.
(87) *t'shile̱pa**, *t'əšilépa**

Rosa acicularis Lindl., *Rosa woodsii* Lindl. and other *Rosa* spp. (wild rose)
(88a) *skhwaa̱yapa'qn, s-xʷá:yapaʔ-qn**, NOM-rose-HEAD
(88b) *sqwa̱ayapa', sqʷáyapaʔ**
(88c) *sqaypa̱qn, sqaypáqn*
(89) *qa'lqhełp, √qal'x̥-ełp*, rose-plant

Rubus idaeus L. (wild raspberry)
(90) *hnhalaatse̱', n-√hala:céʔ*, in-?

Rubus leucodermis Dougl. *ex* T. & G. (blackcap)
(91) *mtsukw, məcúk*^{w}

Rubus parviflorus Nutt. (thimbleberry)
(92) *po̲lpolqn, √pul-pul-qn,* *invert.concave.object-AUG.RDP-head

Rubus hybrid (boysenberry)
(93) *sngwa̲'rus khwe e ti̲łteł'lmkhw, sng*^{w}*árus x*^{w}*e e tíł-teł-l'mx*^{w}*,* descendant PROX ART straight-AUG.RDP-on.the.ground

Rubus sp.
(94) *ti̲łteł'lmkhw, √tíł-tił-l'mx*^{w}*,* straight-AUG.RDP-on.the.ground

Spiraea betulifolia Pall.** (flat-topped spiraea)
(95) *chkw'lkwi̲'lqw* (Spokane), *č-k*^{w}*ɪʔl-√k*^{w}*ɪʔl-alq*^{w}*,* on-AUG.RDP-red-tree~bush

Salicaceae (willow family)

Populus balsamifera L. ssp. *trichocarpa* (T. & G.) Brayshaw, syn. *P. trichocarpa* T. & G. ex Hook. (cottonwood)
(96) *mulsh, mulš*

*Populus tremuloides** (quaking aspen or trembling aspen)
(97) *darełdu̲łdułp, darełdúłdułp, dar-eł-√dúł-duł-p,* containers.stand-CONN-rustle-AUG.RDP-INC
(98) *du̲łdułp, √dúł-duł-p,* rustle-AUG.RDP-INC

Salix sp., probably *S. exigua* Nutt. (willow)
(99) *de̲'lełp, √dél'-ełp*

Salix sp. (willow)
(100) *q'o̲lsalqw, √q'*^{w}*óls-alq*^{w}*,* willow-tree[9]

Solanaceae (nightshade family)

Nicotiana attenuata Torr. *ex* Wats. (wild tobacco)
(101) *smi'lkhw, smil'x*^{w}

Solanum tuberosum L. (potato)
(102) *paata̲q, pa:táq,* possibly from Fr. *patate*

Valerianaceae (valerian family)

Valeriana edulis Nutt. *ex* T. & G.* (edible valerian)
(103) *ma̲sms, √más-məs,* ?-AUG.RDP
(104) *masa̲wi* (Spokane), *masáwi*

Terms not identified scientifically, or not identified in English

(105) *pichelu̲sa*, pičelúsa**
(106) *sk'waqhk'waqhełkwa'*, s-ʔ√k'*^{w}*ex̥-k'*^{w}*ex̥-ił-k*^{w}*eʔ,* NOM-claw-AUG.RDP-inside-water

(107) *taqhtaqhiłp, tex̥-√tex̥-iłp,* AUG.RDP-?bitter-plant; 'black birch' (N2: 56, 254)

(108) *t'eptptełp, √t'ep-t'ep-t-ełp,* ?animate.objects.stop-AUG.RDP-INH-plant

NOTES ON APPENDIX 1

[1] Laurence Nicodemus asserts that the meaning of *qoqo'li̱'t* 'black pine' could be 'easily burned'. This suggests that the linguistic root is *q*^{w}*el* 'light fire' and the analysis is *q*^{w}*e-√q*^{w}*eʔl-iʔt* (AUG.RDP-light.fire$_{\text{INC.GLOT}}$-source). However, this contemporary analysis in Snchítsu'umshtsn may not hold true for cognate forms in other languages.

[2] In Stl'atl'imx, a reduplicated form of the term refers to second growth or young Douglas-fir.

[3] Johnson (1975) has *leq'* 'search for'. Nicodemus (1975a) has *leq'* 'bury' and *laq'* 'pare, peel' and 'to search'. The peeling sense seems more likely.

[4] While the second *p* of the community citation form *p'e̱khwp'ukhw* is here written with a glottal, it should be noted that Reichard and Nicodemus wrote the word without glottalization and one of Palmer's consultants pronounced it without audible glottalization, perhaps as an effect of the reduction in stress on the second syllable.

[5] There are several likely candidates for linguistic root for this term.

[6] The *-elp* ending is unusual, as *-ałp* is more common in this context and Okanagan has the ł, but it has been rechecked with Nicodemus. See the reanalysis at the end of this entry.

[7] The identification is from Teit (1930:90), who has *(sEn)paqpaqa'x̥En "Vaccinium* sp. (white huckleberry)." There is a named variety of saskatoon (serviceberry) which is cognate to this in both Stl'atl'imx and Nlaka'pamux, and the main variety of saskatoon in Secwepmx is named *peqpeqʔuy.* However, Teit may have been correct in his identification of the plant as a *Vaccinium,* as there is a Stl'atl'imx form *p'úp'oq*^{w} 'high-bush blueberry'. Furthermore, there is a fungus or virus that seems to attack huckleberries and render them white, small and inedible. In the coast Salish areas, there is *Vaccinium ovalifolium* called "mouldy blueberry" in Nuxalkmc (Bella Coola), a blueberry with a whitish waxy coating or bloom on the berry.

[8] In Nlaka'pamux (Thompson) one of the names for *Gaillardia aristata* Pursh is *n/ḱwtl'=ús-tn-s e s/c'wén'* lit. 'eyes of a salmon', said to be borrowed from Nsilxtsin (Okanagan-Colville) (Turner et al. 1990:181). There are other variants of this.

[9] Turner et al. (1998:405) has Secwepemc *q'*^{w}*əlsɛ́łp* "from *q'*^{w}*ɛ́l-* 'cooked, ripe', possibly from the color of the bark."

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SHELLFISH ASSEMBLAGES FROM TWO LIMESTONE QUARRIES IN THE PALAU ISLANDS

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ABSTRACT.—Archaeological excavation at two limestone quarries in the Rock Islands of Palau, Micronesia, yielded extensive shellfish assemblages. Both sites were inhabited by Yapese Islanders during the last several hundred years while they quarried limestone deposits for stone money disk production, but there are considerable differences in the preservation and types of shellfish recovered. Comparative analysis of shellfish from Omis Cave (B:OR-1:35) and Metuker ra Bisech (B:IR-2:24) show these differences can be attributed to site location (coastal versus inland), engineering activities associated with quarrying, and possibly cultural preference. This is the first report of faunal material recovered from Yapese stone money quarries and one of the few for Palau. These data have implications for understanding local subsistence strategies and how quarrying activities influenced the preservation of shellfish assemblages.

Key words: shellfish, taphonomy, stone money, Yap, Palau, Micronesia.

RESUMEN.—Las excavaciones arqueológicas en dos canteras de caliza en las Islas Rock de Palau, Micronesia, muestran extensas acumulaciones de conchas marinas. Ambos lugares estuvieron habitados por isleños yapeses durante los últimos varios cientos de años, como muestran los depósitos de tallado de caliza para la producción de dinero discoidal de piedra. Sin embargo, existen diferencias considerables en la preservación y tipos de conchas que han sido recuperados. Un estudio comparativo de las conchas de la Cueva Omis (B:OR-1:35) y de Metuker ra Bisech (B:IR-2:24) muestra que estas diferencias pueden ser atribuidas a la localización del lugar (en la costa versus en el interior de la isla), a actividades de ingeniería asociadas con la explotación de las canteras, y posiblemente a preferencias culturales. Este es el primer informe sobre material faunístico recuperado de las canteras de dinero de piedra yapese y uno de los pocos en Palau. Estos datas poseen implicaciones para la comprensión de las estrategias de subsistencia local y de cómo las actividades de explotación de cantera influyeron en la preservación de las acumulaciones de conchas.

RÉSUMÉ.—Les fouilles archéologiques de deux carrières de calcaire dans les Rock Islands de Palau en Micronésie, ont révélé de vastes collections de coquillages. Les deux sites étaient occupés par les populations de l'île de Yap au cours des siècles derniers. Ils exploitaient les gisements de calcaire pour la taille de disques de monnaie circulaires. L'état de préservation et les espèces de coquillage trouvés varient considérablement. Les analyses comparatives des coquillages provenant des cavernes Omis (B:OR-1:35) et Metuker ra Bisech (B:IR-2:24) montrent que ces différences peuvent être attribuées à l'emplacement du site (zone côtière/intérieur des terres), aux techniques d'exploitation des carrières, et peut-être, aux préférences culturelles. Ce compte rendu et le premier rapport consacré aux matériaux fauniques récupérés dans les carrières que les habitants de Yap exploitaient pour la fabrication de monnaie en pierre, et l'un des rares documents concernant Palau. Ces informations permettent de mieux comprendre les stratégies de subsistance locales et la façon dont les techniques d'exploitation des carrières ont influencé la préservation des collections de coquillages.

INTRODUCTION

Faunal material from archaeological sites provides a wealth of information regarding environment, human subsistence, and cultural processes through time. In Palau, Micronesia, there are numerous midden sites that testify to the importance shellfish played in prehistoric diets (Carucci 1992; McNamara 1991). However, the study of faunal remains here has received relatively limited attention and has focused almost exclusively on fish remains or materials collected using fairly crude recovery techniques. For example, both Osborne (1979) and Masse (1989), who conducted some of the earliest and most substantial excavations in Palau, relied extensively on ¼-inch screen, residuals of which have long been shown to underestimate certain faunal classes (Nagaoka 1994). Due to the high concentration of faunal remains found during his excavations, Masse (1989) only sampled material from every other arbitrary level. His research, concerned mostly with fish remains, was a major contribution to our understanding of prehistoric subsistence in Palau. Unfortunately, the importance of shellfish for understanding local subsistence strategies and site taphonomy was diminished due to these sampling issues, despite Carucci's (1992) detailed analysis of a portion of the assemblages.

To help remedy this situation and provide additional faunal data for the Palauan Rock Islands, I discuss shellfish remains recovered from excavations at Omis Cave (B:OR-1:35) and Metuker ra Bisech (B:IR-2:24), two sites used by Yapese Islanders for quarrying large limestone 'money' disks. Intensive archaeological research from 1998–2000 provides the first detailed analysis of shellfish remains from stone money quarries in the Rock Islands and one of the few for Palau (see Carucci 1992 for the most thorough study to date).

I first begin by briefly describing the processes involved with stone money quarrying in Palau, the radiocarbon chronology, and the archaeological assemblages from each site. I then evaluate shellfish taxa richness and assess the level of fragmentation at Omis Cave and Metuker ra Bisech. These lines of inquiry have implications for determining the underlying reasons behind discrepancies in shellfish taxa, site formation processes, and how these differences compare with other sites in Micronesia.

BACKGROUND

Palau is located in the Western Caroline Islands of Micronesia, roughly 600 km equidistant from the Philippines to the west and New Guinea to the south (Figure 1). The main archipelago stretches 50 km in a northeast/southwest direction and is comprised of over 300 islands, most of which are coralline and locally referred to as the "Rock Islands." These islands are remnants of tectonically up-

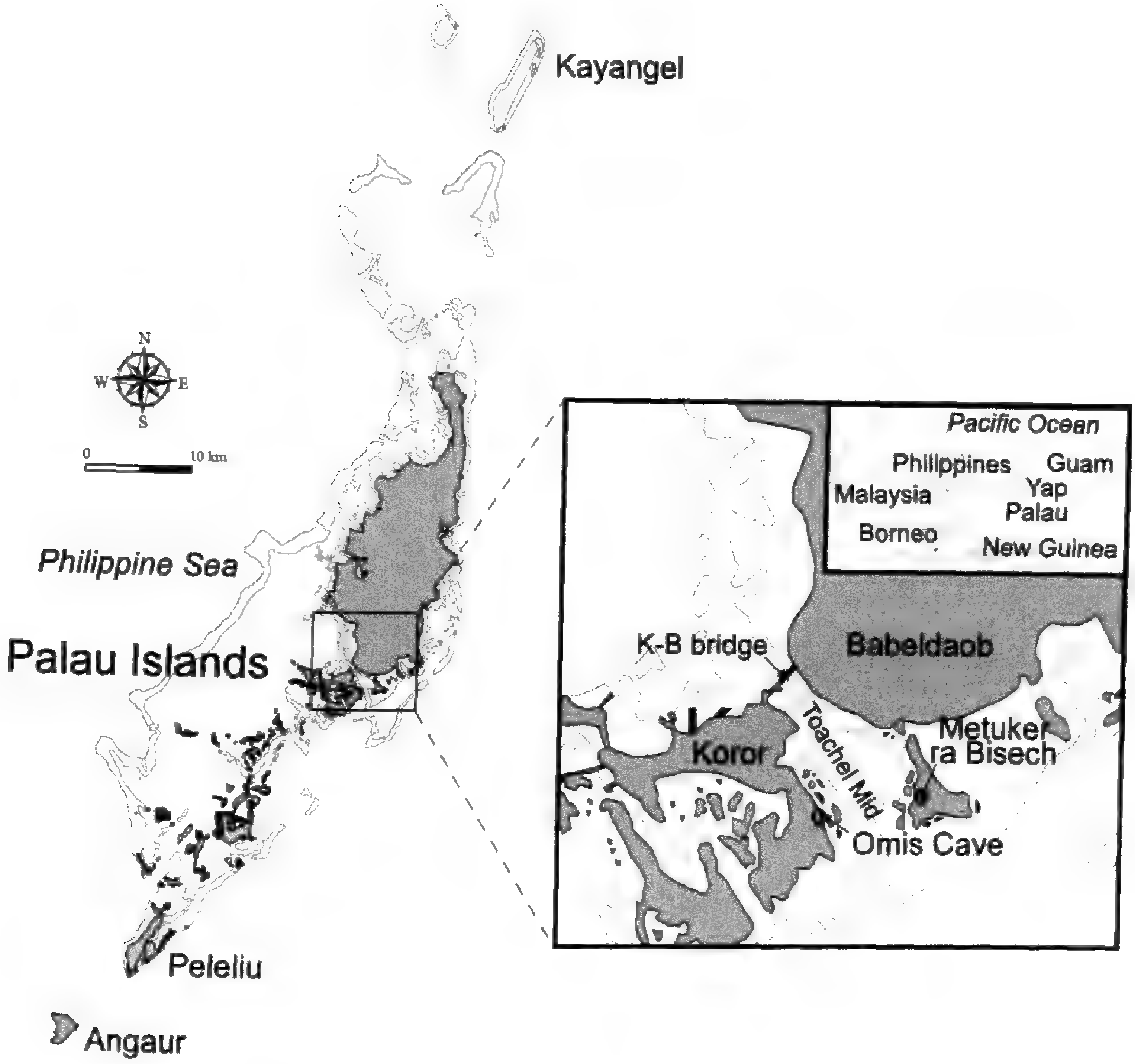

FIGURE 1.—Map of the Palau Islands.

lifted reef systems formed during the Pleistocene that have been chemically and physically weathered over the millennia, forming a rough karstic topography with caves, overhangs, and solution fissures that harbor crystalline limestone deposits (Sem and Underhill 1994). In these many flowstone and dripstone formations stone carvers from Yap quarried their famous stone money (Fitzpatrick 2001).

According to Yapese oral traditions, a navigator named Anagumang first found the stone in Palau and ordered his men to cut it into various shapes, including a fish and then a full moon (de Beauclair 1963; Gillilland 1975). They settled on a circular shape and perforated the large disks so they could be carried with wooden poles or beams (Figure 2). Transported back to Yap, 400 km northeast of Palau, these disks were highly valued exchange items. Their worth depended on the size, shape, quality of stone, and effort expended in quarrying and transporting the disk. Europeans who became involved in this exchange system introduced metal tools and transported disks back on larger vessels, often making stone money produced with traditional technologies (e.g., shell or stone tools;

FIGURE 2.—A stone money disk found on Orrak Island, Palau (photograph by author).

canoes and rafts) even more valuable (see de Beauclair 1963, 1971; Einzig 1966; Fitzpatrick 2001; Gillilland 1975; Nero n.d.).

Several stone money quarry sites have been identified, although the paucity of archaeological research has limited what we currently know of how Yapese used the sites and the social processes that surrounded this exchange system through time. Omis Cave and Metuker ra Bisech, two of the most well known quarries found thus far in Palau, were chosen to begin an intensive survey of stone money production. Analysis of shellfish recovered during excavation provides a foundation for interpreting site formation processes (e.g., engineering efforts that include mass movement of limestone debitage and large stone money disks), and the importance these resources had in the overall subsistence economies of site inhabitants. They also provide important information on the preservation of these and other archaeological remains from the two sites suggesting that a variety of taphonomic processes probably affected the assemblages.

Omis Cave (B:OR-1:35).—Omis Cave, located on the east side of Oreor island (part of Koror State and overseen by Ngermid Village) near the smaller Rock Islands of Itelblong and Ullemetamel, is approximately 3.3 km south of the Airai side of the K-B 'Friendship' bridge which connects the islands of Koror and Babeldaob. The cave encompasses an area of 780 m^2 and is oval-shaped in plan-view. The entrance is at sea level and faces north into a small lagoon where several smaller Rock Islands are visible (Figure 3).

Metuker ra Bisech (B:IR-2:24).—Metuker ra Bisech is a large inland site with numerous caves, overhangs, and stone architectural features. The interior of the site

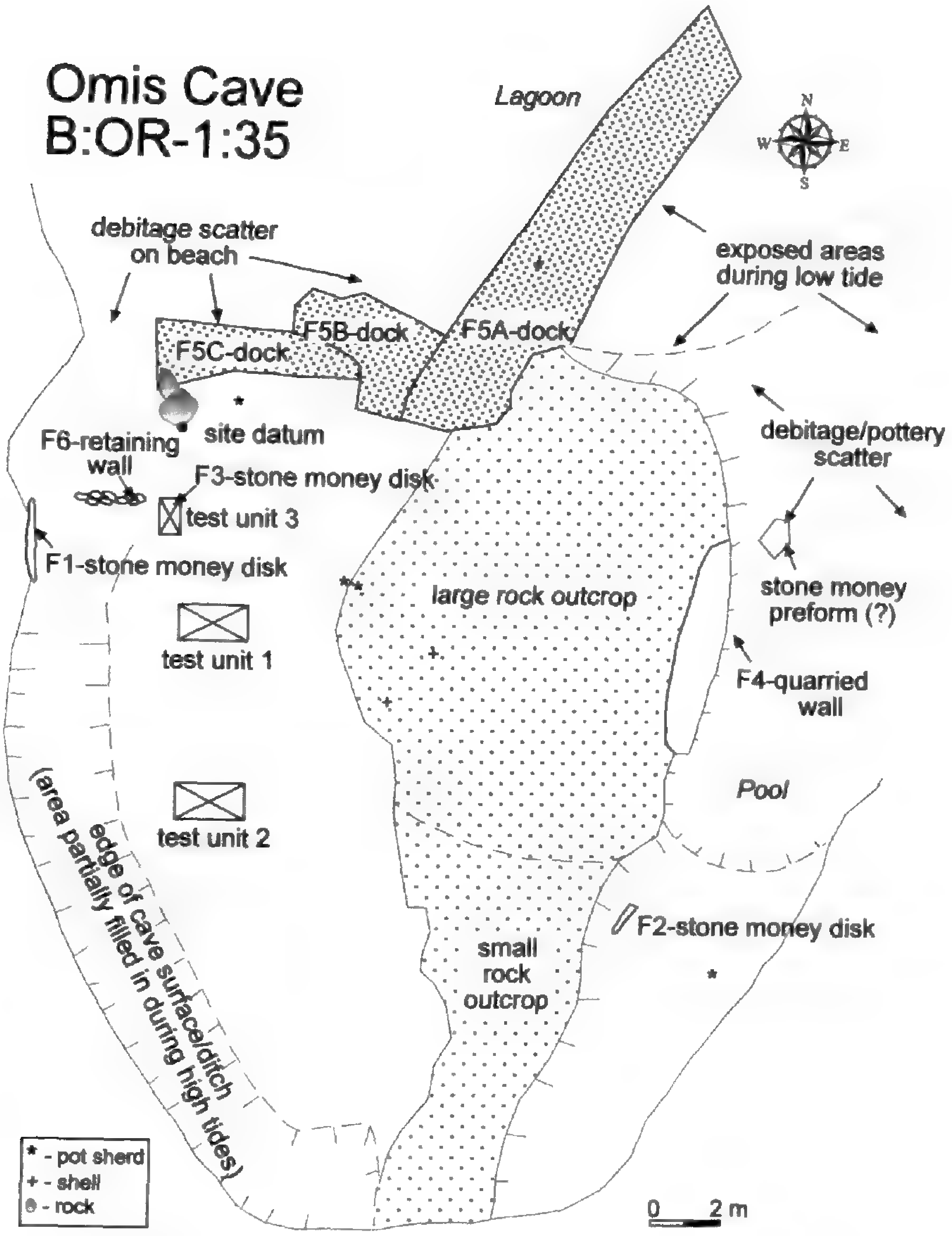

FIGURE 3.—Plan of Omis Cave.

is accessed by a newly constructed dock and summerhouse along the southwest portion of Ngerusar, Airai State. A pathway built as part of an ecotourism project by the government in 1997 takes visitors from the dock up 20 m above sea level into the site where excavations took place (Figure 4). The dock is approximately 2.5 km east of Omis Cave, and 0.5–1.0 km northeast of the Ngedert and Omelochel Rock islands. The Toachel Mid Channel separates Metuker ra Bisech from Omis Cave, roughly 4 km apart.

RADIOCARBON CHRONOLOGY

Nineteen conventional and AMS radiocarbon dates have been obtained thus far from Omis Cave (12) and Metuker ra Bisech (7) (Table 1; Fitzpatrick 2001, 2002). The chronology of Omis Cave suggests that people used the site for over 2,000 years. Four dates range from roughly 360 B.C to A.D. 560 and seven others date to the late historic period. Several older dates are intermixed with ones from the historic period, a reflection of the sloping and highly mixed stratigraphy found throughout the site (Figure 5). Overall, it is apparent that a high level of activity

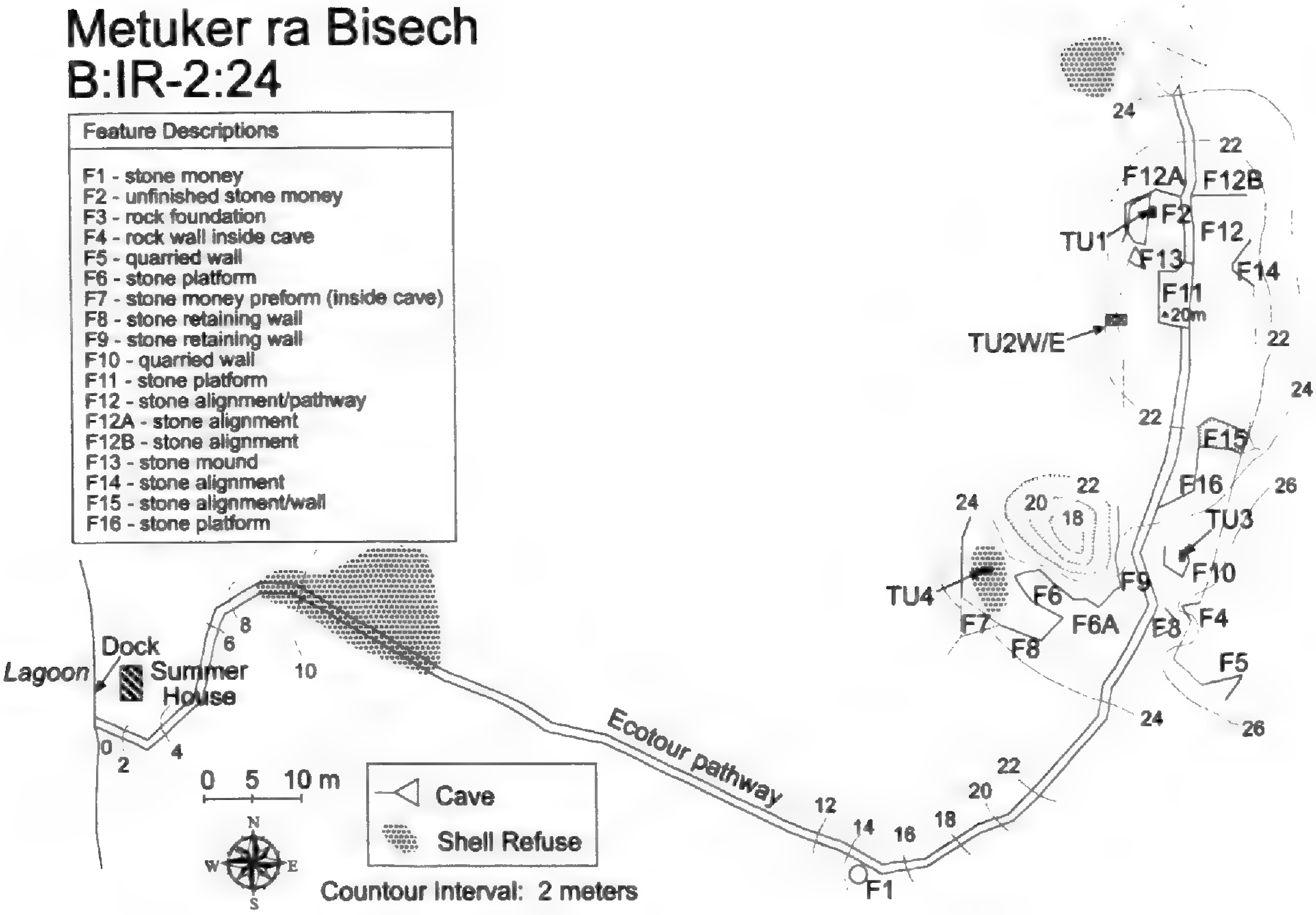

FIGURE 4.—Plan of Metuker ra Bisech.

was taking place within the last few hundred years around the same time that people began intensifying stone money quarrying. These activities drastically affected soil deposits at the site.

Radiocarbon dates from Metuker ra Bisech all post-dated roughly A.D. cal. 1700. In general, the artifact assemblages, quality of stone money disks (those obviously carved using metal tools), and radiocarbon dates indicate that Omis Cave and Metuker ra Bisech were primarily used during the historic period after European involvement when stone money quarrying intensified (Fitzpatrick et al. n.d.).

METHODS

Three test units were excavated at Omis Cave (two—2.0 × 1.0 m; one—0.6 × 0.5 m; total = 2.4 m^3 soil volume) and four at Metuker ra Bisech (one—2.0 × 1.0 m; three—1.0 × 0.5 m; total = 1.9 m^3 soil volume). Despite limited excavation at the sites, a substantial amount of shellfish remains was collected. This was in part due to the excellent preservation of shell in the coralline limestone environment. All excavated materials were water screened over ⅛-inch mesh. Following the methods described by Claassen (1998) and outlined by Grayson (1984) and Gilbert and Steinfeld (1977), total number of fragments (TNF), minimum number of individuals (MNI), and weight (g) were recorded for both assemblages. Shellfish taxa from Omis were identified using comparative collections at the University of Oregon's archaeological laboratory following Hinton (1972), Dance (1974), Wells

TABLE 1.—Radiocarbon dates from Omis Cave and Metuker ra Bisech (MB—Metuker ra Bisech; OC—Omis Cave; AA—Arizona AMS Facility; BA—Beta Analytic, Inc.).

Site	Lab No.	Material	Unit	Layer	Level	Wt. (g) ratio	$^{13}C/^{12}C$	Measured ^{14}C age	Cal. BC/AD (1 sigma)
MB	AA40969	charcoal	1	2	20–30	1.7	−27.6	116 ± 36	historic
MB	AA40970	charcoal	1	6	50–60	1.1	−29.4	143 ± 36	historic
MB	AA40971	*Cypraea* sp.	2	2	20–30	12.3	1.9	423 ± 37	historic
MB	AA40972	*Anadara* sp.	4	1	0–10	9	0.6	509 ± 36	AD 1720 (1820) 1950
MB	AA40973	*Cypraea* sp.	4	1	10–20	12	1.2	446 ± 36	historic
MB	AA40974	*Anadara* sp.	4	3	20–30	11.3	2.1	529 ± 38	AD 1700 (1810) 1840
MB	AA40975	*Venus* sp.	4	3	30–40	9.1	2.0	565 ± 47	AD 1680 (1710) 1820
OC	AA40959	charcoal	1	1	20–30	0.5	−25.2	96 ± 37	historic
OC	AA40958	*Chlamys* sp.	1	2	0–20	1.8	1.2	2379 ± 39	BC 100 (40) AD 1
OC	AA40960	charcoal	1	3	20–30	0.8	−25.6	1559 ± 45	AD 430 (530) 560
OC	AA40961	Cardiidae	1	3	20–30	15.3	2.1	2398 ± 39	BC 130 (70) 20
OC	AA40962	Strombidae	2	2	20–30	12.8	3.3	2519 ± 40	BC 320 (210) 170
OC	BA143445	*H. hippopus*	2	3	30–40	51.5	−2.3	2550 ± 70	BC 360 (300) 170
OC	AA40963	charcoal	2	3	30–40	0.6	−26.2	147 ± 36	historic
OC	BA143446	charcoal	2	4	40–50	1.4	−25.0	100.63 ± 1.12%	historic
OC	AA40964	*Anadara* sp.	2	4	50–60	7.0	2.2	616 ± 37	AD 1660 (1680) 1700
OC	AA40965	charcoal	3	1	20–30	2.7	−26.7	post-bomb	post-bomb
OC	AA40966	charcoal	3	2	30–40	0.6	−26.6	202 ± 37	historic
OC	AA40967	charcoal	3	2	60–70	0.6	−27.6	46 ± 58	historic
OC	AA40968	*Tridacna* sp.	ST1	—	—	7.3	1.9	post-bomb	post-bomb

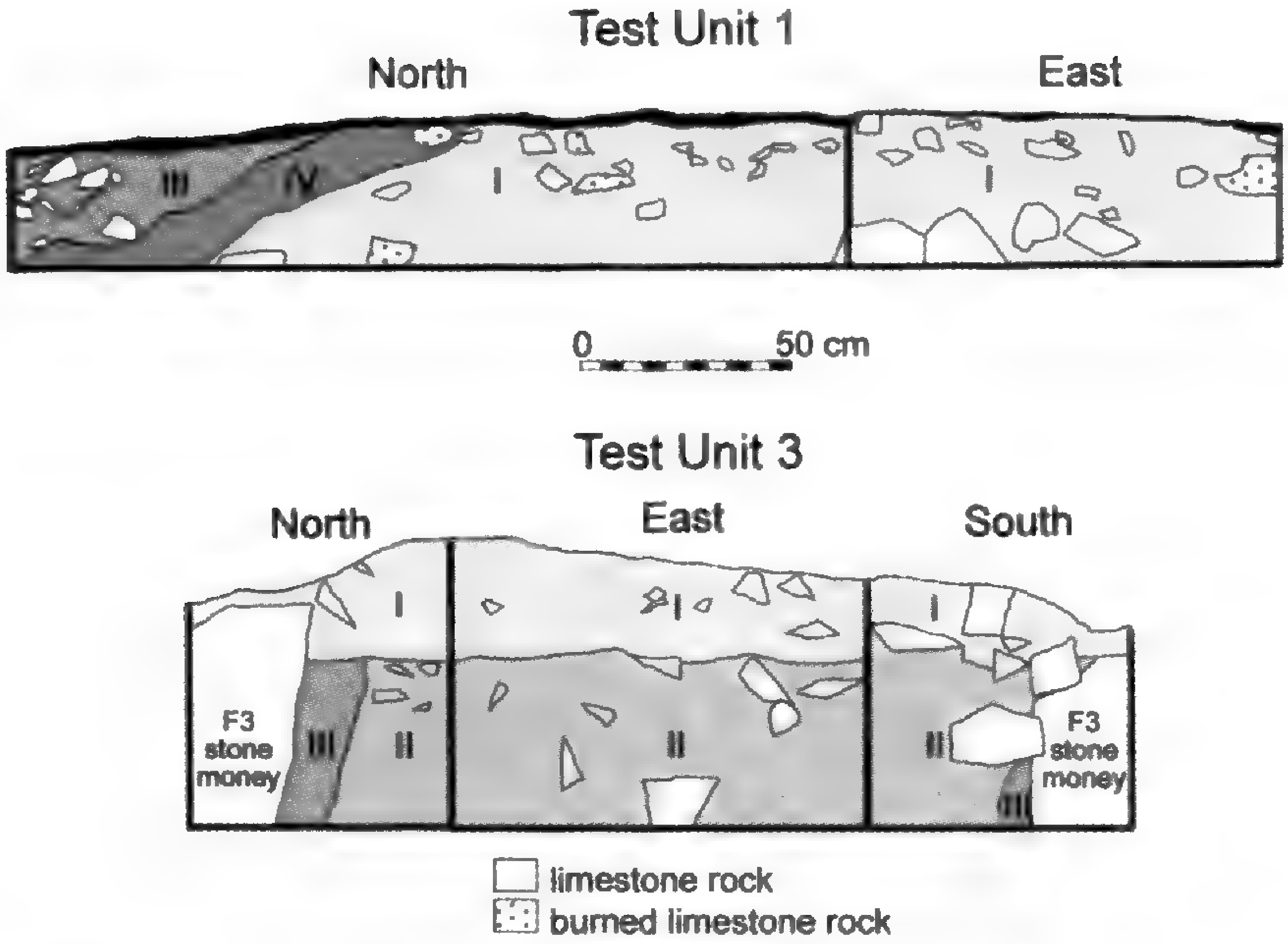

FIGURE 5.—Stratigraphic profiles from Test Units 1 and 3 at Omis Cave.

and Bryce (1988), and Wye (2000). Remains from Metuker ra Bisech were identified in the Palau field laboratory with help from University of Oregon field school students and Palau Bureau of Arts and Culture (formerly the Division of Cultural Affairs) staff using the same reference works.

ARTIFACTS

The most common artifact type found at the two sites was limestone debitage, including over 7,100 flakes and chunks from Omis Cave and nearly 6,000 from Metuker ra Bisech. Pottery was also recovered from Omis Cave and petrographic analysis of 28 of the 51 sherds suggests that they were all made with Palauan clays and tempers (Dickinson 2000; Fitzpatrick et al. 2003). Two fragments from a *Trochus* sp. shell ring were found at Omis Cave in Test Unit 1 and are similar to ones recovered from the Chelechol ra Orrak stone money quarry in 2000 (Fitzpatrick 2001). The only clearly identifiable tools found at the sites were two iron hatchet or blade implements recovered from Metuker ra Bisech in Test Unit 2 (Fitzpatrick et al. n.d.).

SHELLFISH REMAINS

Omis Cave.—From the three test units at Omis Cave, over 2,600 shell fragments (7.2 kg) representing 256 individuals were recovered. At least 50 shellfish taxa were identified from 34 different families (Table 2). Nearly all remains were recovered from Test Unit 1 and Test Unit 2. This is probably due to the location of Test Unit 3 adjacent to an unfinished stone money disk that had been placed upright for final carving and abrasion (Fitzpatrick 2001), an unlikely area for shell refuse deposits. Tridacnids (giant clams) are by far the most common family, representing 66% of the shell weight, 56% of the TNF, and 12% of the MNI. In other Rock Island assemblages analyzed by Carucci (1992), tridacnids were not as well represented, comprising 54.3% of the overall weight at Tmasch, 30.6% at East Beach, and 8.6% at Uchularois; overall, tridacnids make up only 15.6% of those assemblages.

Although we might expect tridacnids to be overrepresented in the overall weight of the assemblage given their large size, they are also quite robust and durable, one of the main reasons for their use in making tools in Micronesia and elsewhere (Moir 1986–87; Osborne 1979). The high fragmentation rate of tridacnids is perplexing, especially given what is already known about tridacnid remains recovered from other shellfish assemblages in Palau (Carucci 1992; Masse 1989; Osborne 1979) where larger and fewer fragments are typically found. Given the restricted area within which Yapese were quarrying stone money at the site and the evidence of large-scale limestone carving and movement of debitage to make room for further quarrying activities (shown most dramatically by slightly vertical, mounded stratigraphic profiles in Test Units 1 and 3), it is likely that tridacnids and other mollusks were effectively crushed during the quarrying process at Omis Cave. Although other uses of tridacnids may have included slaked lime for betel nut chewing (Carucci and Mitchell 1990) or for tools, the sheer quantity of limestone debitage and stratigraphic representations suggest that the fragmentation is due primarily to engineering tasks that included the movement of debitage (e.g., raking, piling, or pushing) and stone money (e.g., pulling, pushing, and lifting disks in armatures or rollers). I discuss alternate hypotheses regarding shellfish remains in the discussion section below.

Many shells found at Omis Cave are quite small, including whole and fragmentary Carditidae, Limidae, Noetiidae, Pandoridae, Architectonicidae, Cerithiidae, Littorinidae, Mitridae, Neritidae, *Strombus mutabilis,* Terebridae, and Trochidae specimens. Significant wave action could be a factor behind the deposition of these specimens. Following the arguments of Hughes and Sullivan (1974) and Gagliano et al. (1982), Carucci (1992:149) notes that materials "redeposited by storm waves generally include tiny and juvenile shells, species not considered food, water worn and fragmented shell, rounded pebbles, and flotsam such as pumice and charcoal." Consistent with Carucci's (1992) findings in the southern Rock Islands, the smaller specimens from Omis Cave include those that appear to be water worn and fragmented. High concentrations of charcoal and a few pebbles observed in site deposits could also be partly attributed to storm action. It is also possible that smaller taxa were boiled in soups or stews, or even entered the site attached to larger shells and other materials such as sea grasses.

Metuker ra Bisech.—A total of 1,019 shellfish fragments (24 kg) from 432 individuals was recovered from the surface and in stratified deposits at Metuker ra Bisech (Table 3). We identified 24 shellfish taxa from 16 families. Surface survey of the main site suggested that shellfish refuse would be found almost exclusively around or adjacent to the larger caves. Excavation of various locations within the site confirmed this pattern with only three marine shells recovered from areas away from these caves (Test Unit 1 and Test Unit 2W).

To examine the spatial distribution and preservation of shellfish remains, a 31.5-m² grid (Grid 1) was placed near the opening and to the west of a large cave along the southern portion of where the investigation was focused. Shellfish re-

TABLE 2.—Shellfish from Omis Cave.

	TU1 Total				TU2 Total				Total (includes TU3)*			
Taxon	TNF	MNI	Wt. (g)	Wt. (%)	TNF	MNI	Wt. (g)	Wt. (%)	TNF	MNI	Wt. (g)	Wt. (%)
Bivalves												
Anomiidae	6	2	3.55	0.0	—	—	—	—	6	2	3.55	0.0
Arcidae	1	1	0.10	0.0	—	—	—	—	1	1	0.10	0.0
Anadara spp.	—	—	—	—	10	2	14.00	0.2	10	2	14.00	0.2
Cardiidae	34	10	54.06	0.8	—	—	—	—	34	10	54.06	0.8
Fragum spp.	—	—	—	—	1	1	5.10	0.1	1	1	5.10	0.1
Carditidae	2	2	1.77	0.0	—	—	—	—	2	2	1.77	0.0
Chamidae	—	—	—	—	1	1	0.70	0.0	1	1	0.70	0.0
Crassatellidae	2	2	1.30	0.0	—	—	—	—	2	2	1.30	0.0
Donacidae	—	—	—	—	1	1	4.10	0.1	1	1	4.10	0.1
Limidae	1	1	0.59	0.0	—	—	—	—	1	1	0.59	0.0
Mactridae	4	3	2.70	0.0	—	—	—	—	4	3	2.70	0.0
Mactra spp.	—	—	—	—	3	3	4.10	0.1	3	3	4.10	0.1
Mytilidae	6	5	0.74	0.0	5	1	0.90	0.0	11	6	1.64	0.0
Noetiidae	1	1	0.23	0.0	—	—	—	—	1	1	0.23	0.0
Ostreidae	6	2	2.46	0.0	5	4	4.20	0.1	11	6	6.66	0.1
Pandoridae	1	1	0.61	0.0	—	—	—	—	1	1	0.61	0.0
Pectinidae	11	6	27.00	0.4	3	1	1.60	0.0	14	7	28.6	0.4
Chlamys spp.	—	—	—	—	4	3	3.20	0.0	4	3	3.20	0.0
Spondylidae	1	1	31.30	0.4	—	—	—	—	1	1	31.30	0.4
Tridacnidae												
Tridacna spp.	1067	10	3881.40	54.0	364	6	879.50	12.2	1431	16	4760.90	66.2
Hippopus hippopus	86	5	535.80	7.4	78	7	468.40	6.5	164	12	1004.20	14.0
(non-cultural)	24	3	190.20	2.6	2	1	222.70	3.1	26	4	412.90	5.7
Tellinacea	—	—	—	—	108	34	97.80	1.4	108	34	97.80	1.4
Tellinidae	170	12	99.50	1.4	35	12	37.40	0.5	205	24	136.90	1.9
Tellina spp.	15	4	14.10	0.2	—	—	—	—	15	4	14.10	0.2
Tellina virgata	1	1	0.10	0.0	—	—	—	—	1	1	0.10	0.0
Veneridae	4	4	3.53	0.0	—	—	—	—	4	4	3.53	0.0
Unident. bivalve	142	—	76.00	1.1	132	—	64.00	0.9	274	—	140.00	1.9

TABLE 2.—Continued.

Taxon	TU1 Total				TU2 Total				Total (includes TU3)*			
	TNF	MNI	Wt. (g)	Wt. (%)	TNF	MNI	Wt. (g)	Wt. (%)	TNF	MNI	Wt. (g)	Wt. (%)
Gastropods												
Architectonicidae	13	11	0.96	0.0	2	2	0.86	0.0	15	13	1.82	0.0
Buccinidae	—	—	—	—	1	1	0.40	0.0	1	1	0.40	0.0
Cerithiidae	3	3	0.07	0.0	—	—	—	—	3	3	0.07	0.0
Conidae	4	3	8.08	0.1	—	—	—	—	7	6	8.33	0.1
Conus spp.	3	1	2.15	0.0	—	—	—	—	3	1	2.15	0.0
Conus pennaceus	1	1	1.87	0.0	—	—	—	—	1	1	1.87	0.0
Conus tessulatus	1	1	1.24	0.0	—	—	—	—	1	1	1.24	0.0
Conus litteratus	2	2	117.69	1.6	—	—	—	—	2	2	117.69	1.6
Cypraeidae	4	2	25.81	0.4	3	3	8.71	0.1	7	5	34.52	0.5
Haliotidae	15	2	2.80	0.0	—	—	—	—	15	2	2.80	0.0
Littorinidae	—	—	—	—	4	4	0.65	0.0	4	4	0.65	0.0
Mitridae	—	—	—	—	1	1	0.49	0.0	10	10	1.05	0.0
Neritidae	3	3	2.98	0.0	1	1	0.21	0.0	2	2	0.35	0.0
Patellidae	1	1	0.33	0.0	—	—	—	—	1	1	0.33	0.0
Strombidae	1	1	110.92	1.5	2	2	35.52	0.5	3	3	146.44	2.0
Lambis lambis	1	1	0.76	0.0	1	1	19.57	0.3	2	2	20.33	0.3
Strombus spp.	6	6	16.86	0.2	—	—	—	—	6	6	16.86	0.2
Strombus mutabilis	—	—	—	—	—	—	—	—	2	2	0.37	0.0
Terebridae	1	1	0.03	0.0	—	—	—	—	1	1	0.03	0.0
Terebra spp.	1	1	0.04	0.0	—	—	—	—	1	1	0.04	0.0
Turbinidae	2	2	0.06	0.0	—	—	—	—	2	2	0.06	0.0
operculum	—	—	—	—	3	3	2.83	0.0	3	3	2.83	0.0
Turridae	—	—	—	—	1	1	0.40	0.0	1	1	0.40	0.0
Trochidae	12	9	15.95	0.2	—	—	—	—	12	9	15.95	0.2
Umbonium vestiarium	9	9	0.39	0.0	—	—	—	—	9	9	0.39	0.0
Undent. operuclum	5	5	0.25	0.0	7	7	3.98	0.1	12	12	4.23	0.1
Unident. gastropod	100	—	34.23	0.5	39	—	14.75	0.2	139	—	48.98	0.7
Total	1773	141	5270.51	73.3	817	103	1896.07	26.4	2602	256	7164.92	99.7

* TU3 is represented by only four taxa. Conidae: 3 TNF, 3 MNI, wt. 0.3 g, wt. % 0.0; Mitridae: 9 TNF, 9 MNI, wt. 0.6 g, wt. % 0.0; Neritidae: 1 TNF, 1 MNI, wt. 0.1 g, wt. % 0.0; *Strombus mutabilis*: 2 TNF, 2 MNI, wt. 0.4 g, wt % 0.4. Total: 15 TNF, 15 MNI, wt. 1.3 g, wt. % 0.0.

TABLE 3.—Shellfish data from Metuker ra Bisech.

	TU4 Total				Grid 1 Total				Total (includes TU1 and TU2W)*			
Taxon	TNF	MNI	Wt. (g)	Wt. (%)	TNF	MNI	Wt. (g)	Wt. (%)	TNF	MNI	Wt. (g)	Wt. (%)
Bivalves												
Anomiidae	—	—	—	—	4	2	109.3	0.5	4	2	109.3	0.5
Arcidae	17	3	102.4	0.4	2	1	70.6	0.3	19	4	173	0.7
Anadara spp.	147	78	5856.1	24.4	88	57	2969.1	12.4	236	136	8871.2	37.0
Cardiidae	2	2	67.8	0.3	—	—	—	—	2	2	67.8	0.3
Fragum spp.	167	87	3617.1	15.1	—	—	—	—	167	87	3617.1	15.1
Acrosterigma sp.	2	2	61.7	0.3	—	—	—	—	2	2	61.7	0.3
Chamidae	4	4	350.8	1.5	4	3	352.4	1.5	8	7	703.2	2.9
Mytilidae	41	2	114.3	0.5	—	—	—	—	41	2	114.3	0.5
Septifer spp.	4	2	4.4	0.0	—	—	—	—	4	2	4.4	0.0
Ostreidae	70	17	837.6	3.5	1	1	4.2	0.0	71	18	841.8	3.5
Pectinidae	2	2	91.9	0.4	3	2	102.1	0.4	5	4	194	0.8
Spondylidae												
Spondylus spp.	7	6	452.3	1.9	1	1	107.8	0.4	8	7	560.1	2.3
Tridacnidae												
Tridacna crocea	95	50	2919.4	12.2	13	13	604.5	2.5	108	63	3523.9	14.7
Veneridae												
Venus spp.	11	3	72.3	0.3	1	1	41.7	0.2	12	4	114.0	0.5
Unident. bivalve	71	—	55.2	0.2	—	—	—	—	71	—	55.2	0.2
Gastropods												
Conidae	—	—	—	—	2	2	88.0	0.4	2	2	88.0	0.4
Conus spp.	61	5	1047.2	4.4	19	14	474.2	2.0	80	19	1521.4	6.3
Conus litteratus	7	7	92.8	0.4	20	13	453.4	1.9	27	20	546.2	2.3
Cypraeidae	24	9	309.1	1.3	1	1	11.2	0.0	26	11	378.4	1.6
Cypraea tigris	18	6	240.9	1.0	3	3	99.3	0.4	21	9	340.2	1.4
Neritidae	—	—	—	—	—	—	—	—	1	1	2.3	0.0
Strombidae												
Lambis lambis	5	5	83.3	0.3	—	—	—	—	5	5	83.3	0.3
Strombus spp.	2	2	0.05	0.0	—	—	—	—	2	2	0.05	0.0
Terebridae	65	22	168.1	7.0	—	—	—	—	65	22	1681.1	7.0
Trochidae	—	—	—	—	1	1	225.0	0.9	1	1	225.0	0.9
Unident. gastropod	28	—	82.1	0.3	3	—	13.3	0.1	31	—	95.4	0.4
Total	850	314	18139.9	75.7	166	115	5726.1	23.9	1019	432	23972.4	100.0

* TU1 had only one taxon, Neritidae: 1 TNF, 1 MNI, wt. 2.3 g, wt. % 0.0; TU2W has only two taxa—*Anadara* spp.: 1 TNF, 1 MNI, wt. 46.0 g, wt. % 0.2; Cypraeidae: 1 TNF, 1 MNI, wt. 58.1 g, wt. % 0.2.

covered from the grid area consisted predominantly of *Anadara* sp. intermixed with mostly Chamidae, *Tridacna crocea, Conus litteratus,* and other *Conus* spp., similar to what was observed in other areas of the site with concentrated shellfish remains. Nearly all of the specimens were whole with only a small percentage of fragments.

To determine the depth of deposits, subsurface shellfish taxa, and taphonomic processes on these specimens, a small 1.0 × 0.5-m test unit was placed within the grid and excavated to a depth of 50 cm. A total of 850 individual fragments weighing 18.1 kg and representing 314 individuals was recovered. The assemblage consisted mostly of *Anadara* sp., *Conus* sp., and *Tridacna crocea,* with a small amount of Chamidae and *Conus litteratus.* This is similar to what was found in the surface collection. A large number of specimens that were not well represented in the surface grid were also recovered: Cardiidae (especially *Fragum* sp.), Cypraeidae, Mytilidae, Ostreidae, Spondylidae, and Terebridae. Overall, excavation revealed extensive shellfish remains primarily concentrated in deposits less than 30 cm deep, numerous taxa that were not visible on the surface, and no artifacts.

Other Shellfish and Faunal Remains.—Although mollusks dominate the Omis Cave and Metuker ra Bisech faunal assemblages, remains of fish, crustacea, echinoderms, and hawksbill turtle (*Eretmochelys imbricata*) carapace were at Omis Cave, and only a few crustacea fragments found at Metuker ra Bisech. Fish remains identified thus far include parrotfish (Scaridae), wrasse (Labridae), grouper (Serranidae), and sea bream (Lerithinidae). Analysis of faunal assemblages is currently underway at the University of Oregon and Kansai Gadai University, Japan.

DISCUSSION

The most common shellfish taxa at both sites would have been collected in intertidal zones or shallow reefs, including those from the families Arcidae (e.g., *Anadara*), Cardiidae (e.g., *Fragum*), Conidae (e.g., *Conus* sp., *Conus litteratus*), Terebridae (*Terebra* sp.), and Tridacnidae (e.g., *Tridacna* sp., *Hippopus hippopus*) (Table 4). Many of the species within these families are found in shell midden deposits elsewhere in the archipelago (Carucci 1992; Osborne 1979) and are food items still popular with present-day Palauans (Melson Miko, pers. comm.). Other genera, including *Tridacna* and *Terebra,* were used for making shell adzes (Osborne 1979), and *Conus* was modified for making beads, pendants, scrapers, peelers, or other ground objects (Carucci 1992:94; Fitzpatrick n.d.; Osborne 1979).

Unfortunately, there is little published ethnographic or ethnohistoric information regarding shellfish collecting in Palau and it remains an understudied aspect of Micronesian subsistence activities. Semper (1873) and Krämer (1926) provide brief accounts of traditional Palauan shellfishing practices, but these are only minimally descriptive and lack quantification. A comparative study by Lebar (1963) in Truk (Chuuk) gives some insight into the importance shellfishing has in the Micronesian diet, but is contemporary in perspective and does not necessarily reflect past food collecting behaviors. Thus, archaeology must be used to determine shellfish abundances and preferences and how this reflects past cultural behavior through time.

TABLE 4.—Habitats of mollusks found at Rock Island limestone quarry sites, Omis Cave (O.C.) and Metuker ra Bisech (M.B.).

		Present		
Taxon	Common name	O.C.	M.B.	Habitat
Bivalves				
Anomiidae	Jingle shells	X	X	usually attached to rocks or coral in shallow water
Arcidae	Ark shells	X	X	muddy or coral sand or attached to rocks in intertidal zones
Cardiidae	Cockle shells	X	X	muddy or coral sand in intertidal zones
Carditidae	Cardita clams	X		attached to the undersurfaces of rocks or coral in intertidal zones
Chamidae	Jewel boxes	X	X	cements to rocks or reefs in intertidal zones or shallow water
Crassatellidae	Crassatellas	X		muddy or sandy bottoms
Donacidae	Donax or Wedge clams	X		exposed sandy beaches in intertidal zones (often shallowly buried)
Limidae	File clams	X		under rocks or coral in intertidal zones
Mactridae	Mactra clams	X		muddy or coral sand in intertidal zones
Mytilidae	Mussel shells	X	X	usually attached to rocks or wood in shallow water; some bore into rocks or burrow in sand or gravel
Noetiidae	Noetias	X		muddy bottoms in shallow water
Ostreidae	True oysters	X	X	cemented to rocks or shells in intertidal zones
Pandoridae	Pandoras	X		generally live in sandy or pebbly bottoms
Pectinidae	Scallop shells	X	X	rock crevices or sandy areas in shallow water; avid swimmers
Spondylidae	Thorny oysters	X	X	attached to rocks or coral
Tridacnidae	Giant clams	X	X	shallow waters of coral reefs; rest unattached to reef or lagoon bottoms; bore into coral pockets
Tellinidae	Tellins	X		burrow in sandy or muddy areas in intertidal regions
Veneridae	Venus clams	X	X	muddy sand or clean coral sand
Gastropods				
Architectonicidae	Sundial shells	X		sandy areas in shallow water
Buccinidae	Whelks	X		rocky shores of intertidal zones
Cerithiidae	Ceriths shells	X		clean coral or grassy sand in shallow waters of intertidal zones; also mud and grassy areas
Conidae	Cone shells	X	X	under coral or in crevices; coral sand or hard reef
Cypraeidae	Cowrie shells	X	X	coral reefs of shallow water
Littorinidae	Periwinkles	X		clings to rocks and grasses near tide line; also inhabits mangrove
Mitridae	Miter shells	X		clings to rocks and grasses or in sandy areas near tide line

TABLE 4.—Continued.

Taxon	Common name	Present O.C.	 M.B.	Habitat
Neritidae	Nerites	X	X	under rocks or in crevices at high tide levels of intertidal regions; clings to wave-washed rocks in great numbers
Strombidae	Conch shells	X	X	muddy, grassy, or clean coral sand in shallow waters of intertidal zones
Terebridae	Auger shells	X	X	sandy floors in shallow water
Turbinidae	Turban shells	X		intertidal reef zones; under coral rocks
Turridae	Turrid shells	X		attached to rocks in intertidal zones
Trochidae	Top shells	X	X	grassy areas; sometimes attached to rocks in intertidal zones

Despite the paucity of archaeological research dedicated to shellfish assemblages in Micronesia, it is clear that shellfish were an important component of the diet to people living in the limestone Rock Islands of Palau and probably the volcanic islands too, although preservation bias precludes a better assessment. One of the difficulties in evaluating the significance of shellfish in the Rock Islands is that some specimens could have been carried by natural phenomena (e.g., wind, tide, and storm activities). Likewise, it is often difficult, if not impossible, to discern which specimens, especially of the smaller taxa, were actually eaten by past inhabitants. And, all of these problems are exacerbated by the fact that different site inhabitants (e.g., Palauans, Yapese) during separate or even overlapping periods of time may have had similar (or dissimilar) cultural behaviors that influenced shellfish collection strategies and responses to environmental stimuli. These are issues that can be partially resolved, however, by careful examination of the faunal assemblages and other site constituents, extensive radiocarbon dating, and complementary lines of evidence such as ethnography and ethnohistoric accounts. So, what are the main factors influencing the quantity and quality of shellfish assemblages at Omis Cave and Metuker ra Bisech?

Despite both sites having both been used as stone money quarries, shellfish assemblages reveal some striking contrasts. In terms of taxonomic richness, Metuker ra Bisech has less than half the number of discrete shellfish taxa (48%) and families (47%) as those found at Omis Cave, despite the much larger sample from the former. As mentioned previously, one reason for this discrepancy is that Omis Cave is situated adjacent to the water and Metuker ra Bisech is far inland and at a much higher elevation. Wave and storm action could deposit smaller species in greater numbers and variety. Other predators such as birds may also contribute to this greater number of taxa. The gathering of larger shellfish (such as tridacnids) or other resources, including sea grasses, may also introduce smaller species into archaeological deposits as "piggy backers"; however, this is difficult, if not impossible, to quantify accurately. Several studies have addressed the sorting of

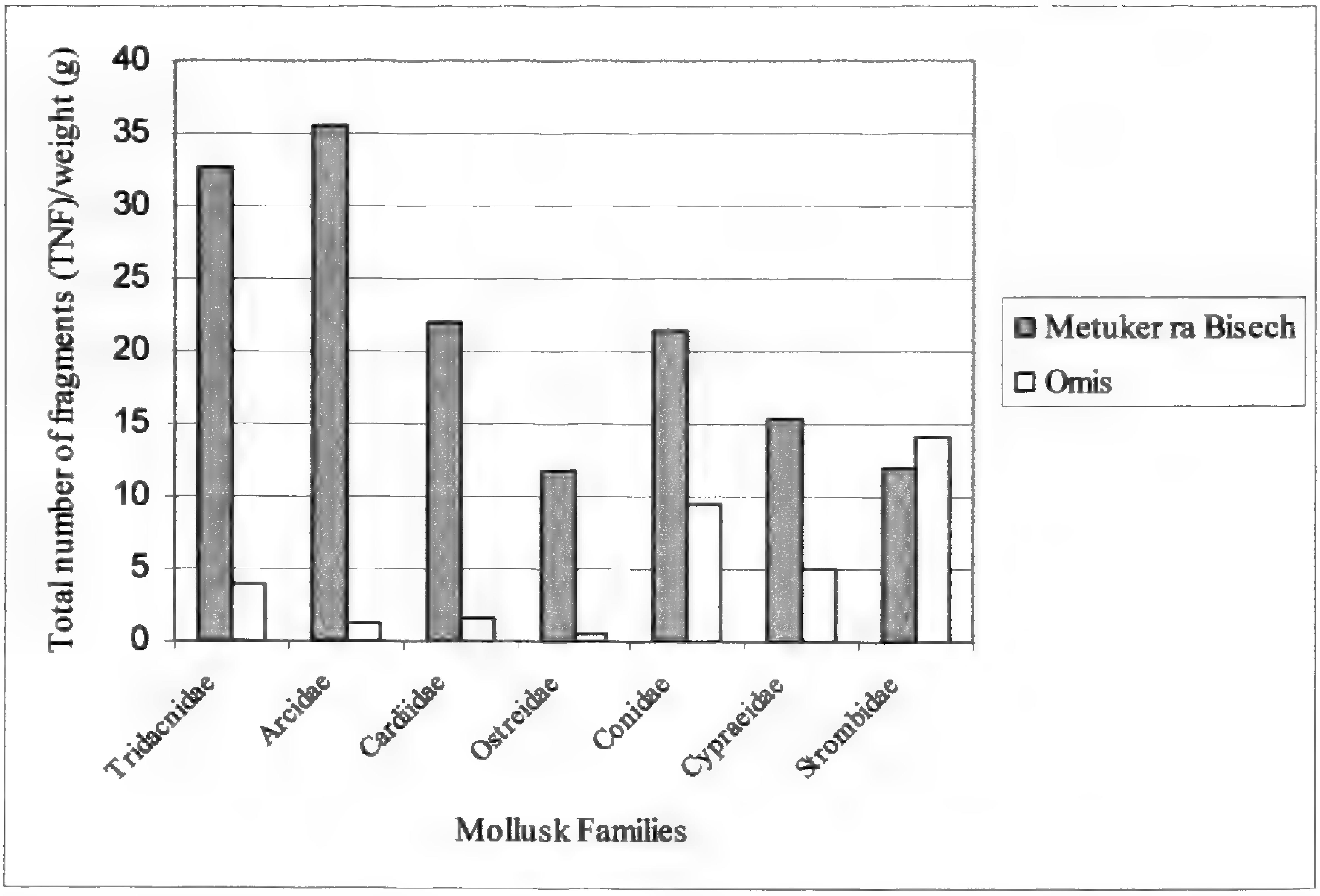

FIGURE 6.—Total number of fragments (TNF)/fragment weight (g). Higher numbers indicate larger size fragments; lower numbers indicate smaller size fragments.

faunal and artifactual material by weather-related phenomena or "piggy-backing" on other shells or objects (Bird 1992; Carucci 1992; Hughes and Sullivan 1974; Lever et al. 1964). These hypotheses, however, have not yet been tested at quarry sites in Palau.

To better compare assemblages from both sites, quantitative measures of the total number of fragments (TNF) for each taxa, minimum number of individuals (or MNI, based on the unique identifiable elements for each taxa that is representative of a single individual), and weight (g) were standardized (see Claassen 1998:117; Grayson 1984). Because the types and quantity of shellfish remains were different between sites, I used the seven most common families that included both bivalves (Tridacnidae, Arcidae, Cardiidae, Ostreidae) and gastropods (Conidae, Cypraeidae, and Strombidae) to standardize the data and give a measure of relative abundance. The TNF were divided by total specimen weight for each site to illustrate differences in fragment size (Figure 6). The MNI were divided by soil volume to establish a comparison of shell quantity between sites (Figure 7). Total shellfish weight (g) for each site was divided by the weights for each family to give a comparative indication of their overall prevalence (Figure 8).

The average weights for individual fragments indicate that shellfish are more highly fragmented at Omis Cave. Taphonomic studies of various mollusks demonstrate that under many conditions, bivalves are more likely than gastropods to become fragmented. The morphology and crystalline composition of bivalves makes them susceptible to breaking along structurally weaker points (Claassen 1998:56). This trend holds true for Omis Cave, where there is an increase in average weight per fragment from bivalves to gastropods. At Metuker ra Bisech the

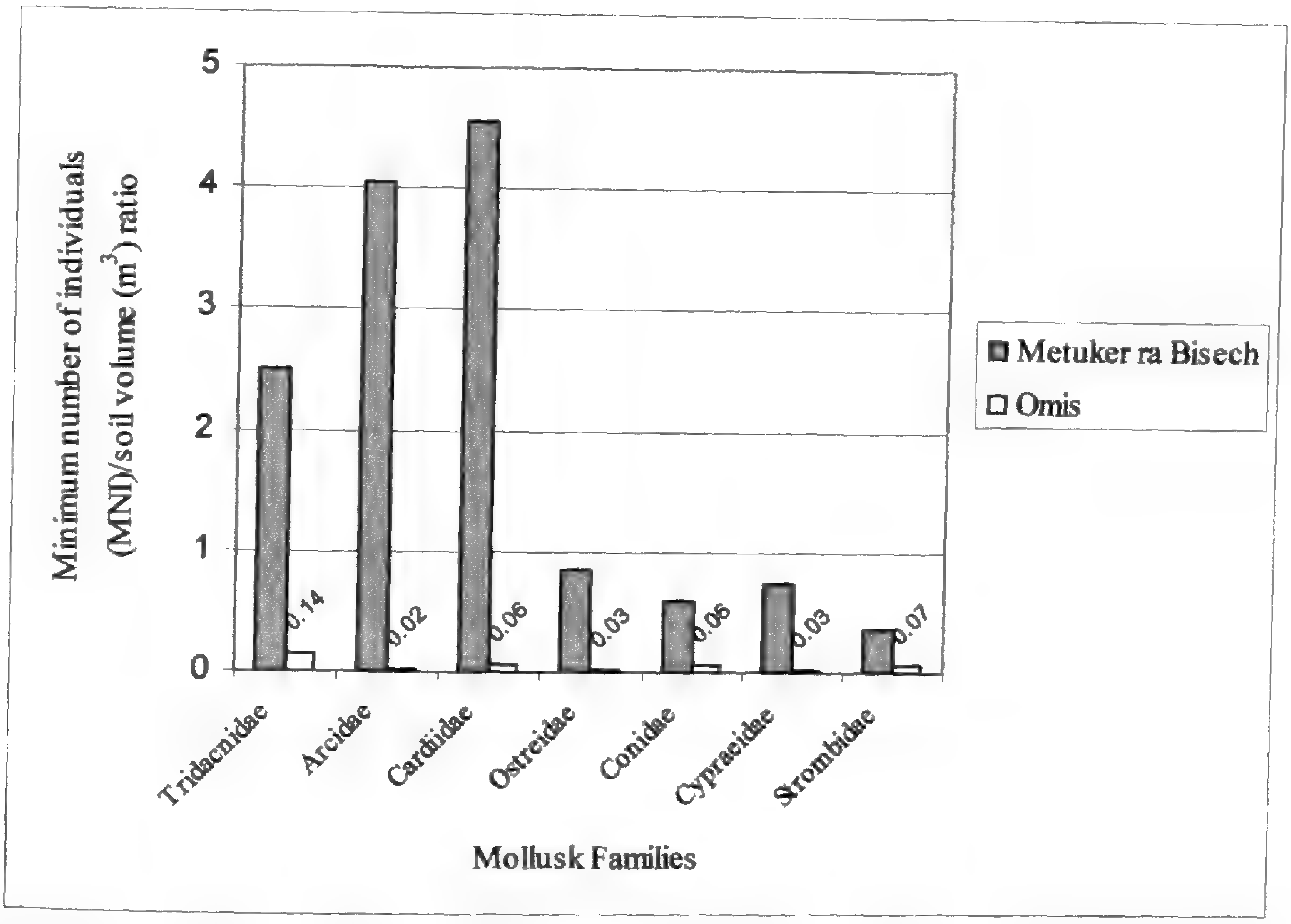

FIGURE 7.—Shellfish density measure for each site using minimum number of individuals (MNI)/soil volume (m^3).

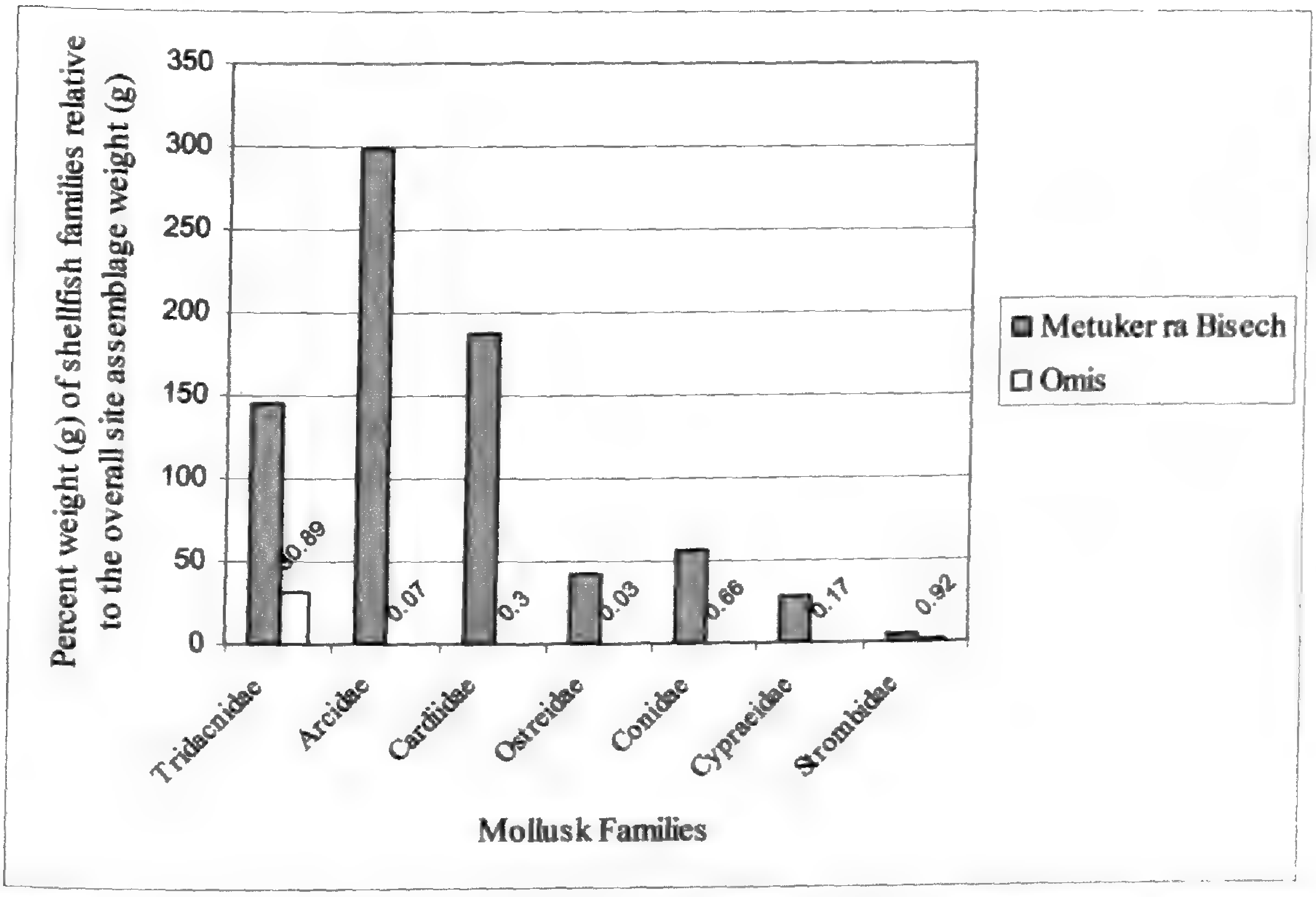

FIGURE 8.—Percentage by weight of major shellfish families relative to the overall site assemblage weight (g). Higher numbers indicate the relative abundance of each family within their respective site.

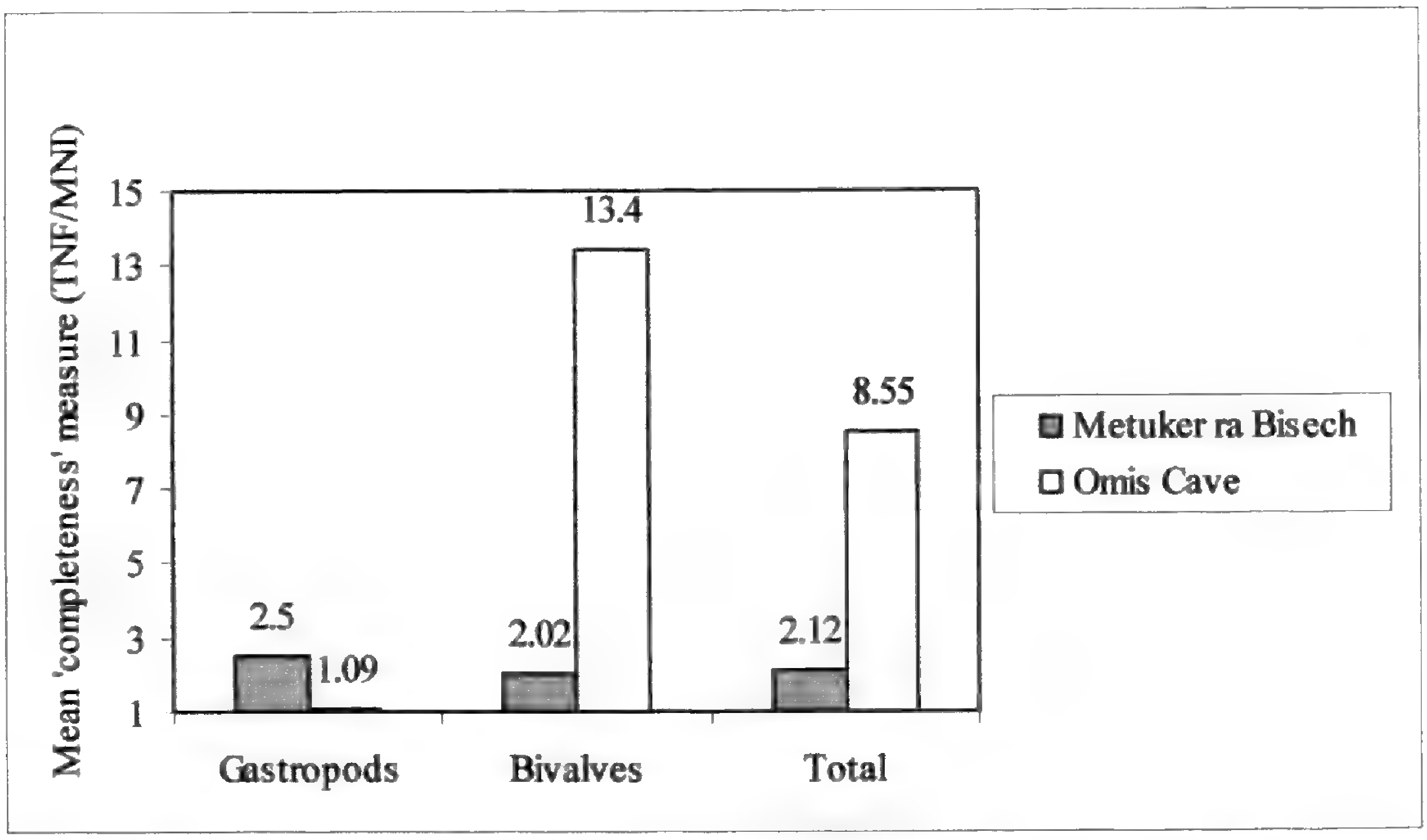

FIGURE 9.—'Mean completeness' of shellfish (TNF/MNI). Values approaching 1.0 are more complete, whereas numbers above 1.0 show increasing rates of fragmentation.

reverse is true, except for Ostreidae. This is not surprising given how oyster shells, having a foliated structure, tend to fracture more easily than other types of bivalves (Claassen 1998:56–57). The ratio of MNI divided by soil volume (Figure 7) follows a similar trend to that of total shellfish weights with a higher density of taxa from Metuker ra Bisech than Omis Cave. More whole bivalve halves were also recovered from Metuker ra Bisech, mirroring what both quantitative standardizations show. Figure 8 simply illustrates the relative abundance of families between each site in terms of weight, but also gives an indication of how weight measures affect the samples. The seven shellfish families from Omis Cave comprise less of the overall site assemblage weight compared to Metuker ra Bisech, with the exception of Strombidae and Tridacnidae. The data presented in these figures suggest that 1) shellfish are more highly fragmented at Omis Cave; 2) Omis Cave is taxonomically richer; 3) the overall assemblage weight is dominated by tridacnids at Omis Cave (not necessarily reflecting a higher percentage of use as seen by MNI counts); and 4) peoples living at Metuker ra Bisech had a preference for bivalves, especially Tridacnidae, Arcidae, and Cardiidae with gastropods being far less important—the similarity in environment between the two sites makes it unlikely that these differences can be attributed to habitat.

The 'mean completeness' of shellfish assemblages was also determined by dividing TNF (minus the indeterminate fragments) by MNI to give another estimation of fragmentation (with values approaching one being more complete; see Grayson 1984 for a review of sample size effects; Figure 9). The completeness measure for Omis Cave gastropods was 1.09, bivalves 13.4, and total assemblage 8.55. Metuker ra Bisech gastropods were 2.5, bivalves 2.02, and total assemblage 2.12. Using this measure of completeness, the Omis Cave assemblage shows an overall fragmentation rate that is over four times that of Metuker ra Bisech. Although gastropod fragmentation is higher at Metuker ra Bisech than Omis Cave and would appear to conflict with the overall trend, this can be attributed to the size of the gastropods found at each site. By dividing gastropod TNF with total weight, individual fragments at Omis Cave weigh 1.7 g, while Metuker ra Bisech weighs 19.0 g. These numbers reflect some of the smaller species or specimens (< 2 cm) in various gastropod families such as Architectonicidae, Cerithiidae, Neritidae, Patellidae, Terebridae, Turbinidae, and Trochidae; although they have a high MNI, they easily could have been washed or brought into the site by noncultural processes.

Two of the other major shellfish assemblages reported from Palau are from Peleliu (Osborne 1979) and sites in the southern Rock Islands such as Ngemelis (Carucci 1992). In general, the most common bivalves found in these studies were *Atactodea* and *Fragum,* occurring in about the same relative abundance (MNI) in both collections. *Strombus gibberulus* was the most common taxon (95% in Osborne's and 89% in Carucci's collection). Except for *Fragum,* which comprises 15% of the total weight and 20% of the MNI at Metuker ra Bisech, these data are quite different from what is found at the two Yapese stone money quarries.

My analysis reveals a disparity in the shellfish taxa identified as well as preservation between the two quarry sites. I suggest that the high shellfish fragmentation at Omis Cave is primarily due to the intensive engineering tasks associated with limestone carving in a smaller, more restricted area, whereas remains from the site of Metuker ra Bisech (most of which were almost completely intact), reflect the separation of habitation and quarrying areas at a much larger inland site. Widely separated radiocarbon dates and evidence of stone money quarrying at Omis Cave suggest substantial disturbance of the soil. I would not discount the possibility that the Yapese collected only certain taxa or restricted their collecting to certain locations, but this hypothesis is difficult to test given differences in location and preservation. Despite these questions, shellfish remains provide important evidence about habitation, subsistence, quarrying, and other daily activities of the Yapese quarry workers who lived at the two sites while they carved stone money disks.

The diversity and abundance of shellfish demonstrates the importance these resources had for people living at the sites. We still do not know, however, the role shellfish actually played. Were they eaten, used for making tools and ornaments, or did they serve some other purpose? In their analysis of *Strombus gigas* in the West Indies, Jones O'Day and Keegan (2001) suggest that "most gastropod and bivalve shells are so durable that they are unlikely to break into fragments without human intervention," and that "there is no reason for large and heavy shells (e.g., *S. gigas*) to be brought to a settlement unless some further use was intended. Thus, we should assume that large shells and their fragments found in archaeological sites were the product of tool manufacture." This may be true of West Indian sites, but not necessarily for others along the North American Pacific coast (see Erlandson et al. 1999 and Sharp 2000 for some California examples), the Mississippi Valley (Peacock 2000), or stone money quarries. Osborne (1979:88) also suggested a similar arrangement, noting that when tridacnid shells were not needed for tools, their meat was collected and the massive shells were left on the reef. However, some shellfish will remain fresh for days if left in shells and then transported over long distances.

There are several possible explanations for the relatively high presence of tridacnid shells (TNF, MNI, and weight) at Omis Cave and Metuker ra Bisech that may also address Jones O'Day and Keegan's (2001) and Osborne's (1979) hypotheses. The first is that radiocarbon dates and metal tools place quarrying activity at Metuker ra Bisech just prior to and after European contact. *Tridacna crocea,* the only species of tridacnid found at the site, was rarely, if ever, used for producing tools in prehistory and was probably only a food item. Because of its smaller size (< 15 cm in length), there would have been little effort expended to bring both the meat and shell up to the main site. The shell then could have served as a container or other unmodified utilitarian instrument. In addition, Yapese quarry workers were generally low caste, often providing corvée labor to Palauan clans or villages in exchange for quarrying rights (de Beauclair 1971; Einzig 1966; Gillilland 1975). It is unlikely that they would have had unrestricted access to any and all food items. Oral traditions describe Palauans bringing food to quarry workers (e.g., Holyoak and Miko 2000), but whether this was done on a regular basis is unknown. The Rock Islands have shallow, poor soils for cultivating crops like taro. Thus, shellfish could have been a nearby, easily captured, and important food source.

The high fragmentation rate of tridacnids and other shells at Omis Cave is probably not explained by tool production either. No shell tools have been found at the site and only two small fragments of a *Trochus* shell ring were recovered during excavation (Fitzpatrick 2001). Shell midden deposits are quite common in other caves and rockshelters in Palau (Carucci 1992; Masse 1989), and it is likely that people living there brought larger shells into the site. The cave's proximity to reef and lagoon habitats would have made this quite easy. Radiocarbon dates at Omis Cave also span more than 2,000 years from 300 cal. B.C. to the modern era. The slightly sloping stratigraphic profiles, radiocarbon dates, and lack of shell artifacts all point to shellfish assemblages having been affected by engineering activities.

It should be noted too, that a fundamental difference between *Strombus gigas* and tridacnids lies in their size and morphology. The most common tridacnids used for tools in the Pacific, *Tridacna maxima* and *Tridacna gigas* (Moir 1986–87), are much larger than *S. gigas,* attaining lengths of 35 cm and 100 cm respectively (Rosewater 1965), whereas *S. gigas* rarely exceeds 30 cm in length (Dance 1974: 83). Tridacnids also have two halves and are often used as containers for water. *S. gigas* is a gastropod and its use as a vessel is not well documented, nor would it be as convenient to use as half of a larger bivalve shell. With such a complex mixing of cave deposits, it is difficult to assign specific faunal remains to a particular cultural period. Nonetheless, it is reasonable to conclude, given the available evidence, that engineering tasks associated with stone money quarrying introduced a variable that broke shell into fragments as a result of human intervention on a massive scale.

CONCLUSIONS

The analysis of shellfish remains from Omis Cave and Metuker ra Bisech suggests the following:

1) Radiocarbon dates and artifact assemblages indicate that Palauans used Omis Cave over a long period of time, perhaps intermittently as a temporary campsite, and by the Yapese for stone money manufacture. Metal tools and a lack of pottery at Metuker ra Bisech suggest that only the Yapese used this site within the last few hundred years for quarrying stone money.

2) The greater varieties of shellfish found at Omis Cave are likely a result of the site's close proximity to the sea. Storms, tidal action, predators, and indirect transport of smaller taxa all likely influenced the kinds and size of shellfish found at the sites.

3) Nearly all shellfish taxa, including those shared by the two sites, are found in intertidal zones or shallow reef areas. This is not unexpected given that Rock Island ecological zones are within a barrier reef with numerous complex coral reef systems.

4) Shellfish remains are highly fragmented at Omis Cave and much less so at Metuker ra Bisech. In the case of stone money quarries, this is probably a result of multiple factors including site dimensions, quarrying activities in a restricted area, and engineering tasks associated with the carving or breaking of limestone, movement of debitage, and transport of stone money disks away from flowstone deposits. We should expect to find similar fragmentation rates in future investigations at quarry sites.

5) People living and working at stone money quarry sites showed a preference for bivalves, particularly tridacnids, although a wide variety of shellfish were exploited. Previously I thought giant clam shells found at quarry sites may have been used for producing tools or as utilitarian objects (e.g., water or food containers) (Fitzpatrick 2001). Very few shell tools have been found at stone money quarry sites and none in direct association with quarry refuse (i.e., limestone debitage). This suggests that tridacnids were predominantly gathered for food, although their use as containers cannot be ruled out. The small number of shell artifacts in general suggests that shellfish at these sites are primarily food remains or incidental site constituents.

6) Shellfish varieties recorded at stone money quarries are dissimilar to those found at other sites in Palau (Carucci 1992; Masse 1989; Osborne 1979), suggesting that even though people took advantage of the rich diversity of faunal material in these environments, they were probably doing so with different dietary or technological preferences. Further research will help determine what these preferences were and if they represent cultural differences (Yapese vs. Palauan). In any case, this research reinforces the idea that shellfish were an important resource for those living in the Rock Islands over a long period of time, as Masse (1989), Osborne (1979), and Carucci (1992) have suggested.

This study provides the first description of faunal remains recovered from Yapese stone money quarries. The data allow for a better understanding of how Yapese Islanders made use of these sites and provide a framework for developing hypotheses about settlement patterns, engineering tasks, and modes of activity at quarry sites. The evidence, especially in the case of the Omis Cave assemblage, suggests that proper sampling techniques using ⅛-inch screen can help in recovering smaller taxa present, some of which may result from non-cultural processes.

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THE USE OF DRIFTWOOD ON THE NORTH PACIFIC COAST: AN EXAMPLE FROM SOUTHEAST ALASKA

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ABSTRACT.—North Pacific Coast societies were dependent on several tree species to supply them with fuel and raw materials used in construction and in making implements with utilitarian, social, and/or ceremonial purposes. Although much of the North Pacific Coast is blanketed with forested ecosystems, usable and accessible wood was not always readily available. An archaeobotanical study of Cape Addington Rockshelter in southeast Alaska (49-CRG-188) revealed that the site occupants relied on driftwood to supplement the live trees and dead wood in the forest. Both accessible and renewable, driftwood also supplied preferred fuel wood taxa that otherwise would have been available only through trade with other groups. A review of the North Pacific Coast ethnographic literature reveals that driftwood was an important source of wood for fuel and technology for several First Nation groups.

Key words: Northwest Coast First Nations, paleoethnobotany, driftwood, Cape Addington, Alaska.

RESUMEN.—Las sociedades de la Costa del Pacífico Norte dependían de diversas especies arbóreas para la obtención de combustible y materias primas usadas en la construcción y en la elaboración de artículos con valor utilitario, social y/o ceremonial. Aunque gran parte de la costa del Pacífico Norte está cubierta por ecosistemas forestales, no siempre era facíl obtener madera aprovechable y accesible. Un estudio arqueobotánico en el sureste de Alaska reveló que los habitantes del sitio usaban madera de deriva como suplemento a los árboles vivos y madera muerta obtenidos del bosque. La madera de deriva, accesible y renovable, también proveía de ciertos taxones preferidos como leña, que de otra manera sólo habrían estado disponibles a través del comercio con otros grupos. Una revisión de la literatura etnográfica de la Costa del Pacífico Norte revela que la madera de deriva era para varios grupos indígenas una fuente importante de combustible y material para manufacturas.

RÉSUMÉ.—Les sociétés de la côte du Pacifique Nord dépendaient de plusieurs espèces d'arbres pour subvenir à leurs besoins en combustible et en matières premières qu'elles utilisaient dans la construction et pour la fabrication d'ustensiles à des fins utilitaires, socials, et/ou cérémonielles. Bien qu'une grande partie de la côte du Pacifique Nord soit recouverte d'écosystèmes forestiers, les arbres utilisables et d'accès facile étaient parfois difficiles à trouver. Une étude archéobotanique de Cap Addington Rockshelter au Sud Est de l'Alaska (49-CRG-188) montre que les occupants du site comptaient sur le bois de grève pour complémenter les arbres et le bois mort de la forêt. À la fois accessible et renouvelable, le bois de grève procurait également des taxons de bois de feu fort prisés qui n'auraient été disponibles autrement que par des échanges commerciaux avec d'autres groupes. Un examen de la littérature ethnographique de la côte du Pacifique Nord révèle que le bois de grève était une importante ressource pour les besoins en combustible et en technologie de plusieurs groupes de Premières Nations.

INTRODUCTION

North Pacific Coast peoples relied on wood.[1] Ethnographically, large quantities of wood were used to construct and heat houses, to process foods, and as raw materials for manufacturing canoes, implements, and art and ceremonial objects (Turner 1998). In the archaeological record, evidence of this high demand for wood can be seen in the size and extensive remodelling of plank houses (Ames et al. 1992; Lepofsky et al. 2000), the abundance of charcoal in most sites (Stenholm 1992), the dominance of wooden artifacts and debris at wet sites (Bernick 1991), and the profusion of standing and dead culturally modified trees with evidence of bark and wood harvesting (Mobley and Eldridge 1992; Pegg 2000; Stryd 1997; Stryd and Eldridge 1993). In addition to sheer quantity, both the ethnographic and archaeological records indicate that North Pacific Coast peoples recognized different qualities of woods for fuel and technology, and sought particular species for specific tasks (Friedman 1975; Lepofsky in press; Turner 1998; Turner and Peacock in press).

Despite a well-developed system of ownership and management of trees (Stewart 1984:36–37; Turner and Peacock in press), the ethnographic record suggests that local forests could not always supply either the amount of wood or the particular species of wood needed by North Pacific Coast groups for fuel and technology. Heavy demands on firewood meant that some groups exerted considerable effort to collect fuel at some distance from their villages (Boas 1935 [1969]:7; Drucker 1951:107; Jewitt 1974:96). The effort involved in harvesting fuel and its overall value is further indicated by the fact that among the Coast Salish, the lower class were often required to supply firewood along with other essential supplies to dominant elite villages (Jenness 1955:86; Suttles 1987:5). In the more sparsely forested ecosystems of the northern portion of the coast, groups such as the Dena'ina had to re-locate their villages when local supplies of firewood were depleted (Kari 1987:15). Further, when specific woods for technology could not be obtained from forests within a group's territory, people traded for wood or the finished products (de Laguna 1972:35, 413; Drucker 1955:61; Singh 1966:27; Turner 1998:43–44; Wennerens 1985:59). The archaeological record of culturally modified trees indicates that North Pacific Coast peoples also travelled considerable distances from their settlements to harvest wood for technological purposes (e.g., Lepofsky and Pegg 1996).

In addition to the wood supply in the surrounding forests and that obtained through trade, many North Pacific Coast peoples could obtain wood as driftwood. This paper explores the importance of driftwood as an accessible and renewable source of wood for fuel and technology. Our paleoethnobotanical investigation of the Cape Addington Rockshelter in southeast Alaska revealed that a significant proportion of fuel wood used at the site did not grow locally, and likely came from driftwood. Further, the results suggest that the inhabitants of the rockshelter

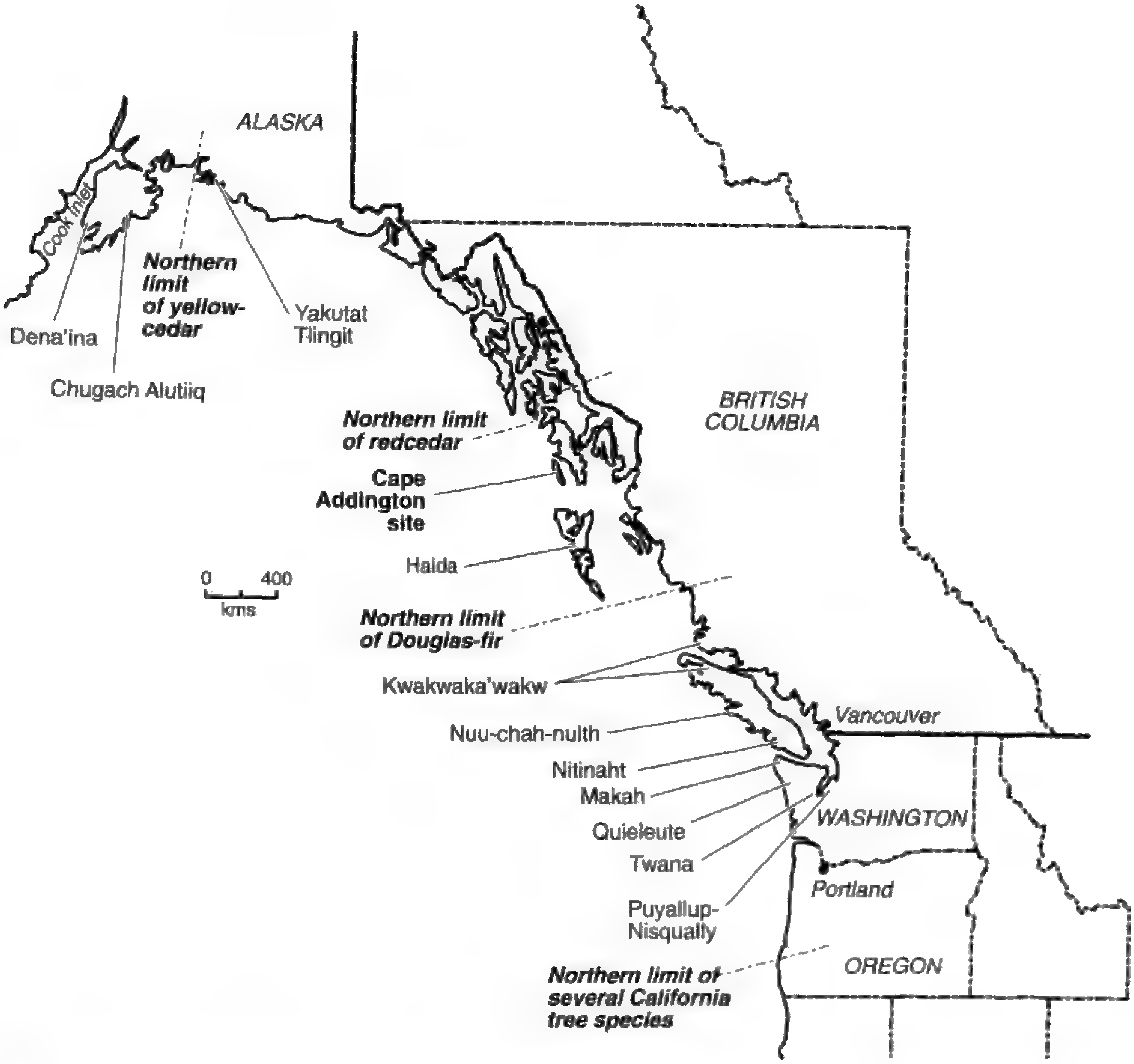

FIGURE 1.—The North Pacific Coast, showing location of Cape Addington Rockshelter, northernmost range limits of some major tree species, and cultural groups for whom there is an ethnographic record of driftwood use (see Table 3). Tree range limits come from Pojar and MacKinnon (1994).

selected preferred fuel wood taxa from among the drift. A review of the ethnographic literature for the region indicates that the Cape Addington Rockshelter inhabitants were not unique on the North Pacific Coast, and that driftwood was an important source of wood for fuel and technology for many groups.

CAPE ADDINGTON ROCKSHELTER

Cape Addington Rockshelter is located on Noyes Island, one of many small islands west of Prince of Wales Island in southeast Alaska (Figure 1). The site was excavated by Moss in 1997. The cultural deposits extend over a 20 × 10-m area on a slope that ranges between 5.5 to 9.0 m above mean high tide within an uplifted wave-cut rockshelter. The 279 cm deep shell midden at the site has produced 13 radiocarbon dates with calibrated midpoints ranging from A.D. 160 to 1420. The site deposits are composed of shell, fire-cracked rock, bone, antler, and charred and uncharred botanical remains. The artifact assemblage numbers about two dozen items, including five deer ulna awls or knives, bone and wood points, a deer scapula spoon, barbed bone harpoon point, mussel shell blade, and fragments of worked bone, wood, and shell.

From the rockshelter, 8918 vertebrate remains have been studied. Thirty-two species, nine additional genera, and another nine families of animals have been identified (Moss n.d.; Moss and Losey 2003). During the earliest period of site occupation (A.D. 70 to 270), the faunal remains are dominated by halibut (*Hippoglossus stenolepis* Schmidt) and deer (*Odocoileus hemionus sitkensis* Merriam). After A.D. 600, Pacific cod (*Gadus macrocephalus* Tilesius) is the most abundant taxon, indicating site occupation during March and April (see Bowers and Moss 2001 for a detailed discussion of Pacific cod). In later periods, harbor seals (*Phoca vitulina* L.) and salmon (*Oncorhynchus* spp.) become key resources, and offshore resources, such as northern fur seals (*Callorhinus ursinus* L.), Steller sea lions (*Eumetopias jubatus* Schreber), and a variety of seabirds attest to use of oceanic islands, possibly including the Forrester Islands. Both faunal and macrobotanical evidence suggest site use during spring and summer (Lepofsky et al. 2001; Moss and Losey 2003). Plants were collected in the site vicinity, and some plant processing and consumption took place on site.

The site occurs within the densely vegetated western hemlock–Sitka spruce (*Tsuga heterophylla–Picea sitchensis*) rainforest characteristic of the southern half of southeast Alaska (Viereck and Little 1972). Some small shore pine (*Pinus contorta*) are also found along the beach fringe today. Mountain hemlock *(Tsuga mertensiana* (Bong.) Carr.), western redcedar (*Thuja plicata*), and yellow-cedar (*Chamaecyparis nootkatensis*) occur within the larger region, but were not observed during reconnaissance of southwest Noyes Island. Shrubs and herbs growing in the immediate vicinity of the rockshelter include Sitka alder (*Alnus crispa*), cow parsnip (*Heracleum lanatum* Michx.), and devil's club (*Oplopanax horridus* Smith). A variety of ferns, grasses, and other low-lying plants are found outside the shelter. The shoreline in front of the site is open to the Gulf of Alaska, but nearby headlands and offshore rocks provide some protection from the full force of Pacific swells and storms. Nonetheless, driftwood is common on the beach in front of the site today.

The vegetation surrounding the site today likely differs little from that of the last 2000 years. The forest surrounding the site has not been altered significantly by modern human activity, and while the record of glacial advances and macrofossils do indicate climatic fluctuations on the Alaska coast in the last 2000 years (e.g., Calkin et al. 2001; Cwynar 1990; Hansen and Engstrom 1996; Mann et al. 1998), there was relatively little change in vegetation in the same period—at least at the coarse level that pollen records can detect (e.g., Gottesfeld et al. 1991; Hebda 1995; Hebda and Whitlock 1997).

METHODS

As part of a larger paleoethnobotanical analysis of 49-CRG-188, Lyons and Lepofsky identified 90 charred and 30 uncharred wood specimens from five bulk sediment samples and from material collected from the ¼-inch screen during the excavation of one deposit (Table 1; Lepofsky et al. 2001). The bulk and ¼-inch

TABLE 1.—Paleoethnobotanical samples analysed from Cape Addington Rockshelter.

Unit	Stratum	Feature	Date (approx.)	Sample volume (liters)	Notes
Unit 1	Layer IIa	18	A.D. 1420	1.4	18 is a hearth with ash lens, burned rock, charcoal. II is a dark, fine silty black matrix with considerable amounts of bone and some shell.
Unit 2	Layer IIIc	22	A.D. 660	1.6	22 is a mussel shell-burned rock concentration. III is light-colored due to large quantities of shell. Large particles of shell, rock; considerable bone.
Unit 2	Layer IVd	N/A	A.D. 500	1.9	IV is a dark matrix with less shell than III. Moist compared to upper strata. Bone occurs.
Unit 7	Stratum B	N/A	A.D. 1250	1.8	B is a dark matrix with some shell and lots of charred wood.
Unit 7	Stratum H	N/A	A.D. 800	1.1	H is a dark matrix with bits of shell.
Unit 3	Layer IIIa	N/A	A.D. 750	N/A	botanical remains collected from 1/4-inch screen. III is light-colored due to large quantities of shell. Large particles of shell, rock; considerable bone.

samples were selected to represent the different areas of the excavation as well as the major deposits within the site. Two of the bulk samples were from features and the other three were from charcoal-rich layers within the shell midden. The material from the ¼-inch screen was from a shell-rich deposit where unique depositional conditions resulted in the preservation of an abundance of both uncharred and charred botanical remains (Lepofsky et al. 2001). Material collected from the ¼-inch screen should be representative of larger-sized botanical remains, but not smaller remains.

We processed the sediment and ¼-inch samples in slightly different ways. The sediment samples were floated using a modified bucket flotation system which collected plant remains >0.425 mm in diameter. These remains were sorted into their constituent parts (charcoal, "seeds," needles, non-woody tissues) with the aid of a dissecting microscope (maximum magnification 40×). We limited our analysis of the ¼-inch screen material to remains >2.0 mm in size, since an unknown amount of smaller material had passed through the screen. We sorted this material directly into three gross categories: charcoal, uncharred wood, and uncharred herbaceous plant. We further subdivided the uncharred wood into two categories based on gross morphology: stem/root and wood. The "wood" category consists of fragments which, based on the curvature of the growth rings, originate from large branches, large roots, or stemwood. The "branch/root" category consists of specimens whose original diameter (based on ring curvature and presence of bark) was <0.5 cm in diameter, and therefore likely originated from either smaller tree roots or small branches.

We randomly selected for identification 15 charcoal specimens from each of the five flotation samples and 15 specimens from the charcoal, uncharred wood, and branch/root from the ¼-inch screen. Based on previous experience with wood analysis on the North Pacific Coast, 15 specimens is the minimum sample size to represent the abundance of the common taxa. All specimens were >2 mm in size. Charred wood was identified using a reflected light microscope (maximum magnification 400×) and uncharred wood was identified with a transmitted light microscope (maximum magnification 400×). All identifications were made by comparing against specimens in the wood reference collection housed in Lepofsky's paleoethnobotany laboratory at the Department of Archaeology, Simon Fraser University.

RESULTS

The Cape Addington Rockshelter flotation and screen samples yielded seeds, needles, buds, wood, and non-woody tissues representing 24 plant taxa (Lepofsky et al. 2001). Of these, uncharred and charred wood taxa dominate the assemblage both in diversity and abundance. The woods are comprised of ten tree species, the majority of which are conifers (Table 2).

Despite the relatively small sample size, there is patterning in the distribution of charred and uncharred wood taxa. Of the charred woods, three species, spruce (*Picea sitchensis*), redcedar (*Thuja plicata*), and Douglas-fir (*Psuedotsuga menziesii*) were collected most often and in greatest quantity (Figure 2). The remaining charcoal species were collected either infrequently, and/or were not harvested in abundance. Our sample of uncharred woods is too limited to discern definitive patterns, but the percent abundances of some taxa do indicate distinct formation processes for the uncharred wood and charred wood taxa (e.g., yellow-cedar charcoal versus uncharred branch/root; hemlock charcoal versus uncharred wood; Table 2).

This non-random distribution reflects the deliberate collection of particular wood species for specific tasks. We assume that the charred wood recovered was collected for fuel, and/or was scrap generated from other tasks, which was later burned. The preference at the site was clearly for spruce, redcedar, and Douglas-fir fuel; each of these taxa is widely recognized among Northwest Coast peoples as an excellent, all-purpose fuel wood (Turner 1998). The uncharred wood from the ¼-inch screen sample may have been brought into the site to manufacture artifacts, or may have also been stockpiled for future fuel consumption (e.g., Reger and Campbell 1986).

The taxonomic abundance of the different woody taxa reflects both local abundance and cultural preference. In charred and uncharred archaeological samples as well as in the local environment today, conifers are more common than hardwoods. However, while both spruce and western hemlock (*Tsuga heterophylla*) are common in local forests today, and were likely so in the past as well, only spruce is ubiquitous and abundant in the archaeobotanical assemblage (Table 2;

TABLE 2.—Wood taxa recovered from Cape Addington Rockshelter.

	N (% Abundance)[1]			
Scientific name (common name)	C	UC W	UC B/R	Distribution
Coniferous Trees				
Abies spp. (true fir)	4 (4)	—	—	could be either *A. amabilis* or *A. lasiocarpa*; both grow in rare, local stands in southeast Alaska; not observed on Noyes Island, but may be present.
Chamaecyparis nootkatensis D. Don (yellow-cedar)	4 (4)	1 (3)	5 (17)	present in southeast Alaska in mixed coniferous forests from sea level to timberline, including muskeg; not in immediate vicinity of site today, but may be present at higher elevations.
Picea cf. *sitchensis* (Bong.) Carr.[2] (Sitka spruce)	27 (30)	6 (20)	3 (10)	abundant in the forests of southeast Alaska from low to mid elevations; abundant in site vicinity today.
Pinus cf. *contorta* Dougl.[2] (shore pine)	3 (3)	—	—	common in shoreline forests, present in site vicinity today.
Pinus/Picea	2 (2)	—	—	—
Psuedotsuga menziesii (Mirbel) Franco (Douglas-fir)	9 (10)	—	—	common component of central and southern B.C. coastal forests; northernmost population is 380 km south of Noyes Island.
Thuja plicata Donn (western redcedar)	11 (12)	1 (3)	—	present in southeast Alaska from low to mid elevations south of Frederick Sound; not in immediate site vicinity today; may occur in more protected habitats on the island.
Tsuga cf. *heterophylla* (Raf.) Sarg.[2] (western hemlock)	3 (3)	5 (17)	2 (7)	common tree of coastal forests; common in site vicinity today.
Tsuga/Chamaecyparis	14 (16)	2 (7)	3 (10)	—
Unidentified conifer	7 (8)	—	2 (7)	—
Deciduous Trees				
Alnus cf. *crispa*[2] (Regel) Rydb. (Sitka alder)	3 (3)	—	—	common along shorelines of southeast Alaska and near site today.
Pyrus fusca Raf. (Pacific crabapple)	1 (1)	—	—	grows in mixed and pure thickets or as a slow-growing small tree in low to mid elevations of southeast Alaska. None observed in the site vicinity today.
Salix spp. (willow)	1 (1)	—	—	several species of willow grow on the outer islands of southeast Alaska; in site vicinity today.
Unidentified deciduous	1 (1)	—	—	—

[1] C = charred, UC W = uncharred stemwood; UC B/R = uncharred branch/root. For charcoal, N = 90 (15 identified specimens from each of the five flotation samples and the one ¼-inch screen sample). For uncharred wood, N = 30 (15 specimens from each of the stemwood and branch/root specimens recovered from ¼-inch screen sample).

[2] Species identifications of these genera are based on phytogeography rather than minute anatomy.

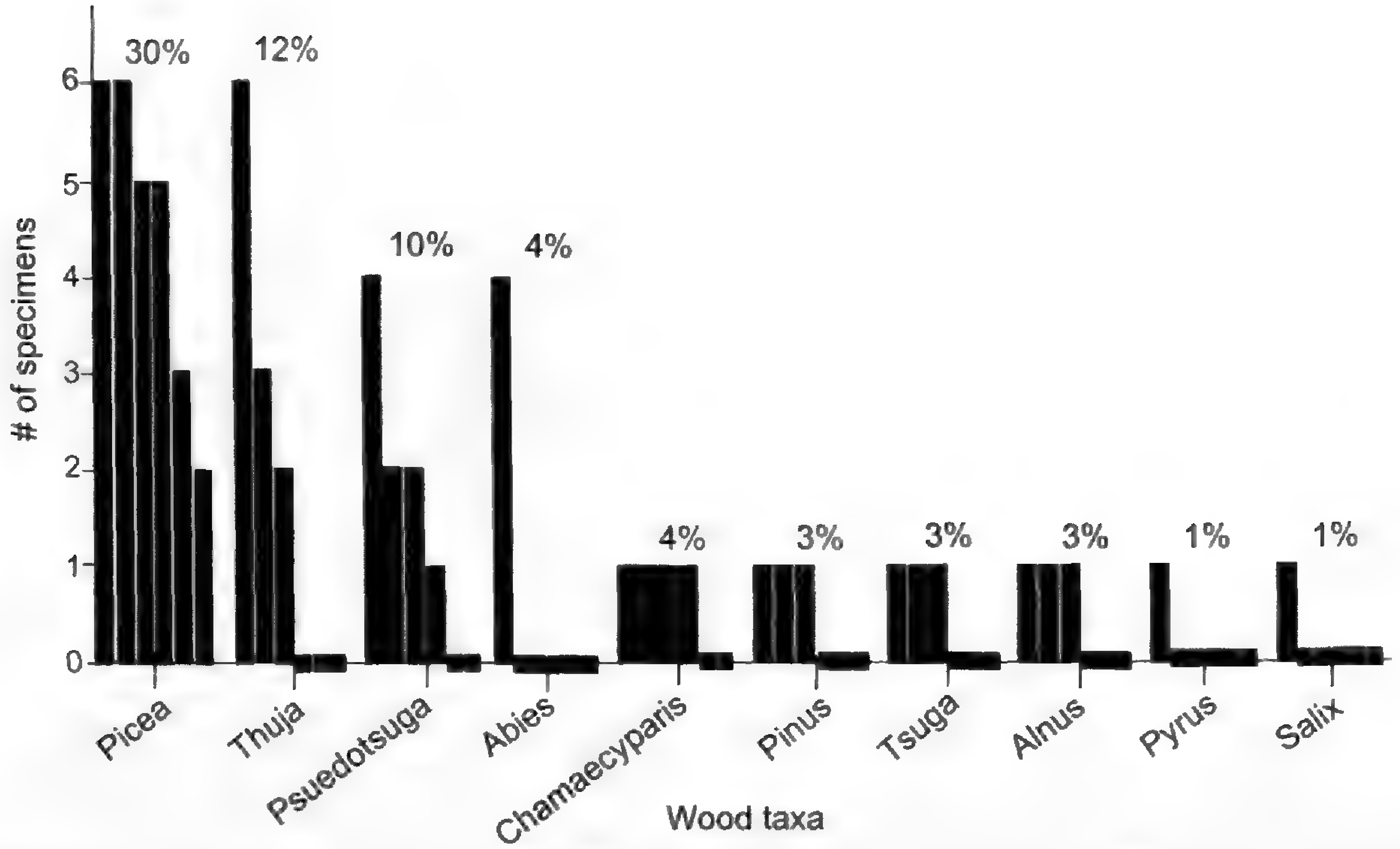

FIGURE 2.—The number of times different charcoal taxa were identified in each of six samples (15 identifications per sample). For each taxon, each bar represents one sample. The numbers on top of the bars represent the average percent abundance for that taxon. Only secure identifications are illustrated, but unidentifiable specimens are included in the calculations of percent abundance.

Figure 2). This may be because unlike spruce, hemlock was not a preferred fuel wood among many Northwest Coast groups (Turner 1998).

In contrast, Douglas-fir does not grow locally, yet is common in the archaeobotanical record. The northern limit of Douglas-fir habitat occurs at about 53° north latitude in central British Columbia, almost 380 km to the south of Noyes Island (Figure 1; Pojar and MacKinnon 1994:17). Distributions of Douglas-fir varied in the past, but never extended north of British Columbia's central coast (Mathewes and Rouse 1975; Hebda 1995; Hebda and Whitlock 1997).

The Douglas-fir wood in the 49-CRG-188 assemblage was undoubtedly collected as drift from Noyes Island beaches. Although it is possible that the Cape Addington Rockshelter occupants travelled south to harvest Douglas-fir or that they received it through trade, both these scenarios seem unlikely, especially given that the archaeological site was not occupied year-round. The Davidson Current, which regularly transports drift from southern California northward along the Alaska coast during the winter (Thomson 1981:231) likely transported the Douglas-fir wood to beaches in the site vicinity.[2]

Other taxa within the archaeobotanical assemblage also may have been collected as driftwood, but this is more difficult to demonstrate based on plant geography. In particular, the abundance of redcedar in the archaeobotanical assemblage is greater than its apparent abundance in the local forest (Table 2). Although we cannot rule out the possibility that site inhabitants went to some effort to transport redcedar back to the rockshelter from elsewhere on the island, or from another island, a more plausible scenario is that they harvested the wood as drift from the beach in front of the rockshelter.

While we cannot quantify how much of the total wood used at the rockshelter was collected as driftwood, it appears to be significant. Conservatively, based on Douglas-fir alone, driftwood accounts for 8% of the charred and uncharred wood recovered at Cape Addington (n = 120). If redcedar is included in the total, at least 18% of the total assemblage may have originated from drift (Table 2). The actual contribution of driftwood could be much higher.

The relative abundance of Douglas-fir and redcedar in the archaeobotanical assemblage suggests that the site inhabitants deliberately selected these woods from among the drift. Although we cannot quantify how common Douglas-fir and redcedar were in the ancient driftwood population, we expect that hemlock was at least as available as the other two species. Yet, whereas hemlock was not collected in abundance as a fuel wood, Douglas-fir and redcedar were clearly sought after. In the case of Douglas-fir, it was only found charred in the deposits (Table 2), suggesting it was selected only for fuel, and not for other purposes.

DRIFTWOOD USE ON THE NORTH PACIFIC COAST

Even though few North Pacific ethnographers discuss the use of woods much at all, our literature review indicates that groups throughout the region relied on driftwood for fuel and technology (Table 3; Figure 1). For the Makah and Kwakwa'ka'wakw, for example, driftwood was the most common source of fuel, while only occasional use is mentioned for other groups. For some groups, access to driftwood meant a supply of valued woods that were not locally available or sufficiently abundant, and could otherwise be acquired only through trade. Such was the case of redcedar among the Alutiiq (Wennerens 1985:59) and Makah (Singh 1966:27), and redcedar and yellow-cedar among the Yakutat Tlingit (de Laguna 1972:43; Drucker 1955:61). Several sources mention preferred uses for particular taxa of drift, indicating that driftwood, like wood found in the forest, was selectively harvested for specific uses.

The ethnographic sources are relatively silent as to specifically who collected driftwood. Slaves and other lower class people were often employed to gather firewood in general (Boas 1935 [1969]:7; Jewitt 1974:96; Oberg 1973:79; Ruyle 1973: 611; Singh 1966:54; Suttles 1987:5), which likely included driftwood as well as wood from the forest. Only Drucker (1951:107) had more specific observations about the harvesting of driftwood. He noted, "[b]oth [Nuu-chah-nulth] men and women got wood, although women's wood gathering consisted chiefly of picking up small driftwood along the beaches. Men got 'big wood'—big lengths of driftwood. . . ."

There is some indication that driftwood was a resource that could be claimed and owned. This is clearly illustrated in the case of a large spruce log that drifted ashore in Nitinaht territory in 1930s that was immediately claimed, and then cut up for firewood (Turner et al. 1983:fig. 16). Since slaves belonged to titleholders or to the households of titleholders (Donald 1997), and slaves often collected firewood, we surmise that driftwood collected for fuel was considered the private property of an individual or the common property of a household. Some southern

TABLE 3.—Aboriginal use of driftwood on the North Pacific Coast.[1]

Group	Use of driftwood	Reference
Puyallup-Nisqually	Driftwood piled to make screen to direct heat from cooking fires on beach	Smith 1940:286
Twana	"Bark was a favored winter fuel, but any kind of wood, including beach drift, was so used"	Elmendorf and Kroeber 1992:220
Makah	Drift logs were split into boards or made into canoes	Swan 1868:4
Quileute and Makah	Driftwood was the principal source of firewood; redcedar drift logs were used for canoes, especially by the Makah	Singh 1966:23
Nitinaht	Drift logs were owned and cut up for firewood; *P. sitchensis* drift for fuel	Turner et al. 1983:fig. 16
Nuu-chah-nulth	Drift was collected for fuel	Drucker 1951:107; Arima 1983:62
Nuu-chah-nulth	Bamboo sometimes drifted ashore	N.J. Turner[2]
Kwakwaka'wakw	Drift logs for firewood	Wolcott 1967:23; Rohner and Rohner 1970:19
Kwakwaka'wakw	Drift logs were most common source of fuel; soft driftwood used as hearth with fire drill	Boas 1909:407
Kwakwaka'wakw	Driftwood was used to process elderberries and to singe the hair off harbor seals	Boas 1921:256, 451.
Haida	*P. menziesii*, *Acer*, *Betula*, and other woods sometimes collected as drift	N.J. Turner[2]
Northern and Kaigani Haida	Drift logs were lashed together to make rafts to migrate to Alaska	Blackman 1981:75
Haida	Drift logs used for pyre to cremate dead	Swan 1876:9
Haida	Driftwood used for fire on beach to process spruce roots	Blackman 1980:85
Yakutat Tlingit	*Thuja* and *Chamaecyparis* found as drift	de Laguna 1972:413
Chugach Alutiiq	*Thuja* available at Nuchek only as drift; it was available year round on the beaches of Prince William Sound, used for paddles, quivers; yellow-cedar sought after on Lower Kenai Peninsula	Wennerens 1985:59, 78
Chugach Alutiiq	Driftwood, small trees, and broken pieces of wood were preferred over standing trees *Thuja* available only as drift; when found, people cut, packed, and shared the wood; *Tsuga* spp. harvested only as drift, though locally available. Paddles and dugout canoes made from *Tsuga* and *Thuja* drift. *Populus trichocarpa* driftwood used to heat homes and steambaths; preferred for smoking fish	Russell 1991b: 6, 19, 20, 21

TABLE 3.—Continued.

Group	Use of driftwood	Reference
Dena'ina	Driftwood and windfalls were sought after for firewood; *Thuja* collected as driftwood	Kari 1987:15, 39
Dena'ina	Fire drills made of *Thuja* drift	Osgood 1966:108
Dena'ina, Aleut	*Populus trichocarpa* drift preferred for smoking fish because is "clean", without sap, contains salt, and slow-burning; for steambath switches, whittling *Thuja* and *Chamaecyparis* used as building material due to resistance to rot; dugout boats for children. Driftwood used as poles for fish drying racks	Russell 1991a: 9, 12, 13

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[1] The aboriginal groups are ordered from south to north along the coast. See Figure 1 for locations of groups.

[2] Dr. Nancy J. Turner, ethnobotanist, University of Victoria, email correspondence with D. Lepofsky, 1999.

Northwest Coast peoples divided beaches into family-owned territories to claim ownership of beached whales (e.g., Hajda 1990), and it is possible that driftwood was also incorporated into this system of ownership.

At the north end of the Pacific Coast, where forest wood is a much scarcer commodity, several groups developed systems of ownership of driftwood. For instance, among the Alutiiq, when redcedar drift was found it was cut up and shared (Russell 1991b:19), and among the Koniag of Kodiak Island, ownership of driftwood was often claimed while the logs were still out at sea (Adams 1998). Among the Aleuts of the Aleutian Islands, wars were started when driftwood was taken from another village's territory (Veniaminov 1984, cited in Hoffman 1999:159), and an excavation of an Aleut village suggests that driftwood was shared within a household group (Hoffman 1999:159). The people of Nunivak Island marked ownership of piled driftwood by placing a large log in an upright position in the pile (Fienup-Riordan 2000:62).

DISCUSSION

From the time of initial colonization of the North Pacific Coast, driftwood probably has been an important source of wood for people of the region (Ames and Maschner 1999:61). Not only was driftwood a readily accessible and renewable source of wood, but it also provided preferred taxa that would not otherwise have been available except through trade. Both the Cape Addington Rockshelter case study and our review of the ethnographic record indicate that North Pacific Coast peoples selectively harvested driftwood for particular purposes. Like living trees or dead wood found in a resource territory, driftwood was integrated into a system of ownership and management typical of other valued resources, by at least some groups.

Although we cannot determine the amount of driftwood available on Pacific Coast beaches prior to industrial logging, early accounts indicate that driftwood was plentiful. For instance, in 1777, when Captain Cook arrived to Nootka Sound on the west coast of Vancouver Island, he was pleased that many drift logs of all shapes and sizes were available to repair various parts of the *Resolution* (Gough 1978:10). Similarly, Dorsey (1898:5), travelling in Dixon Entrance in the late 1800s, commented that many beaches were "piled high with drift, often to a height of sixty feet or more." Likewise, early photographs of the coast (e.g., Curtis's 1912 photograph of "[t]he mouth of the Quinault River") also show abundant driftwood on the beaches (Curtis 1913).

Despite the overall availability of driftwood on the coast, not all people would have had equal access to this valuable resource. Because of the subtleties of local ocean currents, only certain beaches accumulate drift.[3] Undoubtedly, North Pacific Coast peoples had knowledge of beaches where drift tended to accumulate and these were valuable locations for collecting wood. Even though we cannot reconstruct the relative abundance of species that were available as driftwood prior to industrial logging, current patterns of deposition of drift on beaches should reflect the overall spatial availability of driftwood in the past.

In addition to the availability of drift on local beaches, the role of driftwood to any individual group was undoubtedly influenced by regional variation in forest species composition and overall forest productivity. Importantly, the number of tree species declines northward along the coast (Alaback 1996), and the distribution of highly valued species such as Douglas-fir, redcedar, and yellow-cedar becomes increasingly restricted towards the northern ends of their geographic ranges (Figure 1; Pojar and MacKinnon 1994). Where redcedar and yellow-cedar do grow in Alaska, they often are small and stunted (Pojar and MacKinnon 1994:17), and thus are unsuitable for canoes or large structures. In the northernmost part of the region (north of 58° north latitude), forests not only contain fewer tree species in general, but less of the landscape is forested, and those forests are less productive overall (Alaback and Pojar 1997). Based on these vegetation patterns, it seems quite clear that driftwood was more important to people on the extreme northern part of the North Pacific Coast. However, the ethnographic data suggest that geographical variation alone does not account for the relative role of driftwood among North Pacific Coast groups (Table 3).

A final factor in determining the importance of driftwood was settlement type. Large, long-term, permanent settlements would have placed especially high demands on local forests, both for fuel and technological needs. This is clearly illustrated for the Makah, Nuu-chah-nulth, and Kwakwaka'wakw, who are located in some of the most productive coastal forests, yet according to the ethnographic record, driftwood was their principal source of fuel (Table 3). Driftwood may also have played a relatively more important role in some small and/or low-status settlements since these communities are less likely to be associated with the well-developed regional trade systems that supplied non-local woods.

The North Pacific Coast is not unique in northwestern North America with respect to the value of driftwood. Further north in the Western Arctic, where the landscape is sparsely treed or treeless, and the cold winters result in especially heavy demands on fuel, the importance of driftwood permeates the religious, social, and economic systems of most groups (Adams 1998; Barker 1993; Fienup-Riordan 1996, 2000; Oswalt 1957:26). To the east, Plateau groups located their villages and camps along floodplains that accumulated drift, and used the wood both for fuel and for special technological purposes (Miller 1998:258; Rhode 1986; Smith 2000:7.8; Stenholm 1985; Teit 1930:223).

Recognizing the value of driftwood has important implications for our understanding of how people of the North Pacific Coast negotiated resource diversity across the landscape. Even in a heavily forested region, an archaeologist cannot assume that charcoal represented in an archaeobotanical assemblage represents locally growing tree species. North Pacific Coast peoples clearly identified and understood the different properties of various wood taxa, even in the form of drift. Identifying charred remains to genus or species should become a routine archaeological practice, especially for wood samples from coastal sites submitted for radiocarbon dating. Samples of driftwood may be particularly susceptible to the "old wood," or inbuilt age problem, and the magnitude of this effect can be species specific (Gavin 2001; Schiffer 1986).

NOTES

[1] For the purpose of this paper, we define the North Pacific Coast as the region extending from Cook Inlet to the Oregon–California border.

[2] Dr. Curt Ebbesmeyer, Oceanographer, Evans-Hamilton; email correspondence with D. Lepofsky, 1999.

[3] Dr. Curt Ebbesmeyer, Oceanographer, Evans-Hamilton; email correspondence with D. Lepofsky, 1999.

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WOOD REMAINS FROM ANDEAN ARGENTINA: THE USE OF *Prosopis* SP. L. IN HUT CONSTRUCTION

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ABSTRACT.—A desiccated fragmented wooden post, part of the structure of a hut, from the archaeological site of Carrizal de Azampay, Department of Belén, Province of Catamarca, Argentina, was identified and interpreted. The material was broken manually for the analysis. Transverse, radial, and tangential sections were examined with a stereoscopic and incident light microscope and SEM. The remains were identified as either *Prosopis flexuosa* DC or *P. chilensis* (Mol.) L. Stuntz, both of which are common species in the study area. This paper confirms the prehistoric use of this genus in construction and analyzes the function of the post as a part of the hut structure. In addition, recent changes in the utilization of both cultivated and native tree species are discussed.

Key words: Andean region, Argentina, archaeological wood, *Prosopis.*

RESUMEN.—El presente trabajo se basa en la identificación e interpretación de un poste de madera, fragmentado y desecado, perteneciente a la estructura de una vivienda, procedente del sitio arqueológico Carrizal de Azampay localizado en el actual Departamento de Belén, Provincia de Catamarca, Argentina. El material fue fracturado manualmente en laboratorio. Se examinaron las secciones transversal, longitudinal tangencial y longitudinal radial del mismo con Microscopio Estereoscópico, de Luz Incidente y Electrónico de Barrido. Los fragmentos fueron identificados como *Prosopis flexuosa* DC o bien *Prosopis chilensis* (Mol.) L. Stuntz, especies comunes en el área de estudio. El trabajo confirma el uso prehistórico de *Prosopis* como recurso maderero y analiza la función del poste dentro de la estructura de la vivienda. Asimismo se discuten, a partir de observaciones etnográficas, procesos modernos de cambio en el modo de uso de este recurso a partir de la incorporación de especies cultivadas.

RÉSUMÉ.—Ce rapport analyse et interprète un fragment desseché de pieu provenant de la structure d'une hutte et trouvé sur le site archéologique de Carrizal de Azampay, département de Belén, province de Catamarca, Argentine. Les morceaux de bois ont été brisés à la main pour l'analyse. Les sections transversales, radiales, et tangentielles ont été examinées aux trois microscopes suivants: stéréoscopique, à lumière incidente, et éléctronique à balayage. Nous avançons deux hypothèses pour l'identification de l'espèce de bois: il s'agit ou bien du *Prosopis flexuosa* DC. ou bien du *P. chilensis* (Mol.) L. Stuntz. Ces deux espèces d'arbres sont communes dans la région. Cette étude confirme l'utilisation préhistorique de ce genre pour la construction et analyse la fonction du pieu dans la structure de la hutte. Cet article aborde également les récents changements survenus dans l'utilisation d'espèces d'arbres cultivées et indigènes.

INTRODUCTION

The interpretation of wood remains from archaeological sites is important for understanding past plant uses and plant-human evolutionary processes (see Smart and Hoffman 1988), as well as for understanding mechanisms of prehistoric deforestation (Willcox 1974). In Argentina, studies of archaeological wood are rare; however, they are increasing (see for example Garibotti 1998; Heyne 1992; Rodríguez 2000; Roig and Bárcena 1997).

The main goal of this work is the identification and interpretation of a fragmented desiccated wooden post from the archaeological site of Carrizal de Azampay (27°19′ south latitude and 67°02′ west longitude) and the discussion of the changes resulting from the introduction of some exotic woody species in the area.

Regional Setting.—The site of Carrizal de Azampay is located a few kilometers from the modern village of Azampay, in the Department of Belén, Province of Catamarca, Argentina, at an elevation of 2000 m asl. The region is semiarid and the climate subtropical. The mean annual temperature is 18°C, with a range between about 9° and 25°C. The average annual precipitation is about 300 mm, with rainfall occurring mainly in summer. Phytogeographically, the area belongs to the Monte Province, Chaqueño Domain, Neotropical Region (Morlans 1985). The main plant communities are: 1) shrub steppes of *Larrea cuneifolia* Cav., *Plectrocarpa rougessii* Desc. O' Don. et Lourt., *P. tetracantha* Gillies ex Hook & Arn, *Bulnesia schickendantzii* Hieron. ex Griseb. and *Senna rigida* (Hieron.) H. S. Irwin & Barneby, among others, on alluvial terraces and colluvial piedmonts found up to an approximate elevation of 2200 m asl; 2) isolated stretches of open forests of *Prosopis flexuosa, Prosopis chilensis* and *Bulnesia retama* (G. ex H) Griseb. along riverbanks and wetter areas; and 3) grasslands above 2200 m asl.

Unfortunately, there is no paleoclimatic record available for this area. From data related to periglacial sedimentological features in Patagonia, Mercer (1976) concluded that three glacial advances had occurred during an interval of neoglacial cooling which spanned the last 5000 years. The first one occurred between 4700 and 4200 B.P., the second, between 2700 and 2000 B.P. and the third one, the Little Ice Age, over the last three centuries. It is important to note that such neoglacial fluctuation has been confirmed elsewhere in the Andes and in the northern hemisphere (Schubert and Clapperton, in Rabassa and Clapperton 1990). As Prentice (1992) noted, however, even when pollen profiles from different areas record the same climatic fluctuation, differences in timing of the event could result from geographic variation (such as elevation and slope aspect), the sensitivity of a particular plant community to climate changes, or variations in the intensity and duration of the climate event. Therefore, it is difficult to hypothesize about Monte vegetation fluctuation from these data. However, the authors agree with D'Antoni (1976), who has proposed for the Gruta del Indio, Province of Mendoza, a warm and dry period between the years 5500 and 3000 B.P., based on pollen analysis.

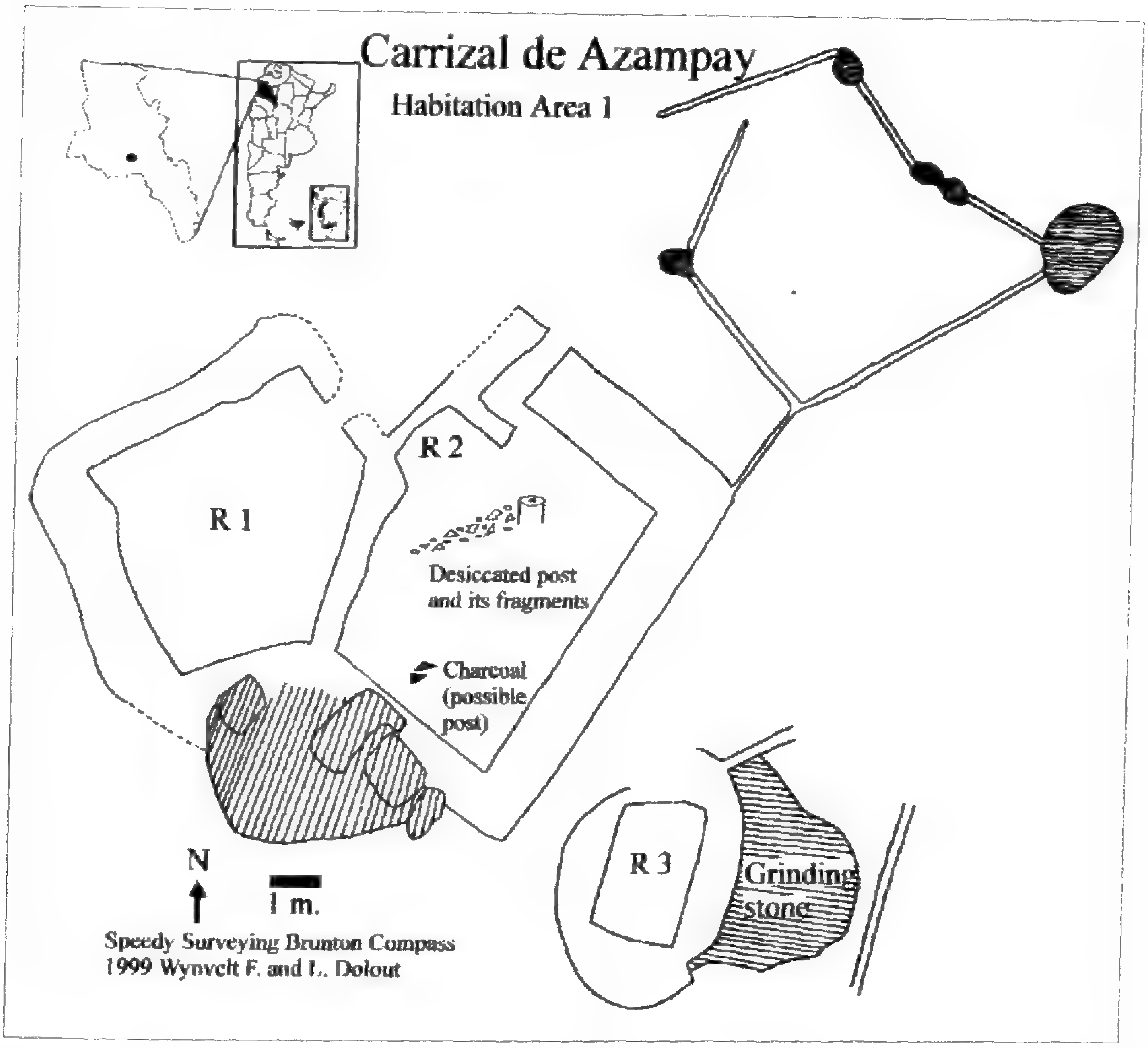

FIGURE 1.—Geographical location and plan of the site at Carrizal de Azampay showing the location of the post remains.

During this period the Monte Phytogeographic Province would have reached its maximum size. Then, between the years 3000 and 2000 B.P., the climate became cold and wet, causing the spatial reduction of the Monte to its present distribution. The climate after 2000 B.P. became similar to that of the present day, and human activities began to have an impact on the landscape.

The Site and the Archaeological Context.—Ongoing archaeological research is being carried out at two closely related sites 3 km apart, Carrizal de Azampay and Loma de los Antiguos. Carrizal de Azampay, in particular, has three habitation areas vertically distributed along the south-facing piedmont of the Quebrada El Carrizal. Ancient artificial cultivation terraces are associated with each of these areas. It is thought that this settlement pattern supported extended families of farmers of the Belén culture during the Regional Developing Period (A.D. 1000–1500) (Balesta and Zagorodny 1999:271; Sempé 1999:250; Zagorodny and Balesta 2000).

Habitation Area 1 has two rectangular rooms (R1 and R2) and a communal stone for grinding (R3) (Figure 1). Radiocarbon dating of charcoal from R1 has yielded a date of 310 ± 60 ^{14}C years B.P.—1σ calibrated date range from A.D. 1487 to 1657. Based on the recovered archaeological remains, however, especially the ceramics, it is thought that A.D. 1487 is the date that best fits this site.

A desiccated preserved wooden post was found in R2 during the fieldwork directed by Dr. M. C. Sempé in 1981. The non-fragmented portion of the post was 35 cm long in all—20 cm above the occupation floor of the room and 15 cm sunk vertically into the occupation floor. The occupation floor was encountered at a depth ranging between 70 and 90 cm under the modern surface. The post was in a standing position directly on the bedrock of the hill, supported by two large granite stones. It was located 4.20 m from the southern wall of the room, 2.85 m from the northern, 2.4 m from the western and 2.0 m from the eastern. Since many fragments of the post were found longitudinally spread along a two-meter line away from its base to the southwest (see Figure 1) at the same depth of the occupation floor, it seems that the post fell down during—or a few years after—occupation, and that it gradually decayed over the past 500 years. This post, estimated to have been at least 2.35 m long, is thought by Zagorodny and Balesta (2000) to have supported the roof.

Traditional Use of Construction Resources.—Although in Azampay and surrounding areas the exotic genus *Populus* sp. L. (*álamo,* poplar) is nowadays commonly used for house construction—specifically for roof trusses and beams—the native species most frequently used are similar to those recorded at the nearby village of El Shincal by Capparelli and Raffino (1997): *Prosopis chilensis* and *P. flexuosa* (*el árbol*), *Zuccagnia punctata* Cav. (*pupo*), *Porlieria microphylla* (Baill.) Desc. O'Don. et. Lourt. (*chucupi*), *Lithraea molleoides* (Vell.) Engl. (*molle córdoba*) and *Acacia visco* Lor. Ap Gris. (*visco*). It was expected that the post analyzed here would belong to one of these taxa.

Today, traditional houses are constructed in one of two ways. Adobe or stone walls may be built first, and the roof is then supported by them. The roof is generally single pitch, constructed in successive layers as follows: 1) beams, which could be made from tree or cactus trunks, 2) twigs or canes, 3) grass, 4) and a beaten surface made from mud and water. The second type of house involves erecting a wooden structure first, built by means of posts and beams (see Figure 2a). This structure supports the roof. Finally, the walls made of adobe, stones or twigs are built (see Figure 2b, c, and d respectively).

MATERIALS AND METHODS

The intact portion of the post and the dispersed fragments were recovered manually and were stored for twenty years at the Archaeological Scientific Department of the Museum of La Plata. It was evident that even before excavation the post had begun to decay, as seen by intrusive roots in vessels and evidence of fungal attack. After being stored for twenty years in the humid city of La Plata, the post had become highly fragmented and labile, crumbling when cut. The weight of the sample was 177 g, of which 120 g correspond to fragments larger than 1 × 1 × 3 cm (one 4.5 cm wide × 3.5 cm thick × 7 cm long; twelve about 3 × 2 × 4 cm; twelve about 1.5 × 1.5 × 4 cm; thirty about 1 × 1 × 3 cm) (see Figure 3a), while the other 57 g correspond to a great number of minute fragments.

Three planes (transverse, radial, and tangential) of the best preserved frag-

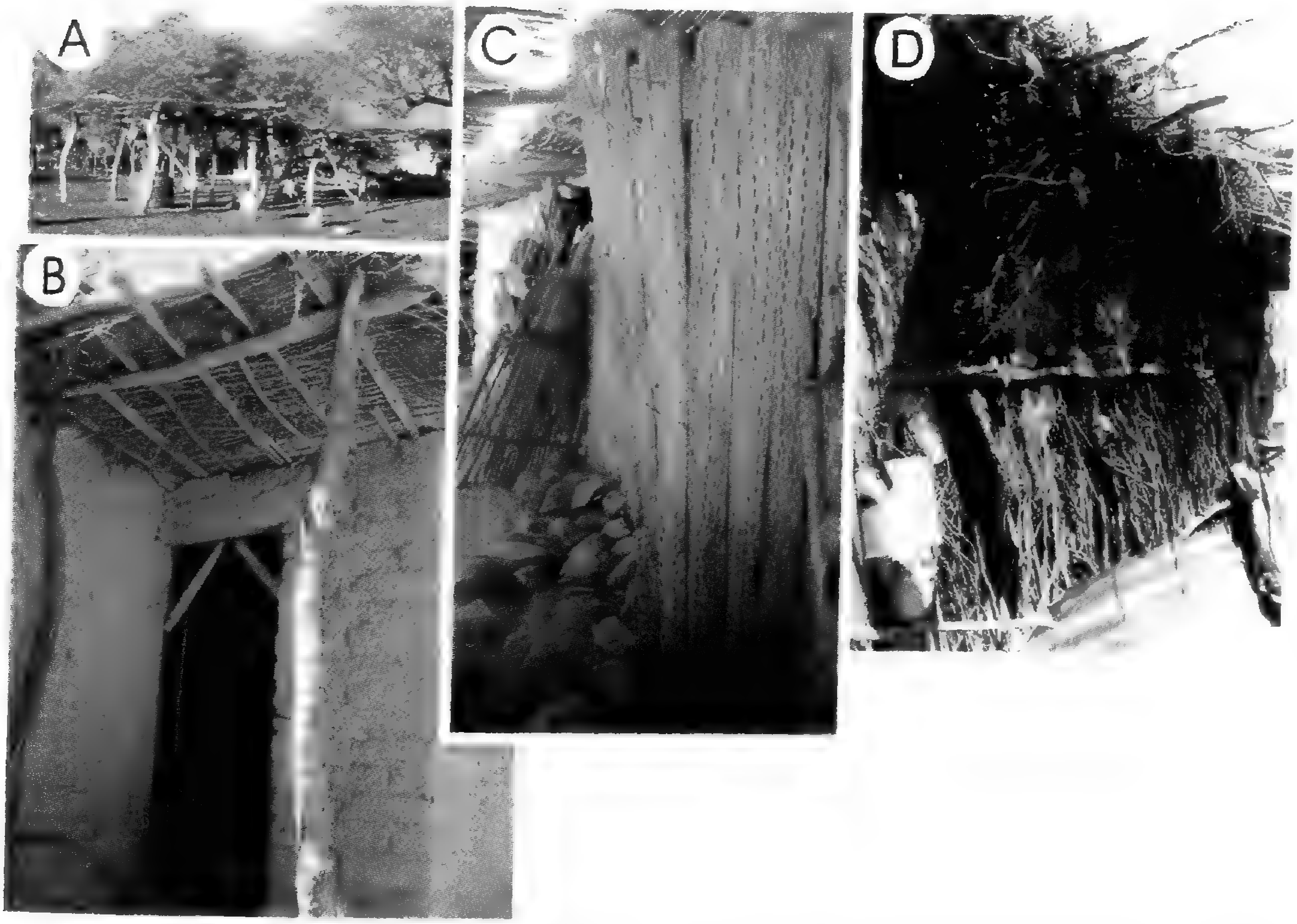

FIGURE 2.—A traditional house at the Hualfin Valley. Different types of construction could be observed at the same habitation area for an extended family: a) wooden structures for shading and drying *Prosopis* fruits; b) adobe bath room; c) stone room; d) twig kitchen.

ments were obtained by manual fracture. The fragments were initially examined under a stereoscopic microscope (Iroscope Mod. M2-14T No. 962329), and for more detail a reflected light microscope (Union ME-3206) was used. One fragment was prepared for SEM examination in a Joel SEM JSM T100. This specimen was mounted on metal stubs with synthetic cement, and then coated with gold. Wood features were photographed at magnifications ranging from 35× to 5000×, according to the amount of structural detail required. Quantitative and qualitative features were described using the "IAWA List of Microscope Features for Hardwood Identification" (IAWA 1989). The quantitative values represent an average of 25 measures, except vessels/mm^2 and rays/mm^2 that represent an average of 5 microscope fields at 4×. In all cases the mean is followed of maximum and minimum values between parentheses.

The number of annual rings of the largest fragment was recorded, and the diameter of the original trunk was estimated from the circumference of its most external ring, following the methodology proposed by Applequist (1958).

Finally, archaeological wood was compared with modern material from the study area in Capparelli's personal comparative collection. Voucher specimens have been deposited for curation in the herbarium of the Scientific Department of Vascular Plants of the Museum of La Plata (LP). Tangential, transverse and radial planes from 1-cm wide slides of air-dried reference material, without previous treatment, were obtained by the use of a microtome.

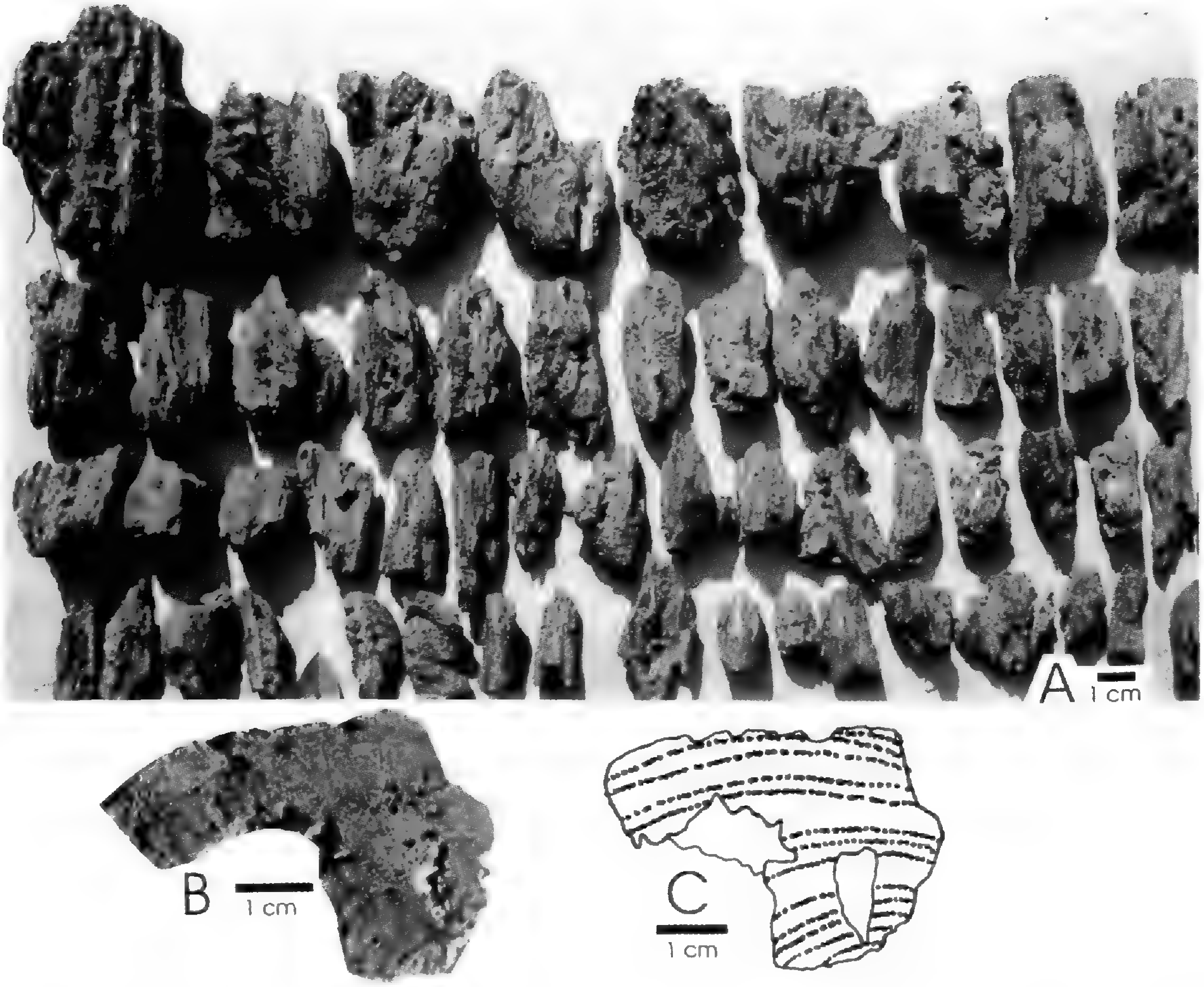

FIGURE 3.—a) General aspect of the best preserved fragments recovered; b) transverse section of the largest fragment where annual rings are evident; c) transverse section diagram showing the 13 annual rings counted.

RESULTS

Identification.—Prosopis sp. (Section Algarobia, Serie Chilenses). Due to geographical distribution of tree species of this genus, it is thought that the post could have been made from either *Prosopis flexuosa* DC or *P. chilensis* (Mol.) Stuntz.

Voucher Specimens.—Capparelli 7 (Herbarium of the Scientific Department of Vascular Plants of the Museum of La Plata: LP) and Capparelli 6 (LP) respectively.

Reference Literature.—Wood anatomic descriptions of these species were published by Cozzo (1951) and Castro (1994).

Wood Description.—Due to the fragmentation and poor preservation of the material it was impossible to decide whether or not it had had some processing before use, such as the sharpening of one of the ends for burying or the removal of its bark. The diameter of the original trunk was estimated to have been equal to or larger than 19 cm. The number of annual rings of the largest fragment was 13 (Figure 3b and c). The color of the wood was brown.

Transverse section (Figure 4a). Growth ring boundaries distinct. Wood semi-ring-porous. Vessels mostly solitary (64%) and in radial multiples of two (20%), commonly more frequent in early wood. Vessels in radial multiples of three or four scarce (4% and 8% respectively) and more frequent in late wood. Tangential diameter of vessel lumina 87 μ (29–194 μ), and density 35 vessels/mm^2 (32–44 vessels/mm^2). Thin- to thick-walled polygonal outline fibers (lumina/double wall thickness index = 2.4 μ). Diameter of fiber lumina 8.2 μ (4.2–12.7 μ). Mean fiber length 248 μ (85.1–364.1 μ). Axial parenchyma abundant, confluent paratracheal and in bands (30 to 54 cells wide). Straight rays with a frequency of 6 rays/mm (5–6 rays/mm).

Tangential section (Figure 4b). Rays 1- to 8-seriate, more common 5-seriate, and ray width 42.3 μ (16.3–88.4 μ). Ray height 24 cells (8–50 cells) and 265.8 μ (119–460.6 μ). Aggregate rays present occasionally. Vessels extending vertically or partially sinuous. Mean vessel element length 140 μ (96.6–185.3 μ). Simple fiber pits. Fusiform parenchyma cells present as well as 2 or 3 cells per parenchyma strand. Prismatic crystals in chambered axial parenchyma cells. One crystal per chamber.

Radial section (Figure 4c). All ray cells procumbent. Simple perforation plates, oblique in narrower vessels and horizontal in larger vessels. Alternate intervessel pits. Size of pits 5 μ (3–6 μ). Vestured pits and vessel wall (Figure 4d).

Finally, Figure 5a–d shows transverse, tangential and radial views of *Prosopis flexuosa* and a detail of the vessel inner wall for reference, and Figure 5e–h shows the same sections for *Prosopis chilensis.*

DISCUSSION AND CONCLUSIONS

As described by Pochettino (1985:206), several findings of pods and seeds of *Prosopis* from archaeological sites of northwestern Argentina have demonstrated that this genus has been an important food resource from 4000 B.P. to the present, even in cases where agriculture was the main subsistence activity. However, the literature mentioning the importance of *Prosopis* wood as a construction resource in the past is sparse (see for example the compilation made by Raffino 1990:172–174). The present work not only confirms its past use as a resource for wooden structures, but also allows us to infer the past presence of this genus in the study area. According to the present-day distribution of plant communities, *Prosopis* could have been collected either from the riverbank communities of narrow valleys adjacent to the site or from the open forests surrounding the village of La Ciénaga, 10 km from Carrizal de Azampay.

Modern studies of tree rings, growth rates and age-size relationships of *Prosopis flexuosa* in central-west Argentina (Martijena et al. 1988; Perpiñal et al. 1995; Villagra et al. 2002) allow us to calculate the values of different related variables, such as diameter of the trunk, age, height, and commercial value of an individual tree. The estimated age for an individual of 19 cm diameter would be, for example, 40 years, while its height would be approximately 4.8 m. Unfortunately, micro-regional climatic and ecological features affect growth rates of this genus. Therefore, extrapolation of data from other regions might not be valid. On the other hand, data coming from the nearby village of El Shincal show that in open forests both *Prosopis flexuosa* and *P. chilensis* can reach a height of 5–7 m, while *P. chilensis* of the closed-canopy riverbank forests (less frequent and further away from the

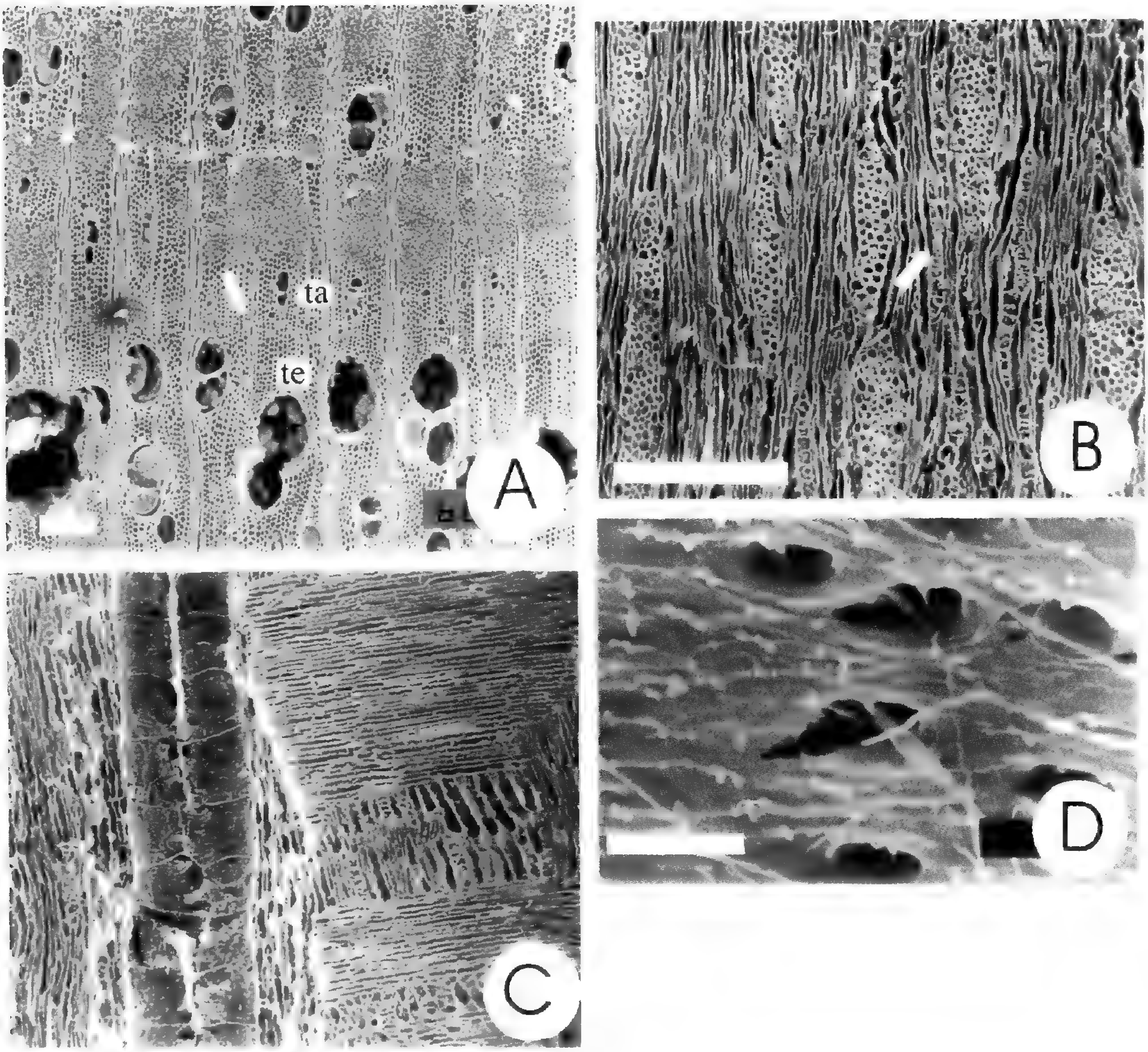

FIGURE 4.—Archaeological *Prosopis* sp. (SEM): a) transverse section (TS) showing the border of an annual ring (arrow), early wood (te) and late wood (ta), semi-ring porosity, axial paratracheal parenchyma confluent to bands, and deposits in vessels; b) tangential longitudinal section (TLS) showing uni- to multiseriate rays and crystals (arrow); c) radial longitudinal section (RLS) showing all cells procumbent in rays; d) detail of the vestured layer of the inner vessel wall and pits. Scale (white bars): a–c, 200 μ; d, 5 μ.

site than the open forest) reaches a height of 9–10 m. The most useful length for posts of this species is 2 to 3 m, because at this height the main trunk usually branches into two or more limbs. Posts are usually cut so that a short length of the branched end remains, to better support the beam. In addition, *Prosopis* is a hard and durable wood (even under water) due to its high tannin content (Castro 1994:13). These advantages are well known to modern local people, and surely were also known to inhabitants in the past.

Judging from the location where it was recovered, the post seems to have been one of the supports of a longitudinal beam. A second post may have been located where some big fragments of charcoal were recorded—but unfortunately not recovered—by Sempé during excavation (see Figure 1). It is not known which species was used for beams. It might have been difficult, however, to find a 7-m

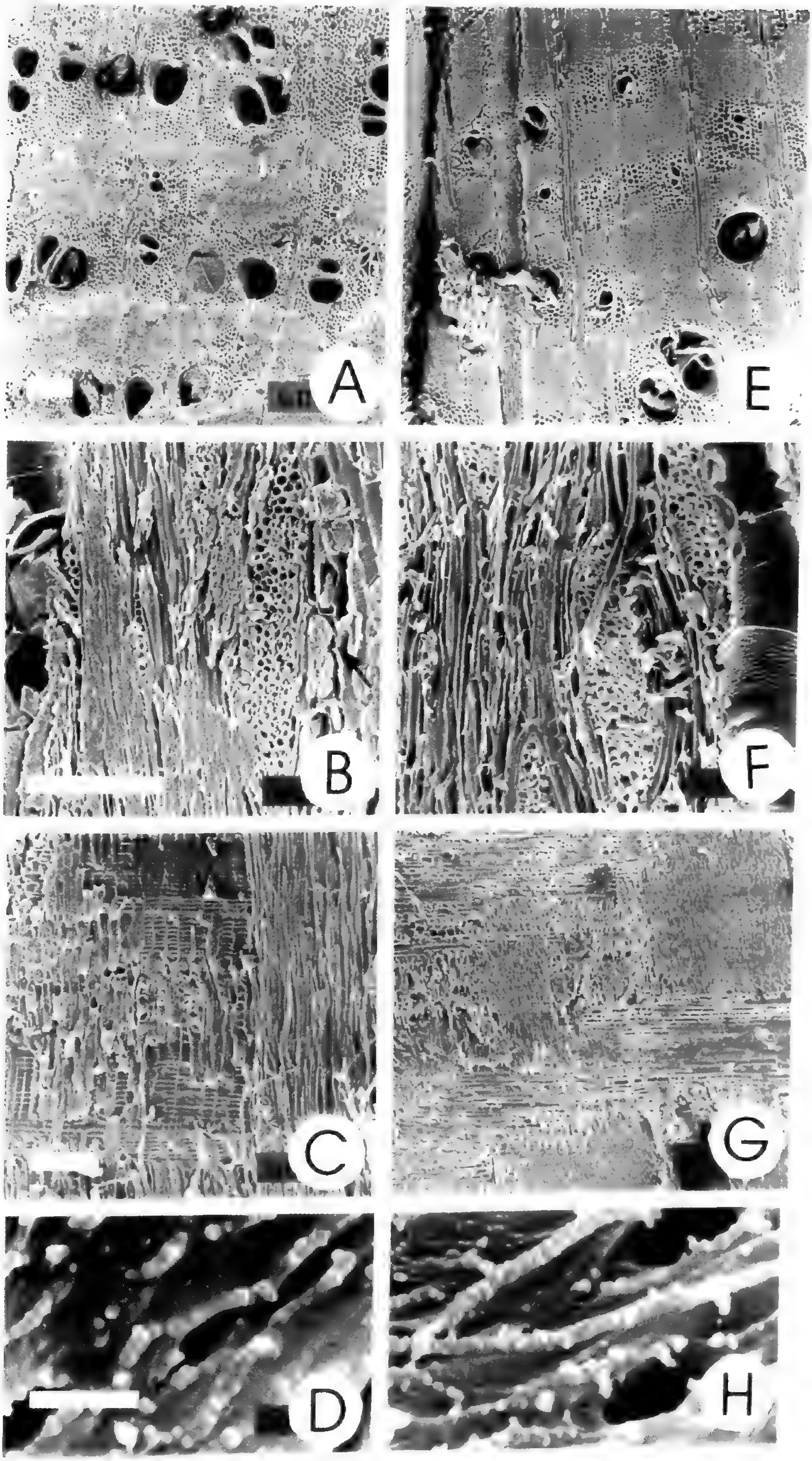

FIGURE 5.—Reference samples: a–d) *Prosopis flexuosa* DC; e–h) *Prosopis chilensis* (Mol.) Stuntz. a) TS; b) TLS showing crystals (arrow); c) RLS; d) detail of the vestured layer of the vessel wall; e) TS; f) TLS; g) RLS; h) detail of the vestured layer of the vessel wall. Scale (white bars): a–c and e–g, 200 μ; d and h, 5 μ.

long trunk for spanning the entire length of the room, but two posts could have supported two 3.5-m long trunks that would have served as a central beam. The shallow hole in which the post was set (15 cm beneath the occupation floor) and the stone circle at the base of the post that helped to keep it in place indicate that the post was held in place by downward vertical pressure; otherwise it would have fallen down. It is not clear what happened to the roof of this room after its abandonment. It might have been blown off by the strong winds characteristic of the area—mainly the Zonda, a wind originating in the Pacific Ocean that discharges all its humidity on the west side of the Andes. (When the Zonda goes down the east side of the Andes and comes to northwest Argentina, it becomes dry and warm, and blows along the valleys in north-south direction at any time of the year, but especially in spring. The maximum mean velocity registered for the Zonda is 28 km/h [Servicio Meteorológico Nacional 1969, data collected 1951–1960]). The post appears to have been fractured at the floor level. There is no evidence it was intentionally broken, so it is thought that insect or rodent attack (for example, by *Ctenomys* sp.), in combination with water erosion on the ancient surface, could have caused the fracture.

Another question that arises from this work is why people of this site used *Prosopis* for posts and not other species, such as *Bulnesia retama, Lithraea molleoides* or *Acacia visco.* Possible answers are that while both *B. retama* and *Lithraea* are as hard as *Prosopis,* the former is a very short tree and the latter is likely to have grown much far away from this site. *A. visco* is softer than the others and less rot-resistant than *Prosopis* in moist conditions.

There have been changes in the long-term pattern of the management of construction resources associated with the introduction of exotic species in Argentina during the period A.D. 1800–1900. Many of them seem to be substitutions rather than changes in construction methods. For example, the exotic *álamo* (*Populus* sp.) replaced native trees for roof beams. *Populus* has much softer and less durable wood than *Prosopis,* and today is generally employed for making matches or packing boxes (FAO 1980). In Argentina it is the second most important cultivated tree, between *Pinus* sp. and *Eucalyptus* sp. (Politzer 1987). Despite the fact that in Catamarca *Populus* is widely used as a field and border tree along irrigation canals, its planting for processing in sawmills is minimal (IFONA 1985). It is thought that the modern uses of *Populus* could have been expanded because it is easy to grow from grafting twigs and can be planted in small plots. Technological factors also favor its cultivation; it is straight, long and easy to work compared with the hard *Prosopis.* In Europe, throughout prehistory, *Populus* satisfied wood needs of farmers in regions with scarce wood resources (FAO 1980). Similar cases of substitution have been observed by Johanessen and Hastorf (1990) in the Mantaro Valley. In this case cultivated *Eucalyptus* sp. replaced cultivated indigenous trees for fuel.

The decrease in *Prosopis* use could be also related to a diminution in the availability of this type of wood. Although there seems to be a decline in the use of native forests for raw material for sawmills (Politzer 1987), modern use of *Prosopis* for wood fuel, charcoal, and posts is well documented for Catamarca (IFONA 1985). The use of *Prosopis* could reduce the native forests, a problem which could also be intensified by the fragility of arid ecosystems—according to Martijena et al. (1988), *P. flexuosa* forest in Córdoba take 40 years to regenerate.

Further charcoal analysis on material from R1 of Carrizal de Azampay and from R21 of La Loma de Azampay will allow a better understanding of the use not only of wood construction resources, but also of wood resources in general and their prehistoric pattern changes.

ACKNOWLEDGMENTS

Authors are indebted to the Comisión Nacional de Investigaciones Científicas y Técnicas (CONICET), which has provided institutional support for this work. The study of prehistoric wood management at the Hualfín Valley is also supported by both the International Foundation for Science, Stockholm, Sweden and Fundación Antorchas, through grants to Aylen Capparelli. The authors would like to thank Dr. Carlota Sempé, who recovered the material; Dr. Rodolfo Raffino (Museo de Ciencias Naturales de La Plata), Lic. Stella M. Rivera, Lic. Silvia Monteoliva (Facultad de Ciencias Agrarias y Forestales, Universidad Nacional de La Plata), Dr. Ian Farrington (Australian National University, Canberra), and Dr. Naomi F. Miller for the revision of this manuscript and their critical suggestions; and to Arch. Aldo Capparelli for his valuable architectonic interpretation. Thanks also to Lic. Rafael Urrejola and Lic. Diego Gobbo for their kind assistance with the SEM and graphical designs in the PC respectively.

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Biodiversity and Native America. Paul E. Minnis and Wayne J. Elisens (eds.). University of Oklahoma Press, Norman. 2000. Pp. 310. $34.95 (cloth) ISBN 0-8061-3232-9, $14.95 (paper) ISBN 0-8061-3345-7.

With contributions from a wide range of respected scholars, *Biodiversity and Native America* is an important contribution to the ethnobotanical literature of North America. Yet this volume is more than a collection of studies about the relationship between Native North Americans and biodiversity; the strong theoretical orientation greatly advances the conceptualization of human-environmental interactions globally. In the introduction to the volume, the editors assert, "Native peoples have been neither passive consumers of nature's economy nor primitive rapists of pristine environments" (p.3), thereby challenging the validity of the 'noble savage' versus '*Homo devastandus*' dichotomy. Instead, the editors suggest that aboriginal peoples have actively shaped North American landscapes and patterns of biodiversity for millennia, and have accumulated important ecological knowledge in the process. These two themes—active indigenous management of the environment and the utilitarian value of Native American knowledge—are explored throughout the book. In doing so, the contributors challenge common biases that have left ethnobiological investigations of indigenous North American peoples under-researched in comparison to the growing body of literature on tropical regions.

The editors rightfully address the irony that although concern for biodiversity is strong in developed countries, temperate regions are often considered less relevant because they are presumed less diverse biologically and occupied by more acculturated indigenous peoples. Collectively, the authors show just how wrong these perceptions are. Minnis and Elisens convincingly establish the importance of ethnobiological research in indigenous North America, given the unique cultural and biological diversity of the region, the significant economic and political resources available for environmental research, and the fact that, despite historical disruptions, ethnobiologically rich cultural traditions still persist.

The editors argue that recognition of indigenous environmental experiences serve multiple purposes, and these purposes fall into two broad categories. First, indigenous environmental experience allows a better understanding of ecosystem dynamics and environmental history, which can help establish ecological "baselines" and lead to better biodiversity restoration, management, and conservation programs. Second, the text recognizes the essential value of Native American medicines, crop diversity, and past and present farming strategies, which may benefit contemporary indigenous peoples and the broader population. The editors define the concept of biodiversity broadly to include the cultural context of human ecology among Native Americans. Native America is defined as encompassing contemporary Mexico, the United States of America, and Canada.

The text's first section, "Issues and Overviews," explores interactions between Native Americans and knowledge. Helping clarify the debate over whether indigenous management practices positively impacted biodiversity, Gary Nabhan proposes longitudinal studies based on careful analysis of case studies within a particular biome—the Sonoran Desert region. Nabhan provides a much-needed critique of how narrow definitions of "species richness" and "language richness" overlook important species interactions of which Native Americans are a part. He likewise criticizes "salvage" approaches to ethnobiology and purely descriptive surveys that provide little information about indigenous perceptions and management of the natural world. In order to overcome these methodological and philosophical shortcomings, Nabhan proposes a focus on indigenous ecological knowledge of plant-animal interactions, the component of biodiversity most likely to be lost. In "Relationships between Mexican Ethnobotanical Diversity and Indigenous Peoples," Robert Bye and Edelmira Linares' overview includes a helpful discussion of the evolutionary, morphophysiological, and ecological impacts of different management intensities. The authors also discuss how the commonly assumed correlation between biological and cultural diversity is inexact and may undervalue entire cultural and ecological regions of importance. Walter Lewis' "Ethnopharmacology and the Search for New Therapeutics" focuses on the drug discovery process in North America and develops a model procedure for the development of future pharmaceuticals based on experiences in Peru. He suggests that bioprospectors should target plants utilized by early settlers and indigenous peoples, highlighting the difficulty of defining and compensating collaborators due to the shared nature of ethnobiological knowledge.

The second section, "Ethnographic Case Studies," presents overviews of indigenous knowledge, management practices, and belief systems in the Great Basin, British Columbia, and Chihuahua, Mexico. Catherine Fowler's chapter explores the dual meaning of utilitarian and spiritual value of plants among the former broad-spectrum hunters and gatherers of the Great Basin. Fowler documents how the Basin's Timbisha Shoshone have "domesticated" their environments in ways that fit their standards of a managed landscape, leaving open for debate whether such changes are ultimately positive or negative. In an exceptionally well-organized and well-written chapter, Sandra Peacock and Nancy Turner discuss how the foraging populations of British Columbia actively managed their environment to increase the local abundance of plants, and argue that the cessation of such management practices has actually led to the deterioration of certain habitats and resources. Enrique Salmón's "Iwígara, A Rarámurí Cognitive Model of Biodiversity and Its Effects on Landscape Management," rounds out this section by discussing how land management practices are often embedded in cultural values and belief systems.

In the final section of the book, "Prehistory and Biodiversity," Ford, Fritz, and Hammett demonstrate how knowledge of environmental interactions and impacts can be extended into the past, with important implications for understanding environmental history and contemporary ecosystem patterns. Richard Ford, in his chapter, "Human Disturbance and Biodiversity: A Case Study from Northern New Mexico," introduces the working concept of "prehistorical cultural topography," or the cultural transformation of place due to intentional interaction with the natural world. Ford argues that prehistoric landscape alterations, such as water control devices, create new habitats, which can have both short term and long term impacts on the distribution of plants and animals. In her chapter, "Levels of Biodiversity in Eastern North America," Gayle Fritz discusses the need to ground information in historical and geographical contexts rather than making sweeping generalizations about all indigenous peoples. She accomplishes this through a well-documented discussion of the environmental impacts of the mixed foraging and farming systems prevalent among eastern indigenous peoples. Her chapter recognizes Eastern North America as an important independent center of plant domestication, and discusses the historical effects of diversified foraging and farming strategies on species diversity, community level diversity, and ecosystem diversity. However, Fritz cautions against the current reactionary trend to overestimate the impact of Native Americans, and warns that such arguments may be appropriated by profit-oriented industries to justify currently destructive practices. Julia Hammett's final chapter utilizes ethnohistorical evidence to describe the initiation and maintenance of a shifting mosaic of environmental "patches" in the Southeast prior to European contact. By providing a valuable assessment of how to use documentary records as data sources, Hammett broadens the scope of methodological possibilities for exploring historical human-environmental interactions.

Collectively, the contributors to this volume provide an insightful and well balanced understanding of the relationship between biodiversity and Native Americans, past and present, as well as a much needed commentary about the utility of this knowledge. Although the theme of indigenous empowerment, intellectual property rights, and involvement in management projects could have been developed further, this book clearly demonstrates that issues of native biodiversity have more than mere academic relevance. As a result, this book is useful for students, scholars, and environmental managers of North American biodiversity, as well as persons interested in human-environmental relations throughout the world.

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Participatory Approaches to the Conservation and Use of Plant Genetic Resources. Esbern Friis-Hansen and Bhuwon Sthapit (eds.). International Plant Genetic Resources Institute Publications, Rome. 2000. Pp. 214. $32.00 (paper). ISBN 92-9043-444-9.

Several sections of the Convention on Biological Diversity (hereafter, the Convention) highlight the relationship between indigenous and peasant peoples and the sustainable use of our world's biodiversity. Signatory countries to the Convention have agreed to recognize this relationship and respect the ecologically sound traditional knowledge that indigenous and peasant communities employ in managing their resources. The Convention signatories also have agreed to involve and equitably share benefits with these local communities in development interventions undertaken by their governments and their partners. One of the international organizations that appears to have taken these sensible and ethical prescriptions to heart is the International Plant Genetics Resources Institute

(IPGRI), based just outside of Rome, Italy. IPGRI is the premier NGO that undertakes, facilitates and coordinates research, conservation and educational programs on plant genetic resources (PGR) worldwide, especially in less-developed countries. While engaged in a broad range of activities linked to both wild and domesticated plants, the greater part of IPGRI's efforts focus on agrobiodiversity. With funding from Denmark's Center for Development Research, IPGRI published this most welcome addition to a growing collection of texts on participatory agrobiodiversity conservation. This body of work, and specifically this book, is an important mechanism for helping agricultural scientists, development specialists, and NGOs understand how they can better involve and assist indigenous and peasant peoples in sustainable agricultural development.

Composed of a preface, an introduction, 25 chapters distributed over five sections, and two appendices (a list of acronyms and a glossary), this edited volume provides a methodological initiation to participatory approaches in the conservation of PGRs, and a compilation of case studies describing the successful application of these approaches in developing countries. A "participatory approach" (or "informal model" approach) is the agrobiodiversity community's way of labeling what occurs when indigenous or peasant farmers are invited (and they accept) to become fully involved in defining problems and seeking solutions within the context of PGR conservation and sustainable use programs. In other words, traditional peoples and their ecological knowledge are integrated into a range of agricultural developmental undertakings from planning, to research and conservation, to production system change, to public awareness and policy revision. Many anthropologists, and especially ethnobiologists, will not be surprised by the positive results attributed to this approach, which is described on p. 12 of the book as a "dramatic change" from existing approaches. Ethnobiology as a field took the lead in promoting this change, and it is a pleasure to read how this paradigm shift is now bearing fruit in so many agrobiodiversity conservation and agricultural development projects around the world. The relative lack of success with the "top-down" (or "formal model") development approach, especially when compared to results achieved through participatory approaches, is also described in several chapters. This conclusion is especially relevant because the agricultural development specialists from the less-developed countries reached it themselves, indicating the extent to which the participatory approach is now accepted and being applied at local levels throughout the world. Similarly encouraging are the calls throughout the chapters for greater involvement of social scientists in agricultural development programs.

The editors have grouped the contributions into five thematic sections: participatory approach methods and gender issues; descriptions of how gene banks now serve local communities and not just formal sector scientists; participatory approaches in crop selection; public awareness raising; and policy changes associated with plant genetic resource conservation and use. Several weaknesses in the presentation detract from the book's readability. It is perhaps inevitable in a book with 25 short chapters that many of the introductory statements repeat the same theoretical justifications and methodological prescriptions. But after reading similar opening paragraphs five or six times, I wished the editors had exerted more control over introductory statements by the chapter authors. The strength of the case studies resides in how and why participatory approaches succeeded in location- and culture-specific contexts. In this regard, the chapters providing background on ethnicity, history, and geography are the ones that succeeded best. Though the editors tried to overcome jargon and institutional naming with the addition of an acronym appendix and a glossary, overuse of acronyms and jargon in some chapters also weakened the book's readability.

These relatively minor criticisms aside, this is a useful book for ethnobiologists and other experts specializing in the area of plant genetic resources, and especially for those people who are working or planning to work in the area of agricultural development in less developed countries. The book confirms that many of the theoretical, ethical and methodological positions fashioned by ethnobiologists over the last 20 years are beginning to influence professionals in other disciplines. At the same time it also provides many useful tips for field-oriented PGR conservation and agricultural development specialists as they plan and implement their own interventions.

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Mayo Ethnobotany: Land, History, and Traditional Knowledge in Northwest Mexico. David Yetman and Thomas R. Van Devender. University of California Press, Berkeley. 2002. Pp. 359. Illus.; scientific, Mayo and Spanish name lists; index. $48.00. ISBN 0-520-22721-2.

A valuable resource for ethnobotanists in northwestern Mexico, this book provides a detailed account of plants used by the Mayo of Sinaloa and Sonora, Mexico. According to the authors, this arid region is losing both its biological diversity and traditional plant knowledge. Their book does a great service by increasing the reader's awareness of indigenous plant knowledge in general and the sophistication of Mayo plant knowledge in particular. The first third of the book is dedicated to Mayo history, culture, and biophysical landscapes, and the remainder lists the ethnobotanical information compiled by the authors over a ten-year period.

The chapters on Mayo ethnography and history are interesting and well written, but leave the reader with only a taste of the complex political and cultural ecologies that characterize landscape and knowledge change in northern Mexico. The title of the book led me to expect more historical ecology and biocultural synthesis, but this book is really a text of economic botany with an ethnographic introduction to the Mayo region. The authors do deliver discussions on land (vegetation and ecotypes), history (political and economic), and traditional knowledge (botanical), but these are presented as separate entities. All the elements are there but, for the most part, the connections amongst them are left for the reader to make.

The few glimpses of biocultural synthesis that are provided do keep the reader interested. For example, the discussion of landscape transformations from productive pitahaya cactus (*Hylocereus polyrhizus* Britton & Rose) fields to bulldozed buffelgrass (*Pennisetum ciliare* (L.) Link) plantations (and associated erosion of traditional plant knowledge) is an excellent illustration of how economic and politico-historical forces propel change in biophysical and sociocultural spheres. The reader comes away with a good understanding of the native ecotypes of the Mayo region (coastal vegetation, coastal and foothills thorn scrub, tropical deciduous forest, oak woodlands and riparian zones), but much of this information, including some of the photographs, has already been published in Martin et al. (1998). The brief discussion of Mayo plant classification is disappointing and would have been better left out. The authors failed to discern a taxonomic system during their research, and go so far as to say, "[w]e now believe that such a system is not to be found among Mayos" (p.129). The methods they mention having used, however (translating names into Spanish, and noting comments regarding relatedness), are not enough to get at any deeper structure. Pile sorts and triad tests would surely have shed some light on this issue.

The chapters "Historical and Contemporary Mayos" and "Eight Plants that Make Mayos Mayos" are stimulating and evocative. They allow the reader to approach an understanding of the links and relationships of human—plant systems of the Mayo, but the book as a whole falls short of providing comprehensive ecological understanding of these relationships. That said, the book is a fun read, accessible to students and aficionados, and an important resource for ethnobotanists, anthropologists, and ecologists interested in arid and coastal lands.

The last and longest chapter, "An Annotated List of Plants," is the heart of the book, providing plant descriptions, uses (in the categories medicine, construction, artifacts, livestock, industry) and names in Latin, Mayo and Spanish, in order of plant family. The bare facts are enriched with anecdotes, observations and comments made by the authors or their Mayo consultants, which makes this list an exceptionally readable, interesting and useful reference tool. One frustrating aspect of the naming of plants here and throughout the book is a lack of differentiation in type style or markings (or inconsistent differentiation) between Spanish, Mayo and English words. Luckily, there is an appendix with thorough and cross-referenced lists of plants in each language, plus a glossary.

The text also considers intellectual property and indigenous knowledge. The authors do a good job of giving credit to their Mayo teachers and consultants, with references throughout and an appendix listing the names of consultants along with brief biographies. It is unclear, however, what kind of consultation was made with individuals or communities regarding the future publication of names of consultants and names and uses of Mayo plants, some of which could be utilized by non-local commercial interests. This places *Mayo Ethnobotany* in that zone of ethical ambiguity that so many of us are trying to navigate through: weighing the value against the dangers to the Mayo community and the scientific community at large of recording and publishing indigenous plant knowledge. If, as the well-presented case is made in this book, Mayo landscapes and traditional knowledge are endangered, this publication is important as salvage ethnobotany. But to be truly useful to future generations of Mayo residents of the thorn-scrub coast, this compilation of plant knowledge should be translated into Spanish—or better still, Mayo—and made available in local communities.

Mayo Ethnobotany is as an important contribution to the growing body of research on arid lands ethnobotany and I recommend it for people working in northwest Mexico who want to learn about its plants and people. The text would also be useful as a preliminary case study for human–plant systems undergoing major ecological transitions.

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Fire, Native Peoples, and the Natural Landscape. Thomas Vale (ed.). Island Press, Washington, D.C. 2002. Pp. 238, maps. $50.00 (cloth) ISBN 1-55963-888-5; $25.00 (paper) ISBN 1-55963-889-3.

With a nod towards environmental determinism, the geographers who have contributed chapters to this book set out, in the word chosen by the editor, to "demythologize" the variably emphasized claims that hunting-gathering societies made significant impacts in using fire in much of the American West. The stated aim of the book as presented by Vale in the first chapter is reasonable enough: to achieve a "middle ground" between the polar positions that North America was an "untouched wilderness" and the counter claims that it was a "humanized landscape."

The outcome, however, is something quite different from a middle ground, and worse, the overall analysis is flawed. The authors conclude that except for the very limited areas of agriculture in the Southwest, indigenous people made little impact on the "natural landscape." As Vale states in the final sentence of the concluding chapter, it was "an American wilderness—a natural landscape—[that] greeted the first Europeans." This is quite different from what Thomas Bonnicksen, an acknowledged authority on forest ecology, concluded in his recently published book, *America's Ancient Forests: From the Ice Age to the Age of Discovery* (2000: 259): "Native Americans helped to create and sustain the ancient forests that Europeans found beautiful enough to set aside in national parks."

Vale, in making his claim against what he calls the "arm-waving, careless generalizations" made by "anthropologically minded observers," is apparently unaware that few anthropologists know about, much less would support, the idea that hunter-gatherers increased the abundance and influenced the distribution of natural resources. As taught to anthropology students, environmental manipulations do not occur until people take up farming.

Indeed, the seminal thinking about hunter-gatherer uses of fire comes out of Vale's own discipline, and only later influenced anthropologists like Omer Stewart. Stewart took seminars from the geographer, Carl Sauer, during the 1930s while a graduate student at the University of California, Berkeley, and on the subject of foragers and fires, went on to become a maverick in anthropology. In this respect, it was geography-minded observers who initiated the "arm-waving, careless generalizations" that concern Vale and his colleagues.

Carl Sauer wrote extensively about the importance of human uses of fire; but his works are scarcely mentioned by Vale and his colleagues. Also, and continuing on that aspect of Sauer's work, the geographer William Denevan has written a great deal about the significance of native people and their uses of fire in both North and South America; and neither he nor Sauer is all that "anthropologically minded." It may well be that Denevan's important 1992 article, "The Pristine Myth: the Landscape of the Americas in 1492," was the motivation behind Vale's charge to "demythologize" the opposing view.

Thus, instead of taking the high middle ground, Vale attempts to resurrect and spruce up the alternative myth that Native Americans lived in essentially passive relationship to nature, seemingly content to wait for natural fires to do for them what they somehow couldn't figure out and do for themselves. Contrary to this view, Stephen Pyne (1982:71) points out that without the knowledge and the will to use fire in ways significantly different from natural fire regimes, "most Indian economies would have collapsed." Collapse they certainly would, had they depended upon disruptive natural fires. Fortunately, they knew how to use fire to help manage local habitats, and in some cases whole regions (e.g., the North American Plains), at preferred stages of ecological succession.

Thus, more appropriate than merely asking why hunter-gatherers set fires, and knowing what we now know about the ecology of fire, it makes more sense to ask why not? Why on earth wouldn't hunter-gatherers have employed such a readily available and easily understood tool, given the resources they sought and their understandings of the complex environments in which they lived? Though we wouldn't be here if our hunter-gatherer ancestors had not been successful foragers, most of us haven't the slightest idea of how to live off the land. But that doesn't stop some of us from claiming to know all about the ecology of hunting and gathering adaptations.

In his opening discussions, Vale makes the claim that the interpretations (two chapters of which are his own) derive from the "wisdom that guide[s] the final words" of the authors. This aggrandizing would be off-putting enough, even if the authors had supported their claims with new evidence, either archival or from field studies. Instead, they criticize and selectively use the work of others (e.g., opting for the lowest population estimates for Native Americans); ignore or overlook a considerable number of relevant publications that do not fit their assumptions; and, worst of all, they fail to include (or even note) any comparisons from what has been written about the uses of fire by indigenous people elsewhere in the world—South America, Asia, Africa, and (most studied of all) Australia. Perhaps most egregious is their omission of any reference to William Cronon's (1983) major work on Native American uses of fire in New England, an area inhabited by people who fall outside their limited view of "native."

As someone who has researched and written a fair amount on the topic of anthropogenic fires, it is disappointing to have so few of my publications cited, the materials selectively used, and the conclusions heavily criticized. Though Australian Aborigines are not within the book's narrow purview of native people as being only those in western North America, in Lewis (1973) and other venues, I have published several items that go to the heart of what some of the authors argue (for example, Lewis 1977, 1980, 1991). The most important not included in their criticisms ("How to Burn a Boreal Forest: Yards, Corridors and Mosaics," Lewis and Ferguson 1988) is applicable to a number of chapters in the book, and could have actually been used to strengthen their arguments, particularly Vale's conclusions that "mosaics" are a feature of the "natural" landscape.

Expressing a typical criticism, one author dismisses the value of historical and ethnographic evidence because of "biases inherent in oral and written accounts." Without question, however, the authors accept the quantitative evidence presented in "tree-ring-based fire history studies" as if there are no biases in the way fire scars are measured and interpreted, or in the way researchers extrapolate data to create whole regional histories of fire. Were it only a question of evaluating the advantages and disadvantages of quantitative vs. qualitative research or, better yet, how such approaches might complement each other, the book could serve as a starting point for a real debate of the topic and not simply a one-sided polemic. In no way does this book represent a definitive argument about the importance of "Native Peoples" and their uses of fire.

Admittedly, historic and ethnographic data are rarely useful for quantitative analysis. Nevertheless, anecdotal evidence is frequently consistent with ecological paradigms, thereby helping to validate such data. In this respect, the ecological effect of hunter-gatherer uses of fire has been widely "tested" by comparing the practices of culturally distinct groups within regions and also of those living in widely separated regions or even on different continents. Most important for scientific verification, however, are the comparisons that can be made with conclusions from ecology, which takes historical and ethnographic accounts ("anecdotal evidence") and converts them into scientific data. Cross-cultural, particularly intercontinental, comparison is anthropology's main claim to scientific credibility; it is our way of getting beyond more parochial kinds of generalization derived from particular sites or even regions—as Vale and colleagues argue for the American West.

History is a messy business, full of "oral and written accounts"; whether social or natural, historical evidence is properly considered, corrected, accepted, or rejected in terms of its overall fit and coherence within larger contexts. Some geographers, like Sauer and Denevan, express this clearly in their writings. Unfortunately, that perspective is largely missing from this book. As I wrote three decades ago in my first publication on indigenous uses of fire ("Patterns of Indian Burning in California," 1973:49–50), "It is not the individual facts nor the total number of such facts that is significant but, rather, how the information fits an ecological system of knowledge that has been gained from the actual study of fire in field situations."

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Trekking Through History: The Huaorani of Amazonian Ecuador. Laura M. Rival. Columbia University Press, New York. 2002. Pp. xiii + 257. Illus., tables, index. $60.00 (cloth). ISBN 0-231-11844.

Rival's *Trekking Through History* is an ethnographic account of the Huaorani of Ecuador contextualized through a historical ecological approach. Although the Huaorani use domesticated plants, she describes them as primarily nomadic trekkers, engaged in a hunting and gathering mode of subsistence. In part, this book is a critique of William Balée's agricultural regression model of Amazonian foraging, which posits that foraging in some Amazonian groups likely arose as a postcontact adaptation, with loss of knowledge of how to cultivate being one consequence of colonization (e.g., Balée 1994). Rival argues that Huaorani nomadic trekking is not necessarily a postcolonial adaptation, but instead is more likely a long-standing tradition that represents a political choice to trek rather than to cultivate. Although the two views would seem opposed at first glance, I believe they are complementary, for they are addressing different questions. Balée's work places more emphasis on ecological change, critical historical events, and the loss of indigenous cultural knowledge, while Rival's work places more emphasis on environmental perception, historicity, and ontology.

Balée has addressed the question of why the Guajá foragers of eastern Brazilian Amazonia do not know how to propagate domesticated plants. Based on the presence of linguistic artifacts of domesticates in their language, ethnohistorical evidence, and their adaptation to anthropogenic forests, Balée's work has provided a convincing case that the Guajá were formerly a horticultural people. He places the likely time for their loss of indigenous horticultural knowledge subsequent to the devastating and chaotic circumstances following European colonization. Guajá foraging involves exploiting dominant palm colonizers of old fallow fields, the fruits of which serve as a caloric staple. Further, his model provides an explanation of the process through which domesticates may be sequentially lost, with high investment bitter manioc disappearing before low-start up cost maize.

In *Trekking Through History,* Rival is addressing a related, but rather different issue: why the Huaorani, who *do* know how to grow domesticated plants, prefer and emphasize nomadic foraging over sedentary horticulture. Taking inspiration from Sahlins that history is organized through structures of meaning, she argues that Huaorani nomadic foraging is not necessarily postcolonial, but likely a manifestation of long-standing cultural and political forces that were in place prior to European colonization.

Rival reaches her conclusions by analyzing an essential division in Huaorani thought between true people—the Huaorani—and all non-Huaorani others. She also describes the essential relationship between the Huaorani and non-Huaorani as being based on predator/prey dynamics: "others" are always predators and the Huaorani are always prey. This holds true whether the other is a supernatural being, a non-Huaorani Amerindian, or a European colonist. These ways of being and relations among beings are expressed repeatedly in myth, in cosmology, as well as in interpretations of more recent historical events. The construction transcends specific history for it is through the structural relationship between predator and prey which the mythic, the sacred, and all historical events are understood. One of the most intriguing discussions in Rival's work is that it is also the structure through which Huaorani homicide of other Huaorani is framed. Simply put, the death of a kinsman is viewed to appropriately invoke rage. A Huaorani, in this state of necessary rage, temporarily becomes "other" and therefore predatory.

Rival describes Huaorani foraging as one manifestation of the relationship between predator and prey. Foraging is a tangible expression of Huaorani embodiment as prey, fleeing from predatory others, whoever those specific others may be. As such, the European colonist is no different from any other non-Huaorani, even if the individual is a Huaorani temporarily taking the position of a predatory, non-Huaorani other. However, foraging is not merely ontological flight. Rival describes food procurement as an encounter with the past. The Huaorani recognize the forest as a patchwork of old fallows, light gaps, and old growth forest with differential proliferation of plants and animals in these zones. Forest sites and cleared fields are remembered not only for their characteristic species, but are historical mnemonics for the activities of specific individuals and more generalized ancestral areas. Foraging includes not only collecting nondomesticated plants, but remnant cultigens from recently abandoned fallows. Anthropogenic growth itself is amplified through planting chonta palm seedlings in cleared fields resulting from past activities.

Rival stresses that it is also important to understand that foraging and flight are viewed as temporary conditions. Huaorani identity is centered in the longhouse to which one returns. Here, kinship and community are created, reinforced, and magnified through day to day interactions. Consanguinity is described as far more dependent on lived relationships than genealogical links. Further, co-residents become consanguinealized through sharing of "substance" (food, semen, breast milk, illness, parasites, space, etc.). Thus, one risks becoming "other" if foraging and flight are not predicated upon and actualized by the eventual return to the longhouse.

Rival's fascinating ethnography demonstrates that ecological adaptation cannot be understood as resource extraction alone, it is deeply embedded in Huaorani identity, sociality, symbolism, and historicity. As she states, "I have analyzed trekking, not as a mundane activity relating to the pragmatics of subsistence and to environmental or historical adaptation, but rather, as a fundamental way of reproducing society through time (p. 178)." *Trekking Through History* is the fourth book in Columbia University Press's Historical Ecology Series, edited by William Balée and Carole L. Crumley, and Rival's work represents an important contribution to this developing approach. In my mind, the most important question her book raises for historical ecology is whether or not Amazonian foraging is a meaningful category of analysis amenable at all to a general model. The Maku of the Northwest Amazon are foragers, yet are involved in direct trade relations with Tukanoan food producers. The Guajá have probably lost indigenous horticultural knowledge, but live independently from food producers through exploitation of anthropogenic forests. The Huaorani know how to grow plants, yet prefer foraging to horticulture. Given these particular cases: Is it possible to integrate continuity and change, history and historicity, epistemology and ontology among Amazonian foragers? Or, are the historical, cultural, and ecological conditions (pre- or post-contact) under which foraging is practiced in specific groups particular enough that generalization is futile?

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