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COVER ILLUSTRATION: Image from the *Florentine Codex* of the preparation of ***tetízatl*** (interpreted by Dibble and Anderson 1963, cited in Godínez et al., this volume).

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ETHNOBIOTICA

Today's local sporting event of note leads me, in roundabout fashion, to ask some questions that may be relevant to readers. It's early June 2001, and as I write this column, Tulane's and LSU's baseball teams are about to play the decisive game in their best-of-three, playoff-bound, super regional series. Zephyrs Stadium in nearby Harahan is sold out, and therefore the game will be broadcast on local cable in addition to the usual media outlets, such as radio and print media. The flow of knowledge from the actual innings and final result will be essentially unimpeded for all in Southeast Louisiana who care to listen or watch. And if either the Greenies or the Tigers, whoever wins today, should go on to victory as the NCAA finalists or even champions in the College Baseball World Series, year 2001, as the series winds down later this month, clips from today's game will be disseminated nationwide and beyond, on the television, Internet, and so on. Baseball is a free and open game.

My first question is, will ethnobiological knowledge ever be as freely available as baseball knowledge? Given the spread of individuals' home pages, web-based teaching, distance learning, internet classrooms, and other multimedia resources, clearly much new knowledge in many fields is becoming freely accessible to anyone who seeks it. For some reason, ethnobiological knowledge in the mental possession of specialists has developed a mystique that seems to constrain full disclosure in the media of our time. And this remains true when demand for such knowledge by students seems to be at an all time high. Ethnobiologists have long pondered the similarities and differences between knowledge encoded in an exclusively oral format and knowledge transmitted via more permanent media, such as written text, electronic publishing, video, and audio. Baseball players communicate the game on a fixed diamond grid according to special rules, timing, referees, and equipment, and they have been trained by specialists called coaches. Ethnobiologists transmit and translate data on relationships among people, language, culture, landscape, and biota that defy spatio-temporal fixation and universal laws that might govern their association. They are supposed to play, nevertheless, "by the rules." If every ethnobiology article was like a baseball game, perhaps a less exclusive medium than a scientific journal, such as this one, would be the right medium for broadcasting it.

However inclusive the subject matter of ethnobiology–hence, its multidisciplinarity–its audience will continue to be more restricted than baseball's, at least in principle and if history is a guide. Ethnobiologists are involved in a lively debate as to the potential impact their special knowledge may have on humankind or segments thereof. True baseball fans rarely question the contribution that their game has made to human welfare. (Other scientists, such as nuclear physicists, of course, have also had some discomfiture with free disclosure of their own data, as have ethnobiologists, so the latter are not unique in this respect, though the rules of the nuclear game seem to be a bit more clear). The connection between basic and applied research in ethnobiology is no longer just on the horizon; it has been crossed. Perhaps in the Western world it was crossed half a millennium ago, when medieval herbalists in Spain, France, and England codified folk knowledge and beliefs about medicinal plants and animals. (On the other hand, maybe medieval herbalists were too naive linguistically, ethnographically, and biologically to be considered ethnobiologists proper, raising the subsidiary question as to what kind of training qualifies one to be an ethnobiologist?). Baseball games do not typically result in changes of the rules of the game or of sportsmanlike conduct. Because it isn't played on a diamond grid, ethnobiological knowledge yields findings with which people sometimes disagree vehemently, as in any science. Calls by umpires in baseball games may be issues of doubt and disagreement, but final scores cannot be changed. Even in some cases where the ethnobiological knowledge in question has passed hurdles of peer review and editorial vetting, questions may persist as to whether it should or should not be disclosed in any media. But all this disagreement follows the rules, or at least it is supposed to do that.

My parting question is, what are the rules and who makes them in ethnobiology? Ethnobiologists don't have a single guide; in baseball, any book containing the rules will suffice, since the rules continue to be essentially the same and the different books available agree on them–the main differences are between leagues, and for junior players the rules may be somewhat defined locally. But these differences themselves are schematically quite minor in comparison, for example, to the philosophical differences evinced between the "utilitarianists" and the "intellectualists" of ethnobiological renown. And they are negligible when compared to the debate between those who would prevent disclosure of any knowledge deemed to be in the domain of intellectual property rights versus those who believe all knowledge developed by science (including ethnobiology) should be automatically and freely available to anyone, anywhere. Although I cannot offer a final answer to this last question, clearly the rules of the game of ethnobiology are ingrained in standards of scholarly inquiry agreed upon by panels of specialists, since those standards represent the first obstacle to be met when disclosing findings in this journal and other, related ones. Obviously many ethnobiologists agree on such standards, and shared commentary on manuscripts submitted for publication is a feature one notes as an editor (though not always, of course). In addition, and no less important, the codes of ethics of the Society of Ethnobiology and the International Society of Ethnobiology together with the ethical codes of the various sister disciplines that converge on ethnobiology, such as that of the American Anthropological Association, which are often updated, constitute a portion of the rules of the game, analogous in a not entirely supercilious way to sportsmanship in baseball. For the most part, these codes accommodate both sound science and ethical conduct in the field of research and study, even if the playing field lacks the psychologically salient and universal design of a baseball diamond. Although the knowledge from ethnobiology, now being produced in prodigious quantities, will probably never be as freely and completely available as the no-hitters, RBI's, home runs, double and triple plays, number of innings, and final score from your or my favorite baseball game, the audience for that knowledge conceivably could grow in sophistication and number with continuing informed debate and inquiry into the rules for research and conduct, as this debate develops in forums that are genuinely open, accessible, and democratic. I am basically optimistic, since it is clear from a recent increase in submissions to this journal and from many presentations at the last annual meeting of the Society of Ethnobiology (the abstracts from which are available at http://www.ethnobiology.org) that ethnobiology counts among its players many dedicated people who are inclined to keep the debate on the rules of the game alive in an admirably professional, forthright manner. It's time to close; the first pitch has just been thrown.

Bill

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RAIN FOREST HABITAT CLASSIFICATION AMONG THE MATSIGENKA OF THE PERUVIAN AMAZON

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ABSTRACT.— The Matsigenka (or Machiguenga) Indians of the Peruvian Amazon describe and define rain forest habitats according to a complex system of ecological classification based on vegetative and other biotic features as well as abiotic features such as topography, hydrology, edaphic characteristics and disturbance regimes. The Matsigenka distinguish some 69 vegetationally-defined habitats (some of which overlap) and 29 abiotically-defined habitats, as well as ten soil types and at least seven habitats associated with specific faunal indicators. Palms and other Monocots are particularly important as indicator species in Matsigenka habitat classification. The Matsigenka consider various subcategories of biotic and abiotic features somewhat independently when assessing forest habitats. Though not organized into a single, unified hierarchy, the multiple systems of habitat description intersect to define forest types. Comparing Matsigenka habitat classification with that of several other Amazonian indigenous groups, a number of common features are observed. Given the scientific validity of indigenous and local knowledge about habitat diversity, and given the accelerating rates of cultural and environmental degradation, it is important that ethnobiologists, tropical biologists, conservationists and indigenous communities collaborate in studies of Amazonian biodiversity.

Key words: Matsigenka, Peru, habitat classification, Amazon rain forest, ethnoecology.

RESUMEN.— Los indígenas Matsiguenka (o Machiguenga) de la Amazonía Peruana describen y definen ambientes (hábitats) de la selva de acuerdo a un sistema complejo de clasificación ecológica que incluye vegetación y otros factores bióticos y también factores abióticos como topografía, hidrología, características edáficas y regímenes de perturbación. Los Matsiguenka distinguen aproximadamente 69 tipos de hábitats definidos por vegetación y 29 hábitats definidos por factores abióticos. Además, distinguen diez tipos de suelos y por lo menos siete hábitats definidos por indicadores faunísticos. Palmeras y otros monocotiledóneas son especialmente importantes como especies indicadoras en el sistema Matsiguenka de clasificación ecológica. Los varios factores bióticos e abióticos son casi independientes y no pueden ser organizadas en una única sistema de clasificación. Sin embargo, estos múltiples sistemas de clasificación paralelos se juntan en la definición de hábitats específicos. Existen varias características en común entre la clasificación ecológica matsiguenka y la clasificación ecológica de otros indígenas amazónicos. Considerando la sofisticación de los conocimientos ecológicos indígenas, y considerando los procesos acelerados de degradación cultural y ambiental en algunas regiones amazónicas, es sumamente importante que etnobiólogos, ecólogos, conservacionistas y comunidades indígenas colaboren en los estudios sobre la biodiversidad amazónica.

RÉSUMÉ.— Les indiens Matsigenka (ou Machiguenga) de l'Amazonie péruvienne décrivent les habitats de la foret tropicale avec un système complexe de classification écologique qui réunit plusieurs facteurs biotiques, par exemple végétation, et des facteurs abiotiques, par exemple topographie, hydrographie, caractères édaphiques et régimes de perturbation. Les Matsigenka distinguent à peu près 69 types de végétation et 29 types d'habitats définis par facteurs abiotiques. En plus, distinguent dix types de sols et au moins sept habitats définis par des associations faunistiques. Dans ce système, palmiers et d'autres monocotylédones sont très importants comme espèces indicatrices. Les plusieurs catégories biotiques e abiotiques sont presque indépendantes et ne peuvent pas être réunies dans un seul système de classification. Ces multiples systèmes parallèles de classification se croisent quand même dans la définition d'habitats spécifiques. Ils se rencontrent plusieurs similarités entre le système Matsigenka de classification écologique et ceux d'autres indiens de l'Amazonie. En considérant la sophistication du savoir indien, et en considérant les rapides procès de dégradation culturel et écologique dans quelques régions amazoniennes, il devient essentielle la collaboration entre etnobiologistes, écologistes et indiens dans la recherche de la biodiversité amazonienne.

PROLOGUE: THE DARE

The research that led to this paper began as a dare. Shepard (an ethnobotanist) heard that Yu (an ecologist) was learning the taxonomy of *Cecropia*, a genus of pioneer trees that host a number of ant species. Shepard suggested that Yu consult with the local indigenous people, the Matsigenka, with whom he had been conducting ethnobotanical research for several years, and who recognized a number of folk species of *Cecropia*. Yu chided, "*Cecropia* taxonomy is a mess. We have been working on it for years. Some of the species are very close. Not even the expert on the genus has been able to figure them out. I doubt the Matsigenka even have names for many species." Shepard dared Yu to test his instinctive distrust of folk biology. Open to the challenge, Yu began to interview the occasional Matsigenka visitors to the Cocha Cashu research station in Manu National Park, and was surprised by the findings. The Matsigenka had names for almost every species of *Cecropia* found in the area, including some that as yet had no established botanical names. More interestingly, the Matsigenka recognized various sub-groups of *Cecropia* that corresponded exactly with the intermediate taxonomic groupings identified by botanists after several seasons of field and herbarium work. Yu was impressed by the sophistication of Matsigenka folk taxonomy, "We could have saved two years of taxonomic muddle!" Unfortunately for Shepard, no formal wager had been made. Instead, the dare shifted to a higher level, and the stakes (in scientific, if not monetary terms) went up. If indigenous people could provide insights into taxonomic conundrums, could they also shed light on the extent of habitat diversity in tropical forests?

HABITAT DIVERSITY IN AMAZONIA

The rain forests of southeastern Peru exhibit a staggering diversity of life: 1300 species of butterflies were identified at a single locality (Lamas et al. 1996) and 319 species of birds were counted in a census of one square kilometer of habitat on the Manu River (Terborgh et al. 1990). One hectare may contain up to 300 species of trees (Gentry 1988b), and a single tree may contain more ant species than are present in all of Britain (Wilson 1986). Complementing this great diversity of locally-occurring species ("alpha-diversity"), there is increasing evidence for high levels of "beta-diversity," that is, diversity at the level of species communities or habitats. Habitat diversity in Amazonia has been found to be associated with a wide range of biotic and abiotic factors. Foster (1990b) discusses how river dynamics in the Peruvian Amazon shape patterns of natural disturbance, forest succession, and vegetative diversity in floodplain areas. Gentry (1988a) analyzes the role of environmental gradients (water regimes, soils, elevation) affecting vegetation types in the Western Amazon. Pires and Prance (1985) describe some twenty vegetation types for the Brazilian Amazon, basing their classification principally on flooding regime and water color ('black'/'white'/'clear') as well as soils, geographic area, overall biomass and other vegetative features (e.g., open forest, dry forest, liana forest, palm forest). Some tropical biologists theorize that alpha and beta diversity are directly related: the high species diversity of Amazonian forests may depend upon a mosaic of juxtaposed niches and micro-habitats (Terborgh et al. 1996).

How many types of habitat exist in Western Amazonian forests, apparently the most species-rich on earth? Erwin (1984) mentions seven forest types found in the Tambopata Reserved Zone. Foster (1990a) describes twelve vegetation types for the Manu River floodplain, half of them referring to successional zones along the river margin. Encarnación (1993) describes eighteen distinct vegetative associations for lowland forests (below 400 m above sea level) of Loreto, Ucayali, and Madre de Dios. Early analysis of satellite images of the southeast Peruvian Amazon resolved ten to fifteen color/shade combinations or 'biotopes' (Salo et al. 1986), corresponding to general forest types distinguished by scientists on the ground: e.g., mature floodplain forest, upland terra firme, swamps, dwarf forests on acidic white sand, and various successional zones. More recently, the same group of Finnish scientists has used satellite imagery to suggest more than 100 habitat types for the Peruvian Amazon (Tuomisto et al. 1995). However, there is still little evidence from the field to support these conclusions (Condit 1996). Large-scale ground surveys are expensive and time-consuming, and so far, perhaps only a few hundred hectares of Amazonia's five million square kilometers of forest have been systematically collected, mostly around cities, along major rivers and highways, and at a handful of well-studied research stations (Nelson et al. 1990; Tuomisto 1998). It is unlikely that such limited surveys are representative of the total diversity of species, not to mention of species communities, in Amazonian forests.[1] What we are attempting to do in this interdisciplinary research project is to take advantage of an already existing database of forest habitat diversity that covers tens of thousands of hectares: the forest classification system of the Matsigenka, an indigenous population of the southeastern Peruvian rain forest.

THE SCIENCE IN ETHNOSCIENCE

Most native peoples living in the Amazon basin do not (yet) have access to herbarium collections, ecological theory, or electronic tools such as computers or satellites. Yet in their daily interactions with the environment, and in the accumulation of this knowledge over generations, indigenous peoples like the Matsigenka have amassed a rich body of knowledge about the diversity of the organisms and species communities in their territory. We are developing an interdisciplinary methodology, which we have dubbed "ethnobotanical ground-truthing" (Shepard et al. in press) to document the vast and understudied body of indigenous knowledge about the environment while taking advantage of recent advances in tropical ecology and remote sensing technology.

The ethnoscience tradition in anthropology seeks to understand not only the content but also the structure of native knowledge (Goodenough 1957). The method of folk taxonomy (Conklin 1964, 1972) has contributed to the study of kinship terminology (Frake 1964), ethnomedical systems (Frake 1961), color classification (Conklin 1955; Berlin and Kay 1969), and especially to the fields of ethnobotany and ethnozoology (Conklin 1954, 1957; Diamond 1966; Berlin et al. 1973, 1974; Bulmer 1974; Hunn 1977; Posey 1979; Berlin 1992). Ethnobiological research over the past fifty years has challenged colonial stereotypes of indigenous peoples as "irrational" or "pre-scientific." The pioneering work of anthropologists Conklin and Berlin and naturalists Bulmer and Diamond served to document the sophisticated botanical and zoological knowledge of indigenous societies around the world, knowledge that in many cases rivaled that of scientific taxonomists of the time (see Bulmer 1974: 9; Carneiro 1978: 204-206; Berlin 1992: 4). Our own experience in the "*Cecropia* challenge" is another in a long list of such anecdotes.

More recent studies in ethnoecology have applied the procedures of ethnoscience to ecological processes as understood by native people (Posey 1983; Posey and Balée 1989; Toledo 1992). If the findings of ethnobotanists and ethnozoologists are any indication, we expect the ecological knowledge of indigenous people to be likewise relevant for scientists. Parker et al. (1983) point out the deficiencies in a number of scientific typologies for Amazonian forests, and suggest that folk knowledge represents an important source of ecological information for academic researchers as well as development planners. In fact, Pires and Prance's (1985) widely accepted forest classification for the Brazilian Amazon draws heavily upon the folk terminology of Brazil's *caboclos*, riverine dwellers of mixed indigenous, European, and African descent whose ecological vocabulary is clearly indigenous (Tupi-Guarani) in origin. Encarnación (1993) likewise combines regional vernacular with scientific vocabulary in a description of lowland forest habitats in Peru. We suggest that further interdisciplinary study of indigenous ecological classification in Amazonia could facilitate the assessment of habitat diversity within local landscapes as well as at broader regional scales (Shepard et al. in press).

STUDY REGION, COMMUNITIES AND PERSONNEL

The Matsigenka belong to the Arawakan cultural/linguistic family, and have a current population of about 13,000 people. They live in extended family settlements and small communities distributed along various tributaries of the Urubamba, Madre de Dios, and Manu Rivers, a region of hilly rain forests, or *montaña*, that fringes the eastern slope of the Andes. Historical records as well as folk tales indicate that the Matsigenka maintained trading relations with Andean populations since at least the time of the Inca Empire (Camino 1977; Lyon 1981; Renard-Casevitz et al. 1988). At the turn of the twentieth century, many Matsigenka fled to remote settlements in the headwater regions in order to escape the atrocities ushered in by the "rubber fever" (von Hassel 1904; Lyon 1976; Rummenhöller 1985). Especially since the 1950's, missionaries of various denominations have sought to contact Matsigenka from dispersed villages and settle them in semi-permanent native communities along major river courses (d'Ans 1981). However, an unknown number of remote populations still persist in a self-imposed state of isolation (Shepard in review).

The Matsigenka cultivate manioc, maize, plantains, sweet potatoes and other crops in small swiddens that are abandoned to forest regeneration after a few years of active cultivation (Johnson 1983). The Matsigenka also hunt, fish, and gather a wide range of forest products. Near mission towns and other trading centers, some Matsigenka engage in small-scale commercial cultivation of coffee, cacao, or annato (Baksh 1984). Many Matsigenka settlements, especially in the Upper Urubamba region, have received legal title to communally-held lands according to Peru's "Native Communities Laws" (Mora and Zarzar 1997). Some communities receive bilingual education based on a practical orthography and didactic materials in the Matsigenka language developed by Protestant missionaries of the Summer Institute of Linguistics (see Snell 1998).

Our principal research sites are in the Matsigenka communities of Yomybato and Tayakome within the Manu Biosphere Reserve, a 1.6 million Ha area of protected tropical forest located in the department of Madre de Dios in southeastern Peru. Additional research was carried out in the Matsigenka communities of Mayapo, Puerto Huallana, and Camaná of the Picha River, some 150 km west of the Manu study site (see Figure 1).

Shepard has carried out ethnobotanical research in Yomybato, Tayakome, and other indigenous communities of the region since 1986, and is fluent in the

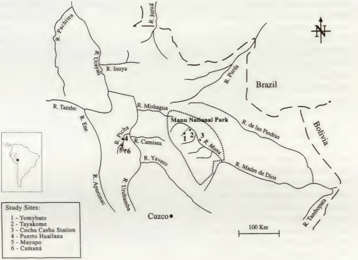

FIGURE 1.— Study area, Southeast Peru

Matsigenka language. In 1996, tropical ecologist Douglas Yu and ethnobotanist Manuel Lizarralde joined Shepard in the field for three months to carry out a preliminary study of Matsigenka forest classification in Yomybato. In 1997, Shepard collaborated in Conservation International's Rapid Biodiversity Assessment of the Cordillera de Vilcabamba (Schulenberg in press). There, he carried out a brief study of ethnoecology, forest classification, and resource use patterns in the mentioned Matsigenka communities of the Picha River. The dialect of Matsigenka spoken on the Picha River is mutually intelligible with that spoken in Manu, but contains a number of dialect variants, including variation in some animal and plant names. In 1999, Shepard and Yu returned to the Manu for three months, armed with LANDSAT satellite images of the region (Shepard et al. in press). Mateo Italiano was our principal indigenous collaborator in the field during all field seasons, though many other Matsigenka also contributed invaluable assistance to this study (see Acknowledgments). Vouchers specimens, including many of the plant species mentioned in this text, have been deposited at the herbaria of Universidad Nacional de San Marcos, Lima, Universidad de San Antonio Abad, Cuzco, and in the reference collection of Robin B. Foster at the Field Museum of Natural History, Chicago. Species authors and voucher collection numbers, where available, are listed in the Appendix.

MATSIGENKA HABITAT CLASSIFICATION

When describing forest habitats, the Matsigenka use a rich and sophisticated vocabulary for designating vegetational and faunal characteristics as well as topographic, hydrologic, edaphic (soil-related), and other abiotic features. Criteria used to designate habitats are not organized into a single hierarchy, but are rather distributed throughout a number of parallel classificatory systems including biotic and abiotic variables. The multiple systems of habitat description intersect to define forest types. In Tables 1-12, Matsigenka habitat vocabulary[2] is organized according to a number of biotic and abiotic criteria: topographic and hydrologic features, disturbance regimes, soil types, vegetation types, and faunal habitat indicators. Habitat types in the tables are assigned reference numbers (hereafter, ref.) for convenience, as follows: prefix 'T' for topographic/hydrologic features (Tables 1 and 2); prefix 'D' for disturbance regimes (Table 3); prefix 'A' for higher-order categories or general classes of abiotic factors (Tables 1-3); prefix 'S' for soil types (Table 4); number only (no prefix) for vegetation types (Tables 5-11); and prefix 'F' for faunal indicators (Table 12). Tables 1-12 include detailed descriptions of the various abiotic and biotic habitat variables and associated vegetation. Table 13 presents a matrix of correspondence between biotic and abiotic variables and indicates which vegetation types are found in each of the study sites.

Because habitat definitions overlap to some extent, it is difficult to count the exact, total number of forest types recognized by the Matsigenka. Informants from five study communities named 76 biotically-defined habitats, some of which overlap, including 50 lowland primary forest types defined by indicator species (individual communities ranged from 38 to 43 types per community), seven kinds of secondary vegetation, six montane-only vegetation types, six forest types defined by overall vegetative aspects, and seven habitats defined by faunal associations. Furthermore, the Matsigenka distinguish 21 habitats defined by topography and hydrology, eight degrees of forest disturbance, and ten soil types affecting vegetation. Studying Table 13, it becomes apparent that some vegetation types are limited to specific topographic, drainage, soil, or disturbance conditions, while others are more widespread. Some vegetation types were noted in all five study communities, while others were restricted to a few communities or only one of the two study regions (Manu, Picha).

Habitat Classification: Abiotic Criteria.— Abiotic variables commonly noted by the Matsigenka fall into four broad categories: topography, hydrology, soils, and disturbance regimes. The categories, however, are not mutually exclusive, but rather depend closely on one another. Topographic and hydrologic features are used by the Matsigenka to distinguish two broad categories of habitats: floodplains (***ovogeshi***), and uplands/interfluvium (***nigankipatsa***). This broad geomorphologic distinction is incorporated into our organization of Tables 1 and 2, and corresponds with the general habitat classification scheme used by Western scientists (see Terborgh et al. 1996). Swamps and lakes (***inkaare***) appear to form a somewhat independent category, cross-cutting the upland/lowland distinction. Montane forests of the Andean foothills (***otishipaketira***) are treated as a separate category due to their distinctive topography, climate and vegetation (see Table 9). The

TABLE 1.— Habitats defined by topography and hydrology, part one: ***Ovogeshi***, 'floodplain forest'. Includes examples of associated vegetation

Ref.	Habitat	Translation	Associated Vegetation
A1	*Ovogeshi*	'Bend forest': i.e., in meander belt, floodplain of river or stream	Floodplain (riverine) forest, general term; also any lowland forest not included in a specific biotic/abiotic habitat type
T1	***otsegoa***	'branch': seasonally flooded island, branch of river	*Cecropia* spp. (***tonko, inkona***), *Ochroma* (***paroto***)
T2	***imparage***	open beach or wide stream bed with sparse vegetation	Sandy beach: *Tessaria* (***impomeri***), *Gynerium* (***savoro***) Rocky beach, sream beds: *Calliandra* (***kovanti***), *Crenea* (***pantyoporoki***), *Cassia* (***pochokiroshi***), *Senna herzogii* (***shimashiri***)
T3	***oaaku, otapiku***	'on the water': at water's edge 'on the bank': on or near river / stream bank	Along rivers: *Cecropia, Ochroma, Ficus* (***potogo***), *Cedrela* (***santari***), *Guadua* (***kapiro, yaivero***), *Urera* (***tanko***) Along streams: *Macrocnemum* (***niapashi***), *Inga* (***intsipa***), *Aulonemia* (***samatsi***), *Cyathea* (***tinkanari***)
T4	***osateni***	'where water gathers': seasonal canal, depression in floodplain	*Heliconia* (***sagonto***), *Bactris* (***shianti***), lianas (***shivitsasemai***), tangled vegetation (***narongashi***)
T5	***otonkoatera ovogeshiku***	'hill in floodplain': levee island	Floodplain near river on small rise forming island when river floods: *Cedrela* (***santari***), ***shinkipini*** (?)
T6	***nigankivoge***	'middle of bend': central floodplain at medium distance from river	Mature (late successional) floodplain forest, characterized by large trees: *Ceiba pentandra* (***pasaro***), *Gallesia integrifolia* (***shitiro***), *Dipteryx polyphylla* (***pageroroki***), *Sloanea* sp. (***terorivanteki***)
T7	***choeni ovogeshi, choeni otishi***	'a little floodplain, a little upland': transitional zone from floodplain to uplands	Mixed floodplain/upland elements; palms *Attalea butyracea* (***shevo***), *Socratea salazarii* (***kompapari***), *Wettinia* (***kepito***) are indicators of transition to uplands
T8	***ovogeshi niateni***	'stream floodplain': large stream gallery forest	Floodplain, gallery, upland elements condensed into a narrow floodplain
T9	***niateniku***	'along the stream': small stream gallery forest	Tree ferns (***tinkanari***), *Socratea exorrhiza* (***vakirintsi***), *Macrocnemum roseum* (***niapashi***)
T10	***inkaare***	lake/swamp, general term; types distinguished according to size, proximity to river, permanence and vegetation	Oxbow lake: aquatic grasses (***sampetashi, kentakorishi***), *Ludwigia* (***yogetsapini***), *Renealmia* (***porenki***) 'Renacal' swamp: *Ficus trigona* (***tiiroki***)

TABLE 2.— Habitats defined by topography and hydrology, part two: ***Nigankipatsa***, 'uplands'. Includes examples of associated vegetation. Dialect variants separated by slash (Manu/Picha).

Ref.	Habitat	Translation	Associated Vegetation
A2	***Nigankipatsa, Otishinapatsa***	'Middle earth' (between river basins), 'hilly earth'	Uplands, interfluvium (*terra firme*), general terms; also any uplands not included in a specific biotic/abiotic habitat type
(T10)	***inkaare***	lake/swamp (see Table 1)	Upland palm swamp: *Mauritia* (***koshi***), *Oenocarpus* (***sega***), *Euterpe* (***tsireri***) Seasonal upland swamp/lake: *Diplasia* (***imere***), aquatic grasses, (***sampetashi***), *Inga* sp. (***intsipa***), *Mauritia* (***koshi***), ant gardens (***sakaropini***)
T11	***osateni niateni***	'stream depression': swampy, ephemeral stream headwaters in poorly drained uplands	*Socratea exorrhiza* (***vakirintsi***), *Diplasia* (***imere***), *Mauritia* (***koshi***), *Cyathea* tree ferns (***tinkanari***), *Oenocarpus* (***sega***)
T12	***pampa***	'flat area': especially flat uplands, alluvial terrace	In uplands, usually with understory palms *Wettinia* (***kepito***), *Socratea salazarii* (***kompapari***), and/or *Geonoma* spp. (***chogina, tsikero, memerishi***)
T13	***agiringira, otonkoatera***	down slope, up slope (depending on speaker's perspective)	Slope specialists: *Aulonemia* bamboo (***samatsi***), *Styloceras*, (***pompoki***), *Phytelephas* (***kompiro***), *Sagotia* (***kovuvapini***)
T14	***otishi***	'hill': hill crest, ridge, mountain	Slope specialists; montane vegetation
T15	***imperita***	cliff, rocky outcrop; also uplands (*terra firme*) on cliff adjacent to river	Cliff: secondary growth, slope specialists: *Erythrina* spp. (***taiiri, songaare***), *Cecropia* spp. (***tonko, yaaro***) Rocky outcrop: ferns (***tsirompi***), orchids and bromeliads (***ananta***), moss (***tagamu***) Uplands adjacent to cliff: Upland forest (***nigankipatsa***)
T16	***okonteaatira***	spring, waterfall	Ferns (***tsirompi***), bromeliads (***ananta***), moss (***tagamu***)
T17	***oyashiaku***	headwaters; higher-elevation foothills, transition to montane habitat	Stream headwaters: small stream gallery forest, slope and rock specialists; higher-elevation species: *Hyospathe*(?) palm (***kapashi***), yellow *Guadua* bamboo (***kiteri kapiro***)
T18	***otishipaketira***	'many hills': Andean foothills	Montane vegetation (above 600 m); see Table 10
T19	***omarani otishi / chovivanteni otishi***	'large mountains' / 'high mountains'	High Andean vegetation

Matsigenka also distinguish primary forest (***inchatoshi***) from secondary or 'weedy' (***tovasiseku***) vegetation (Table 10), regardless of uplands/floodplain status. Matsigenka forest classification defies a strictly hierarchical organization, and reveals a number of intersecting classificatory principles which we have attempted to represent in the accompanying tables.

Many Matsigenka habitat terms, especially those referring to geomorphology and hydrology, are locative expressions, formed by adding the suffix ***-ku*** to nouns. For example, ***niateni***, 'stream' becomes ***niateniku***, 'in or alongside the stream', i.e., habitat found alongside streams. Also common in habitat vocabulary are locative-like verbal expressions formed with the subordinating suffix ***-ra*** ('the place where...', 'the time when...'): ***otarankira***, 'the place where a cliff has eroded'; ***omakaramangaitira***, 'the place where the soil is crunchy and has long hair' (i.e., accumulated *Spaghnum* moss growth).

Topography (Table 2). The lay of the land is of primary importance in Matsigenka forest classification. Matsigenka terminology includes words for slopes (***agiringira***, ***otonkoatira***, ref. T13), plains and plateaus (***pampa***, T12), rock and sandstone outcrops (***imperita***, T15), Andean foothills (***otishipaketira***, T18), and high mountains (***omarani otishi***, ***chovivanteni otishi***, T19). The people of the Picha River use the additional term ***ogisaamaguinteni*** ('blue to look at', much like our own Blue Ridge Mountains) to refer to forested foothills that appear blue from a distance. The word ***otishi*** (T14) is related to the anatomical term ***-tishita*** ('back, spine') and can be used to refer to ridges, hills, and mountain ranges as well as to the uplands in a general sense.

Many topographic features are associated with specific suites of vegetation. For example, steep ridge crests around Yomybato village frequently show an understory dominated by the trunkless palm *Phytelephas macrocarpa* (***kompiro***), a vegetation type known as ***kompiroshi*** (ref. 15). There is not necessarily a one-to-one correspondence between topographic features and vegetation, however. For example, some ridge crests have vegetation other than ***kompiroshi***, while ***kompiroshi*** may also occur in lowland forest near the river.

Hydrology (Tables 1 and 2). The Matsigenka word for water (***nia***) also refers to rivers (***nia***) and streams (***niateni***). Water regimes play a crucial role in shaping forest habitats. Seasonal patterns of rainfall, rising and falling river waters, flooding frequency, and long-term river dynamics are especially important. The Matsigenka have terms that refer to seasonally inundated islands and peninsulas (***otsegoa***, ref. T1), sandy and rocky beaches (***imparage***, T2), and river and stream flood plains in general (***ovogeshi***, Table 1). Distance from the river and frequency and severity of flooding are important factors influencing vegetation. The Matsigenka distinguish habitats found at the water's edge (***oaaku***, T3), along river and stream banks (***otapiku***, T3), at medium distance from the river within the floodplain (***nigankivoge***, T6), and transitional areas from lowland to upland forest (***choeni ovogeshi/choeni otishi***, T7 where seasonal flooding is rare or less severe. The Matsigenka distinguish between the wide, flooded forest of large rivers (***ovogeshisano***, 'true floodplain forest'), the narrower gallery forest of tributary rivers and large streams (***ovogeshi niateni*** 'stream floodplain', T8), and small stream gallery forests (***niateniku***, 'along the stream', T9).

The uplands or terra firme[3] forests are located on the high ground between

TABLE 3.— Habitats defined by disturbance regimes, with examples of associated vegetation.

Ref.	Habitat	Translation	Associated Vegetation
A3	***Karapage***	'Opening, clearing'	Deforested area, general term; forest with open or disturbed canopy or understory; natural forest openings, often ant-plant mutualisms or dry lake beds, some believed to be the villages of invisible guardian spirits (***Saangariite***)
D1	***apamankera nia***	'place of inundation, flooding'	Area subjected to flooding during rainy season, floodplain (***ovogeshi***) as well as upland swamps and rainwater lakes (***inkaare***); vegetation determined by frequency and severity of flooding: ***pairani apamankera***, 'flooded long ago'; ***choeni apamankera***, 'floods a little'; ***magatiro apamankera***, 'floods everything'; ***osateni***, 'water gathers', i.e., standing water during rainy season; ***okenati nia***, 'river runs through it', i.e., seasonal canal, or permanent cut-off of meander loop
D2	***otarankira***	'place of erosion': landslide, cliff	Secondary growth: *Cecropia* spp. (***yaaro, tonko, inkona***), *Erythrina* spp. (***taiiri, songaare***), lianas (***shivitsasemai***), tangled growth (***narongashi***)
D3	***oterongera inchato***	'where a tree fell over'	Gaps caused by tree falls; recent gaps have weeds (***tovaseri***), tangled growth (***narongashi***), vines and lianas (***shivitsasemai***); older gaps have *Cecropia sciadophylla* (***yaaro***), *Capirona* (***kapirona***), other pioneer species
D4	***potagarine***	'burnt hillside'	Hillsides at high elevations with moss (***kamu***), ferns (***tsirompi***) or grass (***shimpenashi***) showing signs of disturbance by fire
D5	***tsamairentsi***	'place of work,' new swidden garden	Recently cleared and planted swidden, actively weeded (1-2 years)
D6	***magashipogo***	productive swidden from prior years	Swidden from prior years (2-15+ years), not weeded, with secondary growth but producing fruit trees and other slow-growing cultigens: *Bactris gasipaes* (***kuiri***), *Inga edulis* (***intsipa***), *Bixa orellana* (***potsoti***),*Tephrosia* (***kogi***)
D7	***pairani magashipogo***	old swidden fallow	Mature secondary or "primary" forest regrown from old or ancient swidden fallow; recognized by historical knowledge, secondary growth (*Cecropica*, etc.) or by presence of hardy cultigens like ayahuasca (*Banisteriopsis*, ***kamarampi***) barbasco (*Tephrosia*, ***kogi***)
D8	***inchatoshi***	'tree leaves': forest, primary forest	Forest, general term; "primary" forest; forest with large-diameter trees that has largely recovered from past disturbance

river basins, beyond the reach of seasonal flooding. The Matsigenka use several words to refer to upland terra firme habitats in general. ***Nigankipatsa*** (Table 2) means literally 'middle earth' or 'land between,' i.e., land between river basins, and is similar to the geological term interfluvium. The term ***otishinapatsa*** (Table 2) means literally 'elevated, hilly earth', implying both elevation and rugged topography, and can also be used as a general term for the uplands. In some instances the term ***otishi*** ('ridge, hill', ref. T14) may also be used in a general sense to refer to the uplands.

Other hydrologic terms refer to seasonally waterlogged depressions or canals in the floodplain (***osateni***, T4), springs and waterfalls (***okonteaatira***, T16), river and stream headwaters (***oyashiaku***, T17), and the swampy headwaters of ephemeral streams in the uplands (***osateni niateni***, T11). The Matsigenka distinguish vegetation associated with several kinds of lakes and swamps (***inkaare***, T10), including semi-permanent oxbow lakes and backwater swamps in the river floodplain, and seasonal lakes or swamps formed by the accumulation of rainwater in flat, poorly drained upland areas.

Disturbance regimes (Table 3). Western Amazonian river floodplains are in a constant state of transition as the river undermines land in some places and deposits sediments in others, provoking a steady wave of forest disturbance and regeneration. Occasionally, the river cuts off a loop (***okenati nia***, 'the water flows across') as it seeks a new course, shifting real estate from one bank to the other and isolating former river meanders to form oxbow lakes. The Matsigenka are well aware of these processes and their long-term effects. Though individuals may not have seen the formation of a particular oxbow lake (***inkaare***) or river bend (***onkuiaatira***) during their lifetime, they have an accurate idea of how these features were formed. Matsigenka informants often remark on the dynamic nature of the forest, for example by noting that the mature lowland forest in which they stand may once have been an open stretch of beach flanked by *Gynerium* cane thickets (***savoroshi***, ref. 29), or by musing about the future of a particularly nice piece of flat uplands near a cliff, fated eventually to erosion and collapse into the river.

The Matsigenka are also expert observers of shorter-term disturbance patterns such as seasonal flooding (***apamankera nia***, ref. D1), forest succession in gaps caused by tree falls (***oterongira inchato***, D3), landslides (***otarankira***, D2), wind storms, lightning strikes, and natural fires as well as human agricultural activities (refs. D5-D7). Matsigenka of the Picha River described 'burnt mountainsides' (***potagarine***, D4), high-elevation areas characterized by moss and grasses that apparently catch fire on especially dry years. The Matsigenka consider certain small, natural forest clearings (***karapage***, Table 3) to represent the village and gardens of the invisible guardian spirits, the ***Saangariite***.

The term ***inchatoshi*** (D8) means literally 'tree leaves', but can be used in a general sense to refer to forest, and more specifically, to "primary" forest, that is, forest that has many large-diameter trees and has largely recovered from any past disturbance. Contrasting with primary forest is a set of terms referring to various stages of forest regeneration in tree-fall gaps, garden clearings, and other forms of disturbance (see Table 9).

Soils (Table 4). The Matsigenka often examine the soil of forest habitats, espe-

TABLE 4.— Soil vocabulary, indicating agricultural suitability and examples of associated habitats.

Ref.	Term	Translation	Agricultural Suitability, Associated Habitats
S1	***jenkivane***	sandy loam	Preferred for manioc, barbasco fish poison; found especially in flat uplands (***pampa***)
S2	***potsitapatsa***	'black earth': river sediments, humus	Preferred for peanuts and plaintains; found in river and stream flood plain (***ovogeshi***)
S3	***kiteri kipatsi***	'yellow earth': yellow (ferralitic?) soils	Suited for agriculture but not ideal; found in uplands, hills (***otishi***)
S4	***impaneki***	sand, beach	Preferred for watermelons, peanuts; aquatic beach vegetation: *Tessaria* (***impomeri***), *Gynerium* (***savoro***)
S5	***sokopane***	white sand soils	Agricultural suitability unknown; rare in uplands, white sand soils with small trees (***otyomiaige inchato***), lianas (***shivitsasemai***), *Oenocarpus* (***sega***)
S6	***kiraapatsa***	'red earth': red clay or red clay/sand loam	Suitable for agriculture if clay content not too high; red clay used for ceramics; hilly uplands (***otishi***); stream floodplains (***niateniku***), animal mineral licks (***itsimini***)
S7	***kusomiriakipatsa***	'hard lumpy earth': i.e., contractile clay soil	Clay soil that forms hard lumps when dry, poor for agriculture; with *Guadua* sp. (***yaiveroshi***), animal mineral licks (***itsimini***)
S8	***inkaarepatsa, jampovatsa***	'swamp/lake earth': mud 'mud'	Poor for agriculture; swamp vegetation: *Mauritia* (***koshi***), *Ficus trigona* (***tiiroki***), *Diplasia* (***imere***), grasses (***sampetashi, kentakorishi***), *Renealmia* (***porenki***), other aquatics
S9	***mapuseku***	rocky soil	Usually poor for agriculture, except in slightly to moderately rocky uplands; beach vegetation: *Cassia* (***pochokirontoshi***), *Senna* (***shimashiri***), Tessaria (***impomeri***); extremely rocky soils in uplands: lianas (***shivitsa***), small trees (***otyomiaige inchato***); rocky hillsides, stream banks: moss (***tagamu***), ferns (***tsirompi***), orchids and bromeliads (***ananta***)
S10	***omakaramangaitira***	'crunchy long-haired soil': i.e., thick accumulation of moss (poor for agriculture)	Agricultural suitability unknown; montane, cloud forest with moss (***tagamu***), ferns (***tsirompi***), orchids and bromeliads (***ananta***)

cially when selecting sites to clear for agriculture (Johnson 1983). The general word for soil, ***kipatsi***, also refers to dirt, clay and pottery, land, ethnic territories or countries, and the world as a whole, much like the English word 'earth'. The Matsigenka distinguish soils according to color, texture, composition (especially clay/sand ratio), and drainage properties. Most terms for soil types include the suffixes -***patsa***, referring to fleshy substances (earth, clay, meat, fruits, bodies), or -***pane*** (-***vane*** in some phonetic environments) referring to powders (ash, sand, tobacco snuff). Specific soil types recognized by the Matsigenka include sandy loam (***jenkivane***, ref. S1), black river sediments (***potsitapatsa***, 'black earth', S2), yellow soils (***kiteri kipatsi***, 'yellow earth', S3), beach sand (***impaneki***, S4), alluvial white sand soils (***sokopane***, S5), red clay soils (***kiraapatsa***, 'red earth', S6), contractile clay soils (***kusomiriakipatsa***, 'hard lumpy earth', S7), mud (***jampovatsa***, 'mud' or ***inkaarepatsa***, 'swamp/lake earth', S8), rocky soils (***mapuseku***, S9), and the spongy or crunchy soils (***omakaramangaitira***, S10) created by moss accumulation at high elevations. Soil drainage properties strongly affect vegetation and are especially important in indicating suitability for agriculture: well-drained, sandy loam in the uplands is generally preferred for manioc and corn cultivation, while upland ridges are ideal for planting barbasco fish poison (*Tephrosia* spp.). Wetter, black lowland soils are preferred for plantains and peanuts. Poorly drained soils are unsuitable for agriculture, and are indicated by specific suites of vegetation.

Habitat Classification: Biotic Criteria.— Abiotic factors interact with biotic processes (*e. g.*, predation, growth, dispersal, and competition), historical events, and human manipulation to shape the species composition and physical structure of a particular habitat. Within the broad habitat categories defined by abiotic variables, the Matsigenka use biotic criteria to achieve a finer level of differentiation. Matsigenka terminology for vegetation types and other biotic indicators is especially rich and nuanced. Biotically-defined habitats are distinguished according to dominant or indicator species (Tables 5-10), overall vegetative aspect or 'phytoarchitecture' (Table 11), and faunal indicators (Table 12).

Most Matsigenka vocabulary items referring to vegetative features include the suffix -*shi*, 'leaf/leaves'. In other contexts, the suffix is used to specify the leaf (as opposed to some other part) of a plant, or acts as a numeral classifier (Shepard 1997). In the case of habitat vocabulary, the suffix -***shi*** is used in a collective sense, indicating that a given species or vegetative feature is dominant or highly salient in a certain habitat. For example, ***kapiroshi***, means literally '***kapiro*** bamboo leaves', but in the context of habitat classification refers to forests dominated by stands of this bamboo (*Guadua weberbaueri*). Many Matsigenka terms for vegetation types refer to such dominant or indicator species, as presented in Tables 5-10.

We have divided indicator species into a number of naturally and perceptually-defined sub-groups: palms (Table 5); bamboos (Table 6); ferns and herbs (Table 7); trees and shrubs other than palms (Table 8); secondary or weedy growth (Table 9); and montane vegetation (Table 10). Some of these groupings reflect named intermediate categories in Matsigenka ethnobotanical classification: ferns (***tsirompi***), herbs (***inchashi***), secondary growth/weeds (***tovaseri***). Other groupings (palms vs. other trees) are natural and salient, but do not correspond to Matsigenka classificatory habits: the term ***inchato***, 'tree', refers to trees including palms, while

TABLE 5.— Habitats indicated by palm species, and their uses. Dialect variants separated by slash (Manu/Picha).

Ref.	Vegetation	Translation	Description	Uses
1	***tirotishi***	*Astrocaryum murumuru* forest	Floodplain only, where *A. murumuru* (***tiroti***) is common, sometimes dominant in understory	edible endocarp, palm heart; palm weevils
2	***shevoshi***	*Attalea butyracea* forest	Transition from floodplain to uplands	roof thatch
3	***tsigaroshi***	*Attalea phalerata* forest	Floodplain only, *A. phalerata* (***tsigaro***) often occurs in stands	edible endocarp, heart; palm weevils; thatch
4	***kontashi***	*Attalea tesmannii* forest	Rare, patchy, occurs along stream banks	edible endocarp; mesocarp carved for pipes, ornaments
5	***shiantishi***	*Bactris concinna* forest	Dense stands of spiny *B. concinna* (***shianti***) along seasonally waterlogged canals, depressions (***osateni***), especially in floodplain	edible mesocarp
6	***tsirerishi***	*Euterpe precatoria* forest	*E. precatoria* var. *precatoria* (***tsireri***), var. *longevaginata* (***suana***) stands in poorly drained uplands, w/ *Oenocarpus* (***sega***), *Mauritia* (***koshi***)	edible mesocarp, heart
7	***tsikeroshi / choginashi***	*Geonoma deversa* forest	Flat uplands with dense understory of *Geonoma deversa* (***tsikero / chogina***)	thatch
8	***tyonkintoshi / chigeroshi***	*Geonoma maxima* forest	Flat uplands with dense understory of *Geonoma maxima* (***tyonkinto / tsikero***)	thatch
9	***memerishi / metakishi***	*Geonoma brongniartii* forest	Hilly uplands, higher elevations, dense understory of *Geonoma brongniartii* (***metakishi***)	thatch
10	***kapashi***	*Hyospathe* (?) sp. forest	Hill crests at higher elevations, dense understory of *Hyospathe* (?) sp. (***kapashi***)	thatch
11	***kamonashi***	*Iriartea deltoidea* forest	Common in floodplain and uplands, *I. deltoidea* (***kamona***) occurs in stands especially in flooplains	palm heart; palm weevils; trunk: keg for manioc beer
12	***koshishi / toturokishi***	*Mauritia flexuosa* forest	Swamps ('aguajal') dominated by *M. flexuosa* (***koshi***, ***toturoki***) in floodplain or wet uplands	edible mesocarp; important habitat for hunting
13	***kinirishi***	*Mauritiella* sp. forest	Swamps with *Mauritiella* sp. (***kiniri***), *S. exorrhiza* (***kontiri***), *Euterpe* (***tsireri***.); not found in Manu	edible mesocarp; important habitat for hunting
14	***segashi***	*Oenocarpus bataua* forest	*O. batahua* (***sega***) in swampy uplands, sometimes with *Mauritia* (***koshi***) or *Euterpe* (***tsireri***); also on white sand (***sokopane***), montane forest near lakes	edible mesocarp, heart; meristem fibers used as kindling
15	***kompiroshi***	*Phytelephas macrocarpa* forest	Especially on hill crests, also in floodplain	edible immature endocarp
16	***vakirintsishi / kontirishi***	*Socratea exorrhiza* forest	Moist areas, especially stream gallery forest and stream headwaters	spiny aerial root used as coarse grater
17	***kompaparishi / konkaparishi***	*Socratea salazarii* forest	Widespread in uplands, especially flat areas	spiny aerial root used as fine grater; temporary thatch
18	***kepitoshi***	*Wettinia augusta* forest	Widespread in uplands at higher elevations, especially flat areas	edible mesocarp; temporary thatch

inchaki, 'stick, shrub', refers to shrubs and small trees, including small palms. Bamboos may represent an unnamed or "covert" intermediate category (see Berlin 1992), since they are considered to be neither trees (***inchato***), nor shrubs (***inchaki***), nor herbs (***inchashi***), nor lianas (***shivitsa***). The distinction montane vs. lowland is salient in Matsigenka classification of vegetation, as discussed below under "Perceptual Criteria."

It seems significant that palms, bamboos, grasses, and other Monocots are so prominent as indicator species in Matsigenka forest classification. Of 50 primary forest vegetation types recognized by the Matsigenka (Tables 5-8), a total of 33 are designated according to the presence of Monocot indicator species, 18 of which are palms. Many palms and other Monocots are colonial, abundant, or highly apparent in the understory, making them salient as indicator species. It also appears that certain palm, bamboo, grass, and other Monocot species have adaptations for specific soil or drainage properties, making them useful as indicators for some habitat type (Gentry 1988a; Encarnación 1993; Clark, Clark and Read 1998).

Palm Forests (Table 5). Palms are especially important economic species for the Matsigenka (see Table 5) and other indigenous groups of Amazonia (Balick 1984). Some of the palm forests recognized by the Matsigenka have been described in the scientific literature (Foster 1990a), for example *Mauritia flexuosa* palm swamps (***koshishi***, ref. 12), and *Attalea murumuru* (formerly *Astrocaryum*) and *A. phalerata* (formerly *Scheelea*) stands in mature lowland forest (***tirotishi***, ref. 1; ***tsigaroshi***, ref. 3). *Attalea butyracea* stands (***shevoshi***, ref. 2) occur in transitional areas between lowlands and uplands, and are harvested as thatch material for temporary shelters, for example seasonal fishing camps on the beach. Moist forests and swamp borders often contain the important edible palms (fruit and heart) *Euterpe precatoria* (***tsirerishi***, ref. 6) and *Oenocarpus batahua* (***segashi***, ref. 14). Seasonal water courses (***osateni***, ref. T4) in the floodplain or uplands are dominated by lianas and dense stands of spiny *Bactris concinna* (***shiantishi***, ref. 5). Hill crests as well as certain stream floodplains contain a dense understory of the palm *Phytelephas macrocarpa*

TABLE 6.— Habitats indicated by bamboo species.

Ref.	Term	Translation	Description
19	***samatsishi***	*Aulonemia* sp. forest	Forest dominated by non-spiny bamboo *Aulonemia* (***samatsi***), uplands and slopes
20	***songarentsishi***	*Chusquea* spp., *Olyra* spp. forest	On slopes, also montane; small bamboo species (***songarentsi***)
21	***manipishi***	*Guadua angustifolia* forest	Single species stands of large diameter, spiny bamboo *G. angustifolia* (***manipi***) near river margin
22	***kapiroshi***	*Guadua weberbaueri* forest	Forest dominated by spiny bamboo *G. weberbaueri* (***kapiro***); occurs in large areas in floodplain and uplands
23	***yaiveroshi***	*Guadua glomerata* forest	Low canopy forest dominated by spiny bamboo *Guadua glomerata* (***yaivero***); floodplain only, especially on clay soils
24	***shinkeroshi***	*Guadua* sp. forest	Forest dominated by spiny bamboo *Guadua* sp. (***shinkerokota***); uplands only

(***kompiroshi***, ref. 15), which has a white endocarp that is edible when immature, and which later hardens into what is known as vegetable ivory or tagua.

Other palm forests do not appear to have been documented by scientists yet, probably because the Matsigenka live at higher elevations in interfluvial areas that are not easily accessible to research teams. For example, upland forests beginning at approximately 450 m elevation on Manu tributaries and along the Picha River are dominated by the understory palm *Wettinia augusta* (***kepitoshi***, ref. 18), previously consider rare for the Manu River. ***Kepitoshi*** is synonymous with flat, well drained uplands for the Matsigenka, and is characterized by loose, sandy soils, making it the preferred forest type to clear for swidden agriculture. Similar forests at slightly lower elevations along the main course of the Manu are dominated by a different understory palm, *Socratea salazarii* (***kompaparishi***, ref. 17). Some flat uplands contain scattered stands of various *Geonoma* species (***tsikero***, ref. 7; ***tyonkinto***, ref. 8; ***memerishi***, ref. 9), all used as roof thatch. Along ridges at higher elevations (approximately 600-700 m elevation) in headwater regions, ***kapashi*** (*Hyospathe* sp.?, ref. 10) palm stands are found, a preferred roof thatch material due to the large leaf size. The palm *Attalea tessmanii* (***kontashi***, ref. 4) is found quite rarely (two stands or less per community visited) in small clusters along stream banks. The palm contains a delicious, almond-like nut guarded within a hard mesocarp that is used to make tobacco pipes and other craft items. Because the ***konta*** palm is both valued and rare, the Matsigenka identify and remember the location of ***kontashi*** stands throughout a large area.

Bamboo Forests (Table 6). Bamboo forests are among the easiest to identify from satellite imagery of Amazonia (Nelson 1994). Nonetheless, the taxonomy and ecology of Amazonian bamboos remains poorly studied, since flowering and fruiting events for some species occur at great intervals, at least 15-30 years in the case of certain *Guadua* species. The Matsigenka describe six bamboo-dominated forest types, and recognize six folk taxa of bamboos within the scientific genus *Guadua*, some of which may not yet have scientific names. *Guadua angustifolia* (***manipishi***, ref. 21) is the largest of the local bamboos, with tall, elegant stems that can exceed 10 cm in diameter and 12 m in height. Occurring only along smaller tributary rivers, ***manipi*** forms small, circular, single-species stands surrounded by thorny branch shoots reminiscent of barbed wire. Stands of the spiny bamboo *Guadua weberbaueri* (***kapiroshi***, ref. 22) dominate much of the upland forests in both the Manu and especially the Picha study sites, and is readily identifiable on satellite imagery of both regions (Shepard et al. in press). *G. weberbaueri* is an important economic species, used in the manufacture of arrow points (***kapirokota***).

Yaiveroshi (ref. 23) appears to refer to *G. glomerata*, having narrower leaves and stems than *G. weberbaueri*. It occurs less commonly in medium to large stands on contractile clay soils, what the Matsigenka describe as 'hard, lumpy earth' (***kusomiriakipatsa***, ref. S7) because of its tendency to form discrete lumps when dry. The Matsigenka observe that contractile clay soils and ***yaiveroshi*** are associated with macaw clay licks (***irapitari kimaro***, ref. F1), which form on the eroding side of river banks. ***Shinkeroshi*** (ref. 24) or ***shinkerokota*** is an unidentified *Guadua* species (possibly *G. sarcocarpa*) forming stands much like *G. weberbaueri* in some upland areas. In addition to these taxa, the Matsigenka name two additional folk

TABLE 7.— Habitats indicated by ferns and herbs. Montane-only vegetation not included (see Table 10). Dialect variants separated by slash (Manu/Picha).

Ref.	Term	Translation	Description
25	***tinkanarishi***	*Cyathea* spp. (tree fern) forest	Tree fern (***tinkanari***) found in dense to diffuse stands along stream beds, in stream gallery forest; also montane
26	***tsirompishi***	Pteridophyta (fern) stands	Patches of miscellaneous fern species in moist or rocky areas in stream gallery forest, uplands; also montane
27	***itsirianeshi matsontsori***	*Aechmea* sp. forest ('jaguar's pineapple plantation')	Small, dense stands of pineapple-like Bromeliad *Aechmea* (***itsiriane matsontsori***, 'jaguar's pineapple') in understory
28	***imereshi***	*Diplasia* sp. forest	In moist to swampy areas, understory with *Diplasia* (***imere***), also known as ***saviripini***, 'machete plant' due to its sharp edges
29	***savoroshi***	*Gynerium saccharoides* stand	Common beach, river bank vegetation, cane thicket often just behind *Tessaria* (***impomerishi***) zone
30	***chakopishi***	*Gynerium sagittatum* stand	Less common, beach vegetation along upper river course, also planted in old gardens; reed for arrow shafts (***chakopi***)
31	***sagontoshi***	*Heliconia metallica* forest	In floodplain, especially in seasonal canals, depressions between levee islands
32	***tsipanashi***	Marantaceae spp. forest	Floodplain, uplands near streams; *Ichnosiphon, Calathea*, other Marantac spp. leaves (***tsipana***) used to steam food
33	***shimpenashi, tiposhi***	Poaceae spp. (grasslands)	Grass and small bamboo species *Paspalum* (***shimpenashi***), *Pariana* (***tiposhi***) in permanent clearings, on eroded slopes; (also montane , Andean 'pajonal' grasslands; Table 10)
34	***sampetashi / kentakorishi***	Poaceae spp. (aquatic grasses)	Aquatic vegetation in lakes, swamps
35	***porenkishi***	*Renealmia* sp. stand	Edge of swamps, lakes; aquatic weeds: ginger-like *Renealmia* (***porenki***), fuchsia-like *Ludwigia* (***yogetsapini***)
36	***impomerishi***	*Tessaria integrifolia* stand	Open beach vegetation, sometimes with *Senna* (***shimashiri***); before *Gynerium* (***savoroshi***) cane thicket

species or varieties related to *G. weberbaueri* (***kapiro***, ref. 22), but which occur only in headwater regions at higher elevations: ***kirajari kapiro***, ('red *Guadua*'), preferred for arrow-points due to its anticoagulant properties, and ***kiteri kapiro*** ('yellow *Guadua*'), noted for its glossy, yellow stem. The non-spiny bamboo *Aulonemia* (***samatsishi***, ref. 19) is a specialist of slopes and disturbed uplands. Like *Guadua*, *Aulonemia* undergoes synchronous flowering, fruiting, and die-back throughout a life cycle that can span decades. Similar to *Aulonemia*, the montane bamboo *Chusquea* (***songarentsi***, ref. 20) was described by the people of the Picha river as occurring in Andean foothills (***otishipaketira***, T18).

Fern and Herb Indicator Species (Table 7). A number of grasses occur in fairly dense stands, mostly in disturbed or inundated areas with few or no trees. Lakes (***inkaare***, T10), including oxbow lakes in the river meander belt and smaller, seasonal rainwater lakes in the uplands, are often dominated by aquatic grasses (***sampetashi***, ref. 34). Terrestrial grasses (***shimpenashi***) and grassy bamboos (***tiposhi***, ref. 33) are found in permanent clearings, on slopes, and in montane and Andean 'pajonal' grasslands. Cane thickets of *Gynerium saccharoides* (***savoroshi***, ref. 29) occur along beach margins just inland from stands of the treelike Compositaceae *Tessaria integrifolia* (***impomerishi***, ref. 36). Arrow cane, *G. sagittatum* (***chakopishi***, ref. 30) is less common, occurring in natural stands along the upper course of rivers and in cultivation in garden fallows. This cane is used in the manufacture of arrows (***chakopi***), and is harvested principally in December and January after it has flowered and fruited.

Ferns and other herb species may occur in distinctive stands in the forest understory, and are used as habitat indicators. The tree fern *Cyathea* (***tinkanarishi***, ref. 25) is a prime indicator of small stream gallery forests (***niateniku***, T9). Other ferns (generically known as ***tsirompishi***, ref. 26) occur in moist or rocky areas and montane habitats. *Heliconia metallica* stands (***sagontoshi***, ref. 31) occur in moist, slightly depressed areas between levee islands in the floodplain, usually parallel to the river. Stands of various Marantaceae species (***tsipanashi***, ref. 32) occur in somewhat moist areas in the floodplain and uplands. The leaves of some Marantaceae (mostly *Calathea* and *Ichnosiphon*) are used to wrap food for steaming. The turmeric relative *Renealmia* (***porenkishi***, ref. 32) occurs in moist areas, especially along swamp and lake borders. The leaves are used to steam fish, imparting their spicy flavor, and the yellow root is used as a dye as well as for various medicinal purposes. The pineapple relative *Aechmea* occurs in the uplands in small stands known as 'jaguar's pineapple plantation' (***itsirianeshi matsontsori***, ref. 27). Moist upland areas and swamp borders contain the razor-edged sedge *Diplasia* (***imereshi***, ref. 28), also known as ***saviripini***, 'saber plant', wrapped around machete blades in the belief that they will maintain a sharp edge.

Other Indicator Species (Table 8). Several habitats recognized by the Matsigenka are defined by the presence of shrubs and understory trees other than palms. Slopes between upland terraces in the Picha River are dominated by stands of the small tree *Sagotia* (***kovuvapishi***, ref. 50), usually mixed with the palm *Wettinia augusta* (***kepitoshi***, ref. 18). At higher elevations on slopes towards stream headwaters in the Picha region, there occurs a low canopy forest two small Clusiaceae tree species, *Chrysochlamys ulei* (***kachopitokishi***, ref. 43) and *Tovomita weddeliana*

TABLE 8.— Habitats indicated by tree species other than palms. Secondary and montane vegetation not included (see Tables 9, 10). Dialect variants separated by slash (Manu/Picha).

Ref.	Term	Translation	Description
37	***matsityananashi***	*Alibertia pilosa* forest	Floodplain near river; open understory w/ *A. pilosa* (***matsityanana***), *Randia armata* (***kitsogirontsipini***), *Psychotria* sp. (***orovampashi***), *Phytelephas* (***kompiro***)
38	***toaroshi***	*Apuleia leiocarpa* forest	Uplands, near streams or in old disturbed areas
39	***kovantishi***	*Calliandra amazonica*	Along steep, rocky banks of tributary rivers, large streams; branches of *C. amazonica* (***kovanti***) hang over water
40a	***setikoshi / inkonashi***	*Cecropia membranacea* forest	Floodplain by river; first stage of forest succession after beach, some times with *Ochroma lagopus* (***paroto***), *Tachigali* spp. (***makotaniro***), *Triplaris americana* (***kanai***)
40b	***tonkoshi***	*Cecropia polystachya* forest	Branch islands, disturbed areas along river or stream; much like *C. membranacea* (***setikoshi***), sometimes used interchangeably with ***setikoshi***
41	***santarishi / santavirishi***	*Cedrela odorata* forest	Successional forest on levee island or by river, often with *Ficus* spp. (***potogo***)
42	***pariashi***	*Cedrelinga caeteniformis* forest	Flat uplands, diffuse stand (old seed shadow?) of canopy tree *C. caeteniformis* (***paria***) with dense palm understory
43	***kachopitokishi***	*Chrysochlamys* cf. *ulei* forest	On slopes at higher elevations near stream headwaters; understory of *C. ulei* (***kachopitoki***), *Tovitoma weddeliana* (***tegarintsipini***) and *Wettinia augusta* (***kepito***)
44	***piamentsishi / pakitsashi***	*Clavija* cf. *longifolia* forest ('bow plant', 'eagle plant')	On slopes with *Aulonemia* (***samatsi***), stands of understory treelet *C. longifolia* used as hunting medicine
45	***taiirishi, songaareshi***	*Erythrina* spp. forest	Successional growth on river bank, eroding cliffs: *Erythrina* spp. (***taiiri*** [orange flowers]; ***songaare*** [purple]), also *Luehea* sp. (***koshirite***), *Cassia/Senna* spp. (***shimashiri***)
46	***potogoshi***	*Ficus* spp. forest (especially *F. insipida*)	Successional forest by river or stream, often with *Cedrela* (***santari***), just beyond beach or*Cecropia* (***inkona***) zone
47	***tiirokishi***	*Ficus trigona* swamp	Floodplain swamp ('renacal') dominated by *F. trigona* (***tiiroki***), other aquatic species
48	***koñorishi / konorishi***	*Hevea brasiliensis* forest	Flat uplands, palm understory, with *H. brasiliensis*, 'India rubber' (***koñori***), *Protium* (***tsivaki***), *Parkia* (***sampoa***)
49	***intsipashi***	*Inga* spp. forest	Water-adapted *Inga* spp. (***intsipa oaaku***) along the forest border of swamps and small lakes
50	***kovuvapishi***	*Sagotia* sp. forest	On slopes with *Wettinia*, ref. 18 (Picha River only)

(***tegarintsipini***), also mixed with *Wettinia* (***kepitoshi***, ref. 18). In the Manu, neither of these forest types were found to occur. Instead, slopes and ridges were found to contain the small tree *Clavija longifolia* in the understory (***piamentsishi***, ref. 44).

The Matsigenka name for the understory shrub *Alibertia pilosa* is ***matsityananashi***, which appears to mean 'sorcerer's *Genipa*' (the exact etymology is somewhat unclear, but the presence of the noun stem ***ana***, '*Genipa*', is unmistakable). In fact related to the fruit tree *Genipa*, *Alibertia* forms distinct stands dominating an otherwise open understory in river and stream floodplains of the Manu. Fleck and Harder (2000) note similar stands of the closely related shrub *Duroia hirsuta*, known as 'devil's swidden' to the Matses Indians. The dominance of *Duroia* may be due to the presence of chemical constituents released by the plant that inhibit the

TABLE 9.— Secondary or 'weedy' (***tovasiseku***) vegetation. Dialect variants separated by slash (Manu/Picha).

Ref.	Vegetation	Translation	Description
	Tovasiseku:	'Place of weeds'	Weedy secondary growth
51	***tovaseri***	'weeds'	Weeds (***tovaseri***), especially along trails, around house clearings, and in swidden gardens; also any weedy secondary growth
52	***narongashi***	'tangled leaves': dense secondary growth	Dense, weedy undergrowth of herbs, shrubs, creeping vines and lianas; especially in recent treefall gaps, swidden fallows
53	***shivitsasemai***	'matted lianas': liana forest	Floodplain, stream gallery or slope forest with thick, woody lianas in understory, especially *Uncaria* spp. (***shamento***), *Davilla nitida* (***tsororoapini***), Bignoniaceae in areas of past flooding, erosion
54	***yaaroshi***	*Cecropia sciadophylla* forest	Secondary forest with *C. sciadophylla* (***yaaro***), other pioneer species; old garden fallows, large wind blow-downs; also in montane forest on slopes
55	***shintishi***	*Guazuma crinita* forest	Low-canopy secondary forest with *G. crinita* (***shinti***), other weedy and pioneer species in swidden fallows
56	***kogi oshivokera***	*Tephrosia* sp. ('where fish poison grows')	"Primary" forest regrown from old or ancient swiddens, recognized by presence of barbasco fish poison (***kogi***)
57	***pugoroshi***	*Vernonia* forest	Young secondary growth with *Vernonia* spp., other weedy species in recent swidden fallows

growth of competing seedlings (Page, Madriñan and Towers 1994 cited in Fleck and Harder 2000). Though not documented, similar processes may be involved in the formation of the *Alibertia pilosa* stands noted by the Matsigenka.

Other forest habitats are indicated by the presence of salient, sparsely abundant emergent trees. These include important timber species *Cedrela odorata* (***santarishi***, ref. 41), occurring in early successional forest along the river's edge, and *Cedrelinga cataeniformis* (***pariashi***, ref. 42), occurring in flat uplands. Both species, used in the manufacture of dugout canoes by the Matsigenka, are abundant in the Manu, but are threatened or locally extinct wherever commercial logging activities are present. *Hevea brasiliensis*, the famous "India rubber" that provoked feverish exploitation throughout the Amazon basin at the turn of the 20th century, occurs in stands (***koñorishi***, ref. 48) in flat upland areas of the Manu and Picha. Some stream gallery and disturbed forests along Manu tributaries were found to contain diffuse stands of the leguminous tree *Apuleia leiocarpa* (***toaroshi***, ref. 38), previously considered rare for Manu.

Secondary Forest (Table 9). Secondary or 'weedy' growth (***tovaseri*** ref. 51) is treated as a separate category by the Matsigenka, contrasting with the category of primary forest (***inchatoshi***, D8). Specific secondary vegetation types include various stages of forest regeneration in garden fallows dominated by weedy pioneer trees such as *Guazuma* (***shintishi***, ref. 55), *Vernonia* (***pugoroshi***, ref. 57), and *Cecropia sciadophylla* (***yaaroshi***, ref. 54). The Matsigenka also recognize old garden fallows in apparently primary forest, belied by the presence of the cultivated fish poison, *Tephrosia* (***kogi***, ref. 56). Wind is an important cause of natural disturbance in upland forests in Matsigenka territory. Moderate winds fell single trees quite commonly, causing small tree fall gaps (***oterongera inchato***, D3) that are quickly colonized by herbs and creeping vines, forming a dense, tangled vegetation described as ***narongashi*** (ref. 52). Strong wind storms are rare, but can topple trees throughout tens and even hundreds of hectares (Nelson and do Amaral 1994).

Trees of the genus *Cecropia* are especially important as indicators of habitats showing various degrees of natural and human disturbance. The Matsigenka recognize both wind-generated and anthropogenic secondary forests by the presence of pioneer species, notably *Cecropia sciadophylla* (***yaaroshi***, ref. 54). *Cecropia membranacea* (***setikoshi***; ref. 40a) and *C. polystachya* (***tonkoshi***, ref. 40b) occur in similar habitats of early forest succession along river margins and on branch islands. In addition to the *Cecropia* species forming conspicuous stands, the Matsigenka recognize a number of additional folk species and varieties, some of which have not been assigned definitive scientific names. Not only do the Matsigenka have distinct names for virtually all the *Cecropia* species occurring in their territory, they also distinguish between species which the specialist of the genus, C.C. Berg, had previously considered to be the same (D. Yu, personal observation). The Matsigenka taxon ***inkitsekago*** corresponds to the provisional taxonomic name C. prov. *pungara*, previously considered by Berg to be identical to *C. membranacea* (***setiko / inkona*** in Matsigenka, ref. 40a). Unlike the latter, ***inkitsekago*** is characterized by strongly stinging ants, and is used by the Matsigenka to make a fire drill. A similar situation is found in the case of the polytypic Matsigenka taxon ***kaveari***, previously included under a single species name,

TABLE 10.— Montane (***otishipaketira***) vegetation types.

Ref.	Vegetation	Translation	Description
	Otishipaketira:	'Many hills': Andes, foothills	Montane habitat general term (Table 2)
58	***katarompanaki***	*Clusia* sp. forest	Montane forest with katarompanaki shrub w/ paddle-shaped leaves, latex, (*Clusia* sp.), formerly traded as incense
59	***kasankari koka***	*Erythroxylum coca*? ('fragrant coca')	On slopes, understory with 'fragrant coca' (***kasankari koka***); said to be former Inca coca plantations
60	***kashikarishi***	*Polylepis* sp. forest	Montane dwarf forest characterized by ***kashikarishi***, reddish shrub w/ narrow coriaceous leaves (*Polylepis* sp.)
61	***yaviroshi***	*Puya* sp. stand	Montane grasslands with spine-tipped terrestrial Bromeliad ***yaviro*** (*Puya* sp.) that 'looks like pineapple'
62	***tsiriantiniroshi***	*Tillandsia* sp. (Spanish moss)	Cloud forest, many epiphytes, notably ***tsiriantiniroshi***, 'mother of pineapple' (*Tillandsia*, indeed a Bromeliad)
63	***tipeshi***	*Spaghnum* sp. (moss)	Montane; ground cover of*Spaghnum* moss (***tipeshi***), spongy or crunchy underfoot (***omakaramangaitira***; Table 4, S10)
(D4)	***potagarine***	'burnt hillside'	(Table 3)
(14)	***segashi***	*Oenocarpus bataua* forest	(Table 5)
(20)	***songarentsishi***	*Chusquea* spp., *Olyra* spp.	(Table 6)
(25)	***tinkanarishi***	*Cyathea* spp. forest	(Table 7)
(26)	***tsirompishi***	Pteridophyta (fern) stands	(Table 7)
(33)	***shimpenashi, tiposhi***	Poaceae spp. (grasslands)	(Table 7)
(54)	***yaaroshi***	*Cecropia sciadophylla* forest	(Table 9)
(66)	***otyomiaigeni inchato***	'small trees'	(Table 11)
(67)	***terira ontime inchato***	'where no trees are'	(Table 11)

C. latiloba. The Matsigenka distinguish between 'true ***kaveari***' (recently recognized by botanists as *C.* prov. *puberula*) and '***kaveari*** adjacent to the water' (*C. latiloba*), accurately noting the ecological difference between two otherwise quite similar species. Bark fibers from both ***kaveari*** species are used to make bowstrings. ***Kirajari tamarotsa*** ('red ***tamarotsa***') is a new species[4] of *Cecropia* that is closely related to but distinct from *C. engleriana*, known as ***kutari tamarotsa*** ('white ***tamarotsa***') by the Matsigenka. Both species have fibers used in the manufacture of net bags.

Montane Forest (Table 10). In 1997, Shepard worked with a team from Conservation International as part of their "Rapid Assessment Program" (RAP) in the Cordillera Vilcabamba (Schulenberg in press). By conducting community mapping exercises, the team was able to generate a highly detailed picture of the spatial distribution of resources and habitats throughout the Picha basin in just a few weeks of fieldwork (Shepard and Chicchon in press). One of the most surprising findings was a remarkably detailed knowledge among lowland Matsigenka communities about high-elevation vegetation types including cloud forest and high-Andean grasslands. This knowledge included details of the plants' colors, forms, odors and other characters sufficient to allow an approximate scientific identification for most of the plants (see Table 10). Many of these identifications were confirmed later by botanists working in the rapid biodiversity assessment of the Vilcabamba mountain range. Though contemporary Matsigenka communities are located on the lower courses of the Picha and its tributaries, oral histories reveal that the Matsigenka inhabited the headwaters of the river system until relatively recent times. Some communities migrated across the Vilcabamba mountain range to and from the adjacent Tambo and Mantaro river systems to escape epidemic diseases or persecution during the rubber fever, the *hacienda* slave trade through mid-century, and the political violence of the 1980's. Younger generations maintain accurate ecological knowledge of distant vegetational and faunal communities they have never seen by means of a rich and active oral tradition.

The Matsigenka of the Picha accurately describe cloud forests containing small, twisted trees (***otyomiaigi inchato***, ref. 68), tree ferns and terrestrial ferns (***tinkanarishi, tsirompishi***, ref. 25, 26), bromeliads and orchids (***keshi, ananta***, see ref. 68), and the ubiquitous garlands of Spanish moss (*Tillandsia*, a pineapple relative), known in Matsigenka as ***tsiriantiniro***, 'mother of pineapple' (ref. 62). Informants also described hilly regions with 'spongy, long-haired soil' (***omakaramangaitira***, ref. S10), apparently referring to the presence of accumulated *Spaghnum* moss (***tipeshi***, ref. 63). In the summer months, this vegetation is said to become extremely dry and burns easily like kindling. At least one mountain with this kind of vegetation in the Picha headwaters is known as ***Potagarine*** (ref. D4), 'burnt mountain'. Folk tales describe ancient trading relations between the Matsigenka and the Inca Empire, and explain the presence of stands of a fragrant variety or species of *Erythroxylum* (***kasankari koka***, 'fragrant coca', ref. 59) on some hillsides, said to be former Inca coca plantations. The Matsigenka describe a number of other montane and Andean grassland elements, for example: ***kurikiipinishi***, "shrub with glossy, spiny leaves" (*Ilex*; see ref. 68); ***oevaroshi***, "shrub with fragrant leaves, white underside, many small seeds" (Asteraceae or Ericaceae, see ref. 68); ***yaviroshi*** (ref. 61), "plant with spine-tipped leaves that looks some-

TABLE 11.— Habitats defined by overall vegetative aspect. Dialect variants separated by slash (Manu/Picha).

Ref.	Vegetation	Translation	Description
64	***kusokiri inchato***	'hard wood trees'	Uplands, primary forest with large diameter hardwood trees, notably sandy-barked Chrysobalanaceae (***mapumetike***, 'stone tree'); difficult to fell with ax for swidden agriculture
65	***kurayongashi / karororoempeshi***	'high leaf forest', 'high branching forest'	High canopy forest: in floodplain, mature, late successional forest (***nigankivoge***) with large trees (Table 1, T6); in uplands, on ridges and along small stream valleys, large canopy trees with high, spreading crowns; it is difficult to hunt arboreal animals because of height of branches; includes*Swietenia macrophylla* (***yopo***), *Cariniana* spp. (***tsirotonaki***), *Copaifera* spp. (***kumpe***, ***koveni***), Lauraceae (***inchoviki***), *Sloanea* sp. (***asingiritaki***), *Huberodendron?* (***yomenta***), other species
66	***okametira***	'good place': i.e., for walking, forest with open understory	Mature lowland forest, upland terraces and wide, flat ridge crests; forest with medium to high canopy, widely spaced emergent trees, and open understory with few understory palms, lianas or treefalls
67	***oshavishitira***	'low leaves': low canopy forest	In uplands: low canopy forest of shrubs, small trees, lianas on eroded soils, clay, or white sand (***sokopane***); in floodplain: on contractile clay soils, usually with ***yaivero*** bamboo
68	***otyomiaigeni inchato***	'small trees': dwarf forest	Montane (see Table 10): elfin cloud forest, small, twisted trees, many epiphytes e.g., Spanish moss (***tsiriantiniro***), lichens (***tsigiri***), Bromeliads/ Orchids (***keshi***, ***ananta***). Cyclanthaceae (***evanaro***); ferns (***tsirompi***), *Selaginella* (***kamu***); trees include ***oevaroshi***, 'fragrant, white leaf, many seeds' (Asteraceae/Ericaceae?), ***sangavantoshi*** (?), *Ilex* (***kurikiipinishi***), Melastomataceae (***savotaroki***), *Cyathea* (***tinganari***)
69	***terira ontime inchato***	'where no trees are'	Andean grasslands (Table 10), mountains above tree line, very cold (***katsingari***)
(D8)	***inchatoshi***	'tree leaves': primary forest	(Table 3)
(51)	***tovaseri***	'weeds'	(Table 9)
(52)	***narongashi***	'tangled leaves': dense secondary growth	(Table 9)
(53)	***shivitsasemai***	'matted lianas': liana forest	(Table 9)

TABLE 12.— Habitats defined by faunal associations.

Ref.	Habitat	Translation	Description / Associated Vegetation
F1	***irapitari kimaro***	'where macaws sit': macaw clay lick	*Guadua* sp. bamboo (***yaivero***), contractile clay soils (***kusomiriakipatsa***)
F2	***itsimini***	'their licking place': animal mineral lick	*Guadua* sp. bamboo (***yaivero***), *Aulonemia* bamboo (***samatsi***), red clay soils (***kiraapatsa***)
F3	***vuimpuyoseku, / itime kovutatsirira***	'place of the screaming piha', 'where the guardians live'	Singing grounds of the screaming piha, *Lipaugus vociferans* (***vuimpuyo***), mostly in flat uplands with *Wettinia* (***kepito***), *Socratea salazarii* (***kompapari***)
F4	***matyaniroshi***	'fire ant forest'	Forest containing large numbers of small fire ant *Wasmannia auropunctata* (***matyaniro***), often associated with tangled under story (***narongashi***) in the uplands; gardens or house sites found to contain this ant are abandoned to avoid massive stinging which can cause serious illness or (in eyes) blindness
F5	***matyagirokishi***	'ant shrub forest'	Small clearings formed by mutualistic relationship of *Cordia nodosa* shrub (***matyagiroki***) and *Myrmelachista* ants (***iriite, matyaniro***); *Cordia* clearings in uplands only
F6	***sakaroshi***	'ant garden forest'	Especially in swamps; large numbers of ant-garden ants (***sakaro***), especially *Campanotus*, on host plants *Codonanthe* (***kimaroshi***), *Peperomia* (***sakaropini***), and others
F7	***kepage***	animal den	Animal den in overturned roots of trees, especially in high-turnover upland forests with understory palms

what like pineapple" (*Puya*); ***kashikarishi*** (ref. 60), "shrub with red, narrow lanceolate leaves" (probably *Polylepis*); and ***katarompanaki***, "tree with latex and paddle-shaped leaves" (*Clusia*), the latex of which was formerly traded as incense.

Overall Vegetative Aspect (Table 11). Additional Matsigenka habitat terms refer to overall vegetative characteristics or forest architecture. High canopy forests (***kurayongashi***, 'high leaves'/ ***karororoempeshi***, 'high, ramifying branches', ref. 65) occur in mature lowland forest (***nigankivoge***, T6), stream gallery forests (T8, T9), and along ridges adjacent to streams. Forests with an open understory are referred to in general as ***okametira***, literally 'good place,' i.e., for walking (ref. 66). Hardwood forests (***kusokiri inchato***, ref. 64) are found in flat upland areas, characterized by numerous large-diameter trees with hard trunks, especially silica-containing Chrysobalanaceae (***mapumetike***, literally 'stone tree'). Such areas were impossible to clear for agriculture before high-quality steel axes were introduced (or re-introduced) to isolated Matsigenka settlements beginning in the 1950's, and are still avoided if possible. Low canopy forests (***oshavishitira***, ref. 67) occur on eroded or white sand soils in the uplands, as well as in disturbed areas. Forests with tangled undergrowth (***narongashi***, ref. 52) and lianas (***shivitsasemai***, ref. 53) are also found in disturbed areas, especially river and stream floodplains. Matsigenka of both the Picha and Manu are aware of the presence of dwarf or cloud forests (***shaveigi inchato***, ref. 68) in the foothills, and of Andean grasslands at high elevations beyond which trees do not grow (***terira ontime inchato***, ref. 69).

Faunal Characteristics (Table 12). In a few cases, the Matsigenka describe habitats according to specific faunal associations. The Matsigenka distinguish between clay licks (***irapitari***, F1) on cliffs or along the river's edge, visited mostly by macaws, and mineral licks (***itsimini***, F2) visited by both birds and mammals, usually along stream beds or eroded banks. Both are associated with red clay and contractile clay soils (S6, S7) and, in the case of macaw clay clicks, with ***yaiveroshi*** bamboo forest (ref. 23). Both are also important places for hunting, especially from blinds. Singing grounds of the screaming piha bird (*Lipaugus vociferans*) are often found in flat, primary forest in the uplands, and are described by the Matsigenka as a forest type unto its own, ***vuimpuyoseku*** ('screaming piha place', F3). The Matsigenka consider the screaming piha (***vuimpuyo*** or ***kovutatsirira***, 'guardian') to be a guardian spirit of shamans, and its voice is likened to shamanistic singing. Certain ant species form associations with some kinds of vegetation, also noted by the Matsigenka as salient forest types (F4-F6).

Perceptual Features of Classification.— The Matsigenka use several sets of dichotomous, paired terms to distinguish perceptually salient groups of organisms. Some of the terms have been discussed individually above, but it is instructive to recreate the dichotomous pairs. Examples include:

- Flatland (***pampa***) vs. Montane (***otishi***) vegetation;
- River's mouth (***otsitiaaku***) vs. Headwater (***oyashiaaku***) species and habitats;
- River's edge or aquatic (***oaaku***) vs. forest interior (***niganki***, 'middle');
- Weedy secondary growth (***tovaseri***) vs. Primary forest (***inchatoshi***);
- Terrestrial (***saaviku***, 'below') vs. Arboreal habit (***enoku***, 'above');
- Women's (***ashi tsinani***) vs. Men's (***irashi surari***) medicinal plants (see Shepard in press);

- Diurnal (***yanutake kutagiteri***, 'walks at day') vs. Noctural habit (***yanutake tsiteniyeti***, 'walks at night');
- Wild (***inkenishiku***, 'in the forest'; ***kogapage***, 'on its own'[5]) vs. Domesticated or tamed plant and animal species (***pankirintsi***, 'planted'; ***piraatsi***, 'reared, raised as a pet');
- Native (***kantani pairani***, "always since ancient times") vs. Introduced crops, animals, pests and diseases (***irashi virakocha***, "of the whites"; ***oponia kamatitya***, "comes from down river").

Such examples further complicate a strictly hierarchical interpretation of indigenous habitat classification. Depending upon the perceptual bias of the speaker, species and environments can be classified and grouped according to a number of equally valid categories.

Spiritual Ecology.— Matsigenka knowledge of forest ecology is an integral part of mythology, cosmology, religion, and spiritual beliefs. For the Matsigenka, shamans play an important role in people's interaction with the environment. The shaman develops a relationship with a spirit twin among the ***Sangariite***, benevolent spirits of the forest, by taking tobacco and other psychoactive plants (Baer 1992; Shepard 1998). The Sangariite themselves are invisible in ordinary states of consciousness, inhabiting a remote plane of existence accessible only to shamans. However the locations of their villages (or at least, pale manifestations thereof on this plane of existence) are perceptible as small, natural clearings in the understory of some upland forests. For the ecologist, these clearings are created by the symbiotic relationship between the shrub *Cordia nodosa* and the mutualistic ant genus *Myrmelachista* (Davidson and McKey 1993). Matsigenka names for this forest type reflect both mundane and supernatural understandings of its nature: 'ant-shrub forest' (***matyagirokishi***; Table 12, F5), 'village of the invisible ones' (***itimira Sangariite***), or simply 'clearing' (***karapage***; Table 3, A3).

Though recognizing the ant-plant symbiosis, the Matsigenka attribute the ultimate cause of the clearings to the activities of the invisible Sangariite, who, like humans, clear the forest and cultivate swidden gardens. By taking hallucinogenic plants, Matsigenka shamans are able to perceive the true, hidden nature of these enigmatic places and thus gain access to the invisible villages of the all-powerful Sangariite. The Sangariite raise as their pets all the game animals eaten by the Matsigenka (Baer 1984), and shamans may bargain with them to improve local hunting conditions. The Sangariite are also said to provide Matsigenka shamans with new crop cultivars for their gardens, especially manioc and medicinal sedges of the genus *Cyperus* (Shepard 1999b).

Such an example sounds quaint, but not particularly relevant to Western scientists. However a closer look led to an interesting discovery. The Matsigenka pointed out distinctive scars and swellings visible on adjacent tree trunks in areas where *Cordia* clearings have been established for long periods of time. For the Matsigenka, these scars are evidence of the other-worldly fires set by the Saangariite to clear gardens around their villages. Shepard pointed out these scars to Yu, who found that they were in fact (at least in this plane of existence) trunk galls created and inhabited by *Myrmelachista* worker ants. This is the first time that ants have been found to gall plants. The increased colony longevity resulting from the behavior helps to explain *Myrmelachista*'s mysterious persistence in the face of competition from other ant species, previously assumed to be superior competitors that can also inhabit *Cordia nodosa*. Thus, Matsigenka observations led to a new insight into the important theoretical problem of species coexistence.

The ecology and taxonomy of bamboos are also incorporated within the Matsigenka belief system. ***Kapiro*** bamboo, *Guadua weberbaueri* (ref. 22), used by the Matsigenka to manufacture arrow points, undergoes synchronous flowering and fruiting on long cycles of 15 to 30 years (Nelson 1994). After fruiting, ***kapiroshi*** stands throughout an entire region die and decay, growing back from seeds over a period of several years. The Matsigenka sometimes attribute the die-back of ***kapiroshi*** stands to the magical powers of shamans. Through the early 1980's, the Matsigenka of the Manu river were raided and attacked periodically by a hostile neighboring indigenous group, the Yora or "Nahua" (Shepard 1999a), resulting in numerous casualties and deaths on both sides. One respected (and feared) Matsigenka shaman/sorcerer had lost many family members to Yora raids in the headwaters of the Manu River, and was wounded himself. According to local accounts, he recovered a long bone from the skeleton of a Yora man killed during a raid in about 1978, split open a length of ***kapiro*** bamboo stem, inserted the bone, applied a mixture of dangerous plants known only to sorcerers, tied the bamboo stem shut, and buried it in a large stand of bamboo. In 1981 or 1982, ***kapiroshi*** bamboo stands throughout the region flowered, fruited, and died. For the Matsigenka, the fruiting and die-back of ***kapiroshi*** was caused intentionally by the sorcerer so that the Yora would suffer a shortage of bamboo for arrows and thus stop attacking the Matsigenka. The Matsigenka also attribute the epidemics that decimated the Yora population beginning in 1985 (see Zarzar 1987) to this act of sorcery.

After ***kapiroshi*** bamboo stands die, arrow-making material becomes scarce for a period of one to two years during which the bamboo grows back. A number of alternate *Guadua* species of similar stem size to ***kapiro*** are available, for example ***yaivero*** (ref. 23) and ***shinkerokota*** (ref. 24). However the Matsigenka consider these species inappropriate as material for arrow points due to spiritual considerations. It is said that if one kills monkeys or other animals with arrow points made from ***yaivero*** or ***shinkerokota***, the Sangariite spirits become angry and send game animal populations far away. This belief may have its basis in empirical observations. The alternate bamboos may be simply less effective at killing prey, leaving more wounded animals to die later. Furthermore, in the aftermath of a major alteration in forest structure such as caused by massive ***kapiro*** bamboo fruiting and die-back, the behavior and territorial distribution of game animals may indeed change. Hunters must certainly be tempted, and perhaps at times obliged, to use alternate bamboo species during the ensuing shortage of ***kapiro*** bamboo for arrow points. The coincidence between the use of alternate bamboos and possible alterations in game animal behavior might have led to these beliefs. The prohibition might also represent an unconscious adaptive strategy of long-term game conservation. Every 15 to 30 years, during the year or two of ***kapiro*** bamboo shortage, Matsigenka hunters who indeed follow the proscribed bamboo avoidance would either have to reduce their hunting of game animals, or migrate to a distant area where independent ***kapiro*** stands in a different stage of the lifecycle could be found. In either case, or even if neither interpretation is correct, the prohibition of alternate bamboo species reflects a principle of ecological homeostasis that pervades Matsigenka beliefs and practices. For the Matsigenka and other indigenous Amazonian groups (see Reichel-Dolmatoff 1976), interactions between humans and the natural world are regulated by a system of checks and balances. When humans violate certain natural and supernatural principles, Nature settles her scores with a vengeance (Shepard in press).

COMPARATIVE ASPECTS OF HABITAT CLASSIFICATION BY NATIVE AMAZONIANS

Though often more descriptive than comparative in focus, ethnobiological studies demonstrate their true power and importance when applied in a comparative context: data from different indigenous and folk societies are compared with one another, and indigenous knowledge is compared to that of Western science. Elsewhere, we have compared the vision of forest as seen by the Matsigenka with that seen by tropical ecologists and LANDSAT satellites (Shepard et al. in press). Here, we compare the results of our study with those of other published research on habitat classification among Native Amazonians.

The forest classification systems of indigenous Amazonian populations have been studied by only a handful of researchers. Carneiro (1978) carried out one of the first systematic studies of tree classification by a Native Amazonian people, and briefly mentions the main forest habitats recognized by the Kuikuru of Brazil: primary forest, early secondary growth (weeds), regrown secondary forest, and gallery forest (forest adjacent to rivers or lakes). Posey (see Parker et al. 1983: 170-171) outlines the major ecological zones recognized by the Kayapó of Brazil: grasslands (***kapôt***), mountains (***krãi***), and forest (***bá***). The category of forest is further divided into gallery forest, dense jungle, high forest, and forest with openings caused by accumulated water; gallery forest is further divided into different zones relating to closeness to water. The category of grasslands is also divided into five vegetative types depending on the height of the grass and the relative abundance of trees. Transitional zones between vegetation types are also important in Kayapó habitat classification, subsistence, and village placement. Posey notes that the Kayapó choose their village sites strategically to take advantage of the maximum possible diversity of ecological zones: for example, eight distinct vegetation types and two transitional zones are located within the vicinity of Gorotire village.

In the same publication, Frechione (ibid.: 178-179) describes soil types and vegetative indicators used by the Venezuelan Yekuana to select garden sites. Ten forest types are discussed. Of these, forests dominated by vines/lianas, bamboo, wild plantains, and two unidentified tree species are suitable for agriculture. The remaining categories are not suitable for agriculture: savanna, palm swamps, other wet forests, forest on steep slopes, and sacred burial grounds. Balée's (1994) innovative ethnobotanical study among the Ka'apor of Brazil included exhaustive botanical surveys of eight one-hectare tree plots. Balée compares species composition between two of the forest types recognized by the Ka'apor, old garden fallows and primary forest, and concludes that indigenous agricultural practices may enhance the biological diversity of Amazonian forests.

Andrello (1998) provides a preliminary description of fifty-three natural habitat types recognized by the Baniwa Indians of the Upper Rio Negro in Brazil. Most habitat types are defined according to the presence of indicator species, many of which have economic importance for the Baniwa. For some habitat types, soil types are included within the definition. Specific habitat types are divided among three broad categories defined by flooding regime and soils: ***edzaua*** (terra firme uplands), ***arapé*** (igapó flooded forest), and ***ramariene*** (nutrient-poor campinarana white sand forest). Secondary forest is treated as a separate category, ***reinhame*** ('used place') and is further sub-divided into multiple vegetation types defined according to the presence of useful species. Unfortunately, the study was carried out in a brief time period, and does not include botanical identifications for indicator species, though some species (especially palms) might be identifiable at least to genus based on common name identifications provided.

The most thorough study to date of forest classification by Native Amazonians is Fleck's (1997) remarkable master's thesis on Matses (Mayoruna) ethnozoology. Fleck describes 47 vegetation types recognized by the Matses within the Galvez River basin in eastern Peru. By combining vegetative and geomorphologic designations, the Matses are able distinguish 178 different habitats. Fleck demonstrates statistically significant differences in vegetation and small mammal fauna among a sample of Matses-defined habitats, demonstrating the ecological relevance of indigenous knowledge (Fleck and Harder 2000). Though the Matsigenka and Matses belong to distinct language families (Arawakan and Panoan) and live some 600 kilometers apart, and though we were not aware of Fleck's work until after completing our first two field seasons, the results of the two studies show remarkably similar overall patterns. The Matsigenka and Matses distinguish many of the same vegetation types, for example: *Attalea tesmanii* palm forest, *A. butyracea* palm forest, *Bactris* spp. palm forest, *Phytelephas macrocarpa* palm forest, *Euterpe precatoria* palm forest, *Mauritia flexuosa* palm forest, *Oenocarpus bataua* palm forest, *Cecropia* spp. secondary forests, *Cedrela* forest, *Ficus* forest, bamboo forest, liana forest, and low-canopy forest on eroded or white sand soils. Both groups rely on many of the same criteria when describing forest habitats: topography, distance from the river, flooding regimes, drainage patterns, and indicator species, especially palms. Geomorphologic (topographic/hydrologic) habitat classification of the Matses and Matsigenka is virtually identical. Both recognize a number of habitats not currently described in the scientific literature, especially in the poorly studied upland terra firme.

Considering the various studies of indigenous habitat classification together, several common themes and patterns emerge. Abiotic and biotic factors are considered somewhat independently. Abiotic factors (topography, flooding and disturbance regimes, soils) are used to distinguish a small number of general categories. The distinction between floodplain (also called gallery forest, lowlands, igapó, etc.) and uplands (terra firme) is found in all indigenous systems, and is also fundamental in current scientific classifications. Also, the distinction between primary forest and secondary forest, including various stages of swidden fallow regeneration, also appears as a salient category in all systems. Depending on the particular ecological setting, swamps, mountains, savannas or grasslands, and white sand forests (campinarana) are also recognized as distinct higher-order categories. Within general abiotic categories, biotic features, mostly indicator plant species, are used to define more specific habitat types. Palms seem to be especially important as indicator species. In several cases, authors mention habitats defined by overall forest architecture, for example liana forests, low-canopy forest, high-canopy forest, and bamboo forest. There are differences between the various systems, which may be due to cultural variation as well as ecological differences between the widely separated regions. Nonetheless, we perceive an overall pattern of extraordinary concordance between habitat classification by culturally distinct and geographically separated groups.

CONCLUSION: ETHNOECOLOGY AND THE FUTURE OF AMAZONIA

Tropical forests and their peoples are increasingly threatened by the global economy. Much of Amazonia remains virtually unstudied in terms of basic floristic and faunal composition (Nelson et al. 1990; Patton et al. 1997; Tuomisto 1998; Terborgh 1999). Indigenous and folk knowledge about the environment represents a vast and underutilized database about habitat diversity, species distributions, ecological interactions among organisms, economically important species, and sustainable management practices (Posey 1983). Indigenous knowledge about habitat diversity is a particularly important area for future ethnobiological research in Amazonia. Considering the highly detailed habitat knowledge of indigenous groups such as the Matsigenka and the Matses, and considering the similarities found among habitat classification systems of multiple indigenous groups, it seems plausible that further ethnoecological research could contribute to the scientific study of tropical forest diversity in the Amazon basin. Indigenous habitat knowledge in combination with GPS and satellite technology proves to be a particularly power tool for carrying out studies of habitat diversity at local, and perhaps broader regional scales (Shepard et al. in press).

Ethnobiological/ethnoecological research methods are especially appropriate for carrying out rapid ecological evaluations (see Sobrevilla and Bath 1992) in indigenous territories. For example, Conservation International's rapid biodiversity assessment (RAP) in the Cordillera Vilcabamba (Schulenberg in press) included resource and habitat mapping exercises with local Matsigenka communities. As a result of the efforts of Conservation International and other Peruvian organizations, the Vilcabamba may soon be granted legal status as a protected natural area linked with two large, indigenous reserves. The World Wide Fund for Nature (WWF) has recently financed a study of feasibility of community-based management of the proposed reserves, and will certainly draw on the ethnoecological data generated by the Conservation International "ethno-RAP" team (Shepard and Chicchon in press). In collaboration with the Peruvian Institute of Natural Resources (INRENA), the World Bank is currently financing a study to implement indigenous management programs for selected natural protected areas in other parts of Peru. With European funding, the Brazilian National Indian Foundation

(FUNAI) has recently initiated a program (PPTAL) of rapid ethnoecological assessments in indigenous territories as a first step toward implementing participatory management plans specific to each territory. By collaborating with indigenous communities, tropical ecologists, and conservation organizations, ethnobiologists could assist in the integration of folk and scientific knowledge in any number of basic and applied research projects.

Ethnobiological research, broadly conceived, is an important tool in documenting and preserving biocultural diversity. In addition to its scientific or practical value, ethnobiological study also reveals the spiritual importance of ecological processes in the native worldview. Studying traditional knowledge carries with it a great ethical responsibility, both in terms of returning benefits derived from research as well as respecting and safeguarding sacred aspects of this knowledge. Ultimately, ethnobiological research can serve to build bridges of mutual understanding and respect between local people and Western scientists and conservationists, and may prove crucial in advancing international conservation goals.

NOTES

[1] Nelson et al. (1990) provide a striking example of the use and abuse of biased data to arrive at conclusions about biodiversity patterns at large scales. Centers of species diversity and endemism, assumed by some scientists to represent forest refuges during the Pleistocene, turned out to correlate strongly with foci of collection effort. Not surprisingly, areas that have been collected intensively show high degrees of species diversity and endemism, while areas that have been poorly collected show low diversity and endemism!

[2] All Matsigenka terms in the text and tables are written using the practical orthography developed by Snell (1998). Matsigenka and other indigenous language terms are written in bold italics.

[3] The uplands or interfluvium are commonly referred to in the scientific literature as *terra firme*, 'solid earth', borrowing the Brazilian folk term as codified by Pires and Prance (1985).

[4] The authors have been in contact with *Cecropia* specialist C.C. Berg about the possibility of assigning a Matsigenka name to the new species. The names suggested include *C. tamarotsa*, reflecting the ethnobotanical name for the species, and *C. hempo*, referring to the net bags (***jempo***) made by the Matsigenka from the species' bark fibers.

[5] The Matsigenka term ***kogapage*** is rather hard to translate into English, since it means simultaneously "on its own," "for no good reason," and "useless." The concept is easier to encapsulate in the Spanish expression, *así no más*!

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THE FUNCTION OF GUACHIPILIN, *Diphysa robinioides*, IN THE LENCA LANDSCAPE

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ABSTRACT.— Guajiquiro Municipio in the forested highlands of southern Honduras is home to the Lenca. The Lenca subsist in the municipio's mountainous 350 square kilometers on a combination of swidden agriculture, transhumance cattle husbandry, cash crop production, local commercial forestry, and emigrant remittances. Recent designation of almost 20% of the municipio as a cloud forest biological reserve has engendered land use conflicts. Field research of changing patterns of Lenca land use demonstrated the ubiquity of trees in the Lenca's settlement landscape. One particular fabaceous tree, ***guachipilin***, *Diphysa robinioides*, Fam. Leguminosae, Subfamily Papilionoideae, is a prominent landscape feature. The tree serves three purposes for the Lenca that manifest themselves in the Lenca landscape. The Lenca intercrop the tree in their milpas for nitrogen-fixation. They harvest it to construct corner posts for their *bajareque* houses. The Lenca also craft ***guachipilin*** crucifixes for gravesites because they believe the durable wood is an appropriate, and lasting, symbol of a lost loved one's enduring spirit.

Keywords: Lenca, landscape, ethnobotany, Middle America.

RESUMEN.— Guajiquiro Municipio en forested montañas de Honduras meridional es casero al

Lenca. El Lenca subsiste en el municipio que los 350 kilómetros cuadrados montañosos en una combinación de swidden agricultura, la agricultura de los ganados del transhumance, la producción vegetal del efectivo, la silvicultura comercial local, y remesas del emigrante. La designación reciente casi de 20% del municipio como reserva biológica del bosque de la nube ha engendrado conflictos de la utilización del suelo. La investigación de campo de caracteres cambiantes de la utilización del suelo de Lenca demostró la ubicuidad de árboles en el paisaje del establecimiento de Lenca. Un árbol fabaceous determinado, ***guachipilin***, *Diphysa robinioides*, Fam. Leguminosae, Subfamily Papilionoideae, es una característica prominente del paisaje. El árbol responde a tres propósitos para el Lenca que se manifiesten en el paisaje de Lenca. El intercrop de Lenca el árbol en sus milpas para la nitrógeno-fijación. La cosechan para construir los postes de la esquina para sus casas del bajareque. El Lenca también hace los crucifixes del ***guachipilin*** a mano para los gravesites porque creen que la madera durable es una apropiada, y durando, el símbolo de un perdido amó su espiritu que aguantaba.

RÉSUMÉ.— Guajiquiro Municipio dans forested des montagnes du Honduras méridional est à la maison au Lenca. Le Lenca subsistent dans le municipio les 350 kilomètres carrés que montagneux sur une combinaison de swidden l'agriculture, l'agriculture de bétail de transhumance, la production végétale

d'argent comptant, la sylviculture commerciale locale, et les remises d'émigrant. La désignation récente presque de 20% du municipio comme réserve biologique de forêt de nuage a engendré des conflits d'utilisation de la terre. La recherche de zone des caractères changeants de l'utilisation de la terre de Lenca a démontré l'ubiquité des arbres dans l'horizontal de règlement de Lenca. Un arbre fabaceous particulier, ***guachipilin***, *Diphysa robinioides*, Fam. Leguminosae, Subfamily Papilionoideae, est un dispositif en avant d'horizontal. L'arbre atteint trois objectifs pour le Lenca qui se manifestent dans l'horizontal de Lenca. L'intercrop de Lenca l'arbre dans leurs milpas pour l'azote-fixation. Ils la moissonnent pour construire les poteaux faisants le coin pour leurs maisons de bajareque. Le Lenca ouvrent également des crucifixes de ***guachipilin*** pour des gravesites parce qu'ils croient que le bois durable est un approprié, et durant, le symbole d'un perdu a aimé son esprit durable.

FIGURE 1.— Guajiquiro Municipio, Honduras.

INTRODUCTION

Guajiquiro Municipio is a remote forested district in the highlands of southern Honduras in the department of La Paz (Figure 1). More than 16,000 Lenca, Honduras' largest indigenous group, comprise the overwhelming majority of the municipio's population. Although having lost their native language by the 1950s (West 1998), persistent land use practices, handicraft, and local market traditions mark the Lenca as a distinctive ethnic group. The Lenca of Guajiquiro currently subsist within a mountainous 350 square kilometers on a combination of swidden agriculture, transhumance cattle husbandry, cash crop production, local commercial forestry, and emigrant remittances.

In 1987 the Honduran government passed a decree that designated highland cloud forests throughout the country as protected areas (Republic of Honduras 1987). Almost 20% of Guajiquiro Municipio became protected as the Guajiquiro Cloud Forest Biological Reserve. Aerial photos demonstrate that the Lenca have occupied the decreed protected area for more than 45 years. Forests within the protected area occupy small, ten to fifteen-acre islands on the steepest slopes and are surrounded by settlements, agricultural fields, and roads.

Certain protected area land use restrictions of the Guajiquiro Cloud Forest Biological Reserve conflict with traditional Lenca land use. Field research of the conflict between protected area management and traditional Lenca land use led to a peripheral, yet related, discovery. Travel afoot throughout Guajiquiro Municipio demonstrated that, although they have cleared much of the forest belatedly targeted for protection, the Lenca integrate forests and trees into their cultural landscape. Trees, live and harvested, are ubiquitous in the Lenca settlement landscape. Managed pine, mixed pine-oak, and broadleaf cloud forests garland milpas (e.g., a swidden plot, or an agricultural plot cut from forest and cultivated 2-10 years). Legions of burnt stumps retain topsoil in a sloped swidden plot. Sturdy manual sawmills made of pine logs occupy small, sunny forest clearings. Pine, oak, and sweet gum galleries shade footpaths that lead through cultivated areas. Narrow forest corridors line the ditches that demarcate milpa boundaries. Large broadleaf trees that punctuate these ditch borders attest to the longevity of some boundaries. Multiple strands of barb-wire nailed to tree trunk posts, or log rail fences separate some agricultural plots. Closer to Lenca dwellings, apple and peach trees cast shade on kitchen gardens, or compete for sunlight in a milpa. In the municipio's lowlands, ***guama*** trees (*Inga oerstediana*, Fam. Leguminosae, Subfamily Mimosoideae) veil small coffee fincas.

A notable member of the forests and trees that the Lenca include in their landscape is a fabaceous tree called ***guachipilin*** (*Diphysa robinioides*, Fam. Leguminosae, Subfamily Papilionoideae). The tree has become a cultural feature that links Lenca agriculture, folk-housing, and religion. The Lenca encourage the tree's growth in their milpas to improve soil fertility. They harvest the tree from their fields to craft corner posts to support their houses. They carve ***guachipilin*** trunks into cemetery crucifixes that symbolize their faith in the immortality of the human spirit. Their multiple uses of the ***guachipilin*** manifest themselves in the Lenca's forested cultural landscape. This article examines the general distribution and use of the ***guachipilin*** in mainland Middle America and explores the specific functions of the tree in the Lenca landscape.

GUACHIPILIN

Other researchers have noted the utility of ***guachipilin*** in mainland Middle America. Budowski (1987) found that farmers in Costa Rica commonly use ***guachipilin*** as a living fence post. Floras of El Salvador (Flora Salvadoreña 1926) and Chiapas (Miranda 1953) report that the ***guachipilin's*** durability and ease of use make it a popular material for tool handles and, surprisingly considering its shape, railroad ties. Throughout the region people also use the tree for firewood.

FIGURE 2.— *Diphysa robinioides* intercropped throughout a harvested Lenca milpa (photo by Scott Brady).

Guachipilin trees found in milpas and fallow patches range from 6-10 m in height (Figure 2 and 3). Their branches form an umbelliform crown. The tree's yellowish, fibrous heartwood is cloaked by 2-3 cm thick grayish-brown bark that is marked by an anastomosing network of deep fissures. Its heartwood yields a yellow dye. ***Guachipilin's*** leaflets are borne on 12-14 cm stems in an odd-pinnate arrangement. Stems carry 10-17 small leaflets, 1 - 1.2 X 2.5 - 3 cm, that are oblong, pointed at the base and rounded at the top (Paquet 1981). ***Guachipilin*** produces short, up to 2 cm long, clusters of yellow flowers and inflated, flattened, oblong seed pods that are 8-10 cm long (Record and Hess 1943).

FIGURE 3.— ***Guachipilin*** leaves (photo by Scott Brady).

The tree's serpentine shaped trunk supports the widely accepted definition of the name ***guachipilin***. Santamaria (1959) explains the word as a contraction of the Nahuatl ***cuahuitl***, which means 'tree', and ***chipilin***, a Nahuatl word for the 'twisted shell of a small marine organism'. Examination of regional gazetteers (Defense Mapping Agency U.S. 1982, 1983a, 1983b, 1984, 1985, 1992; U.S. Army Topographic Command 1969; Office of Geography 1956) demonstrates that past cultures have acknowledged the cultural character of the plant by naming settlements after it. This circumstance does not make the gauchipilin exceptional. Large-scale, topographic maps of Latin America commonly include myriad toponyms derived from plant names.

Figure 4 shows the geographical distribution of the toponym "***Guachipilin***," or "***El Guachipilin***," in mainland Middle America. Most of the 36 occurrences of the toponym are clustered in an east-west zone that occupies the southern half of the Central American isthmus in southwestern Honduras, El Salvador, and southeastern Guatemala. More than half of the toponyms are west of Kirchoff's (1943) southern boundary of Meso-America, the pre-Colombian "high culture" area where Nahuatl-speakers lived and Nahuatl was the *lingua franca*. Rather than a distinct dividing line, later scholars consider Meso-America's southeastern a broad margin where Meso-American and non-Meso-American cultures interacted (Stone 1959; Sharer 1974; Fox 1981). Eleven of the remaining twelve ***Guachipilin*** toponyms are to the east of Kirchoff's boundary and lie within the region occupied by the Lenca at A. D. 1500 (Newson 1986). This distribution corresponds to the transitional character of Meso-America's southeastern periphery.

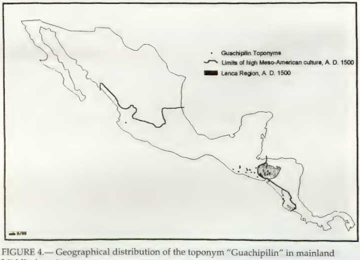

FIGURE 4.— Geographical distribution of the toponym "Guachipilin" in mainland Middle America.

Field observation has demonstrated that within Guajiquiro Municipio the ***guachipilin*** occupies a narrow habitat within the fertile slopes between 1700 m and 1900 m of elevation. Settlements in Honduras that bear the name "***Guachipilin***" are found at elevations ranging from 690 m to 1500 m (Instituto Geografico Nacional 1990). The geographical distribution of the toponym suggests that the tree's habitat extends beyond this 200 m zone. Another possible explanation is that the toponym's wide dispersal reflects ***guachipilin's*** cultural importance rather than its favored habitat.

GUAJIQUIRO MUNICIPIO

Most of Guajiquiro's population resides in loosely-bound hamlets, called *aldeas* and *caserios*, that are scattered throughout the northern third of the municipio at elevations between 1700 m and 2100 m. The *aldea* and *caserio* are indigenous settlement forms that persist throughout Central America's highlands, distinct from the agglomerated-grid settlement model that the Spanish imposed throughout much of Latin America (West and Augelli 1989). The dispersed nature of these settlements creates a landscape in which Lenca communities are closely embedded within the systems of soil, water and forest resources that they depend upon for their subsistence.

The Lenca refer to this upland zone as the *tierra fresca*, 'cool land', or *tierra arriba*, 'upland' (Figure 1). Settlements located below approximately 1700 m are in, what the Lenca call, *tierra calída*, 'warm land'. Both the uplands and lowlands are occupied by milpas, some teetering on steep 40% slopes, fallow patches of briars and ferns called *guamil*, moist, grassy clearings for cattle grazing sometimes called *chaguites*, and a variety of forest patches present in varying stages of manipulated succession.

Forest types include broadleaf cloudforest, generally found above 2000 m on slopes with a northeast aspect. These forests are the primary targets of government protection. They contain towering, buttressed trees (12 m-40 m high) and the rich epiphytic growth common in moist, tropical lowland environments. Mixed pine-broadleaf forests prevail between 1800 m and 2000 m. Several species of pines form this forest's patchy canopy and support masses of epiphytes. Interspersed evergreen oaks and a broadleaf tree/shrub understory complement the pine cover. Pine forests cloak soil-poor slopes below 1700 m. This description of elevational zones is misleading, especially above 1700 m, because of the patchwork nature of temporal patterns of forest clearance. One slope may support several forest types representing several different stages of succession.

MILPAS

Tierra fresca contains the municipio's thickest, most fertile topsoils, known locally as *suelo franco*. The Lenca employ shifting cultivation on these clay loams and produce the traditional maize, beans, and squash crop trio found throughout much of highland Middle America. Annually, the Lenca clear forest or *guamil* for new milpas in February and March. They prepare and plant their milpas during

April and May, the last two months of the dry season and harvest in October and November, the final months of the wet season.

The Lenca rotate their arable land through up to three vegetative stages, milpa, *guamil*, and forest, for periods of varying duration (Figure 5). Traditionally, the duration of each stage depends on factors including slope angle, soil quality, and a family's caloric demand. To determine the timing of *guamil* or forest clearance the Lenca also consider the mix of plants present. For example, a *guamil* patch in which ***frijolillo*** plants (*Acacia angustissima,* Fam. Leguminosae, Subfamily Caesalpinioideae) are dominant is considered suitable for clearance. A *guamil* patch where blackberries, *Rubus* are dominant is not yet ready for clearance.

FIGURE 5.— Milpa, *guaymil*, and pine forest cloak a gentle grade in *tierra arriba* (photo by Scott Brady).

Milpa stages customarily ranged from 2-10 years, as did the *guamil* and forest fallow period. Protected area land use restrictions intended to allow forest regeneration have shortened the duration of the fallow cycle. By prohibiting the clearance of forested land and land where forest is regenerating, protected area restrictions force farmers to clear *guamil* patches earlier than usual. Agricultural extension agents in the municipio work to reduce forest clearance by promoting the cultivation of tree crops, like apples and peaches, as a means to allow permanent cultivation rather than shifting cultivation. Protected area restrictions have only recently begun to be enforced. The fines meted out have only penalized forest clearance. They have not yet prevented it. Similarly, the lack of a dependable market for apple and peaches has prevented farmers from abandoning shifting cultivation.

Lenca milpas support the full range of vegetation lifeforms. Verdant, herbaceous, food plants, like maize and several varieties of beans, sprout up through the dark ash, stumps and skeletons of burnt forest. Their milpas also include intercropped living trees. Lenca traditionally have practiced *de facto* agroforestry by encouraging the growth of fabaceous tree species for soil fertility and erosion prevention in their milpas (Figure 2). ***Frijolillo***, and ***guachipilin***, are the two predominant milpa tree species.

Rather than planting ***guachipilin***, the Lenca manage for the plant's presence in their milpas. They refrain from clearing the plant when clearing *guamil* or forest patches for milpa preparation. This is similar to the practice of the Huastec Maya of Veracruz State in Mexico who also manage for the plant, which they call ***chicath*** (Alcorn 1984). Like the Lenca, Huastec farmers consider the tree an indicator of milpa yields. An abundance of *Diphysa* pods portends abundant bean and maize yields.

Alcorn (1984) also found that the Huastec care for the tree because of its multiple uses. They use leaves, shoots, and bark from the ***chicath*** to ameliorate conditions that range from diarrhea to boils. Recent research by Guatemalan ethnopharmacologists confirmed *Diphysa's* medicinal qualities (Caceres et al. 1990, 1993a, 1993b, 1995). Various preparations of *Diphysa* bark acted against dermatophytic infections, gastrointestinal disorders, and strains of gonorrhea.

The high costs and lack of information about chemical fertilizers have limited the adoption of these by the Lenca of Guajiquiro. They continue to depend on fallowing for restoration of fertility; and, make room in their milpas for two fabaceous trees, the ***guachipilin*** and ***frijolillo***, that, in symbiosis with *Rhizobium*, fix nitrogen (Budowski 1987). Enforcement of protected area land use restrictions and the efforts of agricultural extension agents probably will not diminish the function of ***guachipilin*** in the Lenca agricultural landscape. The Lenca will continue to rely on the tree for soil improvement. The tree's monetary value beyond the milpa will further persuade farmers to include it in their plots.

HOUSES

Similar to the Huastecs, the Lenca also value the multiple uses of ***guachipilin***. The tree's durable trunk is an essential construction material for their houses. The

FIGURE 6.— Twisted ***guachipilin*** horcones support a *bahareque* dwelling (photo by Scott Brady).

Lenca primarily construct two different types of houses: the indigenous *bajareque* and white-washed Spanish *adobe*. *Bajareques* are the more traditional house type (Figure 6), although the Lenca have adopted Spanish architectural components. *Bajareques* have wattle and daub walls framed by corner posts, *horcones*. Prior to the Lenca's adoption of clay tiles and hipped roofs, their bajareques were covered with steep thatch roofs.

An adobe house's mud-brick walls stand without the support of corner posts. Both house types are usually two-room, rectangular structures primarily covered by hipped or gabled clay-tile roofs. In Guajiquiro, both house types are constructed by locals with local materials. Adobe walls, tile roofs, and the two-room rectangular floor plan represent Lenca adoption of colonial Spanish architectural features (West 1998). However, the adobe bricks and the clay tiles, even the white wash that the Lenca use to fashion an exterior veneer, are derived from local deposits from within the municipio.

In response to questions about the respective values of the two house types, the Lenca of Guajiquiro commonly report that adobe houses are easier to decorate while *bajareque* houses are sturdier. The Lenca attribute a *bajareque's* durability to the twisted ***guachipilin*** corner posts that support them. While they also use ***tatascan*** (*Tecoma stans*, Fam. Bignoniaceae) for *horcones*, they consider the ***guachiplin's*** contorted trunk the best wood for the corner posts. Throughout the municipio, informants claim that ***guachipilin*** corner posts cut during the first phase of the moon will endure 100 years, the lifetimes of three houses. Indeed, Guajiquiro Lenca salvage ***guachipilin*** corner posts from abandoned house sites when constructing new *bajareque* houses.

Bajareques with ***guachipilin*** corner posts dot the hills throughout Guajiquiro municipio. ***Guachipilin*** trees, however, do not grow throughout Guajiquiro's uplands. The distribution shown on Figure 4 notwithstanding, in Guajiquiro ***guachipilin*** trees primarily grow in milpas, *guamil,* and secondary forests found on the clay loam slopes located between 1700 m and 1900 m of elevation. Lencas farming in this zone profit by selling the ***guachipilines*** that they have tended in their milpas. The cost of one ***guachipilin*** corner post is 100 *Lempiras* ($7 US). A typical *bajareque* house includes eight corner posts. This makes ***gauchipilin*** corner posts the second most valuable component of a *bajareque* house, after the 3,000 roof tiles that cost 1 *Lempira* each.

A regional authority previously predicted that the Lenca's acculturation would include the wholesale adoption of the Spanish adobe house at the expense of the *bajareque* (West 1998). Recent interviews and field observation suggest that the transition is proceeding only slowly. However, should Lenca throughout Guajiquiro exclusively adopt adobe or substitute the recently introduced cinder blocks for the walls of their houses, the architectural function of ***guachipilin*** will decrease and, similar to the thatch roof, the distinctive contorted *horcones* will recede from the Lenca landscape. A third function of the ***guachipilin*** appears to be less vulnerable to substitution, and figures to remain.

SPIRIT

A final purpose of the ***guachipilin*** tree links Lenca milpa agriculture to Lenca folk housing, and to their faith in the immortality of the human spirit. The tree functions in Lenca religious ritual. Many Lenca of Guajiquiro craft ***guachipilin*** crucifixes for gravesites. They believe the durable wood is an appropriate, and lasting, symbol of a lost loved one's enduring spirit (Figure 7). In this context a reciprocal relationship has developed between the Lenca and the ***guachipilin***. They sanctify the tree by transforming its wood into crosses that embody the human spirit. Conversely, the Lenca bestow a natural characteristic of the tree, its durability, on the human spirit. Masses of ***guachipilin*** crosses stand in formation in the municipio's cemetery bearing witness to this man-plant relationship. The Lenca have endowed the tree with meaning that figures to allow it to persist in their landscape

CONCLUSION

Despite the ***guachipilin's*** utility to the Lenca, development agents in the municipio who promote agro-forestry and prevention of soil erosion ignore the tree, and the potential benefits of incorporating the plant into their projects. A local tree nursery, sponsored by an extension agency to supply seedlings for reforestation and erosion prevention projects, provides some endemic *Pinus* seedlings, but concentrates on introduced trees like *Eucalyptus* and *Casuarina*. Felker and Bandurski (1979) reported similar disinterest in tropical fabaceous trees twenty years ago. Agronomists ignore trees like ***guachipilin*** because they do not produce

FIGURE 7.— ***Guachipilin*** crucifixes in Guajiquiro's cemetery (photo by Scott Brady).

edible fruit. Silviculturalists ignore them because they cannot be managed as a forest crop. Honduras' national forestry school omitted ***guachipilin*** from its list of one hundred useful tree species (Benitez Ramos and Montesinos Lagos 1988). Should the ***guachipilin's*** utility remain unnoticed by outsiders working in Guajiquiro Municipio, the tree will persist in the Lenca landscape because of the interrelated purposes it serves.

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Imperfect Balance: Landscape Transformations in the Precolumbian Americas. David L. Lentz, Editor. Columbia University Press, New York. 2000. $65.00 (cloth), $30.00 (paper). Pp. xxi, 547. ISBN: 0-231-11156-8 (cloth) 0-231-11157-6 (paper).

A long-running debate concerns the ecological management abilities of the indigenous peoples of the Americas. On one side are ecological idealists like Donald Hughes (1983), who see Native Americans as natural conservationists maintaining some form of harmony with their environments. On the other are extreme critics like Paul Martin (Martin and Klein 1984) and Charles Redman (1999), who see them as wanton, reckless destroyers. Most anthropologists would probably find themselves somewhere in the middle, but the middle ground is vast and poorly defined (see e.g. Krech 1999 and my review of that work in Anderson 2000). Until now, there was no one source to which one could turn for authoritative summaries of the actual evidence for pre-Columbian resource management.

This book changes all that. David Lentz has brought together a formidable array of experts. They have produced long, detailed, objective, and comprehensive accounts of Native American environmental management throughout the pre-Columbian Americas.

The book includes a number of general chapters as well as many specific case studies. The general chapters include one on Holocene climate changes by David Hodell, Mark Brenner and Jason Curtis; introductions to the vegetation of each region (North and Central America, Andean South America, lowland South America); and Lentz' introduction, conclusions, and work on anthropocentric food webs. The case studies comprise nine chapters on topic areas of special importance and interest. These are all authoritative summaries of large, important landscapes, written by major authorities: Emily McClung de Tapia on the Basin of Mexico, Charles Spencer on Mexico and Venezuela, Nicholas Dunning and Timothy Beach on the Maya, Charles Peters on Neotropical forests, Gayle Fritz on the Mississippi Valley, Suzanne Fish on the Hohokam, Clark Erickson on the Titicaca Basin, Terence D'Altroy on the Andes, Anna Roosevelt on the Lower Amazon. Many or all of these names will be familiar to readers of *Journal of Ethnobiology*. All provide superb and detailed coverage of vast amounts of information, much of it new and hard to find. This book thus presents, in a single volume, a unique introduction to a vast, scattered, often obscure, but vitally important literature.

As such, it defies summary here. There are dramatic new discoveries such as the enormous size and great age of the Purron Dam in the Tehuacan Valley in Mexico (Spencer's chapter). There are sharp challenges to conventional wisdom, such as Anna Roosevelt's critique of the "Pleistocene refugia" theory of Amazon forests. We are introduced to mind-bending new landscapes such as the vast seasonal wetlands, dry forests, and montane bare-rock fell-fields of tropical South America (James Luteyn and Steven Churchill's chapter on South American vegetation).

More important is to say something about the implications of the book for the broad and facile theories noted above. This book proves, in overwhelming detail, that America's pre-Columbian inhabitants were neither harmonious naturalists nor wanton wreckers. They were expert, thorough, and pertinent landscape managers. They changed whole ecosystems. They carried out major engineering works including canals, dams, ridged field systems, and terracing of mountain ranges. They deliberately and profoundly affected the distribution and abundance of hundreds (if not thousands) of plant and animal species. They domesticated many of these, developing an incredible wealth of crop varieties.

Unsurprisingly, it was the high civilizations that did the most extensive landscape manipulation. They were perhaps especially industrious in drier habitats, where building irrigation works was vital. Yet, many simpler societies, and many groups in wet and favorable climates, also created major works. In some cases, notably in and near the Eastern Andes, we remain in profound ignorance of these creators — we do not even know whether they had a "civilization" or not.

It seems clear that the Native peoples were, in the main, good managers. They got what they wanted: food, fiber, shelter, and security. They did this through careful, fine-tuned control of a large array of resources. They conserved; whatever their ancestors may have done to the Pleistocene megafauna, the peoples described in this book exterminated few if any species. They did not ruin their environments. The highly colored scenarios of writers such as Redman (2000) do not hold up. Redman argued that the Hohokam fell because they allowed their irrigation systems to salt up and silt up, but Fish presents a more complex picture, allowing for long-term Hohokam survival and the possibility that the "fall" was late and somewhat mysterious. Redman also alleged that the Classic Maya civilization declined through overuse of land, but evidence presented in the present book implicates drought at least as strongly. Very possibly, drought was particularly devastating to a system already thinly stretched.

These scholarly consequences have real-world consequences. A debate in *Conservation Biology* (Schwartzman et al. 2000, Terborgh 2000, and following comments) shows what the stakes are. Schwartzman and his coworkers see indigenous Native Americans as good managers, and thus wish to leave them in charge of their traditional lands. Terborgh sees much worse management, and, though he sees indigenous land tenure as a moral imperative, he also feels that large and inviolate sanctuaries must be created if biocomplexity is to be conserved. Both sides can adduce considerable evidence for their positions, but neither can make a really convincing case. Lentz' collection provides the necessary base on which to build, if we are to seek evidence adequate to permit informed planning.

The saddest lack in this book is the voice of the long-dead managers. Current evidence suggests that these farmers, engineers, and rulers needed, and had, a moral and religious shell around their ecological and technical applications. Otherwise, they would have succumbed to the perennial problem of collective action: they could not have motivated their people to work together for the common good. We have historic and ethnographic evidence bearing on the point in a few cases — notably the Andes, as reviewed by Erickson and D'Altroy. But how can we look into the minds of the Hohokam or Cahokians, let alone those of the nameless and mysterious managers of the sabanas of Bolivia? Left with their anonymous works, we can only reflect on the words of Ecclesiasticus:

"Let us now praise famous men....

"And some there be, which have no memorial; who are perished, as though they had never been; and are become as though they had never been born; and their children after them.

"But these were merciful men, whose righteousness hath not been forgotten....

"Their seed shall remain for ever, and their glory shall not be blotted out."

(Ecclesiasticus 44:1, 9-10, 13)

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TRADITIONAL KNOWLEDGE OF MEXICAN CONTINENTAL ALGAE

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ABSTRACT.— A catalog of the knowledge and uses (medicinal, nutritional, soil improvement, phytopathology, industrial, agricultural and cattle ranching) of the Mexican continental algae is presented. Two of the 56 ethnic groups registered in Mexico, the Nahuatl (State of Mexico) and the Maya (Yucatan) are the ones with the most uses and information about this resource. The taxonomic groups most used are the following classes: Cyanophyceae (8 spp.), Chlorophyceae (9 spp.), Bacillariophyceae (2 spp.), Xanthophyceae (1 sp.), Charophyceae (2 spp.) and Rhodophyceae (1 sp.).

Key words: freshwater algae, Mexico, etymology, uses.

RESUMEN.— Se presenta un catálogo sobre el conocimiento y aprovechamiento ficológico de las algas continentales mexicanas, el cual incide en diferentes aspectos: alimentación, medicina, fitopatología, de mejoramiento del suelo y pecuario y usos industriales. De los 56 grupos étnicos registrados para México, son el náhuatl (Estado de México) y maya (Yucatán) los que presentan un mayor conocimiento y utilización del recurso. Las clases taxonómicas encontradas fueron las Cyanophyceae (8 spp.), Chlorophyceae (9 spp.), Bacillariophyceae (2 spp.), Xanthophyceae (1 sp.), Charophyceae (2 spp.) y Rhodophyceae (1 sp.).

RÉSUMÉ.— Nous présentons un panorama général de l'emploi éthnobotanique des algues continentales mexicaines, ainsi comme leur utilisation dans la nutrition, la pharmaceutique, l'amélioration du sol, phytopathologie et l'industrie. Des cinquante-six cultures connues au Mexique, ce sont les Maya et le Nahuatl qui présentent la plus grande tradition dans l'usage de cette resource. Les groupes taxonomiques avec le plus grand nombre de régistres sont les Cyanophyceae (8 spp.), suivies des Chlorophyceae (9 sop.), Bacillariophyceae (2 spp.), Xanthophyceae (1 sp.), Charophyceae (2 spp.) et Rhodophyceae (1 sp.).

INTRODUCTION

Several ancient Mexican cultures developed in close relation to water. Examples of these cultures are the Nahua from the Valley of Mexico, the Purepechas from Patzcuaro, Michoacan and the Maya from the Yucatan Peninsula. These cultures valued the natural wealth of their homelands and knew how to use it. But not only did the Mexican indigenous ancestors appreciate the natural resources, the Spanish conquerors who arrived later left testimonies of the many virtues they found on the land of Anahuac[1] and other regions.

The objective of this research is to provide information related to the uses and names of the continental algae from pre-hispanic and post-hispanic times to the present day. The autochthonous and vernacular nomenclature was our first source of information about the uses of continental algae. This research, written as a catalog, is a guide to the understanding of the vernacular nomenclature of algae as well as their geographical distribution, habitat, and uses. Such concepts, including etymology, have been well documented. This article registers the different vernacular names in Nahuatl and Maya languages; it includes ancient and modern Spanish, scientific names, and some recent research on some of the algae.

METHODOLOGY AND FORMAT

The information about algae found in this research and reflected in the bibliography was obtained by reviewing historical sources: ancient manuscripts, dictionaries, and recent publications. The data herein reported also include the authors' direct observations. Additional information from some herbariums was included.

The catalog's structure consists of six sections for each name. The first section consists of information related to autochthonous and vernacular (common) nomenclature, etymology, and other names. The second section documents the chronology of available information from the 16th century to the present; textual paragraphs taken from facsimiles or recent re-editions can be found in this section. Taxonomic information, generally down to species, is included, although in some cases only an interpretation of its taxonomic identity is given. The updating of biological nomenclature (shown between brackets [...]) is presented according to Ortega (1984) and Silva et al. (1996), except for the Cyanophyceae which follows Komárek and Anagnostidis (1989) and Anagnostidis and Komárek (1988). The third section indicates Mexican distribution: state, in alphabetical order, followed by a colon, then the municipality [Mpio.:] and localities. Where possible, we include a voucher number of a herbarium specimen with the name of the collector or collectors, the number of the collection, the date and herbarium's official registration number with its acronym or initial, according to the *Index Herbariorum* (Holmgren et al. 1990). The fourth section indicates the habitat according to the type of environment, substrate or biological relationship. If no information exists, we specify 'not provided'. The fifth section provides the uses of the algae, or the existing research regarding these uses (in human or animal nutritional, medicine, industry, soil improvement, and so on), and the nature of the finished product. The sixth section, or notes, has been included in many of the paragraphs as a means of explain problems regarding taxonomy, nomenclature or uses. We append a literature list on algae.

CATALOGUE

Common name: ***Algafil***.
Etymology: Spanish. Commercial name.
Chronology: Mendoza and Pino (1964) did research with ***algafil*** and identified it as *Chlorella* sp.
Distribution: Not provided.
Habitat: Not provided.
Uses: Increases the pigmentation in egg yolks of Leghorn hens.
Note: Byproduct of fermentation. Commercially prepared by Abbot de Mexico, S.A. laboratories. Not produced in Mexico anymore.
Common name: ***Amoxtli*** (Figure 1).
Etymology: Nahuatl, ***amox-tli***, writing book (Karttunen 1992:11).
Other names: ***amomoxtli, amoxtle, gelatina de agua*** 'water jelly'.
Chronology: Sahagún in 1571 (1971:221, fo. 220) writes: "There are ***urronas***[2] floating in the water, called ***tecuitlatl*** or ***acuitlatl*** or ***açoquitl*** or ***amomoxtli***, of a light blue color; when thick, you spread it on ashes on the floor and make 'cakes'. You can toast it and eat it." ("Hay unas ***urronas***, que se crían sobre el agua, que se llaman ***tecuitlatl*** o, ***acuitlatl***, o ***açoquitl***, o ***amomoxtli***, son de color azul claro, después que está bien espeso, y grueso, cógenlo, tiendenlo en el suelo sobre ceniza y después hacen unas tortas de ello y tostadas las comen.")
Ortega (1972:93, 95) claims that, "Someone from that place [Zumpango Lake] told us it was called gelatina de agua 'water jelly' or ***amoxtle***." Ortega named it *Nostoc commune* Vaucher *ex* Bornet *et* Flahuault.
Castello Yturbide et al. (1986:73, 190), quoting Mrs. Guadalupe Sánchez, from Tláhuac, D.F.: "Diega, my grandmother, had a canoe, she would row among the ***chinampas*** 'floating gardens' to collect ***amoxtle***: she was the only one who knew how to prepare it. She died in 1966." ("Mi abuelita Diega tenía su canoa, se iba remando entre las chinampas a recoger el amoxtle; sólo ella lo sabía preparar. Murió en 1966.")
Distribution: State of Mexico: Laguna de Zumpango, *M.M. Ortega* 65, 12 Oct. 1970 (MEXU 86).
Habitat: Floating on the lagoon.
Uses: Edible.
Note: It is no longer eaten by the people of Zumpango. It is still used in Bolivia (Halperin 1967) and Perú (Aldave-Pajares 1969). The Zumpango lake was dried out and re-filled with recycled water.
Common name: ***Chilacaxtli*** (Figure 2).
Etymology: The original Mexican term for it is not known; nevertheless, Karttunen (1992:3, 51, 52) mentions the terms: ***chilach-tli***, seed of the chili pepper plant; ***ach-tli***, possessive of *–achyo*, seed.; ***chil-li***, chili pepper. Possibly, seed of the chili pepper.
Other names: ***Chilacastle, chilacascle***.
Chronology: Robelo (***chilacascle***, 1941:384) and Santamaría (***chilacastle***, 1978:491) consider it to be a plant that grows on the surface of ***acequias*** 'causeways' and stagnant water: *Azolla caroliniana* Willdenow [*Azolla filiculoides* Lamouroux].

FIGURE 1.— ***Amoxtle*** [*Nosctoc commune* Vaucher *ex* Bornet *et* Flahault] water jelly floating on the Zumpango Lake.

Espinoza Abarca et al. (1985:61-62) collected this plant in Mixquic, D.F. in December, 1980; it was used as green manure and was identified as *Azolla filiculoides* Willdenow in symbiotic association with *Anabaena azollae* Strasburger [*Trichormus azollae* (Strasburger) Komárek *et* Anagnostidis].

Distribution: Federal District: causeways near the town of Mixquic. Michoacán: Mpio. Morelia: Morelia, *G. Arsene* 3177, 4 Oct. 1909 (MEXU 185015, 186276, as ***chilacaxtli***).

Habitat: Gutters, causeways.

Uses: Green manure.

Note: There is confusion between the terms ***chilacastle*** and ***chichicastle***. Bravo Hollis (1930:7) indicates that the first term is used both for *Azolla* and for *Lemna*, and it is used as duck food. But Lot et al. (1999:37) attribute the term only to *Lemna gibba* Linnaeus whose vernacular name is: ***chilacastle***, ***lenteja*** and ***lentejilla***, terms used in the Federal District, and used as duck food and as manure on the ***chinampas***. Martínez (1979:284) says the term ***chichicastle*** referes to *L. gibba*. For Espinoza Abarca et al. (1985), *Azolla filiculoides* is a plant that captures atmospheric Nitrogen through its symbiosis with *Anabaena*. The oldest reference to ***chilacaxtli*** is found on a herbarium sample collected by G. Arsene (a priest) in 1909 and identified as *Azolla caroliniana*, a synonym of *Azolla filiculoides*. Surely, the ***chilacaxtli*** or ***chilacastle*** is used as green manure [*Azolla*] and ***chichicastle*** [*Lemna*] as duck food. It is easy to be confused because *Azolla* and *Lemna* frequently grow together and tend to intertwine (Bravo 1930:7).

FIGURE 2.— *Chilacastle* floating on the canals of Mixquic, Xochimilco, D.F. (March 23, 1972).

Common name: ***Cuculin*** (Figures 3, 4).

Etymology: Possibly a Nahua term. Orozco y Berra (1798:153) indicates that ***cuculito del agua*** 'water cuculito' is a derivation of the Mexican term ***cuculin***. Robelo (1941:362) states that the ***cocolli*** is a corn and bean ***tamal***[3], prepared with honey and used by the Indians of the Valley of Mexico during religious ceremonies.

Other names: ***Cuculito del agua, cocol, cocolin, cocol de agua*** 'water cocol'.

Chronology: Molina in 1555 (1966:328) states that the name ***cuculin***, means water viscosity or edible thing which grows among certain aquatic plants.

Hernández between 1571-1575 (1959:395) writes: "For the Indians, ***cocolin***, a strong smelling manure, is a brown substance produced in the Mexican lake, which floats on the water and looks and smells like slime, from where the name comes. Indians sell it and use it as food when they are extremely hungry because it has a fetid smell and is not a good thing to eat." ("Llaman los indios ***cocolin*** o sea cieno de olor fuerte, a cierta sustancia parda que produce el lago mexicano, que flota sobre el agua y es semejante al limo y de olor parecido también, de donde le viene el nombre. Lo venden los indios y lo emplean en sus comidas para saciar su gula de cualquier manera, pues exhala un olor fétido y es alimento dañino.")

Orozco y Berra (1798:153) writes: "The Indians call it water foam and it is eaten today under the name of ***cuculito de agua*** 'water cuculito' which is a derivation of the Mexican word ***cuculin***." ("Los indios le llaman espuma del agua y consumen el producto actualmente con el nombre de ***cuculito del agua*** palabra estropeada del mexicano ***cuculin***.")

Ortega (1972:91, 93, figs. 14-19) identified it as *Phormidium tenue* (Meneghini) Gomont and *Chroococcus turgidus* (Kützing) Nägelli, in his writings on Lake Texcoco and in his observations in markets in Coyoacan, the Merced, Zumpango, Cuautitlán, Tláhuac, Xochimilco, Xaltocan and Texcoco. The author say that while in the markets, the fishmongers [women] told us that they sold ***tamales*** (Figure 4) called ***cocol de agua*** 'water cocol' made of a sort of gel found on the water and that we thought was the original ***tecuitate***.

Castelló Yturbide et al. (1986:74) gathered information from Doña Juana García in Xaltocan, State of Mexico: "In Xaltocan, they say that the ***acocol*** is some kind of foam which is gathered from the water in baskets, it is cleaned and mixed with some herbs, salt, and dried chili pepper; corn leaves are then spread into this mixture. They are steam cooked, just as ***tamales*** are, this is why they are called ***tamales de lodo*** 'mud tamales'. We would eat them on their own or with something else." ("En Xaltocan, dicen que el ***acocol*** es espuma que se cría en la superficie del agua, se saca con una canasta, se lava, se muele con epazote y chile seco, se le pone sal y la masa se extiende en hojas de maíz. Luego se cuece al vapor, como los ***tamales***, por eso llaman tamales de cocol de lodo. Los comíamos solo o en guisado.")

Distribution: State of Mexico: Mpio. Ecatepec: surrounding small causeways of the Texcoco lake [the "Caracol"], *F. González leg. M.M. Ortega* 64, 5 Nov. 1971(MEXU 100); external canals of the Caracol [Sosa Texcoco Company], *J.L. Godínez*, 24 August. 1982 (MEXU 1246), Sept. 1982 (MEXU 1493, 1494).

Habitat: On ***tequesquite*** soil[4] of the canals and small causeways of the Texcoco lake.

Uses: Edible. Due to its nutritional importance, some authors did research on its general chemical composition (Salcedo Olavarrieta et al. 1978a), protein (Salcedo Olavarrieta et al. 1978b) and some inorganic elements (Godínez et al. 1984). Its nutritional value did not lie in the proteins but in the inorganic elements such as calcium and iron.

Preparation of the product: Ortega (1972:93) said that: "Fishermen form Xaltocan gather the ***cocol*** form water puddles and canals once it is mature or when the layer of algae is thick enough. It is collected by hand or with very fine nets woven the old Mexican fashion. The algae is carefully washed to get rid of the mud, then it is minced in ***molcajetes***[5] and seasoned with herbs [*Chenopodium ambrosoides* Linnaeus] or parsley [*Petroselinum hortense* Hoffman], slices of green chili pepper [*Capsicum annum* L. var. *acuminatum* Fing] or ***guajillo*** chili [*C. annum* L. *longum* Sendt.] and animal fat; it is finally steam cooked and covered with corn leaves. This dish, when steamed, becomes brownish red, has a strong smell and a "damp" taste. It is eaten with ***tortillas*** 'flat corn cakes' and ***mole***[6], and it is quite nice."

Note: Castelló Yturbide et al. (1986:74) wrote that the ***tamales*** can still be found in Tonatitla, and added: "During the 70's it was still possible to buy these ***tamales*** with the fishmongers in markets in Cuautitlan, Xochimilco and Texcoco." During a trip near the Texcoco canals and markets (November 17, 1984), J.L. Godínez found no traces of this product. It is very possible that they no longer exist, just as Ortega (1972) indicated: "In Xochimilco (November 15, 1970), an old lady and some vendors told us that the ***cocol*** has not been seen for approximately eight years, that it is quickly disappearing due to water pollution [by sewage] and because the lake is now dry."

FIGURE 3.— ***Cocolin*** [*Phormidium tenue* (Meneghini) Gomont] collected from the Sosa Texcoco canals (October, 1982).

FIGURE 4.— ***Tamal*** made of ***cocolin***.

Common name: ***Conferva***.

Etymology: Linnean name, meaning, "made of free filaments" (Stearn 1992:389).

Chronology: Ponce de León (1909:20) named it *Conferva chantransia* Linnaeus [*Lemanea fluviatilis* (Linnaeus) C. Agardh].

Distribution: Sinaloa.

Habitat: Not provided.

Uses: Not provided.

Common name: ***Chonak***.

Etymology: ***Chonak***, very damp thing, *ovas* 'algae' (a very fine filamentous aquatic plant) of the lake, freshwater filamentous slime, filamentous substance growing in stagnant water (*Diccionario Maya Cordemex* 1980:107).

Other names: ***Choonakil, ucho"nakilha***, water *ovas* (*Diccionario Maya Cordemex* 1980:107).

Chronology: Ortega et al. (1995:xvii) interpret these names as Chlorophyceae algae.

Distribution: Yucatan Peninsula.

Habitat: Freshwater.

Uses: Not provided.

Note: *The Diccionario de la Lengua Española* (1970:954) indicates that *ova*, from the Latin *ulva*, refers to unicellular [pluricellular] green algae, which can consist of simple or branched filaments, or large and leafy blades, or narrow, like bands, growing in the sea, rivers or ponds, floating on the water or fixed to the bottom by rootlike appendixes. "Ova de río" refers, therefore, to freshwater algae [possibly filamentous Chlorophyceae, Cladophoraceae] and "ova marina" to algae with laminar expansions or tubular hollow bands, almost always branched, found in sea and brackish water [possibly Ulvales such as *Enteromorpha* and *Ulva*].

Common name: ***Diatoma de copos*** 'diatoms tufted'.

Etymology: Spanish. ***Diatoma*** refers to diatom, common name for an algae of the class Bacillariophyceae; ***copos*** refer to tuft or clot.

Chronology: Martínez Gracida (1891:24) named it *Conserva* [*Conferva*] *pectinalis* O.F. Müller [*Fragilaria diophthalma* (Ehrenberg) Ehrenberg].

Distribution: Oaxaca.

Habitat: Not provided.

Uses: Not provided.

Common name: ***Diatoma erguida*** 'stiff diatom'.

Etymology: Spanish. ***Diatoma*** refers to diatom, common name for an alga of the class Bacillariophyceae; ***erguida*** means stiff.

Chronology: Martínez Gracida (1891:24) named it *Conserva* [*Conferva*] *striathum* [*striatula*] J.E. Smith [*Fragilaria striatula* (J.E. Smith?) Lyngbye].

Distribution: Oaxaca.

Habitat: Not provided.

Uses: Not provided.

Common name: ***Espirulina*** '*Spirulina*' (Figure 5).

Etymology: Spanish. From the Latin *spira*, each of the turns of a spiral. Common name for a member of the class Cyanophyceae or blue-green algae.

Chronology: Since 1967, after the recognition of the existence of *Spirulina geitleri* De Toni in lake Texcoco, Sosa Texcoco Company, in collaboration with the French Institute of Petroleum, studied and cultivated *Spirulina* for twenty years (Sosa Texcoco 1976:6). Research on Mexican *Spirulina* during the 1970s and 1980s was extensive. The bibliography can be consulted in Ortega (1987).

FIGURE 5.— Products made of *Spirulina*.

Distribution: State of Mexico: Mpio. Texcoco: Evaporador Solar El Caracol.[7]

Habitat: It is found in water plankton in canals from "El Caracol."

Uses: Human and animal dietary supplement. High content of proteins, minerals and vitamins. Santillán (1982:42) indicates that more than 50 products were elaborated with *spirulina* (capsules, tablets and powdered ***Spirulina***). Ortega (1987:175) states that they reached a production of almost 1000 tons per year. The algae were exploited, by semi-natural cultivation, by Sosa Texcoco until 80's. During the 1990 this company gradually ceased its production. For more information see Santillán (1982) and Ortega et al. (1995:186-190).

Common name: ***Iximha***.

Etymology: Maya language. ***Ixim***, corn; ***ha***, water: water corn (*Diccionario Maya Cordemex* 1980:275).

Chronology: Doctor Román Sabas Flores (in Brioso Vasconcelos 1923:544) describes it as follows: "The plant known in the peninsula as ***Ixinha*** [***Iximha***] is *Chara gymnopus* A. Braun [*Chara zeylanica* Klein *ex* Wildenow]."

Distribution: Yucatán: Izamal. Veracruz.

Habitat: In deep natural ponds and other natural deposits of permanent water.

Uses: Research on harmful insects (Hoffman and Sámano-Bishop 1938a, 1938b; Peláez 1947) has found a relationship between some algae and the larvae of organisms such as *Anopheles pseudopunctipenis* and *A. albimanus* Wied., which are malaria vectors in regions of Oaxaca, Veracruz and Yucatan. The effect of the algae on these larvae was first observed by medial doctor Lisandro Dorantes (in Brioso Vasconcelos, 1923:544) in ***cenotes*** 'doline', deep natural ponds in Yucatan. Brioso Vasconcelos (1923:546) tried the lethal effect of the algae on larvae of five species of *Chara* [*Ch. fragilis, Ch. foetida, Ch. contraria, Ch. hispida*], including *Chara gymnopus*. He cultivated the algae in order to control the spread of malaria (by *Aedes calopus* and *Culex* sp. mosquitoes) during the anti-malaria campaigns in Veracruz and Yucatan. Dr. Connor (in Brioso Vasconcelos 1923:546) underlines the presence of an active ingredient in *C. gymnopus* which destroys the mosquitoes' larvae in barrels and tanks.

Common name: ***Lama*** 'slime'.

Etymology: Spanish. From the Latin *lama*, soft, loose and sticky slime, of a dark color, found at the bottom of the sea or rivers, or at the bottom of places where there is, or has been, water for a long time. Algae or "ova" of slimy places or puddles (Diccionario de la Lengua Española 1970:784).

Chronology: González Coss (1872:314) called it *Conferva fontinalis* Linnaeus [*Vaucheria fontinalis* (Linnaeus) Christensen] and *Conferva rivularis* Linnaeus [*Cladophora rivularis* (Linnaeus) van den Hoek].

González (1876:32) called it *Byssus flos-aquae* Linnaeus [*Anabaena flos-aquae* Brébisson *ex* Bornet *et* Flahault]; *Conferva bullosa* Linnaeus [*Cladophora glomerata* (Linnaeus) Kützing var. *crassior* (C. Agardh) van den Hoek] and *Conferva rivularis* Linnaeus [*Cladophora rivularis* (Linnaeus) van den Hoek].

Martínez Gracida (1891:24) called it *Conserva* [*Conferva*] *bullosa* Linnaeus [*Cladophora glomerata* (Linnaeus) Kützing var. *crassior* (C. Agardh) van den Hoek], *Conserva* [*Conferva*] *flosaguae* [*flos-aquae*] (Linnaeus) Roth [*Anabaena flos-aquae* Brébisson *ex* Bornet *et* Flahault], *Conserva* [*Conferva*] *pectinalis* O.F. Müller [*Fragilaria diaphthalma* (Ehrenberg) Ehrenberg], *Conserva* [*Conferva*] *rivalaris* [*rivularis*]

Linnaeus [*Cladophora rivularis* (Linnaeus) van den Hoek] y *Conserva* [*Conferva*] *striathum* [*striatula*] [*Fragilaria striatula* (J.E. Smith?) Lyngbye].
Castañeda (1933:142) called it *Spirogyra*, and Bravo Hollis (1936:219) called it *Spirogyra flavescens* (Hassall) Kützing. The *Enciclopedia Universal Ilustrada* (tomo 29:359) describes this slime as a: "Plant growing in Michoacan that seems to be *Microspora fontinalis* De Toni [*Rhizoclonium hieroglyphicum* (C. Agardh) Kützing], freshwater green algae."
Distribution: Guanajuato: Silao. Hidalgo: Mpio. Actopan: La Peña. Jalisco. Michoacán. Nuevo León: Monterrey. Oaxaca.
Habitat: Freshwater.
Uses: Not provided.
Note: ***Lama*** or slime is a name given to many species of algae.
Common name: ***Lama de Comanjilla***.
Etymology: Spanish. Toponym, see ***lama***.
Chronology: González Coss (1872:314) called it *Ulva labergutiformis* [*labyrinthiformis*] Gmelin [*Spirulina labyrinthiformis* (Linnaeus) Gomont].
Distribution: Guanajuato: Silao.
Habitat: Not provided.
Uses: Not provided.
Common name: ***Lama del topo*** 'mole slime'.
Etymology: Spanish. Toponimic, see ***lama.***
Chronology: González (1876:32) called it *Oscillatoria calida* (C. Agardh) González [*Phormidium calidum* (C. Agardh) Gomont *ex* Gomont].
Distribution: Nuevo León: Monterrey: El Topo Ranch.
Habitat: In 40° C water source.
Uses: Not provided.
Common name: ***Lama larga*** 'long slime'.
Etymology: Spanish, see ***lama***.
Chronology: Martínez Gracida (1891:24) called it *Conserva* [*Conferva*] *lutescens* (Vaucher) De Candole [*Zygnema lutescens* (Vaucher) C. Agardh].
Distribution: Oaxaca.
Habitat: Not provided.
Uses: Not provided.
Common name: ***Mancha de la hoja*** 'leaf spot'.
Etymology: Spanish.
Chronology: Martin (1947:156) called it *Cephaleuros virescens* Kunze.
Distribution: Chiapas: on the riverbanks of the Grijalba River. Tabasco-Chiapas. Veracruz: Mpio. Tezonapa: near Tezonapa in El Palmar.
Habitat: Parasite of *Hevea brasiliensis*.
Uses: Not provided.
Note: Ortega (1984:238) indicates that this alga lives on leaves of old trees and young plants. She also states that the "leaf spot" produced by the alga causes relatively little harm.
Common name: ***Nitla*** (Figure 6).
Etymology: Possibly of Nahua origin. ***Nitla,*** indefinite pronoun which refers to things (Siméon, 1988:549).

Chronology: Ortega et al. (1995:190) considers it to be *Prasiola mexicana* J. Agardh.
Distribution: State of Mexico: Mpio. Ocuilan de Arteaga: la Cañada river, *G. Garduño*, 4 Feb. 1981 (IZTA 106), Aug. 1982 (IZTA 68), Nov. 1983 (IZTA 67), 7 Nov. 1983 (IZTA 120), 24 Oct. 1986 (IZTA 84).
Habitat: Grows on river rocks.
Uses: Medicinal (used as cough suppressant and to stop nose bleed).
Preparation of the product: As cough suppressant, a liter of water with some bits of algae. To stop nosebleed, it is put directly on the forehead.
Common name: ***Salivazo de la Luna*** 'moon spit'.
Etymology: Spanish. ***Salivazo*** 'large spit', amount of saliva that is expelled from the mouth all at once.
Ponce de León (1909:20) named it *Nostoc commune* Vaucher *ex* Bornet *et* Flahault.
Distribution: Sinaloa.
Habitat: Not provided.
Uses: Not provided.
Common name: ***Surrupa***.
Etymology: Unknown meaning

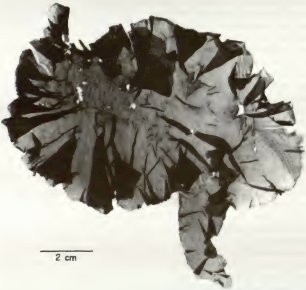

FIGURE 6.— ***Nitla*** or *Prasiola mexicana* J. Agardh collected from the Ocuilan River, State of Mexico (December 18, 1981).

Chronology: Ponce de León (1909:20) named it *Conferva chantransia*? [*Lemanea fluviatilis* (Linnaeus) C. Agardh].
Distribution: Sinaloa.
Habitat: Not provided.
Uses: Not provided.
Note: Ortega (1984:62) states that its identification is doubtful.
Common name: ***Tachak***.
Etymology: Maya language. ***Ta"chak, lama*** 'slime', green and slippery thing. It appears over the soil after much rain (*Diccionario Maya Cordemex* 1980:751).
Chronology: Ortega (1984:36) and Ortega et al. (1995:xvii) refer to it as *Nostoc verrucosum* Vaucher *ex* Bornet *et* Flahault.
Distribution: Yucatán: Mpio. Izamal: Aguada Chulumbay, 9 miles W. of Izamal.
Habitat: On land
Uses: Not provided.
Common name: ***Tecuítlatl*** (Figures 7-9).
Etymology: Nahua language. Siméon (1988:453) mentions that the suffix ***tetl*** means "stone" and ***cuitlatl*** "excrement": excrement of stones. Karttunen (1992:73) speaks of ***te-tl***, stone or gem; ***cuitlatl***, excrement, excrescence, residue: "excrescence or residue of stones." In relation to the names of towns such as Tláhuac, Cuitláhuac [or Cuitlahuatzin, Aztec king], Cuitlahuacan and Tecuitlatongo, Ortega (1972:87) writes that they are all toponyms of the term "algae." There seems to be doubt about the suffixes ***tetl*** and ***teotl;*** if the latter one is joined to other words, it acquires the meaning "sacred," "marvelous," "strange," and "surprising." Robelo (1941:245) wrote, "Their name for gold was ***costicteocuitla*** or yellow excrement of the gods," and for silver, ***iztacteocuitlak*** or "white excrement of gods." Robelo includes the name Tecuitlapan, ***teocui-tla-a-pan***: ***teocuitla***, gold; ***atl***, water and river; ***pan***, in "The river of gold." If the termination ***teotl*** was thought to be ***tetl***, the meaning of ***tecuitaltl*** is completely different; it might mean "sacred excrement" and this could lead us to surmise that the ancient Mexicans considered this product to be a valuable mineral, just as did Hernández (1959).
Other names: ***Tecuitate***.
Chronology: Tezozomoc in 1598 (Alvarado Tezozómoc, 1944:62) states: "On some days Mexican women would go to the market to sell fish, frogs, ***axayactatl***, seawater flies, ***izcahuitle***, ***tecuítlatl*** and other things which came from the lake, and all kinds of ducks." ("Donde otros días las mujeres de los mexicanos iban al mercado de Xochimilco a vender pescado, ranas, ***axayáctatl***, moscas del agua salada, ***izcahuitle***, ***tecuítlatl*** y otras cosas salidas de la laguna y patos de todo género.")
Benavente in 1541 (Benavente, 1903) states: "On the water of the Mexican lake grows a kind of powdered slime, and at certain times of the year, when it becomes thicker, the Indians fish it out of the water with very fine nets until their canoes are full of it; then the slime is put over sand to dry. They then prepare a sort of cake, thick as a finger. Afterwards it is cut in pieces like thick bricks and the Indians eat much of it and enjoy it. It is sold by many vendors in markets. It tastes like salt." ("Críanse sobre el agua de la laguna de México unos como limos muy molidos, y a cierto tiempo del año que están más

cuajados, cógenlos los indios con unos redejoncillos de malla muy menuda, hasta que hinchen los acales ó barcos de ellos, y á la ribera hacen sobre la tierra ó sobre arena unas eras muy llanas con su borde de dos ó tres brazas en largo y poco menos de ancho, y échanlos alli á secar; echan hasta que se hace una torta de gordor de dos dedos y en pocos días se seca hasta quedar de un gordor de un ducado escaso; y cortada aquella torta como ladrillos anchos, cómenlo mucho los indios y tiene se bueno anda esta mercaduria por todos los mercaderes de la tierra, como entre nosotros los que son de la salsa de los indios es bien sabroso, tiene un saborcillo de sal.")

López de Gómara in 1552 (1988:115-116) writes: "With very fine nets they periodically sweep the lake and collect a powdered thing which grows in the lakes of Mexico; this thing becomes thicker, but it is not a grass, nor is it dirt. Rather, it is something resembling slime. There is a lot of this slime, and they collect much of it. They make cakes like bricks with it, the way they do bricks of salt, and they take it to markets, near and far, and sell it. They eat this thing as if it were cheese. It tastes like salt, and with ***chilmolli***[8] it tastes quite good. They say that birds are so attracted to this slime that sometimes in winter the lake is completely covered by it..." ("Con redes de malla muy menuda barren en cierto tiempo del año una cosa molida que se cría sobre el agua de las lagunas de México, y se cuaja, que ni es yerba, ni tierra, sino como cieno. Hay de ello mucho y cogen mucho; y en eras, como quien hace sal, lo vacían y allí se cuaja y seca. Hácenlo tortas como ladrillos, y no sóla las venden en el mercado, más llevánlas también a otros fuera de la cuidad y lejos. Comen esto como nosotros el queso, y así tienen un saborcillo de sal, que con ***chilmolli*** es sabroso. Y dicen que a este cebo vienen tantas aves a la laguna, que muchas veces por invierno la cubren por algunas partes...")

Santa Cruz c. 1555 (Apenes 1947, pl. 2) did the plan of the City and Valley of Mexico, also known as the Upsala Map (Figure 7). Ortega (1972:89) analyzed this map, and wrote, in relation to the algae: The Upsala map is interesting not only as a geographical document but also for its many references to the human activities near the lakes and Valley of Mexico in general. Many traditions and activities continue to exist just as they did many years ago, but many others, such as the gathering of ***tecuitlatl,*** tend to disappear... Fishermen collecting a kind of foam from the water can still be seen (Figure 7). Someone pulls a net to the shore of the lake. They still collect ***ahuauhtle*** and ***cocol*** from the borders of the lake. Other aspects such as bird hunting are more evident. To the right, the isle of Xaltocan can be seen, with a bear in the middle. Today, Xaltocan is a small town located on saltpeter soil, where the lake is only a memory. Nevertheless, they still prepare ***tamales*** made of small fish and of ***cocol de agua*** or *water cocoles*. Fishermen bring this product to markets in Mexico City. ***Cocoles*** can be found in water puddles, canals in Texcoco and sometimes in Zumpango.

Díaz del Castillo in 1568 (1964:159) wrote: "There were fish vendors (women) selling small loaves of bread made from a kind a slimy substance they collect from that large lake and when it thickens they make bread that tastes a little like cheese..." ("Pues pescaderas y otros que vendían unos panecillos que hacen de una como lama que cogen de aquella gran laguna, que se cuaja y hacen panes de ello que tienen un sabor a manera de queso...")

FIGURE 7.— Detail of the Upsala Map (16th century). In the upper left hand corner, people collecting algae can be seen.

Sahagún in 1571 (1971:221, fo. 220) wrote: "There are some ***urronas*** growing on the water which are called ***tecuitlatl*** (Figure 8) or ***acuitlatl*** or ***açoquitl*** or ***amomoxtli***, they are light blue, and when they are thick enough, the people spread this thing over ashes and afterwards they make "cakes" which are toasted and eaten (Figure 9)." ("Hay unas ***urronas***, que se crían sobre el agua, que se llaman ***tecuitlatl*** o, ***acuitlatl***, o ***açoquitl***, o ***amomoxtli***, son de color azul claro, después que esta bien espeso, y grueso, cogenlo, tiendenlo en el suelo sobre ceniza y después hacen unas tortas de ello y tostadas las comen.")

Hernández between 1571-1575 (Hernández 1649, 1959:408-409) wrote: "The ***tecuítlat***, a substance much like mud growing in some places of the Mexican lake, floats to the surface from where it is collected with nets or shovels. Once out of the water, the Indians make small 'cakes' which are put to dry on fresh herbs until completely dry and afterwards these cakes are kept for about a year as if it were cheese. These cakes are eaten when needed, with roasted corn or with the popular ***tortillas***. Each area were this slime is collected provides the owner with good profits. It tastes like cheese, and this is how the Spaniards call it, although it is not as good as cheese, it smells a little like mud, it is of a green color which turns black, it can be eaten only in small quantities and only instead of salt or to give some flavor to corn. Tortillas made of this slime are not good: Spaniards, who eat almost anything, especially in these lands, do not eat these tortillas." ("Brota el ***tecuítlat***, que es muy parecido al limo, en algunos sitios del lago mexicano, y gana el punto la superficie de las aguas de donde se saca o barre con redes o se apila con palas. Una vez extraído y secado un poco al sol, le dan los indios forma de pequeñas tortas; se ponen entonces otra vez al sol y sobre yerbas frescas hasta que se seca perfectamente, y se guarda luego como el queso por sólo un año. Se come cuando es necesario

FIGURE 8.— Images from the *Florentine Codex* interpreted by Ortega (1972:87). Tenate or basket made of woven ***ixtle*** and palm leaves, with small loaves of bread made of ***ixcahuitl***. Below, filaments of the alga ***tecuítlatl***; also, the fish spear used by fishermen to collect the foamy substance or ***tecuítlatl*** may be seen.

FIGURE 9.— Images from the *Florentine Codex* interpreted by Ortega (1972:87) and Dibble and Anderson (1963:fig. 227). Two blue-green plates (in the original) prepared with ***tecuítlatl***.

con maíz tostado o con las comúnes tortillas de los indios. Cada venero de este limo tiene su dueño particular, a quien rinde a veces una ganancia de mil escudos de oro anuales. Tiene sabor de queso, y así lo llaman los españoles, pero menos agradable y con cierto olor a cieno; cuando reciente es azul o verde; ya viejo es de color de limo, verde tirando a negro, comestible sólo en pequeña cantidad, y esto en vez de sal o condimento del maíz. En cuanto a las tortillas que hacen de él, son alimento malo y rústico, de lo cual es buena prueba el hecho de que los españoles, que nada desprovechan de lo que sirve al regalo del paladar, sobre todo en estas tierras, jamás han llegado a comerlas").

Pomar in 1582 (Pomar and Zurita, 1941) wrote: "...neither fish nor birds reproduce here, and those birds which come from Florida in winter eat a small fish which can be found almost all year round, and a kind of food called ***tecuitlatl*** made of green slime that grows in the lake. Cakes are made of this, they are dark green, and the Spanish call them dirt cheese." ("...no se crían peces ni aves y las que vienen de Florida durante el invierno toman un pescadillo que se mantiene casi todo el año y un género de comida llamado ***tecuitlatl*** que hacen de unas lamas verdes que cría [la laguna] lo cual hecho tortas y cocido, queda con un color verde oscuro, que llaman los españoles queso de tierra.")

Clavijero between 1780-1781 (1945:354) wrote: "They not only ate living things, they also ate a slimy substance which floated on the water; they would collect it and make some cakes which would be dried and kept and would be used instead of cheese. They would call this substance ***tecuitlatl***." ("Comían no solamente de las cosas vivientes, sino aun de cierta substancia limosa que sobrenadaba en el lago, la cual recogían, secaban un poco al sol y hacían de ella unas tortas que volvían a secar y guardaban para que les sirviese de queso, cuyo sabor remeda. Daban a esta substancia el nombre de ***tecuitlatl***.")

Ehrenberg (1854:373, 374) analyzed several ancient Mexican documents. In a chapter of *The Edible and Medicinal Soils in Mexico* ("*Las tierras comestibles y medicinales de México*") he wrote, "In descriptions of Mexico we find news about mineral substances, some of which are eaten there for their taste, or for their medicinal properties." Research on the composition and structure of these substances might be very interesting and we might learn more about them. After analyzing the meaning of the ***tecuitlatl*** in the writings of Bernal Díaz del Castillo and Hernández, the author wrote that cakes made from this substance were bad food, which is evident because the Spaniards ate everything with good flavor, but they had not eaten any of this. The description could refer to *Oscillarias*[9] and polygastric[10] with a silica shell which emerge (in small clots) to the surface –in springtime–, from the bottom of stagnant water. One has to imagine isolated puddles in a swamp.

Ancona (1933:55) writes: "Floating on the lake, but preferably on puddles and canals which are still found during the dry season, green slimy masses of *Vaucheria* and Cyanophycea of the genuses *Oscillaria* and *Nostoc* can be found; the slimy secretion of the latter ones is favored by the *Gyrinus* flies and even by the corixids (water bugs), a fact we could appreciate when we dissected their stomachs." This might be what Clavijero referred to when he wrote about a foamy substance which was collected and eaten by ancient Mexicans, because we have never found eggs of the ***ahuautle***[11] which stick to the Cyanophytes.

Ortega (1972:86) wrote: "It is evident that the ***tecuitate*** is an important nutritious element for the poor peoples of the Anahuac." Several authors mention this product as part of a simple tradition practiced on a daily basis.

Distribution: Valley of Mexico [Texcoco and Zumpango].

Habitat: Lakes. Massive algae growth.

Uses: Edible.

Note: In Chad Lake, Africa, the French Petroleum Institute studied *Spirulina platensis* that had been consumed by local population (Léonard 1966:127). While, in Mexico, some authors (Prieto 1985:263; Castelló Yturbide et al. 1986:73) surmised that the ***tecuítlatl*** was *Spirulina maxima*, a blue-green algae, present in highly alkaline waters, such as those of Lake Texcoco. Nevertheless, Ehrenberg

(1854) was the first scientist who discovered that algae (*Oscillarias* and diatoms) were the main component in this Mexican product. Ortega (1987:174) wrote that the vulgar name of ***tecuítlatl***, which had been directly recorded from various informants in the Valley of Mexico, actually belongs to blue-green freshwater algae, which includes the *Phormidium tenue* or ***cuculito del agua*** 'water cuculito'. Farrar (1966:341) writes, based on historical facts, that the inhabitants of Tenochtitlan ate large amounts of blue-green algae [Cyanophyceae] of unknown species. He also states that, today, there are large quantities of Cyanophyceae closely related to toxic algae such as *Microcystis* and *Anabaena*. In spite of all this, it appears that ***tecuítlatl*** is being eaten with no harm to human health. It is possible that changes to the environment caused by urban growth have radically altered the natural habitat of the Valley of Mexico, and edible species have been substituted by toxic ones.

Common name: ***Tízatl*** 'white dirt' (Figures 10, 11).

Etymology: Nahua language. ***Tíza-tl***, a type of varnish or white dirt (Molina 1944:113; Siméon 1988:546; Karttunen 1992:241). Robelo (1902:167) wrote, "Spanish for ***tiza*** or ***tízar***, an Aztec word composed of ***tízatl*** (white dirt) a mixture of fossil microorganisms." Corominas and Pascual (1983:512) included the definition, "some white powder that silver craftsmen and other persons use to clean gold and silver jewelry." The word ***tiza*** is absent from the dictionaries of the classic period as well as from ancient editions. It can be found in the 1843 edition, but the definition says, "ashes of a deers' antlers, to which in 1869, is added white dust used as marker, which can be used to clean metals." Today, the word ***tiza*** is very well known in places where Spanish is spoken, especially as a name for limestone and chalk, and it is used to write on waxed surfaces, on cloth, etc. The terms ***tiçatl***, varnish or white dust, can be found in the Nahuatl Dictionary by Molina in 1571 [Molina 1966:508], together with the word ***tiçayoa***, 'to be full of varnish' or 'of white dirt,' and ***tiçauia***, 'to varnish with white varnish,' from where the Mexican name *Tizapan* comes. In Mexico, the word ***tiza*** is used, and also ***tizar***, which is a more refined word... and ***tizate*** is used in other places. The sound of this last word is like that of many Aztec words (tomate, petate, metate, achiote, etc.) although sometimes the original accentuation is kept and the ending ***tl*** is eliminated. Ximénez in 1615 (1888:282) describes in detail the shape and elaboration of the Mexican ***tiçatlialli*** (of the term ***tlalli***, dirt). If we had not had this information we would have believed that, given that coal can be used in the same way, its name would have been used for white chalk, and we would have supposed that the term came form *tizo, tizon*, which comes form the Latin *titio, -onis:* chalk burnt almost completely...these terms undoubtedly come form *titio*, as well as *atizar*, but we have renounced the use of this etymology. In Asturias, the term "tiz" is used for ***tiza***, white natural or artificial stone, which is a combination of the Mexican term ***tiza*** and the local synonym ***xiz*** [gis], from *gypsum*.

Other names: ***Tetízatl*** (*tetl*, rock; *tízatl*, white dirt), ***tizatlalli*** (*tlalli*, clay), ***tisar***, ***tizate***, ***tiza***, ***tierra blanca*** 'white dirt', ***tierra de diatomeas*** 'diatomaceous dirt', ***diatomita*** 'diatomite', 'diatom dust'. *Chimaltízatl* (*chimalli*, escudo: specular stone). ***Atizatl*** (***a-tl***, water: agua-tízatl). The verb "entizar," to paint with "tiza" or chalk. Robelo (1941:37) writes: ***Tiza-a-pan*** (***tíza, tízatl; atl***, water; ***pan***, in:

in water of tiza). The *Diccionario Porrúa* (1995:3503-3504) includes ***Tizatlán*** (tiza, ***tízatl; tlalli***, clay: over on clay). It is an archeological place, its population belonged to the Cholultec [Tlaxcala] culture. In other parts of the world, the term "tripoli" referred to siliceous deposit formed mainly of frustules of diatoms. Today it means "diatomite" (Díaz Lozano 1917:9; Hernádez Velasco 1955:36).

Chronology: Hernández between 1571-1575 (1959:408) and Ximénez in 1615 (1888:282-283) wrote: "The ***tetízatl*** or ***tízatl*** stone is a white stone used by painters, which is burnt to ashes until it turns white. It is, nevertheless, less white and shiny than the ***chimaltízatl***." ("El ***tetízatl*** o piedra ***tízatl*** es una piedra blanca que usan los pintores, calcinada, para dar el color blanco. Es sin embargo de blancura menos luminosa que el llamado ***chimaltízatl***.") Hernández (1959:410) also wrote: "The ***tizatlalli*** or white dirt is extracted from deposits in the lake...it is kneaded like potter's clay to form small round objects which become white when in contact with fire. It looks much like our mineral ***albayalde*** 'white lead' but ours is made from lead and vinegar; this one is produced spontaneously and is extremely white in some places of New Spain. It is cold, dry and clean but it does not irritate the skin, and it cures skin rashes. It is also useful for curing ulcers on sexual parts of the body, and can be used to paint things white. It is so soft, that Mexican women put it on cotton threads to make weaving easier." ("Se saca también de mina lacustre el ***tizatlalli*** o tierra blanca, se amasa como barro, se hacen de él bolas pequeñas, y puesto al fuego adquiere poco a poco color blanco. Es tan semejante a nuestro albayalde, que podría llamarse con razón albayalde mineral, pues en tanto que el nuestro suele hacerse de plomo suspendido sobre vinagre, éste se produce espontáneamente y de un color blanquísimo en algunos lugares de esta Nueva España. Es de naturaleza fría, secante y detersiva sin ninguna irritación, y, como aquél, cura espolvoreado las rozaduras de los niños. Sana también admirablemente las úlceras de las partes sexuales, y sirve para teñir de blanco cualesquiera cosas. Es de tal suavidad, que las mujeres mexicanas, untando con él sus dedos, les dan la tersura apropiada para hilar más fácilmente el algodón.")

Sahagún in 1571 (1971:372, fo. 221) wrote: "Women use this clay to weave, and it is sold in markets...there are stones in this land, from which varnish is made, they are called ***tetízatl*** (Figures 10, 11): stones that come from streams near Tulan [Tula, state of Hidalgo]; they use these stones to varnish the "jicaras" (small drinking cup). There is also another called ***chimaltízatl***, which is found near Uastepec (Oaxtepec, state of Morelos). They pull them out as if they were stones, then they cook them. These stones are similar to "yeso de Castilla" or chalk. They are sold in the ***tianguis***.[12]" ("Hay greda usanla mucho, las mujeres para hilar y venderse en los ***tianguis*** llamarse ***tízatl***... Hay piedras en esta tierra, de que se hace el barniz, llamanlas ***tetízatl***: son piedras que se hacen en los arroyos hacia Tulan, usan mucho: de las piedras para embarnizar las jícaras. Hay también, otra de las que se llama ***chimaltízatl***, hacense hacia Uastepec [Oaxtepec, state of Morelos], sácanlas, como de pedrova [stones], para labrar: estas piedras cuécenlas primero, son como yeso de Castilla, véndansen en los tianguis.")

FIGURE 10.— Image from the *Florentine Codex* interpreted by Dibble and Anderson (1963:fig. 820). Preparation of ***tízatl***.

FIGURE 11.— Image from the *Florentine Codex* interpreted by Dibble and Anderson (1963:fig. 821). Preparation of ***tetízatl***.

Clavijero between 1780-1781 (1945:315) states: "The white part of the mineral stone called ***chimaltízatl***, once it is burnt to ashes, or of the ***tizatlalli***, which is a mineral soil found in the lake, which is kneaded with mud and made into balls; when cooked, it becomes white just as the "albayalde" from Spain." ("El blanco de la piedra mineral ***chimaltízatl*** después de calcinada, o del ***tizatlalli***, que es una tierra mineral que se halla en la laguna la cual amasada como lodo y reducida a pelotas, recibe con la acción del fuego un color blanco semejantísimo al del albayalde de España.")

Del Barco in XVIII century (1973:156-157) writes: "The Cerro Colorado of Mulegé is famous because it has gold; there is a deposit of fossil matter which is called ***tiza*** in New Spain. It is a very fine dust, very soft, just like flour. It is whiter than chalk, and it is used to paint churches and houses. But its white color is so intense that it is mixed with dark ***agua-cola***[13] to make it less white so it will not be painful to the eyes. It is used in New Spain to clean silver, because it leaves it as if it were new." ("En el cerro Colorado de Mulegé, de que dejamos dicho, que tiene fama de mineral de oro, se halla una veta de aquel fósil que en Nueva España llaman ***tiza***. Y es una especie de finísimo polvo, que se saca en pequeños terrones de la veta, los cuales, tomándolos con los dedos, fácilmente se deshacen en un sutilísimo polvo, que excede en la suavidad aun a la harina floreada, según lo percibe el tacto. Es más blanco que el yeso, y en lugar de este se valen en algunas partes de la ***tiza*** para blanquear las casas e iglesias. Mas su blancura es tanta que, para mitigarla y que no ofenda a la vista, se procura que el ***agua-cola***, con que se mezcla para este efecto, sea de color obscuro. Los plateros usan en la Nueva España de la ***tiza*** para limpiar la plata; y aun en las casas particulares se valen de ella para lo mismo. Porque con gran facilidad la limpian dejándola como nueva.")

Ehrenberg (1854:372, 373) wrote that ***tisar*** of Mexico is a white sandy mixture, it is made almost entirely of shells of diatoms, and the predominant forms are *Eunotia gibberula* and *E. zebrina*, *Synedra capitata* and *Biblarium emarginatum*.

Díaz Lozano (1917:10) wrote that the ***tizate*** or ***tízar*** used in Mexico comes from Ixtlahuaca and in lesser amounts from Tlalnepantla and Texcoco, and it is made of fossil diatoms.

Epifania Cortés, from "Rancho Cuauhtenáhuatl," Huautla, Hidalgo, mentioned, in 1992, that this product is sold in markets of the state of Hidalgo, as round stones to be eaten by those with stomach cramps, vomits and by pregnant women who want to eat chalk (Figure 12).

Roberto Rico Montiel (August 27, 1996, pers. com.) said that the inhabitants of Tizatlán still use the name ***tízar*** when referring to diatoms.

Distribution: Baja California Sur: Mpio. Mulegé: Cerro Colorado de Mulegé. Hidalgo: Huautla: Rancho Cuauhtenáhuatl. State of Mexico: Ixtlahuaca, between the valleys of Toluca and Lerma; Cerro de Sultepec, Texcoco lake. Tlaxcala: Tizatlán.

Habitat: Fossil matter, possibly from ancient aquatic environments.

Uses: Medicinal (colic, vomiting, and for pregnant women who have the urge to eat chalk). Díaz Lozano (1917:10) writes that the quality of the ***tizate*** improves when it is repeatedly washed and burnt. It is used to polish metals, woodwork, ivory, marble, etc. It is also used in the manufacture of toothpaste, music records, and as absorbent material in filters and varnishes previously dissolved in soda (see Hernández Velasco 1955). In 1985, the Mexican industry produced 45,781 tons of diatomite, mainly used by sugar mills, beer factories and in the building industry; some of it was also exported (*Enciclopedia de México* 1987).

Note: There have been controversies about the origin of the term ***tizal*** (is it a mineral or does it come from deposits of diatoms?). Prieto's (1985:261, 262, 263) interpretation was that there was a mineral origin for the term ***tizal*** and other similar names, which were included in F. Hernández's work. From ***chimaltízatl*** or specular stone,[14] he writes that it could be the anhydrite or common chalk used as building material. The ***tetízatl*** could refer to chalky stone or calcium carbonate, which today is the source chalk and a white material which, when hydrated, is used to paint the facades of houses in some regions. It could also

FIGURE 12.— Epifania Cortés, from "Rancho Cuauhtenahuatl", Huautla, Hidalgo (1992), eating ***tízatl***.

mean chalk, or hydrate anhydrite, or hydrate calcium sulfate. The ***tizatlalli,*** or white soil or dirt, is similar to the ***albayalde***, or to basic lead carbonates called "cerusita" or "ceruse" and has been used as the base in white paint. Preto (1985) is doubtful of the medicinal uses, stating that it might be talcum powder, a very common mineral which cannot melt, is of leafy texture, and is very soft. Also, Dibble and Anderson (1963:243-244) did a similar interpretation of these names, which were included in *Florentine Codex*. Nevertheless, Ehrenberg (1854, 1869, the original quotes are in German) was the first scientist who demonstrated that the ***tízatl*** is made of diatoms, although he too, just as Prieto (1985), had doubts about its medicinal uses. Ehrenberg (1854:374) also did a translation of Hernandez' work which he analyzed in his 1869 research (pp. 2, 4, 5, 6): "There is a kind of clay called ***atizal***, white or whitish, it is mixed with clay and turned into ***adobes*** 'building material', it is not good for anything else." He also writes: "I had to inform about the elements conforming this dirt, white as snow, but without knowing where it came from or where it had been extracted from. It was formed by polygastric, mostly Bacillariophytes [Bacillariophyceae], of 38 recognizable species. After more experiments and research on this white powdery substance (like flour), published in *Microgeologie* (Ehrenberg 1854), the number of forms found in this Mexican substance called ***tisar*** went up to 115 organic species, their drawings can be found on table 33, figures 7-17. Workers for Mr. Castillo told him that the Indians around the Ixtlahuaca area, between the Valley of Toluca and Lerma, sell this type of clay for different purposes. According to Dr. Buckhart, Dr. Castillo says that the Indians use the ***tisar***, which they call ***tizate***, for different things, but especially as polish for metals, cutlery, etc. They wash the ***tisar***, and make round things with it, which are then taken to the market. In Europe, they use the polishing schist (black-blue rock) for the same purposes. Painters also use it to paint walls in rooms, to prepare the walls before applying the color...the ***tiza*** is formed by very fine and fragile particles, like dust, but with sharp edges ...it forms flat white deposits which the indians collect and wash. But there are some layers of ***tiza***, which are so pure that do not need to be washed...of what can be seen from Dr. Castillo's information, the Indians wash the dirt that is going to be sold, they make white balls with it. It can also be thought that they make ornaments with these balls, which they sell. And as the stone that was sent to me is natural and not artificial, and has no adhesive material. I am sure the natives do not make the balls with loose dirt but with stones, just as they find it. They sculpture, and they sell it. If the stone is turned to powder, it is impossible to shape it without using something like clay to join the particles. Besides, the name ***tiza*** is an old name, while the idea that white dirt is organic is new. ***Tízatl*** and ***tizatlalli*** mineral dirt which gave ancient Mexicans their white pain when they added clay and kneaded it." It is possible that there was a mix-up with the term at the beginnings of the 20th century or even before that. When C. Ehrenberg received a sample from Antonio del Castillo (a Mexican geologist) (Eherenberg 1876:119), there was doubt about the nametag on the sample. The tag said "***tiza*** from Toluca," yet was it porous stone or microorganisms? Today, several authors have reconfirmed that the origin is from diatoms (Rico-Montiel et al. 1993).

On the other hand, Castelló Yturbide et al. (1986:104) wrote about the tradition of eating dirt, which is religious in origin. Sahagún (1971:appendix of book II, p. 175) claimed: "They would touch the dirt with one finger which they would then put in their mouth, or they would touch their tongue with it; they would say they were eating dirt, as a gesture of reverence to their gods..." ("Tocaban la tierra con el dedo y luego lo llevaban a la boca, o a la lengua; a esto llamaban comer tierra, hacíanlo con reverencia de sus dioses...") Castelló Yturbide et al. (1986:104) confirmed that even though this custom was forbidden in 1625, it was currently still possible to buy bread made from dirt in several places in Mexico (Jalisco and Michoacán). Bread made from dirt is used as a cure for diseases or sadness or to satisfy the whimsical appetite of pregnant women who feel the urge to eat dirt. It has been said that if they eat common dirt, they would deliver a "dirt eating child."

Common name: ***Tripilla***.
Etymology: Spanish. Refers to guts.
Chronology: Ortega (1984:294) gives this name to *Nitella* sp.
Distribution: Michoacán: Mpio. Pátzcuaro: Patzcuaro Lake.
Habitat: Bentic in lakes.
Uses: Not provided.

Common name: ***Tsil***.
Etymology: Maya language. ***Ts"il***, water slime (*Diccionario Maya Cordemex* 1980:885).
Other names: ***Luk*** and ***mum***, mud, slime found at the bottom of lakes and puddles (*Diccionario Maya Cordemex* 1980:464, 540).
Chronology: Ortega et al. (1995:xvii) gives this name to several algae.
Distribution: Yucatan Peninsula.
Habitat: Freshwater.
Uses: Not provided.
Note: It could possibly be a reference to algae of the Cyanophyceae and Chlorophyceae classes.

Common name: ***Tzau***.
Etymology: Maya language. ***Tzau***, slimy (freshwater) place or freshwater excrement? ("mojonera de agua dulce") (Ortega, 1984:36).
Chronology: Ortega (1984:36) and Ortega et al. (1995:xvii) named it *Nostoc verrucosum* Vaucher *ex* Bornet *et* Flahault.
Distribution: Yucatán: Mpio. Izamal: Aguada Chulumbay, 9 miles W. of Izamal.
Habitat: In water puddles.
Uses: Not provided.

Common name: ***Undina***.
Etymology: Spanish. Refers to ***undicola***, something that lives on these water waves (*Enciclopedia Universal Ilustrada* 1929, tomo 65:997).
Chronology: Ponce de León (1909:20) called it *Nostoc commune* Vaucher *ex* Bornet *et* Flahault.
Distribution: Sinaloa.
Habitat: Not provided.
Uses: Not provided.

Common name: ***Verdín***.

Etymology: Spanish. The first green color acquired by grasses or plants that have not reached maturity. Green layer of cryptogamous plants that grow in freshwater, especially in stagnant water... (*Enciclopedia Universal Ilustrada* 1929, tomo 67:1448).

Chronology: Ponce de León (1909:20) called it *Conferva chantransia*? [*Lemanea fluviatilis* (Linnaeus) C. Agardh].

The *Enciclopedia Universal Ilustrada* (1929, tomo 67:1448) states that the common name refers to *Conferva rivularis* Linnaeus [*Cladophora rivularis* (Linnaeus) van den Hoek] and to other green algae.

Distribution: Sinaloa.

Habitat: On damp soil and stones.

Uses: Not provided.

Note: ***Verdín*** is a name, which refers to green algae (Chlorophyceae). There is doubt about the identity of *Conferva chantransia*.

Common name: ***Xkomha***.

Etymology: Maya language. "Short thing in the water" (Ortega 1984:232). *The Diccionario Maya Cordemex* (1980:165, 334) states: ***kom***, valley or cliff, to sink; ***ha***, water; possibly something sunken in the water or thing found at the bottom of the water.

Chronology: J.E. Tilden (in Millspaugh 1896:286; Standley 1930:192) named it *Microspora amoena* (Kützing) Rabenhorst.

Distribution: Yucatán: Izamal, in (water) deposit tanks, *G.F. Gaumer* 571, Jan.-Dec. 1895 (US, BM, *fide* Millspaugh 1896:286).

Habitat: In (water) deposit tanks.

Uses: Not provided.

Common name: ***Yaxkoxmal***.

Etymology: Maya language, ***Ya"xk"oxmal***, "Threads of the lake" ("ovas de laguna"), a genus of aquatic plant (*Diccionario Maya Cordemex* 1980:973). It also refers to ***lama*** 'slime' or ***moho verde*** 'green mold' which grows on damp and shady soil, "into which the feet slide easily" (Álvarez 1980:228).

Chronology: Ortega et al. (1995:xvii) consider it an algae belonging to the Cyanophyceae class.

Distribution: Yucatan Peninsula.

Habitat: On land.

Uses: Not provided.

Note: The *Diccionario de la Lengua Española* (1970:954) indicates that *ova*, from the Latin *ulva*, refers to any unicellular [pluricellular] green algae, with simple or branched filaments, or with large and foliaceous, or narrow and bandlike blades, which grow in the sea, rivers or ponds, floating on the water or fixed to the bottom by radicular appendixes. "Ova de río" refers, therefore, to freshwater algae [possibly filamentous Chlorophyceae] and "ova marina" to algae with laminar expansions or hollow tubular bands, almost always branched, found in sea and brackish water [possibly Ulvales such as *Enteromorpha* y *Ulva*].

TABLE 1.— Knowledge of Mexican freshwater algae.[1]

Taxa	Mexican distribution (State)	Common names	Century	Uses
CYANOPHYCEAE				
Trichormus azollae (Strasburger) Komárek *et* Anagnostidis[2]	Distrito Federal, Michoacan	***Chilacaxtli, Chilacastle, chilacascle***	20th	Soil improvement
Anabaena flos-aquae Brébisson *ex* Bornet *et* Flahault	Nuevo León, Oaxaca	***Lama*** 'slime'	19th	
Nostoc commune Vaucher *ex* Bornet *et* Flahault	State of Mexico, Sinaloa	***Amoxtli, amoxtle, amomoxtli, gelatina de agua*** 'water jelly', ***salivazo de la luna*** 'moon spit', ***undina***	16th, 20th	Food
Nostoc verrucosum Vaucher *ex* Bornet *et* Flahault	Yucatan	***Tachak*** (slime, green and slippery thing), ***tzau*** (fresh water excrement?)	20th	
Phormidium calidum (C. Agardh) Gomont *ex* Gomont	Nuevo León.	***Lama del topo*** 'mole slime'	19th	
Phormidium tenue (Meneghini) Gomont[4]	State of Mexico	***Cuculin*** (water viscosity), ***cuculito del agua*** 'water cuculito', ***cocol, cocolin, cocol de agua*** 'water cocol'	16th, 18th, 20th	Food, mineral supplement (Ca and Fe)
Spirulina geitleri De Toni	State of Mexico	***Espirulina*** 'spirulina'	20th	Food, human and animal protein supplement
Spirulina labyrinthiformis (Linnaeus) Gomont	Guanajuato	***Lama de comanjilla***	19th	
Oscillatoriales ("Oscillarias"), Cyanophyceae	Valley of Mexico	***Tecuítlatl, tecuitate*** (stone residue)	16th, 18th, 19th, 20th	Food
Cyanophyceae	Yucatan Peninsula	***Tsil*** 'water slime', ***yaxkoxmal*** (threats of lake)	20th	
RHODOPHYCEAE				
Lemanea fluviatilis (Linnaeus) C. Agardh	Sinaloa	***Conferva, surrupa***	20th	
BACILLARIOPHYCEAE				
Fragilaria diophthalma (Ehrenberg) Ehrenberg	Oaxaca	***Diatoma de copos*** 'diatom tufted', lama	19th	
Fragilaria striatula (J.E. Smith?) Lyngbye	Oaxaca	***Lama*** 'slime', ***diatoma erguida*** 'stiff diatom'	19th	

Bacillariophyceae (fossil diatome)	Baja California Sur, State of Mexico, Hidalgo, Tlaxcala	***Tízatl*** (white dirt), ***tizatlalli***, ***tetízatl***, ***chimaltízatl***, ***tizar***, ***tizate***, ***atízatl***, ***tiza***, ***tierra blanca*** 'white dirt', ***diatomita*** 'diatomite', ***tierra de diatomeas*** 'diatomaceous dirt'	16th -20th	Paints, medicinal, cotton spinning, filters, polishing and industrial uses
XANTHOPHYCEAE				
Vaucheria fontinalis (Linnaeus) Christensen	Guanajuato	***Lama*** 'slime'	19th, 20th	
CHLOROPHYCEAE				
Cephaleuros virescens Kunze	Chiapas, Tabasco, Veracruz	***Mancha de la hoja*** 'leaf spot'	20th	Phytopathology
Chlorella sp.		***Algafil***	20th	Gives color to eggs' yolk
Cladophora glomerata (Linnaeus) Kützing var. *crassior* (C. Agardh) van den Hoek	Nuevo León, Oaxaca	***Lama*** 'slime'	19th	
Cladophora rivularis (Linnaeus) van den Hoek	Guanajuato, Nuevo Leon, Oaxaca, Sinaloa	***Lama*** 'slime', ***verdin***	19th, 20th	
Microspora amoena (Kützing) Rabenhorst	Yucatan	***Xkomha*** (thing found at the bottom of the water)	19th	
Prasiola mexicana J. Agardh	State of Mexico	***Nitla***	20th	Cough suppressant, nasal hemorrhages
Rhizoclonium hieroglyphicum (C. Agardh) Kützing	Michoacan	***Lama*** 'slime'	20th	
Spirogyra flavescens (Hassall) Kützing	Jalisco	***Lama***	20th	
Zygnema lutescens (Vaucher) C. Agardh	Oaxaca	***Lama larga*** 'long slime'	19th	
Chlorophyceae [filamentous]	Yucatan Peninsula	***Chonak***	20th	
CHAROPHYCEAE				
Chara zeylanica Klein *ex* Willdenow	Veracruz, Yucatan	***Iximha*** (water corn)	20th	Control of mosquito larvae[3]
Nitella sp.	Michoacan	***Tripilla*** (small guts/innards)	20th	

[1] The taxa (class) sequence in Table 1 is done according to Silva et al. (1996) and is in alphabetical order from the class onwards. The "division" category is omitted, as the organization of the "classes" within the "divisions" can be treated in different ways and no consensus has been reached.

[2] With its symbiont *Azolla filiculoides* Lamouroux [fern].

[3] Other species used: *Chara contraria* A. Braun *ex* Kützing , *C. hispida* Linnaeus, *C. foetida* A. Braun [*C. vulgaris* Linnaeus] and *C. fragilis* Desvaux [*C. globularis* Thuillier].

[4] Associated with *Chroococcus turgidus* (Kützing) Nägeli.

CONCLUSION

Results are given in Table 1. We registered 23 species. The families with the highest diversity were Cyanophyceae (8 spp.) and Chlorophyceae (9 spp.). On the other hand Bacillariophyceae (2 spp.), Xanthophyceae (1 sp.), Charophyceae (2 spp.) and Rhodophyceae (1 sp.) were the families with the lowest diversity. Species of ***tízatl*** are not included in the Bacillariophyceae class, as there are many and with many variations depending on the locality of origin.

People from the fifteen states in Mexico know about algae. This knowledge is reflected in the many common names (48) and uses (5) given to these organisms. Algae are used for human and animal consumption (nutritional), for medicinal and health purposes, in agriculture (soil improvement and phytopathology) and cattle ranching activities; they are also used for industrial purposes. The fact that many of the common names could not be related to a particular use could be a reflection of the loss of the resource.

Of the 56 ethnic groups (Instituto Nacional Indigenista 1990) in 32 states in Mexico, the Nahua (State of Mexico) and the Maya (Yucatan) are the ones that reflect the most knowledge and uses of continental algae. People in Oaxaca, Sinaloa and Yucatan also posses information regarding algae. Research related to the recovery of continental Mexican algae and their uses will be crucial in the future.

NOTES

[1] ***Anáhuac***: From the Nahua term ***Atl***: water, and ***nahuac***: near to: near the water. It designates the Valley of Mexico where there used to be large lakes (Macazaga Ordoño 1979:27).

[2] ***Urrona***: Small animals that thrive on the water's surface. The origin of the word is unknown (Santamaría 1959:1101).

[3] ***Tamal:*** From the Aztec term ***tamalli***. Dough made of corn meal and porks' fat, of a thick consistency, which is wrapped in corn or banana leaves, sometimes with meat. The dough of the algae ***tamal*** is made of algae and is wrapped in corn leaves (Santamaría 1959:1000).

[4] ***Tequesquite***: From the Nahua term ***tequizquitl***: efflorescent stone, and ***tetl:*** stone and ***quizquitl***: to spontaneously emerge. It is natural salt made of caustic soda "sesquicarbonates" and sodium chloride. It is an effervescent residue appearing when water evaporates from brackish lakes (Cabrera 1984:134).

[5] ***Molcajete***: From the Aztec term ***molli***: ***salsa*** 'sauce', and ***caxitl***: small box. Small stone mortar with three small "feet," used to crush and prepare species such as chile, to prepare sauces, etc. Used to crush the *tejolote* (Santamaría 1959:732).

[6] ***Mole***: From the Aztec term ***molli***: ***salsa*** 'sauce' or cooked meal. Famous and special meal prepared with chile sauce and sesame seeds, with turkey meat (Santamaría 1959:733).

[7] ***Evaporador Solar El Caracol*** 'Solar Vaporizer': Spiral shaped water canals in Texcoco (State of Mexico), with a diameter of 3200 m and a surface of 850 hectares. ***El Caracol*** is a large "evaporation machine" which uses solar energy and, due to its particular location, – 2240 m above sea level – solar radiation and evaporation are extremely efficient. *Spirulina* algae grow naturally in the external canals of ***El Caracol***. Cultivation of *Spirulina* in Mexico

was successful due to factors such as: solar radiation, adequate temperature and availability of alkaline waters. The industrial growth of the algae has been optimized by the Sosa Texcoco Company.

[8] ***Chilmolli***: From the Nahua term ***chilli***: chile and ***molli***: ***salsa*** 'sauce': meal made of chile peppers, meat and vegetables (Cabrera 1984:70).

[9] ***Oscillarias***: In the 19th Century, the Oscillarias belonged to the group of the green algae; today they belong to the Cyanophyceae (Oscillatoriales) or blue-green algae (Ortega 1987: 174).

[10] ***Poligastric***: These microscopic algae belonged to the diatoms. Today it belongs to the Bacillariophyceae group (Ortega 1987:174).

[11] ***Ahuautle***: From the Nahua term: ***atl***: water; ***huautli***: "mijo" seed: water seeds. It is a sort of caviar or tiny eggs deposited by small flies (*Coriza mercenaria, C. femorata*) on plants which grow near lakes. When dried and turned into pulp, they are edible (Cabrera 1984:30).

[12] ***Tianguis***: From the Aztec term ***tianquiztli***: market; market square or market in general. By extension, it means the selling and buying which took place in the past, on a certain day of the week, in several towns and which still takes place in some small towns in Mexico (Santamaría 1959:1042).

[13] ***Agua-cola***: Strong, transparent and sticky paste obtained by boiling pieces of animal skin, and which, when dissolved in hot water, is used as glue (*Diccionario de la Lengua Española* 1970:319).

[14] Specular stone ("piedra especular"): Diaphanous or transparent stone with mirror like qualities.

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EVALUATION OF THE CULTURAL SIGNIFICANCE OF WILD FOOD BOTANICALS TRADITIONALLY CONSUMED IN NORTHWESTERN TUSCANY, ITALY

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ABSTRACT.—A quantitative method to calculate the cultural significance of wild food plants used in traditional contexts was developed and applied to an ethnobotanical survey carried out in Northwestern Tuscany, Italy. Ninety-five informants were interviewed concerning the cultural significance of gathered wild edibles. Interview data was evaluated through the development of a special index: the Cultural Food Significance Index (CFSI). This index takes into account a wide variety of factors in the evaluation of a specific plant including: quotation frequency, availability, typology of the used parts, frequency of use, kind and number of the food uses, taste appreciation, and perceived role as a food-medicine. Very high CFSI values were identified for several wild "greens," whereas wild fruits seemed to play a subordinate role. The use of this index allows for the quantitative comparison of ethnobotanical data in an intercultural ethnobiological analysis.

Key words: ethnobotany, anthropology, food plants, Tuscany, Italy.

RESUMEN.—En el contexto de un estudio etnobotánico llevado a cabo en nordeste de La Toscana (Italia), se ha desarrollado y aplicado un método cuantitativo para calcular el significado cultural de las plantas silvestres tradicionalmente utilizadas en alimentación. Noventa y cinco informantes han sido entrevistados en relación al posible significado cultural de las plantas comestibles recolectadas. La evaluación de los datos obtenidos se realizó mediante la aplicación un índice especial: el índice de significado cultural alimentario (CFSI), que toma en consideración una amplia variedad de factores como: frecuencia de citación de la especie, disponibilidad o facilidad para conseguirla, tipología de las partes de la planta utilizadas, frecuencia de uso, tipos de empleo alimentario, apreciación del sabor y, por último, papel que se le asigna como alimento medicinal. Valores elevados de CFSI se obtuvieron para varias "hortilizas" silvestres, mientras que los frutos silvestres parecen jugar un papel subordinado. En definitiva, el uso de este índice permite una comparación cuantitativa de datos etnobotánicos en un análisis etnobiológico intercultural.

RÉSUMÉ.—Une méthode quantitative pour calculer la signification culturelle des plantes sauvages comestibles utilisées dans des contextes tratitionnels a été mis au point et appliquée à une étude réalisée dans le nord-ouest de la Toscane en Italie. Quatre-vingt-quinze personnes ont été interrogées sur la signification culturelle que revêt la récolte des végétaux sauvages dans un but alimentaire. Les données recueillies ont été évaluées au moyen d'un index spécial, l'Index de Signification Alimentaire Culturelle (CFSI). Cet index prend en considération un grand nombre de facteurs en vue de l'évaluation d'une plante spécifique: fréquence avec laquelle elle est mentionnée, disponibilité, typologie des parties utilisées, fréquence des utilisations, types et nombre d'usages alimentaires, appréciation du goût et perception du rôle médicinal en même temps qu'alimentaire. De très hautes valeurs de CFSI ont été mises en évidence pour plusieurs légumes sauvages, tandis que les fruits sauvages semblent jouer un rôle secondaire. L'emploi de cet index permet de faire des comparaisons quantitatives entre les données ethnobotaniques dans le cadre d'une analyse ethnobiologique interculturelle.

INTRODUCTION

Several ethnobotanical surveys in Southern Europe have focused over the last few decades on the use of botanicals in folk medical practices. Nevertheless, in the whole Mediterranean area, only a few field studies have focused exhaustively on gathered wild plant edibles (Corsi and Pagni 1979; Corsi, Gaspari, and Pagni 1981; Guarrera 1994; Paoletti, Dreon, and Lorenzoni 1995; Pieroni 1999; Ertu_, 2000). Furthermore, only two pharmaco-botanical field studies *quantitatively* evaluated the use consensus within a specific area (Friedman et al. 1986; Bruni, Ballero, and Poli 1997).

The evaluation of different botanicals used inside a particular geographical and cultural context is important in order to facilitate an intercultural comparative analysis of quantitative ethnobotanical data. Such an evaluation is also necessary in order to discuss cultural components related to food acceptance and even to find insights for investigating phytochemical constituents that could influence popular appreciation of edibles.

Food botanicals have often been used in traditional systems multi-contextually and are commonly ingested as food-medicines. The physiological aspects of nutrition overlap with the bio-pharmacology of non-nutritional plant metabolites (Etkin and Ross 1982; Etkin 1993, 1994, 1996; Johns and Chapman 1995; Johns 1996; Moerman 1996; Ross, Etkin, and Muazzamu 1996; Chapman, Johns, and Mahunnah 1997; Pieroni 2000).

The aim of this study, focused on food plant edibles, is to develop a method for evaluating the cultural significance of biological taxa, defined as the importance of the role that a plant plays within a particular culture. Theoretically, such evaluation should be done by native people themselves living in that given traditional culture (Turner 1988). The problem concerning the evaluation of the cultural significance of biological taxa has been addressed by a few previous works (Berlin et al. 1973; Lee 1979; Hunn 1982). Berlin in particular used a scale of four values in order to classify the vegetable resources of the Tzeltal-Tzotzil society: "cultivated," "protected," "wild but useful," "culturally insignificant," while Lee later classified !Kung San plants in six classes: "primary," "major," "minor," "supplementary," "rare," and "problematic." These scales represented a first simple attempt to measure the cultural significance of plants. These scales, however, did not consider any special variables involved in the complex issue of the evaluation of cultural meanings of biological resources.

In the present study, we elaborated a specific Cultural Food Significance Index (CFSI) by modifying the methods developed by Turner (1988) for the Thompson and Lillooet Interior Salish people (British Columbia, Canada). Turner's index (Index of Cultural Significance, ICS) considered three criteria: the quality of use (plants were placed on a five-point scale, according to their utilisation as primary or secondary food, as medicines, or as rituals), the intensity of use (how frequently the plant was used on a daily, seasonal or annual basis), and the exclusivity of use (how a particular plant has precedence over others in a given cultural role). Stoffle et al. (1990) modified the Turner's ICS in their quantitative analysis of the Paiute and Shoshone ethnobotany at Yucca Mountain (Nevada, USA) and developed an Ethnic Index of Cultural Importance (EICS), which eliminated the quality-of-use criteria and added a contemporary use variable category. Moreover, a Cumulative Index of Cultural Significance (CICS) was also formed by adding the plant's EICS scores for each ethnic group involved in that study.

Both indexes (ICS and EICS) have been developed to facilitate the evaluation of every plant used or known in a given ethnic context and not specifically as species used for food. These indexes fail, however, to take into account the factors of "taste appreciation" and the "perceived" food-medicinal multifunction of ingested botanicals, which represent important anthropological aspects in the phenomenon of ingestion of herbs and other plant dietary supplements (Johns 1990). Moreover, Tuner's index assigned arbitrary values to the "quality-of-use" category (for example medicinal or ritual plants were considered much less "important" than staples), while both indexes don't consider the "perceived availability" of the species, but rather include an indirect "ecological availability" index in the "frequency-of-use" parameter.

METHODS

Field work.— The study site is situated in Northwestern Tuscany, central Italy, and represents the upper part of the Serchio Valley, also called Garfagnana. Qualitative ethnobotanical surveys on the traditional medicinal and food species were carried out only recently in this territory (Uncini, Elisabetia, and Tomei 1999a, 1999b; Pieroni 1999, 2000). The traditional culture of this region has developed in an agricultural and partially pastoral context.

Cultivated species, which have played a central role in the local food economy are represented by *Castanea sativa* L., *Zea mays* L., *Triticum dicoccum* Schübler, *Panicum miliaceum* L. and *Secale cereale* L. together with *Solanum tuberosum* L., *Phaseolus lunatus* L. and *Phaseolus vulgaris* L. These species have long represented the principal vegetable food sources used by locals. In the winter season, chestnut flour based dishes (mostly *polenta*) make up the main meal, substituted in the summertime by corn meal *polenta*. The traditional food culture of the Serchio Valley includes a wide variety of botanicals collected from the wild.

The physical geography of the study area is defined inside 16 small municipalities (Figure 1). This area is a mountainous territory, delimited by the Apuan Alps in the western part and the Apennines in the eastern, respectively facing the Tyrrhenian coast and the region Emilia-Romagna.

Ethnobotanical information was obtained through structured interviews with 95 persons (age range of 67 to 96 years) having extensive knowledge of the food culture and living in small villages (50-500 inhabitants). Informants were asked to

FIGURE 1.—Location of the studied area.

spontaneously quote the names of wild edibles that are gathered and consumed today and those that were gathered and consumed at least 30 years ago. Furthermore, the informants were asked to specify the following information for each quoted taxa including: which part of the plant was used, how the plant part was used, the perception of its availability, the frequency of use of the species at the present time and in the past (taking as reference about 30 years ago), the taste appreciation, and an eventual medicinal purpose attributed to its ingestion. Conversations were carried out in the local dialect, which is known by the author.

All of the quoted botanicals were identified during a previous project (Pieroni 1999), and the adopted nomenclature follows Pignatti (1997) for the vascular taxa, and Gerhardt (1997) for the mushroom species. In this study only wild botanicals native in the region were considered. Species with food value that were long naturalised or domesticated in the region, such as *Robinia pseudoacacia* (Fabaceae) or *Prunus laurocerasus* (Rosaceae) were excluded.

According to the principles of ethnobiological taxonomy (Berlin 1992), traditional cultures identify diverse botanicals in the same "generic" taxa. In the studied region, different botanical species were locally grouped within a unique classification unit by use their use (and according to the so-called "utilitarian factor" described by Hunn 1982). Plants were therefore listed and ordered within the study following these vernacular taxa and not the modern botanical taxa.

Cultural food significance index (CFSI).— The Cultural Food Significance Index, specifically elaborated to evaluate the cultural significance of wild edibles, was calculated as:

$$CFSI = QI \times AI \times FUI \times PUI \times MFFI \times TSAI \times FMRI \times 10^{-2}$$

The formula takes in account seven indexes which express the frequency of quotation (QI), the availability (ALI), the frequency of utilisation (FUI), the plant parts used (PUI), the multifunctional food use (MFFI), taste score appreciation (TSAI), and the food-medicinal role (FMRI).

Similarly, as for the ICS and EICS of Turner (1988) and Stoffle et al. (1990), the components of the index are multiplied. Yet, differently from those indexes, the total number of uses and/or plant parts is not taken into account by adding the multiplied factors, but by specific independent indexes (PUI and MFRI). This method was chosen in order to avoid an overestimation of plants which do not present a unique useful morphological part. In contrast to medicinal taxa, diverse parts of food herbs are in fact commonly used for food.

The seven indexes were then multiplied and not added, in order to amplify eventual variations. They are calculated as described below; TSAI and FMRI were calculated for each taxa considering the raw average value of those provided by the informants.

Quotation Index (QI).— The quotation index (QI) expresses the number of all the positive responses given by the informants about a particular plant, while answering a request to spontaneously mention all the known *and* used wild edibles. Taxa with less than two responses were not considered.

Availability Index (AI).— This index (Table 1) expresses the availability of the plants, perceived by locals and corrected by a factor that considers if the use of the plant is ubiquitous or localised within the studied area. In this last case AI is diminished by half or a whole unit. In this way, AI does not represent a "determined" availability index as in the work of Lepofsky, Turner, and Kuhnlein (1985), but rather a "perceived" availability index. In cultural significance evaluation studies, ecological factors such as relative abundance in the natural milieu cannot be directly considered as criteria because they are not culturally dependent. On the contrary, the perception of the availability of a given species, which only *indirectly* expresses its availability in the natural context, also represents a factor which influences the cultural meanings of that species within a given cultural group and a given natural context.

Frequency of Use Index (FUI).— This index (Table 2) represents the frequency of the utilisation of each plant. As a reference, we use the average value between the quoted frequency "once" (corresponding at about 30 years ago) and that mentioned by the informants for the present times.

TABLE 1.—Availability Index (AI) categories.

Availability	Index value
Very common	4.0
Common	3.0
Middle	2.0
Rare	1.0
Localisation of the use	**Index value**
Ubiquitary	=
Localised	-0.5
Very localised	-1.0

TABLE 2.—Utilisation Frequency Index (UFI) categories

Utilisation Frequency	Index value
> Once/week	5.0
Once/week	4.0
Once/month	3.0
> Once/year but < once/month	2.0
Once/year	1.0
No longer used during the past 30 years	0.5

Part Used Index (PUI).— This value (Table 3) expresses the multiple use of diverse parts of the same plant. It takes into account whether multiple morphological plant parts are collected and eaten instead of single parts. The contemporary use of multiple plant parts for different food aims is evaluated higher than the use of young tissues of the whole plant.

TABLE 3.—Part Used Index (PUI) categories

Part used	Index value
bark	1.0
roots or rootstocks	1.5
roots, only younger parts	1.0
bulbs	1.5
stems	1.0
leaves	1.5
leaves stalks	1.0
young whorls of leaves	1.0
leaves with a few stems	2.0
shoots	1.25
shoots, only younger parts	0.75
buds	0.75
flowers	0.75
receptacles	0.75
fruits	1.5
seeds	1.0
whole aerial parts	3.0
whole aerial parts of very young plants	2.0
caps (mushrooms)	1.5
whole fruiting body (mushrooms)	2.0

Multi-Functional Food Use Index (MFFI).— This index (Table 4) considers the possible food uses of each single vernacular taxa. Values were assigned to traditional food preparations, excluding new "imported" or "creative" utilisation. In the case of species which are boiled and then further processed (stewed, stuffing for diverse preparations), the value attributed to the boiling process is increased by a half unit. If the plant is generally used in mixtures of more than three species, the index value is diminished by a half unit.

TABLE 4.—Multi-Functional Food Use Index (MFFI) categories

Usage	Index value
Raw, as snack	0.5
Raw, in salads	1.5
Fried in fat, without or with beaten eggs ("Frittata")	1.0
Boiled	1.0
Boiled, then stewed of fried	1.5
Boiled, than as stuffing for diverse preparations (pies, "tortelli"...)	1.5
Soups (mixtures)	0.75
Stewed	1.0
Roasted	1.0
Condiment	1.0
Condiment for restricted purposes	0.75
Jams or Jellies	1
Syrups	1
(Usage in mixtures)	(-0.5)

Taste Score Appreciation Index (TSAI).— This index (Table 5) represents the scores by which locals expressed their taste appreciation for each plant. Scores are based on a possible range of values between 4 and 10 (4: lowest, terrible taste; 10: highest, best taste). Similarly, Kuhnlein, Turnep, and Kluckner (1982) used a five-step-scale (1: very poor; 2: poor; 3: fair; 4: good; 5: very good) in a previous work dealing with the taste acceptability of roots used by native people on the coast of British Columbia. A range of values between 4 and 10 was specifically adopted in the present study in order to make it easier for the informants to make their personal evaluation. This range was more applicable because the same values were and still are the values used as marks in the Italian school system, and this mechanism is very familiar to Italians of all ages.

TABLE 5.—Taste Score Appreciation Index (TSAI) categories

Taste Appreciation	Index value
Best	10
Very good	9
Good	7.5
Fair	6.5
Poor	5.5
Terrible	4

Food-Medicinal Role Index (FMRI).— A few species had "special" significance because of their supposed health properties. This index (Table 6) reflects the perceived properties as food-medicine for each quoted species. Supposed ritual or magical "health" aspects related to the ingestion of some particular species were considered in the evaluation of these values. Higher values are attributed in cases of well-defined medicinal properties ascribed to the ingested plants. For the more general assessment of a plant as "healthy," without any specifications, minor FMRI values were assigned.

TABLE 6.—Food-Medicinal Role Index (FMRI) categories

Role as Food-Medicine	Index value
Very high ("that food is a medicine!")	5.0
High ("that food is quite a medicine", with clear specification of the treated affections)	4.0
Middle-high ("that food is very healthy")	3.0
Middle-low ("that food is healthy", no specification of a particular therapeutic action)	2.0
Not recognised	1.0

RESULTS

CFSI values were calculated following the aforementioned formula (see Table 7 for an example of how the scores for a few vernacular taxa were determined are reported). CFSI values of each recognised wild food botanical are listed in Table 8. Plants are ordered according to decreasing ICS values and are listed by their vernacular name. ICS values varied between 0.1 and 662, and it was possible to classify the cited botanicals into six groups: species with very high significance (ICS = 300 and over), with high significance (ICS = 100-299), moderate significance (ICS = 20-99), low significance (ICS = 5-19), very low significance (ICS = 1-4) and negligible significance (ICS< 4).

Food species with very high cultural significance values.— The group with very high significance (ICS = 300+) was mainly comprised of wild "greens" which are used in different preparations (*Borago, Urtica, Taraxacum, Cichorium, Campanula* spp.), and also two species (*Rosa canina* and *Rubus ulmifolius*) which are well known in the local gastronomy for both their fruits and green aerial parts (shoots). All the species included in this first category represent the most frequently quoted edibles. Rose shoots are eaten as snacks and their petals had ritual significance in the past for bringing good omens during St. Rita's day. The taste score of these plants is generally never very high, but they do play a central role in the daily traditional diet.

Food botanicals with high cultural significance values.— The species included in this group typically play a role as the main vegetable source, especially in the spring. The most commonly gathered species are usually eaten raw in mixed salads and are viewed as having a "cleansing" property. The group also includes the two most commonly used wild aromatic species: wild fennel (*Feoniculum vulgare* spp.*vulgare*) and calamint (*Calamintha nepeta*). The first is actually only used to aromatise typical seasonal preparations such as boiled chestnuts or roasted pig liver, but it's "magical" properties against evil-eye when applied inside a closed piece of red cloth ("breo") are also well-known.

The high value attributed to a poisonous species (*Clematis vitalba*) whose young shoots represent the basic ingredient of a kind of traditional spring pancake called "frittata di vezzadri" are also interesting. Studies about the toxic component's intake and evaluation of the efficacy of detoxification processing (cooking) for this species could represent an interesting step toward developing risk assessment research (Uiso and Johns, 1995).

TABLE 7.—Example of derivation of the CFSI for three vernacular taxa gathered in the studied area.

Vernacular taxa	Botanical taxa	Values of the partial indexes (QI/AI/UFI/PUI/MFFI/TSAI/FMRI)	Details of calculation of the CFSI	CFSI
Boragine or ***Buragine***	*Borago officinalis* and Echium vulgare (both Boraginaceae);	QI: 35 AI: common, ubiquitary = 3.0; UFI: < once/week; > once/week = 3.5; PUI: whole aerial parts = 3.0; MFFI: boiled, and stewed and as stuffing for diverse preparations; fried in fat: 1.0+0.5+0.5+1.0 = 3.0; TSAI: = 8.0; FMRI: < "that food is very healthy"; > "that food is healthy" = 2.5	35 x 3.0 x 3.0 x 3.0 x 8.0 x 2.5 x 10^{-2} =	662
Sambuco	*Sambucus nigra* (Caprifoliaceae)	**QI: 13;** AI: common, ubiquitary = 3.0; UFI: < once/month; > once/year = 2.0; PUI: fruits = 1.5; MFFI: syrups =1.0 TSAI = 7.5; FMRI: "that is very healthy" = 3.0;	13 x 3.0 x 2.0 x 1.5 x 1.0 x 7.5 x 3.0 x 10^{-2} =	26.3
Coccora or ***Cocco***	*Bovista nigrescens* (Amanitaceae)	QI: 5; AI: rare, localised = 1.0-0.5 = 0.5; UFI: once/year = 1.0; PUI: whole fruiting body = 2.0; MFFI: raw, salads; fried in fat: 1.0+1.0 = 2.0; TSAI: 9.5; FMRI: not recognised: 1;	5 x 0.5 x 1.0 x 3.0 x 2.0 x 9.5 x 1 x 10^{-2} =	1.19

TABLE 8.—Cultural Food Significance Index (CFSI) values of gathered wild botanicals in Serchio Valley.

Vernacular Names	Scientific Names	Botanical Family	QII	AI	UFI	PUI	MFFI	TSAI	FMRI	ICS
Boragine or ***Buragine***	*Borago officinalis* L. and *Echium italicum* L.	Boraginaceae	35	3	3.5	3	3	8	2.5	**662**
Ortica	*Urtica* sp. pl.	Urticaceae	87	4	3	1.5	2.5	7.5	2	**587**
Piscialletto	*Taraxacum officinale* WEB.	Asteraceae	35	4	3.5	2	2.5	7.5	3	**551**
Scepe or ***Scepon*** or ***Rovo*** or ***Mora***	*Rubus ulmifolius* SCHOTT.	Rosaceae	23	4	2.5	2.5	3.5	7.5	3	**453**
Pittellenga or ***Pettellenga*** or ***Peterlenga*** or ***Rosa selvatica***	*Rosa canina* L.	Rosaceae	44	3	3	2.5	2	7.5	3.5	**446**
Radicchio di campo or ***Radicchio selvatico***	*Cichorium intybus* L., *Crepis* sp.pl. and *Picris* sp. pl.	Asteraceae	33	3	3.5	2	2.5	7.5	3	**390**
Raponzolo	*Campanula rapunculus* L.	Campanulaceae	32	3	3.5	2.25	2.5	8	2.5	**302**
Ingrassaporci or ***Grassaporci*** or ***Piattello***	*Hypochoeris radicata* L.	Asteraceae	27	3.5	2.5	2	3.5	8	2.5	**265**
Nipitella or ***Nepitella*** or ***Empitella***	*Calamintha nepeta* (L.) SAVI	Lamiaceae	45	4	3	1.5	2.5	8	1.5	**243**
Cicerbita or ***Riccino*** or ***Ricciolo*** or ***Riccetto***	*Sonchus* sp. pl.	Asteraceae	36	3	3.5	2	2.5	8	1.5	**227**
Crescione	*Apium nodiflorum* L. and *Veronica beccabunga* L.	Apiaceae	31	2	3	2.5	2.5	7.5	2.5	**174**
Pancagiolo or ***Pancagiotto*** or ***Gallinella***	*Valerianella carinata* LOISEL.	Valerianaceae	55	2.5	3.5	1.5	2	8	1.5	**173**
Finocchio selvatico or ***Anacini***	*Foeniculum vulgare* L. spp. *vulgare*	Apiaceae	50	3	2.5	2	0.75	8	3.5	**158**
Vezzadro	*Clematis vitalba* L.	Ranunculaceae	58	3.5	3	1	1.5	8	2	**146**
Erba striscia or ***Strisciola*** or ***Cucina***	*Silene vulgaris* (MOENCH) GARCKE	Caryophyllaceae	25	3	3	1.75	2.5	9	1.5	**133**
Tassellora or ***Casellora*** or ***Tassella*** or ***Cassella***	*Crepis capillaris* (L.) WALLR.	Asteraceae	17	2.5	3.5	2	3	9	1.5	**120**
Bagola or ***Mirtillo***	*Vaccinium myrtillus* L.	Ericaceae	24	2	2.5	1.5	2	8	3	**87**
Peporino or ***Pepurino***	*Thymus pulegioides* L.	Lamiaceae	32	3.5	2.5	1.5	1.5	9	1.5	**85**
Tirafilo or Tirafila or Lingua di vacca or Orecchie d'asino	*Plantago lanceolata* L.	Plantaginaceae	11	4	3	2	2.5	7.5	1.5	**74**
Pan e vino or ***Erba putta*** or ***Zezzora***	*Rumex acetosa* and *Rumex acetosella* L.	Polygonaceae	35	3	2	1.5	1.5	7.5	2	**70**
Órbaco or ***Alloro***	*Laurus nobilis* L.	Lauraceae	38	2	3	1.5	1.5	8	1.5	**62**
Sassello or ***Sassaiolo***	*Reichardia picroides* L.	Asteraceae	14	2.5	3	2	2	9	1.5	**57**
Pastinella or ***Pastineggio***	*Daucus carota* L.	Apiaceae	20	3	2.5	2	1.5	8	1.5	**54**
Pupattole or ***Belle bimbe***	*Papaver rhoes* L.	Papaveraceae	13	2	3	2	2.5	8.5	1.5	**50**

TABLE 8 (continued).

Vernacular Names	Scientific Names	Botanical Family	QII	AI	UFI	PUI	MFFI	TSAI	FMRI	ICS
Romicia or ***Rombicia*** or ***Romice***	*Rumex crispus* L. AND *Rumex obtusifolium* L.	Polygonaceae	18	3.5	2	1.5	2	8	1.5	**45**
Porcino (***Rosso*** or ***Moro*** or ***Sangiovannnino*** or ***Estatino***)	*Boletus* sp. pl.	Boletaceae	20	1.5	2.5	2	3	9.5	1	**43**
Menta	*Mentha* sp. pl.	Lamiaceae	12	2.5	2	1.5	2	9	2.5	**41**
Erba cipollina	*Allium schoenoprasum* L.	Liliaceae	18	2	2	2	1.5	8.5	2	**37**
Zinepro or ***Ginevro*** or ***Ginepro***	*Juniperus communis* L.	Cupressaceae	52	1.5	2	1.5	1	7	2	**33**
Prignola or ***Uva bócca*** or ***Palline bócche***	*Prunus spinosa* L.	Rosaceae	32	2	2	1.5	1.5	7	1.5	**30**
Sportavecchia,or ***Sporavecchia***	*Bunias erucago* L. and *Lapsana communis* L.	Cruciferae	9	2.5	2.5	2	2	8	1.5	**27**
Sambuco	*Sambucus nigra* L.	Caprifoliaceae	13	3	2.5	1.5	1.5	7.5	3	**26**
Lampone	*Rubus idaeus* L.	Rosaceae	9	2	1.5	1.5	2.5	9	2.5	**23**
Lupporo or ***Lopporo*** or ***Luppolo***	*Humulus lupulus* L.	Cannabaceae	10	3	3	1.25	1.5	9	1.5	**23**
Melissa or ***Menta limona***	*Melissa officinlis* L.	Labiate	12	2	3.5	1.5	2	9	1	**23**
Orecchietta or ***Boccon di pecora***	*Silene alba* (MILLER) KRAUSE	Caryophyllaceae	10	2.5	1.5	2	2	8.5	1.5	**19**
Salvastrella or ***Pimpinella***	*Sanguisorba minor* L.	Rosaceae	9	3	3	1.5	1.5	8.5	1	**16**
Galletto	*Cantharellus cibarius* FR.:FR.	Cantharellaceae	15	1.5	1.5	2	2	9	1	**12**
Nocella	*Corylus avellana* L.	Betulaceae	12	2	3	1	1.5	8	1	**8.6**
Mazza di tamburo	*Macrolepiota procera* (SCOP.: FR.) SINGER	Agaricaceae	14	1.5	1.5	1.5	2	9	1	**8.5**
Aglio selvatico	*Allium vineale* L.	Liliaceae	2	1.5	2	3	1.5	8	2.5	**8.1**
Spinacio che fa in montagna or ***Bieto cacancero***	*Chenopodium bonus-henricus* L.	Chenopodiaceae	9	0.5	2	2	2	8.5	2.5	**7.7**
Fragola	*Fragaria vesca* L.	Rosaceae	7	2	2.5	1.5	1.5	9	1	**7.1**
Nespola	*Mespilus germanica* L.	Rosaceae	6	1	2	1.5	1.5	7.5	3.5	**7.1**
Erbo de' tedeschi	*Lepidium campestre* L.	Cruciferae	13	1	1.5	2	2	8.5	1	**6.6**
Zucca matta or ***Colacci*** or ***Erba de' bisci***	*Bryonia dioica* L.	Cucurbitaceae	12	2	2	1	1.5	9	1	**6.5**
Stioppone or ***Stramontano*** or ***Perticone***	*Cirsium arvense* (L.) SCOP.	Asteraceae	8	2	1.5	1.5	2	8	1	**5.8**
Morella	*Russula cyanoxantha* (SCHAEFF) FR.	Russulaceae	7	2	1	1.5	2.5	8	1	**4.2**
Lattuccio	*Lactuca serriola* L.	Asteraceae	6	1	1	2	1.5	9	2.5	**4.1**
Malva or ***Malvia***	*Malva sylvestris* L.	Malvaceae	6	4	1	1.5	1	7.5	1.5	**4.1**
Timo	*Satureja montana* L.	Lamiaceae	10	1.5	1.5	1.5	1.5	8	1	**4.1**
Prugnolo	*Thricoloma georgii* KÜHN. ET ROMAGN.	Tricholomataceae	9	1	1	1.5	3	9.5	1	**3.9**
Origano	*Origanum vulgare* L.	Lamiaceae	9	1.5	1	1.5	1.5	8	1.5	**3.6**

TABLE 8 (continued).

Vernacular Names	Scientific Names	Botanical Family	QII	AI	UFI	PUI	MFFI	TSAI	FMRI	ICS
Asparago selvatico	*Asparagus acutifolius* L.	Liliaceae	6	1	1	2	1.5	9	1.5	**2.4**
Cimballo	*Clitocybe geotropa* (Bull.: Fr.) Quél. and *Clytocybe gibba* (Pers.: Fr.) P. Kumm.	Tricholomataceae	5	1.5	1	2	2	8	1	**2.4**
Loffa	*Bovista nigrescens* Pers. et Pers.	Lycoperdiaceae	5	1	1	3	2	7.5	1	**2.3**
Barba di becco	*Tragopon pratensis* L.	Asteraceae	8	1	1	2	1.5	9	1	**2.2**
Castracani or ***Centocoglioni***	*Leontodon tuberosus* L.	Astercaeae	3	1	1	2.25	2.5	7.5	1.5	**1.9**
Gramolaccio or ***Fiore di San Pietro***	*Raphanus raphanistrum* L.	Cruciferae	7	1.5	1	1.5	1.5	8	1	**1.9**
Viola	*Viola odorata* L.	Violaceae	5	2	1	1.5	1.5	8	1	**1.8**
Coccora or ***Cocco***	*Amanita cesarea* (Scop. ex Fr.) Pers. ex Schw.	Amanitaceae	5	0.5	1	2	2.5	9.5	1	**1.2**
Pioppino	*Agrocybe cylindracea* (DC.: Fr.) Maire	Bolbiticaeae	6	0.5	1	2	2	9	1	**1.1**
Corniolo or ***Crognolo***	*Cornus mas* L.	Cornaceae	4	0.5	1.5	1.5	1.5	8	2	**1.1**
Cavolo di San Viano	*Brassica oleraceae* ssp. *robertiana* (Gay) Rouy et Fouc.	Cruciferae	5	1	1	1.5	0.5	7	3	**0.8**
Piccicorno or ***Pizzicacorno*** or ***Pizzorcorno***	*Campanula trachelium* L.	Campanulaceae	7	1.5	1	1	1	8	1	**0.8**
Rucoletta	*Diplotaxis tenuifolia* (L.) DC.	Cruciferae	4	1	1	1.5	1.5	9	1	**0.8**
Asprini	*Oxalis acetosella* L.	Oxalidaceae	6	1.5	1	1.5	0.5	7	1.5	**0.7**
Albatra	*Arbutus unedo* L.	Ericaeae	5	1	1	1.5	1	7	1	**0.5**
Genziana	*Gentiana kochiana* Perr. et Songeon	Gentianaceae	4	1	0.5	1.5	0.5	7	4.5	**0.5**
Prataiolo	*Agaricus campestris* L.:Fr.	Agaricaceae	2	1	1	1.5	2	8	1	**0.5**
Ortica dolce	*Lamium album* L.	Lamiaceae	6	2.5	1	0.75	0.5	9	1	**0.5**
Prezzemolo selvatico	*Oenanthe pimpinelloides* L.	Apiaceae	4	1.5	1	1	1	8	1	**0.5**
Salosso	*Symphytum tuberosum* L.	Borraginaceae	4	1	1	1.5	1	8	1	**0.5**
Bertonica	*Salvia verbenaca* L.	Lamiaceae	8	2.5	1	1.5	1.5	8	1	**0.4**
Tasso	*Taxus baccata* L.	Taxaceae	5	1	1	1.5	0.5	8	1	**0.3**
Fiore di San Pellegrino or ***Carlina*** or ***Scarzoni***	*Carlina acaulis* L.	Asteraceae	11	0.5	1	1	0.5	8.5	0.5	**0.2**
Rangagno	*Armillariella mellea* (Vahl. in Fl. Dan. ex Fr.) Karst.	Tricholomataceae	5	1	1	1.5	2.5	8.5	1	**0.2**
Zafferano selvatico or ***Croco***	*Crocus napolitanus* Mord. et Loisel.	Liliaceae	4	2	0.5	0.75	0.5	8	1	**0.1**
Faggiotto	*Fagus sylvatica* L.	Fagaceae	3	2	1	1	0.5	7.5	0.5	**0.1**
Ingannacapre or ***Caprifoglio***	*Lonicera caprifolium* L.	Caprifoliaceae	3	1.5	0.5	0.75	0.5	8	1	**0.1**
Ghianda	*Quercus cerris* L.	Fagaceae	9	1	0.5	1	0.5	7	0.5	**0.1**

Two species had very high taste appreciation scores (*Silene vulgaris* and *Crepis capillaris*) because of their very mild taste, quite different from the commonly perceived light bitter or neutral characteristics of the other greens.

Food botanicals with moderate cultural significance values.— This heterogeneous group consists of species that have a limited role in the local kitchen. Normally they are not frequently used other than in quite specific preparations. These plants include aromatic (wild thyme, *Thymus pulegioides*, laurel, *Laurus nobilis*, wild mint, *Mintha* sp. pl., wild chives, *Allium schoenoprasum*) and a few fruit species (blueberry, *Vaccinium myrtillus*, elderberry *Sambucus nigra*), and secondary greens. The most frequently used mushroom species, *Boletus* sp. pl., are also placed in this group.

Food botanicals with low cultural significance values.— Botanicals with sporadic food usage fell into this group. For many of these species, high taste scores were sometimes reported, but their quotation index and frequency of use are generally very low. Moreover, with the exception of medlar (*Mespilus germanica*) fruits, a medicinal role of such edibles was excluded.

Food botanicals with very low cultural significance values.— Quite rare botanicals, or species that are very rarely used as food, are grouped in this class. Most of the mushroom species are also included here. For the major part of these species, the taste appreciation score is very high and underlines the "exceptional character" of their use. For example, a quite rare wild lettuce (*Lactuca serriola*) was reputed as a "cleanser" by locals with extreme conviction; its taste was considered superb.

Food botanicals with negligible cultural significance values.— This class includes all of the snacks and the species that demonstrated a low frequency of use in the last 30 years. Plants reported by less than four informants are also included in this class. A few snacks were not consumed inside "institutionalised" food frameworks, and neither nutritional, nor special medicinal and/or ritual issues were perceived for these botanicals.

DISCUSSION

Cultural importance indexes allows for the quantification of the role that a given biological taxa plays within a particular culture. The present study, exclusively focused on wild edibles, has permitted the identification of the "culturally" most important plant species gathered and consumed in Northwestern Tuscany. Cultural Food Significance Index (CFSI) values have quantified the ethnobotanical data collected in the studied area and are used to evaluate and classify them by their respective *cultural significance*. Simple qualitative ethnobotanical data, such as lists of used plants, are in fact not generally able to clarify the specific role played by a given species within a given ethnic group. Moreover, bias or personal interpretations, sometimes even suggestive, generally occur carrying out strictly qualitative field studies.

On the other hand, consensus use indexes, which have been successfully applied in inter-cultural ethnobotanical studies focused on medicinal plants (Heinrich et al. 1998), and which have become more frequent in ethnopharmacological studies, do not permit a thorough investigation of the complex phenomenon of the ingestion of edible plants. Sometimes, in fact, species present very low quotation, availability, and frequency-of-use indexes, but are nevertheless appreciated for their taste (as in our studies for example *Crepis capillaris*, *Lactuca serriola*, *Reichardia picroides*) or medicinal properties or are simply perceived to be "healthy" (as in the cases of *Rosa canina*, *Foeniculum vulgare* spp. *vulgare*, *Mespilus germanica*). In these cases, the application of consensus use analysis underestimates the value of these taxa.

In the present survey, very high CFSI values generally occurred for several "wild greens," while wild fruits seems to have played a subordinate role. These data support the hypothesis that non-nutritional factors could have played a central role in the choice of wild vegetal food sources and their acceptance and/or popularity. Availability, multi-functionality and the medicinal and/or ritual characters ascribed by locals to specific plants accord high importance to those species, which under a nutritional point of view would seem to play a subordinate role. "Wild greens" represent an important diet source of *phytoceuticals* (Johns 1999) that support the nutritional need to balance the traditional diet, which in the studied area, is rich in carbohydrates (from chestnut and maize flour "polenta") and relatively poor in minerals, vitamins and phenolics.

The success of this class of edibles and at the same time, the limited role played by wild fruits and aromatic plants, can also be explained with the relative low availability of the former, and the minor frequency of use of the latter. In the traditional rural society of the upper Serchio Valley, the factor of "time" has certainly influenced food choices: the harvest of wild fruits took much longer than that of wild greens, which were normally collected near the house or the farm. Moreover, a few wild fruits are normally sold in the local markets today while cultivated fruits and aromatic herbs tend to substitute wild taxa and can be found in every shop. On the contrary, "wild greens" do not generally reach either of the "official" commercial channels. The traditional "know how" about wild greens seems to belong especially to the female community, while men play a minor role. Men do, however, demonstrate a specific competence in the collection of wild mushrooms and fruits.

The present situation is quickly changing, however, and fewer women gather food plants in the spring and summertime today than in the past. The frequency use index values are in some cases more than 50% lower than those calculated for a few decades ago. Many of the "wild greens" are also considered to taste bitter, but their taste appreciation is never very low. Elderly people especially tend to appreciate their bitter taste, and automatically attribute it to a "medicinal" role, even if its health role is not specific.

This analysis provides an interesting starting point for the further development of comparative studies with other Mediterranean areas and also with future archaeobotanical findings. Such a quantitative approach could clarify relations among foodways of the old times and more recent ones, and even provide insights for the studies of the mechanisms which regulate the acceptance or rejection of foods by humans (Fallon, Fallon, and Rozin 1983). CFSI values could also be successfully evaluated in intercultural and interethnic quantitative ethnobiological studies and more complex comparative schemes could be carried out using these indexes when coupled with multivariate and statistical methods (Höft, Barik, and Lykke 1999).

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Manual Etnomédico de Oxchuc: Guía Básica y Herbolaria. (Stalel Sk'op Ya'Yejal Bit'il Ta Pasel Wamal: Sk'opla Bit'il Ta Meltsanel Poxil Sok Wamaletik.) Elois Ann Berlin. 2000. El Colegío de la Frontera Sur, ECOSUR, Carretera Panamericana y Periférico Sur, Barrio de María Auziliadora. C. P. 29290, San Cristóbal de Las Casas, Chiapas, México.

I purchased this book from two women, presumably Oxchuqueros, at the Seventh International Congress of Ethnobiology in Athens, Georgia, for the modest price of $6. Little did I know, I was purchasing one of the first works of ethnoepidemiology that (out of a broader field of ethnoscientific literature) seems to stress the *ethno*. Written in two languages, Spanish and Tzeltal de Oxchuc, especially for the indigenous people of Oxchuc, this book serves as both a basic guide to ethnomedicine and as an herbal guide. With the help of Brent Berlin, Juana Gnecco and Spanish and Tzeltal translation by Sergio Gómez López, author Elois Ann Berlin presents public health in Oxchuc from the perspective of Oxchuqueros and discusses Maya ethnomedicine and national and local medical systems. The work is largely based upon ethnoepidemiological surveys with 99 families in 20 districts within Oxchuc in 1989.

The book is broken into six chapters as follows: 1) Social characteristics and demographic relations with community health 2); atlas of ethnoanatomy; 3) the principle groups of illness; 4) some illnesses and their treatments with medicinal plants; 5) ethnoepidemiological patterns; and, 6) a dictionary of ethnomedicine. In the first chapter, "Características socials, etnográficas y demográficas relacionades con la salud comunitaria," the author begins with a brief description of the environment and discusses the relations and uses of health services and the infrastructure of public services. The second chapter, "Atlas de etnoanatomía," is a series of illustrations of the human body with the names of each part in Tzeltal de Oxchuc and in Spanish. A pleasing feature included are the three to five inches of blank lines to be filled in with personal or family health notes of the Oxchuqero reader or health care worker. Chapter three, "Los principales grupos de enfermedades," presents the classification of illnesses recognized in Oxchuc and a brief description of each illness in each group. The fourth Chapter, "Algunas enfermedades y sus tratamientos con plantas medicinales," includes the definitions of illnesses according to the Oxchuqueros and the description of causes, signs and symptoms and traditional medical treatments. This chapter includes illustrations of some plant species by botanical illustrator Nicolás Hernández Ruíz. Chapter 5, "Patrones etnoepidemiológicos," presents analysis of the most frequent causes of illness and death in Oxchuc.

Considering that the ethnoepidemiological and demographic data are 10 years old, an updated second edition is surely in the works. What I would like to see in the next edition is a chapter devoted to diet and nutrition. In chapter five, the author lists "de las vias alimenticias" as the leading cause of death in Oxchuc and gives no dietary basis as to why this is so. The public health outlook in Oxchuc is the typical situation where, "the loss or destruction of land, reduced access to resources and economic impoverishment are often the root of malnutrition and disease that afflict people when their traditional subsistence economy breaks down"

(Johns 1999). Diet has an undeniable place in public health care planning in an effort to maintain a level of health for a period of time. Ideally, a section of dietary recommendations based on local crops and foodstuffs that included average daily food intake values, perhaps even gender and age specific, would be useful. Berlin and Berlin (1996) have previously documented the Mayan explanatory model for gastrointestinal diseases and their food-based ethnoetiology; however, the broader dietary basis for these diseases has yet to be published.

Kleinman (1978) states, "in my experience, health care professionals in non-Western societies often accept the biomedical model as their guide to practice without correcting for its ethnocentric bias. An appropriate area for applied ethnomedical teaching would be to train health professionals in non-Western societies in precisely this kind of self-reflexive evaluation and rectification of the potentially negative consequences of their professional beliefs and behaviors." It seems that *Manual Etnomedico de Oxchuc* is an example of a Western model of health care applied to a non-Western society.

The challenge to ethnopharmacologists (Etkin 1991) to move beyond the simple evaluations of medicinal plants to analyzing alternative contexts of plant use (e.g. diet) could be equally posed to the ethnoepidemiologist. And that is the challenge for future research to address. *Manual Etnomédico de Oxchuc* is a valuable resource for not only the community members, but also everyone interested in the dialogue between ethnobiology and public health.

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ETHNOZOOLOGY OF FISHING COMMUNITIES FROM ILHA GRANDE (ATLANTIC FOREST COAST, BRAZIL).

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ABSTRACT.— In this study we cover aspects of the ethnozoology of inhabitants of Aventureiro and Provetá, communities located at Ilha Grande, Atlantic Forest coast (SE Brazil). In particular, ethnotaxonomy is approached analyzing the local nomenclature of fish, and comparing it to the scientific taxonomy. Food taboos and medicinal animals are observed among islanders. Food taboos often refer to carnivorous or to medicinal animals (especially fish), besides other morphological aspects of the tabooed animals. We conclude that for folk taxonomy, and fish and game preferences and taboos, both utilitarian and symbolist explanations are useful. We suggest that local knowledge on game and fish usefulness as well as on folk taxonomy may be an important source of information to develop ecologically sound, and socio-economically appropriate resource management plans.

Key words: ethnobiology, ethnozoology, fisheries, Atlantic Forest coast, Brazil

RESUMO.— Neste estudo apresentamos aspectos da etnozoologia dos habitantes de Aventureiro e Provetá, comunidades localizadas na Ilha Grande, região de Mata Atlântica, no litoral sudeste do Brasil. Em particular, abordamos etnotaxonomia através de uma análise da nomenclatura local dos peixes e através de uma comparação entre esta e a nomenclatura científica. Tabus alimentares e animais medicinais são observados nas duas comunidades. Os tabus alimentares geralmente referem-se a animais carnívoros ou medicinais (especialmente peixes) e a aspectos morfológicos de animais rejeitados para consumo. Concluímos que tanto considerações utilitaristas como simbolistas são úteis para explicar as preferências e os tabus alimentares em relação aos peixes e aos animais de caça, assim com para explicar a etnotaxonomia de peixes. Sugerimos que o conhecimento da população local sobre a utilidade de animais de caça e peixes e sobre a etnotaxonomia de peixes, pode ser uma importante fonte de informação para o desenvolvimento de planos de manejo ecológico, sócio, e economicamente apropriados.

RÉSUMÉ.— Dans cette étude nous couvrons des aspects de l'ethnozoologie des habitants d'Aventureiro et de Provetá, deux communautés situées à l'île d'Ilha

Grande, au sud-est du Brésil et appartenant à la forêt de la Mata Atlântica. En particulier, l'ethnotaxonomie est approché en analysant la nomenclature locale des poissons, et en la comparant à la taxonomie scientifique. On analyse aussi les tabous alimentaires et l'usage des animaux médicinaux parmi des îliens. Les tabous alimentaires se rapportent souvent aux animaux carnivores ou aux animaux médicinaux (en spécial les poissons), sans compter d'autres aspects morphologiques des animaux. Nos conclusions démontrent que les considérations utilitaristes et symbolistes sont importantes pour expliquer les préférences et les tabous alimentaires par rapport à l'utilisation des poissons et des animaux chassés. Nous proposons que la connaissance locale sur l'utilité de chasse et de poissons aussi bien que sur la ethnotaxonomie des poissons est une source importante d'information pour développer des projets de gestion de ressource qui seront écologiquement, socialement et économiquement appropriées.

INTRODUCTION

The study of native or local knowledge systems can contribute to the creation of alternative strategies for ecological management (Posey et al. 1984), especially in geographic areas where scientific data are usually scarce or nonexistent (Johannes 1998, Ruddle 1994). Local knowledge can be a source of information on current status of resources, local ecosystem dynamics, species diversity, species behavior, interactions among components of ecosystems, and local environment characteristics among other things. Traditional natural resource management practices based on local knowledge can also be a source of information on ecologically sustainable management practices. This is not to say, however, that all traditional management practices are ecologically sound. As Johannes (1978:355) pointed out, "Environmentally destructive practices coexisted, in most societies, with efforts to conserve natural resources. But the existence of the former does not diminish the significance of the latter." Sustainable natural resource management based on local knowledge by native or local populations has been recorded in several places worldwide (Berkes 1985; Berkes et al. 1989; Feeny et al. 1990; Berkes and Kislaliogluo 1991; Gadgil et al. 1993).

Several terms have been used to describe the knowledge of local ecological systems, accumulated through a long series of observations and transmitted from generation to generation (Gadgil et al. 1993; Berkes 1999), including native knowledge, indigenous knowledge, traditional (ecological) knowledge, and local knowledge. To avoid semantic and conceptual problems, we will use here the term *local knowledge* because it is the least problematic one (Ruddle 1994).

One way of studying local knowledge about living organisms is to observe how the organisms are classified and what their uses are. Ethnobiological studies on the classification of living organisms, as well as on food taboos and preferences, constantly show the debate between utilitarian/materialist and structuralist/symbolist (Berlin 1992; Hunn 1982; Hay 1982; Harris 1987a, 1987b; Vayda 1987a, 1987b). In the light of this debate, the purpose of this study is then to investigate (a) fish ethnotaxonomy and its relation to scientific taxonomy, (b) food preferences and taboos, and (c) animals used in local medicine, in two fishing communities of Ilha Grande (R.J, Southern coast of Brazil). Understanding the reasons behind food preferences and taboos, the use of animals in local medicine, and the diversity of fishing resources and its classification may help to elaborate more appropriate and ecologically sound management plans for these communities.

STUDY SITES

Ilha Grande means big island in Portuguese. It is almost 190 km^2 and is located off the southeastern Brazilian coast (23∞ 10' S, 44∞ 17' W, Gr.), in front of Angra dos Reis Bay (Angra dos Reis, Rio de Janeiro State) (Figure 1). Today the island is mainly covered by secondary tropical rainforest after being used until some decades ago for agriculture (particularly coffee and sugar-cane plantations), pastures, and tree logging. The size of the local population, known as *caiçaras*, has been quite stable around seven to eight thousand people during the last two centuries (Oliveira et al. 1994). *Caiçaras* are tillers and fishers, descendants of Indians and European settlers, mainly Portuguese (Marcilio 1986). Their subsistence is based mainly on manioc cultivation and fishing activities. However, since 1950's, a shift has occurred from agriculture to fishing due to low prices of agricultural products relative to fish (Diegues 1983; Begossi et al. 1993).

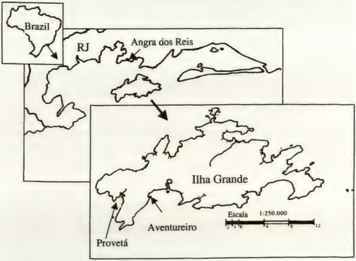

FIGURE 1.— Map of the study site, showing Grande Island Bay and Grande Island, where Aventureiro and Provetá are located. The Bay of Ilha Grande is located in the the southern coast of Rio de Janeiro State, in Brazil.

We studied two fishing communities in Ilha Grande: Provetá and Aventureiro, both situated at the southwestern side of the island. Provetá is the second biggest community of the island including around 260 houses. Its economy is based mainly on the sardine fishery. There is a clear social stratification among its population, where few boat owners employ most of the fishermen in the community. Electric power is offered only to buildings from the center of the village, including the "Assembléia de Deus" (Assembly of God) church (Pentecostal), the elementary and junior high school, the medical office, five small markets, and the most wealthy houses.

Aventureiro is one of the smallest communities of the island (22 families), the most isolated, and the only one facing open sea. Although young men from Aventureiro work for the Provetá sardine fishery, small-scale artisanal fisheries and shifting cultivation are the main subsistence activities of the *caiçaras* of Aventureiro. Inhabitants of Aventureiro depend on Provetá or on Angra do Reis (inland city) to sell their products, to buy goods, and to provide medical assistance. There is an elementary school in Aventureiro, and adult illiteracy level is almost the same as at Provetá (around 20%). There is no municipal electric power or water in Aventureiro. Because Aventureiro is located inside a State protected area (Reserva Biológica Estadual da Praia do Sul - RBEPS), nobody is allowed to move in, except relatives of the inhabitants.

The RBEPS was institutionalized as a top-down management by the Rio de Janeiro State government, as well as the Marine Park of Aventureiro (5 nautical square miles) situated in the ocean adjacent to the community of Aventureiro. The Aventureiro people should live according to State regulations for protect areas, which include prohibition of game hunting and fishing. However, this is not often the case, as the RBEPS staff is insufficient to monitor the entire area and enforce regulations.

METHODOLOGY

The field work on Ilha Grande was carried out from April 95 to September 1996. Surveys about aquatic and terrestrial animals uses were performed to identify the following issues: (a) which fish were the most common, consumed, preferred, avoided, sold, or had medical importance; (b) which game were consumed or avoided; (c) which were the reasons for which fish and game were avoided; and (d) which animals were used for medicinal purposes. Items *a*, *b* and *d* investigated the use of local animal resources by this *caiçara* population. Item *a* also provided information on fish diversity and folk classification of fishing resources. Item *c* focused on understanding the reasons behind food preferences and taboos.

We visited all houses in Aventureiro and interviewed husband and/or wife, for a total of 30 adult *caiçaras*. Because Provetá is a large community, we visited only 25% of its houses and interviewed 100 *caiçaras*. The sampling methodology consisted of visiting one house, skipping the next three, and visiting the fourth house, repeating this procedure until the whole community was covered.

ETHNOTAXONOMY OF FISH

According to Berlin (1973, 1992) folk genera are groups of animals or plants easily recognized on the basis of a large number of gross morphological characteristics, usually described by primary names (monomials). Folk species require a more detailed observation on the basis of very few morphological characters to be distinguished and are linguistically binomials (generic name is modified by an adjective which usually describes some obvious morphological character) (Berlin 1973, 1992).

During field work, 35 fish specimens were collected and identified by *caiçara* folk names, and afterwards by their scientific names[1] according to Figueiredo (1977), Figueiredo and Menezes (1978, 1980), Menezes and Figueiredo (1980, 1985) (Appendix 1). During interviews in both communities studied at Ilha Grande (Provetá and Aventureiro), 123 fish names quoted were registered; their corresponding scientific names were obtained from the above literature plus Godoy (1987) and Begossi and Figueiredo (1995) (Appendix I). From 123 fishes quoted during interviews, 97 fishes had monomial names (folk genera) and 25 had binomials (folk species). In addition, one fish, which had a monomial name (***Languicha***), was considered a folk species for being a contraction of a binomial (***Corcoroca-languicha***). Correspondent scientific names were not found in literature for 4 folk genera and 5 folk species.

In the present study, the analysis of folk and scientific systems of classification had the scientific species and the folk genus as the basic taxa, as proposed by Berlin (1973). We present below four types of correspondence verified by Berlin, and one more type which we call "Over-differentiation Type II."

a) <u>One-to-one correspondence:</u> A single folk genus corresponds to only one scientific species. Example: ***Barana*** (*Elops saurus*) (ladyfish).
b) <u>Over-differentiation type I:</u> Two or more folk generic taxa refer to a single scientific species. Example: *Caranx crysos* is known as ***Manequinho***, ***Carapau*** and ***Xerelete*** (bluerunner). However, in this case, and according to local fishermen, those names are given to different sizes of the same fish (growing phases). Another example is *Trachinotus goodei* known as ***Garabebê*** or ***Pampo-branco***. In this latter case, however, folk names are not associated with growing phases.
<u>Over-differentiation type II</u>: Two or more folk genera are used to designated two or more, although the same, scientific species. Example: ***Camburu*** and ***Moréia*** (moray) are folk names by which are recognized several species from the genus *Gymnothorax*s.
c) <u>Under-differentiation</u>: Refers to polytypy and can be divided into two types:
<u>Type I:</u> A single folk genus refers to two or more scientific species from the same genus. Example: ***Caranha*** (more than one species from the *Lutjanus* genus) (snapper).
<u>Type II:</u> A single folk generic taxon refers to two or more species of two or more scientific genera. Example: ***Corcoroca*** (species from more than one genus from Haemulidae family) (tomtate). There are also some rare cases where a folk genus refers to scientific species from more than one family. Ex: ***Cação*** (species from 13 families) (shark) and ***Arraia*** (species from 10 families) (rays).

The correspondence between the 97 folk genera and the scientific species is presented in Table 1. Carangidae seems to be the most known fish family among *caiçaras* from Ilha Grande. There is a high correspondence among folk genera and scientific species from the Carangidae. Moreover, from 20 folk species we identified, 6 were Carangidae, 4 Haemulidae and 4 Clupeidae, which also suggest the well known importance of Carangidae. These results may indicate species from this family can be easily recognized on the basis of external morphological characters; or, perhaps, local people may have some incentives to recognize Carangidae fishes. Indeed, the Carangidae represent 24% of all fish quoted by more than 10% of interviewees as being of local significance or usefulness (Tables 5 and 6), following in second place by the Scombridae, Haemulidae, Sciaenidae, Serranidae, Sparidae and Mugilidae, which represented only 7%.

Although some folk names of Sciaenidae correspond to only one scientific name, polytypy was common in this family. Polytypy was also often observed for Serranidae and Exocoetidae-Hemiramphidae, which suggests *caiçaras* have more trouble or less incentives to differentiate fish from these families. For instance, no Sciaenidae, Serranidae or Exocoetidae-Hemiramohidae fish were quoted by more than 10% of the interviewees as fish that should be avoided (i.e., ***carregado*** – see below), and only one Sciaenidae (***Corvina***), among all these families, was rejected by interviewees from Ilha Grande (Table 6). It is worth noting, however, that ***Cor-***

TABLE 1.— Correspondence between folk genera and scientific species of the 97 monomial fish names (folk genera) quoted during interviews.

Type of correspondence	Numbers of folk genera involved	Numbers of cases found in each scientific family
One-to-one correspondence	31 folk genera	5 cases from Carangidae 4 cases from Sciaenidae 3 cases from Scombridae 19 cases from 16 different scientific families
Over-differentiation type I (Synonyms)	7 cases including 11 folk genera and 4 folk species	4 cases from Carangidae
Over-differentiation type II (Synonyms)	4 cases including 12 folk genera	
Under-differentiation type I (Polytypy)	13 folk genera	3 cases from Serranidae 10 cases from 9 different scientific families
Under-differentiation type II (Polytypy)	26 folk genera	4 cases from Sciaenidae 3 cases from Exocoetidae-Hemiramphidae 16 cases from 15 different scientific families Plus: ***Arraia*** (ray) from 10 different families ***Cação*** (shark) from 13 different families ***Linguado*** (flounder) (Pleuronectiform)

vina (Croaker) is a well differentiated fish, showing a one-to-one correspondence between folk genus and scientific species (*Micropogonias furnieri*).

So, what are the incentives for local people to classify or differentiate fish? Berlin (1992) proposes and discusses the principles of general classification of plants and animals by traditional societies as reflecting an intellectual or cognitive process of comprehending the world (a process motivated by "interest," first of all). On the other hand, Hunn (1982) argues that ethnoscientists interested in folk biological classification have paid insufficient attention to the practical significance of such systems.

The fact that Carangidae species are well differentiated and also the most represented among those of useful meaning for local people, supports Hunn's arguments. On the other hand, some useful fish are quite under-differentiated referring to species of two or more scientific genera (under-differentiation type II), including species of Clupeidae, Haemulidae, Labridae, Scaridae, Scombridae and Elasmobranchii fish (Tables 5 and 6). To contribute to this debate and to the understanding of folk taxonomy, Clement (1995) suggests that "it is only through minute analysis of uses of plant and animal products alongside study of the classification of the same plants and animals in a taxonomic system which is 'apparently' morphological or behavioral that one can discover the relation between cognitive and utilitarian factors."

Although such "minute analysis" was not performed in this research, there are clear evidences of cognitive factors in the folk taxonomy of *caiçaras* from Ilha Grande. Some folk species from the same folk and scientific genus are differentiated by their colors; examples are ***Pampo-branco*** (white) (*Trachinotus goodei*) and ***Pampo-amarelo*** (yellow) (*Trachinotus carolinus*); and ***Xaréu-branco*** (white) (*Caranx hippos*) and ***Xaréu-preto*** (black) (*Caranx lugubris*). Others are differentiated by their morphological or behavioral characteristics; for instance, ***Galo-testudo*** ("big forehead") (*Selene vomer*) and ***Galo-da-correição*** ("one that moves in schools") (*Selene setapinnis*). Interesting to note here is that ***Galo*** is not quoted among the fishes most useful or avoided; that is, cognitive factors seems to be more evident than the utilitarian principle in this case.

Although all the above examples are from the Carangidae, color, morphological and behavioral characteristics are indeed commonly used adjectives that modify generic names (folk genera) in *caiçara* taxonomy. Examples from the Hemulidae, Labridae, Sciaenidae, Clupeide, include respectively ***Corcoroca-bicuda*** ("long beak") (*Haemulon plumieri*), ***Gudião-prego-de-cobre*** ("old copper color") (*Halichoeres radiatus*); ***pescada-branca*** (white) (*Cynoscion leiarchus*); and ***sardinha-cascuda*** ("hard scales") (*Harengula clupeola*).

Our results suggest that both cognitive and utilitarian factors are important components of the biological classification of fish among *caiçaras*. These findings are in accordance to those presented by Begossi and Figueiredo (1995) for fishing communities in the same coastal region. These authors observed a close relationship between binomial folk names and important economic fish families (e.g., Carangidae, Serranidae and Sciaenidae) except for Labridae and Scaridae (folk name ***Gudião*** or ***Budião***). They suggest that "perhaps, the conspicuousness and beautiful colors of these [***Gudião***] species making them highly noticeable and identifiable, explains their importance in folk nomenclature" (Begossi & Figueiredo 1995: 716). That is, cognitive processes also play a role in folk taxonomy.

COMPARING ETHNOTAXONOMY OF FISHES FROM THREE ISLANDS OF SOUTHEASTERN BRAZILIAN COAST

Based on Berlin's definition for folk genera and species we re-analyzed data from Begossi and Figueiredo (1995) for Buzios island and Sepetiba bay, both *caiçaras* communities also located at the southeastern Brazilian coast. We compared those data to the ones obtained for Ilha Grande (Tables 2 and 3). In all three localities we observed synonyms among folk genera (over-differentiation) varying from 19% to 29% of all folk genera. The percentage of folk genera corresponding to only one scientific species was very low at Ilha Grande (about 1/3) if compared to data from Buzios island and Sepetiba bay (over 2/3). Moreover, 40% of folk genera from Ilha Grande were polytypic whereas polytypy appears only in less than 10% of the folk genera from the other two places (Table 2).

TABLE 2.— Correspondence between folk genera and scientific species of fishes from Ilha Grande (Provetá and Aventureiro), Búzios island and Sepetiba bay.

	Percentage of Folk Genera		
Correspondence Types	Ilha Grande	Búzios Island[1]	Sepetiba Bay[1]
One-to-one correspondence	32	79	68
Over-differentiation type I	11 (7 cases)	16 (8 cases)	26 (7 cases)
Over-differentiation type II	12 (4 cases)	3 (1 case)	3 (1 case)
Under-differentiation type I	13	1	2
Under-differentiation type II	27	1	6
Folk genera not identified	4	0	0
Total of folk genera	97	80	62

[1]Data from Begossi and Figueiredo (1995)

The proportion of folk species in relation to all fish folk names were low (less than 1/3) for all localities: 20% at Ilha Grande, 31% at Búzios island and 16% at Sepetiba bay. The correspondence one-to-one between folk species (binomials) and scientific species (binomials) occurs in 40% of folk species from Ilha Grande, 47% from Búzios island, and 50% from Sepetiba bay. In all localities we found cases of synonyms and cases of polytypy among folk species (i.e., one folk species corresponding to two or more scientific species) (Table 3).

Geoghegan (1976) verified that folk systems of biological nomenclature reflect accurately natural biological diversity, despite of the strong influence of cultural factors. When analyzing folk and scientific taxa as proposed by Berlin, we verified at Ilha Grande that the folk genera directly recognized (correspondence one-to-one), under-differentiated and over-differentiated are distributed in proportions to around one third. This could suggest that classification of fish by *caiçara* from

TABLE 3.— Correspondence between folk species and scientific species of binomial fish names from Ilha Grande (Provetá and Aventureiro), Búzios island and Sepetiba bay.

	Percentage of Folk Species		
Correspondence Types	Ilha Grande	Búzios Island[1]	Sepetiba Bay[1]
One-to-one	40	47	50
Over-differentiation (synonyms)	16 (2 cases)	28 (5 cases)	42 (2 case)
Under-differentiation (polytypy)	16	17	8
Total of folk species[2]	25	36	12

[1]Data from Begossi and Figueiredo (1995)

[2]At Ilha Grande, 20% of the folk species were not identified and 16% were synonymous with folk genera (over-differentiation type I). At Búzios Island, 8% of the folk species were synonymous with folk genera.

Ilha Grande are far from reflecting natural biodiversity. However, when we sum the folk species (10) and folk genera (31) related to only one scientific species and the folk species and folk genera classified as over-differentiated type I (synonyms) (19) we verified that 49% of all fishes cited during interviews at Ilha Grande were easily recognized. Moreover, this percentage is much higher for Búzios Island and Sepetiba Bay, respectively, 91% and 93%. These results suggest that indeed *caiçaras* have an accurate knowledge about fish diversity as proposed by Geoghegan (1976). The lower correspondence of one-to-one type between folk and scientific taxonomy, in relation to folk genera or folk species from Ilha Grande when compared to the other two localities may be the result of the methods used. All fishes from Búzios island and Sepetiba bay were collected during field work, identified by their folk names and afterwards by scientific taxonomy, whereas only 26% of the fishes cited during interviews at Ilha Grande were collected and scientifically identified. The rest of the fish names identification was done through corresponding folk to scientific names obtained from literature about localities from south and southeastern Brazilian coast, including Búzios island and Sepetiba bay. The fact that only 26% of all fishes in Ilha Grande were collected and scientifically identified may also explain the higher percentage of folk genera under-differentiation in Ilha Grande compared to the other two localities.

FISH AND GAME CONSUMPTION, AND FOOD TABOOS[2]

Because of the existence of synonyms and polytypy among fish folk names, when analyzing the usefulness of fishes and the food taboos in Ilha Grande, we grouped some folk genera and folk species of fishes as presented in Table 4. We analyzed animal preference, consumption, uses and prohibition in case of illness at Aventureiro and Provetá (Tables 5 and 6). The most considered common fishes in both communities were also cited as the most consumed ones: spottail pinfish (***marimbá***) (*Diplodus argenteus*), bluefish (***enchova***) (*Pomatomus saltatrix*), yellow chub (***pirajica***) (*Kyphosus sp.*) and bluerunner (***xerelete***) (*Caranx crysos*) at

Aventureiro; and bluerunner, grouper (***garoupa***) (*Epinephelus* sp.) and bluefish at Provetá. These results suggest that consumption is related to those fishes that are more available. Availability here refers to what is caught during fisheries and not to all fishing resources. Another explanation is that interviewees simply associated their answers about the most common fish in their localities to what is the most common in their everyday dishes. If this is the case, this association can create a bias in the use of local knowledge about fish stocks in management design; so, further investigation is needed.

TABLE 4.— Fish folk names from Ilha Grande chosen to represent their synonyms or folk species included within folk genera.

Fish folk names	Synonyms or folk species included in folk genera
Bonito (Bullet mackerel or little tunny)	***Bonito-Cadelão***
Cação (Shark)	any folk species of ***Cação*** cited
Corcoroca (Tomtate)	any folk species of ***Corcoroca*** cited
Camburu (Moray)	***Moréia***
Galo (Atlantic moonfish)	both species of ***Galo***
Garabebê	Pampo-Branco
Gudião (Hogfish, Parrotfish, Wrasse)	excepting ***Gudião-Sabonete*** (it was collected and identified as being from another family) all folk species of ***Gudião*** cited
Imbetara (Southern kingfish)	***Papa-terra*** and ***Perna-de-Moça***
Olho-de-Cão (Bigeye)	***Jaguareçá***, ***Jingolê***, ***Padecedo*** and ***Sambalo***.
Pampo (Florida pompano)	***Pampo-Amarelo***
Parati-Barbudo (Mullet)	***Barbudo***
Peixe-Porco (File fish)	***Capucho***
Pescada (Weakfish)	***Pescada-branca***
Sabonete	***Gudião-Sabonete***
Sardinha (Sardine)	any folk species of ***Sardinha*** cited
Xaréu-Branco (Jack crevalle)	***Xaréu***
Xerelete (Bluerunner)	***Carapau*** or ***Manequinho***

Sardine (***sardinha***) (Clupeidae) is considered a very common fish in Provetá. However, it was not cited among the most consumed fishes in that community. The fact that the sardine fishery is the main source of income in Provetá explains why this fish was cited as the most common and the most sold fish by *caiçaras* from Provetá. Bluerunner and bluefish are also frequently sold by fishermen from both communities.

At *caiçara* communities, food taboos can be observed through animal rejection or avoidance or because animals are considered *carregados*. The term *carregado* (also known as *reimoso*) refers to some types of meat which are "strong" or cause indigestion and should be avoided by ill people.

Bluerunner, grouper and mackerel (***cavala***) (*Scomberomorus cavalla*) are among the most preferred fishes and whitemouth croaker (***corvina***) (*Micropogonias furnieri*) among the most rejected fish in both communities we studied. Pufferfish (***baiacu***) (*Sphoeroides* sp.) and cutlass fish (***espada***) (*Trichiurus lepturus*) at Provetá and moray (***camburu***) (*Gymnothorax* sp.) and mullet (***parati***) (*Mugil* sp.) at Aventureiro, were also rejected. According to interviewees, croaker is avoided because of its stink and bad taste. However, it is very recommended for illness at Provetá (Table 6). This result agrees to the "drugstore hypothesis" (Begossi 1992) which suggests that fish used in case of illness by relatively isolated people may be considered taboo in order to be available for folk medicine. Accordingly, croaker avoidance in Ilha Grande seems to have a conservation purpose since croaker is one of the most consumed and commercialized fishes along the Brazilian southeastern coast (Menezes and Figuereido 1980). In fact, Colding (1997), who studied several taboos found in indigenous societies, verified that 60% of those taboos had some effect on conservation.

According to *caiçaras*, pufferfish is rejected because it is venomous. Indeed, pufferfish poisoning has been reported since the seventeenth century (Piso 1658). Cutlass fish is avoided because it is a scaleless fish (*peixe de couro*), and some times it possesses worms in its flesh. Scaleless fishes are also avoided in Amazon area (Pereira 1974). Moray is rejected because of its snake-shape. Besides its appearance, Begossi (1992) observed that the aggressive behavior, bad smell and conspicuous teeth of moray also contribute to is avoidance at Búzios island.

Mullet (***parati***) is avoided because it is a *carregado* fish. Actually, mullet, bullet mackerel or little tunny (***bonito***) (Scombridae) and jack (***xaréu-preto***) (*Caranx lugubris*) were considered *carregado* fish. An association between *carregado* and carnivorous species (*peixes de dentes*) is suggested by interviewees. This association was proposed by Begossi (1992) and Begossi and Braga (1992). According to these authors, the fish position at the food chain can influence its preference as food item. Fishes at a high trophic level have a higher probability of acquiring toxins and being considered venomous fishes (*carregados*). Indeed, 63% of *carregado* fishes in both communities are piscivorous (Table 7), which reinforces their hypothesis.

Fishes recommended in case of diseases or after childbirth are known as *mansos*. The fishes most cited as *mansos* during interviews were bluerunner and southern kingfish (***imbetara***) (*Menticirrhus* sp.) at Aventureiro, and tomtate (***corcoroca***) (Haemulidae), croaker and grouper (***mira***) (*Mycteroperca* sp.) at Provetá. Begossi (1992), Begossi and Braga (1992) and Hanazaki et al. (1996) verified that *manso* fish are usually plankton eaters or feed on small invertebrates or are detritivorous. This relationship among *mansos* fishes and predators of the beginning or the middle of the food chain is also verified here: 71% of those fishes cited as mansos in Aventureiro or in Provetá are detritivorous or feed on small invertebrates or small fishes (Table 7).

Our results demonstrate that *caiçara* taboos on fish consumption may be related to both utilitarian and cognitive factors. Avoidance of a fish due to its toxicity or indigestibility (e.g., pufferfish and *carregado* fishes) and due to conservation purposes ("drugstore hypothesis") has strong useful meaning (utilitarian perspective), as well as knowledge on *manso* fishes. On the other hand, avoidance of fish due to its appearance and behavior (e.g., moray) is clearly based on cognitive factors (symbolist perspective).

As it occurs among fish resources, some game animals are more preferred or more avoided than others. At both communities, we observed that paca (***paca***) (*Agouti paca*), agouti (***cutia***) (*Dasyprocta azarae*), lizard (***lagarto***) (*Tupinambis merianne*), opossum (***gambá***) (*Didelphis marsupialis*) and nine-banded armadillo

TABLE 5.— Fishes cited as common, consumed, preferred and sold, according to at least 10 % of interviewees from Aventureiro (**Av**) and Provetá (**Pr**), Ilha Grande: Percentage of citations of each species related to (*per*) the number of interviewees.

FISHES		Percentages of Citations							
Folk and English Names	Scientific Names	Common		Consumed		Preferred		Sold	
		Av	**Pr**	**Av**	**Pr**	**Av**	**Pr**	**Av**	**Pr**
Bonito Bullet mackerel or little tunny	Several species from Scombridae	20							
Cavala Mackerel	*Scomberomorus cavalla*	20				43	32	13	11
Cação Shark	Several species							13	
Corvina Whitemouth croaker	*Micropogonias furnieri*	10		14					
Enchova Bluefish	*Pomatomus saltatrix*	53	13	41	22	53		75	37
Garabebe	*Trachinotus goodei*							13	
Garoupa Grouper	*Epinephelus* sp.	33	22	18	21	33	43	13	22
Marimbá Spottail pinfish	*Diplodus argenteus*	57	11	50				13	
Olho de Boi Great amberjack	*Seriola dumerili*						13		
Olho de Cão Bigeye	*Priacanthus* sp.		10						
Olhudo Horse-eye jack	*Caranx latus*	17		18				62	
Pampo Florida pompano	*Trachinotus carolinus*	13				10			
Pirajica Yellow chub	*Kyphosus* sp.	40	13	41	16	27	13	13	
Sardinha Sardine	Several species from Clupeidae	10	59		11			13	52
Sargo Black margate	*Anisotremus surinamensis*			32					
Taínha Mullet	*Mugil platanus*		13		17				
Tiniúna Sargeant	*Abudefduf saxatilis*					23			
Xaréu-Branco Jack crevalle	*Caranx hippos*							25	
Xaréu-Preto Jack	*Caranx lugubris*	13						13	
Xerelete Bluerunner	*Caranx crysos*	50	69	50	66	53	29	75	33
Total of folk names		26	31	17	22	18	19	12	17
Interviewees		30	97	22	81	30	99	8	27

TABLE 6.— Fishes cited as rejected, avoided, and recommended for consumption during illness, according to at least 10 % of interviewees from Aventureiro (**Av**) and Provetá (**Pr**), Ilha Grande: Percentage of citations of each species related to (*per*) the number of interviewees.

FISHES		Percentages of Citations					
Folk and English Names	Scientific Names	Rejected		Avoided (*carregados*)		Recommended (*mansos*)	
		Av	**Pr**	**Av**	**Pr**	**Av**	**Pr**
Baiacu Pufferfish	*Sphoeroides* sp.		15				
Bonito Bullet mackerel or Little tunny	Several species from Scombridae	10	11	67	65		
Camburu Moray	*Gymnothorax* sp.	19					
Cavala Mackerel	*Scomberomorus cavalla*					14	
Corcoroca Tomtate	Several species from Haemulidae					18	42
Corvina Whitemouth croaker	*Micropogonias furnieri*	19	12			21	42
Enchova Bluefish	*Pomatomus saltatrix*			19	14	14	
Espada Cutlass fish	*Trichiurus lepturus*		13	19	14		
Frade Angelfish	*Pomacanthus paru*	14					
Garabebe	*Trachinotus goodei*					11	
Garoupa Grouper	*Epinephelus* sp.					25	15
Gudião Hogfish, Wrasse, Parrotfish	Species from Labridae e Scaridae	10					
Imbetara Southern kingfish	*Menticirrhus* sp.					39	23
Marimbá Spottail pinfish	*Diplodus argenteus*			15		18	
Mira Grouper	*Mycteroperca acutirostris*						36
Olho de Boi Great amberjack	*Seriola dumerili*	10		22			
Olho de Cão Bigeye	*Priacanthus* sp.					18	12
Pampo Florida pompano	*Trachinotus carolinus*					32	
Pirajica Yellow chub	*Kyphosus* sp.	10				32	20
Parati Mullet	*Mugil* sp.	29	10	78	38		

TABLE 6 (continued).

FISHES		Percentages of Citations					
Folk and English Names	Scientific Names	Rejected		Avoided (*carregados*)		Recommended (*mansos*)	
		Av	Pr	Av	Pr	Av	Pr
Sardinha Sardine	Several species of Clupeidae	10		33	17		
Taínha Mullet	*Mugil platanus*					21	
Xaréu-Preto Jack	*Caranx lugubris*			26	46		
Xerelete Bluerunner	*Caranx crysos*					43	13
Total of folk names		14	40	12	25	24	27
Interviewees		21	78	27	96	28	90

TABLE 7.— Feeding habits of fish avoided and recommended during illness according to at least 10% of interviewees from both Aventureiro and Provetá (A + P), only from Aventureiro (A) and only from Provetá (P).

Folk Names[1]	English Names	Communities	Feeding Habits[2]
Avoided (*carregado*)			
Bonito	Bullet mackerel or l Little tunny	A + P	fishes and squid
Enchova	Bluefish	A + P	fishes
Espada	Cutlass fish	A + P	fishes
Marimbá	Spottail pinfish	A	crustacea, molluscs and algae
Olho de Boi	Amberjack	A	fishes and invertebrates
Parati	Mullet	A + P	vegetal detritus
Sardinha	Sardine	A + P	plankton
Xaréu-Preto	Jack	A + P	fishes and invertebrates
Allowed (*manso*)			
Cavala	Mackerel	A	fishes and squid
Corcoroca	Tomtate	A + P	invertebrates
Corvina	Croaker	A + P	small fishes, annelids and benthonic crustacea
Enchova	Bluefish	A	fishes
Garabebe		A	small invertebrates
Garoupa	Grouper	A + P	fishes and crustacea
Imbetara	Southern Kingfish	A + P	worms and benthonic crustacea
Marimbá	Spottail pinfish	A	crustacea, molluscs and algae
Mira	Grouper	P	fishes and crustacea
Olho de Cão	Bigeye	A + P	small fishes, crustacea, molluscs
Pampo	Florida pompano	A	small fishes, molluscs, crustacea and polycheats
Pirajica	Yellow chub	A + P	vegetal matter and small invertebrates
Tainha	Mullet	A	vegetal detritus
Xerelete	Bluerunner	A + P	small fishes and invertebrates

[1]Scientific names are found on Table 4.

[2] From Figueiredo and Menezes (1978, 1980), Menezes and Figueiredo (1980, 1985) and Moyle and Cech (1982)

TABLE 8.— The most preferred and rejected game animals by interviewees from Aventureiro and Provetá: Names and percent of citations in relation to total number of interviewees.

ANIMALS Folk and English Names	Scientific Names[1]	Percentages of Citations Preferred Aventureiro	Preferred Provetá	Rejected Aventureiro	Rejected Provetá
Cutia Agouti	*Dayprocta azarae* Rodentia	68	57	12	2
Gambá Opossum	*Didelphis marsupialis* Marsupialia	59	28	29	20
Lagarto Lizard	*Tupinambis merianae* Saura	62	22	21	40
Macaco or ***Mico*** Howler monkey or Capuchin monkey	*Alouatta fuscus* or Cebus apella Primates	6		27	8
Ouriço Porcupine	*Coendou sp.* Rodentia	6	10	62	32
Paca Paca	*Agouti paca* Rodentia	91	72	3	2
Preá Cavy	*Cavia aperea* Rodentia	38	11	24	7
Rato-de-espinho Spine rat	Echimyidae Rodentia	12		3	
Tatu Nine-banded armadillo	*Dasypus novemcinctus* Xenarthra	56	31	24	19
None		9	12	21	18
All					7
Total of folk names		13	14	14	19
Interviewees		34	97	34	97

[1] Scientific names of mammals were obtained from Nowak (1991) and Emmons and Feer (1990)

(***tatu***) (*Dasypus novemcinctus*) are the most preferred game (Table 8). Nevertheless, opossum also appears among the three most rejected games in both communities, and lizard is the most avoided at Provetá. Porcupine (***ouriço***) (*Coedon* sp.) is also very avoided in both communities, and monkey (***macaco*** or ***mico***) (*Alouatta fusca* or *Cebus apella*) is the third most rejected game at Aventureiro.

Folk explanations for these taboos are based especially in appearance and in physiologic characters (digestibility): lizard is *carregado* and has snake and/or alligator shape. Monkey, when has its skin and tail taken off it, looks like a child. Porcupine (***ouriço***) is *carregado*, stinks, and during certain season of the year its thorns fall down and wounds appears on its body. Opossum is *carregado* and has a bad smell.

We also found scientific explanations to these taboos. The "drugstore hypothesis" (Begossi 1992) cited above is enough to explain why lizard and opossum are avoided: both animals are placed among the most cited ones as medicinal animals (Table 9). This explanation is based on the cost-benefit relationship (utilitarian/

materialist view). On the other hand, Sahlins (1976), who considered symbolic criteria for analyzing human behavior, has proposed that not-consumed animals are close to humanity, and consumed animals are different from human life. This symbolist view seems to be very appropriate and in close accord with the folk explanation for monkey avoidance. As in the case of fish, taboos on game consumption in Ilha Grande seem to related to both utilitarian and cognitive factors.

MEDICINAL ANIMALS

Zootherapy is an important aspect of ethnozoology and deals with animals used as medicine (Freire and Marques 1996). Recently, medicinal animals used by local populations have been recorded in Brazil (Begossi 1992, 1998; Begossi and Braga 1992; Marques 1995; Freire and Marques 1996; Souto 1996; Silva and Marques 1996). *Caiçara* knowledge about the use of medicinal animals from both Aventureiro and Provetá is listed in Table 9. Lizard (***lagarto***) and chicken (***galinha***) (*Gallus domesticus*) are the most used animals for medicinal purposes. The importance of lizard fat as medicine-therapy has been recorded in several Brazilian regions such as Paraíba (Souto 1996), Várzea do Marituba - Alagoas (Marques 1995), and Búzios island - São Paulo coast (Begossi 1992). At these last two places, chicken fat used for medicinal purpose was also recorded. In fact, fat (*banha*) is the body part cited as the most used from most of the animals cited at Ilha Grande; it is usually utilized for curing respiratory diseases, skin thorns, wounds and rheumatism at both studied communities (Table 9).

Bronchitis is usually cured through *simpatia* (beliefs). *Simpatia*, in *caiçara* terms, means that an ill person eats or drinks a processed part of an animal without knowing what she/he is taking. The part of animal (skin, heart, stings, etc) is toasted, ground and mixed in the meal or drinking water. The fact that *simpatia* raw material is characteristically burned (what eliminates the possible decomposition of organic materials), probably guarantees it does not harm the person (usually children) taking it.

The use of animals as medicine could be related to the facilities of (after the animal is killed) keeping at home its useful parts during long periods. Fat, cited as the most used part of several animals, is easily extracted and conserved at daily temperatures. All other animal parts, except eggs and milk, are processed through dehydration/sterilization (toasted), ground and can be conserved as powder until administration. This means that when some *caiçara* get sick, they do not have to leave their house to hunt medicinal animals; they already have at home animal-based medicines for use whenever it is necessary.

Recently, diversity indices have been used in studies on plant utilization, as a measure of folk knowledge, at several Atlantic forest communities (Figuereido et al. 1993, 1997; Hanazaki et al. 1996; Rossato 1996; Begossi 1996). Because *caiçaras* from Provetá have more medical assistance and are closer to Angra dos Reis (geographically, and also because they have much more boats to access the city) than people from Aventureiro, one could expect that Provetá people may lose their knowledge of native animals used as medicine. However, this expectation was not verified in our study. Although we have interviewed three times more people

TABLE 9.— Medicinal animals cited during interviews: From 29 people interviewed at Aventureiro, 4 men and 3 women knew no medicinal animal; and from 100 interviewees from Proveta , 13 men and 23 women knew none.

MEDICINAL ANIMALS		Percentage of Citations			
Folk and English Names	Scientific Names	Aventureiro	Provetá	Diseases	Utilization
Abelha Bees	Hymenoptera	3		cough	Drink orange leaf tea with **honey**
Besourinho do Mar Ray egg	?		1	bronchitis	Toasted, ground and drunk as tea
Caramujo Snail	Molluscs	3		bronchitis	?
Capivara Capybara	*Hydrochaeris hydrochaeris*		3	rheumatism liver pain bronchitis	The **fat** is applied on the affected area. ? The **skin** is toasted, ground and drunk as tea.
Cavalinho do Mar* Sea horse	*Hyppocamus reidi*	7	9	bronchitis	Toasted or sun dried, ground and drunk as tea or eaten with meals by children
Corvina tea. Croaker	*Micropogonias furnieri*		2	bronchitis	The **otolith** is toasted, ground and drunk as
Égua Female horse	*Equus caballus*	3		cough	Drink the **milk**
Galinha caipira Chicken	*Gallus domesticus*	55	21	bronchitis and other respiratory diseases rheumatism skin thorns and wounds earaches cough	The **fat** is drunk with water or massaged on chest The **fat** is applied on the affected area. The **fat** is applied on the affected area. The **fat** is put inside the ear. The yolk of an **egg** is eaten with cooked orange leaves.
Gambá Opossum	*Didelphis marsupialis*	31	6	rheumatism skin thorns and wounds earaches bronchitis	The **fat** is applied on the affected area. The **fat** is applied on the affected area. The **fat** is put inside the ear. The **fat** is drunk with water or massaged on chest

TABLE 9 (continued).

MEDICINAL ANIMALS		Percentage of Citations			
Folk and English Names	Scientific Names	Aventureiro	Provetá	Diseases	Utilization
Guaiamu*	*Cardisoma guanhumi* (?)	3	1	bronchitis	The **nails** are toasted and eaten.
Lagarto Lizard	*Tupinambis merianae*	51	37	skin thorns and wounds	The **fat** is applied on the affected area.
				rheumatism	The **fat** is applied on the affected area.
				respiratory diseases	The **fat** is drunk with water or massaged on chest or on the nose
				sore throat	The **fat** is massaged on the throat
				snake bites	The **fat** is drunk with warm water
Lula* Squid	*Loligo sp.*		8	bronchitis	The ***pena***[1] is toasted, ground and drink as tea.
Macaco Howler monkey	*Alouatta fuscus*	3		any disease	The ***pedra-da-goela***[2] is toasted and eaten.
Marimbondo Hornet	Hymenoptera		1	bronchitis	Its **house** is cooked in water. The water is filtered and drunk by children.
Ouriço* Porcupine	*Coendou sp.*	3		bronchitis	Seven **stings** are toasted and drunk with coffee.
Paca Paca	*Agouti paca*		1	wound in the breast caused by suckling	The **fat** is melted and applied on the breast.
Peixe Porco = Capucho* File fish	*Balistes capriscus*	3	11	bronchitis	The **skin** is toasted or sun dried, ground and drunk as tea or eaten with meals by children.
Peixe-boi Manatee	*Trichechus manatus*	3	3	rheumatism	The **fat** is applied on the affected area.
				skin thorns	The **fat** is applied on the affected area.
				bronchitis	?
Porco Pig	*Sus scrofa*		1	skin thorns	The **bacon** is fastened on skin thorns
Porco-do-Mato Collared peccary	*Tayassu tajacu*		1	bronchitis	?
Rã* Frog	Leptodactylidae	3	1	bronchitis and other respiratory diseases	The **skin** is toasted, ground and drunk as tea or eaten with meals

TABLE 9 (continued).

MEDICINAL ANIMALS Folk and English Names	Scientific Names	Percentage of Citations Aventureiro	Provetá	Diseases	Utilization
Tartaruga* Turtle	Cheloniidae	14	8	bronchitis	The **heart** or **liver** is toasted or sun dried, ground, and drunk with water or eaten with meals
				rheumatism	The **fat** is applied on the affected area.
				skin thorns	The **fat** is applied on the affected area.
Qualquer peixe Any fish	?		1	pain caused by skin fish-thorns	Any part of the fish should be put on the affected area to release the pain
Qualquer animal Any animal	?		1	women after childbirth who got sick after eating any *carregado* fish or animal	The spine or any bone is toasted, ground and drunk as tea.

* Beliefs (*Simpatias*): People should eat or drink it without knowing what they are taking.

[1] *Pena* is the thin flat cartilaginous structure inside squid body which strengthened its soft body

[2] *Pedra da goela* is the hyoid of the *Alouatta fusca* (Howler monkey)

at Provetá compared to Aventureiro, the richness of medicinal animals cited (17 animals at Provetá and 14 at Aventureiro) and the diversity of citation of these animals (Table 10) were not significantly different between the two communities. This fact could be explained as these two communities are located on the same island, exploit the same animal resources, and their inhabitants are associated in similar fishing activities (the sardine fishery) or related through marriages.

TABLE 10.— Diversity indices (Richness and Shannon-Wiener (H´)) based on citations of medicinal animals (folk names) during interviews.

Communities	Interviewees	Citations	Richness	Shannon-Wiener*
Aventureiro	29	57	14	2,84**
Provetá	100	112	17	3,188**

*Formula used:

H'= - S pi log pi (base 2)

where: pi = interviews' number in which an *i* animal was cited divided by the total number of quotations.

**The diversity comparision between both communities, following Magurran (1988), was not significant ($p>0.05$)

CONCLUSIONS

Throughout this paper, we presented data that supports Clement's arguments (1995) on the studies of folk classification of animals and plants: both cognitive and utilitarian factors are "aspects of the same process but on two separate levels." In some sense, we could also extend this argument to fish and game preferences and taboos, where we found both utilitarian and symbolist explanations. Rather than supporting an utilitarian/materialist or a structuralist/symbolist view, our study shows an inter-face between both points of view, which presents satisfactory explanations both for fish ethnotaxonomy as well as fish and game preferences and taboos.

Concerning the use of local knowledge in designing resource management plans, this study calls attention to the importance of a detailed investigation of local knowledge in order to avoid bias in interpreting and using of such data. Local knowledge about fish biodiversity seems an important source of information to elaborate appropriate fishery management strategies for areas adjacent to Aventureiro and Provetá, particularly for the Marine Park of Aventureiro. As well, local knowledge on the usefulness of fish and game as presented in this paper may provide for the elaboration of new regulations which should be more in tune with the local population needs, thereby increasing compliance in management. For example, despite the fact that hunting is prohibited inside the RBEPS and fishing is prohibited inside the Marine Park, compliance to the current regulation is not likely to occur voluntarily as some game and fish species are important sources for local medicine practices.

Understanding the reasons behind food preferences and taboos, the use of animals in local medicine, and the diversity of fishing resources and their classification can provide helpful information for resource managers to elaborate more ecologically sound, and socio-economically appropriate management plans.

NOTES

[1] The term "scientific names" in this paper corresponds to the names given to animals and plants according to Linnean taxonomy.

[2] There are conceptual differences regarding the use of the term "taboo." Some authors argue that taboo should only be used when religious reasons appear behind the avoidance of an item or action. Taboos associated with hot-cold syndromes might be related to Hipocratic humoral medicine. Voeks (1995) found hot-cold syndromes in the Brazilian *candomblé*; the author observed that this ancient concept is present in European and Asian health and healing theories, but it is also present in Mesoamerica's pre- Hispanich civilizations. Hot-cold syndromes are also found among Brazilian rural populations (such as the *caiçaras* of the Atlantic Forest) in referring to a *reimoso* or tabooed food (considered as hot). In this paper, we use the term taboo to refer to any avoidance of an item or action, independent of the reason behind such avoidance. This approach has been previously used by other researchers, such as Ross (1978) and Begossi (1998).

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Appendix I: Fish identification of folk genera and species cited during interviews in Ilha Grande; correspondence between *caiçaras* folk names and scientific names.

Folk Names	Family	FISHES Genera-Species	Other Folk Names
One-to-one correspondence – folk genera			
Gigante	Belonidae	*Tylosurus acus**	
Olhete	Carangidae	*Seriola lalandi*	
Olho-de-Boi[1]	Carangidae	*Seriola dumerili**	
Olhudo	Carangidae	*Caranx lalus*	
Palumbeta	Carangidae	*Chloroscombrus chrysurus*	
Sarabiguara	Carangidae	*Trachinotus falcatus*	
Dourado	Coryphaenidae	*Coryphaena hippurus*	
Pregador	Echeneidae	*Echeneis naucrates*	
Barana	Elopidae	*Elops saurus**	
Roncador	Haemulidae	*Conodon nobilis**	
Salema	Haemulidae	*Anisotremus virginicus**	
Mangorra	Holocentridae	*Holocentrus ascensionis**	
Taínha	Mugilidae	*Mugil platanus*	
Piaba	Pempherididae	*Pempheris schomburgki*	
Frade	Pomacanthidae	*Pomacanthus paru*	
Tiniúna	Pomacentridae	*Abudefduf saxatilis**	
Enchova	Pomatomidae	*Pomatomus saltatrix*	
Bijupirá	Rachycentridae	*Rachycentron canadus*	
Castanha	Sciaenidae	*Umbrina canosai*	
Corvina	Sciaenidae	*Micropogonias furnieri*	
Maria-Luisa[1]	Sciaenidae	*Paralonchurus brasiliensis*	
Xingó	Sciaenidae	*Stellifer rastrifer ****	
Cavala	Scombridae **	*Scomberomorus cavalla ***	
Cavalinha	Scombridae **	*Scomber japonicus ***	
Sororoca	Scombridae **	*Scomberomorus brasiliensis ***	
Mero	Serranidae	*Epinephelus itajara*	
Mira	Serranidae	*Mycteroperca acutirostris*	
Marimbá	Sparidae	*Diplodus argenteus**	
Pargo	Sparidae	*Pagrus pagrus*	
Espada	Trichiuridae **	*Trichiurus lepturus ***	***Peixe-espada***[2]
Cabrinha	Triglidae	*Prionotus punctatus**	
Over-differentiation type I – Folk genera/ species			
Case 1			
Carapau[3]	Carangidae	*Caranx crysos**	***Manequinho, Xerelete***
Manequinho[3]	Carangidae	*Caranx crysos**	***Carapau***
Xerelete[3]	Carangidae	*Caranx crysos ***	***Carapau***
Case 2			
Garabebê	Carangidae	*Trachinotus goodei**	***Pampo-Branco***
Pampo-Branco	Carangidae	*Trachinotus goodei**	***Garabebê***
Case 3			
Pampo	Carangidae	*Trachinotus carolinus**	
Pampo-Amarelo	?		***Pampo***

Folk Names	Family	FISHES Genera-Species	Other Folk Names
Case 4			
Xaréu[5,6]	Carangidae	*Caranx hippos C. latus*	***Xaréu-Branco***
Xaréu-Branco[6]	Carangidae	*Alectis ciliaris*	***Xaréu***
Case 5			
Gudião-Sabonete[1]	Mullidae	*Pseudupeneus maculatus**	***Sabonete***
Sabonete	Mullidae	*Pseudupeneus maculatus**	***Gudião-Sabonete***
Case 6			
Savelha	Clupeidae	*Harengula clupeola* **	
Sardinha-Cascuda	Clupeidae	*Harengula clupeola**	
Case 7			
Capucho	?		***Peixe-porco***[2]
Peixe-Porco[2]	Balistidae	*Balistes capricus*	***Capucho***
Over-differentiation type II – folk genera			
Case 1			
Camburu	Muraenidae	Several species from *Gymnothorax* genus	***Moréia***
Moréia	Muraenidae	Several species from *Gymnothorax* genus	***Camburu***
Case 2			
Imbetara	Sciaenidae	*Menticirrhus americanus* *M. littoralis*	***Papa-terra*** or ***Perna-de-moça***
Papa-terra[1]	Scianidae	*Menticirrhus americanus* *M. littoralis*	***Imbetara, Perna-de-moça***
Perna-de-Moça[1]	?		***Imbetara, Papa-terra***
Case 3			
Jaguareçá[4]	Holocentridae	*Holocentrus ascensionis*	***Sambalo, Olho de Cão, Jingolê***
Jingolê[4]	Priacanthidae	*Priacanthus arenatus* *P. cruentatus*	***Olho de Cão, Jaguareçá, Padecedo, Sambalo***
Olho-de-Cão[1,4]	Priacanthidae	*Priacanthus arenatus* *P. cruentatus*	***Jingolê, Jaguareçá, Sambalo***
Padecedo	?		***Jingolê***
Sambalo	?		***Olho-de-cão, Jaguareçá, Jingolê***
Case 4			
Parati-barbudo[1]	Polynemidae	*Polydactylus oligodon** *P. virginicus*	***Barbudo***
Barbudo	?		***Parati-barbudo***
Under-differentiation type I – folk genera			
Galo	Carangidae	*Selene setapinnis** *S. vomer*	***Peixe-Galo***[2]
Goivira	Carangidae **	Several species from *Oligoplites* genus	
Robalo	Centropomidae	Species from *Centropomus* genus	

Appendix I (continued)

Folk Names	Family	FISHES Genera-Species	Other Folk Names
Pirajica	Kyphosidae	*Kyphosus incisor** *K. sectatrix*	
Caranha	Lutjanidae	More than one species from *Lutjanus* genus	
Parati	Mugilidae	Several species from *Mugil* genus, excepting *M. platanus*	
Namorado	Mugiloididae	*Pseudopercis numida* *P. semifasciata*	
Atum	Scombridae	Species from *Thunnus* genus	
Badejo	Serranidae	Several species from *Mycteroperca* genus	
Garoupa	Serranidae	Several species from *Epinephelus* genus	
Michole	Serranidae	*Diplectrum formosum* *D. radiale*	
Bicuda	Sphyraenidae	Several species from *Sphyraena* genus	
Baiacu	Tetraodontidae	Several species from *Sphoeroides* genus	
Under-differentiation type II – folk genera			
Arraia	10 families		
Cação	13 families		
Bagre	Ariidae	Several species	
Xixarro	Carangidae	More than one genus (e.g., *Selar crumenophthalmus**)	
Sardinha	Clupeidae	Several species	
Baiacu-de-espinho[1]	Diodontidae	Several species	
Panaguaiú	Hemiramphidae	Several species	
Peixe-Agulha[2]	Hemiramphidae	Species from *Hemiramphus* and *Hyporhamphus* genera	***Agulha***
Voador	Exocoetidae	Several genera (e.g.,*Cypselurus melanurus**)	
Carapicu	Gerreidae	Name given to several species (e.g., *Eucinostomus melanopterus**)	
Caratinga	Gerreidae	Name given to several species (e.g., *Diapterus olisthostomus**)	
Emborê	Gobiidae	More than one genus	
Corcoroca	Haemulidae	More than one genus	
Sargo	Haemulidae Sparidae	*Anisotremus surinamensis** *Archosargus probatocephalus* *A. rhomboidalis*	
Emborê-Castigo[1]	Labrisomidae	More than one genus (e.g., *Labrisomus nuchipinnis**)	
Gudião	Labridae Scaridae	Several species from more than one genus from both families	
Vermelho	Lutjanidae	Several species from *Lutjanus* genus *Rhomboplites aurorubens*	

Folk Names	Family	FISHES Genera-Species	Other Folk Names
Trilha	Mullidae	*Mullus argentinae* *Upeneus parvus* **	
Linguado	Families of Pleuronectiforms	Species from more than one family	
Canguá	Sciaenidae	More than one genus	
Goete	Sciaenidae	More than one genus (e.g., *Cynoscion jamaicensis**)	
Maria-Mole[1]	Sciaenidae	Several species	
Pescada	Sciaenidae	More than one genus	
Bonito	Scombridae	More than one genus	
Serrinha	Scombridae	Several species	
Mamangaba	Scorpaenidae **	Several species	
One-to-correspondence – folk species			
Galo-da- Correição	Carangidae	*Selene setapinnis*	
Galo-Testudo	Carangidae	*Selene vomer*	
Xaréu-Preto[5]	Carangidae	*Caranx lugubris*	
Cação-Verdadeiro	Carcharhinidae	*Rhizoprionodon lalandei**	
Sardinha-do-Reino	Clupeidae	*Sardinella brasiliensis*	
Corcoroca-Bicuda	Haemulidae	*Haemulon plumieri**	
Corcoroca-Languicha	Haemulidae	*Haemulon aurolienatum**	
Gudião-Prego-de-Cobre	Labridae	*Halichoeres radiatus**	
Pescada-Branca	Sciaenidae	*Cynoscion leiarchus*	
Garopinha-São-Tomé	Serranidae	*Epinephelus morio*	
Over-differentiation – folk species			
Case 1			
Sardinha-Laje	Clupeidae	*Opisthonema oglinum* **	
Sardinha-Maromba	Clupeidae	*Opisthonema oglinum* **	
Case 2			
Corcoroca-Branca	Haemulidae	*Haemulon steindachneri* *Orthopristis ruber**	
Corcoroca-Sargo	Haemulidae	*Boridia grossidens* *Haemulon steindachneri* **	
Under-differentiation – folk species			
Cação-Anjo	Squatinidae	Species of *Squatina* genus	
Cação-Martelo	Sphyrnidae	Several species from *Sphyrna* genus	
Corcoroca-Branca	Haemulidae	*Haemulon steindachneri* *Orthopristis ruber**	
Corcoroca-Sargo	Haemulidae	*Boridia grossidens* *Haemulon steindachneri* **	

Folk Names	Family	FISHES Genera-Species	Other Folk Names
Folk genera not identified			
Cambebe	?		
Galhado	?		
Manjica	?		
Peixe-Cobra[v]	?		
Folk species not identified			
Bonito-Cadelão	?		
Cavalinha-do-Norte		?	
Gudião-Canivete	?		
Gudião-de-Ferrão	?		
Gudião-Vermelho	?		
Special case			
Languicha[7]	Haemulidae	*Haemulon aurolineatum**	*Corcoroca-Languicha*

Scientific names were first obtained from Figueiredo (1977), Figueiredo and Menezes (1978a, 1978b), and Menezes and Figueiredo (1980, 1985) including species collected and identified in this study (*), and secondly from other literature: (**) from Begossi and Figueiredo (1995) and (***) from Godoy (1987).

NOTES:

[1]Although binomials, these fish names were considered folk genera because they do not represent a variation of its against-part (e.g., ***Baiacu-de-espinho*** and ***Baiacu*** are from different families), or because they are simply complex names (e.g., ***Maria-Luiza***).

[2]*Peixe* means fish, so these are also complex names instead of real binomials; so, we also considered them as folk genus.

[3]As fishermen declared, we considered ***Manequinho***, ***Carapau*** and ***Xerelete*** as the same species: *Caranx crysos*. Thus, we did not consider *Decapterus punctatus* as ***Carapau*** (Begossi and Figueiredo 1995) but as ***Xixarro***, nor *Caranx latus* as ***Xerelete*** (Menezes and Figueiredo 1980) but as ***Olhudo***.

[4]Although ***Jaguareça*** is described in the literature as a member of the Holocentridae family (*Holoncentrus ascensionis*), we considered it as fishermen do - as the same as ***Olho-de-Cão*** and ***Jingolê*** (*Priacanthus* genus), a member of Priacanthidae family - for the reason that *Holocentrus ascensionis* were collected and identified as ***Mangorra*** - another folk name.

[5]According to fishermen, there are two types of ***Xaréu***: ***Xaréu-Preto*** and ***Xaréu-Branco***. ***Xaréu-Preto*** is cited in Menezes and Figueiredo (1980) as *Caranx lugubris* - a very rare species along the southeast Brazilian coast. However, it was many times cited during interviews.

[6]Some fishermen say ***Xaréu*** is the same as ***Xaréu-Branco***. ***Xaréu-Branco*** appears in literature as *Alectis cilliaris* (Menezes and Figueiredo 1980) and ***Xaréu*** as *Caranx hippos* (Menezes and Figueiredo 1980) and *Caranx latus* (Begossi and Figueiredo 1995). Nevertheless, *Alectis cilliaris* is quite morphologically distinct from *Caranx* species. Since *Caranx latus* were collected and identified as ***Olhudo***, we considered, as fishermen do, ***Xaréu*** and ***Xaréu-Branco*** as being the same species: *Caranx hippos*.

[7]Even ***Languicha*** is monomial written we considered it as a folk species because it is a simplification of binomial name ***Corcoroca-languicha***. One may argue that it is also the case of ***Barbudo*** and ***Parati-barbudo*** or ***Sabonete*** and ***Gudião-Sabonete***. In the former case, however, the ***Corcoroca-languicha*** is part of the scientific family (Haemulidae) which include all fish named ***Corcoroca***. In the latter cases, ***Parati-barbudo*** (Polymenidae) and ***Gudião-sabonete*** (Mulidae) are not variations in the same family of its against part ***Parati*** (Mugilidae) and ***Gudião*** (Labridae and Scaridae).

Human Impact on Ancient Environments. Charles L. Redman. 1999. University of Arizona Press, Tucson. Pp. 288, 9 photos, 46 line illustrations. ISBN: 0-8165-1963-3 ($22.96, paper); ISBN: 0-8165-1962-5 ($45.00, library cloth).

Our understanding of the relationship between people and the environment has long been in flux. In the past century alone, it has undergone a series of transformations from the environmental determinism of Ellsworth Huntington in the 1930s to the emergence of the field of human ecology in the 1970s (which has become an important component of both anthropology and archaeology), and more recently to an increasing interest on the degree to which human affairs have influenced the environment. *Human Impact* falls neatly within this latter realm. In what is less a systematic survey than an extended essay on the evidence for, and processes of, anthropogenic change, Charles Redman has not only produced an excellent introduction to this important area of study, but has demonstrated the utility of archaeological data in confronting contemporary problems: "...understanding the diversity of human environmental impacts, both sustainable and destructive, has the potential to become the hallmark of our discipline. No domain of inquiry is more appropriate for the archaeologist nor more pressing for contemporary society" (p. 6).

The title of Redman's first chapter, "Lessons from a Prehistoric 'Eden'," sets both the tone and the stage for the ensuing discussion. Here he takes as his primary example the history of Easter Island as revealed through both archaeological and paleoenvironmental studies. A forested island when colonized by Polynesians approximately 1,600 years ago underwent substantial changes in both native flora and fauna, including extensive deforestation. Although the extensive deforestation and other human impacts on Easter Island occurred perhaps far more rapidly than other locations where humans also had an impact, this example serves well to illustrate both the potential speed and totality of anthropogenic change.

The second chapter, "Attitudes toward the Environment," provides an interesting review of Western perceptions of the environment, and how they influenced the landscape. Here, the examples are drawn primarily from Greek, Roman, and Judeo-Christian sources, with important similarities and contrasts among them noted. The brief discussion includes indications on the degree of environmental impact made by Roman society, for example, as well as comments on the Christian rationale for resource exploitation. However, this review is surprisingly limited on non-Western attitudes (2 pages vs. 6 pages), with China essentially being the only example mentioned. What is missing is attention to non-Western attitudes, such as the influence of Cree worldview regarding hunting or water control through the operation of Balinese water temples. Such examples are important because they hint at the range of environmentally inclusive worldviews and behaviors that may be reflected in the archaeological record.

Aptly titled "Concepts That Organize Our Thoughts," Chapter 3 provides a valuable exposition on the basics of human ecology, which is the study of the relationship between people and their environment. Here, Redman introduces the importance of scale ("we must employ concepts to organize the complexity of the real world into manageable units" [p. 35]); ecosystem composition and operation;

and human decision-making. While there are far more detailed expositions elsewhere on each of these themes (e.g., Dincauze 2000), this chapter suffices for the purposes of the volume.

The remainder of the volume explores various aspects of past human-environmental interactions through archaeological examples drawn from around the world. The first of these, "Animal Exploitation: The Prehistoric Loss of Habitat and Biodiversity" (Ch. 4), begins by examining the relationship that humans and animals have had. It then explores three elements of this relationship in terms of human impacts on the environment: extinction, dispersal, and domestication. The discussion on extinctions is thankfully not limited to Pleistocene mega fauna (although this is included from a brief, but comparative global overview), with its primary example an extended discussion of Polynesian colonization and resource harvesting and its effects on avifauna. The expansion of the geographic range of animals, both intentionally and unintentionally influenced or induced by humans, is but one of the factors explored, which can still have far-reaching consequences (e.g., the transport of the Zebra mussels to North American waters).

Redman hits his stride in the next two chapters, "The Impact of Agrarian Systems" and "The Growth of World Urbanism"— topics that he has had long experience with. When he states that, "In looking back over the vast sweep of the human career, there probably is no greater transformation than the introduction of agriculture" (p. 81), he is referring not only to the transformation of human society, but to that of the landscape. Ranging between New World and Old World examples, Redman's discussion on the processes by which agricultural societies developed and their impact on the environment is clear, and his examples are interesting and appropriate. Ample attention is devoted not only to the usual list of settings (e.g., the Middle East, Mesoamerica), but also to the American Southwest. The dynamic relationship between the operation of large-scale societies and their environments is illustrated through both modeling and field investigations. Perhaps due to space restrictions, aspects of these chapters could have been more fully developed. There is, for example, only passing mention of *chinampas* and their impact on the extensive wetlands of Mesoamerica.

The next chapter, "Forces that Grew with Society," addresses the impacts that agricultural systems and environmental conditions had on humans, ranging from the susceptibility of individuals to malaria to the response of populations to a host of population pressures. It is the most eclectic chapter of the volume with topics ranging from Thomas Malthus and nutrition, to Mediterranean trade networks, to failed Norse colonies in Greenland. Redman pulls all of these together by noting that the various dimensions of the urban revolution — "population growth, community health, industrial production, trade, and hierarchical government"— not only contribute to social change, but also have significant environmental impacts. This last theme is continued in the final chapter of the volume, "The Past as Prologue," in which the author suggests persuasively that the knowledge that we have obtained through archaeology concerning past urban societies has much to contribute in understanding our own. The questions that he poses —"Is there a natural or 'best' environment?" "Is urban society a sustainable solution?" — are not only important, but exactly the ones we need to be asking today. Throughout both this chapter and this book, he encourages us to look at past societies to provide some of the knowledge we need today to make informed decisions as to the future.

Overall, this is a very successful book and will undoubtedly appeal to a broad readership. Not only does it deal with issues relating to the rise of urban societies, but to the larger issues of human ecosystems and anthropogenic processes. The volume could easily have been twice the length to include the wider range of human-environmental interactions once present. The relatively tight focus of the volume adds to the book's attractiveness and readability. Nonetheless, it falls short in several areas. Indigenous environmental perspectives are omitted, as is the role that small-scale societies had on the landscape. For example, there is no mention of fire-stick farming and wetland channeling in Australia, nor the effects on local vegetation of long-term harvesting wood for constructing and maintaining trackways and fish weirs in Europe and elsewhere). Obviously choices have to be made, but the omission of these types of anthropogenic factors is unfortunate nonetheless as small-scale societies were responsible for most of the archaeological record worldwide. Surprisingly, there is no mention of the application of one ancient land-altering technique, raised field farming, which has been demonstrated by Clark Erickson (1998) and others to be an important means of improving contemporary crop yields in Bolivia and Ecuador. One other minor point is that the index is not as inclusive as it should be; there is, for example, no mention of *chinampas* and many other terms found in the text.

All things considered, this is a very well written and organized book. As a general introduction to processes and effects of anthropogenic change, it succeeds admirably. Of equal importance is that Charles Redman puts his subject into context by exploring effects of human-induced environmental change upon a suite of ancient societies. In doing so, demonstrates that human activities may have profound environmental consequences, and that those consequences, in turn, provide new challenges or opportunities for future generations.

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Editor's Note: This appendix to the article by Gregory Forth was inadvertently omitted from vol. 20(2) [Winter 2000] and is here reproduced.

APPENDIX 1.—Bird Species Recorded on Sumba

The list contains species recorded at least once on Sumba according to Coates and Bishop (1997). In one case (the Common sandpiper), where Sumba is not mentioned explicitly as within the range of the species, I follow Monk et al. (1997:443). Species endemic to Sumba are marked with an asterisk.

Grebes (Podicipedidae)
Red-throated little grebe, *Tachybaptus ruficollis*

Cormorants (Phalacrocoracidae)
Little black cormorant, *Phalacrocorax sulcirostris*
Little pied cormorant, *Phalacrocorax melanoleucos*

Pelicans (Pelecanidae)
Australian pelican, *Pelecanus conspicillatus*

Herons (Ardeidae)
Grey heron, *Ardea cinerea*
Great-billed heron, *Ardea sumatrana*
Purple heron, *Ardea purpurea*
Great egret, *Egretta alba*
Intermediate egret, *Egretta intermedia*
White-faced heron, *Egretta novaehollandiae*
Little egret, *Egretta garzetta*
Pacific reef-egret, *Egretta sacra*
Cattle egret, *Bubulcus ibis*
Javan pond-heron, *Ardeola speciosa*
Little heron, *Butorides striatus*
Yellow bittern, *Ixobrychus sinensis*
Cinnamon bittern, *Ixobrychus cinnamomeus*

Ibises and spoonbills (Threskiornithidae)
Glossy ibis, *Plegadis falcinellus*
Royal spoonbill, *Platalea regia*

Hawks, eagles and allies (Accipitridae)
Osprey, *Pandion haliaetus*
Pacific baza, *Aviceda subcristata*
Black-winged kite, *Elanus caeruleus*
Black kite, *Milvus migrans*
Brahminy kite, *Haliastur indus*
White-bellied sea-eagle, *Haliaeetus leucogaster*
Short-toed eagle, *Circaetus gallicus*
Spotted harrier, *Circus assimilis*

Falcons (Falconidae)
Spotted kestrel, *Falco moluccensis*
Australian hobby, *Falco longipennis*
Peregrine falcon, *Falco peregrinus*

Whistling-ducks (Dendrocygnidae)
Wandering whistling-duck, *Dendrocygna arcuata*

Ducks (Anatidae)
Sunda teal, *Anas gibberifrons*
Pacific black duck, *Anas superciliosa*

Megapodes (Megapodiidae)
Orange-footed scrubfowl, *Megapodius reinwardt*

Quails, pheasants and allies (Phasianidae)
Brown quail, *Coturnix ypsilophora*
Blue-breasted quail, *Coturnix chinensis*
Green junglefowl, *Gallus varius*

Buttonquails (Turnicidae)
Red-backed buttonquail, *Turnix maculosa*
Sumba buttonquail, *Turnix everetti**

Rails (Rallidae)
Buff-banded rail, *Gallirallus philippensis*
Ruddy-breasted crake, *Porzana fusca* [recorded once]
White-browed crake, *Poliolimnas cinerea*
White-breasted waterhen, *Amaurornis phoenicurus*
Dusky moorhen, *Gallinula tenebrosa*
Common moorhen, *Gallinula chloropus*
Purple swamphen, *Porphyrio porphyrio*

Jacanas (Jacanidae)
Comb-crested jacana, *Irediparra gallinacea*

Stilts and avocets (Recurvirostridae)
Black-winged stilt, *Himantopus himantopus*

Plovers (Charadriidae)
Little ringed plover, *Charadrius dubius*
Malaysian plover, *Charadrius peronii*
Oriental plover, *Charadrius veredus*

Sandpipers, snipes and allies (Scolopacidae)
Little curlew, *Numenius minutus*
Eurasian curlew, *Numenius arquata*
Common redshank, *Tringa totanus*
Marsh sandpiper, *Tringa stagnatilis*
Common sandpiper, *Actitis hypoleucos*

Great knot, *Calidris tenuirostris*
Sanderling, *Calidris alba*
Curlew sandpiper, *Calidris ferruginea*
Broad-billed sandpiper, *Limicola falcinellus*

Pratincoles (Glareolidae)
Australian pratincole, *Stiltia isabella*
Oriental pratincole, *Glareola maldivarum*

Terns (Laridae, sub-family Sterninae)
Whiskered tern, *Chlidonias hybridus*
White-winged black tern, *Chlidonias leucopterus*
Gull-billed tern, *Gelochelidon nilotica*
Common tern, *Sterna hirundo*
Black-winged tern, *Sterna sumatrana*
Little tern, *Sterna albifrons*
Brown noddy, *Anous stolidus*

Pigeons and doves (Columbidae)
White-throated pigeon, *Columba vitiensis*
Spotted dove, *Streptopelia chinensis*
Little cuckoo-dove, *Macropygia ruficeps*
Emerald dove, *Chalcophaps indica*
Barred dove, *Geopelia maugei*
Nicobar pigeon, *Caloenas nicobarica*
Sumba green pigeon, *Treron teysmannii**
Red-naped fruit-dove, *Ptilinopus dohertyi**
Black-naped fruit-dove, *Ptilinopus melanospila*
Green imperial pigeon, *Ducula aenea*

Parrots, loris and cockatoos (Psittacidae)
Rainbow lorikeet, *Trichoglossus haematodus*
Yellow-crested cockatoo, *Cacatua sulphurea*
Eclectus parrot, *Eclectus roratus*
Red-cheeked parrot, *Geoffroyus geoffroyi*
Great-billed parrot, *Tanygnathus megalorhynchos*

Old world cuckoos (Cuculidae)
Oriental cuckoo, *Cuculus saturatus*
Rusty-breasted cuckoo, *Cacomantis sepulcralis*
Shining bronze cuckoo, *Chrysococcyx lucidus*
Australian koel, *Eudynamys cyanocephala*
Channel-billed cuckoo, *Scythrops novaehollandiae*

Coucals (Centropodidae)
Lesser coucal, *Centropus bengalensis*

Barns owls (Tytonidae)
Barn owl, *Tyto alba*
Eastern grass owl, *Tyto longimembris*

Typical owls (Strigidae)
Sumba boobook, *Ninox rudolfi**

Nightjars (Caprimulgidae)
Large-tailed nightjar, *Caprimulgus macrurus*
Savanna nightjar, *Caprimulgus affinis*

Swifts and swiftlets (Apopidae)
Edible-nest swiftlet, *Collocalia fuciphaga*
Glossy swiftlet, *Collocalia esculenta*
Fork-tailed swift, *Apus pacificus*
Little swift, *Apus affinis*

Wood kingfishers (Halcyonidae)
Collared kingfisher, *Halcyon chloris*
Cinnamon-banded kingfisher, *Halcyon australasia*

Small kingfishers (Alcedinidae)
Oriental dwarf kingfisher, *Ceyx erithacus*
Common kingfisher, *Alcedo atthis*

Bee-eaters (Meropidae)
Blue-tailed bee-eater, *Merops superciliosus*
Rainbow bee-eater, *Merops ornatus*

Rollers (Coraciidae)
Common dollarbird, *Eurystomus orientalis*

Hornbills (Bucerotidae)
Sumba hornbill, *Rhyticeros everetti**

Pittas (Pittidae)
Elegant pitta, *Pitta elegans*

Larks (Alaudidae)
Australian bushlark, *Mirafra javanica*

Swallows and martins (Hirundinidae)
Barn swallow, *Hirundo rustica*
Pacific swallow, *Hirundo tahitica*
Striated swallow, *Hirundo striolata*
Tree martin, *Hirundo nigricans* [recorded once]
Fairy martin, *Hirundo ariel* [recorded once]
Wagtails and pipits (Motacillidae)
Yellow wagtail, *Motacilla flava*
Grey wagtail, *Motacilla cinerea*
Richard's pipit, *Anthus novaeseelandiae*
Pechora pipit, *Anthus gustavi*

Cuckoo-shrikes and trillers (Campephagidae)

Wallacean cuckoo-shrike, *Coracina personata*
Black-faced cuckoo-shrike, *Coracina novaehollandiae*
Pale-shouldered cicadabird, *Coracina dohertyi*
White-shouldered triller, *Lalage sueurii*

Drongos (Dicruridae)
Wallacean drongo, *Dicrurus densus*

Orioles (Oriolidae)
Black-naped oriole, *Oriolus chinensis*

Crows (Corvidae)
Large-billed crow, *Corvus macrorhynchos*

Tits (Paridae)
Great tit, *Parus major*

Thrushes and chats (Turdidae)
Chestnut-backed thrush, *Zoothera dohertyi*
Pied chat, *Saxicola caprata*
Old world warblers (Sylviidae)
Clamorous reed-warbler, *Acrocephalus stentoreus*
Arctic warbler, *Phylloscopus borealis*
Tawny grassbird, *Megalurus timoriensis*

African warblers (Cisticolidae)
Zitting cisticola, *Cisticola juncidis*

Old world flycatchers (Muscicapidae)
Russet-backed jungle-flycatcher, *Rhinomyias oscillans*
Asian brown flycatcher, *Muscicapa dauurica*
Sumba flycatcher, *Ficedula harterti**

Monarch flycatchers (Monarchidae)
Asian paradise flycatcher, *Terpsiphone paradisi*
Spectacled monarch, *Monarcha trivirgatus*
Broad-billed flycatcher, *Myiagra ruficollis*

Fantails (Rhipiduridae)
Rufous fantail, *Rhipidura rufifrons*

Australian robins (Petroicidae)
Grey-headed flycatcher, *Culicicapa ceylonensis*

Whistlers (Pachycephalidae)
Common golden whistler, *Pachycephala pectoralis*

Wood swallows (Artamidae)
White-breasted wood-swallow, *Artamus leucorynchus*

Shrikes (Laniidae)
Brown shrike, *Lanius cristatus*

Starlings and mynas (Sturnidae)
Short-tailed starling, *Aplonis minor*
White-vented myna, *Acridotheres cinereus*

Honeyeaters (Meliphagidae)
Helmeted friarbird, *Philemon buceroides*
Brown honeyeater, *Lichmera indistincta*
Red-headed honeyeater, *Myzomela erythrocephala*

Sunbirds (Nectariniidae)
Brown-throated sunbird, *Anthreptes malacensis*
Apricot-breasted sunbird, *Nectarinia buettikoferi**

Flowerpeckers (Dicaeidae)
Thick-billed flowerpecker, *Dicaeum agile*
Blood-breasted flowerpecker, *Dicaeum sanguinolentum*

White-eyes (Zosteropidae)
Yellow-spectacled white-eye, *Zosterops wallacei*
Ashy-bellied white-eye, *Zosterops citrinellus*

Sparrows, weavers and estrildine finches (Passeridae)
Tree sparrow, *Passer montanus*
Red avadavat, *Amandava amandava*
Zebra finch, *Taeniopygia guttata*
Black-faced munia, *Lonchura molucca*
Scaly-breasted munia, *Lonchura punctulata*
Five-coloured munia, *Loncura quinticolor*
Pale-headed munia, *Lonchura pallida*

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