

## 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, ethnecology.

**RESUMEN.**— Los indígenas Matsigenka (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 Matsigenka 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 Matsigenka 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 matsigenka 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 forêt 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 ethnobiologistes, 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.<sup>1</sup> 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 annatto (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

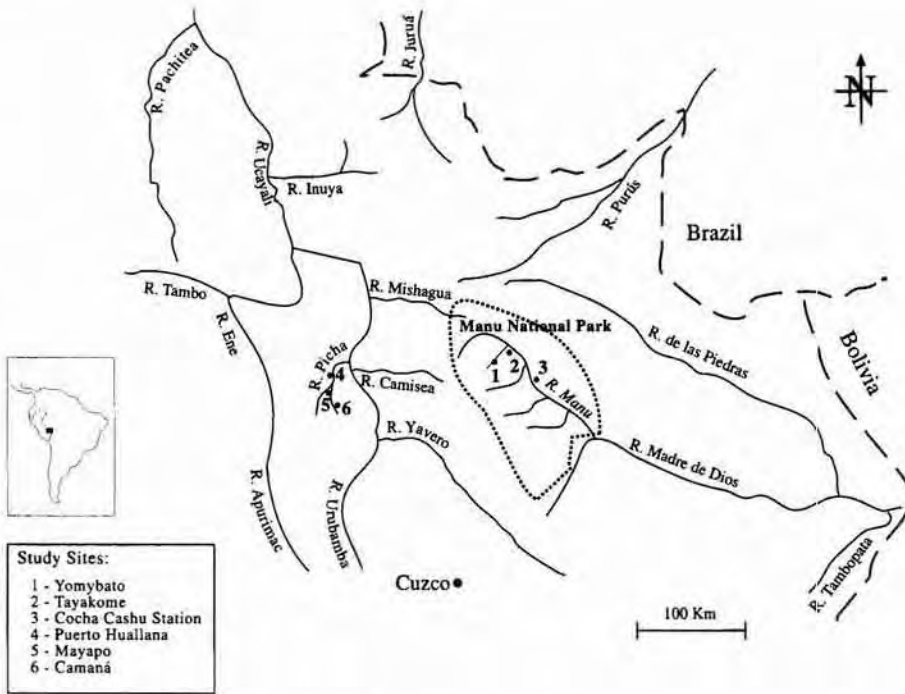


FIGURE 1.— Study area, Southeast Peru

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). Voucher 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<sup>2</sup> 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	<i>Ovogeshi</i>	'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	<i>otsegoa</i>	'branch': seasonally flooded island, branch of river	<i>Cecropia</i> spp. ( <i>tonko</i> , <i>inkona</i> ), <i>Ochroma</i> ( <i>paroto</i> )
T2	<i>imparage</i>	open beach or wide stream bed with sparse vegetation	Sandy beach: <i>Tessaria</i> ( <i>impomeri</i> ), <i>Gynerium</i> ( <i>savoro</i> ) Rocky beach, stream beds: <i>Calliandra</i> ( <i>kovanti</i> ), <i>Crenea</i> ( <i>pantyoporoki</i> ), <i>Cassia</i> ( <i>pochokiroshi</i> ), <i>Senna herzogii</i> ( <i>shimashiri</i> )
T3	<i>oaaku</i> , <i>otapiku</i>	'on the water': at water's edge 'on the bank': on or near river / stream bank	Along rivers: <i>Cecropia</i> , <i>Ochroma</i> , <i>Ficus</i> ( <i>potogo</i> ), <i>Cedrela</i> ( <i>santari</i> ), <i>Guadua</i> ( <i>kapiro</i> , <i>yaivero</i> ), <i>Urera</i> ( <i>tanko</i> ) Along streams: <i>Macrocnemum</i> ( <i>niapashi</i> ), <i>Inga</i> ( <i>intsipa</i> ), <i>Aulonemia</i> ( <i>samatsi</i> ), <i>Cyathea</i> ( <i>tinkanari</i> )
T4	<i>osateni</i>	'where water gathers': seasonal canal, depression in floodplain	<i>Heliconia</i> ( <i>sagonto</i> ), <i>Bactris</i> ( <i>shianti</i> ), lianas ( <i>shivitsasemai</i> ), tangled vegetation ( <i>narongashi</i> )
T5	<i>otonkoatera</i> <i>ovogeshiku</i>	'hill in floodplain': levee island	Floodplain near river on small rise forming island when river floods: <i>Cedrela</i> ( <i>santari</i> ), <i>shinkipini</i> (?)
T6	<i>nigankivoge</i>	'middle of bend': central floodplain at medium distance from river	Mature (late successional) floodplain forest, characterized by large trees: <i>Ceiba pentandra</i> ( <i>pasaro</i> ), <i>Gallesia integrifolia</i> ( <i>shitiro</i> ), <i>Dipteryx polyphylla</i> ( <i>pageroroki</i> ), <i>Sloanea</i> sp. ( <i>terorivanteki</i> )
T7	<i>choeni ovogeshi</i> , <i>choeni otishi</i>	'a little floodplain, a little upland': transitional zone from floodplain to uplands	Mixed floodplain/upland elements; palms <i>Attalea butyracea</i> ( <i>shevo</i> ), <i>Socratea salazarii</i> ( <i>kompapari</i> ), <i>Wettinia</i> ( <i>kepito</i> ) are indicators of transition to uplands
T8	<i>ovogeshi niateni</i>	'stream floodplain': large stream gallery forest	Floodplain, gallery, upland elements condensed into a narrow floodplain
T9	<i>niateniku</i>	'along the stream': small stream gallery forest	Tree ferns ( <i>tinkanari</i> ), <i>Socratea exorrhiza</i> ( <i>vakirintsi</i> ), <i>Macrocnemum roseum</i> ( <i>niapashi</i> )
T10	<i>inkaare</i>	lake/swamp, general term; types distinguished according to size, proximity to river, permanence and vegetation	Oxbow lake: aquatic grasses ( <i>sampetashi</i> , <i>kentakorishi</i> ), <i>Ludwigia</i> ( <i>yogetsapini</i> ), <i>Renealmia</i> ( <i>porenki</i> ) 'Renacal' swamp: <i>Ficus trigona</i> ( <i>tiiroki</i> )

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	<i>Nigankipatsa</i> , <i>Otishinapatsa</i>	'Middle earth' (between river basins), 'hilly earth'	Uplands, interfluvium ( <i>terra firme</i> ), general terms; also any uplands not included in a specific biotic/abiotic habitat type
(T10)	<i>inkaare</i>	lake/swamp (see Table 1)	Upland palm swamp: <i>Mauritia</i> ( <i>koshi</i> ), <i>Oenocarpus</i> ( <i>sega</i> ), <i>Euterpe</i> ( <i>tsireri</i> ) Seasonal upland swamp/lake: <i>Diplasia</i> ( <i>imere</i> ), aquatic grasses, ( <i>sampetashi</i> ), <i>Inga</i> sp. ( <i>intsipa</i> ), <i>Mauritia</i> ( <i>koshi</i> ), ant gardens ( <i>sakaropini</i> ) <i>Socratea exorrhiza</i> ( <i>vakirintsi</i> ), <i>Diplasia</i> ( <i>imere</i> ), <i>Mauritia</i> ( <i>koshi</i> ), <i>Cyathea</i> tree ferns ( <i>tinkanari</i> ), <i>Oenocarpus</i> ( <i>sega</i> )
T11	<i>osatani niateni</i>	'stream depression': swampy, ephemeral stream headwaters in poorly drained uplands	
T12	<i>pampa</i>	'flat area': especially flat uplands, alluvial terrace	In uplands, usually with understory palms <i>Wettinia</i> ( <i>kepito</i> ), <i>Socratea salazarii</i> ( <i>kompapari</i> ), and/or <i>Geonoma</i> spp. ( <i>chogina</i> , <i>tsikero</i> , <i>memerishi</i> )
T13	<i>agiringira</i> , <i>otonkoatera</i>	down slope, up slope (depending on speaker's perspective)	Slope specialists: <i>Aulonemia</i> bamboo ( <i>samatsi</i> ), <i>Styloceras</i> , ( <i>pompoki</i> ), <i>Phytelephas</i> ( <i>kompipo</i> ), <i>Sagotia</i> ( <i>kovuvapini</i> )
T14	<i>otishi</i>	'hill': hill crest, ridge, mountain	Slope specialists; montane vegetation
T15	<i>imperita</i>	cliff, rocky outcrop; also uplands ( <i>terra firme</i> ) on cliff adjacent to river	Cliff: secondary growth, slope specialists: <i>Erythrina</i> spp. ( <i>taiiri</i> , <i>songaare</i> ), <i>Cecropia</i> spp. ( <i>tonko</i> , <i>yaaro</i> ) Rocky outcrop: ferns ( <i>tsirompi</i> ), orchids and bromeliads ( <i>ananta</i> ), moss ( <i>tagamu</i> ) Uplands adjacent to cliff: Upland forest ( <i>nigankipatsa</i> )
T16	<i>okonteaatira</i>	spring, waterfall	Ferns ( <i>tsirompi</i> ), bromeliads ( <i>ananta</i> ), moss ( <i>tagamu</i> )
T17	<i>oyashiaku</i>	headwaters; higher-elevation foothills, transition to montane habitat	Stream headwaters: small stream gallery forest, slope and rock specialists; higher-elevation species: <i>Hyospathe</i> (?) palm ( <i>kapashi</i> ), yellow <i>Guadua</i> bamboo ( <i>kiteri kapiro</i> )
T18	<i>otishipaketira</i>	'many hills': Andean foothills	Montane vegetation (above 600 m); see Table 10
T19	<i>omarani otishi</i> / <i>chovivanteni otishi</i>	'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...'): *otarakira*, 'the place where a cliff has eroded'; *omakaramangaitira*, 'the place where the soil is crunchy and has long hair' (i.e., accumulated *Spagnum* 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 ovogeshilchoeni 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<sup>3</sup> 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	<i>Karapage</i>	'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 ( <i>Saangariite</i> )
D1	<i>apamankera nia</i>	'place of inundation, flooding'	Area subjected to flooding during rainy season, floodplain ( <i>ovogeshi</i> ) as well as upland swamps and rainwater lakes ( <i>inkaare</i> ); vegetation determined by frequency and severity of flooding: <i>pairani apamankera</i> , 'flooded long ago'; <i>choeni apamankera</i> , 'floods a little'; <i>magatiro apamankera</i> , 'floods everything'; <i>osateni</i> , 'water gathers', i.e., standing water during rainy season; <i>okenati nia</i> , 'river runs through it', i.e., seasonal canal, or permanent cut-off of meander loop
D2	<i>otarankira</i>	'place of erosion': landslide, cliff	Secondary growth: <i>Cecropia</i> spp. ( <i>yaaro</i> , <i>tonko</i> , <i>inkona</i> ), <i>Erythrina</i> spp. ( <i>taiiri</i> , <i>songaare</i> ), lianas ( <i>shivitsasemai</i> ), tangled growth ( <i>narongashi</i> )
D3	<i>oterongera inchato</i>	'where a tree fell over'	Gaps caused by tree falls; recent gaps have weeds ( <i>tovaseri</i> ), tangled growth ( <i>narongashi</i> ), vines and lianas ( <i>shivitsasemai</i> ); older gaps have <i>Cecropia sciadophylla</i> ( <i>yaaro</i> ), <i>Capirona</i> ( <i>kapirona</i> ), other pioneer species
D4	<i>potagarine</i>	'burnt hillside'	Hillsides at high elevations with moss ( <i>kamu</i> ), ferns ( <i>tsirompi</i> ) or grass ( <i>shimpenashi</i> ) showing signs of disturbance by fire
D5	<i>tsamairentsi</i>	'place of work,' new swidden garden	Recently cleared and planted swidden, actively weeded (1-2 years)
D6	<i>magashipogo</i>	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: <i>Bactris gasipaes</i> ( <i>kuiri</i> ), <i>Inga edulis</i> ( <i>intsipa</i> ), <i>Bixa orellana</i> ( <i>potsoi</i> ), <i>Tephrosia</i> ( <i>kogi</i> )
D7	<i>pairani magashipogo</i>	old swidden fallow	Mature secondary or "primary" forest regrown from old or ancient swidden fallow; recognized by historical knowledge, secondary growth ( <i>Cecropia</i> , etc.) or by presence of hardy cultigens like ayahuasca ( <i>Banisteriopsis</i> , <i>kamarampi</i> ) barbasco ( <i>Tephrosia</i> , <i>kogi</i> )
D8	<i>inchatoshi</i>	'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 <i>jenkivane</i>	sandy loam	Preferred for manioc, barbasco fish poison; found especially in flat uplands ( <i>pampa</i> )
S2 <i>potsitapatsa</i>	'black earth': river sediments, humus	Preferred for peanuts and plaintains; found in river and stream flood plain ( <i>ovogeshi</i> )
S3 <i>kiteri kipatsi</i>	'yellow earth': yellow (ferralitic?) soils	Suited for agriculture but not ideal; found in uplands, hills ( <i>otishi</i> )
S4 <i>impaneke</i>	sand, beach	Preferred for watermelons, peanuts; aquatic beach vegetation: <i>Tessaria</i> ( <i>impomeri</i> ), <i>Gynerium</i> ( <i>savoro</i> )
S5 <i>sokopane</i> with	white sand soils	Agricultural suitability unknown; rare in uplands, white sand soils  small trees ( <i>otyomiaige inchato</i> ), lianas ( <i>shivitsasemai</i> ), <i>Oenocarpus</i> ( <i>sega</i> )
S6 <i>kiraapatsa</i>	'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 ( <i>otishi</i> ); stream floodplains ( <i>niateniku</i> ), animal mineral licks ( <i>itsimini</i> )
S7 <i>kusomiriakipatsa</i>	'hard lumpy earth': i.e., contractile clay soil	Clay soil that forms hard lumps when dry, poor for agriculture; with <i>Guadua</i> sp. ( <i>yaiveroshi</i> ), animal mineral licks ( <i>itsimini</i> )
S8 <i>inkaarepatsa</i> , <i>jampovatsa</i>	'swamp/lake earth': mud 'mud'	Poor for agriculture; swamp vegetation: <i>Mauritia</i> ( <i>koshi</i> ), <i>Ficus trigona</i> ( <i>tiiroki</i> ), <i>Diplasia</i> ( <i>imere</i> ), grasses ( <i>sampetashi</i> , <i>kentakorishi</i> ), <i>Renealmia</i> ( <i>porenki</i> ), other aquatics
S9 <i>mapuseku</i>	rocky soil	Usually poor for agriculture, except in slightly to moderately rocky uplands; beach vegetation: <i>Cassia</i> ( <i>pochokirontoshi</i> ), <i>Senna</i> ( <i>shimashiri</i> ), <i>Tessaria</i> ( <i>impomeri</i> ); extremely rocky soils in uplands: lianas ( <i>shivitsa</i> ), small trees ( <i>otyomiaige inchato</i> ); rocky hillsides, stream banks: moss ( <i>tagamu</i> ), ferns ( <i>tsirompi</i> ), orchids and bromeliads ( <i>ananta</i> )
S10 <i>omakaramangaitira</i>	'crunchy long-haired soil': i.e., thick accumulation of moss (poor for agriculture)	Agricultural suitability unknown; montane, cloud forest with moss ( <i>tagamu</i> ), ferns ( <i>tsirompi</i> ), orchids and bromeliads ( <i>ananta</i> )

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 (*impaneke*, 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 'phyto-architecture' (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	<i>tirotishi</i>	<i>Astrocaryum murumuru</i> forest	Floodplain only, where <i>A. murumuru</i> ( <i>tiroti</i> ) is common, sometimes dominant in understory	edible endocarp, palm heart; palm weevils
2	<i>shevoshi</i>	<i>Attalea butyracea</i> forest	Transition from floodplain to uplands	roof thatch
3	<i>tsigaroshi</i>	<i>Attalea phalerata</i> forest	Floodplain only, <i>A. phalerata</i> ( <i>tsigaro</i> ) often occurs in stands	edible endocarp, heart; palm weevils; thatch
4	<i>kontashi</i>	<i>Attalea tesmannii</i> forest	Rare, patchy, occurs along stream banks	edible endocarp; mesocarp carved for pipes, ornaments
5	<i>shiantishi</i>	<i>Bactris concinna</i> forest	Dense stands of spiny <i>B. concinna</i> ( <i>shianti</i> ) along seasonally waterlogged canals, depressions ( <i>osateni</i> ), especially in floodplain	edible mesocarp
6	<i>tsirerishi</i>	<i>Euterpe precatoria</i> forest	<i>E. precatoria</i> var. <i>precatoria</i> ( <i>tsireri</i> ), var. <i>longevaginata</i> ( <i>suana</i> ) stands in poorly drained uplands, w/ <i>Oenocarpus</i> ( <i>sega</i> ), <i>Mauritia</i> ( <i>koshi</i> )	edible mesocarp, heart
7	<i>tsikeroshi</i> / <i>choginashi</i>	<i>Geonoma deversa</i> forest	Flat uplands with dense understory of <i>Geonoma deversa</i> ( <i>tsikero</i> / <i>chogina</i> )	thatch
8	<i>tyonkintoshi</i> / <i>chigeroshi</i>	<i>Geonoma maxima</i> forest	Flat uplands with dense understory of <i>Geonoma maxima</i> ( <i>tyonkinto</i> / <i>tsikero</i> )	thatch
9	<i>memerishi</i> / <i>metakishi</i>	<i>Geonoma brongniartii</i> forest	Hilly uplands, higher elevations, dense understory of <i>Geonoma brongniartii</i> ( <i>metakishi</i> )	thatch
10	<i>kapashi</i>	<i>Hyospathe</i> (?) sp. forest	Hill crests at higher elevations, dense understory of <i>Hyospathe</i> (?) sp. ( <i>kapashi</i> )	thatch
11	<i>kamonashi</i>	<i>Iriarte deltoidea</i> forest	Common in floodplain and uplands, <i>I. deltoidea</i> ( <i>kamona</i> ) occurs in stands especially in floodplains	palm heart; palm weevils; trunk: keg for manioc beer
12	<i>koshishi</i> / <i>toturokishi</i>	<i>Mauritia flexuosa</i> forest	Swamps ('aguajal') dominated by <i>M. flexuosa</i> ( <i>koshi</i> , <i>toturoki</i> ) in floodplain or wet uplands	edible mesocarp; important habitat for hunting
13	<i>kinirishi</i>	<i>Mauritiella</i> sp. forest	Swamps with <i>Mauritiella</i> sp. ( <i>kiniri</i> ), <i>S. exorrhiza</i> ( <i>kontiri</i> ), <i>Euterpe</i> ( <i>tsireri</i> ); not found in Manu	edible mesocarp; important habitat for hunting
14	<i>segashi</i>	<i>Oenocarpus bataua</i> forest	<i>O. bataua</i> ( <i>sega</i> ) in swampy uplands, sometimes with <i>Mauritia</i> ( <i>koshi</i> ) or <i>Euterpe</i> ( <i>tsireri</i> ); also on white sand ( <i>sokopane</i> ), montane forest near lakes	edible mesocarp, heart; meristem fibers used as kindling
15	<i>kompirosi</i>	<i>Phytelephas macrocarpa</i> forest	Especially on hill crests, also in floodplain	edible immature endocarp
16	<i>vakirintsishi</i> / <i>kontirishi</i>	<i>Socratea exorrhiza</i> forest	Moist areas, especially stream gallery forest and stream headwaters	spiny aerial root used as coarse grater
17	<i>kompaparishi</i> / <i>konkapparishi</i>	<i>Socratea salazarii</i> forest	Widespread in uplands, especially flat areas	spiny aerial root used as fine grater; temporary thatch
18	<i>kepitoshi</i>	<i>Wettinia augusta</i> 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 <i>samatsishi</i>	<i>Aulonemia</i> sp. forest	Forest dominated by non-spiny bamboo <i>Aulonemia</i> ( <i>samatsi</i> ), uplands and slopes
20 <i>songarentsishi</i>	<i>Chusquea</i> spp., <i>Olyra</i> spp. forest	On slopes, also montane; small bamboo species ( <i>songarentsi</i> )
21 <i>manipishi</i>	<i>Guadua angustifolia</i> forest	Single species stands of large diameter, spiny bamboo <i>G. angustifolia</i> ( <i>manipi</i> ) near river margin
22 <i>kapiroshi</i>	<i>Guadua weberbaueri</i> forest	Forest dominated by spiny bamboo <i>G. weberbaueri</i> ( <i>kapiro</i> ); occurs in large areas in floodplain and uplands
23 <i>yaiveroshi</i>	<i>Guadua glomerata</i> forest	Low canopy forest dominated by spiny bamboo <i>Guadua glomerata</i> ( <i>yaivero</i> ); floodplain only, especially on clay soils
24 <i>shinkeroshi</i>	<i>Guadua</i> sp. forest	Forest dominated by spiny bamboo <i>Guadua</i> sp. ( <i>shinkerokota</i> ); uplands only

(*kompishoshi*, 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 considered 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	<i>tinkanarishi</i>	<i>Cyathea</i> spp. (tree fern) forest	Tree fern ( <i>tinkanari</i> ) found in dense to diffuse stands along stream beds, in stream gallery forest; also montane
26	<i>tsirompishi</i>	Pteridophyta (fern) stands	Patches of miscellaneous fern species in moist or rocky areas in stream gallery forest, uplands; also montane
27	<i>itsirianeshi</i> <i>matsontsori</i>	<i>Aechmea</i> sp. forest (‘jaguar’s pineapple plantation’)	Small, dense stands of pineapple-like Bromeliad <i>Aechmea</i> ( <i>itsiriane matsontsori</i> , ‘jaguar’s pineapple’) in understory
28	<i>imereshi</i>	<i>Diplasia</i> sp. forest	In moist to swampy areas, understory with <i>Diplasia</i> ( <i>imere</i> ), also known as <i>saviripini</i> , ‘machete plant’ due to its sharp edges
29	<i>savoroshi</i>	<i>Gynerium saccharoides</i> stand	Common beach, river bank vegetation, cane thicket often just behind <i>Tessaria</i> ( <i>impomerishi</i> ) zone
30	<i>chakopishi</i>	<i>Gynerium sagittatum</i> stand	Less common, beach vegetation along upper river course, also planted in old gardens; reed for arrow shafts ( <i>chakopi</i> )
31	<i>sagontoshi</i>	<i>Heliconia metallica</i> forest	In floodplain, especially in seasonal canals, depressions between levee islands
32	<i>tsipanashi</i>	Marantaceae spp. forest	Floodplain, uplands near streams; <i>Ichnosiphon</i> , <i>Calathea</i> , other Marantac spp. leaves ( <i>tsipana</i> ) used to steam food
33	<i>shimpenashi</i> , <i>tiposhi</i>	Poaceae spp. (grasslands)	Grass and small bamboo species <i>Paspalum</i> ( <i>shimpenashi</i> ), <i>Pariana</i> ( <i>tiposhi</i> ) in permanent clearings, on eroded slopes; (also montane, Andean ‘pajonal’ grasslands; Table 10)
34	<i>sampetashi</i> / <i>kentakorishi</i>	Poaceae spp. (aquatic grasses)	Aquatic vegetation in lakes, swamps
35	<i>porenkishi</i>	<i>Renealmia</i> sp. stand	Edge of swamps, lakes; aquatic weeds: ginger-like <i>Renealmia</i> ( <i>porenki</i> ), fuchsia-like <i>Ludwigia</i> ( <i>yogetsapini</i> )
36	<i>impomerishi</i>	<i>Tessaria integrifolia</i> stand	Open beach vegetation, sometimes with <i>Senna</i> ( <i>shimashiri</i> ); before <i>Gynerium</i> ( <i>savoroshi</i> ) 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* (*kuvuvapishi*, 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 with two small Clusiaceae tree species, *Chrysoclamys ulei* (*kachopitokishi*, ref. 43) and *Tovomita weddelliana*

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	<i>matsityananashi</i>	<i>Alibertia pilosa</i> forest	Floodplain near river; open understory w/ <i>A. pilosa</i> ( <i>matsityanana</i> ), <i>Randia armata</i> ( <i>kitsogirontsipini</i> ), <i>Psychotria</i> sp. ( <i>orovampashi</i> ), <i>Phytelephas</i> ( <i>kompiro</i> )
38	<i>toaroshi</i>	<i>Apuleia leiocarpa</i> forest	Uplands, near streams or in old disturbed areas
39	<i>kovantishi</i>	<i>Calliandra amazonica</i>	Along steep, rocky banks of tributary rivers, large streams; branches of <i>C. amazonica</i> ( <i>kovanti</i> ) hang over water
40a	<i>setikoshi</i> / <i>inkonashi</i>	<i>Cecropia membranacea</i> forest	Floodplain by river; first stage of forest succession after beach, some times with <i>Ochroma lagopus</i> ( <i>paroto</i> ), <i>Tachigali</i> spp. ( <i>makotaniro</i> ), <i>Triplaris americana</i> ( <i>kanai</i> )
40b	<i>tonkoshi</i>	<i>Cecropia polystachya</i> forest	Branch islands, disturbed areas along river or stream; much like <i>C. membranacea</i> ( <i>setikoshi</i> ), sometimes used interchangeably with <i>setikoshi</i>
41	<i>santarishi</i> / <i>santavirishi</i>	<i>Cedrela odorata</i> forest	Successional forest on levee island or by river, often with <i>Ficus</i> spp. ( <i>potogo</i> )
42	<i>pariashi</i>	<i>Cedrela caeteniformis</i> forest	Flat uplands, diffuse stand (old seed shadow?) of canopy tree <i>C. caeteniformis</i> ( <i>paria</i> ) with dense palm understory
43	<i>kachopitokishi</i>	<i>Chrysoclamys</i> cf. <i>ulei</i> forest	On slopes at higher elevations near stream headwaters; understory of <i>C. ulei</i> ( <i>kachopitoki</i> ), <i>Tovitoma weddelliana</i> ( <i>tegarintsipini</i> ) and <i>Wettinia augusta</i> ( <i>kepito</i> )
44	<i>piamentsishi</i> / <i>pakitsashi</i>	<i>Clavija</i> cf. <i>longifolia</i> forest ('bow plant', 'eagle plant')	On slopes with <i>Aulonemia</i> ( <i>samatsi</i> ), stands of understory treelet <i>C. longifolia</i> used as hunting medicine
45	<i>taiirishi</i> , <i>songaareshi</i>	<i>Erythrina</i> spp. forest	Successional growth on river bank, eroding cliffs: <i>Erythrina</i> spp. ( <i>taiiri</i> [orange flowers]; <i>songaare</i> [purple]), also <i>Luehea</i> sp. ( <i>koshirite</i> ), <i>Cassia/Senna</i> spp. ( <i>shimashiri</i> )
46	<i>potogoshi</i>	<i>Ficus</i> spp. forest (especially <i>F. insipida</i> )	Successional forest by river or stream, often with <i>Cedrela</i> ( <i>santari</i> ), just beyond beach or <i>Cecropia</i> ( <i>inkona</i> ) zone
47	<i>tirokishi</i>	<i>Ficus trigona</i> swamp	Floodplain swamp ('renacal') dominated by <i>F. trigona</i> ( <i>tiiroki</i> ), other aquatic species
48	<i>koñorishi</i> / <i>konorishi</i>		<i>Hevea brasiliensis</i> forest Flat uplands, palm understory, with <i>H. brasiliensis</i> , 'India rubber' ( <i>koñori</i> ), <i>Protium</i> ( <i>tsivaki</i> ), <i>Parkia</i> ( <i>sampoa</i> )
49	<i>intsipashi</i>	<i>Inga</i> spp. forest	Water-adapted <i>Inga</i> spp. ( <i>intsipa oaaku</i> ) along the forest border of swamps and small lakes
50	<i>kovuvapishi</i>	<i>Sagotia</i> sp. forest	On slopes with <i>Wettinia</i> , 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 Matsigenka 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
	<i>Tovasiseku</i> :	'Place of weeds'	Weedy secondary growth
51	<i>tovaseri</i>	'weeds'	Weeds ( <i>tovaseri</i> ), especially along trails, around house clearings, and in swidden gardens; also any weedy secondary growth
52	<i>narongashi</i>	'tangled leaves': dense secondary growth	Dense, weedy undergrowth of herbs, shrubs, creeping vines and lianas; especially in recent treefall gaps, swidden fallows
53	<i>shivitsasemai</i>	'matted lianas': liana forest	Floodplain, stream gallery or slope forest with thick, woody lianas in understory, especially <i>Uncaria</i> spp. ( <i>shamento</i> ), <i>Davilla nitida</i> ( <i>tsororoapini</i> ), Bignoniaceae in areas of past flooding, erosion
54	<i>yaaroshi</i>	<i>Cecropia sciadophylla</i> forest	Secondary forest with <i>C. sciadophylla</i> ( <i>yaaro</i> ), other pioneer species; old garden fallows, large wind blow-downs; also in montane forest on slopes
55	<i>shintishi</i>	<i>Guazuma crinita</i> forest	Low-canopy secondary forest with <i>G. crinita</i> ( <i>shinti</i> ), other weedy and pioneer species in swidden fallows
56	<i>kogi oshivokera</i>	<i>Tephrosia</i> sp. ( <i>'where fish poison grows'</i> )	"Primary" forest regrown from old or ancient swiddens, recognized by presence of barbasco fish poison ( <i>kogi</i> )
57	<i>pugoroshi</i>	<i>Vernonia</i> forest	Young secondary growth with <i>Vernonia</i> 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
	<i>Otishipaketira</i> :	'Many hills': Andes, foothills	Montane habitat general term (Table 2)
58	<i>katarompanaki</i>	<i>Clusia</i> sp. forest	Montane forest with katarompanaki shrub w/ paddle-shaped leaves, latex, ( <i>Clusia</i> sp.), formerly traded as incense
59	<i>kasankari koka</i>	<i>Erythroxylum coca</i> ? ('fragrant coca')	On slopes, understory with 'fragrant coca' ( <i>kasankari koka</i> ); said to be former Inca coca plantations
60	<i>kashikarishi</i>	<i>Polylepis</i> sp. forest	Montane dwarf forest characterized by <i>kashikarishi</i> , reddish shrub w/ narrow coriaceous leaves ( <i>Polylepis</i> sp.)
61	<i>yavirosi</i>	<i>Puya</i> sp. stand	Montane grasslands with spine-tipped terrestrial Bromeliad <i>yaviro</i> ( <i>Puya</i> sp.) that 'looks like pineapple'
62	<i>tsiriantinirosi</i>	<i>Tillandsia</i> sp. (Spanish moss)	Cloud forest, many epiphytes, notably <i>tsiriantinirosi</i> , 'mother of pineapple' ( <i>Tillandsia</i> , indeed a Bromeliad)
63	<i>tipesi</i>	<i>Spaghnum</i> sp. (moss)	Montane; ground cover of <i>Spaghnum</i> moss ( <i>tipesi</i> ), spongy or crunchy underfoot ( <i>omakaramangaitira</i> ; Table 4, S10)
(D4)	<i>potagarine</i>	'burnt hillside'	(Table 3)
(14)	<i>segashi</i>	<i>Oenocarpus bataua</i> forest	(Table 5)
(20)	<i>songarentsishi</i>	<i>Chusquea</i> spp., <i>Olyra</i> spp.	(Table 6)
(25)	<i>tinkanarishi</i>	<i>Cyathea</i> spp. forest	(Table 7)
(26)	<i>tsirompishi</i>	Pteridophyta (fern) stands	(Table 7)
(33)	<i>shimpenashi, tiposhi</i>	Poaceae spp. (grasslands)	(Table 7)
(54)	<i>yaaroshi</i>	<i>Cecropia sciadophylla</i> forest	(Table 9)
(66)	<i>otyomiaigeni inchato</i>	'small trees'	(Table 11)
(67)	<i>terira ontine inchato</i>	'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<sup>4</sup> 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	<i>kusokiri inchato</i>	'hard wood trees'	Uplands, primary forest with large diameter hardwood trees, notably sandy-barked Chrysobalanaceae ( <i>mapumetike</i> , 'stone tree'); difficult to fell with ax for swidden agriculture
65	<i>kurayongashi / karororoempeshi</i>	'high leaf forest', 'high branching forest'	High canopy forest: in floodplain, mature, late successional forest ( <i>nigankivoge</i> ) 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 <i>Swietenia macrophylla</i> ( <i>yopo</i> ), <i>Cariniana</i> spp. ( <i>tsirotanaki</i> ), <i>Copaifera</i> spp. ( <i>kumpe</i> , <i>koveni</i> ), Lauraceae ( <i>inchoviki</i> ), <i>Sloanea</i> sp. ( <i>asingiritaki</i> ), <i>Huberodendron</i> ? ( <i>yomenta</i> ), other species
66	<i>okametira</i>	'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	<i>oshavishitira</i>	'low leaves': low canopy forest	In uplands: low canopy forest of shrubs, small trees, lianas on eroded soils, clay, or white sand ( <i>sokopane</i> ); in floodplain: on contractile clay soils, usually with <i>yaivero</i> bamboo
68	<i>otyomiaigeni inchato</i>	'small trees': dwarf forest	Montane (see Table 10): elfin cloud forest, small, twisted trees, many epiphytes e.g., Spanish moss ( <i>tsiriantiniro</i> ), lichens ( <i>tsigiri</i> ), Bromeliads/Orchids ( <i>keshi</i> , <i>ananta</i> ). Cyclanthaceae ( <i>evanaro</i> ); ferns ( <i>tsirompi</i> ), <i>Selaginella</i> ( <i>kamu</i> ); trees include <i>oevaroshi</i> , 'fragrant, white leaf, many seeds' (Asteraceae/Ericaceae?), <i>sangavantoshi</i> (?), <i>Ilex</i> ( <i>kurikiipinishi</i> ), Melastomataceae ( <i>savotaroki</i> ), <i>Cyathea</i> ( <i>tinganari</i> )
69	<i>terira ontime inchato</i>	'where no trees are'	Andean grasslands (Table 10), mountains above tree line, very cold ( <i>katsingari</i> )
(D8)	<i>inchatoshi</i>	'tree leaves': primary forest	(Table 3)
(51)	<i>tovaseri</i>	'weeds'	(Table 9)
(52)	<i>narongashi</i>	'tangled leaves': dense secondary growth	(Table 9)
(53)	<i>shivitsasemai</i>	'matted lianas': liana forest	(Table 9)

TABLE 12.— Habitats defined by faunal associations.

Ref.	Habitat	Translation	Description / Associated Vegetation
F1	<i>irapitari kimaro</i>	'where macaws sit': macaw clay lick	<i>Guadua</i> sp. bamboo ( <i>yaivero</i> ), contractile clay soils ( <i>kusomiriakipatsa</i> )
F2	<i>itsimini</i>	'their licking place': animal mineral lick	<i>Guadua</i> sp. bamboo ( <i>yaivero</i> ), <i>Aulonemia</i> bamboo ( <i>samatsi</i> ), red clay soils ( <i>kiraapatsa</i> )
F3	<i>vuimpuyoseku, / itime kovutatsirira</i>	'place of the screaming piha', 'where the guardians live'	Singing grounds of the screaming piha, <i>Lipaugus vociferans</i> ( <i>vuimpuyo</i> ), mostly in flat uplands with <i>Wettinia</i> ( <i>kepito</i> ), <i>Socratea salazarii</i> ( <i>kompapari</i> )
F4	<i>matyaniroshi</i>	'fire ant forest'	Forest containing large numbers of small fire ant <i>Wasmannia auropunctata</i> ( <i>matyaniro</i> ), often associated with tangled under story ( <i>narongashi</i> ) 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	<i>matyagirokishi</i>	'ant shrub forest'	Small clearings formed by mutualistic relationship of <i>Cordia nodosa</i> shrub ( <i>matyagiroki</i> ) and <i>Myrmelachista</i> ants ( <i>iriite, matyaniro</i> ); <i>Cordia</i> clearings in uplands only
F6	<i>sakaroshi</i>	'ant garden forest'	Especially in swamps; large numbers of ant-garden ants ( <i>sakaro</i> ), especially <i>Campanotus</i> , on host plants <i>Codonanthe</i> ( <i>kimaroshi</i> ), <i>Peperomia</i> ( <i>sakaropini</i> ), and others
F7	<i>kepage</i>	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. Nocturnal habit (*yanutake tsiteniyeti*, 'walks at night');
- Wild (*inkenishiku*, 'in the forest'; *kogapage*, 'on its own'<sup>5</sup>) 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 *Sangariite* 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 life-cycle 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 (*krâi*), 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: *edzaú* (terra firme uplands), *arapé* (igapó flooded forest), and *ramariene* (nutrient-poor campinarana white sand forest). Secondary forest is treated as a separate category, *reinhamé* ('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 to 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 powerful 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

<sup>1</sup> 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!

<sup>2</sup> 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.

<sup>3</sup> 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).

<sup>4</sup> 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.

<sup>5</sup> 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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