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UNDERDIFFERENTIATED TAXA AND SUBLEXICAL CATEGORIZATION: AN EXAMPLE FROM MATSES CLASSIFICATION OF BATS

DAVID W. FLECK,[a] ROBERT S. VOSS,[b] and NANCY B. SIMMONS[b]

[a]*Department of Linguistics, Rice University, Houston, TX 77251-1892*
[b]*Department of Mammalogy, American Museum of Natural History, New York, NY 10024-5192*

ABSTRACT.—This study looked at the classification of bats by the Matses Indians of Amazonian Peru using four methods: 1) interviews; 2) elicitation of bat names using freshly-captured zoological specimens; 3) grammatical analysis of bat terminology; and 4) analysis of recorded texts about bats. The results showed that although the Matses have only one lexicalized name for referring to bats (of which 57 species have been collected at one Matses village), they recognize morphological and behavioral diversity in the local bat fauna at the level of family, subfamily, genus, or species. We suggest methods for identifying unnamed terminal taxa in folk classification systems, and explore the taxonomic and cognitive nature of sublexical folk-biological terminal taxa. Implications of our results for biological inventory fieldwork are briefly discussed.

Key words: Matses, bats, folk classification, nomenclature, Amazonia

RESUMEN.—Este estudio examina la clasificación de murciélagos por los Matsés de la Amazonía Peruana usando cuatro métodos: 1) etrevistas; 2) elicitación de nombres de murciélagos usando especímenes recién capturados; 3) análisis gramatical de la terminología referente a murciélagos; y 4) análisis de grabaciones de textos sobre murciélagos. Los resultados revelaron que aunque los Matsés tienen sólo un nombre lexicalizado referente a murciélagos (de los cuales hemos capturado 57 especies alrededor de un solo pueblo Matsés), ellos reconocen diversidad en la morfología y conducta de la fauna local de murciélagos al nivel de familia, subfamilia, género, o especie. Aquí sugerimos métodos para la identificación de taxones (categorías biológicas) terminales no nombradas en sistemas de clasificación tradicionales, y exploramos la base taxonómica y cognitiva de taxones terminales en sistemas de nomenclatura biológica tradicional. Discutimos brevemente las implicaciones de nuestros resultados para el trabajo de campo de inventario biológico.

RÉSUMÉ.—Cette étude examine la classification des chauve-souris par les Indiens Matses de l'Amazonie péruvienne en utilisant quatre méthodes: 1) des entrevues; 2) la présentation aux Matses de spécimens récemment capturés pour découvrir le nom des chauve-souris; 3) analyse grammaticale de la terminologie des chauve-souris; et 4) analyse d'enregistrements de textes concernant les chauve-souris. Les résultats montrent que bien que les Matses n'aient qu'un seul nom lexicalisé pour parler des chauve-souris (dont 57 espèces ont été capturées dans un seul village), ils en reconnaissent la diversité dans la morphologie et le comportement au niveau de la famille, la sous-famille, le genre, ou l'espèce. Nous suggérons des méthodes

pour identifier des taxa terminaux sans noms, et nous explorons la nature taxonomique et cognitive des taxa terminaux dans les systèmes traditionels de classification. Nous présentons aussi brièvement l'implication des nos résultats pour les inventaires sur le terrain.

INTRODUCTION

A common finding in ethnobiological classification studies is that some local biological species get lumped into a single named category with no named subordinate categories. The conclusion usually drawn from such observations is that the people whose classification system is being studied are less acute observers of biological diversity than are Western scientists for the organisms in question. Although the inference seems self-evident, it could be misleading if non-scientists consistently recognize some species that they simply do not name. If covert (sublexemic) species recognition is a widespread phenomenon, the use of linguistic criteria to determine which folk categories are considered for comparisons of classification systems could significantly underestimate the ability of traditional societies to discriminate taxa. To emphasize the language-based nature of such comparisons, we refer to situations where a named terminal folk taxon includes more than one biological species by the term "lexical underdifferentiation."

In published ethnobiological studies wherein criteria for accepting or rejecting informant responses have been stated explicitly, names (lexemes habitually used to label taxonomic categories) are distinguished from *ad hoc* descriptive phrases, and only named categories (or categories labelled by terms of ambiguous lexemic status) are considered as relevant data (Berlin et al. 1974; Hunn 1977; Hays 1983; Hunn and French 1984). The inevitable outcome of such methodology is that researchers do not actively look for ethnobiological categories below named terminal taxa. Under a theoretical position that consistent linguistic labeling is required for human category formation, it would be justified to disregard such unnamed entities. However, this assumption has not been substantiated, and there is evidence that folk biology may be a fertile hunting ground for examples of sublexemic categorization. Thus, Diamond and Bishop (1999:37) found that in two out of three cases of lexical underdifferentiation of the local bird fauna by the Ketengban of Indonesian New Guinea, informants ". . . were aware of the differences between the two species bearing the same name." Similarly, Dwyer (1976:434) reported that the Rofaifo of Papua New Guinea recognize five folk-taxonomic mammalian categories ("Rofaifo species") ". . . for which no formal lexeme is available." Unfortunately, all of these interesting cases were mentioned only in passing, and none was formally analyzed. Among the few exceptions to this trend, Bulmer and Menzies (1972, 1973) described several sublexemic folk-zoological taxa recognized by the Karam in some detail.

Curiously, the disregard for unnamed categories is not consistent in ethnobiology. "Covert categories" (unnamed midlevel groupings of named taxa) and unnamed "unique beginners" (highest-level taxonomic categories), by contrast, have received much attention (Berlin et. al 1968; Berlin 1974; Brown 1974; Hays 1976; Atran 1983; Taylor 1984). This inconsistency might be justified in a purely linguistic study, where covert midlevel and unique beginner categories delineate

groupings of lexemes that are relevant to the description of semantic domains. However, if the object of an ethnobiological project is to explore the perceptual and cognitive aspects of folk classifications, either in their own right or in comparison to other taxonomic systems, it does not make sense to dismiss lower-level folk categories based solely on lexemic labeling.

Understanding the relationship between folk-biological knowledge and lexemic labelling can have practical applications as well, notably for field biologists. Lists of local plant and animal names are often collected during botanical and zoological inventories, but the interpretation of such lists can be problematic (Prance 1984; Schultes 1986; Fleck et al. 1999; Wilkie and Saridan 1999). Whereas lexical overdifferentiation (in which one biological species corresponds to two or more nonsynonymous folk species names) can lead to inflated estimates of local biodiversity (Fleck et al. 1999), lexical underdifferentiation can result in equally misleading but oppositely biased estimates. Well researched examples of both phenomena are crucial for more informed applications of folk-taxonomic data in biodiversity research.

This paper explores the classification of bats (Mammalia: Chiroptera) by the Matses Indians of Amazonian Peru. Preliminary ethnobiological research (Fleck 1997) indicated that bats are lexically underdifferentiated by this indigenous rainforest culture, a hypothesis we subsequently tested in a collaborative field study of Matses ethnomammalogy. Using both traditional ethnobiological methods (interviews, listing requests, naming exercises, morpho-syntactic tests) and recorded monologues, we documented Matses knowledge of local bat diversity and natural history, and we analyzed how that information is linguistically encoded. Simultaneous sampling of the local bat fauna provided the necessary materials for naming exercises, a preliminary estimate of chiropteran diversity in our study area, and permanent documentation of the biological taxa described by Matses informants.

THE MATSES AND THEIR INTERACTIONS WITH BATS

The Matses (also known as Mayoruna; Panoan language family) are an indigenous Amazonian society consisting of about 1500 persons living along the Yavarí (Javari) River and its tributaries in Peru and Brazil. Prior to 1969, the Matses avoided contact by staying far from navigable rivers and maintaining hostile relations with neighboring non-tribal Peruvians and Brazilians (Romanoff 1984), although their ancestors may have had sporadic contact with Jesuit missions in prior centuries (Erikson 1994). In 1969, the Matses established first peaceful contact with Summer Institute of Linguistics personnel (Vivar 1975), and in the 1980s some groups moved away from the inland villages and settled on the banks of the Yaquerana (Upper Javari) and Gálvez Rivers. Acculturation of the Matses to the national culture is proceeding rapidly, but because of their recent isolation, older individuals (>30 years of age) still possess undiminished traditional knowledge. Many of the younger men speak Spanish or Portuguese at various levels of fluency, but about 85 percent of the Matses are still essentially monolingual. Most Matses still meet all their nutritional needs through traditional subsistence activ-

ities including hunting, fishing, trapping, horticulture and collection of wild foods.

Although the Matses have no subsistence or ritual interest in bats, it difficult for the Matses to avoid daily contact with them. For example, certain frugivorous species are pests that enter Matses houses to eat ripe plantains, and vampires occasionally bite sleeping Matses and their dogs and chickens. Other species roost in Matses buildings, particularly abandoned houses, where they make noise and leave feces. Bats visit Matses swiddens to eat plantains and papayas, and to roost in plantain leaves or under the bark of felled trees. While hunting, Matses frequently disturb bats that roost in foliage close to the ground, bat roosts in hollow trees are often found when felling trees for swiddens, and Matses remove armadillos from burrows that are often inhabited by bats. At dusk, bats can be seen flying around villages, and at night they can be heard vocalizing and swooping close to the ground outside houses. The Matses generally do not kill bats, except sometimes when they enter houses, or when boys on occasion use them for archery target practice. Apparently, the only Matses belief associated with bats is that forest spirits may manifest themselves as large, black bats that swoop down close to people's heads at night, causing them to become ill.

STUDY AREA AND THE REGIONAL BAT FAUNA

This study was conducted principally at the Matses village of Nuevo San Juan (73°9′50″W, 5°14′50″S, ca. 150 m above sea level), located on the Gálvez River (a left-bank tributary of the Yavarí River), in the district of Yaquerana, department of Loreto, northeastern Peru (Figure 1). Estimates of average annual rainfall (2900 mm) and average annual temperature (25.9°C) are available from Jenaro Herrera, the nearest weather station, located about 100 km west of Nuevo San Juan (Marengo 1983). The Gálvez is a blackwater river with a narrow floodplain that seldom extends more than 0.5 km on either side. The area around Nuevo San Juan is primary rainforest except for gaps from windfalls and active and abandoned swiddens (0.5–2 ha horticultural plots) that have been cleared annually since the village was established in 1984 (see Fleck and Harder [2000] for additional details about local habitats).

Over 100 species of bats could be expected to occur in Matses territory, as inferred from available geographic range data (summarized by Voss and Emmons 1996). Far from constituting a homogeneous group of confusingly similar forms (as a nonspecialist might suspect), this fauna includes many taxa that can be readily distinguished by size and other trenchant morphological differences. The Spectral Bat (*Vampyrum spectrum*; see Appendix A for all bat species authorities) and Greater Spear-nosed Bat (*Phyllostomus hastatus*), for example, are exceptionally large (>100 g), whereas the Thumbless Bat (*Furipterus horrens*) and Little Brown Bats (*Myotis* spp.) are tiny (<10 g). Although most bats are uniformly brownish or blackish, some are distinctively colored; those with distinctive markings include Spix's Disk-winged Bat (*Thyroptera tricolor*, with a sharply contrasting white chest), the Greater Sac-winged Bat (*Saccopteryx bilineata*, with two bright-white dorsal stripes), and Macconnell's Bat (*Ectophylla macconnelli*, with light-gray fur and bright yellow ears, noseleaf, and thumbs). Other taxonomically important

FIGURE 1.—Map showing our study site at Nuevo San Juan on the Gálvez River and other villages where Matses were interviewed or asked to record natural history accounts.

morphological differences concern the shape of prominent body parts: Sheath-tailed Bats (family Emballonuridae) are recognizable (among other traits) by their exceptionally mobile, fleshy rostrums; Free-tailed Bats (family Molossidae) by their dog-like faces and long tails that extend well beyond the flight membranes; Long-tongued Bats (subfamily Glossophaguinae) by their elongated muzzles; and Round-eared Bats (*Tonatia* spp.) by their exceptionally large, rounded ears.

Taxonomic differences in behavior are likewise obvious, even to casual observers. For example, the Proboscis Bat (*Rhynchonycteris naso)* typically roosts in characteristically linear groups on well lit tree trunks over water, where it can be seen on almost any daytime river trip in Amazonia. Many Neotropical Fruit Bats (subfamily Stenodermatinae) roost in tents that they construct from palm fronds and other large leaves in the forest understory, and Round-eared Bats (*Tonatia* spp.) roost in burrows that they excavate in arboreal termite nests. Some bats feed

exclusively on flying insects (e.g., families Emballonuridae, Vespertilionidae and Molossidae), but some Spear-nosed Bats (subfamily Phyllostominae) snatch crickets, katydids, and other crawling insect prey from leaves and stems. Other bats eat fish (*Noctilio leporinus*); blood (subfamily Desmodontinae); birds, rodents and other bats (*Vampirum spectrum*); fruit (subfamilies Carolliinae and Stenodermatinae); or flower nectar and pollen (subfamily Glossophaginae).

METHODS

Data for this study were collected during three field seasons, in 1994 (4 months), 1998 (3 months), and 1999 (3 months). Additionally, in 1995–1996, Fleck worked among the Matses for 20 months documenting their rainforest habitat classification system and their knowledge of non-flying mammal diversity, during which time he became moderately fluent in the Matses language.

Preliminary Interviews.—From April to July 1994, 12 Matses hunters from the villages of Nuevo San Juan, Remoyacu, and Buen Perú (Figure 1) were individually interviewed about the local mammal fauna in order to obtain a list of Matses mammal names. Once this initial list was compiled, 5 informants (Informants A–E) were selected to answer more detailed questions about the natural history of taxa in these lists. Because these earliest interviews were carried out before Fleck was fluent in Matses, they were conducted in the local Spanish dialect with bilingual Matses speakers. However, as soon as the Matses names for mammals were learned, these were used instead of the Spanish terms. Among other questions, each of the 5 informants was asked if there was more than one type of that named taxon; affirmative responses were followed up with a request to list the different kinds. In the case of bats, interviewees were asked, "¿Cuantas calidades de ***cuesban***[1] hay?" The informants were allowed to give as many responses as they could without interruption, and they were not asked to continue once they stopped (hereafter, this part of the preliminary interviews will be referred to as "listing requests"). Interviews were conducted without any other adults present in order to obtain independence of response. Afterwards, the same interviewees were prompted with color drawings from a field guide (Emmons 1990) and a book (Eisenberg 1989), and with specific questions about bats that were expected to be in the area; however, only those responses given without prompting are considered in this paper.[2]

Recording of Bat Natural History Accounts.—From May to July of 1998, monologues about the natural history of local mammals were elicited from 7 Matses men (Informants C–I; two from Buen Perú, two from Nuevo San Juan, two from Buenas Lomas, and one from Estirón; Figure 1) and recorded on digital minidisk. All monologues were in the Matses language (5 of the informants spoke Spanish to various levels of fluency, the other 2 were completely monolingual). To elicit the texts, informants were asked to talk about a terminal folk taxon, which was mentioned only once by the interviewer (Fleck). Informants were asked to say as much as they wanted about any topic relating to the folk taxon in question, and were not interrupted or asked to continue, regardless of the length of their monologue. Each informant was interviewed with no other adults present in order to achieve

independence of response. These recordings were subsequently transcribed and translated by Fleck and checked for accuracy with Matses speakers at Nuevo San Juan in 1999.

Bat Faunal Sampling and Taxonomic Identifications.—From May to July of 1998, Voss sampled the bat fauna within a 3-km radius of Nuevo San Juan by ground-level mistnetting and by searching for roosts (see Voss and Emmons [1996] for detailed descriptions of these inventory methods). Local habitats sampled by mistnetting included gardens and clearings around Matses houses, secondary growth (abandoned swiddens), well drained primary forest, *aguajales* (*Mauritia flexuosa* palm swamps), and river beaches. Under the forest canopy, mistnets were usually deployed in linear (tandem) arrays along existing trails or in specially cut net lanes, but right-angled or other configurations were sometimes used. Nets were opened just before dark (often when it was still light enough to read), and were tended continuously until they were closed (usually before midnight). The equipment used consisted of 2.6 × 6 m nets woven from 70 denier (d) thread, and 2.6 × 12 m nets of 50 d thread; all nets had a mesh size of 36 mm.

Bat roosts were located with and without the involvement of Matses volunteer helpers in 1998, but Voss collected all specimens (usually by shooting) and recorded data (roost location, habitat, etc.) himself. From September to November of 1999, however, 5 Matses men were paid salaries to look for bat roosts: 2 to 4 men were so employed on any given day. For the first month of the 1999 field season, the Matses did not collect bats or record data themselves, but returned to the village to lead Fleck to the roosts where he shot specimens and took notes. Subsequently, Matses assistants both collected specimens and recorded data themselves, and then brought the specimens to Fleck, who identified, catalogued and preserved them. Matses collectors recorded their observations in field notebooks (Figure 2), which Fleck later translated.

All mistnetted and shot bats were provisionally identified to species in the field using published sources (e.g., Emmons 1997) and manuscript keys. Up to 20 voucher specimens were preserved for every species encountered, including any individual whose identification was deemed problematic by Voss or Fleck. Their field identifications were subsequently confirmed by Simmons, who examined all preserved bat voucher material from this project. Duplicate sets of vouchers are deposited in the Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos (Lima) and in the American Museum of Natural History (New York).

Elicitation of Bat Names.—During the 1998 field season, mistnetting provided an ample supply of freshly-killed bats for eliciting Matses bat names. All bat name elicitation was conducted at Nuevo San Juan by Fleck. The bats were presented to the Matses (Informants E–G and J–O) in a plastic tray containing specimens of several species (including multiple individuals of most species), each tagged with an identification number. The Matses were asked, sometimes one person at a time and sometimes in groups, to name the bats in the tray. The Matses were encouraged to inspect the bats by turning them over and stretching out their wings, and thus often gave more than one response, with second or third responses motivated by the discovery of white wing tips, lines on the bat's back, etc. All responses

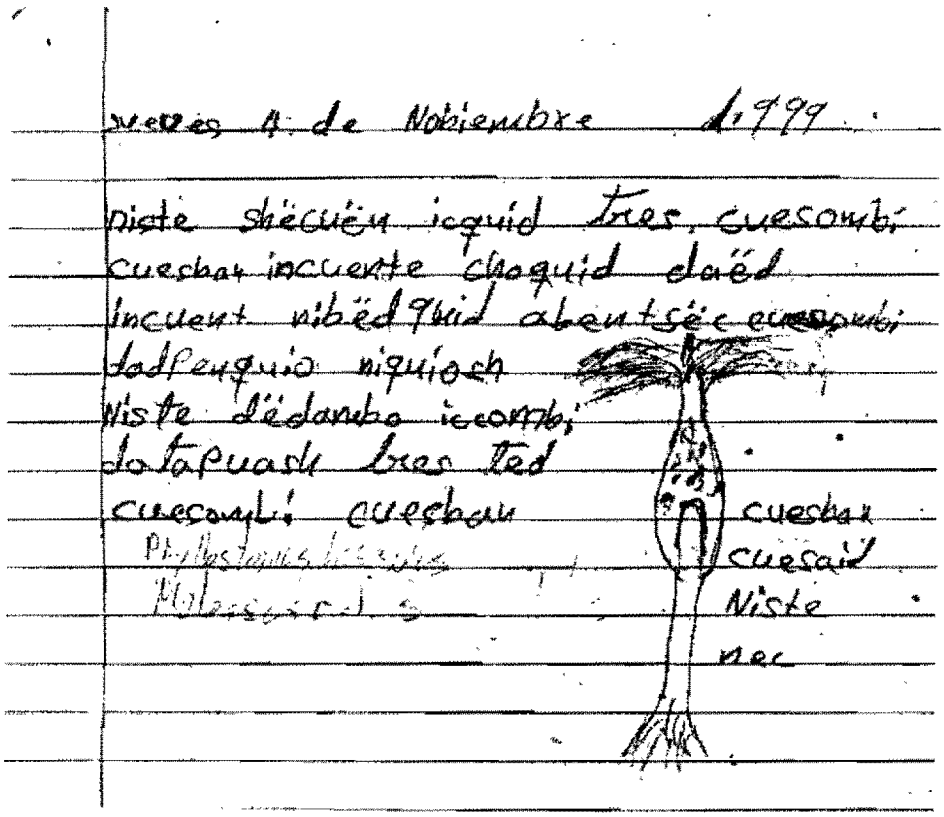

FIGURE 2.—One page from a Matses research assistant's field notebook, describing the roost where he collected two Mastiff Bats (*Molossus rufus*) and one Spear-nosed Bat (*Phyllostomus hastatus*). Translation: 'Tuesday, November 4, 1999. I killed three ***niste*** palm [*Iriartea deltoidea*] hole dwelling ones. I killed two tailed bats and one tailless one. Many flew off. I didn't chop the ***niste*** palm down, after having made a bridge to the trunk [with a log]. I killed a total of three bats.' To right of drawing: 'The ***niste*** palm of the killed bats.'

were recorded along with the name of the informant and the identification number of the specimen referred to.

During the first month of the 1999 field season, while accompanying Matses assistants to collect bats at roosts they had found, Fleck recorded Matses bat names along with relevant roost data for all bats collected. Bat names were elicited at the roost site as the Matses inspected the shot bats. When the Matses started to collect the bats on their own, they were asked to record a name for the bat along with the other relevant roost data. Back at the village, Fleck often discussed (in Matses) the bats with the Matses man who collected them and with any other Matses that were present, and recorded terms and phrases that the Matses used to refer to the bats.

Linguistic Analysis of Bat Terminology.—Matses responses (from listing requests and name elicitations) were subjected to morpho-syntactic tests to distinguish lexicalized terms (endocentric expressions; henceforth "lexemes") from *ad hoc* descriptive phrases (exocentric expressions). These tests involved modifying responses

linguistically and checking with speakers for grammaticality and, if grammatical, recording the meaning of the modified phrases. Morpho-syntactic tests were applied both at the time of the name elicitation with the dead bats at hand, and at other times using the entire inventory of responses. The general principle of Matses grammar upon which these tests were based is that lexicalized polymorphemic names are treated grammatically as noun roots while descriptive phrases are not. Thus, lexicalized phrases cannot have any linguistic material (affixes, clitics or words) inserted between the units in the word/phrase, and modifiers modify the whole lexeme, rather than just one component. Descriptive phrases, by contrast, can have linguistic material inserted between the morphemes, and the scope of the modifiers can be restricted to the word in the phrase that directly precedes them.

RESULTS

Listing Requests.—The 5 interviewees responded to the question of how many types of bats they knew about with a mean of 16.6 responses (ranging from 8 to 22), totaling 83 cumulative responses distributed among 43 different bat descriptive terms. Table 1 is a compilation of all the responses to the listing requests, categorized with respect to the information content of the phrase. Responses referring to morphology (coloration, size, distinctive body part, etc.) were about twice as common as those describing behavior (diet, roosting habits, etc.). None of the responses was given by all 5 interviewees, but many responses were given by 4 of the 5. Inspection of Table 1 reveals that several pairs of responses given by the same informant would be impossible if applied to a single referent or to a homogenous group (e.g., 'big bat' and 'small bat'; 'dark bat' and 'light-colored bat').

Recording of Bat Natural History Accounts.—The seven recorded bat natural history accounts lasted a total of 13:20 minutes, ranging from 99 seconds to 145 seconds, with a mean of 114 seconds. A list of bat natural history information given by the Matses in these interviews appears in Table 2 (see Appendix B for text translations). Interestingly, in contrast to the nature of the listing request responses (Table 1), the Matses monologues included more information about behavior than about morphology, although there was more concordance among responses referring to morphology than to behavior.

Bat Faunal Sampling and Taxonomic Identifications.—We collected a total of 503 bat specimens at Nuevo San Juan from 1998 to 1999. We mistnetted on 21 nights in 1998, deploying an average of 40.9 m of nets for 2.6 hours per night. Overall, we netted for 2,309 net-meter-hours (nmh), capturing 372 bats, of which we preserved 166 as voucher specimens. We recorded data from 24 bat roosts in 1998 and from 142 roosts in 1999, for a cumulative total of 168 recorded roosts. A total of 311 specimens were collected as roost vouchers from 1998 to 1999.

Combining bat identifications obtained by mistnetting and by searching for roosts, we documented the local occurrence of 57 species representing 33 genera in 10 higher-order Linnaean categories (families or subfamilies; Appendix A). In addition, the local occurrence of two or three other species (not observed by us)

TABLE 1.—Compilation of bat descriptive phases listed by five Matses interviewees.

Matses responses	Translation	Informant A	B	C	D	E
Names describing appearance (55 responses; 26 different phrases)						
Color						
cuesban chëshë	'black/dark bat'	A	B	C	D	
cuesban ushu	'white/light-colored bat'		B	C		E
cuesban piu	'red bat'		B	C	D	
cuesban tanun	'gray bat'		B			
cuesban bëshpiu	'yellow bat'	A	B			
cuesban chëshë-chëshë	'brown bat'			C		
cuesban piu-piumbocquid	'reddish bat'	A				
cuesban tanun-tanuquiocquid	'grayish bat'	A				
Distinctive markings						
cuesban mapiu	'red-headed bat'		B			
cuesban cabëdi	'variegated-backed bat'	A	B		D	
cuesban cadaun	'stripe-backed bat'	A	B			E
cuesban bëdi-bëdicquid	'spotted bat'	A				
Size						
cuesbanëmpi	'little bat'	A	B		D	
cuesbandapa	'big bat'	A	B			E
Color and size						
cuesban chëshëmpi	'little black bat'		B	C		E
cuseban chëshëdapa	'big black bat'		B		D	
cuesban ushumpi	'little light-colored bat'	A			D	
cuesban piumpi	'little red bat'	A				
cuesban piudapa	'big red bat'		B		D	
cuesban tanunëmpi	'little gray bat'			C		
Distinctive marking and size						
cuesban bëdimpi	'little spotted bat'		B	C	D	
cuesban tacsedëmpi	'little white-bellied bat'		B			
Distinctive body parts						
cuesban pabiatedapa	'big-eared bat'	A				
cuesban incuente choquid	'free-tailed bat'	A	B	C	D	
cuesban dëuishquedo	'fleshy-nosed bat'	A	B	C	D	
cuesban cabëdi dëuisac	'variegated-backed, long-nosed bat'		B			
Names describing natural history (28 responses; 17 different phrases)						
Feeding habits						
cuesban mani chequid	'plantain-eating bat'	A		C	D	E
cuesban nuëquid pequid	'fish-eating bat'	A				
cuesban cute bacuë chequid	'dicot-tree-fruit-eating bat'				D	
cuesban bucu bacuë chequid	'*Cecropia*-tree-fruit-eating bat'	A				
cuesban chiuish bacuë chequid	'fig-fruit-eating bat'				D	E
cuesban capishto pequid	'cricket-eating bat'				D	
cuesban biush pequid	'fly/mosquito-eating bat'				D	
cuesban intac chishquid	'blood-sucking bat'	A	B	C		E
Roosting habits						
cuesban mechodo icquid	'bat that is in hollow termite nests'	A			D	
cuesban cute shëcuë icquid	'bat that is in dicot tree holes'				D	
cuesban buintad shëcuë icquid	'bat that is in hardwood tree holes'	A				
c. shëcmaucudanmës podo icquid	'bat that is in *Hyospathe* palm fronds'					E

TABLE 1.—(continued)

Matses responses	Translation	Informant A	B	C	D	E
cuesban mani pada podo icquid	'bat that is in wild banana leaves'				D	
acte cuesban	'river bat'	A	B	C	D	
acte nantan cuesban	'on-the-river bat'		B			
abuc cuesban	'high-up bat'		B			
Vocalization						
cuesban coshquequid	'bat that vocalizes saying "cosh"'			C		
Total responses given by each informant (grand total = 83; mean = 16.6)						
Total different responses = 43						

is implied by Matses descriptions of fishing bats (almost certainly *Noctilio leporinus*), vampires that feed on humans and dogs (*Desmodus rotundus*), and vampires that feed on chickens (perhaps *Diaemus youngi* and/or *Diphylla ecaudata*). The local bat fauna therefore includes a probable minimum of about 60 species.

Elicitation of Bat Names.—Elicited bat names showed much inconsistency among informants, among single informants' responses for different specimens of the same species, and even among responses of single informants for a single specimen, suggesting that none of the responses were lexicalized names, i.e., lexemes habitually used to designate a category. Interestingly, however, the responses were not completely random, exhibiting some preferences in the subset of descriptive phrases used, or, perhaps, a tendency to focus on a particular subset of morphological/behavioral characteristics (Table 3).

The most evident pattern in bat name elicitations was that all names elicited using dead bats that were mistnetted the night before were descriptive of the bat's appearance, while some names elicited at roost sites were descriptive of roosting behavior in addition to morphological properties. No names elicited with dead bats referred to feeding habits, vocalization, or other aspects of behavior. Table 3 lists all name elicitation responses for one bat family, illustrating the level of inconsistency in responses and the nature of the names in relation to whether or not the informant saw the bat's roost. This pattern indicates that characteristics of the bats other than those directly observable during elicitation were not inducible by the Matses upon inspection of bat carcasses or roosts.

When several Matses were present during name elicitation, they never argued among each other as to the "correct" name for a bat when they gave different responses. This contrasts with name elicitation for other mammalian taxa, in that there were sometimes arguments about nomenclature. For example, when a group of Matses were presented with a freshly killed specimen of *Scolomys ucayalensis*, a rarely-encountered, tiny, gray mouse, the following discussion ensued:[3]

1st man:	***yama***	***biec-quid***	***ne-e-c***
	short.tailed.opossum	be.like-Agt.Nzr	be-Npast-Indic

'It's one that is like a short-tailed opossum.'

TABLE 2.—Summary of the 7 recorded bat natural history accounts (see Appendix B for the translations of all the natural history accounts).

Type of information	Information given	Informant						
		C	D	E	F	G	H	I
diversity/abundance	there are different kinds of bats	C	D	E		G		I
	bats are numerous	C	D	E	F	G		
morphology	black/dark-colored	C		E	F	G		
	white/light-colored	C			F	G		
	red	C		E		G		
	white-chested			E				
	small	C		E	F			I
	large	C			F			I
	little and black	C				G		
	big and black	C						I
	little and white	C						
	little and gray			E				
	free tail			E	F	G		
	tiny tail		D					
	fleshy nose			E				
	long tongue			E				
	have wings		D				H	
feeding habits	eat all sort of things					G		I
	eat plantains	C	D		F	G		I
	eat only the end of the plantain						H	
	eat plantains in swiddens						H	
	eat dicot tree fruits				F	G	H	
	eat fig (*Ficus* spp.) fruits	C			F		H	I
	eat vine fruits							I
	eat *Cecropia* tree fruits							I
	eat fruits by going back and forth						H	I
	eat fruits while hanging						H	
	eat fruits in primary forest						H	
	vocalize as they eat fruits				F			
	eat roaches				F			
	eat crickets				F	G		
	catch insects on the wing				F			
	suck Matses' blood	C		E	F			
	blood doesn't coagulate after bat bite	C						
	suck dogs' blood				F			I
	bite dogs on the ear							I
	suck chickens' blood			E				
	eat at night					G	H	
roosting habits	roost in different ways			E				
	roost in hollow trees	C		E	F	G		I
	roost in hollow termite nests			E	F	G	H	I
	roost under fallen trees			E	F			
	roost between stilt roots			E				
	roost on trunks of dry trees			E				
	roost in holes in gullies	C			F			I
	roost in rolled wild banana leaves	C		E	F	G		I
	roost in *Hyospathe elegans* palm leaves	C	D					
	roost in *Attalea butyracea* palm leaves	C						
	roost in *Cecropia* tree leaves					G		
	modify leaves to make tents	C		E				

TABLE 2.—(continued)

Type of information	Information given	Informant C	D	E	F	G	H	I
	roost above rafters of houses		D					
	roost in abandoned houses							I
	roost on trees over rivers	C		E				I
	roost near sandy streams			E				
	roost near swiddens			E				
	roost high up					G		
	roost in primary forest		D					
	sleep hanging		D					
	hang upside-down						H	
	roost in groups						H	
	dirty their roosts with feces	C						
sounds	make audible vocalization	C						
	vocalize at night	C			F		H	I
	vocalize high up	C						
	make audible flapping noise	C						
	[call imitations]	C					H	I
	[flapping imitations]						H	
movement	fly around at night	C	D		F		H	
	do not fly around in the day		D		F			
	fly high	C						I
	fly over the river						H	
	always swooping by	C						
	throw down fruits as they fly by						H	
activities in houses	come inside houses		D				H	I
	fly around inside houses		D					I
	come in houses to eat plantains	C						I
	give birth inside in house roofs		D					
	leave feces inside houses		D					
	knock down arrows inside houses	C						
	vocalize inside houses		D					
non-natural history	inedible (dietary taboo)	C	D					
	bats are bad/worthless	C						
	Matses kill bats that come in houses		D					

old man: ***yama*** ***penquio*** ***ne-e-c*** ***tambisëmpi***
short.tailed.opossum NegEmph be-Npast-Indic rat/mouse

ne-e-c
be-Npast-Indic

'It's not a short-tailed opossum. It is a rat/mouse.'

2nd man: ***tambisëmpi-n*** ***bacuë*** ***ne-e-c***
rat/mouse-Gen offspring be-Npast-Indic

'It's a baby rat.' [lit. 'It's a rat/mouse's offspring.']

TABLE 3.—Bat name elicitations for bats of the family Emballonuridae.

Capture date	Specimen number	Informant	Naming response	Translation of response	Informant saw roost
Cormura brevirostris (Chestnut Sac-winged Bat)					
23 June 98	AMNH 272786	F	***cuesban chëshëmpi***	'little black bat'	no
23 June 98	AMNH 272786	L	***cuesban chëshë***	'black bat'	no
23 June 98	AMNH 272786	G	***cuesban chëshë***	'black bat'	no
2 Sep 99	AMNH 273036	F	***cuesban chëshë***	'black bat'	no
2 Sep 99	AMNH 273037	F	***cuesban chëshë***	'black bat'	no
22 Sep 99	AMNH 273108	F	***cuesban cute tëdion icquid***	'bat that is under logs'	yes
22 Sep 99	AMNH 273109	Q	***cuesban dëuishquedo***	'fleshy-nosed bat'	yes
6 Oct 99	AMNH 273132	P	***cuesban piumpi***	'little red bat'	yes
6 Oct 99	MUSM 15174	P	***cuesban piumpi***	'little red bat'	yes
6 Oct 99	MUSM 15175	P	***cuesban piumpi***	'little red bat'	yes
8 Sep 99	MUSM 15248	P	***cuesban piu***	'red bat'	yes
8 Sep 99	MUSM 15248	Q	***cuesban dëuishquedo***	'fleshy-nosed bat'	yes
9 Sep 99	AMNH 273070	F	***cuesban piu***	'red bat'	yes
22 Oct 99	MUSM 15176	L	***cuesban dëuishquedo***	'fleshy-nosed bat'	no
22 Oct 99	MUSM 15177	L	***cuesban chëshëmpi***	'little black bat' (juvenile)	no
3 Nov 99	MUSM 15178	P	***cuesban dëuishquedompi***	'little fleshy-nosed bat'	yes
Peropteryx kappleri (Greater Dog-like Bat)					
25 June 98	AMNH 272797	E	***cuesban bëshpiu***	'yellow bat'	no
11 Sep 99	AMNH 273086	F	***cuesban cute shëcuë icquid***	'bat that is in hollow logs'	yes
23 Oct 99	AMNH 273174	P	***cuesban piumpi***	'little red bat'	yes
23 Oct 99	MUSM 15244	P	***cuesban piumpi***	'little red bat'	yes
26 Oct 99	MUSM 15245	F	***cuesban dëuishquedo***	'fleshy-nosed bat'	yes
Peropteryx leucoptera (White-winged Dog-like Bat)					
23 Sep 99	MUSM 15251	F	***cuesban dëuishquedo***	'fleshy-nosed bat'	yes
26 Oct 99	AMNH 273182	G	***cuesban pësed***	'clear-winged bat'	yes
2 Nov 99	MUSM 15246	G	***cuesban pësedëmpi***	'little clear-winged bat'	yes
3 Nov 99	MUSM 15247	R	***cuesban dëuishquedo***	'fleshy-nosed bat'	yes
12 Nov 99	AMNH 273197	G	***cuesban podo ushumbocquid***	'white-winged bat'	yes

TABLE 3.—(continued)

Capture date	Specimen number	Informant	Naming response	Translation of response	Informant saw roost
Peropteryx cf. *macrotis* (Lesser Dog-like Bat)					
22 May 98	AMNH 272671	F	***cuesban bëshpiumpi***	'little yellow bat'	no
22 May 98	AMNH 272671	K	***cuesbanëmpi***	'little bat'	no
22 May 98	AMNH 272671	O	***cuesban piu***	'red bat'	yes
11 June 98	AMNH 272726	F	***cuesban piumpi***	'little red bat'	no
8 July 98	MUSM 13230	F	***cuesban dëuishquedompi***	'little fleshy-nosed bat'	no
8 July 98	MUSM 13230	F	***cuesban dëuisac***	'long-nosed bat'	no
4 Sep 99	AMNH 273042	F	***cuesban dëuishquedo***	'fleshy-nosed bat'	no
4 Sep 99	AMNH 273042	Q	***cuesban dëpuen shëcuën icquid***	'bat that is in gully holes'	yes
16 Sep 99	MUSM 15249	P	***cuesban piu***	'red bat'	yes
22 Sep 99	MUSM 15250	F	***dëpuen shëcuën diadquid c.***	'bat that hangs in gully holes'	yes
23 Sep 99	AMNH 273116	F	***cuesban dëuishquedo***	'fleshy-nosed bat'	yes
11 Oct 99	MUSM 15252	F	***cuesban acte cuitsipanën icquid***	'bat that is in stream banks'	yes
11 Oct 99	MUSM 15252	F	***cuesban dëuishquedo***	'fleshy-nosed bat'	yes
27 Oct 99	AMNH 273185	G	***cuesban dëuishquedo***	'fleshy-nosed bat'	yes
Rhynchonycteris naso (Proboscis Bat)					
25 May 98	MUSM 13248	L	***acte cuesban***	'river bat'	yes
25 May 98	MUSM 13249	L	***acte cuesban***	'river bat'	yes
25 May 98	AMNH 272684	L	***acte cuesban***	'river bat'	yes
25 May 98	AMNH 272685	L	***acte cuesban***	'river bat'	yes
7 July 98	AMNH 272852	L	***cuesbanëmpi***	'little bat'	no
12 Oct 99	AMNH 273141	L	***acte cuesban***	'river bat'	yes
12 Oct 99	MUSM 15264	L	***acte cuesban***	'river bat'	yes
14 Oct 99	AMNH 273150	F	***cuesban tanunëmpi***	'little gray bat'	no
21 Oct 99	MUSM 15266	L	***acte cuesban***	'river bat'	yes
24 Oct 99	AMNH 273175	L	***cuesbanëmpi***	'little bat'	no
24 Oct 99	AMNH 273175	F	***cuesban dëuishquedo***	'little bat'	no
26 Oct 99	MUSM 15265	F	***cuesban dëuisac***	'long-nosed bat'	no

TABLE 3.—(continued)

Capture date	Specimen number	Informant	Naming response	Translation of response	Informant saw roost
Saccopteryx bilineata (Greater Sac-winged Bat, Greater White-lined Bat)					
22 May 98	AMNH 272672	F	***cuesban cadaun***	'stripe-backed bat'	no
22 May 98	AMNH 272672	K	***cuesban cadaun chëshëmpi***	'little black stripe-backed bat'	no
22 May 98	AMNH 272672	N	***cuesban cabëdi***	'variegated-backed bat'	yes
22 May 98	AMNH 272672	O	***cuesban chëshë***	'variegated-backed bat'	yes
22 May 98	MSUM 13254	F	***cuesban chëshë***	'black bat'	no
8 July 98	AMNH 272863	F	***cuesban cadaun***	'stripe-backed bat'	no
11 Sep 99	AMNH 273082	F	***cuesban niste shëcuën icquid***	'bat that is in *Iriartea* palms'	yes
20 Sep 99	MUSM 15267	P	***cuesban cadaun***	'stripe-backed bat'	yes
20 Sep 99	AMNH 273102	P	***cuesban cadaun***	'stripe-backed bat'	yes
20 Sep 99	MUSM 15268	J	***cuesban chëshë***	'black bat'	yes
28 Sep 99	MUSM 15269	F	***cuesban cadaun***	'stripe-backed bat'	yes
30 Sep 99	AMNH 273127	F	***niste shëcuen cuesban cadaun icquid***	'stripe-backed bat that is in hollow *Iriartea* palms'	yes yes
7 Oct 99	MUSM 15270	P	***cuesban dëuishquedo***	'fleshy-nosed bat'	yes
15 Oct 99	AMNH 273152	L	***cuesban cadaun***	'stripe-backed bat'	yes
21 Oct 99	AMNH 273166	P	***cuesban chëshë cabëdi***	'black variegated-backed bat'	yes
25 Oct 99	MUSM 15271	F	***cuesban cadaun***	'stripe-backed bat'	yes
Saccopteryx leptura (Lesser Sac-winged Bat, Lesser White-lined Bat)					
10 June 98	AMNH 272722	F	***cuesbanëmpi***	'little bat'	yes
10 June 98	AMNH 272722	K	***cuesban ushu***	'light-colored bat'	yes
10 June 98	AMNH 272723	F	***cuesbanëmpi***	'little bat'	yes
10 June 98	AMNH 272723	K	***cuesban ushu***	'light-colored bat'	yes
20 Sep 99	AMNH 273101	P	***cuesban cabëdimpi***	'little variegated-backed bat'	yes
20 Sep 99	MUSM 15272	P	***cuesban cabëdimpi***	'little variegated-backed bat'	yes
20 Sep 99	AMNH 273105	P	***cuesban cabëdimpi***	'little variegated-backed bat'	yes
20 Sep 99	MUSM 15273	P	***cuesban cabëdimpi***	'little variegated-backed bat'	yes

TABLE 3.—(continued)

Capture date	Specimen number	Informant	Naming response	Translation of response	Informant saw roost
7 Oct 99	AMNH 273136	E	***cuesban dëuishquedompi***	'little fleshy-nosed bat'	yes
7 Oct 99	MUSM 15274	E	***cuesban dëuishquedompi***	'little fleshy-nosed bat'	yes
20 Oct 99	MUSM 15275	F	***cuesban cadaumpi***	'little stripe-backed bat'	no
21 Oct 99	AMNH 273167	P	***cuesban cabëdi***	'variegated-backed bat'	yes
22 Oct 99	AMNH 273171	L	***cuesban cabëdi***	'variegated-backed bat'	yes
1 Nov 99	MUSM 15276	R	***cuesban cabëdi***	'variegated-backed bat'	yes

[a] Common names from Wilson and Cole (2000) followed by names from Reid (1997) where different.

old man:	***bacuë***	***penquio***	***ne-e-c***	***en***	***is***	***aton***	***shoma***
	offspring	Neg	be-Npast-Indic	here	look	3Gen	teat

'It's not a baby rat. Look here at its teats.' [it was a female with elongated teats, indicating it had raised a litter]

woman:	***checampi***	***ne-e-c***
	mouse.opossum	be-Npast-Indic

'It's a mouse opossum.'

old man:	***checa***	***penquio***	***ne-e-c***	***checa***	***dëuisac***
	opossum	Neg	be-Npast-Indic	opossum	long.nosed

ic-e-c	***nëid***	***dëbiate-mpi***	***ic-quid***
be-Npast-Indic	this.one	nose-Dim	have-Agt.Nzr

ne-e-c
be-Npast-Indic

'It's not an opossum; opossums have long muzzles; this is one that has a small muzzle.'

Linguistic Analysis of Bat Terminology.—All Matses responses to bat listing requests and name elicitations were synchronically analyzable and descriptive in nature, all containing the superordinate category name ***cuesban*** 'bat' modified by an enclitic, adjective, noun or relative clause. We also note (Table 3) that no responses meaning "genuine bat" or "false bat" or "similar/related to [some other named taxon]," suggesting the Matses concept of bat does not have a single prototype, and that they do not name bats that they are unfamiliar with through extension of other existing category labels (as described by Berlin 1999). Also, the term ***cuesban*** alone was never listed as a type of bat, indicating that ***cuesban*** does not have polysemous meanings (i.e., meaning both 'any bat' and 'true type of bat'), as would be expected if Matses subordinate bat categorization followed a "type-specific" nomenclature pattern (Berlin 1972). If Matses responses were lexicalized, they would all correspond to Conklin's (1962:121) "composite lexemes" and Berlin et al.'s (1973:217) "secondary lexemes," but none of the responses were identified as lexemes using morpho-syntactic tests. Rather, they were all shown to have the characteristics of *ad hoc* descriptive phrases, as indicated below.

In Matses, lexicalized names do not contain relative clauses, so those responses containing relative clauses (e.g., those ending in ***quid*** in Table 1) are clearly not names. However, other *ad hoc* descriptive phrases are often formally indistinguishable from polymorphemic names, as in example (1). But at least two syntactic tests can be used to determine if terms like those in (1) are lexicalized or not. These tests are based on the grammatical property of Matses that lexicalized complex words and phrases are treated morpho-syntactically as roots, even if the elements of the lexeme consists of more that one phonologically independent word. So, despite being a predominantly polysynthetic language (i.e., words in the language can contain many morphemes), compounds can be formed in Matses

without phonological union of the stems (as in Chinese [Anderson 1985]). The first morpho-syntactic test is based on the grammatical pattern in Matses that nominal enclitics generally occur at the end of noun phrases, but if the enclitic is part of a lexicalized name, it will not be moved to the end of the noun phrase when another element is added to the noun phrase after the head noun. For example, in (1) it is not clear whether ***-mpi*** 'Diminutive' is part of a name (***bëuimpi*** is a lexicalized name for the pygmy anteater, *Cyclopes didactylus*, a very small species of anteater) or if it is part of a descriptive phrase meaning 'small tamandua' (a tamandua is a medium-sized anteater; the species found in Amazonia is *Tamandua tetradactyla*). When an adjective is added, however, this ambiguity disappears, because the adjective must follow ***-mpi*** if ***-mpi*** is part of the lexicalized name (ex. 2), but if the utterance is a descriptive phrase, ***-mpi*** will go at the end of the noun phrase, after the adjective (ex. 3).

(1) ***bëui-mpi*** ***ne-e-c***
tamandua-Dim be-Npast-Indic

'It's a pygmy anteater' (name)
or: 'It's a small tamandua' (descriptive phrase)

(2) ***bëui-mpi*** ***chëshë*** ***ne-e-c***
tamandua-Dim black be-Npast-Indic

'It's a black pygmy anteater'
but not: *'It's a small black tamandua'

(3) ***bëui*** ***chëshë-mpi*** ***ne-e-c***
tamandua black-Dim be-Npast-Indic

'It's a small, black tamandua'
but not: *'It's a black pygmy anteater'

The second test involves the morpheme ***-mbo/-quio*** (***-mbo*** is attached to words ending with a vowel, ***-quio*** to those ending in a consonant), which may occur on stems of any open lexical class. Because it is a suffix (rather than an enclitic) its domain is the word to which it is attached, so its emphatic/augmentative meaning normally modifies only the meaning of the word to which it is attached (rather than the whole phrase). Additionally, it can normally be attached to any noun stem without restriction. But in multiple-word monolexemic phrases, like that for puma (*Puma concolor*; ex. 4), the suffix ***-mbo*** treats the whole phrase as a noun root; i.e., when the series ***bëdi piu*** refers to a puma, it is impossible to suffix ***-mbo*** to ***bëdi***, and when ***-mbo*** is suffixed to ***piu***, it affects the meaning of the whole phrase (ex. 5, first translation), but if ***bëdi piu*** is used a descriptive phrase, ***-mbo*** modifies only ***piu*** (ex. 5, second translation). Also, when ***bëdi piu*** is a lexeme, the form in (6) is impossible. Note that although the translation in (6) is unusual, it is the only possible translation for this semantically awkward but grammatically correct sentence.

(4) ***bëdi*** ***piu***
jaguar red

'puma (*Puma concolor*)'
'red/orange/yellow jaguar' (a possible, but unusual gloss)

(5) ***bëdi*** ***piu-mbo*** ***is-o-mbi***
jaguar red-Aug see-Past-1A

'I saw a true puma.'
or: 'I saw a bright red/orange/yellow jaguar.'

(6) ***bëdi-mbo*** ***piu*** ***is-o-mbi***
jaguar-Aug red see-Past-1A

'I saw a true jaguar that was red/orange/yellow.'
but not: *'I saw a true puma.'

Matses speakers rejected all attempts to modify bat listing request and naming responses as if they were lexemes, while accepting the majority of constructions consisting of the response modified as if it were a descriptive phrase. For example, when two specimens of the small, light-colored Lesser Sac-winged Bat (*Saccopteryx leptura*) were captured, one Matses named them both as ***cuesbanëmpi*** 'small bat'. Upon Fleck's attempt to refer to the lighter-colored one of the two by adding an adjective to the noun phrase as though it was a lexeme using (7), (8) was given as a correction, an expression exhibiting the properties of *ad hoc* descriptive phrases (asterisks mark rejected sentences).

(7) * ***cuesban-mpi*** ***ushu***
bat-Dim white

('light-colored small bat')

(8) ***cuesban*** ***ushu-mpi***
bat white-Dim

'small light-colored bat'

If ***cuesbanëmpi*** were a lexicalized name, we would have expected the ***-mpi*** to be inseparable from ***cuesban***. Similarly, when a specimen of the White-throated Round-eared Bat, *Tonatia silvicola*, a large, light-gray bat, was named ***cuesban tanun*** 'gray bat,' the informant allowed the suffix ***-quio*** to be inserted within the phrase (9), and when ***-quio*** was suffixed to the adjective, only the meaning of the adjective was modified, rather than the whole phrase (10).

(9) ***cuesban-quio*** ***ushu***
bat-Aug white

'a light-colored true bat'

(10) ***cuesban*** ***tamun-quio***
bat gray-Aug

'very light-colored bat'
but not: *'true light-colored bat'

In conclusion, the results of such tests show that none of these responses possess any morpho-syntactic properties of lexicalized polymorphemic phrases; instead, all of them appear to represent *ad hoc* descriptions.

DISCUSSION

Do the Matses Recognize Bat Categories Below the Level of Order?—The failure of the polymorphemic expressions to pass the syntactic tests for lexemic status is the most compelling evidence that the Matses lexicon has but one lexicalized name for bats, ***cuesban***. The inconsistency of the naming exercises using dead bats also supports the conclusion that there is only one Matses lexeme for bats. As suggested by Berlin et al. (1974:51), an important clue for determining the lexemic status of an utterance is "the reliability and stability of a particular linguistic designation over time and across informants." However, it must be acknowledged, as noted by Boster et al. (1986) and Diamond (1991), that the inability to identify well-known organisms in the absence of ecological and behavioral cues is a common shortcoming of naming exercises using dead specimens. For example, female Aguaruna informants failed to identify prepared skins of the Screaming Piha (*Lipaugus vociferans*), despite its unmistakable, loud call and the common occurrence of this bird in the region (Berlin 1992). Bats are particularly subject to the limitations of eliciting names in the absence of behavioral and ecological cues, even though we used freshly-killed bats rather than stuffed specimens. Because the Matses do not generally kill bats, they do not regularly inspect dead bats as they would game animals or non-game rodents that are killed frequently in traps. Because bats are nocturnal, it is difficult to observe their morphological characteristics clearly as they feed or fly around. Similarly, roosting behavior is usually more distinctive and observable from afar than are details of coloration and external anatomy. Therefore, it would not be surprising if the Matses responses to naming experiments using dead bats varied widely even if the Matses had lexicalized names for bats. Nevertheless, the observation that responses describing roosting behavior were given only at the roost location, and all other responses were inconsistently-applied phrases describing readily apparent morphological characteristics, suggests that the inconsistency in bat naming was due to the *ad hoc* nature of responses rather than to misidentification.

Thus, the only lexeme in Matses that designates a bat category, ***cuesban***, corresponds to the scientific taxonomic rank of order (Chiroptera). From a biologist's perspective, this is gross underdifferentiation, considering that ***cuesban*** (a category that is not further subdivided into subordinate named categories) refers to >60 locally occurring scientific terminal taxa. By implication, the Matses would seem to be much less acute observers of bat diversity than are biologists. However, this conclusion seems to be contradicted by the results of bat listing requests

(Table 1), which seem to indicate that the Matses recognize bat diversity at levels corresponding to Linnaean family, subfamily, genus, and even species.

The fact that Matses informants could list many kinds of bats from memory prior to our name elicitation exercises implies that bat descriptive phrases used by the Matses are not all based on immediate perception, but reflect a learned classification of bats that exists at some psychological level. In several listed examples, a descriptive phrase could only apply to one biological species, such as ***acte cuesban*** 'river bat', and ***acte nantan cuesban*** 'on-the-river bat', two terms that clearly apply to *Rhynchonycteris naso* (the only bat commonly found roosting over rivers in Matses territory). Another example is ***cuesban nuëquid pequid*** 'fish-eating bat', which could only plausibly refer to *Noctilio leporinus*. Similarly, only bats of the genus *Thyroptera* (Disk-winged Bats) roost in new, rolled-up wild banana leaves, so the expression, ***cuesban mani pada podon icquid*** 'bat that is in wild banana leaves', almost certainly refers to members of this genus. Although the Matses do not seem to know that there is more than one kind of vampire, the frequently listed expression, ***cuesban intac chishquid*** 'blood-sucking bat', reflects knowledge that there is a subset of bats that consume blood (members of the phyllostomid subfamily Desmodontinae). Similarly, the phrase ***cuesban dëuishquedo*** 'fleshy-nosed bat', could only appropriately apply to bats of the family Emballonuridae because the descriptive term ***dëuishquedo*** is otherwise only used to talk about the tapir's strikingly similar proboscis. (Indeed, in naming exercises, the phrase ***cuesban dëuishquedo*** was never a response for any bats belonging to biological taxa other than Emballonuridae.)

Lists such as those in Table 1 reveal a detailed knowledge about variation in bat natural history, but do not necessarily imply that the Matses conceive any categories beyond the level labeled by ***cuesban***. Because all categories in any context necessarily contain some variation in traits among members, the question here is: (i) do the Matses simply recognize variation in bat morphology and behavior, attributing the variation to single individuals exhibiting the whole range of characteristics at different times, or to individuals within the same population displaying any of these characteristics idiosyncratically; or (ii) do they actually recognize discontinuities (and multiple prototypes) within the category of ***cuesban***, and attribute them to separate subcategories? One way to answer this question is to consider whether the Matses recognize multiple consistently co-varying morphological and behavioral traits associated with groups of bats that are referred to with particular descriptive phrases, thus pointing to the existence of natural categories[3] within ***cuesban***.

For comparison, let us consider Matses classification of dogs. The dogs with which the Matses are familiar, their hunting dogs, are thoroughly interbred, so there are no discontinuous breeds. Nevertheless, the Matses recognize variation in coloration, adult size, and hunting abilities of dogs, and they frequently use descriptive expressions like ***opa piu*** 'yellow dog', ***opampi*** 'little dog', ***opa bëdibëdicquid*** 'spotted/variegated dog', and ***opa nëishamë tsibanquid*** 'dog that chases tapirs' (the ultimate accolade of a fearless hunting dog). The Matses know dogs very well, seeing this variation manifested among littermates, and so they do not seem to consider these dogs to be different in kind, nor any of these characteristics to be systematically associated with one another. Nevertheless, Matses speakers

provided lists of descriptive phrases for dogs comparable to those in Table 1. Therefore, listing exercises alone cannot distinguish between the recognition of natural categories on the one hand and of individual variation on the other.

Recorded natural history monologues, however seem to provide unambiguous evidence that the Matses recognize natural categories of *cuesban*.[5] For example, in (F19; the letter represents the informant, the number is the sentence number in the text; see Appendix B for the full texts), the use of the collective marker *-bo* implies that the bats being mentioned are thought of as a group, as opposed to singular referents, whereas in (E03) this seems to be mentioned explicitly—without reduplication of the root, this word would mean 'another (kind)', but with reduplication its literal translation is something like 'another-and-another kind'. In fact, 5 of the 7 informants explicitly stated that there were different kinds of bats and enumerated them in their monologues.

F19	*nua-mbo*	*cuesban*	*ic-nuc-bi*	*utsi-bo*	*ania-tsëc*
	large-Aug	bat	be-while:Diff.Ref-Emph	other-Coll	small-Dim

tsad-quid	*cuesban*	*ne-e-c*
be:Pl-Agt.Nzr	bat	be-Npast-Indic

'Bats are ones that while some bats are large, other (groups) are small.'

E03	*cuesban*	*utsi-utsi-ec-quid*	*cuesban*
	bat	other-(redup=Distr)-Advzr:Intr-Agt.Nzr	bat

ic-e-c	*incuente*	*cho-quid*	*cuesban*	*dëbiate*
be-Npast-Indic	tail	have-Agt.Nzr	bat	nose

dë-uishque-to-aid	*cuesban*	*shidiadquid*	*ushu-mbo*	*ic-quid*
nose-move-Incho-Pat.Nzr	bat	chest	white-Aug	be-Hab

cuesban	*chëshë*
bat	black

'There are different types of bats: tailed bats, fleshy-nosed bats, white-chested bats, black bats.'

Additional examples provide compelling evidence that at least some bat categories recognized by the Matses are natural in the sense of being based on multiple shared characteristics. For example, sentence (I17) describes a category of bat that is defined by both size and coloration. Other kinds of bats are described as sharing morphological and behavioral traits, such as size and roost type (F20), size, color and roosting location (E15–16), size, coloration, roosting location and roost type (G07–08), size and vocalization (I18), size and feeding habits (E17), distinctive body part and feeding habits (D08), ar.d roost type, circadian activity, size and roosting location (D11–12).

I17 ***cuesban-dapa*** ***utsi*** ***ic-e-c*** ***chëshë-mbo-quid*** ***nua***
bat-big other be-Npast-Indic black-Aug-Agt.Nzr large
ic-quid
be-Agt.Nzr
'There is another big bat, a very dark-colored one, a big one.'

E20 ***utsi*** ***bëpucte*** ***podo*** ***an-diad-tsëc-ec*** ***ush-quid***
other leaf leaf inside-hang-Dim-while:S/A>S sleep-Hab
'Other little ones sleep hanging inside monocot leaves [rolled-up new banana and wild banana leaves].'

E15 ***pictsëc-quid-mpi-mbo*** ***ic-quid*** ***aid-bi-en*** ***acte*** ***nantan***
small-Agt.Nzr-Dim-Aug be-Agt.Nzr that-Emph-Focus river on
ic-tsëc-quid
be-Dim-Hab
'One that is very small, that one lives on the river.'

E16 ***cuesban*** ***tanun-mpi*** ***acte*** ***nantan*** ***ic-tsëc-quid*** ***cuesban***
bat gray-Dim river on be-Dim-Hab bat
'(That) little, gray bat roosts over the river . . . the bat.'

G07 ***utsi-bi*** ***cuesban*** ***chëshë-mpi*** ***abuc*** ***ic-tsëc-quid***
other-Emph bat black-Dim high be-Dim-Agt.Nzr
ne-e-c
be-Npast-Indic
'Still another, a little black bat lives high up.'

G08 ***cuëte*** ***shëcuë-n*** ***ic-quid-bi-di*** ***aid*** ***ne-e-c***
dicot.tree hole-Loc be-Agt.Nzr-like-Emph that be-Npast-Indic
'It is likewise one that lives in tree hollows.'

I18 ***utsi-dapa-bi*** ***nua-mbo*** ***tsecque*** ***tsecque*** ***tsecque*** ***que-quid***
other-big-Emph large-Aug bat.call bat.call bat.call say-Agt.Nzr
cuesban-dapa ic-o-sh
bat-big be-Past-3
'There was another big bat, a very big, large bat that said, "tsecque, tsecque, tsecque"'

E17 ***cuesban*** ***piu*** ***aid*** ***intac*** ***chish-quid*** ***ne-e-c*** ***cuesban***
bat red that.one blood suck-Agt.Nzr be-Npast-Indic bat
piu
red
'A red bat, that is one that sucks blood . . . a red bat.'

D08 ***incuente*** ***cho-tsëc-ec*** ***ic-quid*** ***mani***
tail have-Dim-Advzr:Intr be-Agt.Nzr plantain

che-e-c ***que-shun*** ***cues-quid*** ***cuesban***
eat.unchewed-Npast-Indic say-after:S/A>A kill-Hab bat

'After saying, "the one that has a tiny tail eats plantains" they [Matses] kill the bats.'

D11 ***shëcmaucudanmës*** ***shapesh-n*** ***ic-quid-di*** ***cuesban***
wild.banana.species rolled.new.leaf-Loc be-Agt.Nzr-Emph bat

cho-cho-ec ***ne-e-c***
come-(redup=Iter)-Advzr:Intr be-Npast-Indic

'The same one that is in new rolled wild banana leaves is the one that keeps on coming to the house.'

D12 ***nimëduc*** ***ush-tsëc-ec***
primary.forest:Loc sleep-Dim-while:S/A>S

didique-tsëc-ash-bi ***cho-cho-e-c*** ***cuesban***
hang-Dim-after:S/A>S-Emph come-(redup=Iter)-Npast-Indic bat

'The (little) bats keep coming after sleeping hanging in the forest.'

Sentences that mentioned the association of morphological and behavioral characteristics for a category of bat were provided by 6 of the 7 informants. It should be pointed out that those monologues by Matses from Nuevo San Juan were recorded in 1998, prior to their involvement in roost searching, and the other four monologues were by Matses from other villages, who were not involved at all in bat collection or bat name elicitation. Perhaps the most convincing argument that the Matses recognize sublexical categories of ***cuesban*** is in sentences like D08 above, which indicate that the Matses behave differently in response to their categorization of bats.[6]

The finding that Matses bat categorizations have multiple characteristics associated with them allows us to formally distinguish between categories of dogs and bats using set-theoretic taxonomic criteria (Kay 1971): although a "taxonomy" is defined as always including a set of names, we can still determine if sublexemic categorizations are part of a *taxonomic structure*. In the Matses descriptions of dogs, the only time that multiple characteristics can be reliably applied in combination is when referring to a single individual. A single individual does not constitute a set, and therefore cannot be considered a taxon (i.e., there are no "non-null sets" Kay [1971: 868] below the category ***opa*** 'dog'). With bats, on the other hand, multiple characteristics apply to sets of multiple individuals. A second criterion of a taxon (a natural category in a taxonomic structure) is "strict inclusion of sets restricted to members of T" (Kay 1971: 868), i.e., "a set t_i strictly includes another set t_j just if every member of t_j is a member of t_i and there is at least one member of t_i which is not a member of t_j." Because we could consider the set labeled by Matses as ***cuesban*** to be t_i, and (for example) those bats sometimes described by

TABLE 4.—Bat descriptive phases that could be tentatively associated with a single Linnaean bat taxon (See Table 1 for translations of Matses names and Appendix A for English common names).

Matses term	Biological taxon
cuesban mapiu	*Phyllostomus hastatus* (adult males)
cuesban ushumpi	*Ectophylla macconnelli*
cuesban tananëmpi	*Ectophylla macconnelli*
cuesban tacsedëmpi	*Thyroptera tricolor*
cuesban incuente choquid	Molossidae
cuesban dëuishquedo	Emballonuridae
cuesban cabëdi	*Saccopteryx* spp.
cuesban dëuisac	Glossophaginae
cuesban nuëquid pequid	*Noctilio leporinus*
cuesban intac chishquid	Desmodontinae
cuesban mechodo icquid	*Tonatia*
cuesban mani pada podo icquid	*Thyroptera*
acte cuesban	*Rhynchonycteris naso*
acte nantan cuesban	*Rhynchonycteris naso*

Matses as ***cuesban dëuishquedo*** 'fleshy nosed bats' (which correspond exclusively to the biological taxon Emballonuridae) to be t_v and because all members that can be called ***cuesban dëuishquedo*** are included in the superordinate category ***cuesban***, and because there are other bats that are in the set labeled ***cuesban*** but not in the set describable as ***cuesban dëuishquedo***, and because we could apply this formality to several of the groupings of bats by the Matses, it seems clear that those bats that can be described by the Matses as ***cuesban dëuishquedo*** constitute a formally-definable taxon. Some recognized categories of bats, such as ***cuesbanëmpi*** 'little bats' and ***cuesban chëshë*** 'black bats' are problematic (not obviously corresponding to a scientific taxon), but many of the categories of bats described by the Matses seem to follow the same pattern as those referred to by ***cuesban dëuishquedo*** (Table 4). The fact that two categories of emballonurid bats that are sometimes referred to with the descriptive phrases ***cuesban cabëdi*** 'variegated-backed bat' (genus *Saccopteryx*) and ***acte cuesban*** 'river bat' (*Rhynchonycteris naso*) are also sometimes referred to with the phrase ***cuesban dëuishquedo*** 'fleshy nosed bats' (family Emballonuridae), could be interpreted as a hierarchy, further suggesting that there is a taxonomic structure in Matses bat classification. There does appears to be much cross-categorization in Matses bat classification, but cross indexing has been found to be a common phenomenon in folk-biological classification systems generally (Hunn 1975; Ellen 1986).

In summary, although Matses bat classification cannot be described as a perfectly taxonomic structure, there does appear to exist some such structure in at least a subset of their unnamed bat categories. The nature of this taxonomic structure may be stored in the informant's memory, or, as suggested by Randall (1976), it may be an epiphenomenon of classifying behavior; but this argument would not distinguish Matses bat classification from other described folk classification systems.

Lexemes, Linguistic Forms, and Concepts.—A semantic means of recognizing lexemes is to see if characteristics about the referent that are not deducible from the name

are inducible by speakers; i.e., the expressions should be "semantically endocentric" (Hunn 1977:26). This might seem to be an argument for the lexemic status of some of the Matses bat expressions considering that the Matses associate multiple characteristics with some bat descriptive expressions, but this would contradict the results of the morpho-syntactic tests. One solution to this paradox is to consider some responses as being intermediate between fully lexicalized names and completely *ad hoc* descriptive phrases. Such an analysis should not be objectionable if we bear in mind that the dichotomy between lexemes and descriptive phrases simply refers to opposite extremes of a continuum, with some utterances standing in between lexemes and descriptive phrases in any language. This, in fact, seems inevitable, considering that many lexemes originate diachronically from descriptive phrases, such that at any point in time some expressions will be incompletely lexicalized. (Note that this does not imply that expressions standing in the middle of this continuum must be in a transient stage, as there is no evidence to suggest that there is equilibrium only at the extremes.) Therefore, one might argue that where one draws the line between lexemes and descriptive phrases is necessarily subject to considerable arbitrariness. The intermediate status of such expressions may be realized as in several ways, including the following:

1) Sociolinguistic:
   a. Being recognized by only some members of the speech community.
   b. Being treated grammatically as lexemes by some members of a community and not by others.
   c. Being treated as lexemes only sometimes by the same speakers.
2) Grammatical:
   a. Possessing some grammatical properties of lexemes and some of descriptive phrases.
   b. Possessing grammatical, but not phonological properties of lexemes.

The intermediate nature of Matses bat descriptive terms, however, seems to have a basis that is quite different in kind from such sociolinguistic and grammatical phenomena (although some sociolinguistic variation may have been found had we interviewed women and children). This basis might be best elucidated by considering lexemes in light of the form-meaning composites of linguistic units.

Although some ethnobiologists treat linguistic forms and the concepts for which they stand as being one and the same, it is generally understood by linguists (e.g., Saussure 1915) that linguistic forms (the signifier) are only arbitrary labels for extralinguistic concepts (the signified). The latter can all be considered essentially as categories, and it is hard to deny that humans must have some mental categories that are not linguistically labeled. Therefore, when we find that none of the Matses bat terminology behave morpho-syntactically as lexemes, the implication is that the linguistic *forms* do not have the properties of lexemes. The characteristic of having multiple shared and inducible characteristics, on the other hand, is not a property of the linguistic forms, per se, but of the Matses concepts of bats. Therefore, if we consider again the continuum between lexemes and descriptive phrases in light of the different components of a lexeme, we can see why some lexemes appear to be intermediate: the linguistic forms have no properties

of lexemes, but they can be used to refer to a concept that represents a natural category. If one of these linguistic forms was habitually used to refer a bat category, then it would be a typical symbolic linguistic unit.

A symbolic linguistic unit contrasts with an index (such as the English words *that*, *you* and *what*) which are linguistic units consisting of forms that point to different entities/concepts at different times. Consider the following expressions in English:

(1) a. *polar bear* b. *bear*
(2) a. *that bear* b. *that*
(3) a. *big bear* b. *big one*
(4) a. *fox squirrel* b. *big squirrel*

The expressions in (1) are symbolic linguistic units, and can be considered names; i.e., (1a) and (1b) are both lexemes in English. Those in (2) are indexes rather than symbolic units in that they do not habitually refer to the same concept, but *that* is nevertheless a lexeme in English (while *that bear* is not). Those in (3) are not lexemes in English, and therefore not animal names, but these phrases behave as indexes in that they can refer to well-formed concepts (like polar bears), even though the same concepts can be referred to more precisely with the animal's name. Now consider the examples in (4). The expression *fox squirrel* is an interesting expression in American English in that it has intermediate lexemic status in two ways: i) sociolinguistic variation, and ii) sublexemic conceptual status. The sociolinguistic pattern is that some Americans, especially zoologists and naturalists, can identify fox squirrels and regularly refer to them as *fox squirrel*, while most Americans do not distinguish species of tree squirrels and do not use the term *fox squirrel*. Of those Americans who do not use the term *fox squirrel*, some may live in areas where more than one species of tree squirrel occur in sympatry (Burt and Grossenheider 1976). For example, many Texans do not distinguish tree squirrels lexically beyond the term *squirrel*, yet they have noted that there are large, orange-bellied squirrels (Eastern Fox Squirrel, *Sciurus niger*) and smaller, grayer, white-bellied squirrels (Eastern Gray Squirrel *Sciurus carolinensis*). So while it would be inaccurate to suggest that anyone who does not use the term *fox squirrel* does not recognize the category, it would also be false to suggest that *big squirrel* is a lexicalized English name for *Sciurus niger*. This situation, and Matses bat terminology, can be described in the same way: descriptive phrases are used in an indexical manner to refer to recognized sublexemic categories.

When looking for folk-biological categories, it is certainly a useful shortcut to begin by collecting names (lexemes) that refer to biological organisms, but one should not ignore the absence of necessary congruence between the language's lexicon and the underlying folk-taxonomic structure. It is intuitive that there is a difference in the cognitive status between named and unlabeled folk-biological taxa, with lexemically-labeled taxa generally possessing a larger number of shared attributes (and perhaps a better-formed gestalt image), so it does seem justified to make a distinction between named and sublexemic categories. One might even argue that a concept cannot be fully formed until it is habitually labeled by a lexeme, in which case it becomes entrenched and elaborated by being talked about in the community more efficiently, and perhaps by being contemplated more

clearly. However, it is also evident that not all named ethnobiological categories have identical conceptual status, even if they occur at the same ethnobiological rank. For example, almost all Americans are familiar with *lemming* as a biological taxon, but their concept of *lemming* is much less developed than that of *cat*. Therefore, although excluding unlabeled terminal categories is perhaps justified for purely linguistic descriptions, it is indefensible for ethnobiological studies of cognition.

Correspondence of Matses and Scientific Classification.—The issue here concerns which types of folk-biological categories should be considered relevant for comparison with Western scientific taxa. In Matses, it is possible to distinguish three types of categories:

1) Those having no lexicalized labels, and being distinguished by a single characteristic (e.g., Matses ***opa piu*** 'yellow dogs').
2) Those having no lexicalized label, but sharing multiple characteristics (e.g., the different categories of bats recognized by the Matses).
3) Those having a lexicalized name and sharing multiple characteristics (e.g., Matses ***senta*** 'uakari monkey').

Categories of type (1) are simply *ad hoc* groupings of individuals in reference to a single characteristic. Such grouping are neither natural nor habitually labeled, and therefore there is little incentive for comparing these with scientific taxa. It should be noted here that other ethnobiologists have described named categories that are distinguished by a single characteristic, a category type that we have not encountered among the Matses. These categories would be essentially the named counterparts of category type (1). For example, Bulmer and Tyler (1968:359) report that among the Karam of New Guinea, "informants variously distinguish four or five [named] sub-taxa of *jejeg* [a term corresponding to the frog species *Hyla angiana*] which, they say, contrast in colour alone, not in shape, size, call, odour, or any other feature." And Hunn (1977:51) defines varietal taxa (taxa, by his definition, being named) as "deductive subdivisions [divisions based on a single category] of continuously heterogeneous inductive taxa."

Type (3) categories are similar to scientific categories, and therefore lend themselves well to comparison with scientific taxa, but categories of type (2) are problematic because they reflect the absence of isomorphism (one-to-one correspondence) in a language's biological lexicon and its folk-biological taxonomic structure; by contrast, scientific nomenclature and taxonomic structure are, in principle at least, isomorphic. One approach for dealing with categories of type (2) is to consider lexicalized labeling a defining property of subordinate ethnobiological categories (as in Berlin et al. 1973), thereby judging named terminal taxa as the only relevant type of terminal categories. However, if one claims to be comparing folk *classification* to scientific classification, then it is unacceptable to exclude any part of the existing folk-biological taxonomic structure. If lexemic labeling is used to determine what categories are folk taxa, then in the end the comparison is simply of a language's biological lexicon with Western scientific taxonomic labels.

Rather than constructing a criterial definition of "folk-biological taxon" with

linguistic labeling as a necessary condition, one could describe the concept of "folk-biological taxon" as itself exhibiting prototype category structure, with prototypical taxa possessing the attribute of being named, and less prototypical taxa, such as type (2) categories, as lacking that attribute. Thus, one would expect prototypical taxa like "folk generics" (Berlin 1972), "folk speciemes" (Bulmer 1970), and "generic species" (Atran 1999) to be named (the most prototypical possessing monomorphemic names), and less prototypical taxa, like those of "intermediate," "folk varietal" and "folk specific" ranks (Berlin 1992) to sometimes be named (often with polymorphemic names) and sometimes not. Factors affecting recognition of organisms (biodiversity, size, phenotypic salience, ecological salience and cultural salience [Hunn 1999]), could be correlated to the prototypicality of the folk taxon (if any) that corresponds to the biological species, rather than just to whether the species is recognized linguistically.

One way to make more effective comparisons of folk-biological with scientific classifications is to consider lexical correspondence and correspondence of taxonomic structures separately. This seems justified considering that lexicalization is necessarily a product of social consensus, whereas taxonomic structures (while they may be influenced by culture) do not require societal acceptance, and thus are free to be elaborated by individual curiosity and experience. Because biological taxa with no cultural salience but significant perceptual salience (including phenotypic discontinuity, size and ecological behavior) are likely to be recognized but not lexemically labeled,[7] it seems probable that comparisons of taxonomic structures (including covert categories at all levels) will tend to reveal greater convergence in biodiversity recognition between traditional societies and Western science than do comparisons of folk and scientific lexicons.

Implications for Biodiversity Fieldworkers.—Although lists of vernacular names applied to plants and animals by indigenous cultures sometimes provide fieldworkers with important information about local biological diversity, many problems are encountered in attempting to interpret such data (Fleck et al. 1999; Wilkie and Saridan 1999). In particular, the problem explored in this paper, lexical underdifferentiation, can result in negatively biased diversity estimates (if named terminal taxa are assumed to represent biological species), or can lead to incorrect inferences about the observational abilities of native informants (if species recognition is assumed to be encoded by names). Our results suggest that less misleading ethnobiological data can be obtained by interview methods designed to explore the covert taxonomic structure that may exist below the level of named folk species.

Clearly the Matses are more observant naturalists than their impoverished chiropteran lexicon suggests. Despite the fact that bats are apparently of no cultural significance, the Matses recognize many distinct kinds which they spontaneously discriminate by morphological and behavioral features, and there is some evidence that their knowledge of chiropteran diversity includes a shallow hierarchical structure. Although it would be misleading to suggest that such knowledge is consistently shared among all members of Matses society, neither is detailed information about bats widely shared among members of European cultures (all of which likewise label Chiroptera with a single vernacular lexeme).

Given the technical complexities of formally analyzing interview results for lexical and sublexical content, however, alternative (or additional) cross-cultural interactions that can significantly increase the efficiency of biological inventory fieldwork merit consideration. Although specimens haphazardly contributed by (or purchased from) natives are routinely preserved by inventory workers, direct participation of indigenous peoples in routine specimen collection and data recording (e.g., as described by Berlin 1984) is far less common. In the course of our continuing fieldwork at Nuevo San Juan, the Matses have responded enthusiastically to the opportunity of gainful employment as inventory participants, resulting in a larger species list than we could otherwise have obtained in the same time. For example, of the 57 species of bats currently known from vouchered records in our study area (Appendix A), 34 species were collected by Matses hunters, whose notebooks provide hitherto unrecorded aspects of roosting behavior for some taxa. Clearly, the real promise of cross-cultural contributions to biological diversity assessment cannot be realized without transcending the mere recording of local plant and animal names.

Coda.—As a final anecdote, we note that while knowledge of bat natural history may not be important to the Matses for subsistence or ritual purposes, knowledge of bat behavior can come in handy nonetheless. The following sentence, an excerpt from the winning entry in a Matses letter-writing contest at Nuevo San Juan, was meant to make a sweetheart laugh in addition to enamoring her:

cuesban-n	***inchësh-n***	***chiuish***	***bacuë***	***sin-aid***	***istuid-ash***
bat-Erg	night-Loc	fig	fruit	ripen-Pat.Nzr	find-after:S/A>S

cuishonque-an-ac-bimbo-ec	***mibi***	***ush-quin***
rejoice-Incep-Act.Nzr-like-Advzr	2	sleep-while:S/A>A

is-ash	***cuishonque-e-bi***
see-after:S/A>S	rejoice-Npast-1S

'Just as bats start vocalizing joyfully when they find ripe fig fruits at night, I rejoice when I see you in my dreams.'

NOTES

[1] The orthography used in this paper is the phonemically-based practical orthography developed by SIL personnel for Bible translation and pedagogical materials. To approximate spoken Matses, words written in this orthography should be pronounced as if reading Spanish, with the following exceptions: ***ë*** is a high central unrounded vowel ([ɨ]); ***c*** (spelled ***qu*** preceding ***e***, ***ë*** and ***i***) is pronounced as a glottal stop word-finally and preceding consonants, and as [k] elsewhere; ***d*** is pronounced as a flap between vowels, and as a [d] elsewhere; and ***ts*** should be read as an unvoiced alveolar affricate. Word-level stress is on even-numbered syllables (counting from left to right).

[2] Prompted responses were often suspect. For example, Pallas's Long-tongued Bat (*Glossophaga soricina*) illustrated in Emmons (1990: plate 6) extracting nectar from a flower with its extended tongue (a seldom-seen nocturnal activity) was called ***pinu cuesban*** 'hummingbird bat' by a Matses informant, but no Matses were ever heard to utter this phrase in the absence of the picture.

[3] Gloss line abbreviations: 1, First Person; 2, Second Person; 3, Third Person; A, Transitive Subject; Advzr, Adverbalizer; Agt, Agent; Aug, Augmentative; Coll, Collective; Diff.Ref, Different Referent; Dim, Diminutive; Distr, Distributive; Emph, Emphatic; Erg, Ergative; Gen, Genitive; Hab, Habitual; Incep, Inceptive; Incho, Inchoative; Indic, Indicative; Intent, Intention; Intr, Intransitive Agreement; Iter, Iterative; Loc, Locative; Neg, Negative; Npast, Nonpast; Nzr, Nominalizer; O, Direct Object; Pat, Patient; Pl, Plural; redup, Reduplication; S, Intransitive Subject; Tr, Transitive Agreement; >, Interclausal Argument Tracking. Parentheses in free translations enclose implied, but non-predicated information; square brackets enclose information added by Fleck to aid the reader, but not encoded linguistically.

[4] By "natural category" we mean "logically natural" or "polythetic" or "general" in the sense that the members of the set share multiple distinguishing characteristics.

[5] Another way to distinguish between recognition of natural categories and description of individual variation is asking questions about natural history to determine if the categories are characterized by multiple co-varying morphological and behavioral features. Unfortunately, such interview methodology guarantees unreliable answers due to the inherently leading nature of such questioning (Fleck 1997).

[6] Recognition of sublexemic folk-biological categories is not unique to Matses classification of bats. For example, the Matses lexically underdifferentiate species of *Geonoma* treelet palms, lumping more than half of the local *Geonoma* species (at least 8) and the only local species of the closely-related genus *Pholidostachys* in the terminal folk taxon ***chonco***. However, there is only one kind of ***chonco*** that the Matses use for making children's bows (*Geonoma maxima* (Poit.) Kunth), and the leaves of *Pholidostachys synanthera* (Mart.) H. E. Moore are used for thatch, while the leaves of none of the *Geonoma* species are used for this purpose. All palm specimens are deposited at the New York Botanical Garden with duplicates at the Herbario del Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos in Lima, Peru. See Henderson et al. (1995) for palm nomenclature.

[7] By contrast, taxa with high cultural salience but low perceptual salience (e.g., domesticated breeds distinguished by minor genetic discontinuities from selective breeding) will be expected to be named, but as concepts that are non-prototypical in having few distinguishing attributes associated with them. Note that even very high cultural salience with no phenotypic salience, as with Matses dogs, does not always lead to category recognition or naming, but it can, as with Matses lexical overdifferentiation of saki monkeys, *Pithecia monachus* (Fleck et al. 2000).

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APPENDIX A.—List of vouchered bat identifications from Nuevo San Juan.

Family Subfamily Genus species[a]	English common names[b]
Emballonuridae	Sheath-tailed Bats
Cormura brevirostris (Wagner, 1843)	Chestnut Sac-winged Bat
Peropteryx kappleri Peters, 1867	Greater Dog-like Bat
Peropteryx leucoptera Peters, 1867	White-winged Dog-like Bat
Peropteryx cf. *macrotis* (Wagner, 1843)	Lesser Dog-like Bat
Rhynchonycteris naso (Wied-Neuwied, 1820)	Proboscis Bat
Saccopteryx bilineata (Temminck, 1838)	Greater Sac-winged Bat
Saccopteryx leptura (Schreber, 1774)	Lesser Sac-winged Bat
Noctilionidae	Bulldog Bats
Noctilio albiventris Desmarest, 1818	Lesser Bulldog Bat
Phyllostomidae	American Leaf-nosed Bats
Phyllostominae	Spear-nosed Bats
Chrotopterus auritus (Peters, 1856)	Big-eared woolly Bat
Glyphonycteris daviesi (Hill, 1964)	Davie's Big-eared Bat
Glyphonycteris sylvestris Thomas, 1896	Tri-colored Big-eared Bat
Lampronycteris brachyotis (Dobson, 1879)	Yellow-throated Big-eared Bat
Macrophyllum macrophyllum (Schinz, 1821)	Long-legged Bat
Micronycteris hirsuta (Peters, 1869)	Hairy Big-eared Bat
Micronycteris megalotis (Gray, 1842)	Little Big-eared Bat
Micronycteris microtis Miller, 1898	Common Big-eared Bat
Micronycteris minuta (Gervais, 1856)	White-bellied Big-eared Bat
Micronycteris new species	none
Mimon crenulatum (E. Geoffroy, 1810)	Striped Hairy-nosed Bat
Phylloderma stenops Peters, 1865	Pale-faced Bat
Phyllostomus elongatus (E. Geoffroy, 1810)	Lesser Spear-nosed Bat
Phyllostomus hastatus (Pallas, 1767)	Greater Spear-nosed Bat

APPENDIX A.—(continued)

Family Subfamily Genus species[a]	English common names[b]
Tonatia brasiliense (Peters, 1866)	Pygmy Round-eared Bat
Tonatia saurophila Koopman and Williams, 1951	Stripe-headed Round-eared Bat
Tonatia silvicola (d'Orbigny, 1836)	White-throated Round-eared Bat
Trachops cirrhosus (Spix, 1823)	Fringe-lipped Bat
Trinycteris nicefori (Sanborn, 1949)	Niceforo's Big-eared Bat
Glossophaginae	Nectar-feeding or Long-tongued Bats
Anoura caudifera (E. Geoffroy, 1818)	Tailed Tailless Bat [sic]
Choeroniscus minor (Peters, 1868)	Lesser Long-tongued Bat
Glossophaga soricina (Pallas, 1766)	Pallas's Long-tongued Bat
Lonchophylla mordax Thomas, 1903	Goldman's Nectar Bat
Lonchophylla thomasi J. A. Allen, 1904	Thomas's Nectar Bat
Carolliinae	Little Spear-nosed & Short-tailed Fruit Bats
Carollia brevicauda (Schinz, 1821)	Silky Short-tailed Bat
Carollia castanea H. Allen, 1890	Chestnut Short-tailed Bat
Carollia perspicillata (Linnaeus, 1758)	Seba's Short-tailed Bat
Rhinophylla fischerae Carter, 1966	Fischer's Little Fruit Bat
Rhinophylla pumilio Peters, 1865	Dwarf Little Fruit Bat
Stenodermatinae	Neotropical Fruit Bats
Artibeus anderseni Osgood, 1916	Andersen's Fruit-eating Bat
Artibeus glaucus Thomas, 1893	Silver Fruit-eating Bat
Artibeus gnomus Handley, 1987	none
Artibeus jamaicensis Leach, 1821	Jamaican Fruit-eating Bat
Artibeus lituratus (Olfers, 1818)	Great Fruit-eating Bat
Artibeus obscurus (Schinz, 1821)	Dark Fruit-eating Bat
Ectophylla macconnelli (Thomas, 1901)	Macconnell's Bat
Platyrrhinus cf. *helleri* (Peters, 1866)	Heller's Broad-nosed Bat
Platyrrhinus infuscus (Peters, 1880)	Buffy Broad-nosed Bat
Sturnira lilium (E. Geoffroy, 1810)	Little Yellow-shouldered Bat
Sturnira magna de la Torre, 1966	Greater Yellow-shouldered Bat
Uroderma bilobatum Peters, 1866	Tent-making Bat
Furipteridae	Thumbless Bats
Furipterus horrens (F. Cuvier, 1828)	Thumbless Bat
Thyropteridae	Disk-winged Bats
Thyroptera tricolor Spix, 1823	Spix's Disk-winged Bat
Vespertilionidae	Vesper Bats
Eptesicus brasiliensis (Desmarest, 1819)	Brazilian Brown Bat
Myotis albescens (E. Geoffroy, 1806)	Silver-tipped Myotis
Myotis riparius Handley, 1960	Riparian Myotis
Molossidae	Free-tailed Bats
Molossus molossus (Pallas, 1766)	Pallas's Mastiff Bat
Molossus rufus E. Geoffroy, 1805	Black Mastiff Bat
Promops centralis Thomas, 1915	Big Crested Mastiff Bat

[a] Scientific classification and nomenclature follows Koopman (1993) as modified by Simmons and Voss (1998) and Wetterer et al. (2000).

[b] Common names from Wilson and Cole (2000), Reid (1997), and Emmons (1997).

APPENDIX B.—BAT NATURAL HISTORY TEXTS

The first text includes a 3-line analysis: the first line contains the Matses language text segmented morpheme-by-morpheme, the second line contains morpheme glosses, and the third line is a free translation for the whole sentence. For the other 6 texts only the free translations are provided.

Informant F (35-year-old man; Nuevo San Juan; 27 June 1998; 1:39 min)

F01 ***cuesban*** ***chui-nu***
bat tell-Intent:1

'I'm going to tell about bats.'

F02 ***cuesban*** ***nad-quid*** ***ne-e-c***
bat do.thus-Agt.Nzr be-Npast-Indic

'Bats are ones that are like this:

F03 ***cuesban*** ***inchësh-n*** ***natia-mbo-shë*** ***mamën-an-e-c***
bat dark-Loc much-Aug-Aug laugh-Incep-Npast-Indic

'At night, bats begin laughing loudly.'

F04 ***cuesban*** ***capu-e-c*** ***inchësh-n***
bat locomote-Npast-Indic night-Loc

'Bats fly around at night.'

F05 ***cuëte*** ***bacuë*** ***pe-quid*** ***cuesban*** ***ne-e-c***
dicot.tree fruit eat-Agt.Nzr bat be-Npast-Indic

'Bats are dicot tree fruit eaters.'

F06 ***chiuish*** ***bacuë*** ***chedo*** ***pe-quid***
fig fruit etc/too eat-Hab

'They eat figs and other similar fruits.'

F07 ***adembidi*** ***capishto*** ***cucadacha*** ***chedo*** ***pe-quid*** ***cuesban***
likewise:Tr cricket cockroach etc/too eat-Agt.Nzr bat

ne-e-c
be-Npast-Indic

'Likewise, they are ones that eat crickets, cockroaches, etc.'

F08 ***adembidi*** ***cuesban*** ***cuëte*** ***shëcuë-n*** ***ush-quid***
likewise:Tr bat dicot.tree hole-Loc sleep-Agt.Nzr

ne-e-c
be-Npast-Indic

'Also, bats are ones that sleep in hollow trees.'

F09 ***mechodo*** ***shëcuë-n*** ***ush-ash-bi*** ***cute*** ***shëcuë-n***
termite.nest hole-Loc sleep-after:S/A>S-Emph dicot.tree hole-Loc

ush-ash ***dëpuen*** ***shëcuë-n*** ***ush-ash***
sleep-after:S/A>S stream.headwaters hole-Loc sleep-after:S/A>S

que-quid ***cuesban*** ***ne-e-c***
do-Agt.Nzr bat be-Npast-Indic

'Bats are ones that sleep in termite nests, in hollow trees, or in holes in gullies.'

F10 ***badiad-n*** ***capu-esa*** ***cuesban*** ***ne-e-c***
day.time-Loc locomote-Neg.A.Nzr bat be-Npast-Indic

'Bats are ones that do not fly around in the day time.'

F11 ***inchësh-n-uid-bi*** ***cuesban*** ***mamën-an-ec***
dark-Loc-only-Emph bat laugh-Incep-while:S/A>S

capu-e-c
locomote-Npast-Indic

'Bats fly around laughing only at night.'

F12 ***cuëte*** ***bacuë*** ***pe-ec*** ***cuishonque-e-c***
dicot.tree fruit eat-while:S/A>S rejoice-Npast-Indic

'They vocalize happily as they eat dicot tree fruits.'

F13 ***ad-quid*** ***cuesban*** ***ne-e-c***
do.thus-Agt.Nzr bat be-Npast-Indic

'Bats are ones that do like that.'

F14 ***cuesban*** ***mani*** ***che-quid*** ***ne-e-c***
bat plantain eat.unchewed-Agt.Nzr be-Npast-Indic

'Bats are plantain eaters.'

F15 ***adecbidi*** ***matses-n*** ***intac*** ***chish-quid*** ***ne-e-c***
likewise:Intr Matses-Gen blood suck-Agt.Nzr be-Npast-Indic

opa-n ***intac*** ***chedo***
dog-Gen blood etc/too

'Also, bats are ones that suck Matses' blood, dogs' blood, too.'

F16 ***cuesban*** ***utsi-utsi-ec*** ***ic-e-c***
bat other-(redup=Distr)-Advzr:Intr be-Npast-Indic

'There are different kinds of bats.'

F17 *ushu-mbo* *ic-ash-bi* *chëshë-mbo* *ic-ash-bi*
white-Aug be-after:S/A>S-Emph black-Aug be-after:S/A>S-Emph

incuente *cho-quid* *ic-e-c* *cuesban* *ic-quid*
tail have-Agt.Nzr be-Npast-Indic bat be-Agt.Nzr

ne-e-c
be-Npast-Indic

'Bats are light-colored, black or free-tailed.'

F18 *cuëte* *shëcuë-n* *ic-e-c* *cuesban*
dicot.tree hole-Loc be-Npast-Indic bat

ad-ash-bi *mechodo* *shëcuë-n*
do.thus-after:S/A>S-Emph termite.nest hole-Loc

'Bats are in hollow dicot trees; also in hollow termite nests.'

F19 *nua-mbo* *cuesban* *ic-nuc-bi* *utsi-bo* *ania-tsëc*
large-Aug bat be-while:Diff.Ref-Emph other-Coll small-Dim

tsad-quid *cuesban* *ne-e-c*
be:Pl-Agt.Nzr bat be-Npast-Indic

'Bats are ones that while some bats are large, other (groups of bats) are small.'

F20 *utsi* *bëpucte* *podo* *an-diad-tsëc-ec* *ush-quid*
other leaf leaf inside-hang-Dim-while:S/A>S sleep-Hab

'Other little ones sleep hanging inside dicot leaves [rolled-up new banana and wild banana leaves].'

F21 *utsi-bi* *cuëte* *da-diad-tsëc-ec*
other-Emph dicot.tree trunk-hang-Dim-while:S/A>S

ush-e-c *cuëte* *tëdion*
sleep-Npast-Indic dicot.tree below

'Still other (small ones) sleep hanging onto the trunk of a tree, on the underside of the [fallen] tree.'

F22 *cuëte* *chimeshad-aid* *tëdion* *diad-tsëc-ec*
dicot.tree fall.over-Pat.Nzr below hang-Dim-while:S/A>S

ush-quid *cuesban* *ne-e-c*
sleep-Agt.Nzr bat be-Npast-Indic

'[Those] little bats are ones that sleep hanging on the underside of fallen trees.'

Informant G (30-year-old man; Buenas Lomas; 3 July 1998; 1:47 min)

I'm going to tell about bats next. Bats are ones that eat their food, little soft fruits, as they fly around at night. That is how the bats that live in termite nests eat. Another bat, the one that has a tail, also eats like that. That same one sleeps in hollows/holes. That one is one that is inside hollow trees. Still another, a little black bat lives high up. It is likewise one that lives in tree hollows. Bats eat all sorts of things. They eat plantains and things like that, dicot tree fruits, crickets. They eat those at night after grabbing them [the crickets]. They are ones that eat like that. Another bat itself makes a tent from the leaf of wild banana plant and hangs inside. Bats are ones that hang inside like that. Bats exist in different varieties: light-colored bats, red bats, black bats. That's how many [kinds of] bats there are. There are many bats. Others I haven't seen yet. I'm only going to tell about the bats I've seen. That's really how many bats there are. Bats are ones that eat like that. Bats eat in different manners.

Informant E (40-year-old man; Nuevo San Juan; 1 July 1998; 2:25 min)

I'm going to tell about the next one, now. About bats next. There are different types of bats: tailed bats, fleshy-nosed bats, white-chested bats, black bats. On their shoulders there is a "food grabber" or something, as if it had two mouths. Bats exist in different ways. Bats sleep under trees. Bats sleep in wild banana plants. Bats sleep in termite nests. Bats sleep under buttress roots. Bats hang on the trunks of very dry trees. Other bats are under big [fallen] trees where the tree is twisted. Also, others are in big hollows, in big hollows of big ***tëmpa*** trees. There are very, very many (kinds of) bats. Bats are of many different types. One that is very small, that one lives on the river. (That) little, gray bat roosts over the river . . . the bat. A red bat, that is one that sucks blood . . . a red bat. They suck chickens' blood, Matses' too. Bats are like that. Bats exist in truly many different varieties. There are many bats. Bats are ones that are really like that. Bats are ones that you can't say all the places where they sleep. They each sleep in different places. After Matses see how they've made (their nests), they make their nest further away. When people leave, they return again. After making holes in a *Cecropia* leaf, the bats sleep. Where there is a good, dry dead *Cecropia* leaf, the bat sleeps, the light-colored bat. That's where the bats are. Bats are found dwelling in different ways. [I] have not seen every one yet. After catching them we would see all the bats.

Informant D (45-year-old man; Buen Perú; 6 July 1998; 1:20 min)

After not flying around in the daytime, many come out at night. Many come inside houses. After seeing ripe plantains, many bats come inside the house. And eat those. They don't go away. Many bats fly around right inside the house. Bats are ones that keep on coming to the same place, leaving feces right where they eat plantains, many! After saying, "the one that has a tiny tail eats plantains," they kill the bats. Bats are ones that do like that. All of them fly around outdoors and elsewhere. The same one that is in new rolled wild banana leaves is the one

that keeps on coming to the house. The (little) bats keep coming after sleeping hanging in the forest. At the top horizontal roof pole . . . after entering into [the space above] the top roof pole, bats give birth right there and get used to living there. That little bat calls out right from there [the top roof pole]. Bats are numerous ones. There are many bats. Bats are inedible ones. Bats are little ones that are all wing.

Informant C (40-year-old man; Buen Perú; 12 July 1998; 2:11 min)

(And now), bats. Bats are found in places like this: In holes in stream headwater gullies and in ***budëd*** palm [*Attalea butyracea*] leaves on the tip where it is not pinnately divided. After biting the ***budëd*** [*Attalea butyracea*] palm frond while hanging onto the frond, after biting the frond [to shape it into a tent], that one hangs inside. Bats sleep in ***shëcmaucudanmës*** palm [*Hyospathe elegans*] leaves, wild banana leaves, and in all leaves. Bats are ones that are like that. Bats want to bite Matses. People who are bitten by bats . . . after the bat bites them, their blood doesn't heal [i.e., it doesn't coagulate]. Bats are worthless ones. Inedible ones. They fly around at night. They eat plantains that Matses have hung up (in their houses). Bats are ones that want ripened plantains. Large bats fly around everywhere at night. Others fly around very high up. Another [is] extremely large. Bats call out saying "tsecque." There are many bats: little black bats, light-colored bats. Another small one hangs on trees on the big river. Bats are under [fallen] trees and places like that. Bats fly around at dusk. Bats laugh happily at night. After grabbing fig fruits, as they come flying by, they drop fruits down at house roofs. The bats throw fruits at the house so people will think, "a demon is hitting the house throwing things." Bat are ones that do like that. There are different types of bats: black bats and others, red bats, little white bats, black bats, big black bats. Bats vocalize a lot. Big bats fly by making noise with their wings. Others (sound) like a fletched arrow passing by. Bats are ones that are always flying by.

Informant H (55-year-old man; Estirón; 28 July 1998; 1:48 min)

There is another one that is like this, another winged one called "bat." They fly around like this: [bat call and flapping imitations] at night. They fly around in groups: [bat flapping imitations]. After doing like that, many fly around. They keep on flying around there. They keep on going to pick fig fruits and similar fruits. They eat while flying, they do not eat while perching. They continually go back and forth to eat fruits of big fig trees. They drop [fruits] as they continually fly around. They continually fly around like that in groups. At night they continually eat, a lot. They also fly along the river. In the swiddens, they eat plantains and things that have been cut down, without saying, "they have hung this up to eat" [i.e., they don't care that the plantains are products of the labor of Matses, not bats]. They also eat plantains indoors while continually coming inside houses. After eating the sweet ones [fruits] that are in primary forest, they find a swidden, then they find soft [ripened] plantains that have fallen off the tree, and eat them up very quickly. While continually coming back and forth grabbing, and continually coming back and forth ripping off pieces, bats do not eat all [of the plantain].

They eat leaving part of it [i.e., wastefully, without finishing it]. They also do like that when they come in Matses houses. After flying around at night, they sleep hanging in a hollow termite nest, in a termite nest that is halfway up a tree trunk. While hanging, not straight like we sleep, but hanging only by their little feet, with their head toward the ground, bats sleep (in a group). Bats are ones that sleep like that.

Informant I (30 year-old man; Buenas Lomas; 28 July 1998; 2:10 min)

Bats. One is a big bat, another is a little bat, and still another [lives] on the river. Bats were hanging under a fallen tree that bridges a stream. There was one that was a very small one, and another was a big bat. That one [the big bat] lives in termite nests, and another in tree hollows. Bats are even in holes in the ground, too. Their food plantains. . . [incomplete sentence]. They are *bucu* tree [*Cecropia* spp.] fruit eaters. Bats eat all sorts of things. Bats live in holes in the ground. Bats are in new rolled leaves of wild banana plants. Bats hang in old houses, inside the house. Bats are truly plantain eaters. They strongly desire plantains. They continually carry off vine fruits. Fig fruits, bats also eat things like that, things like fig fruits. There is another big bat, a very dark-colored one, a big one. There was another big bat, a very big, large bat that said, "tsecque, tsecque, tsecque." Yet another a small bat . . . [incomplete sentence]. Bats come inside houses wanting to eat plantains. Also, they are ones that bite dogs on the ears. Bats bite dogs, ear-biting them. They come indoors. They fly around indoors. All bats fly around at night outdoors, too . . . high up. That's all.