

PUBLICACIONES  
DEL  
MUSEO DE HISTORIA NATURAL  
UNIVERSIDAD NACIONAL MAYOR DE SAN MARCOS

SERIE A ZOOLOGIA

No. 43

*Publ. Mus. Hist. nat. UNMSM (A) 43: 1-6.*

30 setiembre 1992

**BAT FRUGIVORY AND SEED DISPERSAL IN THE AMAZON,  
LORETO, PERU**

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**ABSTRACT**

We analysed the diet of 15 species of bats (*Phyllostomus elongatus*, *P. hastatus*, *Glossophaga soriana*, *Carollia castanea*, *C. brevicauda*, *C. perspicillata*, *Rhinophylla pumilio*, *Artibeus jamaicensis*, *A. lituratus*, *A. obscurus*, *Platyrrhinus helkri*, *Stumira lilium*, *Uroderma bilobatum*, *U. magnirostrum*, and *Vampyressa pusilla*) captured in the upper Amazon basin of Peru. Seeds of Araceae, Guttiferae, Hypericaceae, Moraceae, Piperaceae, and Solanaceae were found in their feces. An additional nine species represented non-frugivorous guilds.

**RESUMEN**

Analizamos la dieta de 15 especies de murciélagos (*Phyllostomus elongatus*, *P. hastatus*, *Glossophaga soricina*, *Carollia castanea*, *C. brevicauda*, *C. perspicillata*, *Rhinophylla pumilio*, *Artibeus jamaicensis*, *A. lituratus*, *A. obscurus*, *Platyrrhinus helkri*, *Stumira lilium*, *Uroderma bilobatum*, *U. magnirostrum*, y *Vampyressa pusilla*) capturados en la Amazonia Peruana. Se encontraron semillas de Araceae, Guttiferae, Hypericaceae, Moraceae, Piperaceae, y Solanaceae en sus heces. Otras nueve especies pertenecían a no-frugívoros.

**INTRODUCTION**

Although considerable effort has been expended in the study of seed dispersal by bats (De Foresta *et al.*, 1984; Dinerstein, 1986; Dos Reis & Guillet, 1983; Howe & Smallwood, 1982; Janzen, 1983), in Peru these studies are just beginning (Ascorra *et al.*, 1989). We studied bat diets by fecal sample analysis during the rainy and dry season in a floodplain forest of lowland amazonian Peru. Despite the limited size of the sample we obtained noteworthy information on the diet of several species.

**MATERIAL AND METHODS**

Bats were collected near Explorama Lodge at Quebrada Yanamono, a small tributary on the left margin of the Amazon River, ca. 58 km NE of Iquitos, Department of Loreto, Peru (Fig. 1). We collected on forest trails, over forest streams, along forest edges, and on the border between secondary growth and banana groves. Sets of 1-3 nylon mistnets placed at ground level were opened during six evening netting sessions (9-14 March, 1991), from 1800 to 2100 hours for a total of 36

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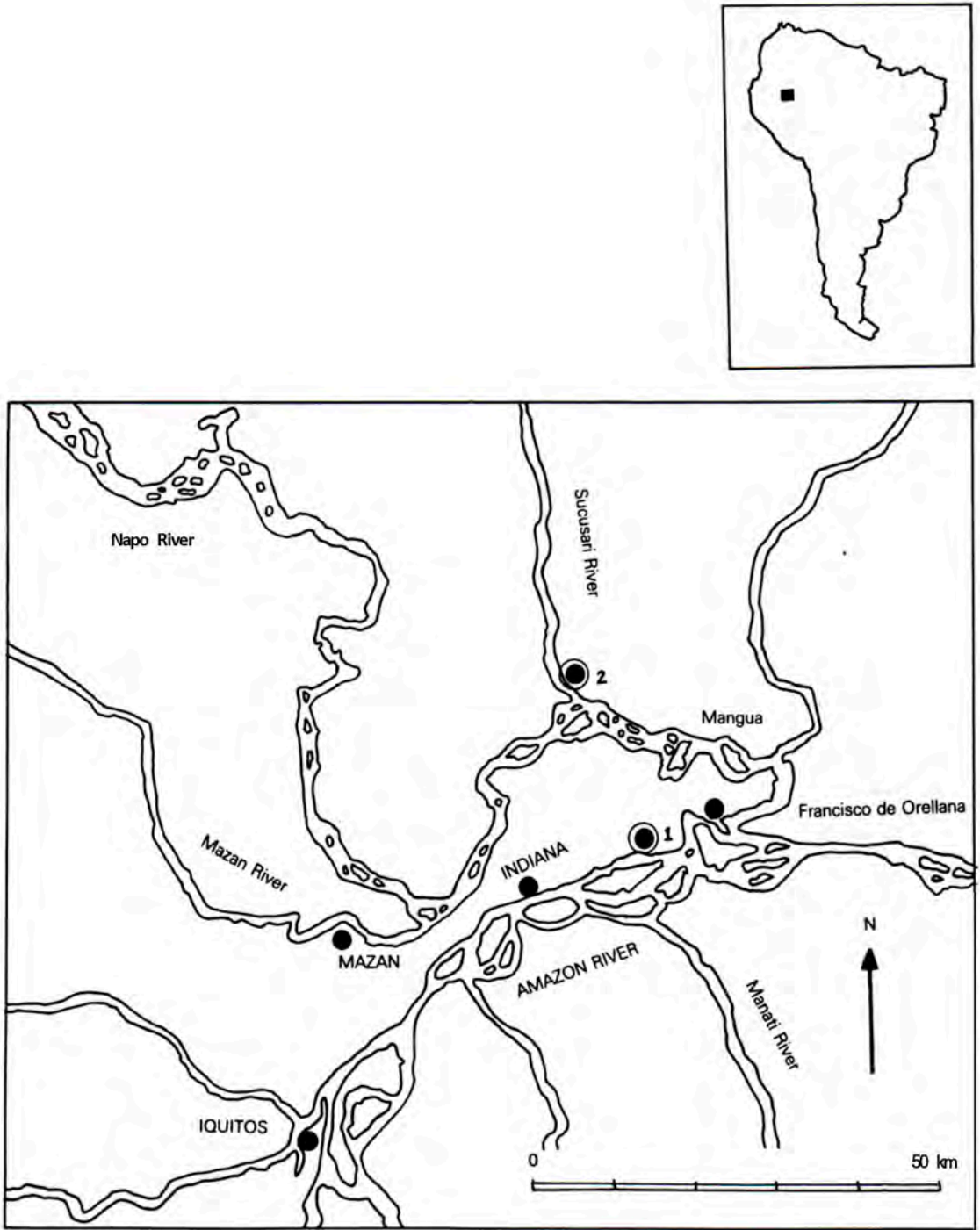


Figure 1- Study Site (1=Explorama Lodge at Quebrada Yanamono, and 2=Explomapo camp at Quebrada Sucusari).

net-hours. Bats were also mistnetted at the Explornapo Camp at Quebrada Sucusari, a tributary on the north bank of the Napo River, ca. 68 km NNE of Iquitos and ca. 22 km NNO of the previous site (Fig. 1). We collected mostly on forest trails, along forest edges and surrounding a small "colpa" or residual salt lick. Sets of five nets were placed at ground level and opened during four evening netting sessions (24-27 June, 1991) from 1800 to 2100-2200 hours, for a total of 54 net-hours. Only twice did we collect by hand at tree roosts.

**Table 1.** Bats collected (ai = aerial insectivores, fg = foliage gleaner insectivores, o = omnivores, n = nectarivores, and f = frugivores) at the study sites (! = Quebrada Yanamono, 2 = Quebrada Sucusari).

Taxa	Trophic guild	Number collected	Procedence
<b>EMBALLONURIDAE</b>			
<i>Peropteryx leucoptera</i>	ai	1	2*
<i>Rhynchonycteris naso</i>	ai	4	1,2
<i>Saccopteryx bilineata</i>	ai	1	2*
<b>PHYLLOSTOMIDAE</b>			
<b>Phyllostominae</b>			
<i>Mimon crenulatum</i>	fg	1	1
<i>Phyllostomus elongatus</i>	fg	2	2
<i>Phyllostomus hastatus</i>	o	1	1
<b>Glossophaginae</b>			
<i>Glossophaga sonana</i>	n	3	1
<i>Lonchophylla thomasi</i>	n	1	1
<b>Caroliinae</b>			
<i>Carollia brevicauda</i>	f	10	1,2
<i>Carollia castanea</i>	f	4	1,2
<i>Carollia perspicillata</i>	f	20	1,2
<i>Rhinophylla pumilio</i>	f	3	1,2
<b>Stenoderminae</b>			
<i>Artibeus jamaicensis</i>	f	43	1,2
<i>Artibeus lituratus</i>	f	10	1,2
<i>Artibeus obscurus</i>	f	1	2
<i>Artibeus sp.</i>	f	1	1
<i>Platyrrhinus helleri</i>	f	5	1,2
<i>Sturnira lilium</i>	f	1	1
<i>Uroderma bilobatum</i>	f	7	1,2
<i>Uroderma magnirostrum</i>	f	1	1
<i>Vampyressa pusilla</i>	f	6	1,2
<b>VESPERTILIONIDAE</b>			
<i>Myotis albescens</i>	ai	2	1
<i>Myotis nigncans</i>	ai	1	2
<i>Myotis riparius</i>	ai	1	2
<b>TOTAL</b>		<b>130</b>	

\* collected by hand.

Bats collected were identified, sexed, measured and released after being held in individually labelled cloth bags for ca. 2 hours to obtain feces. The fecal samples were removed and put into glassine envelopes until analysis. In the laboratory the fecal samples were placed in water and examined under a stereomicroscope. Intact seeds were removed, and allowed to dry. The seeds were identified to species level when possible by comparison with the reference collection of the Seed Dispersal Project, Centro de Investigación "Jenaro Herrera", Instituto de Investigaciones de la Amazonia Peruana (IIAP), Iquitos.

Overall Shannon-Weaver diversity indices are calculated using the formula  $H' = 0.020026 \times (N \log N - \sum ni \log ni)$  (Hair, 1987).

Records of associated fauna were made from daily or nightly observations within the study area.

**Table 2** Positive fecal samples from bats collected at Quebrada Yanamono (Ph = *Phyllostomus hastatus*, Gs = *Glossophaga soricina*, Cb = *Carollia brevicauda*, Ce = *Carollia castanea*, Cp = *Carollia perspicillata*, Aj = *Artibeus jamaicensis*, Pl = *Platyrrhinus helleri*; Sl = *Sturnira lilium*, Ub = *Uroderma bilobatum*, Um = *U. magirostrum*, and Vp = *Vampyressa pusilla*).

Plant species	Bat species											Total
	Ph	Gs	Ch	Ce	Cp	Aj	Pl	Sl	Ub	Um	Vp	
ARACEAE												
<i>Anthurium</i> sp.					1							1
GUTTIFERAE												
<i>Havetiopsis lavida</i>									1			1
HYPERICACEAE												
<i>Vismia</i> spp.			3		4							7
MORACEAE												
<i>Cecropia distachya</i>					3							3
<i>Cecropia /ict/olia</i>					1		1					2
<i>Cecropia membranaceae</i>	1	1										2
<i>Ficus</i> spp.						1	1		3			5
PIPERACEAE												
<i>Piper</i> spp.					2	5					1	8
<i>Photomorpho pe/tata</i>		3		1	2				1	1		8
SOLANACEAE												
<i>Solanum lanceolatum</i>								1				1
UN-IDENTIFIED					2							2

## RESULTS AND DISCUSSION

We collected 130 bats of 24 species and three families (Table 1). Bats of the Phyllostomid subfamily Stenoderminae were the most abundant, with *Artibeus jamaicensis* as the most common, followed by the subfamily Carollinae with *Carollia perspicillata* and *C. brevicauda* as the most abundant. Large numbers of *Artibeus jamaicensis* were collected in a few hours in nets surrounding a small "colpa" or salt lick at Quebrada Sucusari. Such places are well known by hunters searching for terrestrial mammals, and probably the bats also visit the area for water or minerals.

Frugivores comprised 54.2%, aerial insectivores 25%, foliage gleaning insectivores 8.3%, nectarivores 8.3% and omnivores 4.2% of the total sample. The overall Shannon-Weaver diversity index estimated for mistnetted bats was 3.12.

A total of 20 species of non-volant mammals was recorded from the area (Appendix 1).

At Quebrada Yanamono we obtained 40 fecal samples containing seeds (Table 2) of 6 plant families, with Piperaceae (40%) and Moraceae (30%) the most frequently represented. About 80%

**Table 3.** Positive fecal samples from bats collected at Quebrada Sucusari (Pe = *Phyllostomus elongatus*, Cb = *Carollia brevicauda*, Ce = *C. castanea*, Cp = *C. perspicillata*, Rp = *Rhinophylla pumilio*, Aj = *Artibeus jamaicensis*, Al = *A. lituratus*, **A** = *A. obscurus*, Pl = *Platyrrhinus helleri*, Uh = *Uroderma bilobatum*, and Vp = *Vampyressa pusilla*).

Plant species	Bat species										Total	
	Pe*	Ch	Ce	Cp	Rp	Aj	Al	Ao	Pl	Uh		Vp
<b>HYPPERICACEAE</b>												
<i>Vismia</i> spp.		1		3			1				1	6
<b>MORACEAE</b>												
<i>Cecropia /icz/olia</i>									1			1
<i>Cecropia membranacea</i>								2	2			4
<i>Ficus</i> spp.						1		2		2	2	7
<b>PIPERACEAE</b>												
<i>Pipe</i> , spp.				2	1				1			4
UN-IDENTIFIED					2							2

\* we only found insect remains in fecal samples.

of the seeds belong to pioneer and secondary growth plant species (principally *Piper*, *Cecropia*, and *Vismia*), and 15% to primary forest plant species (*Ficus* and *Anthurium*).

At Quebrada Sucusari we obtained 24 fecal samples containing seeds (Table 3) of four plant families, with Moraceae (50%) found most frequently. Some (54%) of the seeds belong to pioneer and secondary growth plant species (principally *Cecropia*, *Piper*, and *Vismia*) and 29% to primary forest plant species (*Ficus*).

Our results are consistent with previous reports on the diet of *Phyllostomus discolor*, *P. hastatus*, *Artibeus jamaicensis*, and *A. lituratus* (Dos Reis & Guillaumet, 1983; Gardner, 1977).

Although Gardner (1977) reports *Glossophaga soricina* feeding on *Piper* and *Cecropia* we found only *Pothomorpha pe/tata* seeds in the feces of individuals collected.

Seeds of *Cecropia* and *Vismia* were found in feces of *Carollia brevicauda*. Seeds of *Piper* and *Pothomorpha pe/tata* were found in fecal samples of *Carollia castanea*. Although Dos Reis & Guillaumet (1983) record *C. perspicillata* feeding on *Vismia*, *Cecropia*, *Ficus*, *Piper* and *Solanum*, we also found *Anthurium*, *Pothomorpha pe/tata*, and unidentified seed in fecal samples.

Seeds of *Cecropia* and *Vismia* were found in feces of *Artibeus lituratus*. *Piper* seeds were obtained from fecal samples of *A. obscurus*.

Although *Sturnira lilium* had been recorded feeding on *Clusza*, *Vismia*, *Piper*, *Solanum* (Dos Reis & Guillaumet, 1983), and *Cecropia* (De Foresta *et al.*, 1984) we found only seeds of *Solanum* in feces.

Although *Uroderma bilobatum* is a well known fig specialist (Dos Reis & Guillaumet, 1983), seeds of *Pothomorpha pelta/a* and *Havetiopsis* were found in feces. Although Gardner (1977) reported *Uroderma magnostrum* feeding on pollen we found seeds of *Pothomorpha pe/tata* in feces.

*Platyrrhinus helleri* had been recorded feeding on *Cecropia* (Dos Reis & Guillaumet, 1983) and we also found *Ficus* seeds from its feces.

*Piper* and *Ficus* seeds were found in fecal samples of *Vampyressa pusilla*.

#### ACKNOWLEDGMENTS

The research at Yanamono was done during the First International Expeditions Rain Forest Workshop in the Pcruvian Amazon. Many participants of the workshop helped us with the sampling. The work at Sucusari was made possible by International Expeditions and Exploraciones Amazónicas S.A. We thank Dr. Richard Milis for his valuable help with the field work at both places and Peter Jcnson of Exploraciones Amazónicas S.A. for facilities at Explorama Lodge and Explor- napo Camp. We are also grateful to James B. Cope, Lynne Hartshorn, and Kate Wilson for field assistance at Sucusari. Research on seeds identification was supported under grant N° 7228, Program in Science and Technology Cooperation, Office of Science Advisor, U.S. Agency for International Development. We thank Dr. Gerardo Lamas for his comments and review of the manuscript.

This is publication N° 19 of the Biological Diversity of Latin America (BIOLAT) Program.

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## APPENDIX 1

Mammals recorded at the study sites and surrounding places during the field work.

### MARSUPIALIA

- 1 *Caluromys lanatus*
- 2 *Didelphis marsupialis*
- 3 *Marmosa* sp.

### XENARTHRA

- Mylomecophagidae*
- 4 *Tamandua tetradactyla*
- Bradyrodontidae*
- 5 *Choloepus* sp.
  - 6 *Bradypus variegatus*

### PRIMATES

- Callitrichidae*
- 7 *Cebuella pygmaea*
  - 8 *Saguinus* sp.
- Cebidae*
- 9 *Callicebus molloch*

### CARNIVORA

- Procyonidae*
- 10 *Potos flavus*
- Mustelidae*
- 11 *Pteromura brasiliensis*

### PERISSODACTYLA

- Tapiridae*
- 12 *Tapirus terrestris*

### ARTIODACTYLA

- Tayassuidae*
- 13 *Tayassu tajacu*

### RODENTIA

- Sciuridae*
- 14 *Sciurus* sp.
- Muridae*
- 15 *Orzomys* sp.
- Agoutidae*
- 16 *Agouti paca*
- Dasyproctidae*
- 17 *Dasyprocta* sp.
  - 18 *Myoprocta* sp.
- Hydrochaeridae*
- 19 *Hydrochaeris hydrochaeris*
- Echimyidae*
- 20 *Proechimys* sp.

