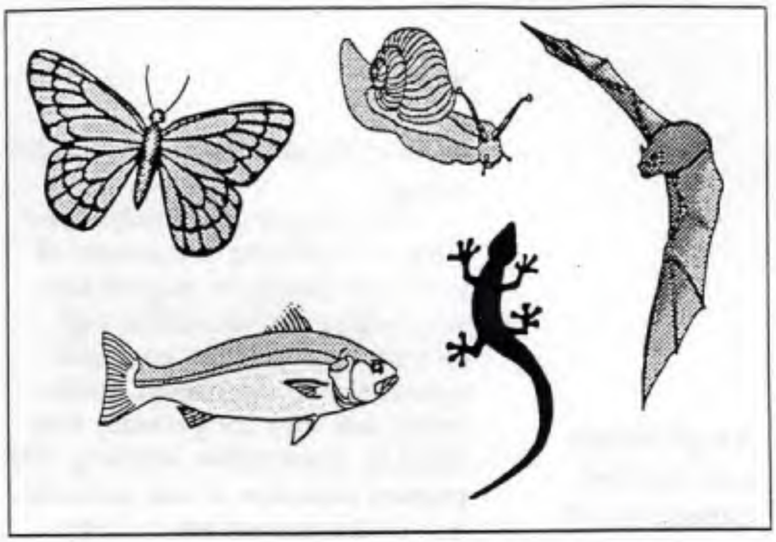
Amphibians and Reptiles I: Biodiversity Assessment in the Lower Urubamba Region



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Introduction

Several studies documenting the amphibians and reptiles in tropical lowland forests of southeastern Perú have been published in recent years. Morales and McDiarmid (1996) reviewed the published herpetofaunal surveys that have been completed in the department of Madre de Dios since 1980 and suggest that as a result of these studies, the herpetofauna of lowland Madre de Dios may be better known than any other similar lowland area in tropical America. Work in the adjacent areas of the Lower Urubamba could complement this baseline knowledge and provide comparative data. The lowland tropical forested area of the Lower Urubamba region has not been studied to the degree that biodiversity has been and is being investigated in Madre de Dios. Morales (1997) recently published the results of a rapid assessment of the herpetofauna in the Rio Camisea area in which he recorded 24 species of amphibians and seven species of reptiles.

The SI/MAB studies at the San Martin-3 and Cashiriari-2 well sites in the Lower Urubamba focus on faunal and floral assessments and the establishment of permanent biodiversity test plots. The next phase of the project will focus on monitoring at the plots to detect diversity, habitat use, relative abundances, and ecological changes.

Amphibians and reptiles comprise an important component of vertebrate faunas in tropical forested regions. They exhibit high diversity and extreme ecological specialization and habitat preferences, and they are generally amenable to quantitative sampling. The primary objective of our participation in this project was to begin establishing baseline data on the herpetofauna present at the two well sites, which can be incorporated into the ultimate task of creating a multi-taxa monitoring program to help detect changes in the ecosystem and assist in management of natural resources in the area. Selected specimens of amphibians and reptiles encountered during the survey were sampled and preserved as vouchers to document individual species occurrence and to begin examining and clarifying distributions and taxonomy of the herpetofauna in the region.

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Methods

Field work at the primary site, San Martin-3, was in non-flooded forest habitat dominated by bamboo (*Guadua sarcocarpa*), (see Alonso et al. this volume). The site has extremely steep and irregular topography lacking swamps, major riverine habitats, and other situations with the standing water typical of many tropical lowland sites in Perú. The tall-growing bamboo, which can have stolons up to several meters long allowing it to become quite invasive, is very dense at this site. Standard nocturnal and diurnal herpetofaunal surveys and sampling for amphibian larvae were conducted March 10 to April 9, 1997.

In addition to the diurnal and nocturnal surveys and larval sampling, specimens were sampled at San Martin-3 using three relatively experimental quantitative methods: 1) mouse glue boards set on the forest floor in canopy gaps, 2) from a 10 X 10-m unfenced plot in which all ground litter was examined and displaced, and 3) from an experimental 10 X 10-m fenced plot from which all above-ground vegetative matter was removed.

The unfenced 10 X 10-m litter plots have been commonly used in New World tropics and elsewhere as a quantitative measure of forest floor herpetological communities. The fenced experimental 10 X 10-m plot allowed for a complete and quantitative sample of the amphibians and reptiles present. In this plot, all vegetation extending upwards from ground level through the canopy was excluded along the perimeter of the plot, and a fence of greased aluminum flashing with walls 0.5 m in height was erected at the plot perimeter to serve as a barrier to amphibian and reptile movement into or out of the plot during the examination period. The vegetation in the plot was then inspected and removed down to the soil substrate, and all amphibians and reptiles encountered were recorded and sampled. Other studies have variably controlled immigration and emigration of specimens from plots (i.e., using perimeter barriers, canopy separation, or isolation of vertical tree trunks), but none to our knowledge have addressed all three at the same time as we attempted in this study.

Additional survey work was done at the Cashiriari-2 well site on the evening of March 26. This area is primary lowland wet forest without the extensive bamboo stands that are present at San Martin-3. The accommodations for scientific personnel at Cashiriari-2 were not completed before the end of our scheduled field time, preventing further work at that site (but see Icochea and Mitchell, this volume). As a result, we were only able to survey amphibians and reptiles for the one evening, and we have minimal data from the site.

Results and Discussion

In contrast to more typical tropical lowland sites where bamboo thickets are only a fraction of the total habitat, nearly all of our efforts at San Martin-3 were conducted in—or in close proximity to—profuse bamboo stands. This habitat feature comprised a significant visual complexity and furnished a myriad of potential perch sites, which undoubtedly affected our sampling results. Exclusive of glue board or removal plot sampling, most surveys of amphibians and reptiles depend on visual searches for animals as well as detecting frog vocalizations. The density and visual complexity of the bamboo forest limited our ability to see even the calling frogs known to be present and undoubtedly reduced sightings of terrestrial and arboreal reptiles.

The timing of the field work coincided with the late part of the wet season and the initial transition period into the dry season. The well-drained soils and steep terrain at San Martin-3 were entirely devoid of standing above-surface ground water suitable for frog breeding and subsequent larval development. However, a myriad of small water-filled sites were available in the form of broken off or otherwise opened bamboo internodes. These water-filled bamboo sites included both standing and fallen stalks, stalks with openings gnawed by arboreal rodents foraging for insect larvae, and stalks that had been opened during camp development, trail maintenance, and natural tree falls. No evidence of frog reproduction (eggs or larvae) was found during examination of more than 200 standing or fallen water-filled bamboo internodes, although the majority of these aquatic sites did contain insect (primarily mosquito) larvae and other organic material.

A single *Phyllomedusa* egg mass was found on the underside of a leaf overhanging a small stream in the biodiversity plot #2. Despite extensive sampling in and along the streams, this was the only evidence of anuran reproduction found. Approximately 100 dip net samples were taken at two second-order streams and five seeps feeding into the streams near San Martin-3. No larvae or other indications of amphibian reproduction were found in the stream samples or observed during the sampling process. Because of the steep topography, most streams at the site were subject to major rising of water levels (up to 4 m during our visit) and dramatic flooding during heavy rains that would easily carry away eggs and larvae from the stream channels.

The most common anurans at San Martin-3 were members of the genus *Eleutherodactylus*. Frogs of this genus develop directly from an egg to the adult stage without a free-living aquatic tadpole stage and are thus not necessarily dependent on standing water for development.

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Members of the typically abundant tropical frog family Hylidae, although present, were remarkably uncommon at San Martin-3. In contrast to the *Eleutherodactylus*, most hylids have a free-living aquatic larval stage and are dependent on standing or flowing water for development. We also encountered *Hemiphractus probocideus* and *H. scutatus*, hylids in which the unpigmented eggs develop on the female's back; four species of Dendrobatids that have the ability to transport larvae over land after the eggs hatch; and *Osteocephalus leprieurii*, a hylid known to deposit eggs in cavities such as bamboo or other isolated water receptacles.

A total of 504 specimens were sampled, documenting more than 80 species of amphibians and reptiles from the San Martin-3 and Cashiriari-2 well sites (Table 1 and Appendix 1). We recorded 16 genera in seven families of amphibians, and 31 genera in 10 families of reptiles. There were substantially more specimens per taxa of amphibians, but more families and

Table 1. Number of genera, species and specimens of the amphibians and reptiles sampled at San Martin-3 and Cashiriari-2 in March and April, 1997, during the biodiversity assessment in the Lower Urubamba region

	Genera	Species	Specimens
CLASS AMPHIBIA	16	40+	410
ORDER ANURA	14	38+	394
Family Buonidae	1	2	52
Family Dendrobatidae	2	4	28
Family Hylidae	5	11	89
Family Leptodactylidae	5	20+	223
Family Microhylidae	1	1	5
unidentified eggs/larvae		2	
ORDER CAUDATA			
Family Plethodontidae	1	1	7
ORDER GYMNOPHIONA			
Family Caediliidae	1	1	4
CLASS REPTILIA	31	40	94
Suborder Sauria	12	15	54
Family Gekkonidae	2	2	3
Family Gymnophthalmidae	5	5	11
Family Polychrotidae	2	5	14
Family Scincidae	1	1	20
Family Teiidae	1	1	3
Family Tropiduridae	1	1	3
Suborder Serpentes	19	25	40
Family Boidae	2	2	2
Family Colubridae	14	20	34
Family Elapidae	1	1	2
Family Viperidae	2	2	2

genera of reptiles even though reptiles constituted only 18% of the total number of specimens collected (Table 1). The species designations for the *Eleutherodactylus* are tentative and some will undoubtedly change as specimen identifications are further refined through additional comparisons with museum collections and the systematic literature.

In addition to the specimens sampled, we also recorded four additional taxa at San Martin-3 that were not sampled. We captured and released one caiman (*Paleosuchus palpebrosus*) from a small creek east of camp and positively identified the call of the tree frog *Hyla boans* one evening from the large quebrada east of camp. That vocalization constituted our only record for this species. A single *Plica plica* was observed out of reach high on a tree trunk in the vicinity of our experimental removal plot. Finally, the botanists reported that they encountered a tortoise (*Geochelone denticulata*) while mapping trees in the biodiversity plot #1.

The difference in numbers of amphibians encountered using traditional plot methodology (i.e., unbounded plots in which litter is moved toward the outside perimeter) versus the barrier plot (where all vegetation was examined and removed after the plot was isolated using a 0.5-m aluminum fence and canopy separation achieved by pruning) was strikingly notable. The traditional plot produced three anurans (one dendrobatid and two *Eleutherodactylus*), whereas the barrier plot produced 29 anurans (including five microhylids not encountered during any other sampling effort) and one snake (*Corallus hortulanus*). In addition to the five *Syncope antenori*, the amphibians captured in the litter plot included *Eleutherodactylus* and *Bufo*. Additional replicates of this methodology are needed to properly evaluate its utility in determining better estimates of absolute abundance relative to the unbounded plots (which are less labor and time intensive), but this initial attempt produced extremely encouraging results.

Study of lizards at San Martin-3 was greatly facilitated by the use of mouse glue boards placed on the ground as well as on low branches and bamboo stems in areas of broken sunlight and shade. The glue boards were successful in capturing four gymnophthalmid lizards (*Arthrosaura, Cercosaura, Iphisa*, and *Prionodactylus*) that were either never or only rarely seen during visual surveys. Glue boards also facilitated capture of some larger lizards (*Kentropyx pelviceps, Anolis punctatus, Mabuya bistriata*) in densely vege-tated areas where hand capture was hindered and less successful. The glue boards were also used on tree trunks and branches to monitor potential movement of animals out of the fenced plot during the removal experiment.

Other Important Activities

We took the opportunity to work with our samples for a few days at the Museo de Historia Natural at the Universidad Nacional Mayor de San Marcos in Lima. While there, we spent considerable time assessing and discussing herpetology collection management issues, data standards, and electronic databases with the curator of

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the herpetology department. As a result of these discussions, we have already begun providing information and guidelines for database structure and management to our Peruvian counterparts based on our collection management activities at the U.S. National Museum. Our recent involvement and commitment to the collection management capabilities at the Museo de Historia Natural is a first step toward a cooperative venture to help improve the status of the herpetology collection there, and hence, the research potential of the specimens. Half of the voucher specimens collected during our field work will be deposited at the Museo de Historia Natural, as have collections from previous work by Smithsonian Institution and other foreign investigators working in Perú. Any effort, therefore, to help enhance the collection capabilities of the museum for conservation and curation is in the best interest of the specimens, the research they support, and their ultimate use by national and international scientists in the future.

We were successful in initiating the surveys and sampling necessary for establishing the baseline data on the herpetofauna present at San Martin-3, but because of circumstances beyond our control, comparable data are lacking for Cashiriari-2 (but see Icochea and Mitchell, this volume). Additional herpetological survey work spanning the wet and dry seasons is necessary at both sites to build on the inventory started during this initial effort. The potential exists for much amphibian reproduction to be restricted to periods of low or intermediate levels of rainfall when pools in streams would be more suitable for reproduction by hylid and microhylid frog species. Tests of new sampling strategies and techniques were encouraging, and our Peruvian counterparts expressed interest in future amplification of quantitative sampling efforts at additional sites in Perú.

References

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Morales, V. R. 1997. La herpetofauna en la zona del Rio Camisea, Cusco, Perú: Una evaluacion rapida. Pages 76-79 in Proceedings from the Workshop on Biological and Cultural Diversity of the Lower Urubamba, Perú. (S. Udvardy and A. Sandoval, eds.) Biodiversity Programs, Smithsonian Institution, Washington, DC.

Appendix 1. Species list of the amphibians and reptiles sampled at San Martin-3 and Cashiriari-2 in March and April, 1997, during the biodiversity assessment in the Lower Urubamba region, Cusco, Perú.

	San Martin-3	Cashiriari-2
CLASS AMPHIBIA		
ORDER ANURA		
Family Bufonidae		
Bufo marinus	x	x
Bufo cf. *typhonius*	x	
Family Dendrobatidae		
Dendrobates biolat	x	
Dendrobates cf. *ventrimaculatus*	x	
Epipedobates femoralis	x	
Epipedobates macero	x	
Family Hylidae		
Hemiphractus proboscideus	x	
Hemiphractus scutatus	x	
Hyla geographica	x	
Hyla lanciformis	x	
Hyla marmorata	x	
Hyla parviceps	x	x
Osteocephalus leprieurii	x	
Phyllomedusa cf. *tarsius*	x	
Phyllomedusa tomopterna	x	
Phyllomedusa vaillanti	x	
Sanax garbei	x	
Family Leptodactylidae		
Adenomera cf. *andreae*	x	
Eleutherodactylus cf. *altamazonicus*	x	
Eleutherodactylus cf. *carvaloi*	x	
Eleutherodactylus cf. *conspicillatus*	x	
Eleutherodactylus cf. *croceoinguinis*	x	
Eleutherodactylus cf. *diadematus*	x	
Eleutherodactylus cf. *fenestratus*	x	x
Eleutherodactylus cf. *martae*	x	
Eleutherodactylus cf. *ockendeni*	x	
Eleutherodactylus Peruvianus	x	x
Eleutherodactylus sulcatus	x	
Eleutherodactylus cf. *toftae*	x	
Eleutherodactylus cf. *ventrimarmoratus*	x	
Ischnocnema quixensis	x	
Leptodactylus leptodactyloides	x	
Leptodactylus pentadactylus	x	
Leptodactylus petersii	x	
Leptodactylus rhodonotus	x	x
Leptodactylus stenodema	x	
Lithodytes lineatus	x	
Family Microhylidae		
Syncope antenori	x	
ORDER CAUDATA		
Family Plethodontidae		
Bolitoglossa altamazonica	x	x
ORDER GYMNOPHIONA		
Family Caeciliidae		
Caecilia tentaculata	x	

Appendix 1. Species list of the amphibians and reptiles (Cont.).

	San Martin-3	Cashiriari-2
CLASS REPTILIA		
ORDER SQUAMATA		
Suborder Sauria		
Family Gekkonidae		
Pseudogonatodes guianensis	x	
Thecadactylus rapicauda	x	
Family Gymnophthalmidae		
Alopoglossus cf. andeanus	x	
Cercosaura ocellata	x	
Iphisa elegans	x	
Prionodactylus argulus	x	
Neusticurus ecpleopus	x	
Family Polychrotidae		
Anolis fuscoauratus	x	x
Anolis punctatus	x	
Anolis trachyderma	x	x
Anolis transversalis	x	
Polychrus liogaster	x	
Family Scincidae		
Mabuya bistriata	x	
Family Teiidae		
Kentropyx pelviceps	x	
Family Tropiduridae		
Plica umbra	x	
ORDER SQUAMATA		
Suborder Serpentes		
Family Boidae		
Corallus hortulanus	x	
Epicrates cenchria	x	
Family Colubridae		
Atractus elaps	x	
Atractus cf. badius	x	
Atractus major	x	x
Chironius cf. monticola	x	
Clelia clelia	x	
Dipsas catesbyi	x	
Dipsas indica	x	
Imantodes cenchoa	x	
Imantodes lentiferus	x	
Leptodeira annulata	x	
Liophis cobellus	x	
Liophis reginae	x	
Oxyrhopus doliatus	x	
Oxyrhopus petola	x	
Pseustes sulphureus	x	
Rhadinaea brevirostris	x	
Tantilla melanocephala	x	
Tripanurgos compressus	x	
Xenodon rabdocephalus	x	
Xenopholis scalaris		x
Family Elapidae		
Leptomicrurus narducci	x	

Appendix 1. Species list of the amphibians and reptiles (Cont.).

	San Martin-3	Cashiriari-2
CLASS REPTILIA		
ORDER SQUAMATA		
Suborder Serpentes		
Family Viperidae		
Bothrops cf. *brazili*	x	
Lachesis muta	x	
LARVAL SAMPLES		
Epipedobates macero	x	
Phyllomedusa sp.	x	
Phyllomedusa cf. *tarsius*	x	