Initial Analysis of Coastal Ecuadorian Herpetofauna of Dry and Moist Forests

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Introduction

Few places in the world represent a greater crisis for biodiversity than the coastal forests of Ecuador. Named as part of the Tumbes-Chocó-Magdalena 'biodiversity hotspot' (Conservation International 2006) for its combination of great biodiversity as well as conservation threats, these forests are less than 10% intact (Dodson and Gentry 1991). The coastal deciduous and semi-deciduous forests in particular are only represented by 2% of the original intact forest cover (Dodson and Gentry 1991).

Indeed, the coastal forests of all of Latin America are in peril (Murphy and Lugo 1986, Bullock et al. 1995). Once comprising at least 60% of the forested tropics, only a few percent remain. One of the biggest challenges in tropical biodiversity conservation today is to explore and protect those neotropical coastal forests in most peril of disappearing, the remaining dry forest fragments.

Biodiversity

The climate and geography of western Ecuador presents a unique scenario for biodiversity. Based on patterns of upwelling in the Pacific Ocean and the Humbolt Current off the coast of Ecuador, the climate of the region exhibits extreme clinal variation in climate (Cañadas 1983). More southern parts of the Ecuadorian coast are primarily influenced by the cold upwelling of the Humbolt current, which sheds little moisture to the coastline, resulting in dry climates. Much of the precipitation yielded from the Humbolt current is in the form of fog, which can increase greatly from the coast to moderate elevations immediately inland.

More northern coastal Ecuador and coastal Columbia are influenced by a warm equatorial current, which yields more precipitation in the form of rain. The middle latitudes of Ecuador around the equator, the sites of the current study, are variously influenced by either the Humbolt or the equatorial currents, which shift in latitude seasonally. From December to June, the equatorial current predominates, yielding large amounts of rainfall. In June, the cool Humbolt current shifts north, covering most of the coastline around the equator, producing a seasonal drying trend.

Some of the wettest rainforests of the world are found on the coast of Columbia in the Choco to the north of western Ecuador, while some of the driest regions on earth are found southward in the Atacama Desert in Peru and Chile. Indeed, there are some regions of the Atacama for which rainfall has never been recorded. Coastal Ecuador is situated in between these extremes in climate and primary plant productivity, and its faunal diversity shares similarities with both regions. Within Ecuador, coastal annual rainfall varies from approximately 700 cm a year in the north to only 30 cm in parts of the south, which are classified as desert (Cañadas 1983).

On the northern coastal region of Ecuador, the Mache Chindul region is the southernmost extent of the Columbian Choco. The habitat is humid tropical forest to humid pre-montane forest (Holdridge, 1967, Cañadas 1983).

South of Mache Chindul, crossing the equator, an extreme gradient in summer rainfall occurs. At our primary study site, most of the 50-60 cm yearly rainfall occurs from May to

January. One result of this seasonal draught is the semi-deciduous to deciduous floral assemblage, dominated by trees from the family Bombacaceae, including the Ceiba (*Ceiba trichistandra*). Another implication of this seasonality is the prevalence of draught-adapted species at more southern, dryer sites. Thus, we *a priori* expect that reptiles might be more prevalent than amphibians in more xeric sites, and the opposite at mesic sites more typical of neotropical forests.

Endemism

The western forests of Ecuador below 900 m elevation are home to high levels of biological endemism (e.g. Borchenius 1997). It has been estimated that about 20% of the flora of western Ecuador is endemic to that region (Gentry 1982). Indeed, a number of plant (Dodson and Gentry 1991) and vertebrate (Lynch and Duellman 1997) species are limited to a single locality. These extreme endemics are often limited to a single hilltop of a certain life zone, separated from other similar zones across low-elevation areas. For instance Cerro Montecristi is a small mountain of only 370 m elevation from the surrounding area and 15 km wide on its longest axis (Dodson and Gentry 1991). No less than nine distinct floristic habitats are found, each at a distinct micro-elevational level. In each habitat is at least one unique species of orchid; some of these species are endemic to this particular mountain. Clearly, the loss of a relatively small patch of habitat in western Ecuador leads, and certainly had led, to the extinction of many range-limited species (Dodson and Gentry 1991).

Threats to Biodiversity

The threats to coastal Ecuadorian biodiversity are many, but ultimately are related to population pressure and development. Agriculture is the single-most devastating form of development in the region, with enormous tracts of forest having been cut down solely for pasture. Banana and citrus plantations also play a large role in the regional economy, and much forest has been cleared for these crops. Oil palm (*Elaeis guineensis*) and eucalyptus (*Eucalyptus spp*.) are also now being grown on large scales in the region. Logging has had the most pervasive impact on otherwise intact forests, and there are very few areas which have not been at least selectively logged (Sierra and Stallings 1998). Even in areas which are not considered deforested, selective logging has had an extreme impact, by removing predominantly large trees in primary or old-growth forest (Sierra and Stallings 1998).

Reptiles and Amphibians

Little is known about the distribution, abundances and population trends of reptiles and amphibians in western Ecuador. This is particularly true of reptiles; only one of the 48 species of reptiles we have documented thus far has been evaluated by the International Union for Conservation of Nature and Natural Resources (IUCN; Table 2). Amphibians fare much better in this regard, with most species having at least been evaluated. However, even those species which have been evaluated are often classified based on incomplete data, with no information on population trends. The lack of knowledge about the reptiles and amphibians in western Ecuador is alarming, considering the importance of these taxa in conservation. Amphibians in particular are excellent indicator species, and may inform us of

a broad range of ecological problems, from environmental toxins to global warming (Kiesecker et al. 2001).

Study Sites

Our study sites run the gamut from the more mesic northern sites in Mache Chindul, to the extremely seasonal sites just south of the Equator (Table 1). We have established three primary study sites, from north to south: Hacienda Siberia, Estacion Bosque Seco Lalo Loor, Reserva Tito Santos). Several smaller datasets are presented herein from incidental observations over a few days effort each have been recorded. One of our primary study sites (Hacienda Siberia at Mache Chindul) as well as a site for supplementary information (Pata de Pajaros) are classified as humid forest. Two study sites (Tito Santos and Lalo Loor) represent stands of dry and dry/humid forest transitions. Two sites (Don Juan and Pedernales) are primarily urban, and observations taken there were within the town boundaries or immediately adjacent to them. We have also recently added two other study sites. Bosque Protector La Perla represents a remnant stand of submontane humid forest just north of Santo Domingo de los Colorados, and is our farthest north and inland site. Playa Paraiso is just south of the town of Jama and represents pure dry forest. Inventories are now under way to collect herpetofaunistic data at these two sites, however no data from these sites is presented herein.

Ecological disturbances on the non-urban study sites were primarily from agriculture, and cattle grazing was the predominant form of agriculture. Two of our study sites (Tito Santos and Lalo Loor) were situated on dairy farms, although extensive tracts of non-cleared

and grazed forest remain. Surveys in these sites were primarily from forests surrounding pastures, but some incidental observations were taken on pasture itself. The northern sites were typified by roads, small settlements and agricultural fields. Pata de Pajaros was the most pristine site, although selective logging was still prevalent there.

Objectives

1) To provide basic data for community composition of reptiles and amphibians in imperiled, little-studied habitats in Manabí Province, Western Ecuador. 2) To examine phenotypic variation in reptiles and amphibians for studies of systematics and taxonomy.

Study Site	Habitats	Disturbances	Latitude	Longitude
Reserva Bosque Seco Tito Santos	Dry and Transitional Humid/Dry Forest; Rural	Cattle, deforestation	S 00.15391	W 080.19553
Estación Biológica Lalo Loor	Dry and Transitional Humid/Dry Forest; Rural	Cattle, deforestation	999 0552 N	17 594576E
Hacienda Siberia	Humid Forest; Rural	Cattle, deforestation, development	624255 622722	24425 0024602
Pata de Pajaros	Humid Forest	Logging	000 404	614 230
Pedernales	Urban	Development		
Punta Prieta	Rural	Development	9985416	17586409
Don Juan	Rural/Mangrove	Development, Cattle	S 00.14285	W 080.23224

Table 1. Study sites.

Methods

We used visual encounter surveys along line transects as our primary method. Transects were primarily trails and streams, and were chosen to reflect the range of habitats and microhabitats available at each site. Transects were usually conducted at night, between 1900 and 0400 hrs. Some additional observations were opportunistically recorded, and were

often around buildings and roads. A few accounts were taken from photographs taken by reserve personnel, when they could be reliable attributed to a location and positively identified.

Upon capture, each individual was identified to species based on available literature. If an identification could not be made, detailed notes concerning its diagnostic traits were taken, as were standardized photographs. A series of voucher specimens were taken during our first survey (Tito Santos January 2003), and additional vouchers of unidentified specimens were taken as needed thereafter. Specimens were deposited into the vertebrate collections at Escuela Politécnica Nacional in Quito. Additional notes were taken at capture regarding body size, sex, microhabitat, and behaviors. Global Positioning System (GPS) coordinates were taken when sattleite positions and terrain allowed an accurate position.

Results and Discussion

Alpha Diversity

A total of 27 species of amphibian and 49 species of reptile were found in a total of 75 survey days effort (Table 2). The preponderance of reptile over amphibian species was expected for dry forest sites (e.g. Sasa and Bolanos 2004). In comparison to Amazonian sites (unpublished data) as well as other humid forest sites, the dry forest sites (Lalo Loor and Tito Santos, etc.) showed twice the proportion of reptiles to amphibians (Table 3).

Shannon Diversity Indices (H) were calculated for each study site (Table 2). Amphibian diversity was high in the January 2003 Tito Santos survey, as well as for both

Mache Chindul surveys (Hacienda Siberia and Pata de Pajaros). Overall amphibian diversity was highest at Hacienda Siberia site and the January 2003 survey of Tito Santos. Surveys of Tito Santos and Lalo Loor during the dry season reveled remarkably similar biodiversity, which was lower than the more mesic site (Hacienda Siberia) and the wet season at Tito Santos. Reptile diversity showed the opposite pattern: higher diversity in the dryer sites and seasons (Table 2).

We expected that within the dry habitats, amphibians would be relatively more prevalent in winter (the wet season) than summer. However, there were only two fewer amphibian species found in Summer of 2003 at Tito Santos as compared to Winter of the same year, and this was paralleled by five fewer reptile species across the same seasons. Abundance of individual animals, however, was much higher for both reptiles and amphibians in the wet season than the dry season at Tito Santos. Shannon Diversity (H) was higher for amphibians in the wet season than the dry, but diversity was higher for reptiles in the dry season than the wet (Table 2).

Total alpha diversity for the two categories of study site (Table 3) shows general concordance with two other study sites in western Ecuador, Bilsa in more northern Mache Chindul Mountains (G.O. Vigle personal communication), and Rio Palenque to the South of Santo Domingo de los Colorados (Miyata 1982). Additional data and further analyses will allow a detailed examination of the beta diversity among these sites.

Species accumulation

Species accumulation curves were completed on data from Tito Santos and Lalo Loor. This analysis was not conducted on data from other sites due to the relatively few days spent at each. For both reptiles and amphibians, and for both sites, the accumulation curves are steep and show no sign of reaching an asymptote (Fig. 1), indicating that continued field effort will continue to yield documentation of more species. Diversity at other western Ecuadorian sites (Table 3) also suggests that more species are yet to be found at Lalo Loor and Tito Santos.

	IUCN Status*	Tito Santos		Lalo Loor		Pedernales	Punta Prieta	Don Juan	Hacienda Siberia		Pata de Pajaros	Total
		Jan 2003	Jul 2003	Jul 2004	May 2005	Jul 2004	Jun 2005	2003	Jul 2004	May 2005	Jul 2004	
Total Survey Days		15	14	20	15	1	2	2	2	2	2	75
Amphibians												
cf. Bolitoglossa sima	VU										1	1
cf. Caecilia nigricans	LC	1										1
Caecilian	-				1							1
Amphibians – Anura	-											
Agalychnis litodryas	VU									1		1
Barycholos pulcher	LC	69	3	10	6			21			1	110
cf. Barycholous pulcher	LC		1									1
Bufo margaritifer	LC								13	13		26
Bufo marinus	LC	123	9	37	170			94	2			435
Colostethus awa	VU								1		8	9
Colostethus machalilla	NT	73	92	153	24				1	16		359
Dendrobates sylvaticus	NT								5			5
Eleutherodactylus achatinus	LC	39	16	10	4			2	5	2	10	88
Eleutherodactylus longirostris	LC								1	6		7
Hyalinobatrachium fleischmanni	LC	5			2					2		9
Hyla cf. alytolylax	NT									1		1
Hyla pellucens	LC								2	12		14
Hyla rosenbergi	LC	1	10	8	12							31
Hyla sp.					1		2					3
Leptodactylus sp					1							1
Leptodactylus labrosus o ventrimaculatus	LC	65	1		25		4	4	3	5		107
Leptodactylus pentadactylus	LC									2		2
Phrynohyas venulosa	LC	40		7				4			1	52
Physalaemus sp		5	1		2			1				9
cf. Physelaemus sp.			1									1
Scinax sugillatus	LC	9	2	17		1						29
Smilisca phaeota	LC	9	1		2							12
Trachycephalus jordani	LC	5			2			2				9

Number of Indiviudals		444	137	242	252	1	6	128	33	60	21	1324
Number of Species		13	11	7	13	1	2	7	9	10	5	27
Individuals/Day		29.6	9.78571	12.1	16.8	1	3	64	16.5	30	10.5	17.65333
Species/Day		0.8666667	0.78571	0.35	0.866667	1	1	3.5	4.5	5	2.5	0.36
Shannon Diversity Index (H)		1.99	1.21	1.24	1.24	-	-	0.91	1.82	1.92	1.16	2.03
Reptiles												
Rhinoclemmys annulata	LR	1		1	2							4
Amphisbaena fuliginosa	NE				1							1
Reptiles – Sauria												
Ameiva cf. ameiva	NE	2										2
Ameiva edracanthra	NE					6						6
Ameiva septemlineata	NE	36	18	7	11		1	1				74
Anoils bitectus	NE	2	2									4
Anolis cf fraseri	NE									2		2
Anolis princes	NE	3	1	5	1					2		12
Anolis sp.1											3	3
Anolis sp.2				1								1
Anolis sp.3										1		1
Basiliscus galeritus	NE								8	4		12
Diploglossus monotropis	NE									1		1
Enyaliodes microlepsis	NE			1								1
Enyalioides heterolepis	NE								1			1
Gonatodes caudiscutatus	NE	2	4	1	1			1				9
Iguana iguana	NE	4	4	4	1			26				39
Lepidoblepharis buchwaldi	NE			4							2	6
Microteiid											3	3
Phyllodactylus reissii	NE				1	4	2					7
Ptychoclossus sp.			1									1
Stenocercus iridescens	NE	45	18	35	10		3			2		113
Thecodactylus rapicaudata	NE	2	1		1		1					5
Reptiles – Serpentes	NE											

Boa constrictor	NE	1	1	2								4
Bothriechis schlegelii	NE			1						2		3
Bothrops asper	NE	1	11	4	1							17
Chironius exoletus	NE		1									1
Clelia clelia	NE									2		2
Coniophanes dromiciformis	NE	4		1	1							6
Dendrophidion percarinatus	NE			1								1
Dipsas andiana	NE	1	2	1	2							6
Dipsas gracilis	NE		1	1	1							3
Drymobius rhombifer	NE								1			1
Imantodes cenchoa	NE	1		1	2		1					5
Lachesis acrochorda	NE								1			1
Leptodeira septentrionalis	NE	10	12	13	10		2		1	1	1	50
Leptophis ahaetulla	NE	2										2
cf. Leptotyphlops sp.			1									1
Mastigodryas sp.	NE	1										1
Micrurus bocourti	NE	1			2							3
Oxybelis aeneus	NE	1										1
Oxybelis brevirostris	NE										1	1
Oxyrhopus petola	NE	1	1	1								3
Psuestes poecilonotus	NE		2									2
Psuestes cf. shorpshirei	NE				1							1
Sibon nebulata	NE	3	3		1					1		8
cf. Spilotes pullatus	NE	1	2									3
Tantilla supracincta	NE	2		1							1	4
Xenodon rhabdocephalus	NE	1		1								2

Number of Indiviudals	128	86	87	50	10	10	28	12	18	11	440
Number of Species	24	19	21	18	2	6	3	5	10	6	49
Individuals/Day	8.5333333	6.14286	4.35	3.333333	10	5	14	6	9	5.5	5.866667
Species/Day	1.6	1.35714	1.05	1.2	2	3	1.5	2.5	5	3	0.653333
Shannon Diversity Index (H)	2.12	2.36	2.22	2.35	-	-	-	1.09	2.09	1.67	2.76

Grand Totals:											
Number of Indiviudals	572	223	329	302	11	16	156	45	78	32	1764
Number of Species	37	30	28	31	3	8	10	14	20	11	76
Total Survey Days	15	14	20	15	1	2	2	2	2	2	75
Individuals/Day	38.1	15.9	16.5	20.1	11.0	8.0	78.0	22.5	39.0	16.0	23.5
Species/Day	2.5	2.1	1.4	2.1	3.0	4.0	5.0	7.0	10.0	5.5	4.3

Table 2. Alpha diversity of western Ecuador study sites. *IUCN Status: EX: Extinct; CR: Critically endangered; EN Endangered; VU: Vulnerable; NT: Near Threatened; LR: Lower Risk; LC: Least Concern; DD: Data Deficient. NE: Not Evaluated

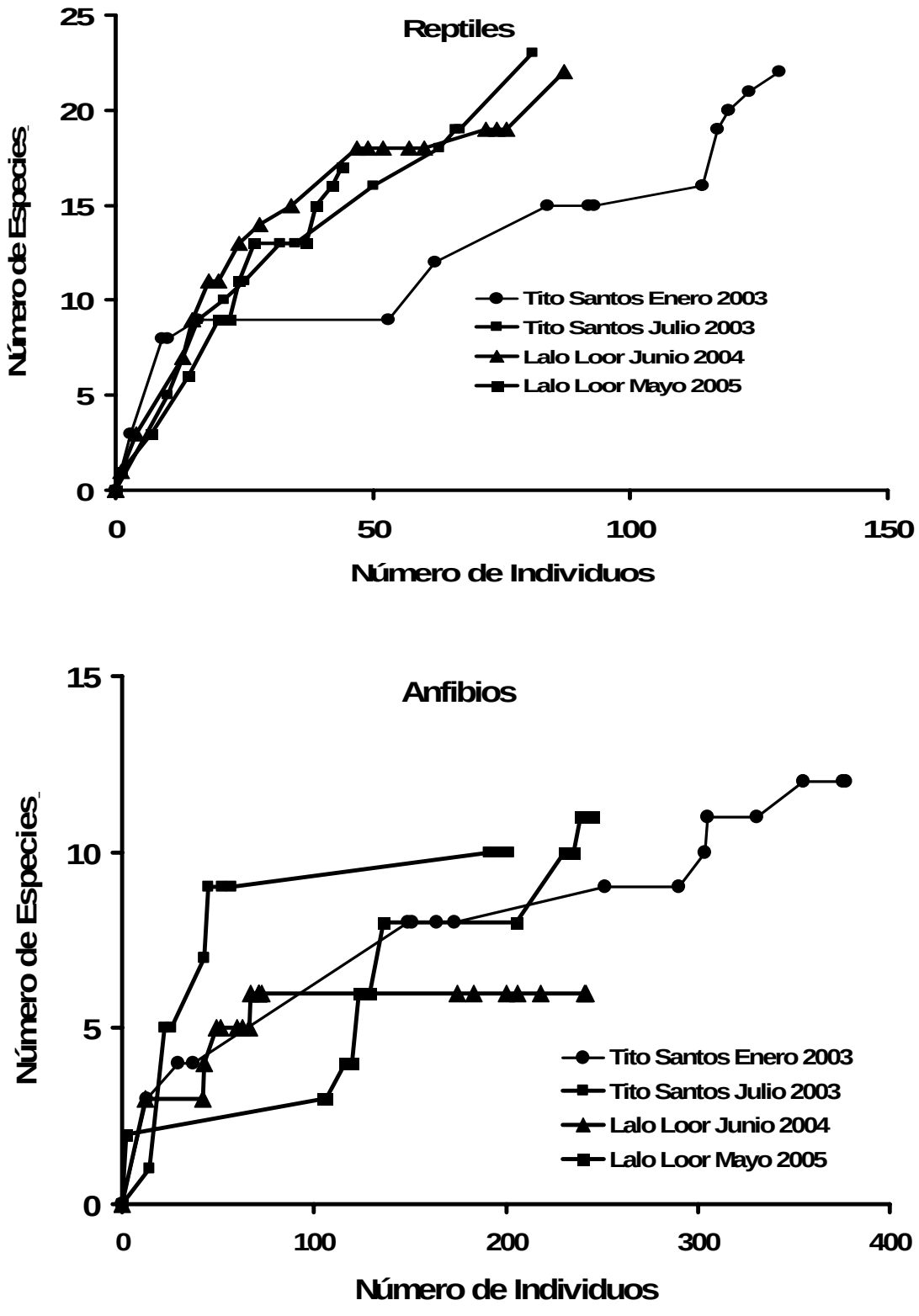

Fig. 1. Species accumulation curves.

Disturbance specialists

There were several species which were most prevalent around human disturbances, such as roads, pastures, and buildings. *Bufo marinus* was the most common animal encountered, and was rarely found more than a few meters from human activity. Indeed, many of the *B. marinus* at Tito Santos were infested with ticks from cattle. A dozen or more individuals could be found under a lamp at night, feeding on insects. Among the reptiles, *Stenocercus iridescens, Iguana iguana,* and *Leptodeira septenrionalis* were the most common encountered, and all were associated with human activities. *S. iridescens* was observed to be a medium to large canopy-gap specialist, and fared well in woodpiles and around fallen trees. A small proportion of these lizards were found in more pristine dry forest. They were often very tame and approachable. *I. iguana* was most common in and around towns. Juveniles were often seen on or near the ground, and adults typically would be encountered at perch heights of greater than 5 m. *L. septenrionalis* was the only snake found in great abundance (N=50). It was found largely in secondary forests, pastures and clearings, but was also quite prevalent in more undisturbed areas.

Some other species, while not necessarily disturbance specialists, were still common around human disturbance. Of the five *Boa constrictor*, two were found in agricultural fields and two were found dead on the road. Many reports were heard of local residents killing and burning large snakes, which matched the general description of *B. constrictor*. Burning the carcass of the snake is rumored in local lore to render the carcass non-venomous; it is thought that a person may be envenomated by coming into contact

with the exposed ribs of a dead snake. *B. constrictor* is incorrectly thought to be a venomous species among the locals in Provincia Manabí.

Colostethus machalilla was the second most common animal encountered, and could be found in nearly any rocky stream bed with some canopy cover, regardless of any other human activities surrounding it.

Habitats	Sites	Source	Amphibian Diversity	Reptile Diversity
Very dry tropical forest/ tropical dry forest/Urban	Lalo Loor, Tito Santos, Pedernales, Don Juan, Punta Prieta	This study	18	39
Premontain wet forest/tropical wet forest	Mache Chindul, Pata de Pajaros	This study	16	17
Humid pre-montain tropical forest	Bilsa, northeastern Mache Chindul Mts.	G. O. Vigle, pers. comm.	22	34
Humid pre-montain tropical forest	Rio Palenque	K. Miyata, 1982	63	82

Table 3. Alpha diversity of herpetofauna at Ecuadorian Sites

Unidentified Species

Several species of reptile and amphibian encountered were not identifiable, or have tentative identifications. Animals listing specimen numbers were deposited into the herpetology collections at the Escuela Politécnica Nacional in Quito. The following are excerpts from our field notes.

cf. *Bolitoglossa sima*. Found at Pata de Pajaros, 07/07/2004, in primary forest. SVL 17.5mm, tail length 11.5mm. A tiny salamander with short tail, dorsum color brown, dorsolateraly and ventrally dark brown/black with tiny white flecks. Snout is white with brown mottling. Occipital dark brown, tail cream. Limbs dark brown, feet light brown. Iris is brown/slightly coppery. Snout short and blunt with somewhat distinct cantus rostralis.

cf. *Caecilia nigracans* Specimen field number PSH-093. Found at Tito Santos, 01/08/2003, on edge of pasture in a stream bed, the morning after a heavy rain. It had apparently been stepped on and killed by a cow. A slate-gray caecilian with whitish annuli.

cf. Caecilionidae Specimen field number PMR-00186. Found at Lalo Loor, 05/21/2005, in primary transitional forest in creek, in running water. It was being eaten by a shrimp. Slender bodied, 6.0mm diameter. Could not discern body length, since the terminal end of the body is missing, apparently eaten by the shrimp. The right side of the head has been chewed off, but the left side is relatively intact, including eye but not tentacle. Annuli are 2.0mm in width, completely indistinct in color. Annular ridges only distinct dorsally, dorsum smooth. Snout somewhat wedge shaped with blunt end. Color when fresh slate blue/grey, in formalin slate gray.

Physelaemus sp. Several individuals found in January 2003 at Tito Santos. Representative description of field number PSH-082: Matches description of

Physelaemus pustlatus (Miata) in having a lack of cranial crests, small parotoid glands, coarse dorsal tuberculation, boldly patterned white venter with black reticulations, dorsal surfaces of limbs balanced with brown. Iris copper with fine black reticulations, horizontal pupils, tuburculate eyelids. Dorsal surface brown with slightly mauve dorsolateral regions and whitish green on parotoid glands, flanks, and lateral surface of tibia; dorsal tubercles arranged in diamond pattern on scapular region; cream spot in middle of diamond; mid-dorsal, pre-anal ridge, cream in color, extending to sacral hump. Fingers and toes lack pads and webbing, white tubercles on ventral (surface of) both; fingers 2,1,4,3; toes 1,2,3,5,4. Black stripe supraoccularly across head

Ameiva cf. *ameiva*. Two individuals at Tito Santos, 01/01/2003 and 01/03/2003 around human disturbances. Observed but not captured. Larger than *A. septemlineata*, with grey heads.

Anolis cf. *fraseri* Two individuals captured on 05/23/2005 and 05/25/2005 at Mache Chindul, near the town of Chindul. Color del dorso cafe con una banda vertebral cafe obscura, vientre moteado crema con cafe, garganta amarilla. Saco gular anaranjado

Anolis sp. 1. Three individuals captured at Pata de Pajaros on 07/08/2004. Top of head and paravertebral stripes chocolate brown, middorsal pattern alternating black and tan splotches. Lateral stripe dark brown starting posterior to eye and extending to base of tail. This stripe is broken by an irregular longitudinal stripe. Flank is grey with irregular brown marks. Iris is reddish brown with bronze circling pupil. Brown bars radiating from

eyes. Forelegs are mottled black/white and hind limbs are mottled tan and dark brown. Dewlap is bright orange with tiny white scales. Subdigital lamellae small. Tail base is large and posterior 3/4 of tail is dull yellow. Well developed parietal. Head scales tiny and granular. Enlarged scales on canthus rostralis. Snout short and pointed.

Anolis sp. 2. One individual captured at Lalo Loor on 07/22/2004. Thick gray middorsal line extending from posterior past of head to first 1/3 of tail. Two dark brown lines running from posterior end of eyes, along the gray ones, to base of tail. Laterally it has a diffused iguana-green color on a grayish background. Ventrolaterally mottled brown and cream. Venter is yellow turning darker at the base of the tail. Throat and neck are whitish with a dense brown mottling. Arms and legs are light tan with irregular small brown and white splotches. Tympanum is brown, eyelids are yellow encircling the eye. Pupil is black and round with a conspicuous blue circle around it. Iris is black. Head is light and dark tan with no noticeable pattern. Toepads and claws present in fingers and toes. When it shed it skin, color changed darker. No dewlap, no femoral pores, only toe one does lacks have lamellae.

Anolis sp. 3. One individual found in the town of Chindul (Hacienda Siberia site) on 05/25/2005. Iris blue. Dewlap white with slightly darker tan longitudinal stripes, Dorsal color mottled brown, with irregular, broad transverse marks on flanks. Body slender with unusually long and slender legs.

Microteiidae. Captured at Pata de Pajaros on 07/08/2004. Body dark brown, lighter brown on top of head and 1/2 way down dorsum. Width of light area is 8 scales wide. Cream throat, belly is slightly pink. Scales: ventral 4 rows of transversal scales, dorsal scales strongly keeled, head scales large, large nostril, 2 large supra oculars. Iris is gold, tympanum somewhat triangular. 20 scales at middorsum around the body with color. 7-10 spots starting from tympanum extending laterally passed the auxiliary. there is a patch of finely granular scales above auxiliary.

Ptychoclossus sp. Captured at Tito Santos on 08/01/2003 at the base of a Cedro de callade between buttress roots under leaf litter. Field specimen number PSH-115. Forked tongue. Nails are transparent. Scales in rings around the body. dorsum is speckled black/brown with blue iridescence. Venter is dark orange.

Leptotyphlops sp. Captured at Tito Santos on 07/29/2003 near buildings. Found buried in loose and moist soil. Field specimen number PSH-89. Total length 81mm. Grey dorsally with darker lateral pinstripes.

Mastigodryas sp. Captured at Tito Santos on 01/08/2003, in transitional dry/wet forest, on steep embankment of creek. Scale count: 17-17-15 Anal scale divided. 4 anterior temporals. Loreal present. Ventrals ~ 180, supralabials – 8, infralabials -10. Dorsal color is olive-brown with a lateral tan stripe on scale columns 4 and 5. Stripe fades posteriorally ending at anal plate. Dark brown eye stripe runs from loreal to temporals. Iris is tan, darker where eye stripe runs through it. Pupil is round. On edge of ventrals for

about 15 ventrals, scales have orange tint. The rest of the venter is cream/gray. Body is long but not elongate, very muscular, appearance of a racer. Very quick moving and keeps head elevated. Large round pupil.

Conservation status

Most of the amphibian species encountered had been evaluated for conservation status by the IUCN Redbook (Table 2). Two frog species and one salamander were listed as vulnerable: *Agalychnis litodryas, Colostethus awa* and *Bolitoglossa sima* (although the later is a currently tentative identification). An additional three species were listed as near threatened: *Dendrobates sylvaticus, Colostethus machalilla* and *Hyla alytolylax*.

The near threatened status of *Colostethus machalilla* is somewhat doubtful considering the current study. *C. machalilla* was the second most common species, only behind *Bufo marinus* in total numbers seen. It was also seen at most of our study sites, and in a variety of habitats. It was apparently resilient to human disturbances, as was found in nearly all stream beds with at least some canopy cover.

Only one species of reptile encountered in this study, *Rhinoclemmys annulata,* has been evaluated by IUCN. This fact points to the lack of information on population trends and distributions of western Ecuadorian reptiles, and the need for additional studies to gather this important data.

Future Work

For future studies, have established additional study sites in Manabí Province. Our primary permanent study site, Lalo Loor, contains primarily transitional humid to dry forest. An additional site south of Lalo Loor in pure dry forest (Playa Paraiso) is expected to contain many species in common with Lalo Loor, as well as additional unique species. In addition to our site at Bosque Protector La Perla, we also wish to establish one or more permanent humid to moist forest sites to the north and east of Lalo Loor in the southern extent of the Mache Chindul range, such as in Pata de Pajaros or Hacienda Siberia. Combined, these sites will give a unique perspective on a sharp ecotone between dry and moist or humid forest.

In addition to establishing additional study sites, we wish to use additional techniques to survey for herpetofauna. Specifically, have started to use quadrat surveys and wish to use and drift fences with pitfall traps. We expect to find more unique species with these techniques, particularly leaf-litter inhabitants, that are often missed with line-transect methods.

Future work will also evaluate unidentified specimens described above for systematic status. It is expected that some new species have been discovered, and continued efforts will explore these possibilities.

References

BORCHSENIUS, F. 1997. Patterns of plant species endemism in Ecuador. Biodiversity and Conservation. 6:379-399.

BULLOCK, S.A., H. A. MOONEY AND E. MEDINA. 1995. Seasonally dry tropical forests. Cambridge University Press. 450 pp.

CAÑADAS L AND W ESTRADA. 1978. Ecuador mapa ecológico. PRONAREG-Ecuador, Minestario de Agricultura y Ganadera.

CONSERVATION INTERNATIONAL. 2006. http://www.biodiversityhotspots.org/xp/Hotspots/tumbes_choco/

DODSON, C.H. AND GENTRY, A.H. 1991. Biological extinction in western Ecuador. *Annals of the Missouri Botanical Garden* 78: 273-295.

GENTRY, A. H. 1982. Patterns of neotropical plant species diversity. Evolutionary Biology. 15:1-84.

HOLDRIDGE, L. R. 1967. Life zone ecology. San Jose Tropical Science Center. 206 pp.

KIESECKER, J. M., A. R. BLAUSTEIN, AND L. K. BELDEN. 2001. Complex causes of amphibian population declines. Nature 410:681-684.

LYNCH, J. D. AND W. E. DUELLMAN. 1997. Frogs of the genus *Eleutherodactylus* in western Ecuador. University of Kansas Natural History Museum. Special Publication No. 23. Kansas.

MIYATA, K. A. 1982. Unpublished Ph.D. Dissertation.

MURPHY, P.G. AND A. LUGO. 1986. Ecology of tropical dry forest. Annual Review of Ecology and Systematics. 17:67-88.

SASA, M. AND F. BOLANOS. 2004. Biodiversity and conservation of Mesoamerican dry-forest herpetofauna. pp. 177-193 in: Biodiversity conservation in Costa Rica: Learning the lessons in a seasonal dry forest. Frankie, G. W., A. Mata and S. B. Vinson (Eds.). University of California Press, Berkeley.

SIERRA, R. AND J. STALLINGS. 1998. The dynamics and social organization of tropical deforestation in northwest Ecuador, 1983-1995. *Human Ecology*. 26:135-161.