Project Chicchan

Estación Biológica las Guacamayas
Biósfera Maya, Petén, Guatemala

The Herpetofauna of Estación Biológica las Guacamayas and Surrounding Areas, South East Laguna del Tigre National Park

Introduction:

Although the herpetofauna of the Yucatan Peninsular, including some areas of El Petén, is relatively well documented, we know little about the herpetofaunal assemblage at Estación Biológica las Guacamayas (EBG) or the Laguna del Tigre National Park (PNLT) (literature search conducted on 15/12/12). Surveys have so far been limited to monitoring the populations of the endemic Morelet's crocodile (*Crocodylus moreletii*) and Central American river turtle (*Dermatemys mawii*) and conducting transects along a 500m stretch of the river bank (Bestelmeyer & Alonso 2000).

EBG has a varied landscape within and bordering its reserve land. EBG is situated at the southern border of the Laguna del Tigre National Park (LTNP), the border of which is delineated by the Rio San Pedro. The LTNP side of the river is characterised by the presence of limestone outcrops that rise relatively sharply from the river bed, the vegetation here is Tropical Dry Forest. The southern side of the river is a flat landscape of seasonally inundated grass/swamps and thorn scrub that borders the Rio San Pedro and Rio Sacluc. To the East the Tropical Dry Forest in bordered by agriculture of the local community, known as Paso Caballos.

The Tropical Dry Forest of LTNP on the northern bank of the Rio San Pedro is heterogenous because as the limestone bedrock undulates the composition of the flora changes. In particular, on the peaks there is very little leaf litter as it gets washed into the troughs by rainfall. Due to this it is possible that the herpetofaunal assemblages within the peaks and troughs are very different.

By surveying various areas throughout all of these habitats Project Chicchan aims to better understand not only the composition of the herpetofaunal communities at EBG, but also what effects the presence of agriculture has on the herpetofaunal community structure at the eastern border of the forest.

Methodology:

Five forest categories (bosque alto, bosque bajo, natural edge, man-altered edge and riparian) were sampled at EBG using a combination of Visual Encounter Surveys (VES) and quadrat surveys (Heyer et al. 1994; McDiarmid et al. 2012).

Visual Encounter Surveys (VES)

Transects were walked at a suitably slow enough pace to allow thorough examination of the vegetation for reptiles and amphibians. The vegetation surrounding each transect was surveyed up to one metre either side of the transect and up to two metres in height. Each transect was surveyed at least once during the day and twice during the night.

At the start of each transect the following environmental data was recorded: time of start(24hr), air temperature (ºC), relative humidity (%), and cloud cover (%). Additionally, time of finish of each transect (24hr), daily rainfall (mm), daily barometric pressure (hPa) and daily moon phase were recorded.

When safe to do so, each individual encountered was captured and the following data recorded: time encountered (24hr), distance along transect (m, location was also be taken using a Garmin Etrex GPS), activity (rest, basking, foraging), position (leaf litter, shrub layer, branch [if on a branch the diameter of the perch was measured in cm], and height from ground [cm]) each individual was first observed body temperature before capture (if possible and calculated with an infrared thermometer in ºC), species, age (adult, juvenile, neonate), sex (if possible), length (mm) and weight (g). Biometric data for amphibians and most lizards was taken in the field. All snakes captured were brought back to EBG for collection of biometric data for ease and were marked for identification using cautery branding of the ventral scales following an adapted method described by Winne et al. (2006), see Appendix 1 for details of the marking scheme. All individuals were released at the point of capture within 48 hours.

Quadrat Survey

For every five VES completed in each plot one 8x8m quadrat was conducted. The position of each quadrat was randomly selected before the survey began. The perimeter of each quadrat was delineated with twine and 30cm of leaf litter was moved from the exterior of this line. This aided in detection of individuals attempting to escape the area during the survey. Quadrats were surveyed as per Jaeger and Inger (1994). Leaf litter was replaced and twine removed after completion of each quadrat. The data collected was the same as for VES with the exception of "distance along transect." Quadrats were only conducted during the day due to safety reasons and the likelihood of encountering the highly venomous barba amarilla (*Bothrops asper*).

Additional Targeted Habitat Surveys

Additional surveys of trails and other interesting habitats surrounding EBG (for example, the swamp and thorn scrub near to Rio Sacluc) were conducted on an ad-hoc basis. Data collected was the same as for VES with the exception of "distance along transect."

Data analysis

Species accumulation curves, Mau Tau with 95% confidence intervals, were constructed to describe the diversity of amphibian and reptile fauna at EBG. Species richness estimators were calculated to evaluate the effectiveness of the survey methods used in relation to the target habitat types, using both nonparametric incidence-based estimators (Bootstrap, Chao 2, ICE, Jacknife 1 and 2) and abundance-based data (ACE and Chao 1). Species accumulation analysis was performed using EstimateS 7.5 software (Colwell 2005). Species diversity was compared between the target habitat types using two-way ANOVA. Analysis of species diversity was performed using Statistix 7.

Results:
Including casual observations, a total of 55 species of reptile and amphibian were recorded during the period 18/05/13 to 19/06/13. Of these 17 were snakes, 19 were lizards, 14 were amphibians, four were turtles and one was a crocodilian (for full species list see Appendix 2).

In total 80 individual snakes were encountered, three of which were re-captured. Several individuals were either not captured or were released without taking biometric measurements for various reasons including, but not limited to, small size in the case of neonates, recovering from injuries, or miss-capture. Only individuals encountered during INF VES were included in further analysis. A total of 46 species of amphibian (13 species) and reptiles (33 species) were recorded during INF VES. Species were encountered at a mean rate of 2.07 per hour (Table 1).

Habitat	Number of surveys	Total survey time (hrs)	Number of species	Species per hr
Bosque Alto	2	5.267	12	2.28
Bosque Bajo	8	7.383	15	2.03
Natural Edge	9	10.92	20	1.83
Man-altered Edge	1	1.35	3	2.22
Riparian	8	7.083	14	1.98

Table 1: Comparison of survey effort between habitat types at Las Guacamayas.

Species Diversity Analysis
Species accumulation curves for reptiles and amphibians (Mao Tao) did not reach stability (Fig. 1). However, the accumulation curve for amphibians showed signs of reaching stabilisation. The species richness estimators consistently produced greater results than the actual numbers of species encountered during this project (Tables 2 & 3).

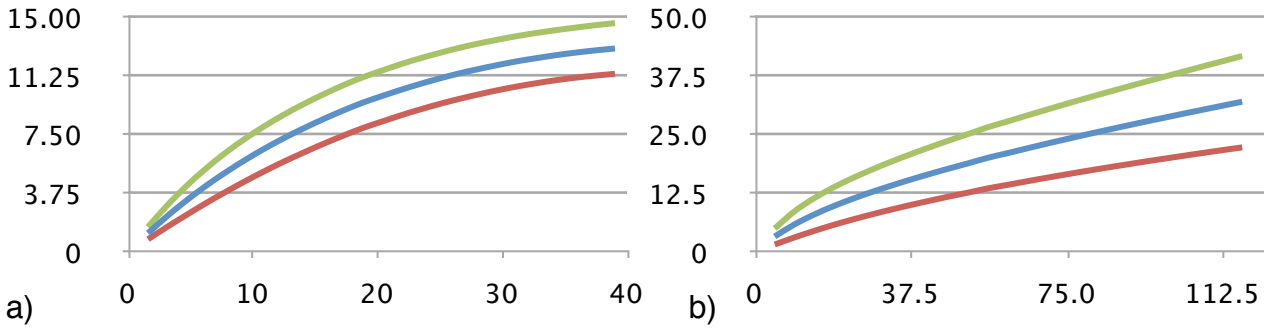

Fig 1: Species accumulation curves (Mao Tao) for a) amphibians and b) reptiles at Las Guacamayas.
Blue = Mao Tao / Green = upper 95% confidence interval / Red = lower 95% confidence interval.

Estimators	Total	Bosque Alto	Bosque Bajo	Natural Edge	Man-altered Edge	Riparian
ACE	14.85	-	4.44	7.80	-	15.45
ICE	14.72	-	4.65	7.50	-	14.67
Chao 1	14.13	-	4.50	7.00	-	12.00
Chao 2	13.75	-	4.25	6.50	-	12.17
Jacknife 1	15.88	-	4.88	7.78	-	12.38
Jacknife 2	13.35	-	4.34	6.61	-	14.20
Bootstrap	14.95	-	4.57	7.11	-	10.02
Observed	13	1	4	6	2	8

Table 2: Species richness estimators of the amphibian assemblage at Las Guacamayas (sample sizes in Bosque Alto and Man-altered Edge were too small for the estimators to function).

Estimators	Total	Bosque Alto	Bosque Bajo	Natural Edge	Man-altered Edge	Riparian
ACE	68.30	31.00	16.20	19.35	-	9.69
ICE	92.22	38.50	23.86	26.47	-	11.64
Chao 1	122.25	27.00	23.50	18.50	-	10.50
Chao 2	142.25	38.50	35.50	27.50	-	8.25
Jacknife 1	52.16	16.50	17.13	22.00	-	8.63
Jacknife 2	69.72	16.50	21.73	26.96	-	9.59
Bootstrap	39.99	13.75	13.51	17.48	-	7.23
Observed	33	11	11	14	1	6

Table 3: Species richness estimators of the reptile assemblage at Las Guacamayas (sample size in Man-altered Edge was too small for the estimators to function).

Species Diversity Analysis

There was a significant difference in diversity between species assemblage across different habitat types at EBG (F=18.354, P=0.0011, df=4) (Table 4). When compared in pairs there were no significant differences in community diversity for Bosque Alto, Bosque Bajo, Natural Edge and Riparian (Table 4). However, there was a significant difference in species assemblage between Man-altered edge and all other habitat types (Table 4).

	F	P value	df
Man altered edge vs natural edge	**17.1900**	**0.0000**	1
Natural edge vs bosque bajo	0.3333	0.5564	1
Natural edge vs bosque alto	5.2609	0.0218	1
Man altered edge vs bosque bajo	**13.0000**	**0.0003**	1
Man altered edge vs bosque alto	**7.3636**	**0.0067**	1
Bosque alto vs bosque bajo	2.0000	0.1573	1
Riparian vs bosque alto	0.3913	0.5316	1
Riparian vs bosque bajo	0.0370	0.8474	1
Riparian vs natural edge	0.1538	0.6949	1
Riparian vs man altered edge	**7.1176**	**0.0076**	1
All habitat	**18.3540**	**0.0011**	**4**

Table 4: Comparison of diversity of herpetofauna species assemblage at Las Guacamayas as determined by two-way ANOVA's. Statistically significant differences are highlighted in bold.

Discussion:
The most recent species list for Guatemalan herpetofauna reports 387 species, 141 amphibians and 246 reptiles (Acevedo et al. 2010). Previous studies had recorded 30 species of amphibian and reptile for EBG (Bestlemeyer & Alonso 2000). To date, including the results of this study expand the number of reptiles and amphibians at EBG to 72 species (19% of the total for Guatemala) (Apendix 2). This includes 17 species of amphibian (12% of the total for Guatemala) and 55 species of reptile (22.5% of the total Guatemala). This 2013 survey recorded 30 species of reptile and amphibian that were previously unknown or unconfirmed for EBG. It is likely that with continuing surveys that the total number of reptiles and amphibians will increase from the current figure of 72 species. This is suggested by the Mao Tao species accumulation curves (Fig. 1). Increases are likely to be higher among reptiles.

During this study several species that were encountered are considered rare (Campbell 1998; Lee 2000; Savage 2002). These included *Clelia scytalina* and *Tretanorhinus nigroluteus*. One species found , *Tropidodipsas fasciatus,* was the first record of the species for Guatemala. *Tropidodipsas fasciatus* was previously only known from Mexico with a disjunct distribution from the States of Guerrero, Veracruz, and Chiapas, and also from Campeche, Yucatán and Quintana Roo (Campbell 1998; Köhler 2008). *Clelia scytalina* is a little known species with scattered records throughout its range. It has been confirmed from Southern Mexico, Guatemala and Belize (Savage 2002; Köhler 2008; Acevedo et al. 2010; McCranie 2011). Debate exists regarding whether *C. scytalina* is present in Costa Rica, with several authorities now believing specimens from this area to be conspecific with the closely related *C. equatoriana* (Savage 2002; McCranie 2011). Previous records in Petén exist for *C. scytalina* (Campbell & Vannini 1989) although the validity of these records has since been disputed (Campbell 1998). It is possible that our record of *C. scytalina* from EBG represents the first confirmation of this species for Petén.

Surveys of the transect parcels and quadrats were abandoned in favour of transects along the trail systems of EBG (referred to as Informal (INF) VES). This was due to lack of individuals being encountered during VES and Quadrat surveys compared to the greater numbers of individuals being encountered during surveys of the trails. All of the described habitat types were surveyed. However, due to the quantity of individuals encountered in other habitats survey effort was compromised in Man-altered edge. Surveys were timed to be able to compare survey effort in each habitat type. Although significant differences in species diversity at EBG were found between habitats, this could be due to the small sample size obtained from Man-Altered Edge. Further investigation would be required to elucidate the differences of species diversity across habitat types at EBG.

Recent work on Guatemalan herpetofauna assessed the country's conservation status (Acevedo et al. 2010). Using Environmental Vulnerability Scores (EVS) the authors categorised species into high, medium, and low vulnerability based on criteria such as the IUCN threat category; distribution, ecological specialisation and susceptibility to human persecution (Acevedo et al. 2010). Approximately 30% (17 species) of the species recorded by this study (including casual observations) fall into the high and medium vulnerability categories. Of these, three species have been classed as being of high vulnerability; *Crocodylus moreleti, Kinosternon acutum* and *Rhinoclemys areolata* (Acevedo et al. 2010). The remaining 14 species are classed as being of medium vulnerability; *Triprion petasatus, Trachemys scripta, Kinosternon leucostomum, Coleonyx elegans, Iguana iguana, Sceloporous teapensis, Norops sagrei, Mesoscincus schwartzei, Clelia scytalina, Coniophanes schmidti, Leptodeira frenata, Tretanorhinus nigroluteus, Xenodon rhabdocephalus, Bothrops asper* (Acevedo et al. 2010).

The other 37 species of amphibian and reptile recorded at EBG by this study were considered to be of low vulnerability (Acevedo et al. 2010). *Tropidodipsas fasciatus* was considered to be extra-limital at the time of the Acevedo et al. (2010) study and thus has not been included in the above discussion. Further work is needed to assess the distribution and abundance of *T. fasciatus* in Guatemala to accurately assess its conservation status. *Tropidodipsas fasciatus* is considered to be an uncommon inhabitant of the Mexican portion of the Yucatán Peninsular (Lee 2000) and it is reasonable to suggest that it is uncommon in Petén.

Given the high diversity of reptiles and amphibian species realised at EBG it is recommended that further survey work is performed across the area at different annual seasons to try to elucidate patterns of activity. Additionally, future studies should be expanded to include survey areas further into Laguna del Tigre National Park such as Waka-El Peru and the CONAP encampment within it.

The high species diversity observed at EBG indicates that Laguna del Tigre National Park is an important asset to the conservation of Guatemalan herpetofauna. With the discovery of species such as *Tropidodipsas fasciatus* and *Clelia scytalina* it is possible that other species not currently known from Petén, or Guatemala, could be discovered in the forests of EBG and the wider Laguna del Tigre National Park.

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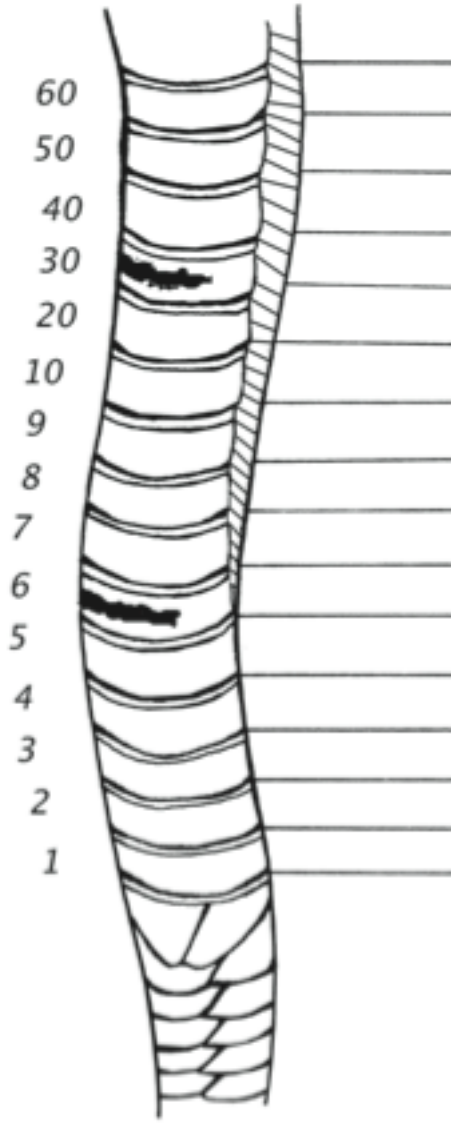
Appendix 1

Diagram for marking snakes using electrocautery ophthalmic medical pens. In this example the individual has been marked with the ID number 36 (from Winne et al. 2006).



Appendix 2

List of species recorded at EBG by Project Chicchan. Where changes in nomenclature have recently occurred the previous scientific name is included in parentheses. ** denotes an introduced non-native species.

FAMILY **Species**	**Project Chicchan** *anecdotal observation outside of survey	**CI RAP** Bestelmeyer & Alonso (2000).	**OTHER** anecdotal observations verified by the author
PLETHODONTIDAE			
Bolitoglossa mexicana			X
BUFONIDAE			
Rhinella (Bufo) marina	X	X	X
Incilius (Bufo) valliceps	X	X	X
MICROHYLIDAE			
Hypopachus variolosus	X		X
HYLIDAE			
Agalychnis callidryas	X	X	X
Dendrosophus (Hyla) microcephala	X	X	
Trachycephalus (Phrynohyas) venulosus	X	X	X
Triprion petasatus	X		X
Scinax staufferi		X	
Smilisca baudini	X	X	X
Tlalocohyla (Hyla) loquax	X		X
Tlalocohyla (Hyla) picta		X	
LEIUPERIDAE			
Engystomops (Physalaemus) pustulosus	X		X
LEPTODACTYLIDAE			
Leptodactylus fragilis (labialis)	X	X	X
Leptodactylus melanolotus	X*	X	X
RANIDAE			
Lithobates (Rana) brownorum (berlandieri)	X	X	X
Lithobates (Rana) vaillanti	X	X	
GEKKONIDAE			
Coleonyx elegans	X	X	X
*Hemidactylus frenatus***	X*		X
Sphaerodactylus glaucus	X*	X	
Thecadactylus rapicauda	X*		X
TEIIDAE			
Ameiva festiva	X		X
Ameiva undulata	X*	X	
IGUANIDAE			
Basiliscus vittatus	X	X	X
Corytophanes cristatus	X		

FAMILY Species	Project Chicchan *anecdotal observation outside of survey	CI RAP Bestelmeyer & Alonso (2000).	OTHER anecdotal observations verified by the author
IGUANIDAE			
Corytophanes hernandesi	X		
Iguana iguana	X*		X
Norops capito	X		X
Norops lemurinus (bourgeaei)	X	X	X
Norops pentaprion			X
Norops sagrei	X		
Norops tropidonotus	X		
Norops uniformis	X	X	
Sceloporus teapensis (variabilis)	X*		X
SCINCIDAE			
Eumeces sumicrasti	X*		
Mesoscincus schwartzi	X*		
Mabuya unimarginata (brachiopoda)	X*	X	
Sphenomorphus cherriei			X
BOIDAE			
Boa constrictor		X	X
COLUBRIDAE			
Clelia scytalina	X*		
Coniophanes imperialis	X		X
Coniophanes bipunctatus		X	
Coniophanes schmidti (quinquevittatus)	X	X	
Drymobius margaritiferus	X	X	
Ficimia publia			X
Imantodes cenchoa	X	X	X
Lampropeltis triangulum			X
Leptodeira frenata	X		
Leptodeira septentrionalis (polysticta)	X	X	
Leptophis ahaetula			X
Leptophis mexicana	X		
Mastigodryas (Dryadophis) melanolotus			X
Ninia sebae	X		X
Oxybelis aneus	X*		X
Oxybelis fulgidus			X
Oxyrhopus petola			X
Senticolis triaspis			X
Sibon nebulata	X		
Spilotes pullatus			X
Tretanorhinus nigroluteus	X	X	
Tropidodipsas (Sibon) fasciatus	X*		

FAMILY Species	Project Chicchan *anecdotal observation outside of survey	CI RAP Bestelmeyer & Alonso (2000).	OTHER anecdotal observations verified by the author
COLUBRIDAE			
Tropidodipsas (Sibon) sartori	X		
Xenodon rabdocephalus	X*		X
ELAPIDAE			
Micrurus sp.	X*		X
VIPERIDAE			
Bothrops asper	X		X
KINOSTERNIDAE			
Kinosternon leucostomum	X	X	
Kinosternon acutum	X		
Staurotypus triporcatus		X	
DERMATEMYDIDAE			
Dermatemys mawi			X
EMYDIDAE			
Trachemys scripta	X*	X	X
Rhinoclemys areolata	X		
CROCODYLIA			
Crocodylus moreleti	X*	X	X