

## **Cloudbridge Herpetological Survey**

7/2/07 – 7/21/07

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### **Introduction**

Reserva Cloudbridge is located Northeast of San Gerardo de Rivas in Cantón Pérez Zeledón, Provincia San José. The reserve is located in the valley of the Rio Chirripó Pacifico where it converges with the Rio Urán on the Pacific slope of the Cordillera de Talamanca. This reserve ranges from 1500 m to 2140 m in elevation in Cloudbridge Sur on the slope of Cerro Chirripó Grande, and from 1680 m to 2620 m in Cloudbridge Norte on the slopes of Cerro Skutch.

The natural habitats of the reserve consist of premontane wet forest and lower montane wet forest (Holdridge et al, 1971), although much of the land has been anthropogenically modified. Most of the higher elevations and steeper slopes, especially in Cloudbridge Norte appear little modified, although there is evidence of past tree cutting. The majority of the lower elevations along the Rio Chirripó Pacifico and Rio Urán have experienced modification for use in ranching and agriculture (S. Culp, personal communication, July, 2007). Historically the property included swampy ponds along the Rio Chirripó Pacifico, although these have been drained in recent times according to E. Kang (personal communication, July, 2007). Since the establishment of the reserve in July 2002, little large scale clearing has been done on the property (I. Giddy, personal communication, July, 2007). Several areas of the reserve still contain old growth “primary” forest which does not appear to have been cleared, although this habitat represents a relatively small portion of the area in Cloudbridge Sur. These areas may have avoided substantial development due to their placement on steep slopes, often near mountain stream beds, or at mountain peaks. Restoration efforts are in progress in some portions of the reserve.

The Cordillera de Talamanca is one of the least biologically studied regions of Costa Rica. The herpetofauna of Reserva Cloudbridge, and its surrounding region, has been little studied. An Anuran survey was conducted at Reserva Cloudbridge by Toby Jacobs in early 2007. This survey focused on the Smithsonian hectare and consisted of visual encounter surveys, passive trapping using drift fences with pitfall traps, and audio sampling (Jacobs, 2007). Jacobs (2007) reports observing ten identified Anuran species and two unidentified species within Reserva Cloudbridge. A summary of the species observed can be found in Appendix A, and additional comments pertaining to this data are discussed below. A second herpetofaunal survey was conducted by Susan Cosineau and Lindsay Dimitri in late spring of 2007. The methods employed by Cosineau and Dimitri included quadrat sampling, pitfall trapping, and nocturnal encounter surveys (Cosineau, 2007). Cosineau’s (2007) survey resulted in the addition of one Caudate and one Anuran to the list of known amphibians from the reserve. Cosineau (2007) also reports capturing multiple unidentified Terraranid frogs.

The primary objective of our study was to collect baseline data of the herpetofauna located within Reserva Cloudbridge using more rigorous sampling methodology and covering a more expansive geographical area than previous studies of herptile activity within the reserve. Our goal was to compile a list of species present within different areas of the reserve, and to compare the diversity of species found within the major habitat types present.

## **Methods**

### Timed Visual Encounter Surveys

Timed Visual Encounter Surveys (TVES) were conducted following (Heyer et al, 1994). Animals were captured and held for the duration of hour-long surveys to ensure that individuals were not captured multiple times in the same survey. Individuals were identified according to Savage (2002). All individuals were released after completion of the TVES. The abundance of herptiles found in an area was standardized by dividing the number of individuals captured by the person-hours spent searching in that habitat (Heyer et al, 1994). All TVES were conducted during the day between 900 and 1700 hours. These surveys were conducted at the locations depicted in Figure 1. Due to logistical constraints, TVES was the only survey method with multiple observations between all habitat types of interest. Thus, all statistical comparison between upland habitat types will be restricted to data collected during these surveys.

### Nocturnal Presence Surveys

Nocturnal Presence Surveys (NPS) were conducted using a modified version of TVES (Heyer et al, 1994) in which surveyors could orient toward auditory cues. Although the NPS were timed, the person-hours spent during each hour are not standardized due to targeted searches for calling Anurans that occurred during the survey time periods. Animals were captured and stored for the duration of hour-long surveys to ensure that individuals were not captured multiple times in the same survey. Individuals were identified according to Savage (2002). All individuals were released after completion of the NPS.

### Opportunistic Surveys

Opportunistic Surveys were conducted throughout the project while traveling between sites, during rest and meal times, and while traveling within adjacent lands and within the town of San Gerardo de Rivas. Herptiles encountered during these surveys were identified according to Savage (2002) and released.

### Auditory Presence Surveys

Auditory Presence Surveys (APS) were conducted by surveyors during night NPS as well as while traveling between and within sites during all times of the day. These surveys were not time constrained and cannot be standardized for effort. Calling anurans were identified based on comparisons with calls of captured individuals during NPS as well as using descriptions of calls (Savage, 2002).

### Area Constrained Surveys

Area Constrained Surveys (ACS) were conducted using a modified version of quadrat sampling (Heyer et al, 1994) in which quadrat locations were not randomized, but instead were constrained by topography and stratified throughout different habitat types. Quadrats measuring 3 m x 3 m were used, and at least thirty minutes was allowed between quadrat placement and surveying of the plot to allow disturbed individuals to return to the quadrat. Quadrats were first searched visually, then leaf litter and surface debris were removed to detect hidden individuals. All herptiles found within the quadrat were retained for the duration of the sampling. Captured individuals were identified according to Savage (2002) and released near the quadrat.

### Passive Trapping

Three drift fences with pitfall traps were used during the course of the survey. Each pitfall trap was checked daily. Captured individuals were identified using Savage (2002) and released in a nearby location. Two drift fence arrays were in operation from 7/5/07 to 07/13/07. One of these fences was located within Gavilán Primary Forest, while the other was located in Gavilán Natural Regrowth (Figure 1). These trapping arrays were located at elevations of 1760 m and 1780 m respectively. A third trapping array was in operation from 7/15/07 to 7/20/08. This array was located within El Jilgero at an elevation of 1500 m.

### Photographic Verification

Photographs taken by past visitors to Reserva Cloudbridge were reviewed by the authors and used to identify and verify the presence of herptile species within the reserve.

## Results

A summary of all species of herptiles observed in Reserva Cloudbridge and nearby areas of San Gerardo de Rivas during all survey efforts from this study and all herptile surveys of this area that have preceded it (Jacobs, 2007; Cosineau, 2007) can be found in Appendix A. Some species recorded by Jacobs (2007) are questionable, and these records have been noted in both Appendix A and the discussion below. Additionally, species recorded by Cosineau (2007) that were verified by the authors using photographic records are also noted (Appendix A). A summary of all species of herptiles found during the July 2007 survey in Reserva Cloudbridge and nearby areas of San Gerardo de Rivas can be found in Table 1. Records that have not been identified to species level represent individuals that were sighted but not captured. These individuals were not able to be identified with the desired degree of certainty established for this study, and are not included in any statistical analyses that require species level data (e.g. species richness, Shannon diversity).

The data collected during the TVES indicated that diversity, as measured by the Shannon Index, was not significantly different between the four upland habitat types ( $X^2 = 4.000$ ,  $DF = 3$ ,  $p > 0.260$ ) (Table 2.) However, the mean number of herptiles caught per hour differed significantly within the habitat types surveyed ( $X^2 = 16.59$ ,  $DF = 3$ ,  $p < 0.002$ ) (Figure 2). The median number of herptiles caught per hour within the primary forest was significantly greater than the median number of herptiles caught in

either the natural regrowth or the plantation areas (Mood's Median Test,  $\alpha = 0.05$ ). No significant difference was observed in the median number of herptiles caught per hour within the secondary forest, natural regrowth, or plantation habitat types. The median number of herptiles caught per hour also did not differ significantly between the primary forest and the secondary forest. No Serpentes were observed during TVES, and Lacertids were only observed in the natural regrowth habitat during TVES.

## Discussion

Forested uplands within the reserve provide suitable habitat for the leaf litter frogs *Craugastor podiciferus* and *Pristimantis cruentus*. These species were found in much higher densities in primary and secondary forests than in adjacent natural regrowth and plantation areas. *C. podiciferus* was a common species in forested areas and is known to prefer interior forests rather than open pastures (Schlaepfer & Gavin, 2001). *P. cruentus* is also known to prefer interior forests and undisturbed sites (Guyer & Donnelly, 2005; Schlaepfer & Gavin, 2001). *C. fitzingeri* and *C. crassidigitus* were only detected in disturbed areas of the reserve. These species are known to utilize forest edge habitat, pasture, and plantations (Lynch & Myers, 1983). *C. fitzingeri* has been noted to reach high densities in disturbed areas (Lynch & Myers, 1983). *Diasporis diastema* and *D. hylaeformis* are both arboreal species (Savage, 2002) and were found associated with primary and secondary forests as well as forested riparian zones. Reptiles were primarily found in disturbed areas of the reserve. *Sceloporus malachiticus* was found associated with exposed rocks, wood, and human made structures. These objects likely provide basking spots for this heliophilic lizard (Savage, 2002). *Norops polylepsis* was found along trails during opportunistic sampling in disturbed areas, consistent with the findings of Schlaepfer & Gavin (2001). Secondary forests within the reserve exhibited similar herptile abundances to primary forests, but slightly lower diversity. This may be due to primary forests providing more diverse and suitable habitats to species than secondary forests (Pawar et al, 2004). These forested areas exhibited significantly greater diversity than the non-forested natural regrowth and plantation sites, consistent with Pawar et al (2004). Pawar et al (2004) also suggest that Lacertid diversity is higher in early successional stages of forests than Anuran diversity. Maintenance of restoration effort and protection of remnant primary forest patches are key to recovery of herptile diversity in Reserva Cloudbridge.

Many herptiles expected to be found during sampling in this study were not. This may be an indication of local extirpations or broad scale regional extinctions (Lips, 1998). Many Amphibians noted for their abundance were not detected by this survey. Additionally, few Polychrotids were detected by this survey, including species that should occur in abundance (Savage, 2002). Serpentes were encountered in low numbers (5 individuals over 20 days). Though this taxon is notorious for being cryptic, the authors feel this represents an actual low abundance due to the incredible paucity of individuals.

Studies conducted by Lips (1998) at Zona Protectora Las Tablas, a site further south in the Cordillera de Talamanca (Cantón Coto Brus, Provincia Puntarenas) demonstrated the decline of Anurans in a similar habitat (lower montane rainforest). Lips (1998) documented the local extirpation of three Anurans (*Atelopus chiriquiensis*,

*Lithobates vibicaria*, *Cranopsis fastidiosa*) and declines in three species (*Isthmohyla rivularis*, *Craugastor melanostictus*, *Craugastor punctariolus*). The Bufonid *Atelopus chiriquiensis* was last recorded in 1996 despite repeated searches for the species in sites known to formerly harbor populations (La Marca et al, 2005). Its absence from Reserva Cloudbridge was expected due to this probable species extinction. Similarly *Atelopus varius* was not expected due to local extirpation, likely due to chitridiomycosis (Puschendorf, 2003). *Lithobates vibicaria* is a semi-aquatic species associated with riparian habitats, usually found near bodies of water (Savage, 2002). Savage (2002) notes that breeding choruses can only be detected from within 100 m of calling individuals. The majority of our survey was conducted away from riparian areas, although searches of riparian areas along Rio Chirripó Pacifico conducted during the day (24.25 hrs) and at night (2.5 hrs) did not yield sightings of this species. Removal of natural swamplands may have reduced breeding habitats for this species in the Reserve, although the channels of the Rio Chirripó Pacifico and Rio Urán are little altered within the reserve. *Cranopsis fastidiosa* has not been reported from sites as far north in the Cordillera as Reserva Cloudbridge, and its absence is therefore assumed to be due to species range limits. *Craugastor punctariolus* is described by Savage (2002) as an uncommon nocturnal species found in the spray zone of rivers. This species was not detected, although insufficient time at night was spent surveying this habitat (2.5 hrs) to necessarily detect this uncommon species. *Craugastor melanostictus* on the other hand is an uncommon nocturnal forest species that should have been detected in this survey. Savage (2002) describes this species as preferring relatively undisturbed sites which may account for its absence. This species may be present in the higher elevations of Reserva Cloudbridge, especially Cloudbridge Norte, which are less disturbed, and were not surveyed as intensely. Its absence from lower elevations at this reserve is likely due to human disturbance. The absence of *Isthmohyla rivularis*, and the closely related *Isthmohyla tica*, in these surveys may also be indicators of true local declines or extirpations. Both species are common inhabitants of riparian zones in Lower Montane Wet Forest (Savage, 2002). Savage (2002) describes both species as being active year-round, with *Isthmohyla rivularis* calling throughout the night during most of the year. Tadpoles of both species inhabit fast-moving streams and should have been present during July (Savage, 2002). The lack of detection of individuals of either species during NPS, APS, TVES, and OS in suitable habitat may indicate local decline or extirpation. No Centrolinids were observed during sampling, but insufficient sampling of preferred habitats at night may be the cause of lack of detection.

Decline or local extirpation of many of these amphibians may be due to recent outbreaks of chitridiomycosis in the region (Puschendorf, 2003). Lips (2003) implicated *Batrachochytrium dendrobatidis* as a cause of declines seen in Zona Protectora Las Tablas, including declines of *Atelopus chiriquiensis*, *Isthmohyla rivularis*, *Isthmohyla calypsa*, *Lithobates vibicaria*, *Hyalinobatrachium fleischmanni*, *Craugastor melanostictus*, and *Oedipina grandis*. Surviving species such as *Craugastor podiciferus*, *Craugastor fitzingeri*, *Craugastor crassidigitus*, and *Pristimantis cruentus* may be less affected by this pathogen, due to differences in genetics or life histories.

The lack of detection of *Isthmohyla pseudopuma* by this survey is likely the result of a real decline. Although an individual was captured earlier in the year (Cosineau, 2007), this species was not observed in our survey. The species is described as a

common species, found of both pristine and degraded sites, by Savage (2002). This species is an explosive breeder, reproducing in natural and created lentic pools. The recent removal of such habitats from parts of Reserva Cloudbridge may have contributed to the species' scarcity, although this species was not observed in created ponds within the reserve, or in lentic systems in adjacent properties.

Pounds et al (1999) have tied amphibian declines in the Monteverde Cloud Forest Preserve to global climate change, specifically reductions in mist frequency. Moreover they have implicated climate change in simultaneous population declines of birds and Polychrotid lizards (Pounds et al, 1999). Many of the Polychrotid lizards expected to occur at Reserva Cloudbridge were not recorded, possibly showing the effect of similar phenomena at this site.

#### Examination of Previous Records

Many species of herptile are reported from Reserva Cloudbridge that are not photographically verified as existing within the reserve. Additional species were documented as occurring within San Gerardo de Rivas and are likely to occur within the reserve.

The only Caudate reported as occurring within Reserva Cloudbridge is *Oedopina uniformis* (Cosineau, 2007). Although photographs of the captured individual were reviewed by the authors, identification could not be verified based on the photographs. The *O. uniformis* complex is known to contain at least two cryptic species, *O. pacificensis* and *O. gracilis* besides the nominate form (Good & Wake, 1997). *O. pacificensis* and *O. gracilis* are geographically restricted to the Pacific and Atlantic lowlands respectively while *O. uniformis* is known from higher elevations in the Costa Rican cordilleras and Meseta Central, although there are no known specimens from this region of the Costa Rican Cordillera de Talamanca (Savage, 2002). The diagnosis made by Cosineau (2007) is recommended based on elevational occurrence records (Savage, 2002), although genetic sampling must be used to verify the identity of this species within the reserve.

Jacobs (2007) reported finding numerous species of Terraranid that have not been confirmed by other surveys. Some of these species were likely misidentified, although some may be verified as present within the reserve in the future. Jacobs (2007) reports *Pristimantis ridens* from both Amanzimtoti (1500 m) and the Smithsonian hectare (1850 m). Savage (2002) reports an upward elevational limit of 1600 m for this species. This species likely occurs in the lower areas of Reserva Cloudbridge, but it is unlikely to occur within the Smithsonian hectare. Individuals referred to as *P. ridens* by Jacobs (2007) may be misidentified *P. cruentus* or *Craugastor crassidigitus*. This species' inclusion in the herpetofauna of the reserve should be considered tentative until further verification. Similarly, *C. stejnegerianus* and *C. bransfordii* were reported by Jacobs (2007) from the Smithsonian hectare. These closely related species have documented upward elevational limits of 1330 m and 880 m respectively. Additionally *C. bransfordii* is only known from the Atlantic versant of Nicaragua and Costa Rica (Savage, 2002). Individuals attributed to these species by Jacobs (2007) were likely misidentified *C. podiciferus*. Individuals from the Smithsonian hectare identified as *C. gollmeri* by Jacobs (2007) are also likely misidentified *C. podiciferus*. This species has an upward elevational limit of 1520 m and is known primarily from Atlantic slopes with the few records from the

Pacific Slope in Northwest Costa Rica (Savage, 2002). Although *C. melanostictus* is likely to occur in Reserva Cloudbridge in areas of primary forest such as the Smithsonian hectare or Cloudbridge Norte, its presence has not been verified by any other researchers at the reserve. The authors believe Jacobs' (2007) diagnosis of *C. melanostictus* should be considered tentative until further verification.

Reports of *Ctenosaura similis* at Amanzimtoti (Cosineau, 2007; G. Giddy, personal communication, July, 2007) require further investigation. This species is known from the Pacific lowlands and the adjacent Valle de el General, but has a reported upward range limit of 765 m (Savage, 2002). Individuals of this species captured in the adjacent lowlands may occasionally be released in the vicinity of the reserve, but it is unlikely that a breeding population occurs in or near the reserve. A photo of a Polychrotid lizard was taken at Reserva Cloudbridge in early 2007. This individual has not yet been identified, although it is likely of the genus *Dactyloa*. Additional individuals must be examined to properly identify this 'blue-eyed lizard'.

G. Giddy (personal communication, July, 2007) reported that an individual identified as *Bothrops asper* was seen in Amanzimtoti. This species is reported by Savage (2002) to range only as high as 1200 m. An individual was seen by the authors in the town of San Gerardo de Rivas (1500 m), and a photo was taken by R. Romero of a dead individual in the town verifying that this species is found in the immediate area, and is likely to occur in the lower elevations of Reserva Cloudbridge.

#### Elevational Records

Numerous species present in Reserva Cloudbridge appear to be living at higher elevations than previously known. Some of these species were not found much higher than the limits reported in Savage (2002): *Dermophis glandulosus* (found 1500 m, reported 1400 m), *Craugastor fitzingeri* (found 1750 m, reported 1520 m), and *Norops polylepis* (found 1550 m, reported 1330 m). Other species were found much higher than previously reported (Savage, 2002): *Norops aquaticus* (found 1500 m, reported 1170 m), *Dendrophidion paucicarinatum* (found 1700 m, reported 1200 m), and *Bothrops asper* (found 1500 m, reported 1200 m). This exceptional number of species found higher than previously reported requires investigation. Before 2007, Reserva Cloudbridge had no previous herpetofaunal surveys, and the surrounding region is little studied. Many of these species are wide-ranging, though, and it is striking that all would range much higher at Reserva Cloudbridge than in other parts of their ranges.

The San Gerardo de Rivas area is largely modified and clearing of native forests may have changed environmental variables throughout the valley. These changes may promote colonization of lowland species (Pounds, Fogden, & Campbell, 1999). Global climate change may cause species to extend their ranges into higher elevations (Grabherr et al, 1994). Warming combined with anthropogenic change could help explain these wayward species.

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**Tables:**

Table 1. All species of herptiles found using all survey methods from July 2 – 21, 2007 in Reserva Cloudbridge and nearby areas of San Gerardo de Rivas.

T = Timed Visual Encounter Survey, N = Nocturnal Presence Survey, A = Auditory Presence Survey, O = Opportunistic Survey, P = Passive Trapping, C = Area Constrained Surveys

	<i>Craugastor podiciferus</i>	<i>Pristimantis cruentus</i>	<i>Craugastor crassidigitus</i>	<i>Craugastor fitzingeri</i>	<i>Diasporis diastema</i>	<i>Diasporis hylaeformis</i>	<i>Rhinella marina</i>	<i>Craugastor sp.</i>	<i>Sceloporus malachiticus</i>	<i>Mabuia unimarginata</i>	<i>Norops aquaticus</i>	<i>Norops polylepis</i>	Polychrotid Lizard	<i>Dendrophidion paucicarinatum</i>	<i>Bothriechis nigriviridis</i>	<i>Bothrops asper</i>	<i>Geophis brachycephalus</i>	<i>Dermophis glandulosus</i>
Amanzimtoti (Riparian)			N		A	A						O			O			
Cloudbridge Norte (All Habitat Types)	N		N	N				T	T									
Cloudbridge Sur Natural Regrowth								T	T, O									
Cloudbridge Sur Plantation			T															
Cloudbridge Sur Secondary Forest	T, O, C	T						T										
El Jilguero Secondary Forest	T, N, O				A	A		T									O	P
Gavilán Primary Forest	T, N	T, N			A			T										
Gavilán Natural Regrowth	P		O	O				O	O									
Heliconia Natural Regrowth			N															
Lower Meadow Plantation									T									
Rio Chirripó Pacifico (Riparian)																		
Sendero Rio (Riparian and Natural Regrowth)													T	O				
San Gerardo de Rivas (outside Reserva Cloudbridge)							N, O			O	O					N	O	

Table 2. Timed visual encounter survey herptile diversity between terrestrial habitat types.

	<b>DIVERSITY</b> <b>Shannon</b> <b>Index</b>	<b>RICHNESS</b> <b>Species</b> <b>Richness</b>	<b>Median</b> <b>Anurans/Hour</b>	<b>ABUNDANCE</b> <b>Median</b> <b>Lacertids/Hour</b>	<b>Median</b> <b>Herptiles/Hour</b>
<b>Primary</b>	0.303	2	1.667	0.000	1.667
<b>Secondary</b>	0.072	2	5.000	0.000	5.000
<b>Natural</b>					
<b>Regrowth</b>	0.000	1	0.000	0.000	0.000
<b>Plantation</b>	0.000	1	0.000	0.000	0.000
<b>Total</b>					
<b>Cloudbridge</b>	0.167	5	0.333	0.000	0.500

Figures:

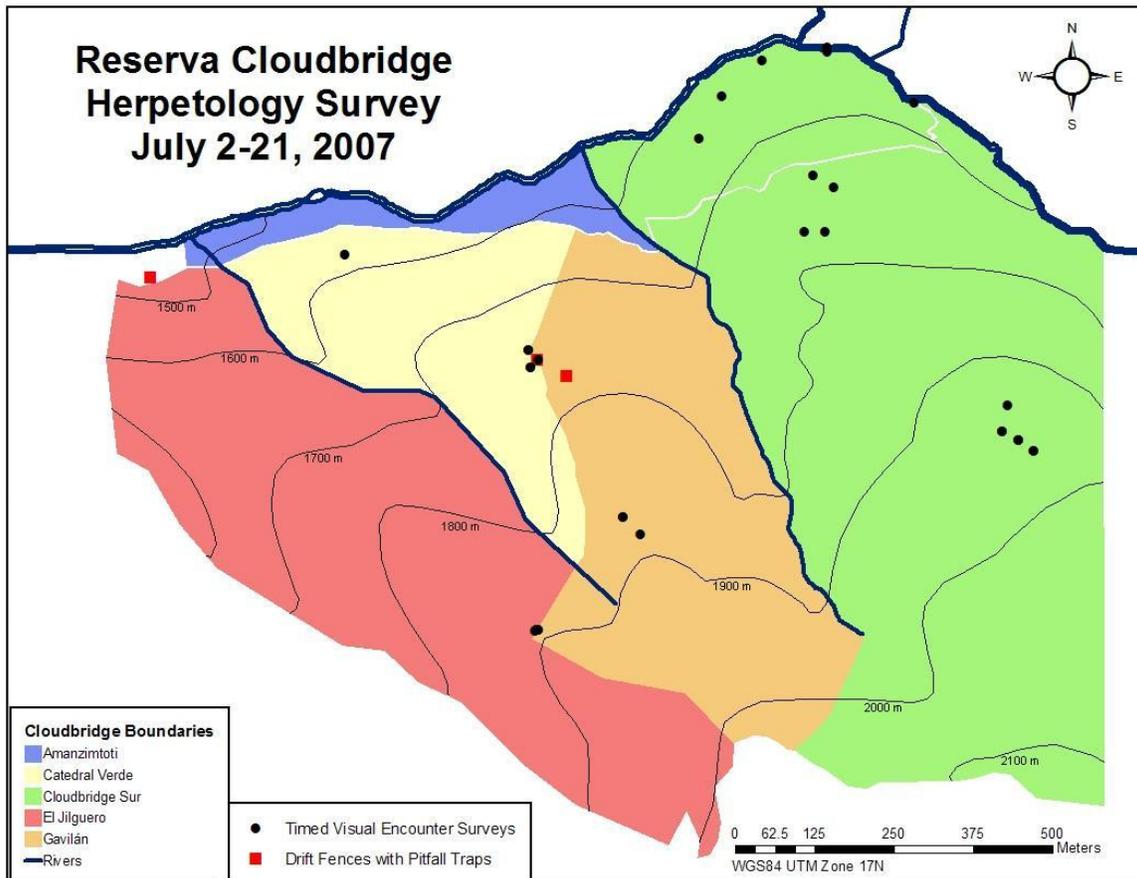


Figure 1. Location of study sites within Reserva Cloudbridge. Locations of timed visual encounter surveys are indicated with black dots and locations of drift fences with pitfall traps are indicated with red squares.

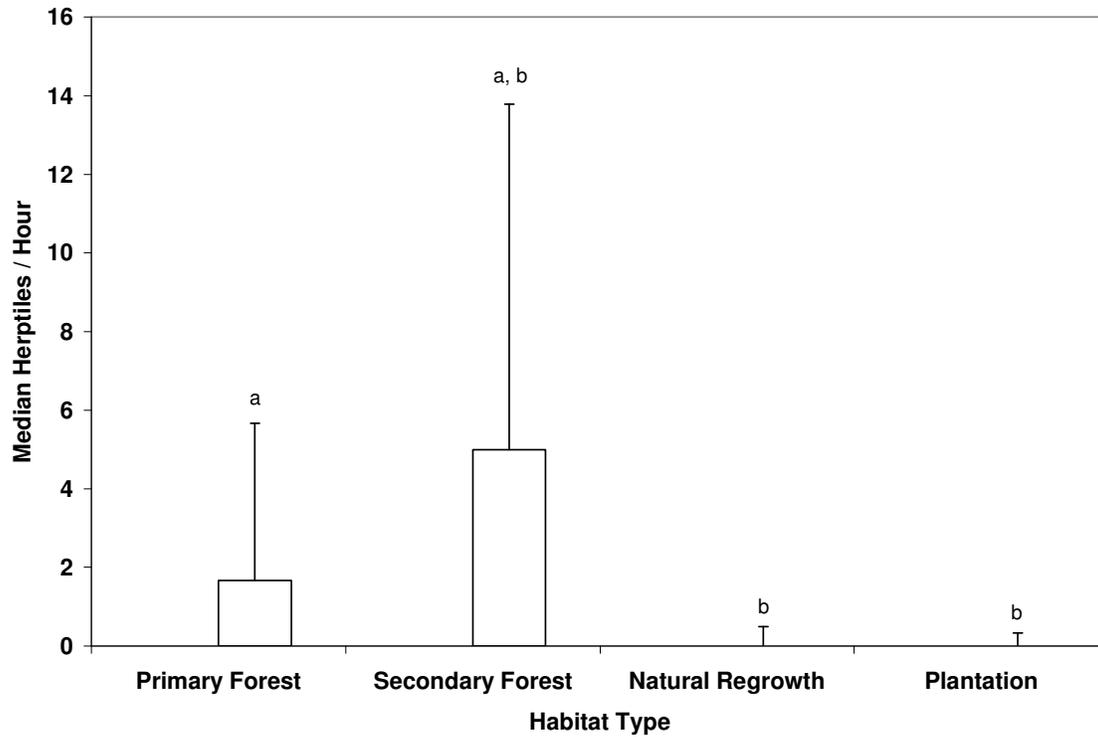


Figure 2. Median herptiles captured per hour during timed visual encounter surveys in each upland habitat type. Error bars represent 95% confidence interval, and data labels indicate groups of habitat types that were significantly different ( $X^2 = 16.59$ ,  $DF = 3$ ,  $p < 0.002$ ; Mood's median test,  $\alpha = 0.05$ ).

**Appendices:****Appendix A. Herpetofauna of Reserva Cloudbridge and the Surrounding Area**<sup>1</sup> denotes a species observed by Jacobs (2007)<sup>2</sup> denotes a species observed by Cosineau & Dimitri (2007)<sup>3</sup> denotes a species observed by this study

\* denotes a species observed outside, but in close proximity to Reserva Cloudbridge

# denotes a species confirmed by the authors based on photographic records

? denotes a species of questionable occurrence within Reserva Cloudbridge

Records appearing in bold are those that the authors believe to be present within the reserve.

## Amphibians

## Gymnophiona

## Caecilidae

***Dermophis glandulosus***<sup>3#</sup>

## Caudata

## Plethodontidae

***Oedipina uniformis***<sup>2#</sup>

## Anura

## Craugastoridae

*Craugastor bransfordii*<sup>1?</sup>***Craugastor crassidigitus***<sup>1 2 3#</sup>***Craugastor fitzingeri***<sup>1 3#</sup>*Craugastor gollmeri*<sup>1?</sup>*Craugastor melanostictus*<sup>1?</sup>***Craugastor podiciferus***<sup>1 2 3#</sup>*Craugastor stejnerianus*<sup>1?</sup>

## Bufonidae

***Rhinella marina***<sup>1 3 \* #</sup>

## Hylidae

***Isthmohyla psuedopuma***<sup>2#</sup>

## Strabomantidae

***Diasporis diastema***<sup>3</sup>***Diasporis hylaeformis***<sup>3</sup>***Pristimantis cruentus***<sup>1 2 3#</sup>*Pristimantis ridens*<sup>1?</sup>

## Reptiles

## Lacertes

## Phrynosomatidae

***Sceloporus malachiticus***<sup>3#</sup>

## Polychrotidae

***Norops aquaticus***<sup>3 \* #</sup>***Norops polylepis***<sup>3#</sup>

## Scincidae

***Mabuya unimarginata***<sup>3 \* #</sup>

## Serpentes

Colubridae

*Dendrophidion paucicarinatum*<sup>3 #</sup>

Crotalidae

*Bothriechis nigriviridis*<sup>3 #</sup>

*Bothrops asper*<sup>3\* #</sup>

Dipsadidae

*Geophis brachycephalus*<sup>3 #</sup>