

# Black-headed Bushmaster Survey

December 2008

Osaaventura Research Based Tours  
Golfo Dulce Region, Costa Rica

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Dear Fellow Herpers:

Your passion is needed! Revitalize your zeal for herps by joining us in the hunt for the fabled Black-headed Bushmaster! Collect your nerves as we explore the mountainous region of southwestern Costa Rica seeking to better understand this remarkable viper through sound scientific research.



No other snake in the New World inspires such reverence and dread within us than the Bushmaster, a reaction most likely stemming from our ignorance of this uncommon snake. The Black-headed Bushmaster (*Lachesis melanocephala*) will act as our research focal point for snakes as we will also include other species of concern, namely terrestrial snakes. Amphibians will be investigated through our separate Amphibian Tour!

This enigmatic viper, the largest in the world, is endemic to the verdant forests of southwestern Costa Rica and possibly into adjacent western Panama. A very restricted range indeed, compounded further by their constraint to undisturbed tropical wet forests. The black-headed occurs within the Costa Rican National Park system (Corcovado and Piedras Blancas National Parks), but most remaining low and middle elevation forest within their distribution has been converted to agriculture. This habitat conversion has severely fragmented their range and the snake is undoubtedly subjected to needless killing, and commercial collecting (Zamudio and Greene 1997) which continues unhindered as they are not protected under CITES.

It is imperative that the status and distribution of *L. melanocephala* and others be quickly determined, for two reasons. First, the threats leading to the loss of lifeforms effect with more drastic consequences, isolated and rare species more than on common, widespread species; simply put, rarity increases the probability of extinction. Second, extensive herpetological monitoring of the biodiverse Golfo Dulce region of Costa Rica is urgently needed. A recent paper by Whitfield *et al.* (2007) raises the already well known need to monitor Central American herpetofauna. The paper documents a massive decline in density (75 percent) of the leaf litter herpetofauna in a protected area, La Selva, over the past 30 years. By their very nature, these gradual community wide declines are difficult to perceive. They, therefore, strongly advocate the need for long term abundance-based data on population densities collected by using consistent methodology.

This is where you are needed! We are urgently in need of dedicated herpers with a basic knowledge of Central American herps, a keen sense for herp detection and the ability to tackle rough conditions. We have room for 8-12 adventure seeking individuals to partake

in this important research. Your participation in the project is vital in sustaining this essential monitoring. While here you will play two pivotal roles:

1. Being actively involved in surveys gathering data vital to conservation and;
2. Acting as the core source of funding while participating.

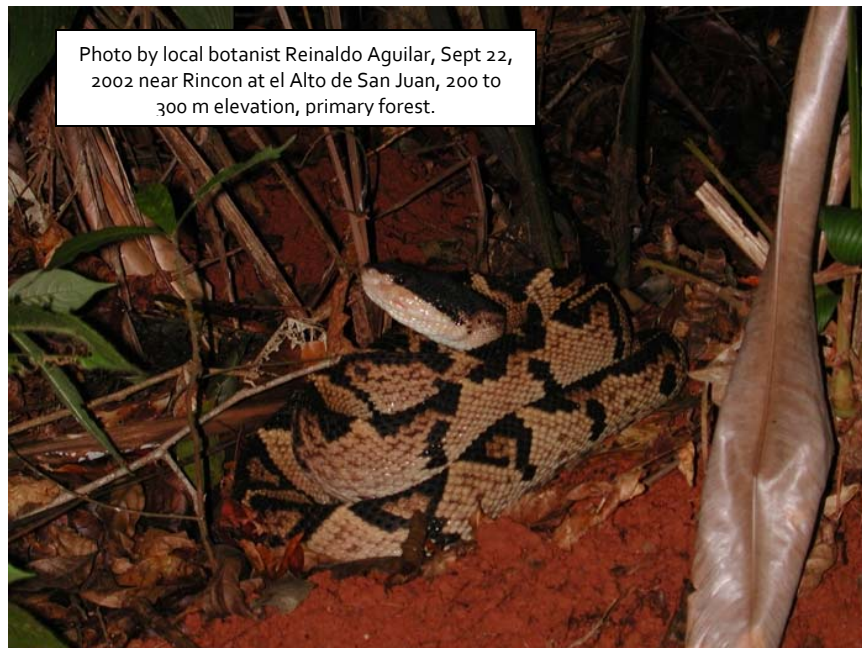
Due to the very inconsistent nature of research grants this project, vital in assessing the herpetofauna of the region, cannot be consistently fueled without your help!

This investigation will direct us through the wilder locales of the Golfo Dulce region with the ultimate goal of documenting the distribution, habitat preference and abundance of the bushmaster and other species encountered. We will rely heavily upon interactions with local people whose superbly practical knowledge will help in our quest for this often intangible snake. So, join us as we delve into the mysterious world of the Bushmaster and immerse ourselves in the many local legends appropriately surrounding this viper!

Sincerely,

*Michael Boston*  
Principal Investigator

*Gareth Blakemore*  
Investigator



# Bushmasters of the Golfo Dulce

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# Research Proposal

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## Investigators

*Gareth D. Blakemore*  
*Mike R. Boston*

## Project Title

*Long-term monitoring of the Black-headed bushmaster and other terrestrial snakes with an emphasis on assessing relative abundance and distribution*

## Research Site

*Golfo Dulce Region of southwestern Costa Rica*

## Team Size

*Minimum: 8 Maximum: 12*

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## Introduction

Snakes, by their very nature, are extremely secretive and often hard to find. The natural tendencies of pitvipers (sit-and-wait predation, generally nocturnal) and cryptic coloration further enhances this groups intractability. Studies on these species therefore require sufficient funds and man hours to gather data on their ecology and ecologists tend to shy away from studying them as a result. A thorough knowledge of snake ecology, and especially population biology, is therefore lacking. This lack of knowledge hampers the development of effective conservation strategies and prohibits biologists from contending the argument that conservation is needed at all (Dorcas and Wilson, in print). Though underrepresented in the literature, snakes have gained recognition as potential model organisms for studying ecological questions (Shine and Bonnet 2000). Snakes occupy the mid to upper levels in ecological food webs and therefore have strong effects on web dynamics (Lind et al. 2005). For example, the target species of this research, *Lachesis melanocephala*, has a narrow diet focused on spiny rats (Echimyidae) and may therefore play a significant role in forest structure as these rats are important dispersal agents of the *Welfia* palms. Yet, before such questions may be answered, a focused effort on establishing the status and distribution of snake species in question is needed.

The relatively uncommon Black-headed bushmaster (*Lachesis melanocephala*) has an especially limited distribution in southwestern Costa Rica and, possibly, adjacent western Panama. Their distribution is further restricted by their constraint to undisturbed Lowland Moist and Wet Forests (Savage, 2002). *L. melanocephala* is protected where it occurs within the Costa Rican National Park System (Corcovado and Piedras Blancas National Parks), but most remaining low and middle elevation forest within their

distribution has been converted to agriculture. This habitat conversion has severely fragmented their range and the snake is undoubtedly subjected to needless killing and commercial collecting (Zamudio and Greene 1997). These factors, coupled with the apparent rarity of this snake, are reason enough to assess its status. Furthermore their occurrence within protected areas may provide a false impression of permanence. A recent paper by Whitfield *et al.* (2007) documents a massive decline in density (75 percent) of the leaf litter herpetofauna in a protected area, La Selva, over the past 30 years raising the well known need to monitor Central American herpetofauna. By their very nature, these gradual community wide declines are difficult to perceive. The authors, therefore, strongly advocate the need for long term abundance-based data on population densities collected by using consistent methodology.

Through systematic sampling of the Golfo Dulce region, this project aims to gather data on the distribution, abundance and status of the Black-headed bushmaster and other terrestrial snakes encountered. Through continual monitoring we will be able to assess any changes in abundance over time when referred back to baseline counts. Data of this sort is lacking from our region of research, yet it is fundamental to further studies. A better understanding of the status of snakes at various scales (individual, population and landscape) will provide a basis for conservation measures and further ecological studies.

## **Research Objectives**

### *Overview*

*Lachesis melanocephala* is known to be relatively uncommon throughout its range. Individual capture probability (ICP) will most likely be low, though this is yet to be determined. Therefore, mark-recapture methods may not provide useful estimates of population parameters due to low recapture rates, as is generally true of intractable species. However, all captured *L. melanocephala* will be marked to assess individual capture probabilities. Furthermore, any recapture data would allow us to assess movement and changes in body size, condition or reproductive status of individuals. We will monitor population health using approaches that don't depend on recapturing individuals. Initial studies will help us assess ICP to determine whether a mark-recapture method of population monitoring is feasible.

### *Objective #1*

**To determine the presence/absence of *L. melanocephala* at survey sites.**

- **Where is the Bushmaster present?**
  - a. The first goal of surveys is to determine occupancy of the Bushmaster at survey sites. Presence/absence sampling will allow us to investigate patterns of distribution.
  - b. A standardized methodology will be used. A detection probability can then be calculated and a likelihood of absence can be estimated for sites where the species was not found.

## ***Objective #2***

**To determine the relative abundance of the Black-headed bushmaster.**

- **What is the relative abundance of *L. melanocephala*?**
  - a. An index of number of snakes encountered/person-hour will be used. With this type of assessment we don't have to sample the entire population.
  - b. Because the main concern in relative abundance assessment is bias:
    - The sampling method used will be repeatable.
    - Volunteers will be trained in survey techniques and identification beforehand.
    - Sampling events will be timed to minimize differences in behavior.
    - Sampling events will be conducted in similar seasons and under similar environmental conditions.

## ***Objective #3***

**To monitor population trends over time.**

- **Is the population growing, declining or stable?**
  - a. The ultimate goal of surveys is to assess population health founded on the baseline data gathered. The index of relative abundance will be used to assess stability.
  - b. Because this is a long-term study, high intensity, short duration sampling events will be used as they are preferable to continuous sampling. If capture rates permit, then this 'pulsed' design will meet the assumptions of mark-recapture analyses in assessing population health.

## ***Objective #4***

**To determine if mark-recapture is possible.**

- **Are there an adequate number of recaptures to estimate population parameters?**
  - a. We will determine the capture probability to determine if mark-recapture will provide useful estimates of population parameters.
  - b. Mark-recapture data will allow more in depth analysis of community composition and differences of density between sites than relative abundance analysis alone.

## ***Objective #5***

**An overall inventory of snake species composition and assessment of their relative abundance.**

- **What other snake species are encountered and what is their relative abundance?**
  - a. As surveys are conducted we will undoubtedly encounter other snake species. We will gather data on these snake species, allowing for an assessment of their abundance and distribution as well.
  - b. This will allow us to
    - Compare species richness between sites.
    - To monitor all species of terrestrial snakes.
    - Produce an inventory list of species present.

### *Objective #6*

**To gather a better understanding of Bushmaster ecology.**

- **What may we find out?**
  - a. Careful observations of any Bushmasters encountered may provide valuable insights into the ecology of these rarely observed snakes.

### **Methods**

**Objective #1 and #2:** To determine the presence/absence of *L. melanocephala* and the relative abundance of all terrestrial snakes encountered.

Diurnal and nocturnal visual encounter surveys (VES) of low intensity will be used to assess the presence or absence of *L. melanocephala* at survey sites. Surveys will also act as an overall inventory of snake species composition. The number of individuals of each species found, the total time searched and the size of area searched will all be recorded. As there is no standardized protocol for surveying this species we will try several methods and modify as we go.

1. Diurnal surveys will consist of time constrained area searching (quadrats and/or transects) by groups of 3-5 individuals. Volunteers will move through search area in a consistent fashion, systematically scanning all surfaces and searching all possible refuges for snakes. Individual duties: one data/time logger and at least two searchers, one capable of identification to the species level and the other a designated handler.
  - Searches will be time constrained or area constrained. To assess the relative abundance of all terrestrial snakes encountered, an index of snakes encountered/person-hour[x number of observers] will be used.
  - Refuges include: fallen trees and hollow logs, animal burrows and excavations (made by agoutis, pacas, spiny rats and armadillos), rocky caves, tree buttresses and hollows at base of trees. Burrows will be investigated through the use of a fiber optic camera, hollow logs and fallen trees with a small flashlight.

- During surveys all potential burrows will be numbered and their exact location recorded. Burrows will be considered patches to be searched after VES survey is completed.
    - There will be two survey events during daylight hours, each of 2-4 hours in duration. Survey times will remain consistent throughout census.
- 2. Nocturnal surveys will be of a transect design, using established trails and roads. The 3-5 surveyors (same duties as above) will walk trail at a constant speed, systematically scanning the forest floor (1m either side of trail) with head lamps for snakes.
  - Searches will be time constrained. To assess the relative abundance of all terrestrial snakes encountered, an index of snakes encountered/person-hour[x number of observers] will be used.
  - There will be one survey event per night, from 2-4 hours in duration. Times will remain consistent throughout survey.
  - Distance traveled, locations and environmental conditions will be noted.
- Upon encountering a snake, timekeeper stops time while data is collected and voucher photos are taken.
- All snake species encountered will be identified to species. If a capture is needed in order to confirm identity, then ONLY the designated handler will be allowed to do so. Data collected on each snake encountered will be:
  - Species, voucher photo, snout-vent length estimate, GPS location, time of capture and activity.
  - Additional data to be collected on each bushmaster caught: exact snout-vent length, weight, habitat description and sex.
  - For all surveys the following variables will be noted:
    1. Temperature
    2. Relative humidity
    3. Barometric pressure
    4. Canopy cover
    5. Litter Depth
    6. Ground Cover
    7. Weather (cloud cover, precipitation)
    8. Altitude

**Objective #3:** To monitor population trends in the long run the above mentioned surveys will be repeated several times per year for at least 10 years into the future. The results will be compared back to previous years to assess population health.

**Objective #4:** To determine if mark-recapture is possible. We plan to mark captured bushmasters through the use of PIT tags (Passive Injectable Transponder). These glass-

encapsulated microchips give each marked animal a unique digitized code. This method of marking animals is ideal for use in long-term population assessment and management, and PIT-tagged animals do not appear to suffer greater mortality than untagged animals (Camper and Dixon, 1988). Snakes to be tagged will be restrained manually. A PIT tag will then be injected subcutaneously, with the use of a modified needle, on the right side two-thirds down the length of the body and the small wound will be sealed with cyanoacrylate glue. All bushmasters encountered will be scanned with portable readers to determine if individual is a recapture.

**Objective #5:** To produce an inventory list of all terrestrial snake species encountered at study sites. As we will most likely observe other snake species during surveys, it would be worthwhile to compile an inventory list and to assess their relative abundances.

**Objective #6:** In the rare event a bushmaster is encountered, we will devote much time into pure observation to gather as much data on behavior as possible. For example we may be able to test certain behavioral characteristics of the snake, such as its reported aggressiveness. Involving the Instituto Clodomiro Picado in the future would yield useful data on this snake's venom.

## **Volunteer Training**

No prior knowledge of research techniques is needed, lucky you! All training will be given on-site; an introductory presentation will be given the first day followed by in field training. One of the main concerns in ecological monitoring are biased results, which may result for many reasons. When using VES methods we must make several assumptions which may or may not hold true; i.e. that every individual of every species is equally conspicuous, each species is equally likely to be observed during each sampling session and that each individual is recorded only once. The latter two may be minimized through sampling at similar times of the year and under similar weather conditions and keeping track of individuals so as not to record multiple recounts. Another concern is that observers will most likely have different search images for target species. Therefore, the quality and consistency of information gathered by volunteers is also a source of potential bias. To reduce this source of bias, all volunteers will be trained in field techniques and snake identification before actual surveys begin. As it will be beneficial to do as much reading as possible before coming we have included a suggested reading list. Also included is a list of the local snake species so that volunteers may become acquainted with them beforehand.

## **Volunteer Assignments**

The gathering of scientific data is an often monotonous and boring process. We will spend hours on end in the field under hot, humid and muddy conditions adhering to rigid protocol. What, you thought this was going to be a relaxing holiday? Each volunteer will be assigned a duty during surveys. Tasks are as follows:

1. Data logger: This individuals task is in recording all environmental variables, specimen data and keeping note of time.
2. Instrument Reader: This individuals task is in gathering all environmental variables, specimen data and reporting them to the data logger.
3. Observers: These individuals have the task of systematically searching sites for all terrestrial snake species. At least one observer should be capable of species level identification and another (most likely the principal investigators) designated as a handler if specimens warrant capture.
4. Miscellaneous: many other small tasks will be assigned as needed.

## **Project Staff**

### **Michael R. Boston**

I was born in Rawalpindi, Pakistan of Irish parents. Soon after my birth, we moved to Trinidad & Tobago in the West Indies, where I spent the next 14 years of my life. It was there that my father, known throughout the islands as “Snake Man,” bequeathed to me his passion for snakes and crocodiles and, indeed, the natural world. I completed my secondary level schooling in Northern Ireland, and for the next five years worked as a research assistant for the Department of Industrial & Forensic Science as a water pollution analyst. However, biology was my passion, and I moved to England to become an undergraduate. In 1979, I graduated with honors in Biology from the University of Portsmouth. After graduating, I worked for many years in the Ulster Museum, Belfast, as an Entomologist, studying the taxonomy and faunistics of parasitic wasps (the Ichneumonidae!). I was elected Fellow of the Royal Entomological Society of London for my published contributions to entomological research. Subsequent to this I took another position in the Ulster Museum working on the conservation of bats in Ireland. Indeed, I was one of the founding members of the Northern Ireland Bat Group, and Ireland’s first professional batman! Accepting an offer to establish the first Tropical Butterfly and Reptile House in Northern Ireland, I went on to develop and manage this project into one of the province’s leading tourist attractions. I then moved to Scotland and began a project with The Highlands & Islands Development Board to create a rainforest exhibit entitled “The Living Rainforest.” This was to be an expansion of the ideas I gained from my experiences in Northern Ireland. However, a 29% fall in tourism in 1994 spelled the end to the project. During this period I wielded a pickaxe and shovel to make ends meet – I was a laborer, and loved it! However, I yearned to return to the tropics, and to rainforests that I so love. Bewitched by the wild beauty of the Osa Peninsula during a visit in 1995, I returned to there to live and work the following year. In 1998, I established Osa Aventura. Since then, I have been imbuing in others that passion for tropical rainforests that my father imbued in me in my formative years.

Mike has been named a Research Associate of Friends of the Osa ([www.osaconservation.org](http://www.osaconservation.org)). Under the auspices of this foundation he is carrying out a long-term survey of the American crocodile (*Crocodylus acutus*) populations in the Osa Peninsula region of Costa Rica. For the past three years he has been monitoring whale sharks in the Golfo Dulce as part of a collaborative project with PRETOMA ([www.tortugamarina.org](http://www.tortugamarina.org)) and Vida Marina ([www.vidamarina.org](http://www.vidamarina.org)).

### **Gareth D. Blakemore**

I am a California native with a B.s. in Zoology from Humboldt State University. During university I worked summers for the U.S. Forest Service conducting TES (Threatened/Endangered Species) wildlife surveys in Arizona. Our main focus was the critically endangered Chiricahua leopard frog (*Rana chiricahuensis*). The task of the project was in assessing the presence/absence of this species throughout the Pleasant Valley Ranger District of the Tonto National Forest through systematic surveys, the determination of suitable release sites for captive reared individuals, the modification and restoration of these sites and then the eventual reintroduction of tadpoles and metamorphs into sites. A very exciting and radical project indeed, especially when we discovered that individuals had begun colonizing new sites! We monitored the five known populations from year to year. Other species we monitored included the infamous Mexican spotted owl (*Strix occidentalis lucida*) and the goshawk. We also undertook some rather unorthodox work in the form of non-native removal as we slaughtered bullfrogs, crayfish and tiger salamanders by the tons. I am currently conducting similar work in the rugged backcountry of Sequoia and Kings Canyon National Parks of California.

It was my first trip to the Osa Peninsula, in 2000 that triggered a profound change in me. In tropical ecology I had a new found passion but have since focused more intently on researching the diverse herpetofauna of the region.

### **Research Area**

Flying over the Golfo Dulce you gain an appreciation for the intense beauty of the region. Packed into an incredibly small area are an absurd number of habitats that lend to the areas unique biological richness, indeed a naturalists paradise. Within the region is the largest intact mangrove ecosystem in Pacific Mesoamerica (the Terraba-Sierpe system), the most significant remaining areas of lowland Pacific tropical rainforest, and one of only four tropical fjords on the planet, the Golfo Dulce. These ecosystems, and numerous others, provide habitat that is essential for the Osa's plentiful wildlife. The Talamanca Mountains, east of the Golfo Dulce, act as a shield against the winter trade winds so that precipitation arrives from the pacific lending to the areas wetter climate than the rest of Pacific Central America. The area thus supports the richest tropical lowland forest on Central America's west coast and possesses strong floristic affinities to the Colombian Chocó-region. Many South American tree species reach their northern limits here. On the Osa Peninsula temperatures seldom drop below 27°C (80°F), in the rainy season, and may exceed 35°C (95°F), in the dry season. Combined with the high humidity (60 - 100%), conditions here can become uncomfortable, even oppressive. Rainfall ranges from 4 to 7 meters (160 to 280 inches) annually, and falls mainly between the months of April and November, heaviest in October.

## **Itinerary**

December 1<sup>st</sup>-10<sup>th</sup>, 2008

### **Day 1**

By taxi to *Rio Nuevo Tent Camp*. The afternoon will be devoted to field training and the first survey. A nocturnal survey will follow dinner.

### **Day 2**

Morning and afternoon survey of 3-4 hours in length. A nocturnal survey will follow dinner.

### **Day 3**

Cross peninsular hike to the small coastal outpost of *Carate*. The hike will act as a diurnal survey. From *Carate* a taxi will transport us to the *Finca Profirio*, a large working farm in the Rio Piro Region with extensive primary forest habitat.

### **Day 4 and 5**

Morning and afternoon survey of 3-4 hours in length. A nocturnal survey will follow dinner.

### **Day 6**

By taxi to the *Osa Biodiversity Center (OBC)*, operated by *The Friends of the Osa*. The OBC is situated on 800 acres of forested habitat with access to an additional 3000 acres through cooperative use arrangements with adjacent land owners. A nocturnal survey will follow dinner.

### **Day 7**

Morning and afternoon survey of 3-4 hours in length. A nocturnal survey will follow dinner.

### **Day 8**

By taxi to the small mountain community of *La Tarde* above the Rio Rincon. Afternoon and nocturnal surveys.

### **Day 9**

Morning and afternoon survey of 3-4 hours in length. A nocturnal survey will follow dinner.

### **Day 10**

Morning survey followed by a debriefing. Transport to *Puerto Jimenez* for much needed rest and relaxation!

**Total cost/person: \$1,975**

Price includes all food and lodging, transportation and guide fees during stay and is subject to change. Please notify us beforehand if you have any special food preferences or allergies.

## *Snake species of the Osa Peninsula*

### **Serpentes**

#### **Alethinophidia**

##### **Boidae**

###### **Boinae**

*Boa constrictor* (SA/N,D)

*Corallus hortulanus* (A/N)

*Epicrates cenchria* (T/N)

##### **Ungaliophiidae**

*Ungaliophis panamensis* (A/N)

#### **Colubridae**

##### **Xenodontines**

*Clelia clelia* (T/N, D)

*Oxyrhopus petolarius* (T/N)

*Tripanurgos compressus* (T/N)

*Erythrolamprus mimus* (T/D)

*Xenodon rabdocephalus* (T/D)

##### **Amastridines**

*Amastridium veliferum* (SF/D)

*Enulius sclateri* (F/D)

*Nothopsis rugosus* (SF/D)

##### **Dipsadines**

*Coniophanes fissidens* (T/N,D)

*Dipsas tenuissima* (A?/?)

*Geophis hoffmanni* (T/?)

*Hydromorphus concolor* (SA/D)

*Imantodes cenchoa* (A, T/N)

*I. inornatus* (A/N)

*Leptodeira rubricata* (SA/N)

*L. septentrionalis* (SA/N)

*Ninia maculata* (T/D)

*N. sebae* (T/N)

*Rhadinea decorata* (T/D)

*Sibon dimidiatus* (?/?)

*S. nebulatus* (A/N)

*Urotheca decipiens* (T/D)

*U. fulviceps* (T/N, D)

*U. guentheri* (T/D)

##### **Colubrines**

*Chironius carinatus* (T/D)

*C. grandisquamis* (T/D)

*Dendrophidion percarinatum* (T/D)

*Drymarchon corais* (SA/D)  
*Leptophis ahaetulla* (A/D)  
*L. riveti* (?/D)  
*Mastigodryas melanolomus* (T/D)  
*Oxybelis aeneus* (A/D)  
*Pseustes poecilonotus* (A/D)  
*Scaphiodontophis annulatus* (T/D)  
*Spilotes pullatus* (SA/D)  
*Stenorrhina degenhardtii* (SF/D)  
*Tantilla ruficeps* (SF/D)  
*T. schistosa* (SF/?)  
*T. supracincta* (SF/?)

## **Elapidae**

### **Elapinae**

*Micrurus alleni* (T/N)  
*M. nigrocinctus* (T/N)

## **Viperidae**

### **Crotalinae**

#### **Lachesines**

*Bothriechis schlegelii* (A/N)  
*Bothrops asper* (T/N)  
*Lachesis melanocephala* (T/N)  
*Porthidium nasutum* (T/N)

Possible species, based on their occurrence in similar habitat in southwestern Costa Rica:

*Geophis brachycephalus* (SF/?)  
*Leptodeira annulata* (T/N)  
*Dendrophidion nuchale* (T/D)  
*Dendrophidion vinitor* (SA/D)  
*Drymobius margaritiferus* (T/D)  
*Drymobius rhombifer* (?/?)  
*Lampropeltis triangulum* (T/N,D)  
*Leptophis depressirostris* (A/D)  
*Leptophis nebulosus* (A/D)  
*Micrurus clarki* (T/N)

### **Key to abbreviations**

A-arboreal  
T-terrestrial  
SF-semifossorial  
N-nocturnal

SA-semiarboreal  
F-fossorial  
SA-semiaquatic  
D-diurnal

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4. Savage, J. M. *The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two seas*. Chicago and London: The University of Chicago Press, 2002.
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## Suggested Reading (additional to above)

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