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# NATURAL HISTORY OF SNAKES IN FORESTS OF THE MANAUS REGION, CENTRAL AMAZONIA, BRAZIL*

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**Abstract.** We present natural history information on 66 species of snakes found in the forests of the Manaus region, Central Amazonia, Brazil. For each species, we provide information on size, color pattern, habitat and microhabitat, feeding habits, reproduction, and defense. We also include a partial summary of the information available in the literature for Amazonian localities. Our results are based on nearly 800 captures or sightings of snakes made from 1990–95 at localities around Manaus, mostly at a primary forest reserve 25 km north of Manaus. Field data at this reserve were obtained during over 2600 person-h of visually searching for snakes, ca. 1600 of which occurred during time-constrained search. Temperature and relative humidity in Manaus are high and the amount of annual rainfall (2075 mm/yr) is relatively small, with a long dry season (4–7 mo). Of the 65 species for which information is available, 28 (42%) are primarily terrestrial, 20 (30%) fossorial and/or cryptozoic, 13 (20%) arboreal, and four (6%) aquatic, although many species use more than one microhabitat when active. Nearly all inactive snakes were found on vegetation. In relation to time of activity, 26 (41%) of the 62 species for which information is available seem to be strictly diurnal, 13 (21%) strictly nocturnal, and 23 (38%) both diurnal and nocturnal. The five prey types most commonly consumed by snakes in the Manaus region are vertebrates: lizards (consumed by 58% of the species), frogs (39%), mammals (23%), birds (18%), and snakes (16%). A cluster analysis combining data on microhabitat use, diel activity, and diet resulted in several groups of species with similar habits. All these "guilds" included closely related species, as well as distantly related ones that converge in habits. These combined results indicate that in addition to current ecological factors (e.g., predation pressure, differential prey availability in different microhabitats), historical factors (phylogeny and biogeography) may have played an important role in determining the current natural history patterns of this snake assemblage. A high diversity

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*This study is dedicated to O.R. Cunha and F.P. Nascimento (both now retired from Museu Goeldi, Belém) for their unparalleled contributions to the knowledge of Brazilian Amazonian snakes, including natural history, and the immense collection of snakes at the MPEG, an invaluable source of natural history information for years to come.

of defensive tactics was found in this assemblage, and phylogeny may be a strong determinant factor for the occurrence of defensive tactics in each species. Contradicting generalizations on the timing and length of reproductive season in Amazonian snakes, juvenile recruitment seems to occur mainly during the rainy season in most species from the Manaus region, although some species seem to breed throughout the year. This may be a consequence of the prolonged dry season that occurs in the region, during which time some resources occur in limited supplies.

**Key Words.** Serpentes; Amazonia; Microhabitat; Feeding; Defense; Reproduction.

**Resumo.** São apresentadas informações sobre a história natural de 66 espécies de serpentes encontradas em matas na região de Manaus, Amazônia central, Brasil. Para cada espécie são fornecidas informações sobre tamanho, coloração, habitat e microhabitat, hábitos alimentares, reprodução e defesa. Também é fornecida uma revisão parcial das informações disponíveis para outras localidades amazônicas. Os resultados são baseados em quase 800 capturas ou avistamentos de serpentes realizados entre 1990 e 1995 em localidades ao redor de Manaus, principalmente em uma reserva de floresta primária localizada a 25 km ao norte de Manaus. Os dados de campo nesta reserva foram obtidos durante mais de 2.600 horas-homem de procura visual, cerca de 1.600 durante procura limitada por tempo. As temperaturas e a umidade relativa em Manaus são altas e a quantidade anual de chuvas (média 2075 mm/ano) é relativamente pequena, com estação seca prolongada (4–7 meses). Entre 65 espécies para as quais existe informação, 28 (42%) são primariamente terrestres, 20 (30%) fossórias e/ou criptozóicas, 13 (20%) arborícolas e quatro (6%) aquáticas, embora várias espécies uilizem mais de um microhabitat quando ativas. Quase todas as serpentes inativas foram encontradas sobre a vegetação. Com relação ao período de atividade, das 62 espécies para as quais esta informação está disponível, 26 (41%) parecem ser estritamente diurnas, 13 (21%) estritamente noturnas e 23 (38%) tanto diurnas como noturnas. As cinco presas mais comuns consumidas pelas serpentes de mata da região de Manaus foram: lagartos (consumidos por 58% das espécies), anuros (39%), mamíferos (23%), aves (18%) e serpentes (16%). Uma análise de agrupamento combinando dados sobre uso de microhabitat, período de atividade e dieta resultou em vários grupos de espécies com hábitos similares. Todas estas "guildas" incluem espécies filogeneticamente próximas, bem como espécies distantes que convergem em hábitos. Estes resultados combinados indicam que, além de fatores ecológicos correntes (e.g., pressão de predação; disponibilidade diferencial de presas em diferentes microhabitats), fatores históricos (filogenia e biogeografia) devem ter tido um papel importante na determinação dos padrões atuais de história natural desta comunidade de serpentes. Foi encontrada uma grande diversidade de táticas defensivas na comunidade e a filogenia deve ser um importante fator determinante na ocorrência de táticas defensivas em cada espécie. Contradizendo generalizações sobre o período e a duração da estação reprodutiva em serpentes amazônicas, o recrutamento de jovens na região de Manaus parece ocorrer principalmente durante a estação chuvosa na maioria das espécies, embora algumas se reproduzam ao longo de todo o ano. Esse padrão deve ser conseqüência da estação seca prolongada que ocorre na região, período no qual alguns recursos ocorrem em quantidades limitadas.

Good natural history information (cf. Greene 1993) forms the essential raw data for studies on evolutionary biology and ecology (see Greene 1986, 1993, 1994*a*,*b* for further discussion). The few available studies that provide good (sensu Greene 1993) natural history data on Amazonian snakes (especially Beebe 1946; Dixon and Soini 1986; Duellman 1978) have been widely used in reviews on snake diversity and community structure (e.g., Cadle and Greene 1993; Duellman 1989, 1990). Amazonian habitats are shrinking relatively rapidly, threatening snake populations with extinction. Thus, accumulation of detailed natural history data on Amazonian snakes is crucial for future conservation and management (see Greene 1993).

The snake fauna of Central Amazonia is still poorly known compared to its western (e.g., Dixon and Soini 1986; Duellman 1978; Fugler 1986; Lescure and Gasc 1986; Rodríguez and Cadle 1990; Vanzolini 1986), eastern (see Cunha and

Nascimento 1993 and references therein), and northern (e.g., Beebe 1946; Chippaux 1986; Gasc and Rodrigues 1980; Hoogmoed 1979 1982*b*; Lancini 1979; Roze 1966; Test et al. 1966) portions. The available information on the snakes of Central Amazonia is scarce (Martins and Oliveira 1993), and the few references to this fauna (Egler et al. 1996; Hoge and Nina 1969; Martins 1993; Martins and Gordo 1993; Martins and Oliveira 1993; Schmidt and Inger 1951; Vanzolini 1985) deal with one or only a few species. The only relatively detailed study on the snakes of Central Amazonia is that by Zimmermann and Rodrigues (1990), which provides an analysis of the herpetofaunal community in some reserves located about 70 km north of Manaus. For snakes, these authors provided short descriptions of resource use and abundance data, based on 226 captures or sightings.

Herein we present detailed natural history data on 62 species of snakes found in the forests of the Manaus region, based on about 800 snake captures or sightings, most of them (552 sightings) made during a long-term study at Reserva Ducke, a primary forest reserve 25 km north of Manaus. Additionally, we examined several museum specimens (most of them from other Amazonian regions) and used unpublished data obtained in other Amazonian localities to complement our data on diet and reproduction. It is not our intent to review the taxonomic status of the species treated herein. However, we indicate references containing detailed taxonomic information for each species. We follow the taxonomic arrangement in Peters and Donoso-Barros (1970), except when stated otherwise in the taxonomic comments.

## MATERIALS AND METHODS

### Study Areas

Most of the field data provided here were gathered from 1990–95 in several localities in the Manaus region (see a map in Martins and Oliveira 1993). We consider the Manaus region to be a somewhat triangular area limited on the west by an arbitrary straight line from the Anavilhanas archi-

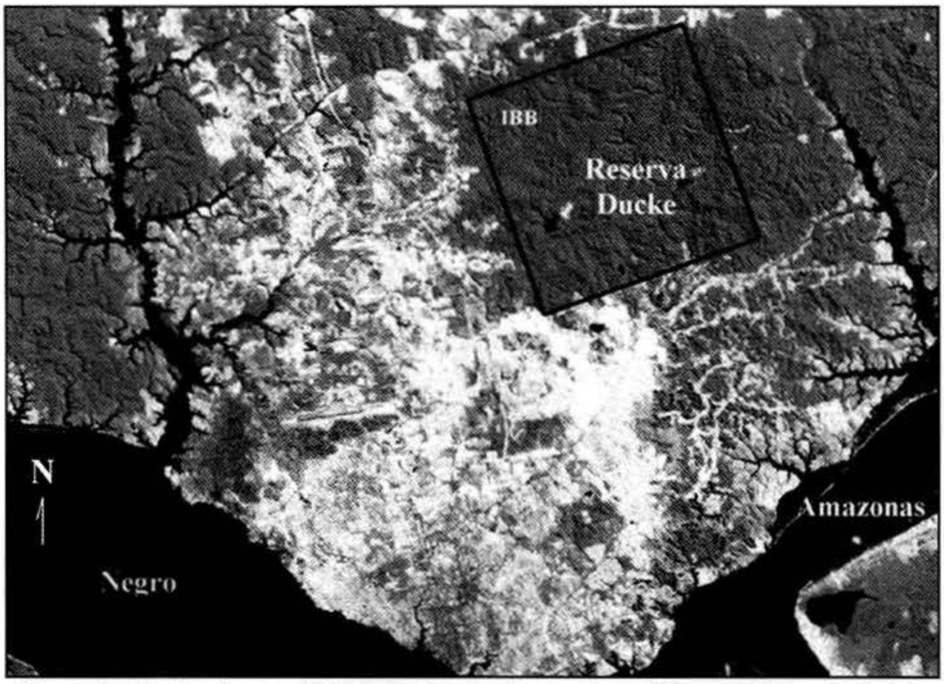

**Figure 1.** Landsat image of Manaus, showing the location of Reserva Florestal Adolpho Ducke, a primary forest area where most of the data presented here were gathered. IBB indicates the location of the Igarapé Barro Branco. The black areas below are the rivers Negro and Amazonas. Note that Manaus is encircling the reserve, which will become a 100 km$^2$ urban park in the near future. Each side of Reserva Ducke is 10 km long. Courtesy of INPA.

pelago (close to the mouth of the Rio Negro) to the Rio Pitinga (ca. 250 km north of Rio Amazonas), on the northeast by the Rio Uatumã, and on the south by the Rio Amazonas. This large area encompasses about 35,000 km$^2$. However, most of our collecting effort was made in a few scattered localities within this large area (see below and Fig. 1 in Martins and Oliveira 1993). Biogeographically, it is important to stress that our sample is restricted to the northern banks of the Rio Negro and the Rio Amazonas; if we had expanded our samplings to the southern banks of these two major rivers, some additional species would be included in our list.

Most of our field data (552 snake sightings of 52 species) resulted from a regular snake-searching program (see Materials and Methods) that operated from October 1991–March 1993 at the Reserva Florestal Adolpho Ducke (RFAD; Figs. 1–3). Results from fieldwork before and after this period are also included. The RFAD is a 100 km$^2$ tract of forest, mostly undisturbed, located at Km 26 on Highway AM-010 (connecting Manaus to Itacoatiara), north of Manaus. It is under the administration of the Instituto Nacional de Pesquisas da Amazônia (INPA). A comprehensive treatment of the history and vegetation of the RFAD was provided by Prance (1990); the summary provided here is extensively based on this treatment.

**Figure 2.** Views of the terra firme forest understory in the plateau area (A) and in the stream valley (B) at Reserva Ducke, Manaus, Amazonas, Brazil.

**Figure 3.** A trail through the floodable area in the stream valley (Igarapé Barro Branco) at Reserva Ducke, Manaus, Amazonas, Brazil. Note buriti palms (*Mauritia flexuosa*) and dense herbaceous cover on the ground.

From the early 1960s to 1972, INPA developed a silvicultural program of forest enrichment and forest nurseries at the reserve. In 1972 the RFAD was declared a biological reserve and all silvicultural work, except seed collecting and phenology, was transferred to other reserves around Manaus. However, the area utilized in the silvicultural experiments represented less than 2% of the total area of the reserve. Today, these areas are composed of tall trees with a clean understory. Even with the additional clearings to house buildings and eventual invasions, over 90% of the reserve remains intact (see Fig. 1). The RFAD is covered

**Figure 4.** The terra firme forest at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil, with a line of pitfall traps with drift fence.

by tropical rainforest on terra firme latosol (Figs. 2, 3). Several small streams flood their banks creating swamps during the rainy season (Fig. 3). These swamps contain many species typical of flooded forests, especially buriti palms (*Mauritia flexuosa*; Fig. 3). There are areas of white sand with dense "campinarana" forests. Additionally, there are a few areas of secondary growth ("capoeiras").

Regular searches for snakes at the RFAD were done in two study areas (1.4 km apart) located in physiognomically and topographically different regions—a plateau and a stream valley. The plateau is covered by terra firme forest with tall trees, many with thick trunks, and a relatively sparse understory with many sessile palms (Fig. 2A). It was sampled using a 2 ha (100 x 200 m) study area with trails cut every 10 m. The stream valley consists of swamp forest with many tall buriti palms, relatively short, thin trees, dense herbaceous growth over a large portion of the ground surface (Fig. 3), and a relatively dense understory with many low palms (Fig. 2B). The valley is dissected by a small stream (about 1–3 m wide, 10–100 cm deep) on relatively level ground; its slopes are separated by a floodplain about 50–100 m. This area was sampled using two trails that were cut approximately parallel to the stream, one of them (approximately 650 m long) mostly on the banks of the stream and the other (approximately 750 m long) mostly following one of the slopes (Fig. 3); the latter trail was surveyed most intensively. Trails were marked every 10 m to allow exact locations of individual snakes. Additional sightings were made in other areas in the RFAD, mainly on unpaved roads and other disturbed areas. The area sampled at the RFAD, including opportunistic sightings, was less than 100 ha (i.e., less than 1% of the reserve).

Additional observations were made in other localities around Manaus. Rio Pitinga is an area where a mining company constructed a dam to install a small hydroelectric station. The area is covered by terra firme forest on latosols (Fig. 4) similar to that at the RFAD. In late 1991, the water behind the dam rose 4 m above the initial flooding that had occurred some years before. The work at Rio Pitinga included both visual searching and the use of pitfall traps (Fig. 4; see Materials and Methods). A few additional observations made at the Balbina hydroelectric station (ca. 100 km north of Manaus), also in the Rio Uatumã basin, also are included (see description of this region in Martins 1991). A total of 118 observations of 39 species were made in the Rio Uatumã basin.

Rio Cuieiras (ca. 90 km northwest of Manaus) is a blackwater tributary of Rio Negro characterized

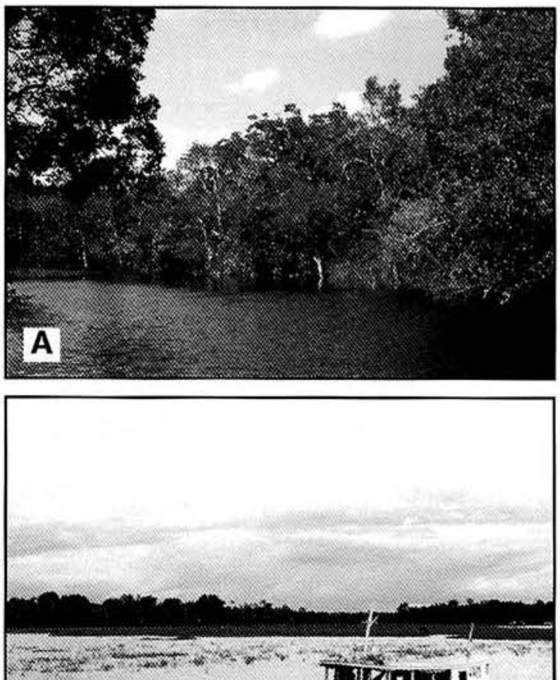

**Figure 5.** "Igapó" forest at the margin of Rio Cuieiras, Manaus (A), and "várzea" region in the Rio Solimões near Careiro, Amazonas, Brazil (B), showing "várzea" forests behind the floating meadows.

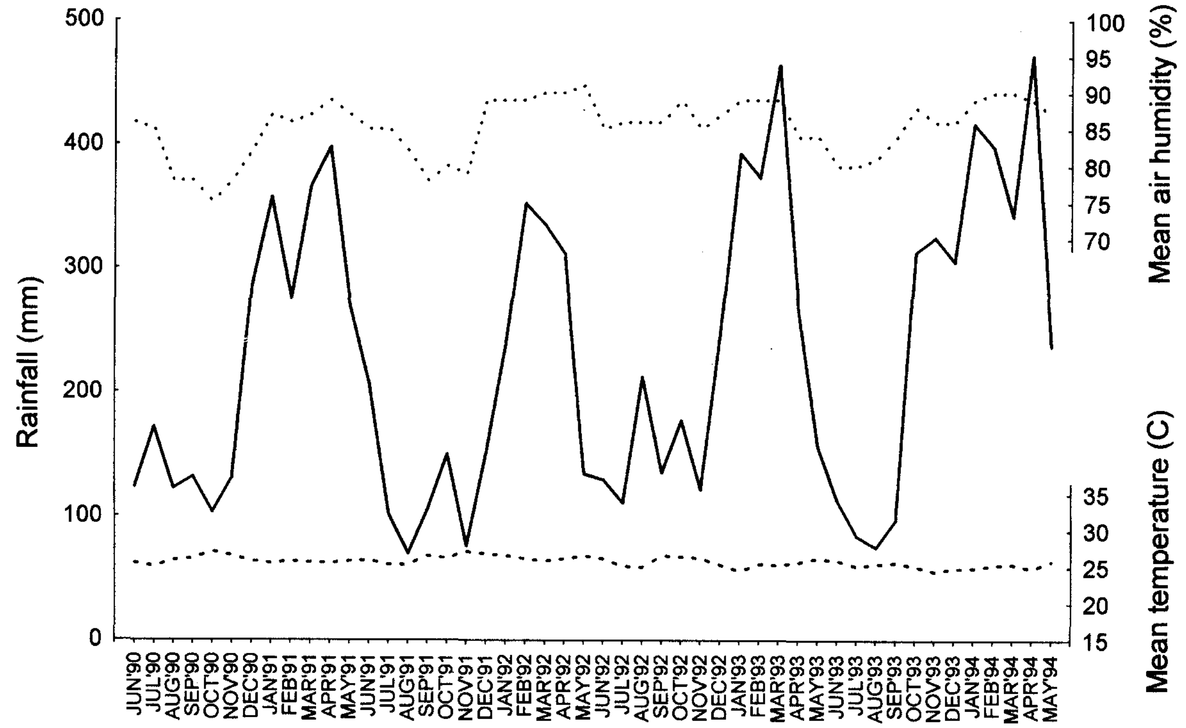

**Figure 6.** Variation of monthly rainfall, mean temperature, and mean air humidity from mid-1990 through mid-1994 in the Manaus region, Amazonas, Brazil. Note the marked dry seasons.

by "igapó" vegetation on the river banks and terra firme forests inland (Fig. 5A). "Igapó" consists of seasonally flooded low forests on the banks of blackwater rivers. Careiro is a region of "várzea", including white water rivers, lakes, and seasonally flooded "várzea" forests (with low trees; Fig. 5B). The work at Rio Cuieiras and Careiro was limited to visual searching and resulted in 16 observations of 13 species of snakes.

Besides the localities given above, 105 snake observations of 26 species were made elsewhere in the Manaus region, mostly in disturbed areas inside the Manaus metropolitan area. To further substantiate our conclusions on some species included here, we provide unpublished field data on specimens found at additional localities in Amazonia, besides those in the Manaus region. These snakes were found by us (in the States of Acre, Amazonas, Rondônia, Roraima, and Pará, Brazil), by C. Gascon at Rio Juruá (Acre and Amazonas, Brazil), by L.J. Vitt and J.P. Caldwell both in Brazil (Pará, Rondônia, and Roraima) and Ecuador (Río Cuyabeno, Sucumbíos Province), and by W.W. Lamar at several localities in western Amazonia.

## Climate

The climate in the Manaus region is characterized by a mean annual rainfall of 2075 mm (in the period of 1931–60; DNPM 1976), with a well defined dry season (Fig. 6). From mid-1990 through mid-1994, the rainy seasons were concentrated from October–December through April–June and the generally long dry season extended from May–July through September–November (Fig. 6). The years of 1991–93 were relatively wet (ca. 20% above the mean in 1991 and 1992, 40% in 1993). Temperatures in Manaus range from 18–37°C throughout the year (Leopoldo et al. 1987; monthly means 26–28°C, Fig. 6) and the relative humidity is about 85% (monthly means ca. 80–90%, Fig. 6).

## Snake Observations and Collections

Snake searching at the RFAD was undertaken mostly from October 1991–March 1993, as part of the regular snake searching program. Additional sightings at the RFAD and a few sporadic collections were made from March–September 1991 and from November 1993–August 1995. For practical purposes, snake searching at the RFAD was divided into two categories, time constrained search (TCS; see Campbell and Christman 1982) and opportunistic sightings (OS). Only the trails at the 2 ha plateau area and those in the stream valley were used for TCS. We walked 80–100 person-h every month, totaling 1595 person-h in 18 mo, 479 during daytime and 1116 at night. We made a higher effort at night because the mean rate of snake sightings was higher during this period (see below). Five people worked in TCS, although for most samples only two were present. Each previously inexperienced searcher was trained in the method before working in TCS. This method consisted of walking very slowly along forest trails searching for snakes; the search effort extended to all visually accessible microhabitats. At night, we almost always made 5h-searches; during daytime, samples varied from 1–4 h. During a 5h-search, we usually walked 300–400 m (60–80 m/h). A total of 274 observations of 31 species was made during TCS. During the total of 1595 man-h of TCS, about 112 km of trails were walked. Mean rate of snake sightings during TCS was 0.064 snake per person-h during daytime and 0.217 snake per person-h at night (i.e., one snake in 15h37min of search by day and one snake in 4h36min at night). Considering the mean length of trails walked by each person during each sampling hour of TCS (ca. 70 m), one snake was found per 1.10 km walked during daytime and one snake per 0.32 km walked at night.

Opportunistic sighting (OS) consisted of searching for snakes during other activities at the RFAD and at the additional localities cited above; although not quantified as precisely as in TCS, our sampling effort was over 1000 person-h. At the RFAD, OS was performed in various habitats, mostly disturbed ones (see Study Areas). OS also includes those eventual snake sightings or captures made by other researchers working at the RFAD and other localities around Manaus. A total of 278 observations of 49 species made at the RFAD were considered OSs.

Almost all snakes found were captured (during TCS, OS, or using pitfall traps; see details of this latter method below), although most of them were released soon after capture. For each snake we recorded: species, date and time of capture/sighting, location in the reserve and/or in the study area (when at the RFAD), snout–vent length (SVL), tail length (TAL), and weight, individual (both during markings and recaptures, sex (on a few occasions), microhabitat where the snake was first seen, activity, and any additional observations on behavior, color pattern, natural marks, presence/absence of eggs and/or prey, etc. At the RFAD, almost all snakes found were marked by clipping ventral scales (Spellerberg 1977).

Less than 5% of the snakes observed at the RFAD were killed and preserved both before and at the end of the regular snake searching program. At the other localities sampled, most specimens found were killed and preserved. Most of these voucher specimens are deposited in the snake collections of the Instituto de Medicina Tropical de Manaus (IMTM) and a few of them are in the collections of the Instituto Nacional de Pesquisas da Amazônia (INPA) and Museu de História Natural da Universidade Estadual de Campinas (ZUEC).

At Rio Pitinga, we used pitfall traps (see Fitch 1987) made with large metal buckets (100–150 l), installed every 10 m and linked with a plastic mesh drift fence 100 cm high (Fig. 4). About 500 m of trapline was installed parallel to the margins of the dam. Traps were kept open continuously and inspected daily, resulting in the capture of about 100 snakes during about 3 mo (late September–late December 1991). Additional pitfall traps, using 20–27 l buckets and plastic mesh, were installed at the RFAD at the end of 1992. However, these traps were opened only rarely, resulting in the collection of only three small snakes; besides the small sampling effort, the buckets seemed to be too small to capture snakes. For live and preserved specimens we provide body sizes as length and, when informative, mass. Length is provided as SVL, SVL+TAL, or total length (TTL).

## Habitats

A useful, clearly defined classification of habitats is found in Duellman (1978). Except for minor modifications mainly because of local particularities of the vegetation (see Study Areas, above), we use Duellman's (1978) classification. Microhabitat is used here as the position of the animal in the environment while active (see Cadle and Greene 1993, for an alternative use of the term microhabitat). Resting microhabitats are also informative (Cadle and Greene 1993) and are provided when known.

In order to characterize microhabitat use by snakes objectively, a classification with well-defined categories must be available. We define categories of microhabitat use as follows: (1) Aquatic (similar to the "Water" microhabitat of Duellman 1978) indicates those snakes that regularly spend at least part of their activity time inside the water. (2) Fossorial snakes (similar to "subterrestrial" in Dixon and Soini 1986) are those capable of burrowing and/or using soil galleries, and those that regularly spend at least part of their activity time in the soil. We did not search for snakes inside the soil; thus, most fossorial snakes were found within or on the leaf litter when they emerged from the soil (see accounts on fossorial species). Snakes caught in pitfall traps were considered to be within or on the leaf litter before falling into the trap. (3) Cryptozoic (cf. Cadle and Greene 1993; similar to "leaf litter inhabitants" in Duellman 1978) are those snakes that regularly spend at least part of their activity time inside the leaf litter. (4) Terrestrial snakes (similar to "ground inhabitants" in Duellman 1978) are those that regularly spend at least part of their activity time on the ground (in forests, they are found on the leaf litter). (5) Arboreal snakes (similar to "bush and tree inhabitants" in Duellman 1978) are those that regularly spend at least part of their activity time on the vegetation above the ground level. The term vegetation as used here includes epiphytes, vines, shrubs, and trees of various sizes, as well as decomposing vegetation such as fallen logs, branches, and large palm leaves.

Use of discrete categories allowed quantification of relative importance of each microhabitat category. For instance, for a given species that is most often seen active on the ground and occasionally on the vegetation (e.g., adult *Bothrops atrox*), we define the species as primarily terrestrial and occasionally arboreal. To provide a quantitative view of microhabitat use, we give the number of individuals of each species found in each category as in Duellman (1978). In some analyses of habitat and microhabitat we use "ecological species" following Duellman (1989); i.e., a given species may be included in more than one category depending on whether it uses more than one resource state.

### Time of Activity

Time of activity is here considered the period during which the snake is performing its activities (most commonly foraging). Only two categories are used here: diurnal and nocturnal. As with microhabitat use, we provide the number of individuals found in each category as in Duellman (1978).

### Diet

We have relatively few data on snake diets from the Manaus region, mainly because we killed only a few individuals during the study at the RFAD. We provide data from regurgitated prey and gut contents of a few snakes captured at the RFAD, as well as a few from the Manaus region deposited in the snake collection of the Instituto de Medicina Tropical de Manaus (IMTM). However, most specimens at the IMTM collection (including several collected by us during this study) were not available to us before the end of the study. Additional data on the diet of some species were obtained by examining specimens from other Amazonian localities (mostly from Pará) deposited at the Museu Paraense Emílio Goeldi (MPEG), Belém, Pará, Brazil. For preserved specimens, each prey item or their remains were recorded. The identity of many prey items was inferred by their remains. Identification of prey remains were made under a dissecting microscope. The presence of earthworm remains was detected by their chetae. Frogs are often completely digested before reaching the hindgut; thus, insect remains (chitinous fragments) found in the hindgut of those species known to feed primarily on vertebrates were considered to be from the gut contents of frogs (Martins and Gordo 1993), although caecilians also may be completely digested and thus misidentified as a frog (O.A.V. Marques, pers. comm. 1996). When possible, we provide prey/predator mass ratio (Greene 1989). Weight was obtained with spring scales and length with a flexible rule or a caliper.

### Reproductive Data

We provide field and laboratory data on presence of vitellogenic follicles, oviductal eggs or embryos in females and observations of neonates or small juveniles throughout the year. Our analyses of reproductive data are limited to reproductive mode and timing and length of juvenile recruitment in the populations sampled (in this latter case, using only data from the Manaus region). In live specimens, number of vitellogenic follicles, oviductal eggs, or embryos was estimated by palpation and/or through the translucent body (against a headlamp) of most slender and/or small snakes. A few specimens collected at the RFAD as well as a few from the Manaus region deposited in the IMTM collection also were examined for the occurrence of juveniles and presence and number of vitellogenic follicles, oviductal eggs or embryos. Additional data on reproduction of some species were obtained by examining specimens from other Amazonian localities deposited at the MPEG. In this latter case, we ignored the date of collection in the museum records, because most of these dates at the MPEG are doubtful (F.P. Nascimento, pers. comm. 1995). Measurements of eggs are presented as length or (mostly) maximum width and length.

### Defensive Behavior

Data on defense were gathered during the fieldwork at the RFAD and other localities in the Manaus region. Occasional observations on captive specimens also are included. We attempt to describe as clearly as possible the context during which each behavior was performed. Almost all defensive postures and behaviors were generally included in the categories defined by Greene (1988). The category "body rotation" (along the long axis of the body) used here does not fit any category defined by Greene (1988; see Natural history summary). "Gular inflation" is defined here as the inflation of the gular region and anterior portion of the neck (as if the snake is swallowing an egg); this behavior was included in "lateral neck expansion" by Greene (1988). "Body thrash" is used here as defined by Greene (1988) and involves grasping the snake (or restraining it during handling by the observer). "Subtle thrashes" are those subtle movements (including partial coiling) stimulated simply by approaching the snake, with no need of touching or restraining it. "Coiling" is defined here as defensive body coiling in pitvipers (always associated with an S-coil) and is not to be confounded with the "coil body" category defined by Greene (1988). "Rub cloaca" is defined here as the intentional rubbing of the cloaca on the observer's hand during handling. Venomous and large snakes bit leather gloves (Sazima and Abe 1991), although *Bothrops atrox* was able to bite through them (see Hardy 1994).

### Resource Utilization

In order to determine patterns in resource utilization for the whole assemblage, the information on microhabitat use, diel activity, and diet were analyzed together with cluster analyses of qualitative data (presence/absence). We used Euclidean distances to generate the dissimilarity matrices and unweighted pair group average to generate trees. Categories of microhabitat and diel activity were soil, leaf litter, ground, vegetation, and water, each divided into day and night, resulting in 10 categories. For diet, we used 10 prey categories: arthropods, mollusks, earthworms, fish, anurans, caecilians, lizards, snakes plus amphisbaenians, birds, and mammals. All computations were performed in Statistica (StatSoft 1996).

## SPECIES ACCOUNTS

Below we present natural history information on 66 species of snakes found in the forests of the Manaus region. For each species, we provide information on body length, relative tail size, and eye diameter, color pattern (in life), habitat and microhabitat, feeding habits, reproduction, and defense. Besides pictures and detailed color descriptions, we also provide clues for distinguishing similar species, as well as references containing detailed taxonomic information (e.g., scale counts) that may assure confident identification.

About 80 species of snakes are known to occur in the Manaus region (see Jorge da Silva and Sites 1995), as defined by Martins and Oliveira (1993; see Study Areas). Besides the 66 forest species listed below, some species typical of open areas known to occur in the Manaus region (e.g., *Chironius carinatus*, *Drymarchon corais*, *Liophis cobellus*, *L. miliaris*,) may be found occasionally in forests (especially forest borders). Surprisingly, three viperids that occur throughout Amazonia (*Bothrops bilineatus*, *B. brazili*, and *B. taeniatus*; see distribution maps in Campbell and Lamar 1989) were not found in the Manaus region (see definition of this region in Study Areas). Considering our sampling effort and the apparent absence of these species in the region of the Balbina hydroelectric station dam (no specimen was found during the faunal rescue, when hundreds of *B. atrox* and at least 60 *Lachesis muta* were collected), we suspect that these three species are actually absent in this region.

Our species list differs in some points from that provided by Zimmermann and Rodrigues (1990) for the Manaus region. Those authors referred to two species of *Leptotyphlops* for the Manaus region: *L. septemstriatus* and *L. tenellus*. However, we found only one species of this genus in the region (as defined here), that we identified as *L. diaplocius* (see account on this species below). They also referred to two species of *Apostolepis*, one of them most probably the same we treat here as *Apostolepis* sp. The *Atractus* sp. referred to by Zimmermann and Rodrigues (1990) may be one of the species cited herein (see, for instance, the account of *A. major* below; see also Martins and Oliveira 1993). The name *Chironius cinnamomeus* used by these authors currently is considered to be a synonym of *C. scurrulus* (e.g., Dixon et al. 1993). We failed to find *Dipsas catesbyi*, *Liophis poecilogyrus*, and *Bothrops bilineatus*, also referred to by Zimmermann and Rodrigues (1990), in the Manaus region as defined herein; there are specimens of *D. catesbyi* at the IMTM collection from the southern banks of Rio Amazonas and Negro, regions not included in this study (see comment on *B. bilineatus* above). Considering our sampling effort and the absence of these species at the IMTM and INPA collections, we suspect these three species do not occur in the Manaus region as defined herein. Finally, the species identified as *Oxyrhopus trigeminus* in Zimmermann and Rodrigues (1990) may be identical to the one we identify here as *O.* aff. *melanogenys*.

### Anomalepididae

*Typhlophis squamosus* (Schlegel 1839)
Plate1

**Identification.** Maximum TTL unsexed 255 mm (Cunha and Nascimento 1978); minimum TTL 78 mm (at the MPEG); TAL 2.1% of TTL (one individual; Gasc and Rodrigues 1980); tail tip with a sharp spine; vestigial eyes (see taxonomic information in Cunha and Nascimento 1978). The dorsum and venter are dark brown. The head is pinkish cream above and below. The tip of the tail is brown.

**Habitat and microhabitat.** At Pitinga, one individual fell into a pitfall trap in a primary forest. At least three individuals were inside termite nests in rotting logs on the forest floor by day (L.J. Vitt, pers. comm. 1996), and a pair was under a rock (J. Howland, unpublished data). Cunha and Nascimento (1978) stated that this fossorial species inhabits galleries in ant nests.

**Feeding habits.** No information is available for the Manaus region. We found ant pupae in the stomach of one specimen at the MPEG. Cunha and Nascimento (1978) found ant eggs and pupae in the stomachs examined.

**Reproduction.** One female from Pitinga laid four eggs in October. Another from Belém, Pará (at the MPEG) had three eggs (14.0 x 2.4 mm, 14.2 x 2.6 mm, and 14.3 x 2.9 mm).

**Defense.** This species thrashes the body and presses the sharp tip of the tail against the captor's hand when handled.

### Leptotyphlopidae

*Leptotyphlops diaplocius* Orejas-Miranda 1969
Plate 2

**Identification.** Maximum TTL unsexed 208 mm; TAL 5.1–7.0% of TTL; tail tip with a sharp spine; vestigial eyes (see taxonomic information in Nascimento et al. 1988; Orejas-Miranda 1969). The dorsum and flanks are shiny dark brown with four pairs of golden yellow stripes, middorsally, dorsolaterally, laterally (generally poorly distinguishable), and ventrolaterally. The head is dark brown with a bright yellow spot anteriorly and pale yellow spots lateroposteriorly; ventrally, the head is yellowish brown. The tail tip is bright yellow. The venter is reddish brown, with dark brown stripes. The small, vestigial eyes are blackish. The tongue is cream.

**Habitat and microhabitat.** At the RFAD, four individuals were crawling on the exposed soil of a deforested area, by day. Also at the RFAD, one individual was on the trunk of a palm ca. 2 m above the ground, trying to enter a termite nest (*Nasutitermes*) during a light rain (L.J. Vitt, pers. comm. 1996). In other localities in the Manaus region, six individuals were found after heavy rains that saturated the soil of disturbed areas within primary and secondary forests. Literature records also indicate this species is a fossorial forest dweller (Duellman and Salas 1991; Nascimento et al. 1988).

**Feeding habits.** One individual from the RFAD had unidentifiable insect remains in the hindgut.

**Reproduction.** One female (185+10 mm) from the RFAD laid two eggs (23 x 5 mm and 26 x 5 mm) in September; one newborn was found in April in Manaus.

**Defense.** Besides thrashing the body, this species presses the sharp tip of the tail against the captor's hand and expels a strong, foul-smelling cloacal secretion when handled.

**Taxonomic comments.** Zimmermann and Rodrigues (1990) included *Leptotyphlops tenellus* and *L. septenstriatus* in their list for the Manaus region. However, we found only one species of *Leptotyphlops* in this region, which agrees in all characters with the original description of *L. diaplocius* by Orejas-Miranda (1969), apparently a good species easily distinguished from *L. tenellus* and *L. septemstriatus* (see also Hoogmoed 1977; Nascimento et al. 1988).

### Typhlopidae

*Typhlops reticulatus* (Linnaeus 1758)
Plates 3, 4

**Identification.** Maximum TTL unsexed 522 mm (Dixon and Hendricks 1979); minimum TTL 115 mm; TAL 1.6–4.3% of TTL (Dixon and Hendricks 1979; Gasc and Rodrigues 1980); sharply pointed tail; vestigial eyes (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986; Dixon and Hendricks 1979). The dorsum is deep grayish brown with several poorly distinct darker stripes; the venter is yellowish cream. The head anterior to the eyes is cream (each scale with yellowish margins); posteriorly it is deep grayish brown. The tip of the tail is yellowish cream.

**Habitat and microhabitat.** At Pitinga, seven individuals fell into pitfall traps. O'Shea (1989) caught one individual in a pitfall trap in primary forest and Cunha and Nascimento (1978) stated that *Typhlops reticulatus* is fossorial, living in galleries of leaf-cutting ants (*Atta* spp.).

**Feeding habits.** Beebe (1946) found ants (*Atta* sp.), several termites, and a beetle in three stomachs, Cunha and Nascimento (1978) found ants (*Atta* sp.) in one stomach, and Dixon and Soini (1986) found 30 ant eggs.

**Reproduction.** One individual from Rio Jamari, Rondônia, laid 10 eggs (26 x 14 to 29 x 14 mm) in early March; three juveniles (TTL 115–120 mm, 2.3–2.5 g) were born 52 d later.

**Defense.** When handled, *Typhlops reticulatus* thrashes the body, presses the sharp tip of the tail against the captor's hand, and expels cloacal secretions.

### Aniliidae

*Anilius scytale* (Linnaeus 1758)
Plate 5

**Identification.** Maximum TTL male 810 mm, female 1184 mm (Dixon and Soini 1986), minimum TTL 206 mm (specimen at MPEG); TAL 2.4–4.8% of TTL (Beebe 1946; Duellman 1978; Gasc and Rodrigues 1980; this study); blunt tail; vestigial eyes beneath an hexagonal scale (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986). The color pattern dorsally (including the tail) consists of a reddish orange ground with wide black spots that fuse middorsally giving rise to black bands; sometimes the blotches fuse only partially or do not fuse at all middorsally, resulting in a checkered pattern. The venter is yellowish cream (except on the chin and tail that are reddish orange) with the ventral extensions of some of the black lateral blotches. The small, blackish eyes are beneath a single hexagonal scale. The tongue is slightly pinkish cream. Although at first sight *Anilius scytale* may be similar to venomous coral snakes, none of these in the Manaus region has such a pattern of orange and black bands.

**Habitat and microhabitat.** At the RFAD, three individuals (one juvenile, two adults) were found at night moving on the exposed soil surface of disturbed areas, always close to bodies of water (a stream and an man-made pond); one juvenile was observed in the water within the vegetation at the bottom of the shallows of an man-made pond.

At Manaus, three additional individuals were moving on the soil of clearings in secondary forests by day. The available data (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Duellman and Salas 1991; Vanzolini 1986; W.W. Lamar, unpublished data; this study) indicate that *Anilius scytale* may live in diverse habitats, is primarily fossorial and occasionally aquatic and terrestrial when active, is almost always associated with bodies of water, and may be active both during daytime and at night. In the Manaus region, this species is found almost always on the pounded, exposed soil of disturbed areas (clearings, unpaved roads, old forest trails; see also Duellman 1978); the compressed soil probably restricts underground movement, forcing these fossorial snakes to emerge. As suggested by Martins and Oliveira (1993) for other fossorial snakes (*Atractus* spp.) from the Manaus region, the activity of *A. scytale* may be influenced by other factors (e.g., hunger, flooding of underground galleries), instead of daily light patterns (but see accounts of *Micrurus lemniscatus* and *M. spixii* below).

**Feeding habits.** One individual from the RFAD regurgitated a fish, *Synbranchus marmoratus*. One individual from Manaus (220 TTL, 4.5 g) regurgitated a nearly intact *Amphisbaena vanzolinii* (198 mm TTL, 3.5 g, MR 0.78), and another from Anavilhanas contained the remains of an unidentifiable lizard. Two specimens from Rio Jau had remains of snakes in the stomach (one of them contained *Atractus torquatus*). The available information (Cunha and Nascimento 1978,1981; Greene 1983*a*; Beebe 1946) indicate that *Anilius scytale* feeds primarily on elongate fossorial and aquatic vertebrates. Beebe (1946) found insects in one stomach, that may have resulted from an accidental or secondary ingestion.

**Reproduction.** One female (598+24 mm) collected in June at Balbina gave birth to eight young (CT 154–163 mm) and another (424+17 mm) from Manaus contained seven fully developed embryos (CT 157–173 mm), both in October; another from the Manaus region (no collecting date) contained five developing embryos. A female (898+29 mm, 181 g, preserved) from eastern Amazonia (at MPEG) gave birth to 15 young (the smallest had a TTL of 206 mm and the largest 234 mm; combined weight of all 15 young, 52 g). Cunha and Nascimento (1981) reported females with 5–12 embryos and Dixon and Soini (1986) reported two females that gave birth to four and six young.

**Defense.** *Anilius scytale* rarely bites when handled; however, its bite is very powerful, like that of large amphisbaenians. In non-venomous fossorial snakes that feed on long vertebrates, powerful bites may be selected primarily to facilitate prey restraining inside soil galleries; thus, its use as a defense may be secondary. When disturbed, besides trying to flee by moving away or digging into the soil, this species also compresses the body dorsoventrally, elevates the tail tip, and hides the head under body coils (see also Greene 1973*a* 1988). Its supposed coral snake mimic color pattern (see Savage and Slowinski 1992) is possibly a case of abstract coral snake mimicry (see Pasteur 1982, Pough 1988) since it does not resemble that of any Amazonian *Micrurus* (but see Campbell and Lamar 1989). However, many fossorial snakes have strongly contrasting banded patterns even in areas in which coral snakes do not occur (see also Vitt 1992). Cloacal discharge was also described in *A. scytale* (see Greene 1988).

### Boidae

*Boa constrictor* (Linnaeus 1758)
Plates 6, 7

**Identification.** Maximum TTL unsexed 4200 mm (Roze 1966; see also Henderson et al. 1995 and Murphy 1997); minimum TTL 650 mm; TAL 10.1–11.9% of TTL (Beebe 1946; Dixon and Soini 1986; Duellman 1978; this study); ED about 1/8 to 1/10 of HL; vertical pupil; small curved spines (vestigial hindlimbs) lying ventrolaterally in the cloacal region (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986). The dorsal ground color is pale gray to reddish tan anteriorly with brown to dark brown, narrow to broad transverse bands that often fuse dorsolaterally giving rise to elliptic pale gray to reddish tan blotches. Dorsolaterally, the dark brown spots may bear short cream stripes. Laterally, there are brown to reddish brown spots enclosing small cream spots. On the posterior part of the body and on the tail, the ground color becomes cream to pale cream and the dark spots become reddish brown. The head is tan with a brown middorsal stripe extending from the snout to the neck and small dark markings on the supraorbital region; laterally, there is a broad brown mark on the loreal region and an oblique dark brown to black postorbital stripe from the posterior margin of the eyes to the posterior end of the head. The venter is cream with dark brown flecks and spots anteriorly, and reddish brown spots posteriorly. The iris is cream above, dark reddish brown on the middle, and mottled with dark brown and cream below; the darker area connects anteriorly and posteriorly with the dark stripes on the loreal and postorbital regions, respectively. The tongue is black.

**Habitat and microhabitat.** At the RFAD, a large individual was observed resting on a tree branch 5 m above ground, for three consecutive days, in a disturbed area. In Manaus and its outskirts, this species is commonly found in disturbed areas, mainly at night; two were seen crossing a paved road, one by day and the other at night. The available information (Beebe 1946; Cunha and Nascimento 1978; Cunha et al. 1985; Dixon and Soini 1986; Duellman and Salas 1991; Henderson et al. 1995; Montgomery and Rand 1978; Murphy 1997; Pope 1961; O'Shea 1989; Sasa and Solórzano 1995; Schwartz and Henderson 1991; this study) indicate that *B. constrictor* occurs in several habitats, is primarily terrestrial and occasionally arboreal when active, may hide in burrows, and is active mainly at night but also during daylight (including basking). Henderson (1993) suggested that young *Boa constrictor* may be arboreal.

**Feeding habits.** No information on diet is available from the Manaus region. William W. Lamar (pers. comm. 1996) found one individual killing a monkey (*Saimiri sciureus*) and another constricting an armadillo (*Dasypus novemcinctus*). The available information (Beebe 1946; Chapman 1986; Cunha and Nascimento 1978; Greene 1983*b*; Henderson et al. 1995; Murphy 1997; Pope 1961; Sasa and Solórzano 1995; Schwartz and Henderson 1991; W.W. Lamar, pers. comm. 1996) indicate that *Boa constrictor* feeds on rodents (*Proechimys*, *Rattus*, *Agouti*, *Dasyprocta*, squirrels), bats (*Brachyphylla*), monkeys (*Saimiri*), armadillos (*Dasypus*), marsupials, heliophylic lizards (*Ameiva*, *Cnemidophorus*, *Tupinambis*), and birds (formicariid).

**Reproduction.** No information on reproduction is available from the Manaus region. Litter size in the literature vary from 6 to 64 embryos (Fitch 1970; Dixon and Soini 1986; Murphy 1997; Pope 1961; Schwartz and Henderson 1991) for this viviparous species.

**Defense.** Besides biting occasionally, *Boa constrictor* retracts the head and neck (an S-coil) and may produce long, loud hisses when disturbed (see also Beebe 1946, Greene 1983*b* 1988, Murphy 1997, Pope 1961). It may also constrict and discharge from the cloaca when handled.

*Corallus caninus* (Linnaeus 1758)
Plates 8, 9

**Identification.** Maximum TTL male 1175 mm (Duellman 1978), female 1945 mm (Gasc and Rodrigues 1980); minimum TTL 440 mm (Duellman 1978); TAL 14.1–16.9% of TTL (Beebe 1946; Duellman 1978; Gasc and Rodrigues 1980); ED about 1/8 to one twelfth of HL; vertical pupil; labial scales bearing pits; small curved spines (vestigial hindlimbs) lying ventrolaterally in the cloacal region; (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986). The dorsal and lateral ground color is cinnamon brown to red in juveniles and pale to deep green in adults. In older juveniles, the transitional ground color consists of red and green mottling. Both juveniles and adults have lateral white bands that are longer, and may fuse, middorsally; sometimes a middorsal white stripe connecting the transverse bands is also present. Laterally, besides the larger white bands, a series of short white bands may be present ventrolaterally. In adults The head is uniformly green. The ventrolateral and ventral surfaces are pale reddish orange in juveniles and yellow to greenish yellow in adults. The tongue is dark gray to black. The iris is grayish cream to pale grayish brown.

**Habitat and microhabitat.** At the RFAD, two individuals were found in the primary forest of a stream valley: one juvenile was moving on a fallen palm leaf 0.8 m above ground, at night; an adult was observed coiled on a fallen tree trunk 0.5 m above the ground, for three consecutive days. At Manicoré, Amazonas, a large individual was hanging from a horizontal tree branch, at night, about 1 m above the ground, with the mouth widely open and the head close to the ground (H. Höfer and A. Brescovit, pers. comm. 1997; see also below). The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Henderson et al. 1995; Jorge da Silva 1993; Stafford and Henderson 1996; this study) indicate that *Corallus caninus* is a nocturnal, forest dwelling species and primarily arboreal when active, rarely descending to the ground.

**Feeding habits.** No information on diet is available from the Manaus region. Individuals of this species and of *Corallus hortulanus* were seen coiled around the base of small trees at night with the head out ready to strike close to the ground (L.J. Vitt, pers. comm. 1996). Cunha and Nascimento (1978) stated that it feeds on small rodents on the ground and Henderson (1993) found 10 rodents (most were probably murids and two were *Oecomys*) and a lizard (probably *Thecadactylus*) in 11 stomachs (see also Henderson et al. 1995, Stafford and Henderson 1996). These data indicate that *C. caninus* feeds primarily on rodents. Considering its stout body, as well as its sedentary behavior in captivity (pers. obs. 1991), we suppose *C. caninus* is primarily a sit-and-wait predator (but see Stafford and Henderson 1996).

**Reproduction.** No information on reproduction is available for the Manaus region. Fitch (1970) reported a female with 10 embryos and Cunha and Nascimento (1981) reported a female that gave birth to seven juveniles.

**Defense.** Although sluggish, *Corallus caninus* makes an S-coil and bites powerfully when disturbed; the caniniform teeth on the proximal end of the mouth cause deep lacerations. It may also constrict when handled (see also Greene 1988).

*Corallus hortulanus* (Linnaeus 1758)
Plates 10, 11, 12, 13

**Identification.** Maximum TTL male 1643 mm, female 1700 mm (Dixon and Soini 1986), unsexed 1880 mm (Beebe 1946); minimum TTL 525 mm; TAL 19.2–23.8% of TTL (Beebe 1946; Duellman 1978; Dixon and Soini 1986; Gasc and Rodrigues 1980; this study); ED about 1/6 to 1/8 of HL; vertical pupil; labial scales bearing pits; small curved spines (vestigial hindlimbs) lying ventrolaterally in the cloacal region (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986). The ground color of the dorsum and flanks is highly variable, including grey, pale tan, yellowish tan, orange tan, reddish brown, brown, and black (see also color plates in Stafford and Henderson 1996). A series of darker blotches, spots, or bands is always present on the flanks, sometimes giving rise to very complex color patterns. In some individuals, these spots are broader on the middorsal region. These markings may be tan to dark brown and may enclose paler (cream to yellow) markings. The head has the same ground color of the dorsum with five darker stripes running posteriorly to the eyes (one middorsally, a pair dorsolaterally, and another pair laterally). The venter is also variable; it may be, at least, cream, gray, brown, and reddish brown, with or without darker markings. The iris may be yellowish, grayish, and reddish cream and reflects light at night. The tongue is black.

**Habitat and microhabitat.** At the RFAD two individuals were moving on the vegetation (1.2 and 1.8 m above ground) at night. William Magnusson (pers. comm. 1996) found several hanging on shrubs facing the ground, in forests. At Careiro, one individual was crossing a road at night. At Anavilhanas, five individuals were seen active at night on the vegetation in the margins of the "igapó", 1–2 m above the water; at the Parque Nacional do Jau, Novo Airão, Amazonas, two were found in a similar situation (0.5–3.0 m above the water) also in the "igapó" and another was coiled asleep inside a hollow trunk 1.5 m above the water by day. At Marechal Taumaturgo, Acre, two individuals were found at night in a primary forest: one juvenile was descending a vine 2 m above ground and an adult was moving on a tree 1.6 m above ground. At Rio Juruá, four individuals were active on shrubs in a terra-firme forest at night and two others were in "várzea", one on a shrub and the other on a tree, also at night (C. Gascon, unpublished data). In Guajará-Mirim, Rondônia, five individuals were found in activity at night: three juveniles and one adult were within "igapó" trees in the margins of rivers and another adult was moving in the crown of a tree, about 25 m from the ground, in a terra firme forest. At Ilha de Maracá, Roraima, one individual was hanging on the vegetation at the edge of a trail in primary forest at night. In Peru, several individuals were found active at night in spiny palms along oxbow lakes or on vegetation over streams (W.W. Lamar, pers. comm. 1996). The available information (Beebe 1946; Cunha and Nascimento 1978; Cunha et al. 1985; Dixon and Soini 1986; Duellman 1978; Duellman and Mendelson 1995; Duellman and Salas 1991; Fugler 1986; Henderson 1993; Henderson and Boos 1994; Henderson et al. 1995; Jorge da Silva 1993; Murphy 1997; Schwartz and Henderson 1991; Stafford and Henderson 1996; this study) indicate that *Corallus hortulanus* is nocturnal, inhabits forests and disturbed habitats, may be very abundant in river margins, is primarily arboreal (using low to high vegetation) and occasionally terrestrial when active, and may hide on the vegetation when inactive.

**Feeding habits.** One individual from Careiro had a passerine bird in the stomach. Hopkins and Hopkins (1982) observed an arboreal boid, most probably *Corallus hortulanus* (M. Hopkins, pers. comm. 1992) eating a bat (probably *Phyllostomus bicolor*). At the RFAD, several individuals were hanging on the vegetation facing the ground, apparently in a sit-and-wait posture (W. Magnusson, pers. comm. 1996); one individual from a primary forest at Ilha de Maracá, Roraima, was also hanging on the vegetation at the edge of a trail, probably foraging for bats that used the trail as a flying corridor. Four individuals from Rio Jau had prey or prey remains in the gut: one (1495+360 mm, 365 g) had a bat (55 mm, 7 g, MR 0.02) in the stomach; another (855+254 mm, 125 g) had an echymid rat (90 mm, 21 g, MR 0.17) in the stomach and the remains of bird (*Chloroceryle inda*) in the hindgut; and two other had each the remains of a bird and those of a frog in the hindgut. Two from Ecuador (676+155 mm and 905+220 mm, both females), had a bat and a rodent (body length 90 mm; L.J. Vitt and J.P. Caldwell, unpublished data). William W. Lamar (pers. comm. 1996) found lizard and bird (caprimulgid) remains in stomachs. These records and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman and Mendelson 1995; Henderson 1993; Henderson and Boos 1994; Henderson et al. 1995; Murphy 1997; Schwartz and Henderson 1991; Stafford and Henderson 1996) indicate that *C. hortulanus* is euryphagic, feeding on frogs (*Elachistocleis*, hylids), lizards (*Anolis, Basiliscus, Iguana*), birds (*Coereba*, *Elaenia*, caprimulgid, psittacid) rodents (*Akodon*, *Mus, Rattus,* squirrels, porcupines), bats (*Myotis*), and marsupials (*Marmosa*), and foraging both on the vegetation and on the ground. The results above indicate that *C. hortulanus* may use both active and sit-and-wait tactics when foraging (see also the account of *C. caninus*). Henderson (1993) documented ontogenetic changes in the diet and foraging mode in a population from Grenada: from juveniles that forage actively for lizards to large adults that mostly ambush mammals.

**Reproduction.** No information on reproduction is available for the Manaus region. Murphy (1997) and Schwartz and Henderson (1991) reported three females with 15-40 oviducal eggs or embryos.

**Defense.** This species bites and makes an S-coil when approached (see Plates 10, 12, 13); when manipulated, it may form balls with the body (the distal third or the whole snake, with the head inside) and tail (see Plate 11), constrict, and rotate the body (see also Greene 1988). Both the gray and brown morphs of *Corallus hortulanus* may also benefit from concealing coloration during daytime.

*Epicrates cenchria* (Linnaeus 1758)
Plates 14, 15

**Identification.** Maximum TTL male 1855 mm, female 1920 mm (Duellman 1978); minimum TTL 502 mm; TAL 11.0–15.2% of TTL (Beebe 1946; Dixon and Soini 1986; Duellman 1978; Gasc and Rodrigues 1980; this study); ED about 1/8 to 1/10 of HL; vertical pupil; labial scales bearing pits; small curved spines (vestigial hindlimbs) lying ventrolaterally in the cloacal region (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986). The dorsum is iridescent pale pinkish brown (in juveniles) to dark reddish (or greyish) brown (in adults) with large, black bordered reddish brown to yellowish brown round spots middorsally (in large adults the color of these spots is indistinguishable from the ground color) and round black spots enclosing a cream (reddish or orange in some specimens) crescent-shaped mark laterally. The head is a little darker than the dorsal ground color with five dark stripes: one mid-

**Plate 1.** An adult of *Typhlophis squamosus* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 2.** An adult of *Leptotyphlops diaplocius* from a disturbed area in Manaus, Amazonas Brazil. Photo by M. Martins.

**Plate 3.** An adult of *Typhlops reticulatus* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 4.** Detail of the head of the same individual of *Typhlops reticulatus* in Plate 3. Photo by M. Martins.

**Plate 5.** Adult of *Anilius scytale* from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 6.** Juvenile (total length ca. 650 mm) of *Boa constrictor* from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 7.** Detail of the head of the same individual *Boa constrictor* in Plate 6. Photo by M. Martins.

**Plate 8.** Adult (total length ca. 1000 mm) of *Corallus caninus* from Balbina, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 9.** Juvenile of *Corallus caninus* found moving on low vegetation at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

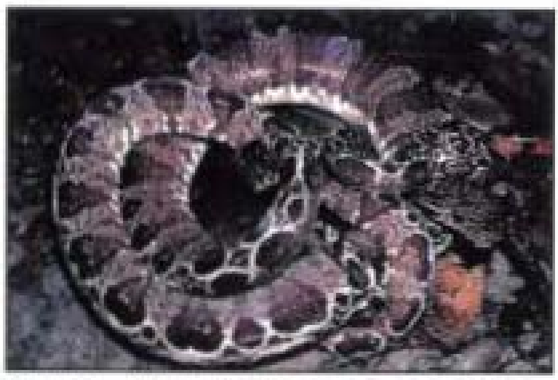

**Plate 10.** Adult of *Corallus hortulanus* from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 11.** The same individual of *Corallus hortulanus* in Plate 10 forming a ball and coiling the tail. Photo by M. Martins.

**Plate 12.** A juvenile of *Corallus hortulanus* (IMTM 1258) from Rio Urucu, Coari, Amazonas, Brazil. Photo by M. Martins.

**Plate 13.** A half-grown individual of *Corallus hortulanus* (IMTM 1205) from Careiro, Amazonas, Brazil. Photo by M. Martins.

**Plate 14.** An adult (1130+195 mm) of *Epicrates cenchria* found moving on the leaf litter in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 15.** Juvenile of *Epicrates cenchria* (532+72 mm) found in a primary forest at Reserva Ducke, forming a ball. Photo by M. Martins.

**Plate 16.** Adult of *Eunectes murinus* from Sandolândia, Tocantins, Brazil. Photo by O.A.V. Marques.

**Plate 17.** An adult of *Apostolepis* sp. found crossing an unpaved road at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins

**Plate 18.** An adult of *Atractus latifrons* from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 19.** Adult *Atractus latifrons* (IMTM 1309) found moving on leaf litter at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. The tail coiling is similar to that of several coral snake species. Photo by M. Martins.

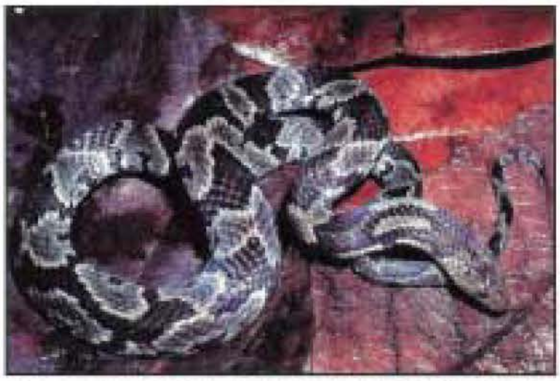

**Plate 20.** Adult of *Atractus major* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 21.** Adult of *Atractus poeppigi* from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 22.** Adult of *Atractus schach* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil, Photo by M. Martins.

**Plate 23.** Adult of *Atractus snethlageae* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 24.** Adult of *Atractus torquatus* from Manaus, Amazonas, Brazil. Photo by M. Martins.

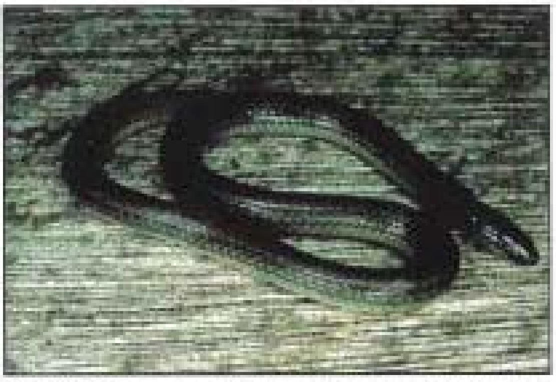

**Plate 25.** An individual of *Atractus trilineatus* from Roraima, Brazil. Photo by L.J. Vitt

**Plate 26.** An individual of *Chironius fuscus* from 100 km south of Santarém, Pará, Brazil. Photo by L.J. Vitt.

**Plate 27.** Juvenile (429+255 mm) *Chironius multiventris* found at night on a branch 4 m above ground in primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

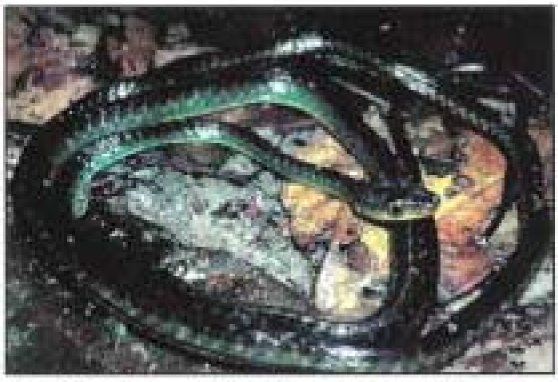

**Plate 28.** Half-grown individual of *Chironius multiventris* from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 29.** Juvenile of *Chironius scurrulus* from Reserva Ducke, Manaus, Amazonas, Brazil. Photo by K.-H. Jungfer.

**Plate 30.** Half-grown individual of *Chironius scurrulus* from Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 31.** Adult of *Chironius scurrulus* from Marechal Taumaturgo, Acre, Brazil. Photo by M. Martins.

**Plate 32.** Juvenile of *Clelia clelia* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 33.** Half-grown individual of *Clelia clelia* from Guajará-Mirim, Rondônia, Brazil. Photo by M. Martins.

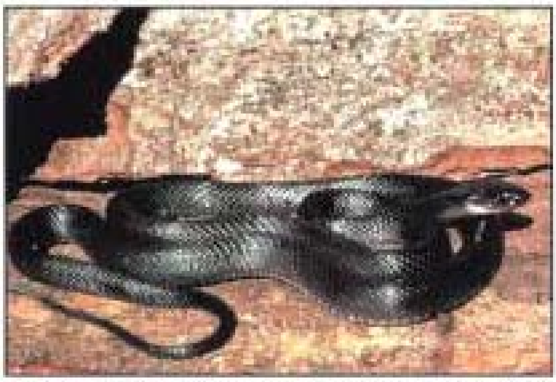

**Plate 34.** Adult of *Clelia clelia* from Rondônia, Brazil. Photo by L.J. Vitt.

**Plate 35.** Adult (438+430 mm) of *Dendrophidion dendrophis* sleeping on a palm leaf at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 36.** Adult of *Dendrophidion dendrophis* from Rio Urucu, Coari, Amazonas, Brazil. Photo by M. Martins.

**Plate 37.** Juvenile of *Dipsas indica* from Balbina, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 38.** Half-grown individual of *Dipsas indica* foraging on the vegetation in a primary forest at Marechal Taumaturgo, Acre. Photo by M. Martins.

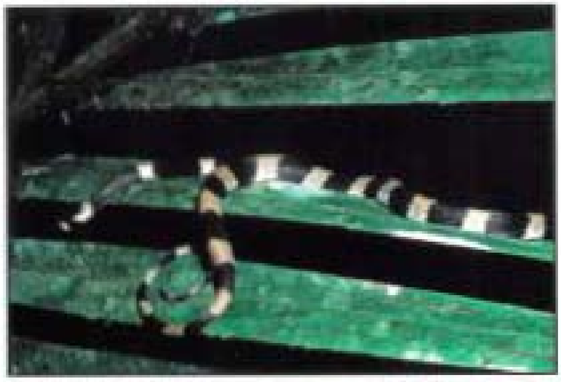

**Plate 39.** Half-grown (348+127 mm) *Dipsas pavonina* resting on a palm leaf at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 40.** An adult (424+163 mm) of *Dipsas pavonina* resting on a shrub at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 41.** Adult female (662+175 mm) *Drepanoides anomalus* found moving within a root mat at night in primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 42.** Detail of the head of the same individual of *Drepanoides anomalus* in Plate 41. Photo by M. Martins.

**Plate 43.** Juvenile (275+107 mm) of *Drymoluber dichrous* found in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

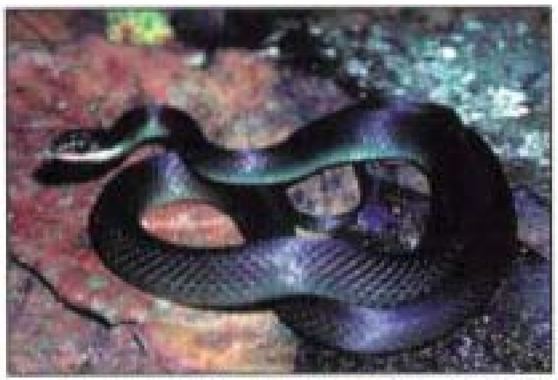

**Plate 44.** Adult (615+261 mm) of *Drymoluber dichrous* found sleeping at night on a palm in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 45.** Half-grown individual of *Erythrolamprus aesculapii* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 46.** Adult of *Erythrolamprus aesculapii* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 47.** Adult of *Helicops angulatus* from Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 48.** Adult of *Helicops angulatus* in the shallows of a pond at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 49.** Half-grown individual of *Helicops hagmanni* found in a stream at night at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 50.** Juvenile (128+40 mm) of *Helicops hagmanni* found in the shallows of a stream by day at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 51.** Adult of *Imantodes cenchoa* from Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 52.** Half-grown individual of *Imantodes cenchoa* moving on a tree branch at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 53.** An adult of *Imantodes cenchoa* ingesting a lizard (*Anolis fuscoauratus*) at night in a primary forest at Marechal Taumaturgo, Acre, Brazil. Photo by M. Martins.

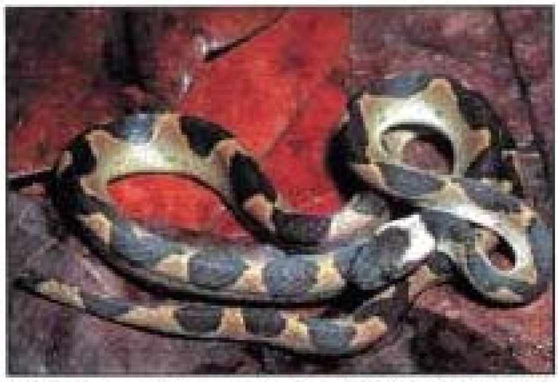

**Plate 54.** Half-grown individual of *Leptodeira annulata* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 55.** An adult of *Leptophis ahaetulla* from Balbina, Presidente Figueiredo, Amazonas, Brazil, performing a threat display. Photo by M. Martins.

**Plate 56.** An adult of *Leptophis ahaetulla* from Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 57.** A juvenile (162+34 mm) of *Liophis breviceps* (IMTM 1359) from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 58.** An adult male (476+109 mm) of *Liophis breviceps* (IMTM 1703) found moving by day on the leaf litter of a secondary forest in Manaus. Photo by M. Martins.

**Plate 59.** An adult of *Liophis reginae* found in a primary forest north of Manaus, Amazonas, Brazil. Photo by J. Sabino.

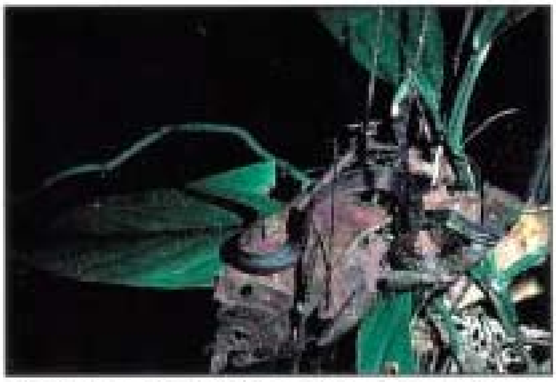

**Plate 60.** An adult of *Liophis reginae* sleeping at night on a shrub in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 61.** Adult (490+102 mm; green morph) *Liophis typhlus* sleeping at night on a shrub in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 62.** Adult (SVL 355 mm; reddish brown morph) *Liophis typhlus* (IMTM 1846) from Rio Cuieiras, Manaus, Amazonas, Brazil. Note anterior body compression. Photo by M. Martins.

**Plate 63.** Adult (370+85 mm; bluish gray morph) *Liophis typhlus* (IMTM 1277) found in primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Note body compression. Photo by M. Martins.

**Plate 64.** Adult female (695+267 mm) *Mastigodryas boddaerti* (ZUEC 665) found by day in the leaf litter of a secondary forest at Serra dos Carajás, Marabá, Pará, Brazil. Photo by I. Sazima.

**Plate 65.** Juvenile of *Mastigodryas boddaerti* (IMTM 1276) from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 66.** Juvenile (365+217 mm) of *Oxybelis aeneus* sleeping at night on a shrub in a disturbed forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 67.** An individual of *Oxybelis aeneus* ingesting a lizard (*Gonatodes humeralis*) by day in a secondary forest at Manaus, Amazonas, Brazil. Photo by W. Magnusson.

**Plate 68.** An adult of *Oxybelis fulgidus* from Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 69.** A hatchling of *Oxybelis fulgidus* from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 70.** A juvenile (144+34 mm) of *Oxyrhopus formosus* (IMTM 1380) that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 71.** A half-grown individual of *Oxyrhopus formosus* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 72.** An adult of *Oxyrhopus formosus* found moving on a fallen trunk above the water in an "igapó" forest at Rio Cuieiras, Manaus, Amazonas, Brazil. Photo by M. Martins.

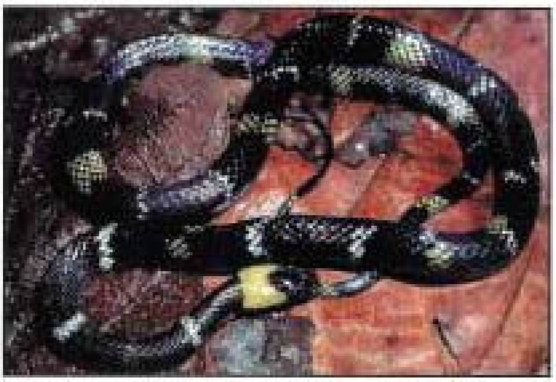

**Plate 73.** A half-grown individual of *Oxyrhopus melanogenys* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 74.** An adult of *Philodryas viridissimus* from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 75.** An adult of *Pseudoboa coronata* from Marechal Taumaturgo, Acre, Brazil. Photo by M. Martins.

**Plate 76.** An adult of *Pseudoboa neuwiedii* from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 77.** A juvenile of *Pseudoboa neuwiedii* from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 78.** An adult of *Pseudoboa neuwiedii* ingesting a lizard (*Ameiva ameiva*) by day in a disturbed area at Manaus, Amazonas, Brazil. Photo by M. Martins.

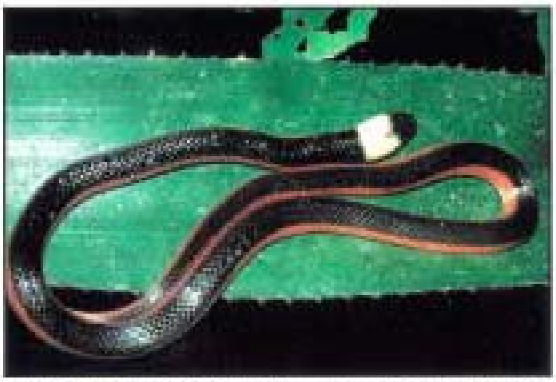

**Plate 79.** A juvenile of *Pseudoboa* sp. A resting at night on the leaf of a ground bromeliad in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by K.-H. Jungfer.

**Plate 80.** An adult (680+256 mm) of *Pseustes poecilonota* (IMTM 1352) from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 81.** The same individual of *Pseustes poecilonotus* in Plate 85 performing a defensive display. Photo by M. Martins.

**Plate 82.** A juvenile (319+124 mm) of *Pseustes poecilonotus* (IMTM 1379) from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 83.** Adult (1010+355 mm) *Pseustes sulphureus* found by day moving on a tree branch 1.8 m above ground in a primary forest north of Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 84.** A juvenile (TTL ca. 600 mm) of *Pseustes sulphureus* from Manaus, Amazonas, Brazil, performing a defensive display. Photo by M. Martins.

**Plate 85.** An adult of *Rhinobothryum lentiginosum* (IMTM 1704) found at night in the ground at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 86.** An adult of *Siphlophis cervinus* from Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

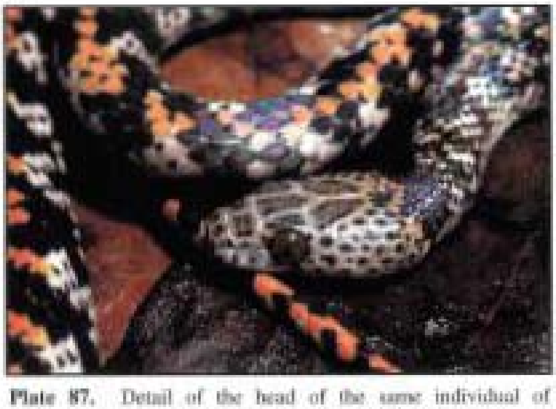

**Plate 87.** Detail of the head of the same individual of *Siphlophis cervinus* in Plate 86. Photo by M. Martins.

**Plate 88.** An individual of *Spilotes pullatus* from Cuyabeno, Ecuador. Photo by L.J. Vitt.

**Plate 89.** An adult of *Taeniophallus brevirostris* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 90.** An adult of *Taeniophallus nicagus* found in a primary forest at Rio Cuieiras, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 91.** An adult of *Tantilla melanocephala* from Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 92.** An adult of *Tripanurgos compressus* from Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 93.** A juvenile (393+102 mm) of *Tripanurgos compressus* resting on a shrub at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 94.** A juvenile (456+130 mm) of *Tripanurgos compressus* foraging at night within the petioles of a palm in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 95.** An adult of *Tripanurgos compressus* capturing a lizard (*Anolis nitens*) in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 96.** An adult of *Xenodon rhabdocephalus* from Manaus, Amazonas, Brazil. Photo by I. Sazima.

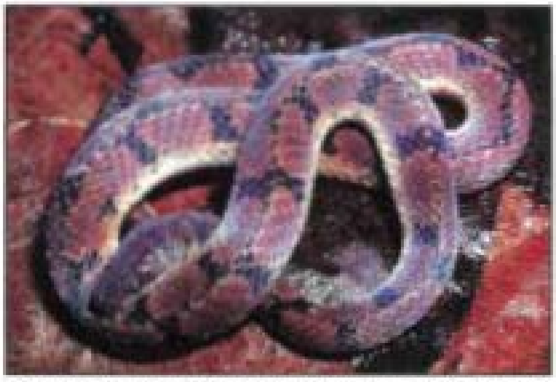

**Plate 97.** An adult of *Xenopholis scalaris* that fell into a pitfall trap at Rio Pitinga, Presidente Figueiredo, Amazonas, Brazil. Photo by M. Martins.

**Plate 98.** A juvenile (495+293 mm) of *Xenoxybelis argenteus* moving by day on herbs in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 99.** A juvenile (556+386 mm) of *Xenoxybelis argenteus* coiled at night on a shrub in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 100.** An adult (448+43 mm) of *Micrurus averyi* (ZUEC 1498) found in a disturbed area at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by I. Sazima.

**Plate 101.** Adult of *Micrurus hemprichii* (IMTM 1218) found moving at the base of a large tree in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 102.** An adult of *Micrurus hemprichii* (IMTM 1269) from Rio Urucu, Coari, Amazonas, Brazil. Photo by M. Martins.

**Plate 103.** A half-grown individual of *Micrurus lemniscatus* from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 104.** An adult male (922+51 mm) of *Micrurus spixii* (IMTM 1344) from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 105.** Detail of tail coiling display of the same individual of *Micrurus spixii* in Plate 104. Photo by M. Martins.

**Plate 106.** Adult of *Micrurus surinamensis* (IMTM 1272) from Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 107.** Detail of the head of a juvenile *Micrurus surinamensis* found in a disturbed area at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 108.** Juvenile (272+42 mm) *Bothrops atrox* on a twig, apparently foraging (note exposed yellow tail tip), at night in primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 109.** Adult female (TTL ca. 1500 mm) of *Bothrops atrox* coiled in the leaf litter at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 110.** A juvenile of *Bothrops atrox* moving on the ground at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 111.** An adult (TTL ca. 1000 mm) of *Bothrops atrox* coiled on a twig at night in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

**Plate 112.** Subadult female (TTL ca. 1000 mm) *Bothrops atrox* ingesting a snake (*Atractus torquatus*) by day in primary forest at Reserva Ducke, Manaus, Amazonas, Brazil (see Egler et al., 1996). Photo by M. Martins.

**Plate 113.** An adult male (TTL ca. 2100 mm) of *Lachesis muta* coiled in the leaf litter by day in a primary forest at Reserva Ducke, Manaus, Amazonas, Brazil. Photo by M. Martins.

dorsal from the tip of the snout to the neck, a pair dorsolaterally behind the eyes, and another pair laterally, running from the naris region posteriorly to the corner of the mouth (in juveniles, the loreal region may lack these stripes). The venter is whitish cream. The iris is coppery brown to golden. The tongue is black in adults.

**Habitat and microhabitat.** At the RFAD, four individuals were found at night in primary forest, always on a plateau. Two juveniles were on fallen logs (0.2 and 0.8 m above ground) and one on the leaf litter; all these snakes were moving slowly, apparently foraging. One adult marked on 26 January 1992 (1130+195 mm) was recaptured on 21 April 1992 (1170+210 mm, SVL increment 0.47 mm/d), 70 m far from the site of capture; on both occasions, the snake was moving on the leaf litter, one of them alongside a fallen tree trunk; on February 1992 a decomposing carcass of this species (TTL ca. 1400 mm) was on a fallen tree trunk, only 3 m from the site of first observation of the marked adult; the distal 100 mm of the tail was 3 m apart from the body and the head was missing. Additional individuals were found in a stream valley at the RFAD (W. Magnusson, pers. comm. 1996). At Rio Pitinga, three individuals were found in primary forests: one was inside a fallen palm trunk by day, another was leaving a hollow fallen log at night, and another was eating a rat on the forest floor by day. At Rio Juruá, one was found active in the leaf litter by day (C. Gascon, unpublished data). At Costa Marques, Rondônia, one juvenile was crossing an unpaved road at night. In Serranía de Macarena, Colombia, this species was found in caves eating bats; in other western Amazonian localities, a subadult was foraging at night on a tree about 3 m above the ground, a large adult was submerged and motionless in a forest pool also at night, three adults were found moving on the leaf litter by day, and a large adult was buried in the leaf litter by day (W.W. Lamar, pers. comm. 1996). The available information (Beebe 1946; Cunha and Nascimento 1978; Cunha et al. 1985; Dixon and Soini 1986; Duellman 1978; Duellman and Salas 1991; Henderson et al. 1995; Jorge da Silva 1993; Murphy 1997; Nascimento et al. 1988; O'Shea 1989) indicate that *Epicrates cenchria* inhabits mostly forests, but may also occur in disturbed areas, may be active both during daytime (including under sunlight) and at night, and when active is primarily terrestrial, occasionally climbing low vegetation.

**Feeding habits.** An adult was captured just after eating a chicken in Manaus. At Rio Pitinga, one individual was found on the forest floor while eating a spiny rat (*Proechimys*); this individual had another large prey in the stomach. One individual (942+119 mm, 229 g) from Rio Jau had two bird eggs (both collapsed, ~50 x 20 mm, 11.5 g, MR 0.05) in the stomach. This record and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Henderson et al. 1995; Lemke 1978; Murphy 1997) indicate that *Epicrates cenchria* is euryphagic, feeding on frogs, lizards, birds (*Gallus*, formicariid), bird eggs, bats (phylostomatid), rodents (*Proechimys*), and foraging actively (see above) primarily on the ground, but also on the vegetation.

**Reproduction.** At the RFAD, three small juveniles (502–606 mm TTL) were found in December and March, indicating that hatching may occur at least during the rainy season.

**Defense.** This species bites powerfully, makes an S-coil with the anterior third of the body, laterally coils the tail tip (only adults observed), and forms tight balls with the head hidden within body coils (only juveniles observed; see Plate 15) (see also Greene 1988). It sometimes defecates when handled.

*Eunectes murinus* (Linnaeus 1758)
Plate 16

**Identification.** A female killed on a road 70 km north of Manaus had a TTL of 6200 mm (E. M. Venticinque, pers. comm. 1995; see also Belluomini e Hoge 1958, and Belluomini et al. 1977; Strimple 1993 provided larger records, but see Gilmore and Murphy 1993, Murphy 1997 and Murphy and Henderson 1997); minimum TTL 730 mm (Belluomini et al. 1977); TAL 9.8–15.1% of TTL (Beebe 1946; Dixon and Soini 1986; Gasc and Rodrigues 1980; this study); ED about 1/11 to 1/13 of HL; pupil vertical; small curved spines (vestigial hindlimbs) lying ventrolaterally in the cloacal region (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986). The dorsal surfaces are dark brown to blackish brown, sometimes with a greenish tint, with pairs (alternating or fused) of dark brown to black round spots dorsally and a series of black, small round spots each enclosing a cream to yellow spot laterally. The head is darker than the dorsum with a cream to orange stripe running from the eye posteriorly to the corner of the head and bordered below by a black stripe. The venter is grayish to yellowish cream with irregular dark marks. The tongue is black.

**Habitat and microhabitat.** Only one individual of *Eunectes murinus* was seen at the RFAD (near the southeastern border): a large adult over 4000 mm long was within the roots of a tree at the margin of a small stream by day. One adult female was crossing an unpaved road 70 km north of Manaus, near an artificially flooded area. At Rio Cuieiras, one individual was basking at noon on the rocks of a waterfall. At Rio Uatumã, a large individual was basking on debris at the margin of a large river by day and two large individuals were trapped in fish nets installed at night in a small river. At Ilha de Maracá, Roraima, two individuals were active by day at the margins of a large flooded area. This species is common in oxbow lakes in western Amazonia (W.W. Lamar, pers. comm. 1996). These records and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Henderson et al. 1995; Murphy 1997; Murphy and Henderson 1997; Pope 1961; Strimple 1993) indicate that *E. murinus* is a nocturnal species (usually basking during daytime) that is primarily aquatic when active, occurring in various kinds of aquatic habitats.

**Feeding habits.** One juvenile (905+137 mm) from Rio Jau contained the remains of a lizard (*Kentropyx*). At Ilha de Maracá, Roraima, an adult (TTL ca. 3000 mm) was chasing a rallid bird at the margin of a flooded area. The available information (Beebe 1946; Cunha and Nascimento 1978; Henderson et al. 1995; Murphy 1997; Murphy and Henderson 1997; Pope 1961; Strimple 1993; this study) indicate that *Eunectes murinus* is euryphagic, feeding on several aquatic and terrestrial vertebrates: fish, frogs, reptiles (*Kentropyx, Caiman, Palaeosuchus*, snakes, and turtles), birds (jacana, jabiru, stork), and mammals (*Agouti, Dasyprocta, Hydrochoerus, Tayassu, Tapirus*, deer, primate).

**Reproduction.** An adult female (6200 mm TTL) found in May, 70 km north of Manaus, had 50 developing embryos and another from Manaus had 18 embryos. A juvenile was found in September in Manaus. Also in the Manaus region, Hero and Santos (1987) found a female with 45 fetuses in October. Literature records on number of offspring are 4–82 (Belluomini et al. 1977; Cunha and Nascimento 1978; Fitch 1970; Murphy and Henderson 1997; Pope 1961; Strimple 1993).

**Defense.** Besides trying to flee, *Eunectes murinus* bites, makes an S-coil, and may produce long, loud hisses when disturbed. When handled, it defecates, discharges cloacal gland products, and constricts (see also Strimple 1993 and Murphy and Henderson 1997).

### Colubridae

*Apostolepis* sp.
Plate 17

**Identification.** Three specimens from Manaus ranged from 321 to 398 mm in TTL; TAL 7.0–7.5% of TTL; ED 1/9 to 1/10 of HL; pupil round. The only live individual we observed had a brown to yellowish brown dorsum with five dark brown stripes, a cream venter, a dark brown head (paler between scales) with the tip of the snout yellowish brown, a pair of yellow spots on the dorsolateral region of the neck and a pair of yellowish cream spots on the supralabials, below the eyes; the tip of the tail was dark brown.

**Habitat and microhabitat.** At the RFAD, one individual was moving on the ground of an unpaved road by day. At Rio Pitinga, two individuals fell into pitfall traps in primary forest. This species may be fossorial like other species of *Apostolepis*.

**Feeding habits.** No information is available.

**Reproduction.** No information is available.

**Defense.** The only individual handled did not try to bite, thrashed the body, and pressed the tail tip against the captor's hand.

**Taxonomic comments.** The identification of *Apostolepis* from Manaus is problematic. Zimmermann and Rodrigues (1990) referred to two species, *A. pymi* and an unidentified one. The specimens from Manaus we examined (IMTM 1335, 1537, 1577, INPA 1166) show supposed distinctive characters of both *A. pymi* and *A. quinquelineata* (based on pers. comm. 1995 by T. de Lema). Thus, we prefer to assign no specific name to these specimens, awaiting a taxonomic revision of Amazonian species of *Apostolepis.*

*Atractus alphonsehogei* Cunha and Nascimento 1983

**Identification.** Maximum TTL male 251 mm (Martins and Oliveira 1993), female 305 mm (Cunha and Nascimento 1983*b*); minimum TTL 183 mm (Cunha and Nascimento 1983*b*); TAL 7.2–12.5% of TTL (Cunha and Nascimento 1983*b* 1984; Martins and Oliveira 1993); ED about 1/6 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1983*b* 1984; Martins and Oliveira 1993). The dorsum is brown to dark brown (all scales bearing cream borders) with poorly distinct middorsal and dorsolateral darker stripes and a yellowish cream stripe ventrolaterally. The head is dark brown with a paler occipital band (darker above); underside of head cream with brown markings. The venter is cream, each scale with dark brown borders, giving rise to a pair of lateral dark stripes.

**Habitat and microhabitat.** No habitat data is available for the single specimen found in the Manaus region. Cunha and Nascimento (1983*b*) stated that in eastern Pará *Atractus alphonsehogei* inhabits the soil of primary and secondary forests.

**Feeding habits.** Cunha and Nascimento (1983*b*) found earthworm remains in the gut of one individual.

**Reproduction.** No information is available.

*Atractus latifrons* (Günther 1868)
Plates 18, 19

**Identification.** Maximum TTL male 561 mm, female 618 mm; minimum TTL 210 mm (Martins and Oliveira 1993; this study); TAL 8.8–17.9% of TTL (Martins and Oliveira 1993; Gasc and Rodrigues 1980); ED about 1/7 of HL; pupil round (see taxonomic information in Hoogmoed 1980; Martins and Oliveira 1993). Dorsally, the body and tail are deep red with no to various black bands bearing no to three narrow white bands. The head is black with a transverse white (or red) occipital band and a small white (or red) spot on the anterolateral region; the underside of the head is white or rarely red, except the chin shields, the first infralabials, and the first ventrals that are black. The venter is red, either plain or with black spots scattered throughout (Martins and Oliveira 1993). In the Manaus region, *Atractus latifrons* may be similar to venomous (*Micrurus* spp.) and non-venomous coral snakes (especially *Erythrolamprus aesculapii*); from all these snakes, *A. latifrons* is distinguished by having a single pair of chinshields (two pairs in *Micrurus* spp. and *E. aesculapii*); furthermore, *Erythrolamprus* has a larger eye than *Micrurus* spp. and *A. latifrons*.

**Habitat and microhabitat.** At the RFAD, one individual was moving on the leaf litter of an old trail in primary forest at night. At Rio Pitinga, one individual was moving on the leaf litter in the morning, and two other fell into pitfall traps, all in primary forest (see also Martins and Oliveira 1993). These records and those in the literature (Cunha and Nascimento 1978; Dixon and Soini 1986) indicate that *Atractus latifrons* is a forest species able to occupy disturbed habitats, may be both diurnal and nocturnal (see account on *Anilius scytale* above), and seems to be primarily fossorial and occasionally cryptozoic and terrestrial.

**Feeding habits.** At Rio Pitinga, one adult was ingesting a large earthworm on the exposed soil at midmorning. Five individuals from the Manaus region had earthworm chetae, tiny acari, and remains of insects in their hindgut (Martins and Oliveira 1993). Earthworms seems to be the primary food of *Atractus latifrons.*

**Reproduction.** Two females with three oviductal eggs and three vitellogenic follicles were found in July and September, respectively; juveniles (TTL < 240 mm) were found in March, June, August, and October. Our data indicate that hatching occurs at least from the middle of the rainy season to the end of the dry season (probably throughout the year) in the Manaus region. One female (489+62 mm) from Rio Jau had three enlarged follicles.

**Defense.** Besides trying to flee by moving away or digging into the soil, this species compresses dorsoventrally the posterior third of the body, coils and elevates the tail (see Plate 19), and makes subtle thrashes such as those observed in *Micrurus.* It does not bite. Its coral snake mimic color pattern does not closely resemble that of any species of sympatric *Micrurus* and may represent a case of abstract coral snake mimicry (see Pasteur 1982, Pough 1988).

*Atractus major* Boulenger 1894
Plate 20

**Identification.** Maximum TTL male 595 mm (Martins and Oliveira 1993), female 723 mm (Duellman 1978); minimum TTL 210 mm (Martins and Oliveira 1993); TAL 10.4–17.4% of TTL (Martins and Oliveira 1993); ED about 1/7 to 1/8 of HL; pupil round to semi-elliptical (see taxonomic information in Hoogmoed 1980; Martins and Oliveira 1993). The dorsum is generally brown to reddish brown with transverse dark brown spots, wider on the middorsal region, with internal margins blackish and external margins pale brown. The flanks bear small dark brown spots between the larger ones. The head is brown, paler laterally; the underside of the head is cream with diminutive brown markings. The venter is cream with small dark brown spots (see a detailed description of color variation in Martins and Oliveira 1993). This species may be similar to *Atractus schach*, *A. snethlageae*, and *A. torquatus*; *A. schach* has often a longitudinal middorsal stripe (besides dark transversal bands) and *A. snethlageae* has light transversal bands on the dorsum. Some individuals of *A. major* are very similar to *A torquatus* and may be distinguished only by the number of maxillary teeth (six in *A. major* and eight in *A. torquatus*).

**Habitat and microhabitat.** At the RFAD, a juvenile was moving on the leaf litter of primary forest at night. At Rio Pitinga, one adult was moving on the leaf litter at night and one juvenile was moving on the ground in a clearing by day, both in primary forest; additionally, 10 individuals were caught in pitfall traps in primary forest. These data and those in the literature (Dixon and Soini 1986; Duellman 1978; Duellman and Salas 1991) indicate that *Atractus major* lives primarily in forests, seems to be both nocturnal and diurnal (see account on *Anilius scytale* above), and seems to be primarily fossorial and occasionally cryptozoic and terrestrial (eventually climbing low vegetation).

**Feeding habits.** Two specimens from Manaus had giant earthworms in their stomachs; another individual had acari and remains of insects in the hindgut. Duellman (1978) also found a giant earthworm in one stomach. Earthworms may be the primary prey of *Atractus major*.

**Reproduction.** One female (627 mm TTL) collected in October had six oviductal eggs. Juveniles (210–235 mm SVL) were found in August through November. Our data indicate that hatching occurs at least from the middle of the dry season to the middle of the rainy season (assuming that the gravid female from October would have laid its eggs soon and that hatching would have occurred three to 4 mo after oviposition). Duellman (1978) reported a female with 12 eggs.

**Defense.** Besides trying to flee by moving away or digging into the soil, this species may hide its head under body coils when disturbed. When handled it thrashes the body, forces its head against the observer's hand, and does not bite. It also may flatten the body (L.J. Vitt, pers. comm. 1996).

**Taxonomic comments.** Zimmermann and Rodrigues (1990:442) suggested that "... there appear to be two species under *Atractus major* that cannot be distinguished using the literature ...". In spite of the variations in color pattern, the sample from the Manaus region described here and in Martins and Oliveira (1993) seems to comprise only one species.

*Atractus poeppigi* (Jan 1862)
Plate 21

**Identification.** Maximum TTL male 503 mm (Martins and Oliveira 1993); minimum TTL 240 mm; TAL 9.5–11.9% of TTL (Martins and Oliveira 1993); ED about 1/6 to 1/7 of HL; pupil round (see taxonomic information in Dixon et al. 1976; Martins and Oliveira 1993). The dorsum is dark brown (nearly black) with white triangular spots on the flanks, reaching the ventrals. The head is dark brown with cream supralabials and temporals; the underside of the head is cream or orange. The venter bears transverse dark brown spots, often irregularly shaped, on a background of orange to reddish orange on the anterior third; the undersurface of the tail and midbody are cream. This species is similar to *Liophis breviceps* and *Micrurus collaris*; *L. br viceps* has 17 scales around midbody (15 in *Atractus poeppigi*) and larger eyes and *M. collaris* has a complete nuchal band (incomplete in *A. poeppigi*).

**Habitat and microhabitat.** No individual was found during visual searching at the RFAD, although two were caught in pitfall traps in primary forest. At Rio Urucu, two individuals were found in primary forest during clear-cutting. The available information (Dixon and Soini 1986; Dixon et al. 1976; this study) indicate that *Atractus poeppigi* is a primarily fossorial, forest-dwelling snake.

**Feeding habits.** One individual from the Manaus region had insect remains in the hindgut. One individual from Rio Urucu had an earthworm in the stomach and another from Rio Jau had earthworm chetae in the midgut. These limited data indicate that earthworms may be the primary prey of *Atractus poeppigi*.

**Reproduction.** No information is available.

**Defense.** Besides trying to flee by moving away or digging into the soil, this species may hide its head under body coils when disturbed. When handled it thrashes the body and does not bite. Additionally, the nearly black dorsum associated with the contrasting ventral pattern of *Atractus poeppigi* resembles that of the sympatric *Micrurus collaris* (except for the nuchal band that is incomplete in *A. poeppigi*), suggesting a case of coral snake mimicry (see Martins and Oliveira 1993, and Savage and Slowinski 1992, for additional cases of supposed mimicry of ringless *Micrurus*). Dorsoventral body compression and tail display was also observed in *A. poeppigi* (see also Dixon et al. 1976, Greene 1973*a*).

*Atractus schach* (F. Boie 1827)
Plate 22

**Identification.** Maximum TTL male 361 mm, female 421 mm (Martins and Oliveira 1993); minimum TTL 190 mm (Martins and Oliveira 1993); TAL 7.9–13.6% of TTL (Martins and Oliveira 1993); ED about 1/6 to 1/7 of HL; pupil semi-elliptical (see taxonomic information in Cunha and Nascimento 1978 1983*b*; Hoogmoed 1980; Martins and Oliveira 1993). The dorsum and upper surface of the tail are brown to reddish brown with a dark brown middorsal stripe, sometimes interrupted, and/or short transversal bars. The head is dark brown bearing a wide darker occipital band preceded by a cream band; the underside of the head is cream with dark brown spots anteriorly. The venter is cream with dark brown spots giving rise to a midventral stripe. The underside of the tail is more melanic than the venter (Martins and Oliveira 1993). See how to distinguish this species from *Atractus major*, *A. snethlageae*, and *A. torquatus* in the account of *A. major*. This species is also similar to *Xenopholis scalaris*, which has a narrower neck, a longer head, and an immaculate venter.

**Habitat and microhabitat.** At the RFAD, one individual was moving on the leaf litter in the primary forest at night. Four specimens were caught in pitfall traps in primary forest at Rio Pitinga. These records and those in the literature (Cunha and Nascimento 1978 1983*a*; Hoogmoed 1980) indicate that *Atractus schach* is found both in forests and disturbed areas, seems to be active both during daytime and at night (see account on *Anilius scytale* above), and may be primarily fossorial and occasionally cryptozoic and terrestrial.

**Feeding habits.** One individual from the Manaus region had earthworm chetae and insect remains in the hindgut. Cunha and Nascimento (1978) found earthworms in the stomachs and Cunha and Nascimento (1983*b*) mentioned sand, sometimes associated with insect remains. This species seems to feed primarily on earthworms; the sand referred to by Cunha and Nascimento (1983*b*) may represent the gut contents of digested earthworms and the insect remains (generally very small chitinous fragments, impossible to refer to any group of arthropods, commonly found in the hindgut of other *Atractus*), may be part of the soil eaten by the earthworms (however, insect remains are not always associated with earthworm remains; see account on *Atractus major* above).

**Reproduction.** One female collected in October had five oviductal eggs; the only juvenile was found in June.

**Defense.** Besides trying to flee by moving away or digging into the soil, this species may hide its head under body coils when disturbed. When handled, it thrashes the body and does not bite.

*Atractus snethlageae* Cunha and Nascimento 1983
Plate 23

**Identification.** Maximum TTL male 446 mm, female 465 mm (Martins and Oliveira 1993); minimum TTL 218 mm (Cunha and Nascimento

1983*b*); TAL 5.9–13.9% of TTL (Martins and Oliveira 1993); ED about 1/10 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1983*b*; Martins and Oliveira 1993). The dorsal surfaces of the body and tail are dark brown with several cream (pale orange in one specimen from Rio Pitinga) transversal spots or bands (one or two scales wide). The head is dark brown with a cream to pale brown occipital band; the underside of the head is cream with dark brown spots. The venter is cream with dark brown spots at the midventral region or scattered throughout, becoming more melanic toward the tail (Martins and Oliveira 1993). See how to distinguish this species from *Atractus major*, *A. schach*, and *A. torquatus* in the account of *A. major*.

**Habitat and microhabitat.** At the RFAD, one juvenile was moving on the ground of an unpaved road in primary forest, at night, and another was caught in a pitfall trap. Eight specimens were caught in pitfall traps in primary forest at Rio Pitinga. Cunha and Nascimento (1983*b*) found it in primary and secondary forests and stated that it is fossorial or semi-fossorial. These limited data indicate that *Atractus snethlageae* inhabits forests and is primarily fossorial.

**Feeding habits.** Two individuals had earthworm chetae in the hindgut; another had insect remains. Two individuals (247+33 mm and 382+36 mm) from 100 km south of Santarém, Pará, had earthworms (126 mm, 3.0 g, MR 0.25, and 120 mm, 6.1 g, MR 0.24, respectively) in the stomach (L.J. Vitt and J.P. Caldwell, unpublished data). Cunha and Nascimento (1978) found an earthworm in a stomach and sand in many others (see account on *Atractus schach*). This species seems to feed primarily on earthworms.

**Reproduction.** A recently caught female from the Manaus region laid a clutch of three eggs in February. Cunha and Nascimento (1983*b*) found two females with three and nine eggs.

**Defense.** When approached, besides trying to flee by moving away or digging into the soil, this species may hide its head under body coils. When handled, it thrashes the body, forces its head against the observer's hand and does not bite.

**Taxonomic comments.** Cunha and Nascimento (1983*b*) described this taxon as a subspecies of *Atractus flammigerus*; however, we agree with Vanzolini (1986) in that these may represent distinct species (see also Martins and Oliveira 1993).

*Atractus torquatus* (Duméril et al. 1854)
Plate 24

**Identification.** Maximum TTL male 633 mm, female 754 mm (Martins and Oliveira 1993); minimum TTL 170 mm (Martins and Oliveira 1993); TAL 8.0–16.4% of TTL (Martins and Oliveira 1993); ED about 1/6 of HL; pupil round (see taxonomic information in Hoogmoed 1980; Martins and Oliveira 1993). The body and tail are iridescent grayish, greenish, pinkish, reddish or dark brown, plain or bearing dark brown to black spots, or short bands, scattered throughout the body and flanks. The head is slightly darker than the body with a darker nuchal band (poorly distinct in dark animals); the supralabials are cream; the underside of the head is cream to yellowish cream, blackish on the anterior half. The venter is cream to yellowish cream, sometimes bearing small dark spots; the paraventrals are sometimes reddish. The underside of the tail bears blackish spots and is sometimes completely brown (Martins and Oliveira 1993). See how to distinguish this species from *Atractus major*, *A. schach*, and *A. snethlageae* in the account of *A. major*.

**Habitat and microhabitat.** At the RFAD, nine individuals were moving in primary forest at night, six amidst the leaf litter (two of them digging into the soil), two on the ground of unpaved roads, and one on a fallen palm leaf 0.8 m above the ground; two additional individuals were found by day, one on the leaf litter of primary forest and another on the ground of a manmade clearing. All these were in stream valleys, but one that was at the margin of a small pool in a plateau. In the primary forests of Rio Pitinga, two individuals were moving on the leaf litter, one by day and the other at night, another was on a shrub 0.6 m above the ground at night, and eleven were caught in pitfall traps. In a site about 35 km north of Manaus, one was inside a rotten log, 1.5 m above ground. These data and those in the literature (Dixon and Soini 1986; Hoogmoed 1980; Martins and Oliveira 1993) indicate that *Atractus torquatus* inhabits various habitats, from forests to cultivated fields, occurring mainly in areas around bodies of water, is both nocturnal and diurnal (see account on *Anilius scytale* above), and is primarily fossorial and occasionally cryptozoic and terrestrial (eventually climbing low vegetation).

**Feeding habits.** At the RFAD, one individual (576+92 mm) was caught just after swallowing a giant earthworm (180 mm). Ten specimens from the Manaus region had earthworm chetae, tiny acari, and remains of insects in the hindgut (Martins and Oliveira 1993). An individual from Rio Jau had earthworm chetae and remains of insects in the gut. *Atractus torquatus* seems to feed primarily on earthworms.

**Reproduction.** In the Manaus region, three females (TTL 754 mm, 654 mm, and 671 mm) collected in October (*n* = 2) and February (*n* = 1) had seven, eight, and at least three oviductal eggs, respectively. Hatchlings and small juveniles (TTL 170–260 mm) were found in January, February, August, and November.

**Defense.** Besides trying to flee by moving away or digging into the soil, this species may hide its head under body coils when disturbed. When handled it thrashes the body, forces its head against the observer's hand, and does not bite. A large adult expelled a jet of a transparent, apparently scentless liquid from the cloaca when handled. At the RFAD, an adult individual was preyed upon by a subadult *Bothrops atrox* (details on this predation are in Egler et al. 1996).

*Atractus trilineatus* Wagler 1828
Plate 25

**Identification.** Maximum TTL female 276 mm (Cunha and Nascimento 1980), unsexed 350 mm (Murphy 1997); minimum TTL 116 mm (Martins and Oliveira 1993); TAL 5.4–6.0% of TTL (Beebe 1946; Martins and Oliveira 1993; Murphy 1997); ED about 1/6 to 1/7 of HL; pupil round (see taxonomic information in Martins and Oliveira 1993; see also Hoogmoed 1982*a*). The dorsum is brown with dark brown middorsal and dorsolateral stripes and two yellowish cream lateral stripes; the ventrolateral region is cream. The head is dark brown with light brown spots above and lateroposteriorly; underside of head cream with dark brown markings. Venter cream with light brown markings on the posterior ventrals; underside of tail cream with light brown markings midventrally (see additional color descriptions in Beebe 1946).

**Habitat and microhabitat.** One individual was found in a flooded "igapó" forest in Anavilhanas. The available information (Beebe 1946; Murphy 1997; O'Shea 1989; this study) indicate that *Atractus trilineatus* is a fossorial forest species.

**Feeding habits.** No substantiated food record is available.

**Reproduction.** Clutch sizes in literature (Beebe 1946; Murphy 1997) are 3-5.

**Defense.** Beebe (1946) stated that *Atractus trilineatus* flees by digging into the soil and that when handled it forces the head and pointed tail against the observer's hand and does not bite (see also Murphy 1997).

*Chironius fuscus* (Linnaeus 1758)
Plate 26

**Identification.** Maximum TTL male 1597 mm (Dixon et al. 1993), female 1409 mm (Dixon et al. 1993); minimum TTL 340 mm (Dixon et al. 1993); TAL 26.7–40.9% of TTL (Dixon et al. 1993; this study); ED 1/5 to 1/6 of HL; pupil round; males with a pair of keeled paravertebral scale rows (see taxonomic information in Dixon and Soini 1986; Dixon et al. 1993). The dorsum and tail are brown to reddish brown with a pair of dark brown stripes on the paravertebrals; in adults, a series of tan bands (one scale wide) is present on the posterior two thirds of the flanks; the lateral borders of the ventrals are often orange. The head is dark to reddish brown, reddish orange on the tip of the snout and on the ventrolateral region; the underside of the head is white to reddish orange. The venter is orange-cream, darkening towards the tail. The tongue was pale blue in the only juvenile observed; in adults, the tongue is pinkish. The dorsal pattern of juveniles is very similar to that of *Chironius multiventris*, except for the head and venter that have an orange tint instead of yellowish cream; furthermore, *C. fuscus* has 10 dorsal scale rows around midbody, while *C. multiventris* has 12.

**Habitat and microhabitat.** At the RFAD, 10 individuals were found in primary forest. Nine were sleeping at night, coiled on leaves and branches of shrubs and on palm leaves 1.2–2.5 m above the ground and one was found active by day on a palm leaf 0.4 m above the ground. None of 10 marked individuals was recaptured. At Rio Cuieiras, one individual was active among palm leaves 1.3 m above the ground and another was moving on a tree in the flooded "igapó", both by day. At Rio Pitinga, one individual was swimming in a lake by day. At Marechal Taumaturgo, Acre, one juvenile was sleeping coiled on a palm leaf 1.8 m above ground at night in primary forest. At Rio Juruá, six individuals were found active in the leaf litter of "várzea" forests by day, two were active in the leaf litter of terra-firme forests also by day, and three were inactive in terra-firme forest, one in a tree and two on the ground (C. Gascon, unpublished data). These data and those in the literature (Cunha and Nascimento 1978 1982*b*; Dixon and Soini 1986; Dixon et al. 1993; Duellman 1978; Duellman and Salas 1991; Nascimento et al. 1988) indicate that *Chironius fuscus* inhabits various habitats, from primary forests to cultivated fields, is exclusively diurnal, primarily terrestrial (but also arboreal) when active, and uses low vegetation to sleep at night.

**Feeding habits.** One individual from the RFAD had a small frog in the stomach. A juvenile (331+182 mm, 12.3 g) from Marechal Taumaturgo, Acre, had a hylid frog in the stomach (SVL 37 mm, 2.1 g, MR 0.17) and an adult had also the remains of a hylid frog. Two specimens from Ecuador (786+413 mm and 651+390 mm) had frogs (both *Leptodactylus* of the *wagneri* complex with SVL 28 mm); another (785+407 mm) from 100 km south of Santarém, Pará had a frog (*Eleutherodactylus* sp., SVL 20 mm) in the stomach (L.J. Vitt and J.P. Caldwell, unpublished data). These records and those in the literature (Ayarzaguena 1987, quoted in Dixon et al. 1993; Cunha and Nascimento 1978 1982*b*; Dixon and Soini 1986; Dixon et al. 1993) show that *Chironius fuscus* feeds primarily on frogs (*Dendrobates*, *Adelophryne*, *Eleutherodactylus*, *Leptodactylus*, *Hyla*) and occasionally on salamanders (*Bolitoglossa*) and lizards (*Anolis*, *Kentropyx*).

**Reproduction.** One female from the RFAD, observed in December, had three enlarged follicles (detected by palpation). Another (820+472 mm) from Rio Cuieiras had four eggs (17.8 x 7.6, 19.2 x 7.3, 19.0 x 7.0, and 20.3 x 7.4 mm) in December. Duellman (1978: Table 16) reported a female with six eggs, Dixon and Soini (1986) another with eight eggs, and Dixon et al. (1993) found three to seven eggs in 12 females.

**Defense.** When handled, *Chironius fuscus* may rotate and thrash the body, vibrate the tail, inflate the gular region, but it rarely bites (see also Beebe 1946, Dixon and Soini 1986). In central Colombia, this species also rarely bites, although in the Iquitos region, Peru, it bites readily. By day, it freezes when approached. Freezing associated with a brown to reddish brown color makes it very difficult to find by day within the vegetation. Duellman (1978) reported that individuals sleeping at night on bushes dropped to the ground and rapidly crawled away at the slightest disturbance (as we observed in *C. scurrulus* by day; see below).

*Chironius multiventris* Schmidt and Walker 1943
Plates 27, 28

**Identification.** Maximum TTL male 2611 mm (Dixon et al. 1993), female 2260 mm (Duellman 1978); minimum TTL 465 mm (Dixon et al. 1993); TAL 34.7–41.6% of TTL (Cunha and Nascimento 1978; Dixon and Soini 1986; Dixon et al. 1993; Duellman 1978; this study); ED about 1/4 to 1/6 of HL; pupil round; males with a pair of keeled paravertebral scale rows (see taxonomic information in Cunha and Nascimento 1978 1982*b*, Dixon and Soini 1986, Dixon et al. 1993). The dorsum and tail are brown (Plate 27) to dark olive green (Plate 28), becoming brownish towards the tail. The head is dark greenish brown; the underside of the head is yellow. The venter and underside of the tail is pale to deep yellow; the paraventrals are greenish yellow. Juveniles and adults have pinkish tongues. This species is similar to *Pseustes sulphureus*, which has 21–23 dorsal scale rows around midbody (12 in *Chironius multiventris*). Furthermore, the dorsal pattern of juveniles is very similar to that of *C. fuscus* (see how to distinguish them in the account of the latter species).

**Habitat and microhabitat.** At the RFAD, six individuals were found in primary forest. Three adults (CT ca. 2000) were found by day, one moving on the leaf litter, one moving on shrubs 1.5 m above the ground, and another coiled on tree branches, 1.7 m above the ground. At night, three individuals (two adults, one juvenile) were sleeping coiled on palm leaves and a shrub branch at 1.1–4.0 m above ground. In western Amazonia, a large adult was found swimming across a river and another large adult was on floating vegetation (W.W. Lamar, pers. comm. 1996). These data and those in the literature (Cunha and Nascimento 1978 1982*b*; Cunha et al. 1985; Dixon and Soini 1986; Dixon et al. 1993; Duellman 1978; Duellman and Salas 1991; Nascimento et al. 1988) indicate that *Chironius multiventris* is primarily a forest inhabitant, occurring occasionally in disturbed areas, is exclusively diurnal, and primarily terrestrial when active, using the vegetation to rest by day and to sleep at night.

**Feeding habits.** No information on diet is available for the Manaus region. Literature data (Cunha and Nascimento 1978 1982*b*; Dixon et al. 1993) indicate that *Chironius multiventris* feeds on frogs (*Hyla*, *Phrynohyas*, *Eleutherodactylus*, *Leptodactylus*) and lizards (*Anolis*, *Polychrus*, *Tropidurus*).

**Reproduction.** A female from Rio Cuieiras had four developing follicles (7 x 17 mm to 7 x 21 mm) in December. At the RFAD one juvenile (429+255 mm TTL) was found in March. Duellman (1978: Table 16) reported a female with seven eggs.

**Defense.** When disturbed, adults of this large, strong *Chironius* elevates the head, makes an S-coil, and strikes and bites frequently (see also Dixon et al. 1993); the only juvenile handled did not bite. When handled, adults rotate and thrash the body, inflate the gular and neck region, and expel cloacal secretions. When approached by day it freezes.

*Chironius scurrulus* (Wagler 1824)
Plates 29-31

**Identification.** Maximum TTL male 2332 mm (Cunha and Nascimento 1982*b*), female 2430 mm (Duellman and Mendelson 1995); minimum TTL 445 mm (Dixon et al. 1993); TAL 27.5–35.8 % of TTL (Cunha and Nascimento 1982*b*; Dixon et al. 1993; Gasc and Rodrigues 1980); ED about 1/4 to 1/5 of HL; pupil round; all dorsal scales smooth in both males and females (see taxonomic information in Cunha and Nascimento 1982*b*, Dixon and Soini 1986, and Dixon et al. 1993). In juveniles (Plate 29), the dorsum is green, somewhat grayish on the middorsal region, the head is grayish green above, green laterally and bluish green ventrolaterally, and the venter is greenish white. A half grown individual (Plate 30) had a brownish green dorsum with the ventrolateral region and the tip of the snout brownish orange. In adults (Plate 31), the dorsum is mottled with brown, dark brown, and orange (in some individuals most of the dorsum is orange), the head is dark brown, and the venter is orange cream. The iris is bronze above and below, dark bronze medially. The tongue is pale to bright blue in juveniles and grey to black in adults. Juveniles of *Chironius scurrulus* may be very similar to *Philodryas viridissimus* (see below), but is easily distinguished by having 10 dorsal scale rows around midbody (19 in *P. viridissimus*).

**Habitat and microhabitat.** At the RFAD, 10 individuals were found in primary forest, five in plateaus and five in a stream valley. At night, three juveniles were sleeping coiled on shrubs and ferns, at 2–3 m above the ground; two of them (newborns) were on adjacent ferns (1.5 m apart) hanging over an artificial pond in an unpaved forest road; a half grown individual was coiled on a tree 1.5 m above the ground. During the day, five adults and one juvenile were found; one adult and one juvenile were moving on the ground of an unpaved forest road in the morning; four adults, three of which with large prey in the stomach, were coiled on vines and tree branches at 2.2–4.0 m above the ground, three of them close to a stream and one close to a pool in a plateau, at noon and afternoon. These records and those in the literature (Cunha and Nascimento 1978 1982*b*; Dixon and Soini 1986; Dixon et al. 1993; Duellman 1978; Duellman and Mendelson 1995; Duellman and Salas 1991; Hoogmoed and Ávila-Pires 1991) indicate that *Chironius scurrulus* inhabits various habitats, from primary forest to disturbed areas, is exclusively diurnal and primarily terrestrial when active, using the vegetation to rest by day and to sleep at night.

**Feeding habits.** At the RFAD, one adult (TTL 1995 mm, 640 g) found 10 m from a stream, regurgitated the legs of an adult *Leptodactylus pentadactylus* (SVL ca. 140 mm); two additional large individuals not captured had bulky prey (possibly large *Leptodactylus*) in the stomachs; *Leptodactylus pentadactylus* is a common inhabitant of stream banks, where it uses subterranean daytime retreats (pers. obs. 1987). This frog was also found in stomachs of *Chironius scurrulus* in western Amazonia (W.W. Lamar, pers. comm. 1996). These data and those in the literature (Cunha and Nascimento 1978 1982*b*; Dixon and Soini 1986; Duellman 1978) indicate that that *C. scurrulus* feeds primarily on frogs (*Hyla, Scinax, Eleutherodactylus, Leptodactylus*) and occasionally on lizards (one of 33 prey found by Dixon et al. 1993).

**Reproduction.** At the RFAD, neonates (TTL 449–564 mm) were found in February, March, and November; these limited data indicate that hatching may occur at least during the rainy season. Duellman (1978: Table 16) reported a female with six eggs and Dixon et al. (1993) found females with 6–11 eggs.

**Defense.** Adults and juveniles of this large, strong snake strike and bite frequently, elevate the head, and make an S-coil with the anterior third of the body. In juveniles, the color pattern (see above) and defensive behavior are extremely similar to those of *Philodryas viridissimus* (even an experienced collector may doubt its identity before restraining the snake; W.W. Lamar, pers. comm. 1996, shares this impression), suggesting a possible case of mimicry; *P. viridissimus* is known to inflict harmful envenomations (e.g., Campbell and Lamar 1989) and thus may be a model. Another possibility is that these juveniles are mimics of *Bothrops bilineatus* (Campbell and Lamar 1989). When handled, both adults and juveniles thrash and rotate the body. Adults resting on the vegetation by day are very difficult to capture: when the observer approaches, they become very alert, fall to the ground, and move away very quickly; two adults fell into a stream and fled by swimming underwater for several meters (in western Amazonia this species was also observed to dive and swim excellently; W.W. Lamar, pers. comm. 1996).

### *Clelia clelia* (Daudin 1803)
Plates 32-34

**Identification.** Maximum TTL unsexed 2280 mm (Murphy 1997); minimum TTL 448 mm (from Puraqueú, Maranhão); TAL 14.7–22.2% of TTL (Dixon and Soini 1986; Duellman 1978; Gasc and Rodrigues 1980; this study); ED about 1/6 to 1/9 of HL; pupil semi-elliptical (see a recent taxonomic revision in Zaher 1996). In juveniles (Plate 32), the dorsum is deep red, the head is black with a white to cream nuchal band, and the venter is cream. Half grown individuals (Plate 33) show a blackish suffusion in each red dorsal scale (darker on the middorsal region) and lack the nuchal band. In adults (Plate 34) the dorsum is dark gray (almost black); the head is also dark gray, paler on the labials; the venter is grayish cream. In the Manaus region, juvenile *Clelia clelia* is especially similar to juvenile *Drepanoides anomalus*, *Pseudoboa coronata*, and *P. neuwiedii* in color pattern; however, *C. clelia* and *P. neuwiedii* have 19 scale rows around midbody, *P. coronata* 17, and *D. anomalus* 15; additionally, subcaudals are not divided in both species of *Pseudoboa*. Adults of *C. clelia* may be similar to adults of *Drymoluber dichrous*, although the latter has 15 scale rows around midbody (19 in *C. clelia*) and larger eyes.

**Habitat and microhabitat.** One juvenile fell into a pitfall trap at Pitinga. A large adult was crossing a road at night in a flooded "várzea" region at Careiro. At Rio Juruá, one individual was found active in the leaf litter of a terra-firme forest at night (C. Gascon, unpublished data). At Guajará Mirim and Costa Marques, Rondônia, three individuals were active on the ground at night, two of them at the margins of bodies of water. The information available (Dixon and Soini 1986; Duellman 1978; Murphy 1997; Yanosky et al. 1996; this study) indicate that *Clelia clelia* is a terrestrial species that inhabits both forests and open areas, and is both diurnal and nocturnal. Beebe (1946) referred to both arboreal and terrestrial habits; however, all the remaining information indicates that *C. clelia* is terrestrial (an impression also shared by L.J. Vitt, pers. comm. 1996), indicating that at least some individuals cited by Beebe (1946) may have been misidentified (*Drepanoides anomalus*, a partially arboreal Pseudoboini that may occur at Kartabo and Caripito, is similar to *C. clelia*; only scale counts assure the distinction between these two species).

**Feeding habits.** No information is available for the Manaus region. One individual from Acre, Brazil, had a snake (*Boa constrictor*) in the stomach.

The available information (Dixon and Soini 1986; Duellman 1978; Murphy 1997; Yanosly et al. 1996; this study) indicates that *C. clelia* feeds on snakes, lizards, and mammals.

**Reproduction.** No information is available for the Manaus region. Duellman (1978) reported a female with 20 vitellogenic follicles (see also Murphy 1997).

**Defense.** When handled, this species thrashes the body, constricts powerfully (especially adults), and rarely, if ever, bites (see also Greene 1973*a*).

*Dendrophidion dendrophis* (Schlegel 1837)
Plates 35, 36

**Identification.** Maximum TTL male 1142 (Gasc and Rodrigues 1980), female 1183; minimum TTL 331 mm; TAL 44.9–52.2% of TTL (only for the Manaus region, since there is a strong geographical variation in tail size within Amazonia; pers. obs. 1995); ED about 1/4 of HL; pupil round; dorsals keeled (see taxonomic information in Cunha and Nascimento 1978; Lieb 1988). The dorsum is dark to reddish brown, paler (tan to grayish tan) anteriorly, with a series of darker lateral bars enclosing a yellowish to orange cream mark. The skin between each pair of dorsal scale row (apparent when the snake inflates the lung) is yellow. The head is tan to brown, paler laterally, and white ventrolaterally and below. The venter is white anteriorly, becoming yellow posteriorly. The iris is cream above and dark reddish brown medially and below (W.W. Lamar, pers. comm. 1996, reported that the eye reflects light at night). The tongue is black.

**Habitat and microhabitat.** At the RFAD, nine individuals were found in primary forest, five in plateaus, three in a stream valley at night, and one crossing an unpaved road by day. Eight individuals found at night were sleeping coiled on palm leaves and shrubs 0.4–2.0 m above ground (two of these individuals, both unsexed, were asleep on the vegetation 5 m apart); the only individual found by day was chasing a frog on the ground of an unpaved road. None of eight marked individuals was recaptured. One adult kept for 1 wk in a large terrarium spent the day on the ground and slept by night on a twig; a very alert high-head posture was adopted throughout the day and the snake remained immobile for hours. Also at the RFAD, W. Magnusson (pers. comm. 1996) found at least eight individuals also active by day on the ground. At Rio Cuieiras, a recently killed individual (probably by a hawk) was still thrashing the body on the leaf litter by day and at a primary forest 70 km north of Manaus, one individual was moving by day on the leaf litter. At Rio Pitinga, one was in the water by day and at Rio Jau, one individual was crossing a river by day. At Rio Urucu, one individual was sleeping on a palm 1.8 m above the ground, at night in a terra-firme forest. Laurie J. Vitt (pers. comm. 1996) also found many active in the leaf litter by day and asleep on bushes at night. These records and those in the literature (Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Nascimento et al. 1987; Vanzolini 1986) indicate that *Dendrophidion dendrophis* is a forest inhabitant, diurnal and terrestrial when active, using the vegetation to sleep at night. Cunha and Nascimento (1978) and Nascimento et al. (1987) stated that this snake is arboreal, as its name and the long tail would imply, but the records on active individuals strongly indicate terrestrial habits; the long tail may be associated with defense (see Defense below).

**Feeding habits.** Two individuals from the RFAD had frogs in the stomach. One of them (TTL 1081 mm, 59 g) had recently eaten a diminutive frog, *Adenomera andreae* (SVL 23 mm, 1.7 g, MR 0.03). The other (TTL 669 mm, 17g) had an unidentified frog (SVL ca. 30 mm, ca 3.0 g, MR ca. 0.18). Also at the RFAD, one individual (557+571 mm, 62.5 g) was chasing an adult female *Eleutherodactylus fenestratus* (SVL 48 mm, 7.0 g, MR 0.11). One individual (405+388 mm) from Rio Cuieiras had two small leaf litter frogs (*A. andreae* and *Colostethus stepheni*, both ca. 17 mm SVL) in the stomach. An individual from Rio Jau had a frog (*Colostethus*) in the stomach and another had frog remains in the hindgut. Another from Guajará-Mirim, Rondônia, had a frog (*Scinax*) in the stomach. An adult (510+436 mm, 42.3 g) from 100 km south of Santarém, Pará, had two frogs (both *Eleutherodactylus* sp., one with SVL 22 mm, 0.8 g, MR 0.02, and another with SVL 12 mm) (L.J. Vitt and J.P. Caldwell, unpublished data). These records and those in the literature (Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Nascimento et al. 1987; Vanzolini 1986) indicate that *Dendrophidion dendrophis* is a frog specialist

(*Adenomera, Eleutherodactylus, Colostethus, Hyla, Scinax*). Cunha and Nascimento (1978) stated that besides frogs, *D. dendrophis* also feeds on insect larvae; however, this may be a case of accidental or secondary ingestion. The low mass ratios here reported and the frog taxa in the literature also indicate that this species feeds mainly on tiny to small frogs, mostly found in the leaf litter by day (in fact, all diurnal frogs at the RFAD are small, SVL < 50 mm). The alert high-head posture observed in captivity may facilitate finding these frogs in the leaf litter and indicates a somewhat sit-and-wait strategy, although a frog may be actively chased after it is seen by the snake.

**Reproduction.** At the RFAD, one female (539+542 mm) had well developed vitellogenic follicles (detected by palpation) in January and the only juvenile (249+203 mm) was found in February. A recently caught female from the Manaus region laid a clutch of four eggs in January. One female from Manaus (SVL 571 mm, tail incomplete), collected in August, had six eggs 11–16 mm in length and 4–5 mm in diameter. A female from Rio Pitinga laid eggs in November. These limited data indicate that juvenile recruitment may occur at least during the rainy season in the Manaus region. One female from Rio Jau had three enlarged follicles. Duellman (1978) reported a female with six eggs.

**Defense.** This species expels cloacal gland products, vibrates the tail, inflates the body (exposing the yellow skin within the dorsal scales; Plate 36), rotates the body vigorously when handled, and does not bite. Some individuals may break their tail voluntarily (M. Martins and M.E. Oliveira, unpublished data; see also Duellman 1978). Concealing coloration may be effective when active on the leaf litter. At Rio Cuieiras one individual was probably killed by a hawk (see above).

*Dipsas indica* Laurenti 1768
Plates 37, 38

**Identification.** Maximum TTL male 707 mm (Duellman 1978), female 1028 mm (Dixon and Soini 1986); minimum TTL 357 mm; TAL 27.3–30.6% of TTL; ED about 1/4 of HL; pupil vertical to elliptical. The dorsum is dark brown with several light spots that often become narrower in the middorsal region. In juveniles, these spots are cream anteriorly, becoming greyish brown posteriorly; in adults, even the anterior spots become gradually greyish brown. Each light dorsal spot as well as each dark brown interspaces most often bears a small white spot ventrolaterally, sometimes poorly distinguishable; most often, these small white spots are more easily distinguishable on the dark brown interspaces anteriorly and on the light spots posteriorly. The head is grey (in juveniles) to dark greyish brown (in adults) with several dark brown spots, most of them with yellowish cream borders; there is always a pair of these spots on the parietals (these are often the larger ones on the head). The venter is brown to dark brown bearing the extensions of the ventrolateral white spots throughout. The iris is light grey. The tongue is black.

**Habitat and microhabitat.** One individual was moving on the vegetation at night in a primary forest about 70 km north of Manaus. At Marechal Taumaturgo, Acre, three individuals were found moving slowly on the vegetation 0.4–1.7 m above the ground at night in primary and disturbed forests. The information available (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978) indicate that *Dipsas indica* inhabits primary and secondary forests and is nocturnal (but see Beebe 1946) and arboreal when active.

**Feeding habits.** No information is available from the Manaus region. A juvenile from Marechal Taumaturgo, Acre, had the remains of a snail in the midgut. The available information (Beebe 1946; Cunha and Nascimento 1978; Duellman 1978; Hagmann 1910; this study) indicate that *Dipsas indica* feeds primarily on snails and slugs.

**Reproduction.** No information is available.

**Defense.** All individuals handled thrashed the body, triangulated the head (sometimes exaggeratedly), expelled cloacal gland products, and did not bite.

*Dipsas pavonina* Schlegel 1837
Plates 39, 40

**Identification.** Maximum TTL male 741 mm, female 737 mm (Gasc and Rodrigues 1980); minimum TTL 247 mm; TAL 24.5–31.8% of TTL (Gasc and Rodrigues 1980; this study); ED about 1/4 to 1/6 of HL; pupil vertical to elliptical (see taxonomic information in Peters 1960). The dorsal surfaces are tan to white with a series of large black blotches laterally, which usually fuse in the middorsal region; anteriorly, the spaces between each pair of black blotches may be white. The head is black with a narrow white band anteriorly (just posterior to the tip of the snout), a tan to yellowish tan nuchal band, and a white area lateroposteriorly. The venter is white with wide black marks (the extensions of the lateral black blotches). The iris and the tongue are black.

**Habitat and microhabitat.** At the RFAD, 37 observations of 33 individuals were made in primary forests, always at night. In 11 observations the snakes were moving, eight on or amidst the leaf litter on the forest floor and three on shrub branches at 0.8–3.0 m above the ground. None of these snakes had stomach contents. In 26 observations, the snakes were resting on the vegetation at 0.3–2.3 m above the ground (see Plates 39, 40); these snakes were coiled ($n = 20$), loosely coiled ($n = 2$) or stretched ($n = 4$) and of 17 palpated for stomach contents (see below), 10 (59%) had prey. Three marked individuals were recaptured: one 15 d after being marked was 91 m from the original site; a second, marked on 19 April 1992 (358+134 mm, 9 g), was recaptured on 5 July 1992 (371+138 mm, 12.5 g, SVL increment 0.17 mm/d) 21 m from the site of marking; a third, marked on 8 October 1992 (395+142 mm, 15 g) was recaptured twice, on 31 October 1992, 23 m from the site of marking, and on 23 February 1993 (409+144 mm, 15 g, SVL increment 0.10 mm/d) 15 m from the site of marking. This information and that in the literature (Beebe 1946, misidentified as *Dipsas indica*, see Peters 1960; Cunha and Nascimento 1978; Duellman 1978) indicate that *D. pavonina* is a nocturnal forest species, able to occupy disturbed habitats. Beebe (1946), Cunha and Nascimento (1978), and Duellman (1978) stated that this species is arboreal; however, our observations indicate that, in the Manaus region, it forages primarily within the leaf litter and rests on low vegetation at night. Differences among areas could be due to species misidentification or a different spatial distribution of prey.

**Feeding habits.** At the RFAD, evidently foraging snakes were on or amidst the leaf litter. One individual regurgitated the body of a gastropod (ca. 25 mm) and five palpated for stomach contents had snails and slugs (10–30 mm). One individual (244+167 mm) from 100 km south of Santarém, Pará, had the foot of a lizard; another (472+216 mm, 9 g) had a snail (14 mm in length, 0.7 g, MR 0.08); and a third (500+242 mm) had a slug (9.7 mm in length) (L.J. Vitt and J.P. Caldwell, unpublished data). The information available (Beebe 1946; Cunha and Nascimento 1978; this study) indicates that *Dipsas pavonina* feeds primarily on snails and slugs.

**Reproduction.** A gravid female (400+145 mm) from January had one egg (about 10 mm long). Six small juveniles (TTL 247–290 mm) were found from November–March. These data indicate that hatching occurs only during the rainy season.

**Defense.** When handled, *Dipsas pavonina* invariably discharged a fetid mixture from the cloaca (apparently consisting of uric acid, feces, and glandular products) while thrashing and tightly coiling the body around the observer's hand, rubbing its cloaca; it may also hide the head within body coils. When approached, it usually become immobile and may compress the body dorsoventrally (giving rise to a triangular cross section of the body), enlarge the head, and make subtle thrashes.

### *Drepanoides anomalus* (Jan 1863)
Plates 41, 42

**Identification.** Maximum TTL male 506 mm (Dixon and Soini 1986), female 837 mm, minimum TTL 193 mm (specimen at MPEG); TAL 20.9–26.5% of TTL (Dixon and Soini 1986; Duellman 1978; this study); ED about 1/4 to 1/6 of HL; pupil semi-elliptical (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986). In the adult found at the RFAD, the dorsum was bright coral red with a black tip on each scale. The head and anterior portion of the neck were grayish black. The venter was immaculate white. The iris was black and the tongue pinkish with a gray tip. One juvenile from Rio Pitinga was similar, although less melanic and bearing a creamy white band on the head. The white band on the head is cited in all descriptions we found in literature (e.g., Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Jorge da Silva 1993). A juvenile from Rondônia photographed by I. Sazima has an extensively white head with a black snout and a black nuchal band. Juvenile *Drepanoides anomalus* is very similar to juvenile *Clelia clelia*, *Pseudoboa coronata*, and *P. neuwiedii* in color pattern; see how to distinguish these species in the account on *C. clelia*. Additionally, adults of *D. anomalus* are also similar to adult *P. coronata* and *P. neuwiedii*, although both latter species have undivided subcaudals.

**Habitat and microhabitat.** The only individual found at the RFAD was moving on a root mat at the base of a tree at night. At Rio Pitinga, one individual fell into a pitfall trap. One individual from Rio Jaú was moving within the branches of a tree, 3 m from the ground at night. In western Amazonia, several individuals were found moving on the ground at night, except one which was on a stump ca. 0.9 m above the ground. These records and those in the literature (Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Duellman and Salas 1991; Vanzolini 1986) indicate that *Drepanoides anomalus* is a nocturnal species that inhabits forests and disturbed areas, and is primarily terrestrial and occasionally arboreal when active.

**Feeding habits.** No information on diet is available for the Manaus region. We found two specimens with gut contents at the MPEG: one (480+146 mm) with five squamate eggs (three were 13.1 x 4.3, 13.5 x 3.7, and 15.4 x 5.0 mm) and another (174+59 mm) with one squamate egg (28.0 x 2.4 mm). Two juveniles from Ecuador and Peru had also squamate eggs in the gut (H. Greene, pers. comm. 1997). Additional specimens from Peru, Ecuador, and Brazil confirm this surprising dietary specialization (Cunha and Nascimento 1978; Dixon and Soini 1986; W.W. Lamar, pers. comm. 1996).

**Reproduction.** One female (662+175 mm, 71 g, alive) from the RFAD laid three eggs (ca. 45 x 12 mm each) in March. A female (466+140 mm) from eastern Amazonia (at the MPEG) had two eggs (38.1 x 8.6 mm and 36.7 x 10.5 mm).

**Defense.** The only live individual observed tried to flee into a root mat; when handled, it thrashed the body insistently, discharged cloacal secretions, and did not bite. When disturbed in captivity, it made subtle thrashes and hid the head under body coils. In western Amazonia this species invariably flee quickly when the light fall on them (W.W. Lamar, pers. comm. 1996).

### *Drymoluber dichrous* (Peters 1863)
Plates 43, 44

**Identification.** Maximum TTL male 1300 mm, female 1032 mm (Dixon and Soini 1986); minimum TTL 341 mm; TAL 25.4–31.9% of TTL (Dixon and Soini 1986; Gasc and Rodrigues 1980; this study); ED about 1/4 to 1/5 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978, and Dixon and Soini 1986). In juveniles (Plate 43), the dorsal surfaces are reddish to dark brown with a series of dark bordered, cream to yellowish cream bands anteriorly, gradually fading to disappear on the posterior third of the body and on the tail. In adults (Plate 44), the dorsal surfaces are greenish, bluish or grayish black; the ventrolateral region is green to pale grayish green anteriorly, becoming yellowish posteriorly. The head is dark brown dorsally and white on the labials. The ventral surfaces are white under the head, becoming yellowish cream to yellow posteriorly. The head is dark brown with greenish tan to orange yellow marks, the most evident being narrow stripes between the parietals and between these scales and the frontal, a nuchal band with irregular borders, and a paler area laterally behind the eyes. The venter is cream, becoming dark brown laterally. In both adults and juveniles the iris is bronze above and coppery brown medially and below. The tongue is black. In the Manaus region, large adults of *Drymoluber dichrous* may be similar in appearance to adult *Clelia clelia* (see account on the latter species).

**Habitat and microhabitat.** Eleven individuals were found at the RFAD; nine were sleeping coiled on palm leaves and shrub branches at 0.7–2.2 m above the ground at night, and two were moving on the soil by day, one within fallen logs in a forest clearing and the other in a disturbed area. At Rio Urucu, an adult that was shedding the skin was coiled in a sunspot on the ground in the morning. At Rio Juruá, two were active in the leaf litter by day and one was sleeping in the leaf litter at night, all in terra-firme forests (C. Gascon, unpublished data). These data and those in the literature (Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Duellman and Salas 1991; Fugler 1986; Nascimento et al. 1988) indicate that *Drymoluber dichrous* inhabits forests and disturbed areas, is exclusively diurnal and terrestrial when active, using the vegetation to sleep at night.

**Feeding habits.** At the RFAD, one juvenile had a frog (*Colostethus*) in the stomach and one adult had a lizard egg in the stomach and lizard remains in the hindgut. One individual from Rio Pitinga had the remains of a lizard in the hindgut. A juvenile (285+114 mm) from Rio Jau had the broken tail of a gymnophthalmid lizard in the stomach and the remains of a frog (*Colostethus*) in the midgut. One female from Ecuador (624+250 mm), had two gymnophthalmid lizards (both *Arthrosaura reticulata*, SVL 52 mm and 35 mm); another individual (658+287 mm, 104.5 g) from 100 km south of Santarém, Pará, had a lizard (*Iphisa elegans*, SVL 44 mm, 1.8 g, MR 0.02) and two unidentified frogs (both 8.4 mm SVL); and four from Acre had lizards (*Iphisa elegans*, *Cercosaura ocellata*, *Arthrosaura* sp., and *Gonatodes hasemanni*; L.J. Vitt and J.P. Caldwell, unpublished data). Also in Acre, one individual was found foraging: it crawled along the edge of fallen logs poking its head under them (L.J. Vitt and J.P. Caldwell, unpublished data). These records and those in the literature (Cunha and Nascimento 1978; Cunha et al. 1985; Dixon and Soini 1986; Duellman 1978) indicate that *Drymoluber dichrous* feeds mainly on lizards (*Gonatodes, Anolis, Ameiva, Kentropyx, Arthrosaura, Cercosaura, Iphisa, Leposoma, Neusticurus*) and frogs (*Colostethus, Leptodactylus*), but also on lizard eggs and snakes (*Oxybelis, Drymoluber*). Besides the low MR presented above, L.J. Vitt (pers. comm. 1996) has additional unpublished data indicating that even large individuals eat small prey (the same occurring in another colubrine, *Spilotes pullatus*; O.A.V. Marques, pers. comm. 1997).

**Reproduction.** One female (615+261 mm) from the RFAD had three eggs (8 x 35 mm, 9 x 30 mm, and 7 x 37 mm) in March. A recently caught female from the Manaus region laid a clutch of five eggs in January. In the Manaus region, juveniles (TTL 341–423 mm) were found in February, October, and November. Fitch (1970) described females with two to six eggs and Cunha et al. (1985) referred to a female with four eggs.

**Defense.** When handled, *Drymoluber dichrous* rotates the body, vibrates the tail, and occasionally bites. One individual from Porto Velho, Rondônia, was very aggressive, striking and vibrating the tail frequently (O.A.V. Marques, pers. comm 1997). Concealing coloration may be effective when active on the leaf litter. It may also freeze when approached, which makes it very cryptic.

*Erythrolamprus aesculapii* (Linnaeus 1766)
Plates 45, 46

**Identification.** Maximum TTL male 767 mm, female 927 mm (Dixon and Soini 1986); TAL 10.7–13.7% of TTL (Dixon and Soini 1986; Duellman 1978; Gasc and Rodrigues 1980); ED about 1/5 to 1/6 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978, and Dixon and Soini 1986). The color pattern is highly variable in the Manaus region. The color of the dorsal surfaces may be orange red, bright red (Plate 45), brown, or grayish dark brown (Plate 46) with a series of black and pale (white, cream or yellowish cream) bands, which may be lacking anteriorly. The arrangement of bands is very variable, although at least three patterns may be distinguishable: (1) black bands with a wide white band medially (in most individuals the white band is about as wide as the black ones; Plate 45); (2) similar to the latter but bearing a pair of additional, narrow, white bands (on each side of the wide white band, most often incomplete above); and (3) black with narrow white borders (sometimes with an incomplete white band midlaterally). In those individuals with patterns 1 and 2, the head is black with a wide white band (posterior to the eyes); the tip of the snout has often the same color of the dorsal ground. In those individuals with pattern 3, the head is completely black above (white ventrolaterally). Non-black scales in all three patterns may be suffused with black. The venter bears the extensions of the dorsal pattern. Although polymorphic, *Erythrolamprus aesculapii* always exhibit a coral snake appearance in the Manaus region and thus may be confounded with venomous coral snakes (*Micrurus* spp.), as well as with the non-venomous *Atractus latifrons* (see how to distinguish *A. latifrons* from *E. aescu-*

*lapii* in the account on the former). Patterns 1 and 2 described above are similar to that of the syntopic *Micrurus lemniscatus* when the ground color is red (most often), except for the general lack of additional white bands (besides the wide one that is always present). Pattern 3 is almost identical to that of the syntopic *Micrurus averyi*. However, *E. aesculapii* has two secondary temporals and an opisthoglyphous dentition (with enlarged teeth posteriorly on the maxillary) while all *Micrurus* have only one secondary temporal and a proteroglyphous dentition (with poison fangs anteriorly on the maxillary). Those individuals of *E. aesculapii* with brown to dark brown dorsal ground color (Plate 46) are not similar to any species of *Micrurus*, although they still have a coral snake appearance (abstract coral snake mimicry; see Pasteur 1982, Pough 1988; see also Marques and Puorto 1991).

**Habitat and microhabitat.** The only individual observed at the RFAD was moving on the ground of a disturbed area by day. At Rio Pitinga, three individuals fell into pitfall traps in primary forest. These records and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Murphy 1997) indicate that *Erythrolamprus aesculapii* is primarily a forest inhabitant, occurring occasionally in disturbed areas, and is exclusively diurnal and terrestrial when active (see also Sazima and Abe 1991).

**Feeding habits.** Five individuals from Rio Jau had snakes in the gut; two of these (725+102 mm, 100 g, and 621+97, 90 g) had *Atractus torquatus* (TTL ~700 mm, ~70 g, MR ~ 0.70, and 340+60 mm, 19 g, MR 0.21) and another had the remains of an unidentified *Atractus*. The available information (Beebe 1946; Cunha and Nascimento 1978; Cunha et al. 1985; Hoogmoed 1980; this study; see also Marques and Puorto 1994) indicate that *Erythrolamprus aesculapii* feeds on long-bodied vertebrates (eels, *Symbranchus*; snakes, *Atractus, Liophis, Tantilla, Micrurus*; lizards). Beebe (1946) also found two large crickets in one stomach (probably a secondary ingestion).

**Reproduction.** A female (855+113 mm) from Rio Jau had two oviductal eggs (18.5 x 13.5 and 28.0 x 12.0 mm). A neonate was found in November at Pitinga. Duellman (1978: Table 16) reported a female with five eggs.

**Defense.** When approached, this species compresses the body dorsoventrally (mainly the anterior third), makes subtle thrashes, and coils the tail, in a similar way to sympatric *Micrurus*. When handled, it may bite and thrash the body (see also Beebe 1946, Greene 1973*a*, Sazima and Abe 1991). One individual from Rio Urucu everted the hemipenis when handled. All color morphs of *Erythrolamprus aesculapii* in the Manaus region (see above) bear a coral snake appearance, that may be both aposematic and mimetic.

*Helicops angulatus* (Linnaeus 1758)
Plates 47, 48

**Identification.** Maximum TTL male 686 mm (Dixon and Soini 1986), female 735 mm (Gasc and Rodrigues 1980), unsexed 1025 (Cunha and Nascimento 1978); minimum TTL 244 mm; TAL 20.4–33.8% of TTL (Dixon and Soini 1986; Duellman 1978; Gasc and Rodrigues 1980; this study); ED about 1/7 to 1/10 of HL; eyes directed upward; pupil round to slightly semi-elliptical; dorsal scales keeled (see taxonomic information in Cunha and Nascimento 1978, ad Dixon and Soini 1986). The dorsal surfaces are tan to grayish tan with dark brown dorsal blotches narrowing laterally and becoming black ventrolaterally. The head is tan to reddish brown above, paler laterally; posteriorly and on the neck, the first dorsal dark blotch extends anteriorly giving rise to a short middorsal line. The venter is pale yellow to red with black marks (the extensions of the dorsal blotches). The iris is golden. The tongue is black.

**Habitat and microhabitat.** At the RFAD, 61 observations of 52 individuals were made. In 57 observations of 49 individuals, the snakes were in still or slow flowing water in disturbed areas: a small dam (up to 1 m deep) and small ponds surrounding it in a large artificial clearing (*n* = 40 observations), several small to large ponds along an unpaved road crossing primary forest, both on plateaus and stream valleys (*n* = 16), and inside a stream (*n* = 1). Only four observations of three individuals were made in primary forest; these snakes were in shallow ponds (5–10 cm deep; Plate 48) in a stream valley. In all 61 observations snakes were active at night in shallow water (up to 20 cm deep), except two that were foraging by day: one at a depth of about 60 cm and another in shallow water (see below). Snakes in shallow water had the body more or less stretched out and only the tip of the head at the surface. Three marked individuals were recaptured at the same place: two adult females found in the shallow water of a small dam were marked on 14 January 1992 and 14 February 1992 (495+170 mm, 99 g; 475+157 mm, 94 g) and recaptured on 27 May 1992 and 16 April 1992 (500+177 mm, 114 g, SVL increment 0.04 mm/d; 482+166 mm, 74 g, SVL increment 0.11 mm/d), respectively; another individual found in a small forest pond was marked on 29 January 1992 (358+111 mm, 34 g) and recaptured on 12 March 1992 (370+114 mm, 39 g, SVL increment 0.28 mm/d) in the same pond. The limited data on recapture of marked individuals indicate that snakes may remain in a general area for long periods or, alternatively, may visit the same areas in different periods (see similar observations on one individual in Henderson et al. 1976). At Rio Urucu, one adult was in a large, shallow pond in terra firme at night. At Rio Juruá, one was found active on the leaf litter of a "várzea" forest at night (C. Gascon, unpublished data). In Rondônia, one individual was in a sandy beach of an "igapó" river at night. Our results and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Duellman and Salas 1991; Murphy 1997; Vanzolini 1986) show that *Helicops angulatus* may occur in various habitats from primary forests to open areas, is primarily nocturnal, occasionally being active during daytime, and is exclusively aquatic when active, found primarily in still water of small (forest ponds) to large (rivers) bodies of water.

**Feeding habits.** At the RFAD, one individual (TTL ca. 500 mm) was observed grasping a tadpole of the treefrog *Hyla geographica*, at a depth of about 60 cm. A large school of tadpoles was swimming at the surface when the snake swam up from the bottom, grasped a tadpole (TTL about 40 mm) and swam back to the bottom where it hid within the detritus. A second individual (308+142 mm, 35 g), found in a small pool in a disturbed area, regurgitated six recently caught tadpoles of *Osteocephalus taurinus* (mean weight 0.16 g, MR 0.005), four of them still alive. A third snake (TTL ca. 500 mm) was observed in a shallow area, at night, within a school of tadpoles of the frog, *Leptodactylus riveroi*, but it fled immediately to a deeper area (ca. 100 cm) when approached. Another (252+80 mm, 20 g with prey) was found when it came to the surface of a muddy shallow natural pool to breath. It had a large semi-aquatic lizard, *Neusticurus bicarinatus* (57+115 mm), in the stomach. A fifth snake was swimming in a shallow stream margin by day, close to a *N. bicarinatus*. One individual from Rio Jau had the remains of a fish in the stomach and another had three tadpoles. In Vaupés, Colombia, individuals moved into temporary primary forest pools to feed on tadpoles (there were no fish present; W.W. Lamar, pers. comm. 1996). Laurie J. Vitt (pers. comm. 1996) found mostly frogs in guts. These records and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Vanzolini 1986) show that *Helicops angulatus* feeds on aquatic vertebrates, mainly fishes and tadpoles (*Hyla, Osteocephalus*), probably the most commonly available prey in the habitats it lives, but also frogs and aquatic lizards (*Neusticurus*).

**Reproduction.** Five females with eggs were found in February, July, September, October, and November; three of these (450+180 mm, 455+165 mm, and 475+170 mm) had four, six and five eggs, respectively; one female with six eggs brought to the laboratory laid an imperfectly shelled egg in July and was then released at the site of capture. Two neonates (one with TTL 244 mm and the other similar-sized) were found in January. A female from Rio Jau had nine enlarged follicles (13 x 9 to 15 x 12 mm). These results indicate that hatching is restricted to the rainy season in the Manaus region. Duellman (1978) reported a female with 11 vitellogenic follicles and Cunha and Nascimento (1981) found 7–20 eggs in 12 females; these authors state that they found embryos in one of these, although this may be an error (L.J. Vitt, pers. comm. 1996).

**Defense.** When handled, this species varies from docile to very aggressive, depending on the individual. Aggressive individuals bite, rotate, and thrash the body vigorously, and may also constrict. When approached outside the water, it may compress the body dorsoventrally and enlarge the head, gape, and make subtle thrashes (see also Duellman 1978, Mole 1924, Murphy 1997).

*Helicops hagmanni* Roux 1910
Plates 49, 50

**Identification.** Maximum TTL male 624 mm, female 945 mm (this study); minimum TTL 168 mm; TAL 19.2–28.5% of TTL; ED about 1/8 of HL; pupil round; dorsal scales keeled (see taxonomic information in Cunha and Nascimento 1978; Rossman 1975). The dorsum is brown with five longitudinal series of dark brown spots: a pair of large, more distinct spots dorsolaterally; another pair of smaller, less distinct spots middorsally, alternating with the larger ones and sometimes fused above; and a third laterally, darker, each bearing reddish brown flecking. Ventrolaterally, the spaces between the lateral dark spots are white above, reddish brown below. The head is tan to reddish brown posteriorly, bearing a dark brown middorsal stripe, dark brown medially, and brown anteriorly. Laterally, the head is brown with a dark brown stripe extending ventroposteriorly from the eyes to the corner of the head; the upper and lower lips bear dark brown bars. The venter is reddish to orange brown (suffused with dark brown) with black marks (the extensions of the lateral dark spots). The iris is bronze to copper with a median dark brown fleck. In the only neonate observed, the dorsal ground color was tan and the head was white on the snout and posteriorly.

**Habitat and microhabitat.** At the RFAD, three individuals were found in a small stream in primary forest. Two adults were found at night anchored in roots at the margin of a small stream, with the tip of the head outside the water. One juvenile was swimming in a shallow at the margin of a small stream in late morning (Plate 50). These data and those in the literature (Cunha and Nascimento 1978; Jorge da Silva 1993) indicate that *Helicops hagmanni* inhabits streams and flooded areas, and is aquatic and primarily nocturnal when active.

**Feeding habits.** One captive individual from the Manaus region readily accepted fishes. One individual (305+93 mm, 43 g) from Rio Uaupés, Amazonas, Brazil, had a characoid fish (standard length 4.5 mm, 3 g; MR 0.07) in the stomach and the remains of two other fish in the hindgut (C. Nogueira, unpublished data). Cunha and Nascimento (1978) stated that this species feeds on fishes.

**Reproduction.** At the RFAD, one neonate (TTL 168 mm) was found in January. One female (677+161 mm) from Rio Jau had 16 enlarged follicles (13 x 10 to 16 x 12 mm) and another (748+197 mm) had 35 (8 x 5 to 13 x 11 mm). Cunha and Nascimento (1981) found 4–20 eggs in 14 females and 17 embryos in another.

**Defense.** All three individuals handled thrashed and rotated the body and did not try to bite.

*Imantodes cenchoa* (Linnaeus 1758)
Plates 51-53

**Identification.** Maximum TTL male 1168 mm, female 1172 mm (Duellman 1978); minimum TTL 492 mm; TAL 27.6–31.6% of TTL; ED about 1/5 of HL; pupil vertical to elliptical (see a taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986, Myers 1982). The dorsum is tan to tan-brown with a series of dorsal dark brown blotches narrowing laterally. The head is dark brown with grayish tan lines mostly between the head plates. The venter is grayish tan with dark flecking. The iris is tan to yellowish cream.

**Habitat and microhabitat.** At the RFAD, 24 observations of 21 individuals were made, always at night in primary forest. On 16 occasions, the snakes were moving (probably foraging) on palm leaves and branches of shrubs and trees (Plate 52), at 0.5–2.5 m above the ground; on eight occasions, they were resting partially coiled on the vegetation at 0.6–2.8 m above the ground. At the RFAD three marked individuals were recaptured: (1) one adult (831+319 mm, 19 g) was recaptured 2 d after marking, 12 m from the site of first observation; (2) another adult (827+355 mm, 14 g) was recaptured 29 d after marking (839+364 mm, 14 g, SVL increment 0.4 mm/d), 21 m from the site of the first observation; and (3) one subadult (485+200 mm, 4.5g) was recaptured (with 503+208 mm, 7.0 g, SVL increment 0.7 mm/d) 26 d after marking, 10 m from the site of the first observation. These limited data indicate that individuals remain in the same general area for relatively long periods. At Rio Cuieiras, two adults, one male (moving) and one female (resting), were found on the vegetation (1.6 and 2.0 m above ground) 10 m apart in primary forest at night. At Rio Pitinga, one individual was active within the leaves of a bromeliad 1.8 m above the ground. Also at Rio Pitinga, five additional individuals were found: four were on the vegetation at 1–2 m above ground at night and one was coiled under the bark of a large palm at 2 m above ground by day. At Marechal Taumaturgo, Acre, two individuals were found active on the vegetation at night in forests, one juvenile moving on a shrub 0.3 m above the ground and an adult ingesting a lizard (see below) in a tree 1.8 m above ground; a third individual was sleeping coiled inside a dead bamboo 1.6 m above the ground in a primary forest. At Rio Juruá, eleven were active on shrubs at night, nine in terra-firme forests (one of them in the margins of a forest pool) and two in "várzea" forests (C. Gascon, unpublished data). These records and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Duellman and Mendelson 1995) characterize an arboreal, nocturnal forest species, able to invade disturbed areas, being active in low to moderately high vegetation and seeking retreat in the vegetation by day (see also Henderson and Nickerson 1976*b*).

**Feeding habits.** Two individuals from the RFAD had frogs in their stomachs; both were adults (male, 844+372 mm, 17.5 g; gravid female, 812+362 mm, 27 g) and had adult frogs, *Eleutherodactylus fenestratus* (SVL ca. 35 mm and ca. 30 mm, respectively). A preserved individual (697+315 mm) from a road close to the RFAD had a lizard in the stomach (*Anolis punctatus*, 68+190 mm). One adult from Marechal Taumaturgo, Acre, was ingesting a lizard (*Anolis fuscoauratus*; Plate 53) on a tree 1.8 m above ground and another had the remains of a lizard (*Anolis*) in the midgut. Four individuals from Ecuador (345+135 mm, 904+303 mm, 795+365 mm, and 795+348 mm) had lizards (all *Anolis fuscoauratus*, SVL 36 mm, 41 mm, 40 mm, and 33 mm, respectively); and four (317+115 mm, 2.6 g; 620+272 mm, 11.6 g; 750+330 mm, 31 g; and 375+144 mm) from 100 km south of Santarém, Pará, had *Anolis* lizards (*A. fuscoauratus*, SVL 34 mm, 0.5 g, MR 0.19; *A. ortonii*, SVL 46 mm, 2.5 g, MR 0.21; *A. punctatus*, SVL 67 mm, 6.4 g, MR 0.21; and *A. fuscoauratus*, SVL 43 mm) (L.J. Vitt and J.P. Caldwell, unpublished data). These data and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Duellman and Mendelson 1995; Henderson and Nickerson 1976*b*) show that this species feeds mainly on lizards (*Gonatodes*, *Anolis*, mostly the latter) and occasionally on frogs (*Eleutherodactylus*, *Scinax*) and forages mostly on the vegetation.

**Reproduction.** At the RFAD, one female (812+362 mm, 27 g) with a small egg was found in March and another (815+377 mm, 25 g) had two well developed eggs in February. Hatchlings and small juveniles (349–431 mm SVL) were found in January, February, June, and November. Our limited data indicate that hatching may occur throughout the year in the Manaus region. Literature records of clutch size (Duellman 1978; Duellman and Mendelson 1995; Murphy 1997; Zug et al. 1979) are 1–5 eggs.

**Defense.** Moving individuals freeze when approached. When handled, this species invariably discharges fetid cloacal gland products and may also thrash and rotate the body (see also Beebe 1946). One male everted the hemipenis during handling.

*Leptodeira annulata* (Linnaeus 1758)
Plate 54

**Identification.** Maximum TTL male 794 mm, female 869 mm; minimum TTL 265 mm; TAL 23.4–31.5% of TTL; ED about 1/7 of HL; pupil vertical to elliptical (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). The dorsum is tan to brown with a series of dorsal dark brown blotches that may fuse giving rise to a straight or zigzag middorsal stripe. The head is dark brown with a tan or white area posteriorly and laterally (behind the eyes). The venter is whitish cream. The iris is brown.

**Habitat and microhabitat.** At the RFAD, a total of 18 observations of 17 individuals were made in primary forest, both on plateaus (*n* = 11) and stream valleys (*n* = 7). Eight were moving on the vegetation at 1.5–3.5 m above ground; seven were moving on the leaf litter or fallen palm leaves up to 0.3 m above the ground; one was active inside a ground bromeliad (with many tadpoles in the axillae); and two were resting partially coiled on a tree branch and a palm leaf at 3.5 and 1.6 m above ground. Active snakes were commonly found within aggregations of frogs, especially *Phyllomedusa* spp. (often *P. bicolor*, *P. tarsius*, and *P. tomopterna* together), at permanent pools. No *Leptodeira annulata* was found by day at the RFAD. At Pitinga, two were active on the vegetation at 1.5 and 2.0 m above ground at night. At Rio Urucu, a juvenile was active in a tree over a primary forest pool (1.6 m above the water surface) at night. At Marechal Taumaturgo, Acre, a large adult was moving on a tree branch 1.8 m from the ground at night in a primary forest. At the Serra dos Dois Irmãos, Rondônia, one individual was on a shrub 1 m above the ground at night, in primary forest, in a site with many shallow ponds where several hylid frogs were breeding. At Ilha de Maracá, Roraima, this species was found frequently sleeping within debris around buildings close to primary forest. At Rio Juruá, four individuals were active at night on vegetation, two of them in terra-firme forests, one in a "várzea" forest and another in a river bank (C. Gascon, unpublished data). The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Duellman and Salas 1991; Duellman and Mendelson 1995; Murphy 1997; Sasa and Solórzano 1995; Test et al. 1966; Vitt 1996; Yanosly et al. 1996; this study) shows that *L. annulata* is a forest species able to occupy disturbed areas, is exclusively nocturnal, and primarily arboreal and occasionally terrestrial when active. It uses retreats in the vegetation or under piles of vegetation on the ground to sleep during the day.

**Feeding habits.** At the RFAD, one individual regurgitated an adult male treefrog, *Osteocephalus* sp. (SVL ca. 45 mm); another individual was eating an egg clutch of *Phyllomedusa tarsius*. Two individuals from Rio Jau had frogs in the gut; one of them (495+177 mm, 33.5 g) had a *Leptodactylus* (SVL 51 mm, 20 g; MR 0.60); a third individual had the remains of a gekkonid lizard. These records and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Duellman and Mendelson 1995; Murphy 1997; Sasa and Solórzano 1995; Vitt 1996; Yanosky et al. 1996) show that *Leptodeira annulata* feeds primarily on frogs (*Bufo*, *Synapturanus*, *Adenomera*, *Eleutherodactylus*, *Leptodactylus*, *Hyla*, *Osteocephalus*, *Scinax*) and tadpoles and occasionally on frog eggs (*Phyllomedusa*) and lizards. The only apparently substantiated record of lizard as prey is that by Beebe (1946; see also Vitt 1996).

**Reproduction.** A female (599+192 mm) found in February at the RFAD had six eggs (7 x 17 mm to 8 x 18 mm); small juveniles (265 and 346 mm TTL) were found in December and May. A recently caught female from the Manaus region laid a clutch of five eggs in September. Our data indicate that hatching may occur at least during the rainy season in the Manaus region. A female (668+193 mm) from Rio Jau had five enlarged follicles (12 x 7 to 15 x 7 mm). A female collected in July in Roraima laid five eggs in September. Literature records on clutch size are 2–7 eggs (Dixon and Soini 1986; Duellman 1978; Fitch 1970; Murphy 1997; Vitt 1996).

**Defense.** When handled, this species nearly invariably discharges extremely fetid, long lasting cloacal gland products. Of 14 marked individuals, only two bit during ventral scale clipping and one during measurement. This species also enlarges and triangulates the head, makes an S-coil, and performs false strikes (with the mouth closed) when disturbed (see also Beebe 1946, Murphy 1997).

### *Leptophis ahaetulla* (Linnaeus 1758)
Plates 55, 56

**Identification.** Maximum TTL male 1526 mm (this study), female 1069 mm (Dixon and Soini 1986), unsexed 2340 mm (Beebe 1946); minimum TTL 242 mm (Rand 1969); TAL 37.2–39.5% of TTL; ED about 1/5 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). The dorsum is metallic green often with a grayish to reddish tan middorsal stripe, more evident posteriorly, and a grayish white stripe ventrolaterally; the ventrolateral region of the neck is white to golden yellow. All dorsal scales are black edged. The head is metallic green with a dark brown stripe laterally (behind the eyes); the lips are white. The venter is white anteriorly, becoming gray posteriorly. The iris is bronze with a wide black median stripe.

**Habitat and microhabitat.** At the RFAD, four individuals were found in primary forests and five in disturbed areas. In primary forest, two individuals were active during daytime; they were moving on low vegetation (1.5 and 1.7 m above the ground). Two additional individuals from primary forests were sleeping at night, coiled on a palm leaf and a shrub branch (at 1.5 and 0.8 m above the ground). In disturbed areas at the RFAD, five individuals were observed: two were sleeping on the vegetation (1.2 and 1.8 m above ground) on the margins of a dam at night; one was moving on the ground by day; one was moving on aquatic plants (0.6 m above the ground) on the margins of a dam shortly after sunset (1840h); and another was grasping a treefrog (see below) on a tree 8 m above the ground, at noon. At Rio Cuieiras, an adult female was on a tree in "igapó", by day. At a site 70 km north of Manaus, one individual was chasing a frog on the vegetation 2 m above ground in a disturbed forest by day (see below). These data and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Murphy 1997; Nascimento et al. 1988; Yanosky et al. 1996) indicate that *Leptophis ahaetulla* is a forest species able to occupy disturbed and open areas, is primarily diurnal, and mainly arboreal (but occasionally terrestrial) when active, using low vegetation to sleep at night.

**Feeding habits.** At the RFAD, one individual (871+531 mm, 86 g) was grasping a large treefrog, *Osteocephalus taurinus*, by its back; the frog was insistently emitting distress calls. The frog and the snake were on a cultivated tree, 8 m above ground, in a man made clearing during the day. Two additional individuals had prey in their stomachs when marked: one (670+422 mm, 23 g) had a lizard (*Anolis* sp., SVL ca. 60 mm) and the other (a juvenile), a small frog. At a reserve 70 km north of Manaus, in a disturbed forest at noon, one adult was chasing a small treefrog (*Hyla* sp., of the *minuta* group) on the vegetation 2 m above ground; both snake and frog fell to the ground, where the snake struck the frog on the third attempt. One individual from a road near the RFAD had a frog (*Scinax* sp.) in the stomach. Another from Rio Jau had the remains of a frog in the hindgut. An adult female from Ecuador (690+445 mm) had a frog (*Osteocephalus leprieuri*, SVL 61 mm) in the stomach (L.J. Vitt and J.P. Caldwell, unpublished data). In Acre, one individual was found eating a frog (*Osteocephalus* sp.; T.C.S. Ávila-Pires, unpublished data). These records and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Hero and Magnusson 1987; Nascimento et al. 1988; Sexton and Heatwole 1965; Yanosky et al. 1996) show that *Leptophis ahaetulla* feeds primarily on arboreal frogs (*Hyla*, *Osteocephalus*, *Scinax*) and occasionally on lizards (*Anolis*).

**Reproduction.** A female from Rio Cuieiras (806+389 mm) had eight eggs (25 x 10 to 31 x 11 mm). Another (590+402 mm) from Costa Marques, Rondônia, had four enlarged follicles (19.0 x 4.7, 20.5 x 6.3, 21.2 x 5.3, 23.0 x 5.2 mm). Literature records on clutch size are 1–6 eggs (Fitch, 1970; Oliver 1948; Sexton and Heatwole 1965; Yanosky et al. 1996; Zug et al. 1979).

**Defense.** When approached, this species enlarges the head, makes an S-coil, gapes (Plate 55), strikes, and occasionally bites. When handled it thrashes the body and bites (see also Murphy 1997 and a review in Greene 1988). Concealing coloration is effective when active within the vegetation.

*Liophis breviceps* Cope 1861
Plates 57, 58

**Identification.** Maximum TTL male 585 mm (this study), female 607 mm (Dixon 1983*a*); minimum TTL 182 mm (this study); TAL 15.2–20.0% of TTL (Dixon 1983*a*; this study); ED about 1/6 to 1/7 of HL; pupil round (see taxonomic information in Dixon 1983*a*). The dorsum is dark brown to black with a series of 30–45 short (half scale long) white bands (interrupted above in adults); the dorsal surface of the tail is similar to the dorsum and also bears (9–19) short white bands; the ventrolateral region bear the angular extensions of the red ventral blotches. The venter is black with a series of large red blotches that extend upward into the ventrolateral region. The head has the same background color as the dorsum; the labials are cream, some with dark reticulation; the underside of head is cream with dense dark reticulations. *Liophis breviceps* is similar in general appearance to *Atractus poeppigi* and *Micrurus collaris* (see account on *A. poeppigi*).

**Habitat and microhabitat.** One individual was moving on the ground in a disturbed area at the RFAD, during daytime. Another individual was moving on the leaf litter by day in a secondary forest inside Manaus. Several additional individuals were found in disturbed areas inside and around

Manaus. In western Amazonia, this species is frequently found in or around bodies of water (W.W. Lamar, pers. comm. 1996). These data indicate that *Liophis breviceps* is primarily terrestrial and occasionally aquatic when active.

**Feeding habits.** Three individuals from the Manaus region had prey remains in the hindgut: one juvenile and one adult (270 mm and 409 mm TTL) had earthworm chetae and a third had frog remains. Beebe (1946) found earthworms, centipedes, and a fish (*Synbranchus*) in two stomachs. These few data indicate that *Liophis breviceps* feeds on earthworms, centipedes, frogs, and fish.

**Reproduction.** Hatchlings (182–197 mm TTL) were found in August, October, and November, indicating that hatching may occur at least during the dry season and the beginning of the wet season.

**Defense.** When handled, this species thrashes the body and may bite (only one adult). The general aspect of *Liophis breviceps* is very similar to that of *Atractus poeppigi* and *Micrurus collaris* (see accounts on these species) and may also represent a case of coral snake mimicry (Martins and Oliveira 1993).

*Liophis reginae* (Linnaeus 1758)
Plates 59, 60

**Identification.** Maximum TTL male 762 mm, female 810 mm (Dixon 1983*b*); minimum TTL 273 mm (this study); TAL 20.2–31.0% of TTL (Dixon 1983*b*; this study); ED about 1/5 to 1/6 of HL; pupil round (see taxonomic information in Dixon 1983*b*). The dorsum is grayish tan to dark reddish brown with dark and pale (sometimes yellow) flecking; on the anterior third of the body, the ventrolateral region is greenish tan to yellow; posteriorly a dark brown stripe is present on the ventrolateral region, extending throughout the tail. The venter is cream to yellowish cream, plain or bearing dark brown marks (sometimes forming a checkered pattern). The head is slightly darker than the dorsum; laterally, a dark brown stripe extends from the eyes to the corner of the head; the lips are yellowish white to yellow. The iris is bronze above and dark brown medially and below. The tongue is black. This species may be very similar to *Liophis typhlus*, but is easily distinguished by having 15 or 17 scale rows around midbody (19 in *L. typhlus*) and by the presence of a dark brown stripe on the ventrolateral region (absent in *L. typhlus*).

**Habitat and microhabitat.** At the RFAD, eleven individuals were found: nine were sleeping coiled on palm leaves and shrub branches and leaves, at 0.3–2.3 m above the ground (Plate 60), one was moving on the leaf litter in late afternoon (1815h), and another fell into a pitfall trap. None of eight marked individuals was recaptured. At other localities in the Manaus region, four individuals were moving on the leaf litter of primary forests during daytime. In Guajará Mirim, Rondônia, one adult was moving on the ground in a disturbed forest by day. These records and those in the literature (Cunha and Nascimento 1978; Duellman 1978) indicate that *Liophis reginae* is a forest inhabitant occasionally found in disturbed habitats, and is exclusively diurnal and terrestrial when active, using low vegetation to sleep at night.

**Feeding habits.** One individual from the RFAD (238+83 mm, 10 g) regurgitated an adult leptodactylid frog, *Adenomera andreae* (SVL ca. 20 mm, 0.6 g, MR 0.06). Three individuals from the Manaus region had two frogs (*A. andreae* and *Colostethus* sp.) and one lizard (*Leposoma* sp.) in their stomachs; eight had arthropod remains in the hindgut (two of which also had bone fragments) probably from the stomachs of frogs. Another (327+120 mm, 25 g) from Balbina (at the MPEG) had a toad (*Bufo marinus*; SVL 42 mm, 4 g, MR 0.16) in the gut. These data and those in the literature (Ávila-Pires 1995; Cunha and Nascimento 1978; Duellman 1978) indicate that *Liophis reginae* feeds primarily on frogs (*Adenomera*, *Leptodactylus*, *Colostethus*) and occasionally on lizards (*Cercosaura*, *Leposoma*) and tadpoles (*Hyla*). Michaud and Dixon (1989) provided a comprehensive review of the diet of *L. reginae* (but see Taxonomic Comments below).

**Reproduction.** One female from the RFAD, found in February (342+118 mm, 27 g), had five eggs (detected by palpation), each ca. 10 mm in length. Small juveniles (312 and 321 mm TTL) were found in January and June. At other localities in the Manaus region, juveniles (273–321 mm TTL) were found in March, September, and November, and a female with one oviductal egg (6 x 20 mm) was found in May. Our data indicate that hatching may occur throughout the year in the Manaus region. Duellman (1978) found two females with three and six eggs.

**Defense.** When handled, this species may discharge fetid cloacal gland products and thrash the body; only one individual bit (insistently) when handled. When approached or handled, both during the day and at night, it may compress dorsoventrally the anterior third of the body (cf. dorsoventral neck compression in Greene 1988; see also Mole 1924, Mole and Ulrich 1894). One individual voluntarily fell from the sleeping perch (0.5 m above the ground) when approached by night and fled. One individual (SVL 366 mm) had part of the tail lacking. Concealing coloration may be effective when active on the leaf litter.

**Taxonomic comments.** The species identified by Dixon and Soini (1986) as *Liophis reginae* has a similar scutellation in relation to that found in the Manaus region, although the coloration and habits are quite dissimilar; they possibly represent ecologically distinct subspecies, although both seem to fit the diagnosis of *L. r. semilineata* (Dixon 1983*b*). Based on the color descriptions provided by Beebe (1946), we suspect that this author treated as *L. reginae* more than one species or races. We agree with Dixon (1983*b*) in considering *L. oligolepis* as a synonym of *L. reginae.*

*Liophis typhlus* (Linnaeus 1758)
Plates 61-63

**Identification.** Maximum TTL male 740 mm, female 853 mm (Dixon 1987); minimum TTL 184 mm (this study); TAL 17.6–25.3% of TTL (this study); ED about fifth of HL; pupil round (see taxonomic information in Dixon 1987). The dorsum is pale to deep green (Plate 61), dark reddish brown or salmon-brown (Plate 62) or bluish gray (Plate 63), always with darker flecking (e.g., black, dark brown) and pale or dark skin between the scale rows (e.g., white, cream, pale gray, yellow, pale blue, black). The head is slightly darker than the dorsum; the lips are white to yellow. Juveniles bear broad black stripes running obliquely on the corner of the head. The venter is white to yellowish white, rarely bearing dark marks; in the salmon-brown individuals, the venter has many pale salmon marks. The iris is coppery brown. This species may be very similar to *Liophis reginae* in general appearance (see account on the latter).

**Habitat and microhabitat.** Seven individuals were found at the RFAD. Four were moving on the leaf litter or on the ground of unpaved roads within primary forests, three during the day and one at night (1930h); three individuals were coiled asleep on low branches (0.3–0.7 m above the ground) at night (Plate 61), one of them nearly completely under dead leaves, the remaining two exposed; all individuals were in primary forests (see also Martins 1993). At Balbina, two were moving on the leaf litter and at Rio Cuieiras, four were active also on the leaf litter, all during daytime. At Rio Urucu, one juvenile was moving on the leaf litter of a primary forest in the morning. At Rio Juruá, one was active in the leaf litter of a terra-firme forest by day (C. Gascon, unpublished data). In Guajará Mirim, Rondônia, one adult was moving on the leaf litter of a primary forest by day. In Vaupés, Colombia, it was found in sandy areas by water (W.W. Lamar, pers. comm. 1996). These records and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Martins 1993; Nascimento et al. 1987) show that *Liophis typhlus* is a forest species able to occupy disturbed areas, is primarily diurnal (only one observation of nocturnal activity), and terrestrial when active, using low vegetation to sleep at night.

**Feeding habits.** Five individuals from the Manaus region had small toads and a frog (four *Bufo* sp. of the *typhonius* complex and one leptodactylid) in the stomach and 15 had arthropod remains in the hindgut, most probably from the stomachs of already digested frogs (but see Beebe 1946), three of them containing also bone fragments of anurans. These records and those in the literature (Beebe 1946; Cunha and Nascimento 1978; Michaud and Dixon 1989) indicate that *Liophis typhlus* feeds primarily on frogs (*Bufo*, *Leptodactylus*); Beebe (1946) referred to an individual with a frog and a mass of over one hundred ants (probably a secondary ingestion).

**Reproduction.** Two females from the RFAD, found in January and April, had five and four well developed eggs (the larger ca. 25 and 35 mm in length, respectively). Two small juveniles (TTL 214 mm and 266 mm) from the RFAD were found in January and March. Four gravid females from the Manaus region had oviductal eggs: 420+90 mm, five eggs (8–10 x 24–26 mm); 372+83 mm, three eggs (6–7 x 16–17 mm) in October; 426+99 mm, three eggs (9–10 x 20–21 mm) in January; and 398+101 mm, two eggs (both 5 x 13 mm) in June. A female from Rio Cuieiras had four developing follicles (6 x 14 mm to 6 x 17 mm) in September. In the Manaus region, small juveniles (184–258 mm TTL) were collected in August, October, and November. Our data indicate that hatching may occur throughout the year in the Manaus region. Beebe (1946) found a female with five eggs.

**Defense.** When approached, this species often compresses the body dorsoventrally (mainly the anterior third; Plates 62, 63) and hides the head under body coils. When handled, it may discharge fetid cloacal gland products and thrash the body (see also Beebe 1946). Only one individual bit during handling. Concealing coloration may be effective when active on the leaf litter (which always includes green leaves).

*Mastigodryas boddaerti* (Sentzen 1796)
Plates 64, 65

**Identification.** Maximum TTL male 1180 mm, female 1505 mm (Gomes 1918); minimum TTL 314 mm (at MPEG); TAL 24.5–28.8% of TTL (at MPEG); ED about 1/6 of HL; pupil round (see taxonomic information in Chippaux 1986, Cunha and Nascimento 1978). In adults (Plate 64), the dorsum is brown to dark brown with a pair of tan dorsolateral stripes that fade posteriorly. Juveniles (Plate 65) also have dorsolateral pale stripes, but also a series of tan bands dorsally and laterally, that also fade posteriorly. In both adults and juveniles, the head is brown to dark brown with a darker stripe running from the naris region to the corner of the mouth; the lips are white to brownish white. The venter is grayish white. The iris is bronze above and copper medially and below.

**Habitat and microhabitat.** The only individual found at the RFAD was coiled asleep on the branches of a small tree (1.8 m above the ground) at night, in the forest border of a man-made clearing. In secondary forests in Manaus, four individuals were found on the ground by day (one was in a white sand forest). At Carajás, Pará, one adult was moving on the ground in a disturbed forest by day. The available information (Beebe 1946; Cunha and Nascimento 1978; Murphy 1997; Nascimento et al. 1988; this study) indicates that *Mastigodryas boddaerti* may live in forests and open and disturbed habitats, is exclusively diurnal, and primarily terrestrial, occasionally using low vegetation (see below) when active. The only observation at night indicates that it uses the vegetation to sleep during this period.

**Feeding habits.** One individual from the Manaus region had a lizard (*Ameiva ameiva*) in the stomach and another from Rio Jau had the remains of a lizard (Gekkonidae) in the hindgut. Ten individuals from eastern Amazonia (at MPEG) had prey in the gut: nine lizards (three *Ameiva ameiva*, two *Cnemidophorus lemniscatus*, one *Arthrosaura* sp., one *Gonatodes humeralis*, and two unidentified) and two frogs (*Leptodactylus longirostris* and *Scinax* sp.); MR for lizards were 0.006, 0.014, 0.357, and 0.510, and for frogs, 0.077 and 0.100. At Santarém, Pará, two individuals were capturing lizards (*Cnemidophorus* sp.) and five had the same lizard in the stomach (W. Magnusson, pers. comm. 1996). Another (390+132 mm, 14.5 g) from 100 km south of Santarém, Pará, had a lizard (*Kentropyx calcarata*, SVL 50 mm, 3.2 g, MR 0.221) in the stomach (L.J. Vitt and J.P. Caldwell, unpublished data). The available information (Ávila-Pires 1995; Beebe 1946; Cunha and Nascimento 1978; this study) indicates that *Mastigodryas boddaerti* feeds primarily on lizards, but also on frogs (*Scinax*, *Leptodactylus*), reptile eggs, birds (*Glyphorhynchus*), and rodents, and forages by day on the ground and at low heights on the vegetation.

**Reproduction.** One neonate was found in April in Manaus. A female (SVL 924 mm) from eastern Amazonia (at MPEG) had six eggs (20.0 x 12.9 mm, 29.8 x 11.1 mm, 30.7 x 11.2 mm, 31.6 x 10.8 mm, 35.1 x 10.4 mm, and 38.2 x 12.8 mm).

**Defense.** When approached by day, this agile species flees very quickly. When manipulated, it thrashes and rotates the body, vibrates the tail, elevates the head, makes an S-coil, strikes, and bites insistently (see also Mole 1924). Concealing coloration may be effective when active on the leaf litter.

*Oxybelis aeneus* (Wagler 1824)
Plates 66, 67

**Identification.** Maximum TTL male 1360 mm, female 2000 mm (Beebe 1946); minimum TTL 374 mm (Sexton and Heatwole 1965); TAL 37.3–41.2% of TTL (Beebe 1946; Sexton and Heatwole 1965; this study); ED about 1/8 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). The dorsum is pale to grayish tan with sparse small dark markings. The head is tan to brown above, with a narrow dark brown line running from the naris region to the corner of the mouth; the lips are white. The chin and throat are white; the venter is brown to dark brown. The iris is bronze, sometimes with a black border on the middle.

**Habitat and microhabitat.** At the RFAD, three individuals were asleep, loosely coiled on the vegetation (1.0–2.3 m above the ground) at night (Plate 66), all of them in the border of clearings in primary forest, and another was grasping a lizard on the vegetation by day. At Carajás, Pará, one individual was moving on the vegetation in a secondary forest by day and two were active in a scrub by day, one on rocks and another on the ground. The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Henderson 1974; Henderson and Nickerson 1976*a*; Murphy 1997; Sasa and Solórzano 1995; this study) indicates that *Oxybelis aeneus* is diurnal, and primarily arboreal and occasionally terrestrial when active. At night it sleeps on the vegetation (low to high heights).

**Feeding habits.** One individual was observed ingesting a lizard (*Gonatodes humeralis*) in a disturbed forest inside Manaus (W. Magnusson, pers. comm. 1996; Plate 67). A specimen (845+592 mm, 37 g) from Rio Jau had three lizards in the gut (one *Alopoglossus* and two *Gonatodes*); MR for one *Gonatodes* was 0.03. The available information (Ávila-Pires 1995; Beebe 1946; Cunha and Nascimento 1978; Murphy 1997; Sasa and Solórzano 1995; this study) indicates that *Oxybelis aeneus* feeds on small vertebrates, mostly lizards (*Gonatodes*, *Anolis*, *Alopoglossus*, *Colobosaura*, *Ameiva*, *Cnemidophorus*) and frogs (*Scinax*), but also birds, foraging by day on the vegetation (but see Beebe 1946). Henderson (1974) and Henderson and Binder (1980) described *O. aeneus* as a sit-and-wait forager.

**Reproduction.** The only juvenile (TTL 582 mm) from the RFAD was found in March. Literature records of clutch size are 3–6 eggs (Beebe 1946; Dixon and Soini 1986; Mole 1924; Sexton and Heatwole 1965).

**Defense.** When disturbed, this species makes an S-coil, gapes widely exposing the dark grey to black floor of the mouth, and sometimes strikes and bites. When handled, it may thrash and rotate the body, and defecate and discharge fetid cloacal gland products (see also Beebe 1946, Murphy 1997, and a review in Greene 1988). Concealing coloration, including shading (the venter is darker than the dorsum), is evidently effective when active among branches on the vegetation. Fleishman (1985) described the probably cryptic movements of *Oxybelis aeneus* (see also Henderson and Binder 1980).

*Oxybelis fulgidus* (Daudin 1803)
Plates 68, 69

**Identification.** Maximum TTL male 1620 mm (Dixon and Soini 1986), female 2063 mm (Beebe 1946), unsexed 2160 mm (Beebe 1946); minimum TTL 335 mm (Conners 1989); TAL 28.3–35.8 % of TTL (Beebe 1946; Conners 1989; this study); ED about 1/8 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). The dorsum is green, paler ventrolaterally (young have a paler dorsum). Dorsally and dorsolaterally, the head is slightly darker than the dorsum; ventrolaterally and ventrally, the head is pale yellowish green to yellow. The venter is pale yellowish green to green, with a white to yellowish cream line running through the lateral angle of each scale (this line separates the darker color of the dorsum and flanks from the paler color of the venter). The iris is bronze with dark flecking. An adult had a dark green tongue above and pale green below.

**Habitat and microhabitat.** At the RFAD, four individuals were found: three were coiled asleep on the vegetation (0.7–2.5 m above ground) at night and one was moving on the forest floor by day. In the Manaus region, three were crossing roads by day in disturbed areas; at Careiro, one individual was found by day on the vegetation hanging over the water in a "várzea" forest on the margin of a lake. In western Amazonia, this species seems to be less terrestrial (W.W. Lamar, pers. comm. 1996). The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Sasa and Solórzano 1995; this study) indicates that *Oxybelis fulgidus* is usually associated with forests, although able to use disturbed areas; is diurnal and primarily arboreal (but occasionally terrestrial) when active, using vegetation to sleep at night.

**Feeding habits.** One adult from the Manaus region had lizard scales in the hindgut. Two from Rio Jau had prey: one had remains of a lizard (*Ameiva*) and a bird and another (1353 mm SVL, 315 g) from Rio Jau had a lizard (*Ameiva*, 85+214 mm, 15 g; MR 0.05) in the stomach and the tail of another lizard (*Ameiva*) in the hindgut. At Rio Catrimani, Roraima, a large individual (TTL about 2000 mm) was eating a bird in a tree ca. 10 m above the ground (L.J. Vitt, pers. comm. 1996). In Colombia, an individual was found ingesting a bird (*Thraupis episcopus*; W.W. Lamar, pers. comm. 1996). The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Nascimento et al. 1988; Sasa and Solórzano 1995; this study) indicate that *Oxybelis fulgidus* feeds on birds (*Pipra*, *Thraupis*, *Volatinia*) and lizards (*Anolis*, *Ameiva*), foraging both on the ground and on the vegetation. Although *O. fulgidus* may occasionally forage actively (pers. obs), Henderson and Binder (1980) described it as a sit-and-wait forager.

**Reproduction.** A recently caught female from the Manaus region laid a clutch of 10 eggs (15 x 32 mm to 18 x 38 mm) in 28 October 1987; six young were born between 15 and 18 January 1988 (78–81 d after the clutch was laid; Plate 69). Beebe (1946) found a female with six eggs and Conners (1989) reported a female that laid 10 eggs.

**Defense.** When approached, this species often flees quickly; however, in some circumstances it may face the observer (and even an approaching car) and strike insistently toward it. The offensive behavior includes body inflation, an S-coil, head enlargement, and rapid strikes and bites (Plate 68). When handled, besides trying to bite, it thrashes and rotates the body (see also Beebe 1946, and a review in Greene 1988). Concealing coloration is effective when active on the vegetation.

*Oxyrhopus formosus* (Wied 1820)
Plates 70-72

**Identification.** Maximum TTL male 819 mm, female 1027 mm (Duellman 1978), minimum TTL 302 mm (this study); TAL 17.2–24.3% of TTL (Duellman 1978; this study); ED about 1/10 of HL; pupil elliptical (see taxonomic information in Cunha and Nascimento 1983*a*). A notable ontogenetic change in color pattern occurs in this species (Plates 70–72); during growth the dorsum and head gradually become reddish (and melanic in adults) and the tip of the snout gradually becomes yellow (see also Duellman 1978; Jorge da Silva 1993). In neonates, the dorsum is white with long black rings; the head is orange, paler on the tip of the snout, with black scales around the eyes. In older juveniles and subadults, the dorsum becomes reddish (the black bands reddish brown, the white bands reddish orange), except for the first white ring that generally remains white; the head becomes reddish orange with a yellowish orange tip and the black area around the eyes disappears. In large adults, the dorsum is bright red, although darker areas corresponding to each dark ring are still distinguishable (especially on the anterior third of the body); each dorsal scale becomes dark edged, giving a melanic appearance, mostly on the neck; the head is dark red and the tip of the snout is bright yellow. The venter is whitish cream in juveniles and yellowish to reddish in larger individuals. The iris is reddish brown. The tongue is pink.

**Habitat and microhabitat.** Two individuals were found at the RFAD: both were moving on the leaf litter of primary forest at night, one of them with half the body within roots. At Rio Cuieiras, an adult was moving on a fallen trunk (diameter 15 cm), 1 m above the water, in the margins of a blackwater river, at night. At Rio Urucu, a subadult was active on a fallen leaf palm 0.3 m above the ground in a terra-firme at night. At Marechal Taumaturgo, Acre, two adults were moving on the leaf litter at night in primary forest. At Rio Juruá, one individual was active in a shrub in a terra-firme forest at night (C. Gascon, unpublished data). In western Amazonia, this species was found in the leaf litter of primary forests (W.W. Lamar, pers. comm. 1996). The available information (Beebe 1946; Cunha and Nascimento 1978; Duellman 1978; Duellman and Salas 1991; this study) indicates that *Oxyrhopus formosus* is a nocturnal, primarily terrestrial (occasionally cryptozoic) forest snake, that may climb low vegetation.

**Feeding habits.** No information on diet was obtained at the RFAD; both individuals found seemed to be actively foraging on or within the leaf litter. Duellman (1978) found a lizard (*Arthrosaura*) in one stomach.

**Reproduction.** At the RFAD, one juvenile (302 mm TTL) was found in December. Duellman (1978) found two females with 13 and 17 eggs.

**Defense.** When approached *Oxyrhopus formosus* try to flee into the leaf litter. When handled, this species thrashes the body; one adult bit after being handled for a long period (in western Amazonia this it tends to bite when collected; W.W. Lamar, pers. comm. 1996). The color pattern of young and subadults may represent a case of abstract coral snake mimicry.

*Oxyrhopus* aff. *melanogenys* (Tschudi 1845)
Plate 73

**Identification.** Maximum TTL male 816 mm, female 1018 mm (Duellman 1978), minimum TTL 271 mm (this study); TAL 18.6–22.9% of TTL; ED about 1/8 of HL; pupil elliptical (see taxonomic information in Dixon and Soini 1986; see also Zaher and Caramaschi 1992). The dorsum has long deep black bands separated by short yellow bands, each black ring bearing a pair of short white bands, giving rise to a yellow-black-white-black-white-black-yellow sequence (some bands in some individuals do not meet middorsally). Both yellow and black scales are dark edged. The head is black with a long yellow nuchal band. The venter is yellowish cream on the anterior third and cream, with or without dark marks, on the posterior two thirds. The iris is dark reddish brown. This species is very similar to *Micrurus hemprichii*, but may be easily distinguished by having 19 dorsal scale rows around midbody (15 in *M. hemprichii*).

**Habitat and microhabitat.** At the RFAD, four individuals were found moving on the leaf litter and one was moving on a shrub 1 m above the ground, in primary forest, at night. At Pitinga, four individuals were active at night in forests: three were in the leaf litter accumulated within the leaf petioles of low palms and one was on the ground. The available information (Dixon and Soini 1986; Duellman 1978; Duellman and Salas 1991; this study) indicates that *Oxyrhopus melanogenys* is a primarily terrestrial forest snake; the data on time of activity in Duellman (1978) contradict ours and those provided by Duellman and Salas (1991).

**Feeding habits.** No information on diet was obtained in the Manaus region. Duellman (1978) found one small rodent and three lizards (*Arthrosaura*, *Iphisa*, and *Leposoma*) in four stomachs.

**Reproduction.** At the Manaus region, including the RFAD, two juveniles (196 and 230 mm TTL) were found in March. Duellman (1978) reported a female with 12 eggs.

**Defense.** When approached, *Oxyrhopus melanogenys* tries to flee into the leaf litter. When handled, it thrashes the body, occasionally vibrates the tail, and does not bite. The color pattern of *O. melanogenys* from the Manaus region is nearly identical to that of the syntopic *Micrurus hemprichii* (see also Campbell and Lamar 1989).

**Taxonomic comments.** Zaher and Caramaschi (1992) restricted the name *Oxyrhopus melanogenys* to populations that occur south of the Amazon river and considered those specimens from the north (including localities in Brazil, Peru, and Ecuador) as *O.* aff. *melanogenys*, awaiting a revision of the latter species.

*Philodryas viridissimus* (Linnaeus 1758)
Plate 74

**Identification.** Maximum TTL male 650 mm, female 826 mm (Dixon and Soini 1977), unsexed 1195 mm (Beebe 1946); minimum TTL 350 mm (specimen at MPEG); TAL 25.3–28.1% of TTL; pupil round (Beebe 1946; Dixon and Soini 1977; this study); ED about 1/7 of HL (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1977). The dorsum is green to deep green, paler ventrolaterally. The head is green (darker than the dorsum) above and laterally; the lips are bluish white. The venter is pale green under the head and neck, becoming yellowish green posteriorly. The iris is bronze. This species may be very similar to juvenile *Chironius scurrulus* (see account of the latter species).

**Habitat and microhabitat.** Only one individual was found at the RFAD: an adult inside a tree hollow (a nest of the hylid frog *Phrynohyas resinifictrix*), 5 m above ground, during the day. At Rio Cuieiras, one was descending a 15 m tall tree (trunk diameter about 0.6 m, with striated bark) in a sand beach in "igapó", by day. At Rio Urucu, one individual was crossing a trail in primary forest by day. The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986) indicates that *P. viridissimus* is a diurnal, primarily arboreal forest species. Although it may be found on the ground (of primary forests and disturbed areas), we share the impression of Dixon and Soini (1986) that *Philodryas viridissimus* lives on the higher levels of the forest (including the canopy), rarely descending to the ground. This habit may be partially responsible for its scarcity in faunal surveys (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman and Salas 1991; this study), since these high levels are seldom (if ever) sampled.

**Feeding habits.** The only individual found at the RFAD was evidently foraging inside a water-filled trunk hollow being used by a male *Phrynohyas* as a nest. If it had been present by then, the large frog would certainly have been found (and probably eaten) by the snake. An juvenile (325+111 mm) from rio Jau had the remains of a lizard in the hindgut. Three adults (SVL 690–848 mm) from eastern Amazonia (at MPEG) had mammal remains (one of them, 848+304 mm, 171 g, preserved, had a rodent, body length ca. 120 mm, 38 g, MR 0.22) and three smaller individuals (SVL 256–489 mm) had frog remains (one hylid and two unidentified). The available information (Cunha and Nascimento 1978; this study) indicates that *Philodryas viridissimus* feeds on frogs, lizards, and mammals, apparently shifting its diet from ectothermic (frogs and lizards) to endothermic (mammals) prey during its ontogeny.

**Reproduction.** Three females (705+106 mm, 710+284 mm, and 815+275 mm) from eastern Amazonia (at MPEG) had 11, nine, and 13 oviductal eggs (the larger were 12.6 x 9.1 mm, 20.0 x 8.0 mm and 26.9 x 12.2 mm, respectively).

**Defense.** When handled, *Philodryas viridissimus* thrashes the body and tries to bite viciously. When approached, it flees or face the observer enlarging the head, laterally compressing the anterior third of the body, making an S-coil, and striking and biting; *P. viridissimus* inflicts harmful envenomations (e.g., Campbell and Lamar 1989). Concealing coloration may be effective when active on the vegetation.

### *Pseudoboa coronata* Schneider 1801
Plate 75

**Identification.** Maximum TTL male 975 mm, female 1076 (Dixon and Soini 1986); minimum TTL 299 mm; TAL 21.6–29.5% of TTL (Beebe 1946; Gasc and Rodrigues 1980; this study); ED about 1/7 to 1/8 of HL; pupil semi-elliptical (see taxonomic information in Cunha and Nascimento 1983*a*, Dixon and Soini 1986). The dorsum is bright to pale red to violet red, paler laterally. The head and neck are black, with a white nuchal band in juveniles and half-grown individuals. The venter is creamy white. The iris is black. Juvenile *Pseudoboa coronata* is very similar to juvenile *P. neuwiedii*, *Clelia clelia* and *Drepanoides anomalus* in color pattern (see account on *C. clelia*). Additionally, adults of *P. coronata* are also similar to adult *D. anomalus* and *P. neuwiedii* (see account on *D. anomalus*).

**Habitat and microhabitat.** Two individuals were found killed on a paved road that crosses disturbed forests north of Manaus. Another was found in a disturbed area in Manaus. In Marechal Taumaturgo, Acre, one adult was moving at the base of a large tree in a primary forest at night. The available information (Beebe 1946; Cunha and Nascimento 1983*a*; Dixon and Soini 1986; Duellman 1978; this study) indicate that *Pseudoboa coronata* is a terrestrial forest species (also occurring in disturbed areas) that may be active both during daytime and at night.

**Feeding habits.** No information is available for the Manaus region. One adult from Marechal Taumaturgo, Acre, had the remains of a lizard (*Mabuya*) in the gut. The scarce available information (Cunha and Nascimento 1978; Duellman 1978; this study) indicate that *Pseudoboa coronata* feeds on lizards (*Ameiva*, *Mabuya*), mammals, and birds.

**Reproduction.** No information is available for the Manaus region. A female (670+208 mm) from Marechal Taumaturgo, Acre, had five eggs (29 x 15, 31 x 13, 31 x 13, 31 x 14, and 34 x 13 mm). Duellman (1978) reported a female with four eggs.

**Defense.** The only live individual handled thrashed the body and constricted.

*Pseudoboa neuwiedii* (Duméril et al. 1854)
Plates 76-78

**Identification.** Maximum TTL male 1086 mm (Jorge da Jorge da Silva 1993), female 1217 mm (this study); minimum TTL 279 mm (Cunha and Nascimento 1980); TAL 19.7–26.7% of TTL (Beebe 1946; Gasc and Rodrigues 1980; this study); ED about seventh to 1/8 of HL; pupil semi-elliptical (see taxonomic information in Chippaux 1986, Cunha and Nascimento 1983*a*, Schwartz and Henderson 1991). The dorsum is bright to pale red to violet red, paler laterally. The head and neck are dark brown to black, with a white nuchal band in juveniles (Plate 77). The venter is creamy white. The iris is dark brown. In the Manaus region, *Pseudoboa neuwiedii* may be easily confounded with *Clelia clelia*, *Drepanoides anomalus*, and *P. coronata* (see account on *C. clelia*).

**Habitat and microhabitat.** Three individuals were found at the RFAD: all three were moving on or within the leaf litter of primary forest at night. In Manaus, one individual was active in grass in a disturbed area by day. The available information (Beebe 1946; Murphy 1997; Schwartz and Henderson 1991; this study) indicate that *Pseudoboa neuwiedii* is a terrestrial, primarily nocturnal species.

**Feeding habits.** One individual was grasping and constricting a lizard (*Ameiva ameiva*) in grass by day, in a disturbed area in Manaus (Plate 78). Schwartz and Henderson (1991) reported one individual with a lizard (*Cnemidophorus*) in the stomach. Murphy (1997) found the remains of a snake and reviewed the literature food records for Trinidad snakes (that included eggs, conspecifics and vertebrates).

**Reproduction.** Clutches of 3-9 eggs were reported for Trinidad snakes (see Murphy 1997).

**Defense.** When approached, this species flees quickly into the leaf litter (see also Beebe 1946). When handled it thrashes the body, constricts the observer's arm, and occasionally bites.

*Pseudoboa* sp. A
Plate 79

**Identification.** Maximum TTL unsexed ca. 900 mm (from Rio Jau, Amazonas); minimum TTL 275 mm (from Guajará Mirim, Rondônia); TAL 22.4% of TTL in one individual from Manaus; ED about 1/8 of HL; pupil semi-elliptical. The dorsum is black middorsally, abruptly becoming red in the flanks. The head is black with a long nuchal band in juveniles. The venter is reddish cream.

**Habitat and microhabitat.** At the RFAD, a medium-sized individual (ca. 600 mm TTL) was coiled on a ground bromeliad in a primary forest at night (Plate 79); another individual (TTL ca. 1000 mm) was moving on the leaf litter by day. A third individual (510+147 mm) was collected in a disturbed area north of Manaus. These observations indicate that *Pseudoboa* sp. A is terrestrial.

**Feeding habits.** A large female from southern Roraima had the remains of a snake in the hindgut.

**Reproduction.** A female from southern Roraima had six enlarged follicles.

**Defense.** At least five individuals handled at the RFAD did not try to bite (W. Magnusson, pers. comm. 1996).

**Taxonomic comments.** This is an undescribed species that occurs from Central to western Amazonian Brazil (F. Franco, pers. comm. 1997).

*Pseustes poecilonotus* (Günther 1858)
Plates 80-82

**Identification.** Maximum TTL male 1527 mm (Dixon and Soini 1986), female 1806 mm (Beebe 1946); minimum TTL 446 mm (Beebe 1946); TAL 22.7–28.6% of TTL (Beebe 1946; Dixon and Soini 1986; this study); ED about 1/6 to 1/7 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). In adults (Plates 80, 81), the dorsum is tan, orange tan or greenish brown; the head is slightly darker than the dorsum with yellowish, orange or greenish cream lips; the ventrolateral region of the neck and the venter are yellowish, greenish or orange cream. In juveniles (Plate 82), the dorsum is tan with a series of complex darker marks (including brown, dark brown, and reddish brown scales); the head is darker than the dorsum with brown areas middorsally and a brown lateral stripe passing through the eye; the ventrolateral region of the neck and the venter are white. In both adults and juveniles, the pupil is bronze with a dark median stripe. The tongue is black. This species is similar to *Pseustes sulphureus*, but is easily distinguished by having 19 dorsal scale rows around midbody (21–23 in *P. sulphureus*).

**Habitat and microhabitat.** At the RFAD, three individuals were found sleeping coiled or partially coiled on the vegetation 1.8–3.5 m above ground in primary forest at night. The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Murphy 1997; this study) indicates that *Pseustes poecilonotus* is a diurnal, primarily terrestrial forest species. However, the data on food (mostly birds and bird eggs, see below) strongly indicate that it may be occasionally arboreal. In western Amazonia, it is an arboreal species that tends to forage on the ground from early to mid-morning (W.W. Lamar, pers. comm. 1996).

**Feeding habits.** No information on diet was obtained in the Manaus region. The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Meede 1984, quoted in Ávila-Pires 1995; Sexton and Heatwole 1965) shows that *Pseustes poecilonotus* feeds primarily on birds (*Falco*, emberizid) and bird eggs (*Penelope*), occasionally feeding on lizards (*Plica*) and terrestrial and arboreal mammals (see also Murphy 1997)

**Reproduction.** At the RFAD, neonates were found in January, November, and December, suggesting that hatching may occur at least during the rainy season. Beebe (1946) reported a female with 11 eggs.

**Defense.** This species makes threat displays involving gape, head and neck elevation, an S-coil, gular inflation, and false and true strikes (Plates 80–82; see also Beebe 1946, Murphy 1997, and a review in Greene 1988). In juveniles, the color pattern resembles that of the pitviper *Bothrops atrox* and is probably mimetic. In adults, concealing coloration is clearly effective when active on vegetation. A rigid undulated posture, possibly to resemble a stick, is adopted when individuals moving on the ground are approached.

*Pseustes sulphureus* (Wagler 1824)
Plates 83, 84

**Identification.** Maximum TTL male 2374 mm (Jorge da Silva 1993), female ca. 1700 mm (Goode 1989), unsexed 2752 mm (Beebe 1946); minimum TTL 486 mm (Goode 1989); TAL 24.7–31.2% of TTL (Beebe 1946; Duellman 1978; this study); ED about 1/5 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). In adults (Plate 83), the dorsum is grayish green to greenish brown, paler ventrolaterally; the head is darker with pale green lips; the venter is pale yellowish green anteriorly and pale green with some pale yellow scales posteriorly. In juveniles (Plate 84), the dorsum is tan with dark brown crescent marks, that are broader middorsally and enclose a paler area; posteriorly, the dark marks are much broader and close to each other; the venter is yellowish cream anteriorly becoming pale brown posteriorly. The iris is bronze in juveniles, darker in adults. The tongue is black. This species is similar to *Pseustes poecilonotus* and *Chironius multiventris* (see accounts on these species).

**Habitat and microhabitat.** Five small individuals (753–1007 mm TTL) and one large adult (TTL over 2000 mm) were found at the RFAD. Of the small individuals, four were active during daytime, three on low vegetation (0.7–1.2 m above ground) and one on the leaf litter, and another was coiled asleep on the vegetation 2 m above ground, at night. The adult was crossing an unpaved road within primary forest by day. At other localities in the Manaus region, one adult (1365 mm TTL) was moving on the vegetation at 1.8 m above ground (Plate 83) and one neonate (665 mm TTL) was moving on low vegetation, both during daytime. The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Murphy 1997; this study) indicates that *Pseustes sulphureus* is a forest species able to occupy disturbed areas, seems to be exclusively diurnal, and is primarily arboreal and occasionally terrestrial when active. Juveniles are cryptically colored and very difficult to see when lying within branches; as in the previous species, this fact may lead to an exaggerated sampling of terrestrial activity despite the probably primary arboreal habits.

**Feeding habits.** No information on diet is available for the Manaus region. The available information (Beebe 1946; Cunha and Nascimento 1978; Duellman 1978; Murphy 1997) indicate that *Pseustes sulphureus* feeds on lizards, birds and small mammals (see also).

**Reproduction.** In the Manaus region, one neonate (TTL 665 mm) was found in November and three small individuals (742–764 mm TTL) were found in April and August. These limited data indicate that hatching may occur at least during most of the year in the Manaus region. Goode (1989) reported two females with seven and 11 eggs.

**Defense.** When approached by day, this species either freezes, flees, or makes threat displays involving head and neck elevation, an S-coil, gular inflation, and head enlargement (Plate 84) see also Beebe 1946, and a review in Greene 1988). When handled it may thrash and rotate the body. Concealing coloration may be effective when active both on the leaf litter and on the vegetation. Tail vibration was observed in an individual from Balbina (A.S. Abe, pers. comm. 1996; see also Greene 1988).

*Rhinobothryum lentiginosum* (Scopoli 1785)
Plate 85

**Identification.** Maximum TTL male 1343 mm (from eastern Pará), female 1605 mm (this study); minimum TTL 580 mm (from Pará; L.J. Vitt and J.P. Caldwell, unpublished data); TAL 18.8–22.3% of TTL (from eastern Pará); ED about 1/6 of HL; pupil elliptical (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). The dorsum has long black bands separated by white bands that enclose black bordered red bands (with sparse black scales), giving rise to a black-white-red-white-black sequence. The head is black, each scale white bordered, with a narrow white nuchal band and red marks on the lateral scales behind the eyes and on the posterior end of the head. The venter is black with white marks. The iris is dark gray with diminutive gray points.

**Habitat and microhabitat.** The only individual found at the RFAD was active on the ground at the margin of a small pond at night. At Guajará-Mirim, Rondônia, one juvenile was moving on the leaf litter by day. The scarce available information (Cunha and Nascimento 1978; Cunha et al. 1985; this study) indicates that *Rhinobothryum lentiginosum* is a forest species, found active both at night and during daytime. Besides the terrestrial habits reported above, the lizard taxa used as food indicate that *R. lentiginosum* is also arboreal.

**Feeding habits.** No information on diet is available for the Manaus region. We found lizards (four identified were *Mabuya* sp., *Plica umbra*, *P. Plica*, *Polychrus marmoratus*) in the gut of eight specimens from eastern Amazonia at the MPEG (see also Cunha and Nascimento 1978). One individual (461+119 mm, 13.3 g) from 100 km south of Santarém, Pará, had a lizard (*Gonatodes humeralis*, SVL 34 mm, 0.8 g, MR 0.06) in the stomach (L.J. Vitt and J.P. Caldwell, unpublished data). These data indicate that *Rhinobothryum lentiginosum* is a lizard specialist.

**Reproduction.** One female (1085+293 mm) collected in June at Nova Olinda do Norte, Amazonas (at the MPEG), had three enlarged follicles.

**Defense.** The only live individual handled (an adult) did not try to bite; it vibrated the tail and enlarged the head. The color pattern (see above) is most probably a case of abstract coral snake mimicry (see Pasteur 1982, Pough 1988).

*Siphlophis cervinus* (Laurenti 1768)
Plates 86, 87

**Identification.** Maximum TTL male 764 mm (from eastern Pará), female 1022 mm (Cunha and Nascimento 1993); minimum TTL 280 mm (from eastern Pará); TAL 22.3–25.8% of TTL (from eastern Pará); ED about 1/6 of HL; pupil elliptical to semi-elliptical (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). The dorsum is dark brown with a series of pale yellow irregular bands that become reddish orange in the vertebral region. The head scales are pale brown with dark brown spots and/or lines and cream margins. The iris is reddish brown. The tongue is dull pink. The complex color pattern of *Siphlophis cervinus* is apparently variable (e.g., Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978).

**Habitat and microhabitat.** One individual fell into a pitfall trap in a primary forest at Pitinga. Another individual was hiding inside a house in a "várzea" forest region at Careiro. At Guajará Mirim, Rondônia, one adult was moving on a palm leaf about 4 m above the ground, in a disturbed forest at night. In western Amazonia, it was frequently found in trees at night (W.W. Lamar, pers. comm. 1996). The available information (Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Murphy 1997; Nascimento et al. 1987; this study) indicates that *Siphlophis cervinus* is a nocturnal forest inhabitant, primarily arboreal and occasionally terrestrial.

**Feeding habits.** No information on diet is available for the Manaus region. We found arboreal lizards (*Gonatodes*, *Hemidactylus*, *Thecadactylus*, *Polychrus*, *Plica*, *Tropidurus*, *Mabuya*) in the stomach of 11 specimens from eastern Amazonia examined at the MPEG; MR for two lizards were 0.086 and 0.418. One individual from Guajará-Mirim, Rondônia, had the remains of a lizard in the stomach and another from western Amazonia had a lizard (*Plica umbra*) in the stomach (W.W. Lamar, pers. comm. 1996). The available information (Cunha and Nascimento 1978 1993; Duellman 1978; Nascimento et al. 1987; Prudente et al. 1998; this study) shows that *Siphlophis cervinus* feeds primarily on lizards (see genera above), eventually eating other prey such as a bat and an anuran found in two individuals. Prudente et al. (1998) suggest that it also feeds on snakes like other pseudoboines, based on the finding of snake teeth and scales in the gut of some specimens; however, as already pointed out by the authors, these specimens may have ingested their own teeth and scales. Cunha and Nascimento (1978 1993) stated that a bird was found in one stomach, although the examination of all specimens of *S. cervinus* at the MPEG revealed no bird; thus, this record awaits confirmation.

**Reproduction.** We found five enlarged follicles in a female (685+222 mm) collected in March in Apeú, Pará (at the MPEG).

**Defense.** Besides thrashing the body, this species forms tight balls with the head hidden within body coils. When handled, it does not bite.

### *Spilotes pullatus* (Linnaeus 1758)
Plate 88

**Identification.** Maximum TTL female 2170 mm (Dixon and Soini 1986), unsexed 2430 mm (Cunha and Nascimento 1978); TAL 24.1–27.1% of TTL (Amaral 1929); ED about 1/5 to 1/6 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). The dorsum is black and yellow, generally with the yellow areas forming bands (sometimes oblique laterally) and concentrated anteriorly. The head is yellow with black stripes between the scales and a black occipital band that extends anteriorly between the eyes. The venter is yellow with black spots. The iris is black.

**Habitat and microhabitat.** In the Manaus region, individuals of *Spilotes pullatus* were found only in disturbed areas. At Ilha de Maracá, Roraima, three individuals were found by day, basking in the margins of a flooded field. The information available (Cunha and Nascimento 1978 1993; Cunha et al. 1985; Dixon and Soini 1986; Fugler 1986; Murphy 1997; O'Shea 1989; this study) indicates that *S. pullatus* is diurnal (basking frequently), primarily arboreal (occasionally terrestrial), and inhabits various habitats, from open fields to primary forests.

**Feeding habits.** One individual from Rio Jau, Amazonas, had insect remains in the hindgut (probably the stomach contents of a frog). Literature data (Beebe 1946; Cunha and Nascimento 1978 1993; Murphy 1997) indicates that *Spilotes pullatus* feeds on frogs, lizards, mammals, birds, and bird eggs.

**Reproduction.** Amaral (1930) reported females with 8-12 eggs.

**Defense.** When approached, this species makes threat displays involving head and neck elevation, an S-coil, and gular inflation (Plate 88); in some situations, it may even chase the observer for some meters and suddenly turn away and flee very quickly. When handled it thrashes and rotates the body and may bite (see also Amaral 1929, Murphy 1997, and a review in Greene 1988).

*Taeniophallus brevirostris* (Peters 1863)
Plate 89

**Identification.** Maximum TTL male 476 mm (Cunha and Nascimento 1978), female 355 mm (Duellman 1978); minimum TTL 188 mm (this study); TAL 16.5–24.2% of TTL (Duellman 1978; this study); ED about 1/4 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). The dorsal surfaces are dark brown with a pair of dorsolateral stripes, tan anteriorly, becoming grayish tan posteriorly. Laterally, the upper third (just below the dorsolateral stripes) is darker (more evident posteriorly) than the lower two thirds; a paler narrow line may be present between the upper third and the lower two thirds, as well as middorsally. The head is brown to reddish brown posteriorly and lateroposteriorly, dark brown with grayish tan marks above and anterolaterally, white with brown flecks ventrolaterally, and bearing a narrow dark brown stripe behind the eyes. The venter is white, suffused with dark brown laterally. The iris is reddish brown. This species is similar to *Taeniophallus nicagus*, which nearly always has paired pale spots on the neck (absent in *T. brevirostris*) and immaculate white infralabials and posterior supralabials (infralabials and posterior supralabials spotted in *T. brevirostris*).

**Habitat and microhabitat.** At the RFAD, three individuals were moving in the leaf litter in the afternoon in primary forest; a fourth individual was found dead in a disturbed area. Thirteen individuals were caught in pitfall traps in primary forest at Rio Pitinga. At Rio Juruá, two were active in leaf litter in terra-firme forests by day (C. Gascon, unpublished data). These data and those in the literature (Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Duellman and Mendelson 1995) indicate that *Taeniophallus brevirostris* inhabits forests, occurring occasionally in disturbed areas, and is diurnal, primarily cryptozoic, and occasionally terrestrial.

**Feeding habits.** One individual from Rio Pitinga and another from Balbina had insect remains in the hindgut, probably from already digested frogs, although literature records (Ávila-Pires 1995; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978) show that *Taeniophallus brevirostris* feeds primarily on small leaf-litter lizards (*Coleodactylus*, *Leposoma*, *Prionodactylus*, *Ptychoglossus*). Laurie J. Vitt (pers. comm. 1996) also found lizards (*Pseudogonatodes*) in their stomachs.

**Reproduction.** One female from the RFAD had well developed eggs in October. Two females (265+54 mm and 285+59 mm) from Pitinga, collected in November, had two and three eggs (14 x 5 and 16 x 5 mm, and 20 x 6, 23 x 7, and 24 x 6 mm, respectively); another female laid two eggs in November; the smallest individuals (TTL 273–288 mm) were found in September and November. These data show that hatching in the Manaus region occurs at least from the end of the dry season to the beginning of the rainy season. Duellman (1978) and Dixon and Soini (1986) reported two females with two eggs.

**Defense.** When disturbed, this species flees quickly into the leaf litter. When handled it may thrash the body, press the tip of the tail on the observer's hand, and discharge cloacal gland products. Concealing coloration may be effective when active on the leaf litter.

**Taxonomic comments.** Until recently, this species was included in the genus *Rhadinaea*. DiBernardo (1992) resurrected the genus *Echinanthera* for South American species of *Rhadinaea* and more recently, Myers and Cadle (1994) revalidated the genus *Taeniophallus* for the *brevirostris* group (sensu Myers 1974).

*Taeniophallus nicagus* Cope 1895
Plate 90

**Identification.** Maximum TTL male 465 mm, female 466 mm; minimum TTL 317 mm; TAL 20.7–23,0% of TTL; ED about 1/3 to 1/5 of HL; pupil round (see taxonomic information in Myers and Cadle 1994). The dorsum is tan to reddish brown, gradually becoming brown posteriorly, with a brown to dark brown middorsal stripe with serrated lateral borders and two dorsolateral series of paired pale tan spots beginning just behind the occipital region and extending backwards the length of two to three head lengths (rarely these spots are lacking); after this point, these spots gradually become the serrated margins of the middorsal stripe. The head is reddish brown with a dark brown stripe running from below the eyes to the neck and paler areas on the corners of the head. The venter is yellow, paler under the tail, with a dark brown ventrolateral line more evident posteriorly. This species is similar to *Taeniophallus brevirostris* (see account of this latter species).

**Habitat and microhabitat.** Five individuals were observed at the RFAD: all were moving within the leaf litter by day. Another was found dead under a recently fallen tree branch in an unpaved road in primary forest by day (J.-M. Hero, pers. comm. 1993). At Rio Cuieiras and at a reserve 70 km north of Manaus, two were moving within the leaf litter during daytime in primary forest; at Pitinga, two fell into pitfall traps in primary forest. These data indicate that this species is primarily cryptozoic, diurnal, and restricted to forests.

**Feeding habits.** Two individuals from the RFAD had tiny frogs in the stomachs: one 410 mm TTL, 12.5 g) had a *Colostethus stepheni* (17 mm SVL) and another (325 mm SVL) had a *Colostethus* sp.; another was ingesting a tiny frog (*Adenomera andreae*; SVL ca. 15 mm) on the leaf litter during daytime. These data indicate that *Taeniophallus nicagus* is a frog specialist.

**Reproduction.** No information is available.

**Defense.** When approached, this species flees quickly into the leaf litter. When handled, it thrashes the body and does not bite. Concealing coloration may be effective when active on the leaf litter.

**Taxonomic comments.** Myers and Cadle (1994) recently revalidated the genus *Taeniophallus* which type species is *Taeniophallus nicagus*. A detailed redescription of *T. nicagus* from the Manaus region, including data on pholidosis, will be published elsewhere.

*Tantilla melanocephala* (Linnaeus 1758)
Plate 91

**Identification.** Maximum TTL male 435 mm (Duellman 1978), female 399 mm (L.J. Vitt and J.P. Caldwell, unpublished data), minimum TTL 133 mm (specimen at MPEG); TAL 20.3–27.0% of TTL (specimens at MPEG); ED about 1/8 of HL (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). The dorsum is brown with a narrow dark brown vertebral stripe (sometimes poorly distinct). The head is dark brown with paired white to pale brown spots on the neck, behind and anterior to the eyes, and on the tip of the snout. The venter is cream. The iris is black.

**Habitat and microhabitat.** Eleven individuals fell into pitfall traps in primary forests at Pitinga. One was crossing an unpaved road by day in a disturbed area at Pitinga; another was active by day in a disturbed area within secondary forests in Manaus. The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Murphy 1997; Vanzolini 1986; this study) indicate that *Tantilla melanocephala* is a diurnal forest snake, both terrestrial and cryptozoic.

**Feeding habits.** No information on diet is available for the Manaus region. Twenty specimens from eastern Amazonia examined at MPEG had centipedes in the gut. The available information (Beebe 1946; Cunha and Nascimento 1978) indicates that *Tantilla melanocephala* feeds primarily on centipedes and perhaps occasionally on other arthropods. Cunha and Nascimento (1978) stated that *T. melanocephala* feeds also on diplopods, although this may be an error since these arthropods seem to be unpalatable for nearly all vertebrates (see Vitt 1992).

**Reproduction.** No information is available for the Manaus region. A female (231+72 mm) from eastern Amazonia (at MPEG) had two eggs (23.0 x 5.2 mm and 26.0 x 4.8 mm). Clutch sizes in the literature (Dixon and Soini 1986; Fitch 1970) are 1-3 eggs.

**Defense.** When handled, this species thrashes the body vigorously and does not bite.

*Tripanurgos compressus* (Daudin 1803)
Plates 92-95

**Identification.** Maximum TTL male 1077 mm, female 1431 mm (both from eastern Pará); minimum TTL 367 mm (this study); TAL 18.1–24.9% of TTL (Beebe 1946; Duellman 1978; this study); ED about 1/4 to 1/6 of HL; pupil vertical to elliptical (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986). The dorsum is red to violet red (paler on the ventrolateral region) with a series of short dark brown to black bars that do not reach the ventrolateral region and sometimes do not meet middorsally; the length of the black bars are 1/3 to half the length of the red areas. The neck is black. The head is dark reddish brown in large adults, orange red in half-grown individuals, and dark orange with a short yellow nuchal band in juveniles; in both adults and half-grown individuals, the distal region of the head has an orange tint. The venter is creamy white. The iris is dark reddish brown. The tongue is dull red with paler tips.

**Habitat and microhabitat.** Thirteen observations of 12 individuals were made in primary forest at the RFAD, nine on plateaus and four in stream valleys. Twelve individuals were observed at night: eight were on the vegetation, half of them in activity (three evidently foraging, Plate 94, and one eating a lizard, Plate 95; see below) and half apparently resting (Plate 93), and four were active on the ground. One was sleeping by day amidst the leaf litter accumulated within the leaf petioles of a palm 0.2 m above ground. At Costa Marques, Rondônia, an adult was crossing an unpaved road at night. In western Amazonia, every specimen but one was found in trees and bushes (W.W. Lamar, pers. comm. 1996). The available information (Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Murphy 1997; this study) indicates that *Tripanurgos compressus* is a primarily nocturnal, forest species that is mainly arboreal and occasionally terrestrial when active, rests exposed on the vegetation at night, and sleeps in retreats in the vegetation during daytime.

**Feeding habits.** At the RFAD, data on diet and/or foraging behavior were obtained for seven individuals. One adult was grasping a lizard (*Anolis nitens*) on a shrub (Plate 95). When another individual was caught on the ground, a lizard (*Kentropyx calcarata*) ran from within the leaf litter where the snake was foraging. Two other individuals were evidently foraging, one on a fallen log and another within the leaf litter accumulated within the leaf petioles of a palm (Plate 94). Two additional individuals had prey in their stomachs (detected by palpation): both were lizards. We found lizards or lizard remains (*Gonatodes*, *Anolis*, *Alopoglossus*, *Neusticurus*, and *Kentropyx*) in the gut of 14 specimens from eastern Amazonia examined at the MPEG; MR were 0.011, 0.043, and 0.051 for three lizards. One individual (815+232 mm, 98 g) from Costa Marques, Rondônia, had a lizard (*Tropidurus*; SVL 93 mm, 22 g, MR 0.224) in the stomach. One individual (696+218 mm) from near Caracaraí, Roraima, had a lizard (*Gonatodes humeralis*, SVL 35 mm) in the stomach (L.J. Vitt and J.P. Caldwell, unpublished data). The available information (Cunha and Nascimento 1978; Duellman 1978; Hagmann 1910; Murphy 1997; this study) indicates that *Tripanurgos compressus* feeds exclusively on lizards (*Gonatodes*, *Anolis*, *Enyalioides*, *Alopoglossus*, *Neusticurus*, *Ameiva*, *Kentropyx*).

**Reproduction.** At the RFAD, one neonate (367 mm TTL) was found in March. Each of two females from eastern Amazonia (deposited at MPEG) had each nine eggs.

**Defense.** When handled, this species rotates the body, thrashes the body and head, makes an S-coil, strikes with the mouth closed (false strikes), vibrates the tail, and does not bite.

### *Umbrivaga pygmaea* (Cope 1868)

**Identification.** Maximum TTL male 232 mm, female 247 mm (Dixon and Soini 1986); minimum TTL 181 mm; TAL 13.9–14.3% of TTL (only males; see taxonomic information in Dixon and Soini 1986). The dorsum is brown to olive brown with dark brown spots on the anterior half; laterally, there is a lighter stripe (more distinct on the posterior half) followed below by a darker one; the ventrolateral region is greyish brown. The head is light brown, darker around the eyes and on the nuchal region; nasals and lips cream; underside of head cream with dark brown markings anteriorly. The venter is cream with brown markings laterally.

**Habitat and microhabitat.** Two individuals were found by day in disturbed areas around secondary forests inside Manaus. At Rio Urucu, one individual was crossing a paved road that cuts forests. Dixon and Soini (1986) found this species close to bodies of water in open fields and on the leaf litter of primary and secondary forests. The available information indicates that *Umbrivaga pygmaea* is diurnal and terrestrial.

**Feeding habits.** One individual from Rio Urucu had insect remains in the hindgut (probably the stomach content of an already digested frog).

**Reproduction.** No information is available.

**Defense.** No information is available.

*Xenodon rhabdocephalus* (Wied 1824)
Plate 96

**Identification.** Maximum TTL male 750 mm, female 875 mm (Dixon and Soini 1986); unsexed 943 mm (Cunha and Nascimento 1978); minimum TTL 189 mm (specimen at MPEG); TAL 12.4–14.0% of TTL (this study). ED about 1/5 to 1/7 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986). The dorsum is brown to yellowish brown with large dark bands that become narrower mid-dorsally (an individual from Rio Urucu had a uniform greenish brown dorsum). Each of these dark bands is brown to greyish dark brown and has its internal borders dark brown or black and external borders cream. The head is brown to reddish brown (often darker than the dorsum) with a broad postocular stripe bordered above by a narrow cream stripe. The venter is cream to yellowish cream with several dark brown to black marks throughout. The ventrolateral region has sometimes small contrasting cream and dark marks. The iris is bronze. Except for the large eyes, round pupil, and absence of loreal pits, *Xenodon rhabdocephalus* is often very similar to the syntopic *Bothrops atrox*.

**Habitat and microhabitat.** At the RFAD, an adult was crossing an unpaved road in a plateau and two juveniles were found on the ground in stream valleys, all during the day. At Rio Pitinga, one individual was found resting under a log at night. The information available (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Fugler 1986; this study) indicate that *Xenodon rhabdocephalus* inhabits forests (where it is frequently found close to or inside bodies of water) and is diurnal and terrestrial.

**Feeding habits.** No information is available for the Manaus region. We found 22 prey in 17 preserved specimens from eastern Amazonia (at MPEG): 17 *Bufo* sp. (of the *typhonius* complex), two *B. marinus*, one *B. granulosus*, and two *Leptodactylus* sp.; all but three of these frogs were ingested head first; MRs for 18 prey were very variable: 0.007 for a tiny *Bufo* sp. (SVL 26 mm) eaten by a large female (841+136 mm) to 0.929 for a large *Bufo* sp. (SVL 55 mm) eaten by a small male (332+59 mm). The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; this study) indicates that *Xenodon rhabdocephalus* feeds primarily on post-metamorphic anurans (*Bufo*, *Eleutherodactylus*, *Leptodactylus*) and occasionally on tadpoles.

**Reproduction.** One female from Rio Jau had six oviductal eggs. Dixon and Soini (1986) reported on two females with six and eight eggs.

**Defense.** When approached, this species compresses the body dorsoventrally. When handled it may bite (see also Beebe 1946; Greene 1988).

*Xenopholis scalaris* (Wucherer 1861)
Plate 97

**Identification.** Maximum TTL male 329 mm (Dixon and Soini 1986), female 354 mm (L.J. Vitt and J.P. Caldwell, unpublished data); minimum TTL 138 mm (L.J. Vitt and J.P. Caldwell, unpublished data); TAL 14.4–18.9% of TTL (Duellman and Mendelson 1995; L.J. Vitt and J.P. Caldwell, unpublished data); ED about 1/6 to 1/9 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978, Dixon and Soini 1986). The dorsum is brown to reddish brown with a series of lateral dark brown, bold bands that may meet in the vertebral region; the ventrolateral region is pale brown. The head is dark to reddish brown with cream labials. The venter is cream. The iris is dark reddish brown. The tongue is pink with paler tips. This species is similar to *Atractus schach* (see account of this species).

**Habitat and microhabitat.** One individual fell into a pitfall trap in a primary forest at Pitinga. At Marechal Taumaturgo, Acre, two individuals were moving on the leaf litter of primary forests at night. In western Amazonia, all individuals found by day were inactive in the leaf litter, while those found at night were actively foraging (W.W. Lamar, pers. comm. 1996). The available information (Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Duellman and Mendelson 1995; Nascimento et al. 1985; Vanzolini 1986; this study) indicates that *Xenopholis scalaris* is a terrestrial forest inhabitant, both diurnal and nocturnal.

**Feeding habits.** One individual (176+22 mm) from Rio Jau had the remains of a microhylid frog in the midgut. Two individuals (113+25 mm, 1.2 g, and 303+51 mm, 13.1 g) from 100 km south of Santarém, Pará, had tiny frogs (*Adenomera* *andreae*, SVL 12.1 mm, 0.2 g, MR 0.17, and SVL 25.6 mm, 1.4 g, MR 0.11) in the stomach (L.J. Vitt and J.P. Caldwell, unpublished data). The available information (Cunha and Nascimento 1978; this study) indicates that *Xenopholis scalaris* is a frog specialist.

**Reproduction.** A female (262 mm SVL) from Pitinga had small follicles in December. Another (273+43 mm) from Marechal Taumaturgo, Acre, has two shelled eggs (23 x 8 and 24 x 8 mm). Duellman (1978) reported a female with three eggs.

**Defense.** *Xenopholis scalaris* stiffens and compresses the body dorsoventrally when disturbed. When handled, it thrashes the body.

*Xenoxybelis argenteus* (Daudin 1803)
Plates 98, 99

**Identification.** Maximum TTL male 1292 mm (this study), female 1335 mm (Duellman 1978); minimum TTL 418 mm; TAL 33.7–44.1% of TTL; ED about 1/5 to 1/7 of HL; pupil round (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986; Keiser 1975). The dorsum is tan with three greenish brown (juveniles) to green (large adults) narrow stripes, two laterally and one middorsally. On the neck, the lateral stripes broaden. The head is tan to brown, pale tan on the posterior, dorsolateral region, with a greenish brown to green lateral band (the extension of the lateral bands of the body) passing through the eyes; the lips are greenish white to pale green. The venter is greenish tan to green with a pair of green to deep green midventral stripes. The iris is pale bronze with a dark median stripe. The tongue is pale yellow above and below (tan above in larger individuals) with cream to pinkish cream tips.

**Habitat and microhabitat.** A detailed study on the population biology of this species at the RFAD will be published elsewhere; here we present a summary of the data obtained. A total of 102 observations of 43 individuals was made at the RFAD. In all observations the individuals were on the vegetation in primary forest; in 12 observations they were moving on low vegetation by day (Plate 98; none was found on the ground) and in 90 they were coiled asleep on low to medium-height vegetation (Plate 99; see Martins 1993). At Rio Cuieiras, two individuals were moving in shrubs (0.5 and 1.0 m above the ground) in a primary forest by day. At Rio Juruá, two were active in terra-firme forests by day, one in the leaf litter and the other on a shrub; another was sleeping on a shrub in a "várzea" forest at night (C. Gascon, unpublished data). At Guajará Mirim, Rondônia, one individual was coiled asleep on a shrub, about 1.5 m from the ground, at night in a disturbed forest. The available information (Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Nascimento et al. 1987 1988; this study) characterize a strictly diurnal species that uses low vegetation when active. Based on the finding of leaf litter frogs and lizards in stomachs, Duellman (1978) speculated that it may forage occasionally on the ground; however, our data (see below) indicate that it may pick up leaf litter frogs and lizards while hanging in low vegetation (W.W. Lamar, pers. comm. 1996, shares this impression for western Amazonian populations). At night this species uses the vegetation to sleep.

**Feeding habits.** At the RFAD, seven marked individuals had identifiable prey (regurgitated forcefully or detected through the translucent body): four had tiny leaf litter frogs (three identified were *Adenomera andreae*, *Colostethus stepheni*, and *Dendrophryniscus minutus*), one had a lizard (75 mm TTL), and another had a relatively hard prey with acute extremities (an insect?). We found 41 lizards (small gekkonids, polychrotids, gymnophthalmids, and teiids), 16 frogs (small microhylids, bufonids, dendrobatids, leptodactylids, and an allophrynid), and one squamate egg in the gut of 91 preserved specimens from eastern Amazonia at the MPEG (unpublished data); furthermore, in 27 snakes there were insect remains in the hindgut, indicating that the prey was a frog. The available information (Ávila-Pires 1995; Cunha and Nascimento 1978; Duellman 1978; M. Martins and M.E. Oliveira, unpublished data; this study;) shows that *Xenoxybelis argenteus* feeds primarily on small terrestrial and arboreal lizards (*Gonatodes*, *Anolis*, *Alopoglossus*, *Leposoma*, *Prionodactylus*, *Ameiva*) and frogs (*Dendrophryniscus*, *Adenomera*, *Eleutherodactylus*, *Physalaemus*, *Allophryne*, *Colostethus*, *Chiasmocleis*) while foraging on low vegetation.

**Reproduction.** No gravid females were found at the RFAD. However, neonates were found from

January through March, indicating that hatching may occur in the middle of the rainy season. We found two to six eggs in 11 gravid females from eastern Amazonia examined at the MPEG. Duellman (1978) found three females with three, four, and six eggs and Dixon and Soini (1986) reported two females with four and eight eggs.

**Defense.** When approached by day, this species freezes with the tongue exposed and immobile (see Keiser 1975). When handled it thrashes the body, expels cloacal gland secretions, and may defecate and most rarely bite. Concealing coloration is clearly effective when active on the vegetation; its general appearance (color and form) and behavior when active on the vegetation by day make it similar to a dead palm leaflet (an common object in rainforests). When moving by day on the vegetation, it may perform lateral head winding (similar to wind movements, cf. Greene 1988; see also Henderson and Binder 1980); however, these movements may also serve to enhance three-dimensional vision.

**Taxonomic comments.** Based on hemipenial morphology, Machado (1993) described the genus *Xenoxybelis* to include the former *Oxybelis argenteus* and *O. boulengeri*.

### Elapidae

### *Micrurus averyi* Schmidt 1939

Plate 100

**Identification.** Maximum TTL male 658 mm, female 715 mm, minimum TTL 366 mm (Vanzolini 1985); TAL 8.0–15.3% of TTL (Vanzolini 1985; this study); ED about 1/7 of HL (see a taxonomic information in Roze 1996, Vanzolini 1985). The dorsum bears long red rings separated by short white-bordered black rings; on the tail, the black rings are very close to each other and the red rings, as well as the white borders of the black rings, are melanic. The head is black dorsally and anterolaterally, and red lateroposteriorly (the black area is often asymmetrical). The venter bears the extensions of the dorsal rings, with no melanism. A detailed description of color variation in a sample from the Manaus region was provided by Vanzolini (1985). This species may be confounded with *Atractus latifrons* and *Erythrolamprus aesculapii* (see accounts on these species).

**Habitat and microhabitat.** Four individuals were found at the RFAD, all of them in stream valleys: two were crossing an unpaved road in a man-made clearing close to a dam and one was within the leaf litter of primary forest, all three at night, and another fell into a pitfall trap. At a forest reserve 70 km north of Manaus, one individual was moving on the soil of a forest trail by day. At Rio Pitinga, one individual was moving on the leaf litter at night and six fell into pitfall traps, all in primary forest. The available information (Roze 1996; Zimmermann and Rodrigues 1990; this study) indicates that *Micrurus averyi* is a fossorial and cryptozoic forest species that may be active during daytime and at night.

**Feeding habits.** One specimen from the RFAD had the remains of a snake in the gut. Two specimens from Balbina (at MPEG) had prey remains: a lizard (*Bachia*) and a snake. One individual from Rio Jau had the remains of an elongate lizard (*Bachia*) in the midgut. These limited data indicate that *Micrurus averyi* feeds on elongate reptiles.

**Reproduction.** One female (538+47 mm) from Balbina, Presidente Figueiredo had three enlarged follicles.

**Defense.** The color pattern is evidently aposematic. When disturbed, this species tries to flee into the leaf litter or makes subtle thrashes, coils the tail, and hides the head under body coils. When handled it thrashes the body and may bite.

### *Micrurus collaris* (Schlegel 1837)

**Identification.** Maximum TTL unsexed 456 mm (Roze and Bernal-Carlo 1987); TAL 5.2–7.2% of TTL (Roze and Bernal-Carlo 1987, and a specimen at the MPEG); ED about 1/8 of HL (see taxonomic information in Brongersma 1966; Hoge and Romano 1965; Roze 1996; Roze and Bernal-Carlo 1987). The dorsum is uniform dark brown (almost black). The head is dark brown with a yellow nuchal ring. The venter is black with a series of large yellow spots (43 in the only individual known from the Manaus region). The iris is black. This species may be confounded with *Atractus poeppigi* and *Liophis breviceps* (see account on *A. poeppigi*).

**Habitat and microhabitat.** One individual was found dead in loose soil during deforestation of a strip of secondary forest bordering primary forest, about 40 km north of Manaus. The scarce information (Roze and Bernal-Carlo 1987; this study) indicates fossorial habits in forests.

**Feeding habits.** No information on diet is available.

**Reproduction.** No data on reproduction is available.

**Defense.** The color pattern may be aposematic (see Savage and Slowinsky 1992).

*Micrurus hemprichii* (Jan 1858)
Plates 101, 102

**Identification.** Maximum TTL male 882 mm (Dixon and Soini 1986), female 760 mm (Schmidt 1955), unsexed 917 mm (Roze 1996); minimum TTL 273 mm (Cunha and Nascimento 1982*a*); TAL 8.6–13.9% of TTL (Cunha and Nascimento 1982*a*; Schmidt 1953*a*, 1955); ED about 1/8 to 1/9 of HL (see taxonomic information in Cunha and Nascimento 1982*a*; Dixon and Soini 1986; Roze 1996; Schmidt 1953*a*). The dorsum has very long black rings, each with a pair of short white rings, separated by slightly orange yellow rings; black rings are six to eight times longer, and white rings are twice to three times shorter, than the yellow ones; in a few individuals most of the white rings are lacking (Plate 102); each scale on the paler rings have black edges. The head is black with a long yellow nuchal ring. The venter has the extensions of the dorsal rings, with no melanism. In recently preserved specimens, the yellow areas become pinkish red; this may have lead Cunha and Nascimento (1978 1982*a*) to state that *Micrurus hemprichii* has red rings. This species may be easily confounded with *Oxyrhopus* aff. *melanogenys* (see account on the latter species).

**Habitat and microhabitat.** Two individuals were found at the RFAD; one was moving within the leaf litter and roots at the base of a large tree at night and another was moving within the leaf litter by day, both in primary forest. In Manaus, one individual was moving in the leaf litter at night in a forest. At Rio Pitinga two individuals were caught in pitfall traps in primary forest. At Rio Urucu, one individual was moving on the disturbed ground, apparently fleeing, during a clear-cut. The available information (Cunha and Nascimento 1978; Dixon and Soini 1986; Roze 1996; this study) indicates that *Micrurus hemprichii* may be primarily fossorial and cryptozoic, occasionally terrestrial, is restricted to forests, and has no defined period of activity.

**Feeding habits.** No information on diet is available for the Manaus region. One preserved specimen from northeastern Pará (at MPEG) had an onychophoran. A juvenile from Ecuador (114+41 mm) had a lizard (*Leposoma parietale*, SVL 36 mm) in the stomach (L.J. Vitt and J.P. Caldwell, unpublished data). The available data (Cunha and Nascimento 1978; Dixon and Soini 1986; Greene 1973*b*; Roze 1996; Jorge da Silva 1993; Schmidt 1953*a*; this study) shows that *Micrurus hemprichii* feeds on onychophorans, lizards (*Leposoma*), amphisbaenians (*Amphisbaena*) and snakes (*Atractus*, *Tantilla*). Onychophorans are found frequently in the leaf litter at the RFAD (W. Magnusson, pers. comm. 1996).

**Reproduction.** One female from Balbina laid a clutch of two eggs in May. Another from Porto Velho, Rondônia (at the MPEG), also laid a clutch of two eggs (in April). Schmidt (1953*a*) cited W. Beebe who also found a female with two eggs.

**Defense.** The color pattern is evidently aposematic. When disturbed, this species tries to flee into the leaf litter or makes subtle thrashes, elevates and coils the tail, and hides the head under body coils. When handled it thrashes the body and may bite insistently.

*Micrurus lemniscatus* (Linnaeus 1758)
Plate 103

**Identification.** Maximum TTL male 1352 mm (Cunha and Nascimento 1982*a*), female 1160 mm (Dixon and Soini 1986), unsexed 1390 mm (Roze 1996); minimum TTL 275 mm; TAL 7.6–9.6% of TTL (Beebe 1946; Cunha and Nascimento 1982*a*; Duellman 1978; this study); ED about 1/9 to 1/10 of HL (see taxonomic information in Cunha and Nascimento 1978, 1982*a*; Dixon and Soini 1986; Roze 1996). The dorsum has long black rings, each with a pair of white rings separated by pinkish to orange red rings; the length of the red rings is similar or up to three times longer than that of the white rings and to the length of the black areas of the black rings, (the middle black area of the black rings is always longer than the lateral ones). In larger individuals, each scale on the red and white rings is dark tipped. The tip of the snout is black, followed by a short white ring (anteriorly to the eyes), that is followed by a black ring (enclosing the eyes), and finally a long red area that extends to the neck. The venter has the extensions of the dorsal rings, with no melanism. This species may be confounded with *Atractus latifrons* and *Erythrolamprus aesculapii* (see accounts on these species). From other species of *Micrurus*, it is easily distinguished by details of the color pattern, especially on the head.

**Habitat and microhabitat.** Eleven individuals were found active at the RFAD, all at night in primary forest: eight were moving on or within the leaf litter, two were crossing an unpaved road, and one was moving in the bottom of a pool in the margin of a stream; nine of these individuals were in stream valleys, two were in plateaus. At Rio Urucu, a large adult was moving on the leaf litter at night in primary forest. At Rio Juruá, one individual was crawling in the leaf litter of a terra-firme forest at night (C. Gascon, unpublished data). The available information (Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Murphy 1997; Roze 1996; this study) indicates that *Micrurus lemniscatus* inhabits forests and open areas, generally associated with water; microhabitat data indicate that it is primarily cryptozoic, but also terrestrial, fossorial, and even aquatic. Data on time of activity is contradictory: data from Manaus (this study) and from Trinidad (Murphy 1997) strongly indicate nocturnal activity whereas Duellman (1978) found two individuals active by day and Beebe (1946) reported activity under overcast sky (probably by day).

**Feeding habits.** All active individuals found on the forest floor seemed to be foraging (probing the leaf litter with the tongue) and the individual found inside a pool was probing the muddy bottom with its tongue; two individuals from the RFAD had prey remains in the gut: a lizard and a snake. One individual (438+40 mm, 15.6 g) from 100 km south of Santarém, Pará, had a caecilian (*Microcaecilia* sp., TTL 150 mm, 1.2 g, MR 0.08) in the stomach (L.J. Vitt and J.P. Caldwell, unpublished data). Greene (1973*b*) provided a review on the diet of *Micrurus lemniscatus*. The available information (Beebe 1946; Greene 1973*b*; Cunha and Nascimento 1978 1982*a*; Dixon and Soini 1986; Roze 1982 1996; Sazima and Abe 1991; Vanzolini 1986; this study) show that *M. lemniscatus* feeds on terrestrial and aquatic long-bodied vertebrates: freshwater eels (*Gymnotus*, *Synbrachus*), caecilians (*Microcaecilia*, *Oscecilia*), snakes (*Typhlops*, *Atractus*, *Hydrops*, *Liophis*, *Micrurus*), amphisbaenians (*Amphisbaena*, *Leposternon*), and lizards (*Bachia*).

**Reproduction.** A recently caught female from the Manaus region had five eggs in July. At the RFAD, small juveniles (275–310 mm TTL) were found in January and March, indicating that hatching occurs at least during the rainy season. Clutch size in the literature (Cunha and Nascimento 1982*a*; Dixon and Soini 1986; Murphy 1997) are two to six eggs.

**Defense.** The color pattern is evidently aposematic. When disturbed, this species tries to flee into the leaf litter, or compresses the body dorsoventrally, makes subtle thrashes, performs false and true strikes, elevates and coils the tail, and hides the head under body coils. When handled it thrashes the body and invariably bites (see also Beebe 1946; Greene 1973*a*; Mole 1924).

*Micrurus spixii* (Wagler 1824)
Plates 104, 105

**Identification.** Maximum TTL male 1482 mm (this study), female 939 mm (Cunha and Nascimento 1982*a*), unsexed 1602 mm (Roze 1996); minimum TTL 258 mm (Cunha and Nascimento 1982*a*); TAL 4.8–6.3% of TTL (Cunha and Nascimento 1982*a*; Duellman 1978; Nascimento et al. 1988; this study); ED about 1/7 of HL (see taxonomic information in Cunha and Nascimento 1978; Dixon and Soini 1986; Roze 1996). The dorsum has long black rings (each with a pair of yellow rings) separated by red rings (in one large adult male, a short black stripe was present middorsally on each red ring); the length of red rings is similar or up to four times that of the yellow rings and twice to four times that of the black areas of the black rings. All dorsal scales are more or less melanic; some individuals may be extremely melanic. The head is black; each scale has yellow (anteriorly) to red (posteriorly) edges; laterally, there is a red area behind the eye and a yellow one on the loreal region; in highly melanic specimens, the head may be almost completely black. The venter has the extensions of the dorsal rings, with no melanism. The iris is dark brown. The tongue is black. This species may be confounded with *Atractus latifrons* and *Erythrolamprus aesculapii* (see accounts on these species). From other species of *Micrurus*, it is easily distinguished by details of the color pattern, especially on the head.

**Habitat and microhabitat.** Only one individual was found at the RFAD; it was burrowing into the sandy soil within the exposed roots of a fallen tree in the morning, in primary forest. At Manaus, two were freshly killed on paved roads crossing secondary forests and at Rio Cuieiras one was moving on the leaf litter in primary forest, all three during daytime. At Rio Juruá, one individual was crawling in the leaf litter of a terra-firme forest by day (C. Gascon, unpublished data). In western Amazonia it was found around ant nests (*Atta* sp.; W.W. Lamar, pers. comm. 1996). The available information (Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978; Duellman and Mendelson 1995; Roze 1996; this study) indicates that *Micrurus spixii* is a diurnal forest species that seems to be primarily cryptozoic but also fossorial and terrestrial.

**Feeding habits.** One juvenile from the Manaus region had a lizard (*Arthrosaura reticulata*) in the stomach and one adult had the remains of a blind snake (*Typhlops reticulatus*). One from Rio Yavari (Peru-Brazil border) was found eating a snake (*Liophis reginae*; W.W. Lamar, pers. comm. 1996). The available information (Cunha and Nascimento 1978; Dixon and Soini 1986; Greene 1973*b*; Schmidt 1953*b*; Roze 1996; Jorge da Silva 1993; this study) indicate that *Micrurus spixii* feeds primarily on fossorial, cryptozoic, and terrestrial long-bodied reptiles: snakes (*Typhlops*, *Apostolepis*, *Atractus*, *Dipsas*, *Liophis*, *Umbrivaga*, *Micrurus*), amphisbaenians (*Aulura*), and lizards (*Arthrosaura*, *Kentropyx*).

**Reproduction.** In the Manaus region, a pair was found mating in June.

**Defense.** The color pattern is evidently aposematic. When disturbed, this species tries to flee into the leaf litter or compresses the body dorsoventrally, makes subtle thrashes, performs false and true strikes, elevates and coils the tail (Plate 105), and hides the head under body coils. When handled it thrashes the body and rarely bites (see also Greene 1973*b*).

*Micrurus surinamensis* (Cuvier 1817)
Plates 106, 107

**Identification.** Maximum TTL male 1262 mm (tail tip lacking; Duellman 1978), female 1235 mm (Dixon and Soini 1986); minimum TTL 243 mm (at the MPEG); TAL 8.7–15.8% of TTL (Cunha and Nascimento 1982*a*; Duellman 1978; this study); ED about 1/9 to 1/10 of HL (see taxonomic information in Cunha and Nascimento 1978, 1982*a*; Dixon and Soini 1986; Roze 1996; Schmidt 1952). The dorsum has long black rings (each with a pair of short, cream to pale yellow rings) separated by long red rings; pale rings (cream to pale yellow) tend to be longer laterally; the red rings may be nearly as long as the black rings or much shorter; the middle black area of the black rings are always much longer than the lateral ones. Each pale dorsal scale is black edged and/or tipped. The head is red with each scale black edged and/or tipped, more melanic in older individuals; behind the red area, there is a short black ring followed by a short cream to pale yellow ring (these rings also belong to the first black ring). The venter has the extensions of the dorsal rings, with no melanism. The iris is dark brown (nearly black). The tongue is black. This species may be confounded with *Atractus latifrons* and *Erythrolamprus aesculapii* (see accounts on these species). From other species of *Micrurus*, it is easily distinguished by details of the color pattern, especially on the head.

**Habitat and microhabitat.** At the RFAD one juvenile was active at night on the floor of a building in a clearing, 30 m from a stream; two additional juveniles were found: one was active in the margin of a small pool in an unpaved road within primary forests on a plateau, at night, and another was moving within the leaf litter in a stream valley, by day. Also at the RFAD, one juvenile was in the leaf litter near a stream by day (L.J. Vitt, pers. comm. 1996). In other localities in the Manaus region, six individuals were found inside or around bodies of water in disturbed areas associated with streams and flooded forests, four during daytime and two at night. The available information (Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman and Salas 1991; Roze 1996; this study) indicates that *Micrurus surinamensis* is primarily aquatic, both diurnal and nocturnal, inhabiting various kinds of bodies of water in forest regions and open or disturbed areas.

**Feeding habits.** One individual from a disturbed area in Manaus had a gymnotid fish in the stomach. Ten preserved specimens from Brazilian Amazonia deposited at MPEG had prey or prey remains in the gut: seven fish (one *Callichthys*, two *Gymnotus*, one *Synbranchus*, and three unidentified) and one unidentified lizard. In western Amazonia, gymnotids and *Synbranchus marmoratus* were found in their stomachs (W.W. Lamar, pers. comm. 1996). The available information (Cunha and Nascimento 1978; Dixon and Soini 1986; Greene 1973*b*; Roze 1996; this study) show that *Micrurus surinamensis* feeds primarily on fishes (*Callichthys*, *Gymnotus*, *Synbranchus*) and occasionally on lizards.

**Reproduction.** At the RFAD, two neonates were found in April. Two females from Pará and Maranhão at MPEG (M.E. Oliveira, unpublished data) had five and 12 eggs, respectively; another from Pará had eleven enlarged follicles. Dixon and Soini (1986) found a female with 11 eggs.

**Defense.** The color pattern is evidently aposematic (see also Roze 1996). When disturbed, this species compresses the body dorsoventrally, makes subtle thrashes, performs false and true strikes, coils the tail, and hides the head under body coils. When handled, it thrashes the body and rarely bites (see also Greene 1973*b*).

## Viperidae

*Bothrops atrox* (Linnaeus 1758)
Plates 108-112

**Identification.** Maximum TTL male 945 mm, female 1532 mm, minimum TTL 284 mm; TAL 11.2–16.7% of TTL; ED about 1/7 to 1/9 of HL; pupil vertical to elliptical (see taxonomic information in Dixon and Soini 1986; see also the taxonomic comments below). The dorsum is tan, reddish tan, grayish tan or brown with darker blotches that become narrower and meet middorsally, giving rise to a trapezoid shape in lateral view. These blotches are often bordered by cream lines and each bears darker and paler areas (a dorsolateral darker area and a pair of lateral darker spots are often present); the paler areas between the darker blotches often bear darker markings. The tip of the tail is cream to yellow in juveniles (Plate 108) and dark above and pale below in half-grown individuals. The top of the head is tan to brown often with darker spots or stripes; lateroposteriorly there is a pair of slightly oblique postorbital stripes, the upper cream to tan, the lower brown to dark brown; the lips and anterolateral region are whitish cream to pale yellow with or without dark marks on the loreal region. The venter is white to cream with pale to deep black blotches; the ventral pale and dark contrasting areas are evident in lateral view (Plate 110); the ventrolateral region of the neck may bear a reddish tint. The iris is bronze. The tongue is black. This species may be very similar to *Xenodon rhabdocephalus* (see account of this species).

**Habitat and microhabitat.** A detailed analyses of our field data on this species obtained in the Manaus region, mostly at the RFAD, will be published elsewhere; here we present a summary of these data. A total of 85 observations of 65 individuals was made at the RFAD in primary forests, 72 at night and 13 by day. At night, in 35 observations the individuals were on the ground, coiled ($n = 24$; Plate 109) or moving ($n = 11$; Plate 110); in 37 observations, individuals were on the vegetation at 0.05–1.50 m above ground (Plates 108, 111). During the day, 13 individuals were moving ($n = 9$) or coiled ($n = 4$) on the ground. Most coiled individuals found on the ground at night seemed to be active (Plate 109; see Materials and Methods). At other localities in the Manaus region, several individuals were found in similar situations; one was swimming in an "igapó" lake by day (several adults were found crossing rivers and streams in western Amazonia; W.W. Lamar, pers. comm. 1996). The extensive available information (Dixon and Soini 1986; Duellman 1978; Duellman and Mendelson 1995; Henderson et al. 1976; this study) shows that *Bothrops atrox* occurs in high densities, in most habitats (mostly in forests), is primarily nocturnal, but also found active by day, and may use both the ground and the vegetation.

**Feeding habits.** Three juveniles from the

RFAD had small frogs (*Eleutherodactylus* and *Adenomera*) in the stomach. One individual (ca. 600 mm TTL) was striking and eating a frog (*Osteocephalus*) on a bromeliad at night; one was facing an envenomed lizard (*Ameiva*) on the ground at noon; and one was found after envenoming a frog (*Phyllomedusa*), that it did not eat, at night. A subadult female (SVL about 900 mm; Plate 112) was observed foraging actively, capturing, and ingesting a snake (*Atractus torquatus*) by day (Egler et al. 1996). Seventeen preserved specimens from the Manaus region had frogs, lizards, and mammals. Eight individuals from Rio Jau had frogs, lizards (*Ameiva*, *Kentropyx*), and mammals in the gut. The extensive data available (Dixon and Soini 1986; Duellman 1978; Duellman and Mendelson 1995; Egler et al. 1996; this study) show that *Bothrops atrox* is euryphagic, consuming centipedes, frogs, lizards and mammals, and showing an ontogenetic shift from ectothermic to endothermic prey. Foraging occurs both at night and during daytime, mostly through a sit-and-wait strategy, although active foraging was also observed.

**Reproduction.** At the RFAD, newborns (284–356 mm TTL) were found in December ($n$ = 8), January ($n$ = 6), and February ($n$ = 1), indicating that hatching may occur in the beginning of the rainy season. Two pairs were found copulating in April. Recently caught females from the Manaus region (mostly from disturbed areas) gave birth to 11–43 young in June through October and December indicating that in disturbed areas hatching occurs during the dry season and the onset of the rainy season. A female from Moura, Amazonas, gave birth to 14 young.

**Defense.** When approached, a moving *Bothrops atrox* may flee quickly or coil the body facing the observer, make an S-coil, and eventually strike; resting individuals adopt this same alert posture when disturbed. Although some individuals are extremely aggressive when approached, coiled foraging individuals rarely strike. While being captured, two individuals (578 and ca. 1000 mm TTL) were able to puncture leather gloves and inject venom on the observer's hand. When fleeing on the forest floor or open ground, they may vibrate the tail and move rapidly in a fashion similar to sidewinding. When handled, it invariably strikes and bites. One juvenile hid its head under a body coil when insistently disturbed. Concealing coloration is effective at least when coiled on the leaf litter, especially when partially hidden beneath leaves and fallen branches.

**Taxonomic comments.** The taxonomy of populations historically assigned to *Bothrops atrox* in Amazonia is still poorly understood (Wüster et al. 1996, 1997). The population of *B. atrox* from the Manaus region is apparently conspecific with those found in western Amazonia (at least that of Rio Branco, Acre); on the other hand, those from eastern Amazonia seem to represent a distinct species (Wüster et al. 1997). Based on these recent studies, we made comparisons only with the populations from western Amazonia.

*Lachesis muta* (Linnaeus 1766)
Plate 113

**Identification.** Maximum TTL male 2160 mm (Cunha and Nascimento 1978), female 2910 mm (W.W. Lamar, pers. comm. 1996; see also Murphy 1997); minimum TTL 738 mm (at the MPEG); TAL 7.9–9.7% of TTL (Beebe 1946; Cunha and Nascimento 1982*a*; Duellman 1978; this study); ED about 1/9 to eighth of HL; pupil vertical to elliptical (see taxonomic information in Cunha and Nascimento 1978, 1982*a*; Dixon and Soini 1986). The dorsum is tan with large dark brown to black, middorsal, diamond shaped marks; each of these marks are cream bordered and bear a lateral pale spot; on the posterior fifth of the body and on the tail, the tan areas between the large dark marks bear small, mostly triangular, dark marks; the tip of the tail is black with narrow white bands. The head is darker than the dorsum with small black marks above and an oblique, black postorbital stripe; the remaining lateral areas are tan, paler on the lips. The venter is creamy tan to cream. The iris is dark coppery brown, paler on the margins. The tongue is pinkish red to black.

**Habitat and microhabitat.** Two individuals were found at the RFAD: one was moving on an unpaved road that crosses a forest, late in the night; another was coiled on the leaf litter by day in primary forest. One large subadult was crossing a paved road in a disturbed area 10 km from the RFAD at night. At Rio Pitinga, one adult was found by day under a fallen tree bark in a primary forest. The available information (Beebe 1946; Cunha and Nascimento 1975 1978 1982*a*; Dixon and Soini 1986; Duellman 1978; Murphy 1997; this study) indicates that *Lachesis muta* is a nocturnal, terrestrial forest species.

**Feeding habits.** One individual from the Manaus region had a marsupial (*Monodelphis brevicaudata*) in the stomach. We found 21 mammals (rodents, marsupials, and a squirrel, *Sciurus* sp.) in the gut of 13 preserved specimens (10 males and three females) at the MPEG; seven of eight relatively intact prey were ingested head first; MRs in our sample were surprisingly low for a viper (0.009–0.040 for eight prey). The available information (Beebe 1946; Cunha and Nascimento 1978 1982*a*; Jorge da Silva 1993; this study) indicates that *Lachesis muta* feeds exclusively on mammals (*Monodelphis*, *Dasyprocta*, *Proechimys*, *Sciurus*).

**Reproduction.** No information on reproduction is available for the Manaus region. Beebe (1946) reported two females with one and seven eggs and Duellman (1978) found another with 13 eggs.

**Defense.** When approached both by day and at night, this species rarely strikes and eventually flees; at night it may make a high S-coil facing the observer. Tail vibration was also observed (see a review in Greene 1988).

## NATURAL HISTORY SUMMARY

### Spatial Distribution and Time of Activity

It is important to note that the results on habitat and microhabitat use presented here are limited by sampling biases, as in most studies on snake assemblages. For instance, we searched for snakes only in visible microhabitats; thus, those snakes that inhabit the soil or rest hidden in the vegetation were found only occasionally. Considering only the mostly used microhabitat of each of the 65 species for which this information is available, 28 (42%) are primarily terrestrial, 20 (30%) fossorial and/or cryptozoic, 13 (20%) arboreal, and four (6%) aquatic, although many species use more than one microhabitat when active (Table 1). In the assemblage of Santa Cecilia, Ecuador (Duellman 1978), 50% were terrestrial, 17% fossorial and/or cryptozoic, 27% arboreal, and 6% aquatic. These differences may simply reflect differences in the species composition of these assemblages, i.e., the relative contribution of each phylogenetic lineage, each with their own constraints in relation to microhabitat use (see Cadle and Greene 1993). For instance, the higher number of fossorials and/or cryptozoics in the Manaus region may be due to the occurrence of eight species of *Atractus* in this region (only three *Atractus* were found by Duellman at Santa Cecilia). However, some of these differences may also be a consequence of differences in predation pressures and/or prey availability in each microhabitat (e.g., the account on *Dipsas pavonina*).

The proportions of snakes found in each microhabitat varied between day and night. Considering only active individuals, during the day we found a higher proportion of snakes in the leaf litter than at night (75.5 and 55.5% of ecological species, respectively), a lower proportion of snakes on the vegetation (15.1 and 28.8%) and also a lower proportion in the water (9.4 and 15.5%; Table 2). Similar proportions appear when data from other localities are incorporated (68.7 and 51.8%, 20.9 and 31.5%, and 10.4 and 16.7%, respectively; Table 2). Considering inactive (resting or sleeping) individuals, similar proportions were found in each microhabitat during the day and at night (Table 2). However, in absolute numbers, we found nearly twice more species resting at night than during daytime (21 and 11 ecological species, respectively). This difference may be a result of a prevalence of diurnal species (that rest at night) over nocturnal ones (that rest during daytime; see below). Furthermore, nearly all inactive snakes found were on vegetation (82% of ecological species found by day and 95% of those found at night; Table 2). Only three were found inactive (exposed) on the leaf litter, two during the day and one at night, and none was found inactive in the water (Table 2). A high predation pressure in the leaf litter may have lead several snakes to rest on vegetation (including those that are strictly terrestrial when active; Martins 1993). Interestingly, most species resting in leaf litter are large and aggressive (e.g., boids, *Chironius* spp., vipers). Similarly, high predation pressure may be responsible for the absence of resting snakes in aquatic microhabitats. (Suggestively, tail damages tend to be more common in aquatic colubrids than in those that use other microhabitats

**TABLE 1.** Species of snakes found (this study) or expected to occur (based on the literature cited herein and personal observations and/or communications for other Amazonian regions) in each microhabitat in the forests of the Manaus region (see definitions of microhabitat categories in Materials and Methods). Fossorial species were found within or on the leaf litter (see Materials and Methods). Abbreviations are: A = active, D = by day, N = at night, nf = not found in the Manaus region, R = resting (includes probably asleep individuals), U = time of the day and/or activity unknown. An asterisk indicates that the species was under a log or a rock, inside the soil, or in a burrow (i.e., it was not exposed).

| Species | Within or on leaf litter | | | | | On vegetation | | | | In water | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A,D | A,N | R,D | R,N | U | A,D | A,N | R,D | R,N | A,D | A,N |
| Anomalepididae | | | | | | | | | | | |
| *Typhlophis squamosus* | - | - | nf* | - | x | - | - | nf | - | - | - |
| Leptotyphlopidae | | | | | | | | | | | |
| *Leptotyphlops diaplocius* | x | - | - | - | - | nf | - | - | - | - | - |
| Typhlopidae | | | | | | | | | | | |
| *Typhlops reticulatus* | - | - | - | - | x | - | - | - | - | - | - |
| Aniliidae | | | | | | | | | | | |
| *Anilius scytale* | x | x | - | - | - | - | - | - | - | - | x |
| Boidae | | | | | | | | | | | |
| *Boa constrictor* | x | x | - | - | - | nf | nf | x | x | - | - |
| *Corallus caninus* | nf | - | - | - | - | - | x | x | - | - | - |
| *Coralus hortulanus* | - | x | - | - | - | - | x | - | - | - | - |
| *Epicrates cenchria* | x | x | nf | - | - | nf | x | x | - | - | nf |
| *Eunectes murinus* | x | - | - | - | - | - | - | - | - | x | x |
| Colubridae | | | | | | | | | | | |
| *Apostolepis* sp. | x | - | - | - | - | - | - | - | - | - | - |
| *Atractus alphonsehogei* | - | - | - | - | nf* | - | - | - | - | - | - |
| *Atractus latifrons* | x | x | - | - | - | - | - | - | - | - | - |
| *Atractus major* | x | x | - | - | - | - | - | - | - | - | - |
| *Atractus poeppigi* | - | - | - | - | x | - | - | - | - | - | - |
| *Atractus schach* | x | x | - | - | - | - | - | - | - | - | - |
| *Atractus snethlageae* | x | x | - | - | - | - | - | - | - | - | - |
| *Atractus torquatus* | x | x | - | - | - | - | x | - | - | - | - |
| *Atractus trilineatus* | - | - | - | - | nf* | - | - | - | - | - | - |
| *Chironius fuscus* | x | - | - | nf | - | x | - | x | - | - | - |
| *Chironius multiventris* | x | - | - | - | - | x | - | x | x | nf | - |
| *Chironius scurrulus* | x | - | - | - | - | - | - | x | nf | - | - |
| *Clelia clelia* | - | x | - | - | - | - | - | - | - | - | X |
| *Dendrophidion dendrophis* | x | - | - | - | - | - | - | - | x | - | - |
| *Dipsas indica* | - | - | - | - | - | - | x | - | - | - | - |
| *Dipsas pavonina* | - | x | - | - | - | - | x | - | x | - | - |
| *Drepanoides anomalus* | - | x | - | - | - | - | nf | - | - | - | - |
| *Drymoluber dichrous* | x | - | - | nf | - | - | - | - | x | - | - |
| *Erythrolamprus aesculapii* | x | - | - | - | - | - | - | - | - | - | - |

**TABLE 1.** Continued

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Helicops angulatus* | nf | - | - | - | - | - | - | - | - | x | x |
| *Helicops hagmanni* | - | - | - | - | - | - | - | - | - | x | x |
| *Imantodes cenchoa* | - | - | - | - | - | - | x | x | - | - | - |
| *Leptodeira annulata* | - | x | - | - | - | - | x | nf | x | - | nf |
| *Leptophis ahaetulla* | x | - | - | - | - | x | x | - | x | - | - |
| *Liophis breviceps* | x | - | - | - | - | - | - | - | - | nf | - |
| *Liophis reginae* | x | - | - | - | - | - | - | - | x | - | - |
| *Liophis typhlus* | x | x | - | - | - | - | nf | - | x | - | - |
| *Mastigodryas boddaerti* | x | - | - | - | - | nf | - | - | x | - | - |
| *Oxybelis aeneus* | - | - | - | - | - | nf | - | - | x | - | - |
| *Oxybelis fulgidus* | x | - | - | - | - | x | - | - | x | - | - |
| *Oxyrhopus formosus* | - | x | nf* | - | - | - | x | - | - | - | - |
| *Oxyrhopus* aff. *melanogenys* | - | x | - | - | - | - | x | - | nf | - | - |
| *Philodryas viridissimus* | nf | - | - | - | - | x | - | - | - | - | - |
| *Pseudoboa coronata* | x | x | - | - | - | - | - | - | - | - | - |
| *Pseudoboa neuwiedi* | x | x | - | - | - | - | - | - | x | - | - |
| *Pseudoboa* sp. A | x | - | - | - | - | - | - | - | x | - | - |
| *Pseustes poecilonotus* | x | - | - | - | - | nf | - | - | x | - | - |
| *Pseustes sulphureus* | x | - | - | - | - | x | - | - | x | - | - |
| *Rhinobothryum lentiginosum* | - | x | - | - | - | - | - | - | - | - | - |
| *Siphlophis cervinus* | - | - | - | - | nf* | - | nf | - | x | - | - |
| *Spilotes pullatus* | x | - | - | - | - | x | - | - | - | - | - |
| *Taeniophallus brevirostris* | x | - | - | - | - | - | - | - | - | - | - |
| *Taeniophallus nicagus* | x | - | - | - | - | - | - | - | - | - | - |
| *Tantilla melanocephala* | x | - | - | - | nf | - | - | - | - | - | - |
| *Tripanurgos compressus* | - | x | - | - | - | - | x | x | x | - | - |
| *Umbrivaga pygmaea* | x | - | - | - | - | - | - | - | - | - | - |
| *Xenodon rhabdocephalus* | x | - | - | - | - | - | - | - | - | - | - |
| *Xenopholis scalaris* | x | nf | nf | - | nf | - | nf | - | - | - | - |
| *Xenoxybelis argenteus* | nf | - | - | - | - | x | - | - | x | - | - |
| Elapidae | | | | | | | | | | | |
| *Micrurus averyi* | x | x | - | - | - | - | - | - | - | - | - |
| *Micrurus collaris* | - | - | - | - | x* | - | - | - | - | - | - |
| *Micrurus hemprichii* | x | x | - | - | - | - | - | - | - | - | - |
| *Micrurus lemniscatus* | nf | x | - | - | nf* | - | - | - | - | - | x |
| *Micrurus spixii* | x | - | - | - | - | - | - | - | - | - | - |
| *Micrurus surinamensis* | x | x | - | - | - | - | - | - | - | x | x |
| Viperidae | | | | | | | | | | | |
| *Bothrops atrox* | x | x | x | x | - | x | x | x | x | x | - |
| *Lachesis muta* | x | x | x* | - | - | - | - | - | - | - | - |

[C. Nogueira pers. comm. 1997; pers. obs. 1997] and several aquatic snakes have contrasting color patterns at least in the venter, which may be mimetic [Martins 1996].) Thus, we suspect that the spatial distribution of inactive snakes in the forests of the Manaus region is highly influenced by predation pressure.

In relation to time of activity, of the 62 forest snakes found in the Manaus region for which this information is available, 26 (41%) seem to be strictly diurnal, 13 (21%) strictly nocturnal, and 23 (38%) both diurnal and nocturnal. These figures may reflect phylogenetic constraints, although local spatial distribution and activity patterns of predators and prey could also lead to shifts in the time of activity in snakes (e.g., the account on *Dipsas pavonina*).

Considering absolute total numbers, we found more ecological as well as taxonomic species active during the day than at night (1.0:1.2 ecological and 1.0:1.3 taxonomic species, respectively; Table 2); similar differences appear when data from other localities are incorporated (1.0:1.2 and 1.0:1.4, respectively; Table 2). These results may reflect the prevalence of diurnal over nocturnal species in the Manaus region (see above), but also a higher detectability of diurnal species over nocturnal ones. Diurnal species are more prone to flee on approximation by the observer (who may fail to detect the snake before it flees), and most species bear cryptic color patterns (see plates and Defense), making them more difficult to detect. On the other hand, nocturnal snakes are much less prone to flee on approach and, in general, bear contrasting color patterns. (Curiously, when resting at night, some cryptic diurnals turn to be very easily detectable by a person using a headlamp [e.g., *Xenoxybelis argenteus*]). This differential detectability may also be responsible for the higher rate of snake sightings at night during TCS.

Except for minor differences (see, e.g., the accounts on *Dipsas pavonina* and *Micrurus lemniscatus*), for each species, habitat, microhabitat and time of activity are very similar to those observed by other authors in other Amazonian localities (e.g., Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978). Thus, the diel activity and the habitat and microhabitat used by a given species seems not to vary as a consequence of different co-occurring species in different localities in Amazonia.

### Diet and Foraging Mode

Information on feeding habits of neotropical snakes is surprisingly scarce in the literature (e.g., Mushinsky 1987). The five most common prey of 62 forest snakes from central Amazonia are all

**TABLE 2.** Numbers of ecological (ES) and taxonomic species (TS) found in this study, or expected to be found in each microhabitat (see references in the Species Accounts) in the forests of the Manaus region, based on the data shown in Table 1 (see definitions of ecological and taxonomic species in Materials and Methods). Percentages are in parenthesis. Resting include probably sleeping individuals (see Materials and Methods).

| Activity/time | Leaf litter | Vegetation | Water | ES | TS |
|---|---|---|---|---|---|
| This study | | | | | |
| Active by day | 40 (75.5) | 8 (15.1) | 5 (9.4) | 53 | 43 |
| Active at night | 25 (55.5) | 13 (28.8) | 7 (15.5) | 45 | 32 |
| Resting by day | 2 (18.2) | 9 (81.8) | 0 (0.0) | 11 | 10 |
| Resting at night | 1 (4.8) | 20 (95.2) | 0 (0.0) | 21 | 20 |
| All studies | | | | | |
| Active by day | 46 (68.7) | 14 (20.9) | 7 (10.4) | 67 | 47 |
| Active at night | 28 (51.8) | 17 (31.5) | 9 (16.7) | 54 | 33 |
| Resting by day | 6 (35.3) | 11 (64.7) | 0 (0.0) | 17 | 14 |
| Resting at night | 3 (12.0) | 22 (88.0) | 0 (0.0) | 25 | 23 |

vertebrates (Table 3): lizards (consumed by 58% of the species), frogs (39%), mammals (23%), birds (18%), and snakes (16%). Invertebrates are consumed by scolecophidians (insects), *Atractus* spp. (earthworms), *Dipsas* spp. (mollusks), *Liophis breviceps* (earthworms), *Tantilla melanocephala* (centipedes, insects), *Micrurus hemprichii* (onychophorans), and *Bothrops atrox* (centipedes, only juveniles). Essentially carnivorous, snakes are secondary to tertiary consumers in food webs (Mushinsky 1987). Thus, for some prey species (especially lizards, frogs, earthworms), the snakes analyzed here may be important predators.

The results above are similar to those provided by Duellman (1978), except that frogs were the main prey item (consumed by 46% of the species), followed by lizards (40%), at Santa Cecilia. These differences are most probably a consequence of historical factors, i.e., different phylogenetic lineage (each with their own constraints) are differently represented in each locality (Cadle and Greene 1993). The diet of those species for which we have a considerable amount of information on prey types for the Manaus region is very similar to those found by other authors in other Amazonian localities (e.g., Beebe 1946; Cunha and Nascimento 1978; Dixon and Soini 1986; Duellman 1978). Thus, the diet of a given species seems not to vary as a consequence of different co-occurring species in different localities in Amazonia.

Most forest snakes studied here seem to be primarily active foragers (Table 3). The sit-and-wait tactic is apparently absent in scolecophidians, *Anilius*, and elapids, rare in colubrids (e.g., the vine snakes of the genera *Oxybelis* and *Xenoxybelis*), and widespread in boas and vipers. The classical division of foraging mode (e.g., Huey and Pianka 1981) and some of the associated traits in predator feeding habits are corroborated by a few observations on the forest snakes from the Manaus region (see also Henderson 1982). For instance, the diurnal, slow moving *Oxybelis aeneus* and *Xenoxybelis*

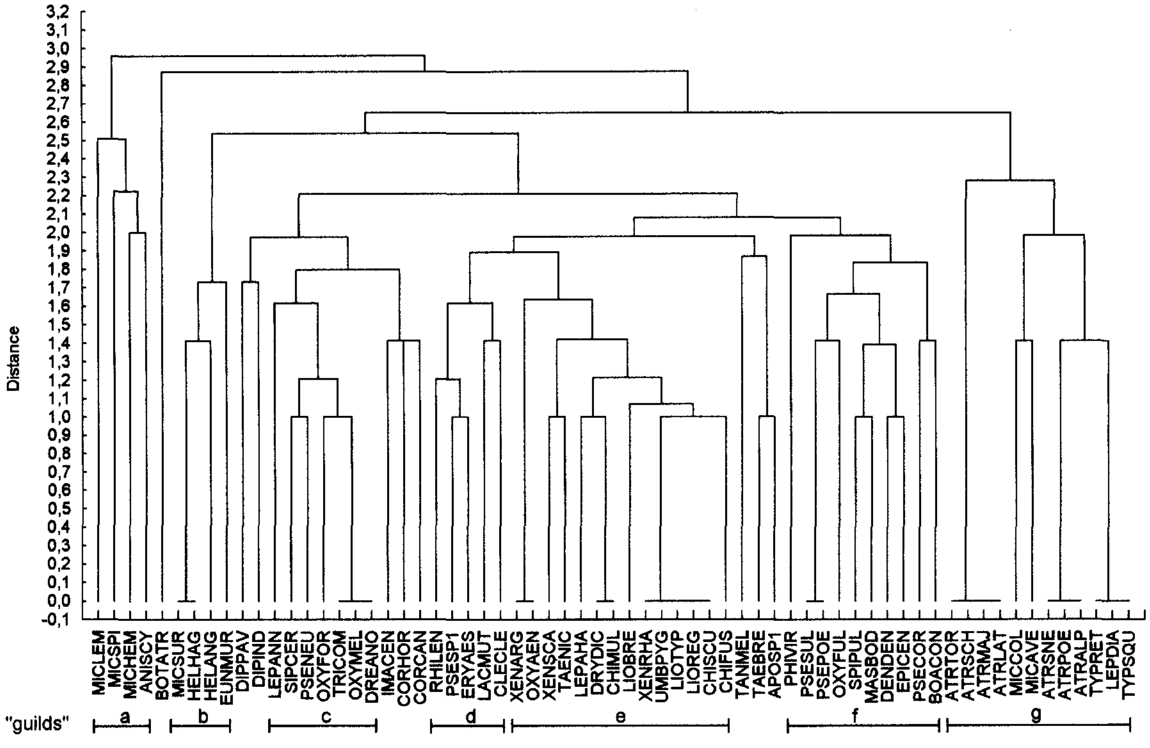

**Figure 7.** A cluster analysis combining data on microhabitat use, diel activity, and diet (see categories in Materials and Methods) for 65 forest snakes of the Manaus region, Amazonas, Brazil.

*argenteus* feed on frogs and lizards that are active by day; the diurnal, active foragers *Leptophis ahaetulla* and *Chironius scurrulus* search for nocturnal frogs that sleep hidden in retreats in the ground or within the vegetation by day, and the nocturnal *Tripanurgos compressus* forages for sleeping diurnal lizards on the vegetation (see Species Accounts).

### A Combined Analysis of Resource Use and Time of Activity

The cluster analysis combining data on microhabitat use, diel activity, and diet (see categories in Materials and Methods) resulted in several groups of species with similar habits ("guilds"; Fig. 7). All guilds include closely related species as well as distantly related ones that converge in habits. In the case of related species, all species of *Atractus* are grouped in Guild G, nearly all pseudoboines are grouped in Guild C, and all colubrines are grouped in Guilds E and F. On the other hand, Guilds B, E and F, for instance, comprise distantly related species that converge in habits (e.g., one boid, two colubrids, and one elapid in Guild B; South American xenodontines and colubrines in Guild E; boids and colubrines in Guild F).

These combined results indicate that besides current ecological factors (e.g., predation pressure; differential prey availability in different microhabitats), historical factors may have played and important role in the current natural history patterns of the forest snake assemblage of the Manaus region (see Cadle and Greene 1993).

### Defense

Most defensive tactics observed in snakes supposedly are directed at visually oriented predators (especially birds and mammals), although this may be a result of observer bias since vision is the primary sense in humans (Greene 1988). Considering

**TABLE 3.** A summary of prey types and foraging mode (Fm), and for the snakes found in the forests of the Manaus region, including literature and unpublished data (see Species Accounts). Data in parenthesis are considered secondary. Data followed by a question mark are presumed (i.e., not observed). Abbreviations: ac = active; sw = sit-and-wait. See text for foraging modes marked with an asterisk.

| Species | Prey type | Fm |
|---|---|---|
| Anomalepididae | | |
| *Typhlophis squamosus* | insects | ac? |
| Leptotyphlopidae | | |
| *Leptotyphlops diaplocius* | insects | ac |
| Typhlopidae | | |
| *Typhlops reticulatus* | insects | ac? |
| Aniliidae | | |
| *Anilius scytale* | snakes, fish, amphisbaenians, caecilians | ac |
| Boidae | | |
| *Boa constrictor* | mammals, lizards, (birds) | ac, sw |
| *Corallus caninus* | mammals, (lizards) | sw |
| *Corallus hortulanus* | mammals, lizards, frogs, birds | ac, (sw) |
| *Epicrates cenchria* | mammals, birds, bird eggs, frogs | ac |
| *Eunectes murinus* | birds, mammals, fish, frogs, reptiles | ac, (sw) |
| Colubridae | | |
| *Atractus alphonsehogei* | earthworms | ac? |
| *Atractus latifrons* | earthworms | ac |
| *Atractus major* | earthworms | ac |
| *Atractus poeppigi* | earthworms | ac? |
| *Atractus schach* | earthworms | ac? |
| *Atractus snethlageae* | earthworms | ac |

**TABLE 3.** Continued

| | | |
|---|---|---|
| *Atractus torquatus* | earthworms | ac |
| *Chironius fuscus* | frogs, salamanders, (lizards) | ac |
| *Chironius multiventris* | frogs, lizards | ac |
| *Chironius scurrulus* | frogs, (lizards) | ac |
| *Clelia clelia* | snakes | ac |
| *Dendrophidion dendrophis* | frogs | ac* |
| *Dipsas indica* | mollusks | ac |
| *Dipsas pavonina* | mollusks | ac |
| *Drepanoides anomalus* | squamate eggs | ac |
| *Drymoluber dichrous* | lizards, lizard eggs, frogs, snakes | ac |
| *Erythrolamprus aesculapii* | snakes, lizards, fish | ac |
| *Helicops angulatus* | fish, tadpoles, frogs, lizards | ac, (sw) |
| *Helicops hagmanni* | fish | sw |
| *Imantodes cenchoa* | lizards, frogs | ac |
| *Leptodeira annulata* | frogs, lizards, (anuran eggs), (tadpoles) | ac |
| *Leptophis ahaetulla* | lizards, frogs | ac |
| *Liophis breviceps* | earthworms, frogs, centipedes, fish | ac |
| *Liophis reginae* | frogs, (lizards), (tadpoles) | ac |
| *Liophis typhlus* | frogs | ac |
| *Mastigodryas boddaerti* | mammals, birds, lizards, frogs, (reptile eggs) | ac |
| *Oxybelis aeneus* | lizards, frogs, (birds) | sw |
| *Oxybelis fulgidus* | birds, lizards | sw, (ac) |
| *Oxyrhopus formosus* | lizards | ac |
| *Oxyrhopus* aff. *melanogenys* | lizards, (mammals) | ac |
| *Philodryas viridissimus* | frogs, lizards, mammals | ac |
| *Pseudoboa coronata* | lizards, mammals, (birds) | ac |
| *Pseudoboa neuwiedii* | lizards | ac |
| *Pseudoboa* sp. A | snakes | ac? |
| *Pseustes poecilonotus* | birds, bird eggs, lizards, mammals | ac |
| *Pseustes sulphureus* | birds, mammals | ac |
| *Rhinobothryum lentiginosum* | lizards | ac |
| *Siphlophis cervinus* | lizards | ac |
| *Spilotes pullatus* | frogs, lizards, mammals, birds, bird eggs | ac |
| *Taeniophallus brevirostris* | lizards | ac |
| *Taeniophallus nicagus* | frogs | ac |
| *Tantilla melanocephala* | centipedes, insects | ac |
| *Tripanurgos compressus* | lizards | ac |
| *Xenodon rhabdocephalus* | frogs, tadpoles | ac? |
| *Xenopholis scalaris* | frogs | ac |
| *Xenoxybelis argenteus* | frogs, lizards | ac* |
| Elapidae | | |
| *Micrurus averyi* | lizards, snakes | ac |
| *Micrurus hemprichii* | onychophorans, snakes, lizards | ac |
| *Micrurus lemniscatus* | snakes, lizards, amphisbaenians, fish, caecilians | ac |
| *Micrurus spixii* | snakes, lizards, amphisbaenians | ac |
| *Micrurus surinamensis* | fish, (lizards) | ac |
| Viperidae | | |
| *Bothrops atrox* | centipedes, frogs, lizards, snakes, mammals | sw, (ac) |
| *Lachesis muta* | mammals | sw |

the diversity of snake predators that use chemical cues to find prey (mostly other snakes), there may be various defensive tactics directed at these predators, although only a few can be easily detected by humans (e.g., fetid cloacal gland products; see, Egler et al. 1996).

A summary of defensive tactics observed in the forest snakes of the Manaus region was provided by Martins (1996). Surprisingly, information on defensive tactics in Neotropical snakes is extremely scarce in the literature (e.g., Greene 1988; Sazima and Abe 1991). Most data presented here and in Martins (1996) have not been reported previously (see Greene 1988). There seem to be several apparent trends in our results, some of them highly expected (see also Martins 1996). For instance: (1) virtually all species use inaccessibility, employing various methods to achieve it (see Species Accounts); (2) the most used (and probably primitive) tactics are fleeing, thrashing the body, and biting; (3) almost all diurnal species are cryptically colored; (4) most snakes that flee when approached are diurnal or both diurnal and nocturnal; (5) the supposed coral snake mimics use several defensive tactics used by *Micrurus* spp. (as already shown by Sazima and Abe 1991, and apparently corroborating the coral snake mimicry hypothesis; see, e.g., Campbell and Lamar 1989, Greene and McDiarmid 1981; but see an alternative hypothesis in Vitt 1992); (6) head triangulation occurs in supposed mimics of *Bothrops atrox* (*Dipsas pavonina*, *Helicops angulatus*, and *Leptodeira annulata*), in green species (supposedly mimics of *Bothrops bilineatus*; see Campbell and Lamar 1989; however, these similar behaviors may have converged, independent of mimicry), and in two supposed coral snake mimics (*Rhinobothryum* and *Tripanurgos*).

Martins (1996) suggested that phylogeny may be a strong determinant factor for the occurrence of defensive tactics in Neotropical snakes, although shared potential predators may also lead to convergent defensive tactics. In other words, it seems possible to preview with some certainty the set of defensive tactics exhibited by a given species by knowing its phylogenetic affinities, its habitat and

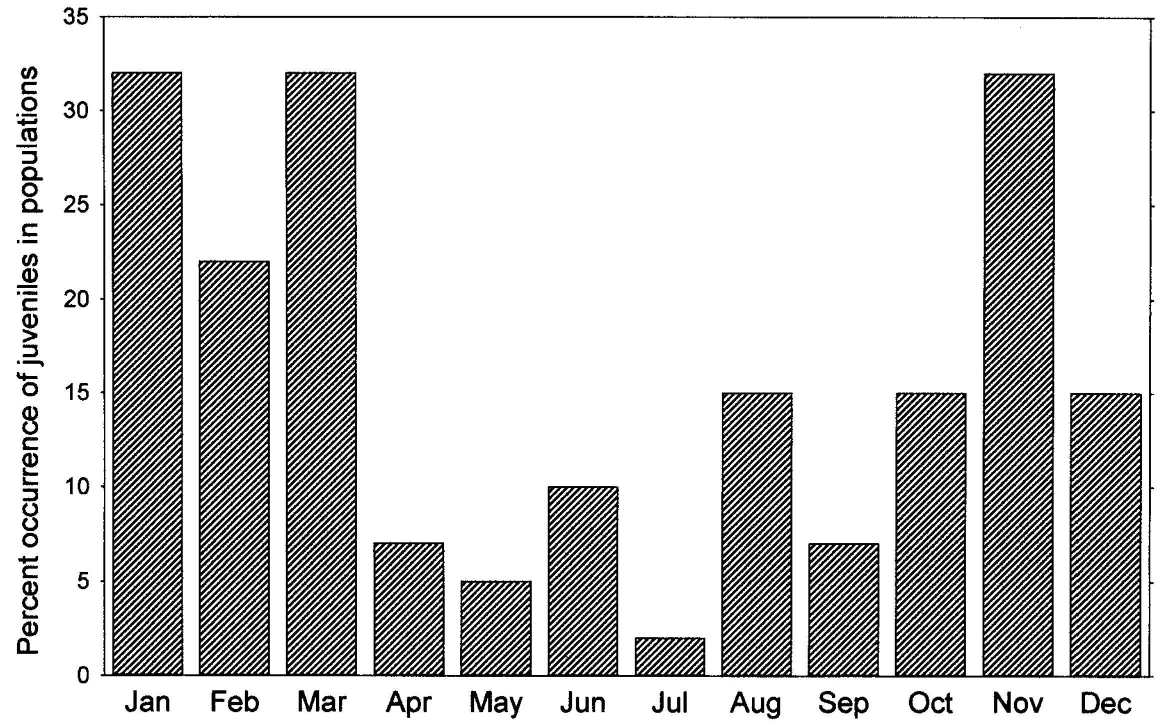

**Figure 8.** Variation in the proportion of species found throughout the year with juveniles in the populations, considering the whole assemblage of forest snakes of the Manaus region, Amazonas, Brazil.

microhabitat, and perhaps its eventual mimetic relations. Our results also show the potential of Neotropical snakes to answer theoretical questions in snake defensive biology since about three fourths of the 45 categories of snake antipredator mechanisms defined by Greene (1988) occur in the Manaus assemblage (Martins 1996).

### Reproduction

The period and length of juvenile recruitment, for species for which we have a relatively large sample for the Manaus region, are apparently restricted to the rainy season in some species (*Dipsas pavonina*, *Helicops angulatus*, *Xenoxybelis argenteus*), while others seem to breed throughout the year (*Atractus latifrons*, *Liophis reginae*, *L. typhlus*, *Pseustes sulphureus*, *Bothrops atrox*; see Species Accounts). Considering the whole assemblage, the variation in the proportion of species with juveniles in the populations throughout the year (Fig. 8) indicates a general trend of a higher juvenile recruitment during the rainy season in the Manaus region. Fitch (1982) found no evident trend to breeding during certain periods of the year when interpreting the relatively abundant information gathered on the reproduction of the snakes from the Iquitos region (although breeding tends to be seasonal in this region; W.W. Lamar, pers. comm. 1996). When interpreting his results from Santa Cecilia, Duellman (1978) suggested that breeding throughout the year might be a general trend in Amazonian snakes. The data for the Manaus region presented here apparently contradict Duellman's (1978) hypothesis. The apparent seasonality in reproduction for most species in the Manaus region (Fig. 8) could be a consequence of the extended dry period in this region, contrasted by the virtual lack of a dry season at Iquitos and Santa Cecilia (see Dixon and Soini 1986, Duellman 1978). In markedly seasonal environments such as the forests in the Manaus region, the shortage of food in the dry season (pers. obs. 1990–1995) could be a constraint to recruiting juveniles during this period, especially for those species whose juveniles feed on highly seasonal prey (e.g., frogs).

Regarding reproductive modes, except for the viviparous *Anilius scytale*, boids, *Helicops hagmanni*, and *Bothrops atrox*, all other snakes from the Manaus region for which this kind of information is available (see Species Accounts) are oviparous, an obvious trend in Neotropical snake assemblages because most colubrids, that predominate in these assemblages, are oviparous (see also Fitch 1970 1982).

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## LITERATURE CITED

Amaral, A. 1929. Estudos sobre ophidios neotrópicos. XIX. Revisão do gênero *Spilotes* Wagler, 1830. Mem. Inst. Butantan 4:275–298.

Amaral, A. 1930. Notes on *Spilotes pullatus*. Bull. Antiv. Inst. America 3:96-99.

Ávila-Pires, T.C.S. 1995. Lizards of Brazilian Amazonia (Reptilia: Squamata). Zool. Verhand. 299:1–706.

Beebe, W. 1946. Field notes on the snakes of Kartabo, British Guiana, and Caripito, Venezuela. Zoologica 31:11–52.

Belluomini, H.E. and A.R. Hoge. 1958 (1957/1958). Contribuição à biologia de *Eunectes murinus* (Linnaeus 1758) (Serpentes). Observações sobre hábitos alimentares de "sucuris" em cativeiro. Mem. Inst. Butantan 28:207–216.

Belluomini, H.E., T. Veinert, F. Dissmann, A.R. Hoge, and A.M. Penha. 1977 (1976/1977). Notas biológicas a respeito do gênero *Eunectes* Wagler, 1830 "sucuris" [Serpentes: Boinae]. Mem. Inst. Butantan 40/41:79–115.

Brongersma, L.D. 1966. Note on *Leptomicrurus collaris* (Schlegel) (Reptilia, Serpentes). Zool. Meded. 41:243–254.

Cadle, J.E. and H.W. Greene. 1993. Phylogenetic patterns, biogeography, and the ecological structure of Neotropical snake assemblages. In: R.E. Ricklefs and D. Schluter (eds.), *Species Diversity in Ecological Communities*, pp. 281–293. The University of Chicago Press, Chicago, Illinois.

Campbell, H.W. and S.P. Christman. 1982. Field techniques for herpetofaunal community analysis. In: N.J. Scott, Jr. (ed.), *Herpetological Communities: a Symposium of the Society for the Study of Amphibians and Reptiles and the Herpetologists' League*, pp. 193–200. U.S. Fish Wild. Serv. Wildl. Res. Rep. 13.

Campbell, J.A. and W.W. Lamar. 1989. *The Venomous Reptiles of Latin America*. Cornell University Press, Ithaca, New York.

Chapman, C.A. 1986. *Boa constrictor* predation and a group response in White-faced *Cebus* monkeys. Biotropica 18:171–172.

Chippaux, J.P. 1986. *Les serpents de la Guyane Française*. ORSTOM, Paris.

Conners, J.S. 1989. *Oxybelis fulgidus* (Green Vine Snake). Reproduction. Herpetol. Rev. 20:73.

Cunha, O.R. and F.P. Nascimento. 1975. Ofídios da Amazônia VII - As serpentes peçonhentas do gênero *Bothrops* (jararacas) e *Lachesis* (surucucu) da região leste do Pará. (Ophidia, Viperidae). Bol. Mus. Par. Emílio Goeldi 83:1–42.

Cunha, O.R. and F.P. Nascimento. 1978. Ofídios da Amazônia X - As cobras da região leste do Pará. Publ. Avul. Mus. Par. Emílio Goeldi 31:1–218.

Cunha, O.R. and F.P. Nascimento. 1980. Ofídios da Amazônia XI - Ofídios de Roraima e notas sobre *Erythrolamprus bauperthuisii* Duméril, Bibron & Duméril, 1854, sinônimo de *Erythrolamprus aesculapii* aesculapii (Linnaeus, 1758). Bol. Mus. Par. Emílio Goeldi 102:1–21.

Cunha, O.R. and F.P.Nascimento. 1981. Ofídios da Amazônia XII - Observações sobre a viviparidade em ofídios do Pará e Maranhão (Ophidia: Aniliidae, Boidae, Colubridae e Viperidae). Bol. Mus. Par. Emílio Goeldi 109:1–20.

Cunha, O.R. and F.P.Nascimento. 1982*a*. Ofídios da Amazônia XIV - As espécies de *Micrurus*, *Bothrops*, *Lachesis* e *Crotalus* do sul do Pará e oeste do Maranhão, incluindo áreas de cerrado deste estado. (Ophidia: Elapidae e Viperidae). Bol. Mus. Par. Emílio Goeldi 112:1–58.

Cunha, O.R. and F.P. Nascimento. 1982*b*. Ofídios da Amazônia XV - As espécies de *Chironius* da Amazônia oriental (Pará, Amapá e Maranhão). (Ophidia: Colubridae). Mem. Inst. Butantan 46:139–172.

Cunha, O.R. and F.P. Nascimento. 1983*a*. Ofídios da Amazônia XIX - As espécies de *Oxyrhopus* Wagler, com uma subspécie nova, e *Pseudoboa* Schneider, na Amazônia oriental e Maranhão. (Ophidia, Colubridae). Bol. Mus. Par. Emílio Goeldi 122:1–42.

Cunha, O.R. and F.P. Nascimento. 1983*b*. Ofídios da Amazônia XX - As espécies de *Atractus* Wagler, 1828, na Amazônia oriental e Maranhão. (Ophidia, Colubridae). Bol. Mus. Par. Emílio Goeldi 123:1–38.

Cunha, O.R. and F.P.Nascimento. 1984. Ofídios da Amazônia XXI. *Atractus zidoki* no leste do Pará e notas sobre *A. alphonsehogei* e *A. schach* (Ophidia: Colubridae). Bol. Mus. Par. Emílio Goeldi, Sér. Zool. 1:219–225.

Cunha, O.R. and F.P. Nascimento. 1993. Ofídios da Amazônia. As cobras da região leste do Pará. Bol. Mus. Par. Emílio Goeldi, Sér. Zool. 9:1–191.

Cunha, O.R., F.P. Nascimento and T. C. S. Ávila-Pires. 1985. Os répteis da área de Carajás, Pará, Brasil (Testudines e Squamata). Publ. Avul. Mus. Par. Emílio Goeldi 40:10–92.

Di-Bernardo, M. 1992. Revalidation of the genus *Echinanthera* Cope, 1894, and its conceptual amplification (Serpentes, Colubridae). Comun. Mus. Ciênc. PUCRS, série zool. 5:225–256.

Dixon, J.R. 1979. Origin and distribution of reptiles in lowland tropical rainforests of South America. In: W.E. Duellman (ed.), *The South American Herpetofauna: its Origin, Evolution, and Dispersal*, pp. 217–240. Mus. Nat. Hist. Univ. Kansas Monogr. 7.

Dixon, J.R. 1983*a*. Systematics of *Liophis reginae* and *L. williamsi* (Serpentes, Colubridae), with a description of a new species. Ann. Carnegie Mus. 52:113–138.

Dixon, J.R. 1983*b*. The *Liophis cobella* group of the Neotropical colubrid snake genus *Liophis*. J. Herpetol. 17:149–165.

Dixon, J.R. 1987. Taxonomy and geographic variation of *Liophis typhlus* and related "green" species of South America (Serpentes: Colubridae). Ann. Carnegie Mus. 56:173–191.

Dixon, J.R. and F.S. Hendricks. 1979. The wormsnakes (Family Typhlopidae) of the Neotropics, exclusive of the Antilles. Zool. Verhand. 173:1–39.

Dixon, J.R. and P.Soini. 1977. The reptiles of the upper Amazon basin, Iquitos region, Peru. II. Crocodilians, turtles and snakes. Contr. Biol. Geol. Milwaukee Publ. Mus. 1977:1–71.

Dixon, J.R. and P. Soini. 1986. *The Reptiles of the Upper Amazon Basin, Iquitos Region, Peru.* Milwaukee Public Museum, Milwaukee, Wisconsin.

Dixon, J.R., R.A. Thomas, and H.W. Greene. 1976. Status of the Neotropical snake *Rhabdosoma poeppigi* Jan, with notes on variation in *Atractus elaps* (Günther). Herpetologica 32:221–227.

Dixon, J.R., J.A. Wiest, Jr., and J.M. Cei. 1993. Revision of the Neotropical snake genus *Chironius* Fitzinger (Serpentes, Colubridae). Mus. Reg. Sci. Nat. Torino Monografie XIII:1-279.

DNPM (Departamento Nacional de Produção Mineral). 1976. *Radambrasil, Levantamento de Recursos Naturais*. Vol. 18. Manaus. Folha SA.20. Ministério das Minas e Energia, Rio de Janeiro, Rio de Janeiro.

Duellman, W.E. 1978. The biology of an equatorial herpetofauna in Amazonian Ecuador. Univ. Kans. Mus. Nat. Hist. Misc. Publ. 65:1–352.

Duellman, W.E. 1989. Tropical herpetofaunal communities: patterns of community structure in Neotropical rainforests. In: M.L. Harmelin-Vivien and F. Bourliére (eds.), *Vertebrates in Complex Tropical Systems*, pp. 61–88. Springer-Verlag, New York, New York.

Duellman, W.E. 1990. Herpetofaunas in Neotropical rainforests: comparative composition, history, and resource use. In: A. H. Gentry (ed.), *Four Neotropical Rainforests*, pp. 455–505. Yale University Press, New Haven, Connecticut.

Duellman, W.E. and J.R. Mendelson, III. 1995. Amphibians and reptiles from northern Departamento Loreto, Peru: taxonomy and biogeography. Univ. Kansas Sci. Bull. 55:329–376.

Duellman, W.E. and A.W. Salas. 1991. Annotated checklist of the amphibians and reptiles of Cuzco Amazonico, Perú. Occ. Pap. Mus. Nat. Hist. Univ. Kansas 143:1–13.

Egler, S.G., M.E. Oliveira, and M. Martins. 1996. *Bothrops atrox* (Common Lancehead). Foraging behavior and ophiophagy. Herpetol. Rev. 27:22–23.

Fitch, H.S. 1970. Reproductive cycles of lizards and snakes. Univ. Kansas Mus. Nat. Hist. Misc. Publ. 52:1–247.

Fitch, H.S. 1982. Reproductive cycles in tropical reptiles. Occ. Pap. Mus. Nat. Hist. Univ. Kansas 96:1–53.

Fitch, H.S. 1987. Collecting and life-history techniques. In: R.A. Seigel, J.T. Collins, and S.S. Novak (eds.), *Snakes: Ecology and Evolutionary Biology*, pp. 143–164. MacMillan Publishing Company, New York, New York.

Fleishman, L.J. 1985. Cryptic movement in the vine snake *Oxybelis aeneus*.Copeia 1985:242–245.

Fugler, C.M. 1986. La estructura de una comunidad herpetologica en las selvas benianas en la estación de sequia. Ecología en Bolívia 9:1–20.

Gasc, J.P. 1977. Liste commentée de lezards capturés en Amazonie Colombienne. Bull. Soc. Zool. France 102:267–276.

Gasc, J.P. and M.T. Rodrigues. 1980. Liste preliminaire des serpents de la Guyane Française. Bull. Mus. nat. Hist. Nat. Paris (A) 2:559–598.

Gilmore, R.M. and J.C. Murphy. 1993. On large anacondas, *Eunectes murinus* (Serpentes: Boidae), with special reference to the Dunn-Lamon record. Bull. Chicago Herpetol. Soc. 28:185–188.

Gomes, J.F. 1918. Contribuição para o conhecimento dos ophidios do Brazil. III. Ophidios do Museu Paraense. Mem. Inst. Butantan 1:57–77.

Goode, M. 1989. *Pseustes sulphureus*. Reproduction. Herpetol. Rev. 20:73.

Greene, H.W. 1973*a*. Defensive tail display by snakes and amphisbaenians. J. Herpetol. 7:143–161.

Greene, H.W. 1973*b*. The food habits and feeding behavior of New World coral snakes. Unpubl. M.S. Thesis. University of Texas at Arlington, Arlington, Texas, USA.

Greene, H.W. 1983*a*. Dietary correlates of the origin and radiation of snakes. Amer. Zool. 23:431–441.

Greene, H.W. 1983*b*. *Boa constrictor* (boa, bequer, boa constrictor). In: D.H. Janzen (ed.), *Costa Rican Natural History*, pp. 380–382. The University of Chicago Press, Chicago, Illinois.

Greene, H.W. 1986. Natural history and evolutionary biology. In: M.E. Feder and G.V. Lauder (eds.), *Predator-prey Relationships: Perspectives and Approaches from the Study of Lower Vertebrates*, pp. 99–108. The University of Chicago Press, Chicago, Illinois.

Greene, H.W. 1988. Antipredator mechanisms in reptiles. In: C. Gans and R.B. Huey (eds.), *Biology of the Reptilia, Vol. 16, Ecology B, Defense and Life History*, pp. 1–152. Alan R. Liss, New York, New York.

Greene, H.W. 1989. Ecological, evolutionary and conservation implications of feeding biology of Old World cat snakes, genus *Boiga* (Colubridae). Proc. Calif. Acad. Sci. 46:193–207.

Greene, H.W. 1993. What's good about *good* natural history. Herpetol. Nat. Hist. 1:3.

Greene, H.W. 1994*a*. Systematics and natural history, foundations for understanding and conserving biodiversity. Amer. Zool. 34:48–56.

Greene, H.W. 1994*b*. Homology and behavioral repertoires. In: B.K. Hall (ed.), *Homology: The Hierarchical Basis of Comparative Biology*, pp. 369–391. Academic Press, New York, New York.

Greene, H.W. and R.W. McDiarmid. 1981. Coral snake mimicry: does it occur? *Science* 213:1207–1212.

Hagmann, G. 1910. Die Reptilien der Insel Mexiana, Amazonenstrom. Zool. Jahrb. Jena 128:504–573

Hardy, D.L., Sr. 1994. Snakebite and field biologists in México and Central America: Report on ten cases with recommendations for field management. Herpetol. Nat. Hist. 2:67–82.

Henderson, R.W. 1974. Aspects of the ecology of the neotropical vine snake *Oxybelis aeneus* (Wagler). Herpetologica 30:19–24.

Henderson, R.W. 1982. Trophic relationships and foraging strategies of some New World tree snakes (*Leptophis*, *Oxybelis*, *Uromacer*). Amphib.-Rept. 3:71–80.

Henderson, R.W. 1993. On the diets of some arboreal boids. Herpetol. Nat. Hist. 1:91–96.

Henderson, R.W. and H.E.A. Boos. 1994. The tree boa (*Corallus enydris*) on Trinidad and Tobago. Liv. World, J. Trinidad & Tobago Field Natur. Club 1993–1994:3–5.

Henderson, R.W. and M.H. Binder. 1980. The ecology and behavior of the vine snakes (*Ahaetulla, Oxybelis, Thelotornis, Uromacer*): a review. Milwaukee Publ. Mus. Contrib. Biol. Geol. 37:1–38.

Henderson, R.W. and M.A. Nickerson. 1976*a*. Observations on the feeding behavior and movements of the snakes *Oxybelis aeneus* and *O. fulgidus*. Brit. J. Herpetol. 5:663–667.

Henderson, R.W. and M.A. Nickerson. 1976*b*. Observations on the behavioral ecology of three species of *Imantodes* (Reptilia, Serpentes, Colubridae). J. Herpetol. 10:205–210.

Henderson, R.W., T.W.P. Micucci, G. Puorto, R.W. Bourgeois. 1995. Ecological correlates and patterns in the distribution of Neotropical boines (Serpentes, Boidae): a preliminary assessment. Herpetol. Nat. Hist. 3:15-27.

Henderson, R.W., M.A. Nickerson and S. Ketcham. 1976. Short term movements of the snakes *Chironius carinatus, Helicops angulatus* and *Bothrops atrox* in Amazonian Peru. Herpetologica 32:304–310.

Hero, J.-M. and W.E. Magnusson. 1987. *Leptophis ahaetulla*. Food. Herpetol. Rev. 18:16.

Hero, J.-M. and A. Santos. 1987. *Eunectes murinus* (anaconda). Reproduction. Herpetol. Rev. 18:36

Hoge, A.R. and A.C.M. Nina. 1969. Serpentes coletadas pelo Instituto Nacional de Pesquisas da Amazônia. Mem. Inst. Butantan 30:71–96.

Hoge, A.R. and S.A.R.W.D.L. Romano. 1965. *Leptomicrurus* in Brazil. Mem. Inst. Butantan 32:1–8.

Hoogmoed, M.S. 1977. On a new species of *Leptotyphlops* from Surinam, with notes on the other Surinam species of the genus (Leptotyphlopidae, Serpentes). – Notes on the herpetofauna of Surinam V. Zool. Meded. 51:99–123.

Hoogmoed, M.S. 1979. The herpetofauna of the Guianan region. In: W.E. Duellman (ed.), *The South American Herpetofauna: its Origin, Evolution, and Dispersal*, pp. 241–279. Mus. Nat. Hist. Univ. Kansas Monogr. 7.

Hoogmoed, M.S. 1980. Revision of the genus *Atractus* in Surinam, with the resurrection of two species (Colubridae, Reptilia). Notes on the herpetofauna of Surinam VII. Zool. Verhand. 175:1–47.

Hoogmoed, M.S. 1982*a*. Nomenclatural problems relating to *Atractus trilineatus* Wagler, 1828. Zool. Meded. 56:131–138.

Hoogmoed, M.S. 1982*b*. Snakes of the Guianan region. Mem. Inst. Butantan 46:219–254.

Hoogmoed, M.S. and T.C.S. Ávila-Pires. 1991. Annotated checklist of the herpetofauna of Petit Saut, Sinnamary River, French Guiana. Zool. Meded. 65:53–88.

Hopkins, H.C. and M.J.G. Hopkins. 1982. Predation by a snake of a flower-visiting bat at *Parkia nitida* (Leguminosae: Mimosoideae). Brittonia 34:225–227.

Huey, R.B. and E.R.Pianka. 1981. Ecological consequences of foraging mode. Ecology 62:991–999.

Jorge da Silva, N., Jr. 1993. The snakes from Samuel hydroelectric power plant and vicinity, Rondônia, Brazil. Herpetol. Nat. Hist. 1:37–86.

Jorge da Silva, N., Jr. and J.W.Sites, Jr. 1995. Patterns of diversity of Neotropical squamate reptile species with emphasis on the Brazilian Amazon and the conservation potential of indigenous reserves. Conserv. Biol. 9:873–901.

Keiser, E.D., Jr. 1975. Observations on tongue extension of vine snakes (*Oxybelis*) with suggested behavioral hypotheses. Herpetologica 31:131-133.

Keiser, E.D., Jr. 1989. *Oxybelis boulengeri* Procter, a valid species of vine snake from South America. *Copeia* 1989:764–768.

Lancini, A.R. 1979. *Serpientes de Venezuela.* Editorial Ernesto Armitano, Caracas.

Lemke, T.O. 1978. Predation upon bats by *Epicrates cenchriis cenchris* in Colombia. Herpetol. Rev. 9:47.

Leopoldo, P.R., W. Franken, E. Salati, and M.N. Ribeiro. 1987. Towards a water balance in the central Amazonian region. Experientia 43:222–233.

Lescure, J. and J.P. Gasc. 1986. Partage de l'espace forestier par les amphibiens et les reptiles em Amazonie du Nord-Ouest. Caldasia 15:707–723.

Lieb, C.S. 1988. Systematic status of the Neotropical snakes *Dendrophidion dendrophis* and *D. nuchalis* (Colubridae). Herpetologica 44:162–175.

Machado, S.R. 1993. A new genus of Amazonian vine snake (Xenodontinae: Alsophiini). Acta Biol. Leopoldensia 15:99–108.

Marques, O.A.V. and G. Puorto. 1991. Padrões cromáticos, distribuição e possível mimetismo em *Erythrolamprus aesculapii* (Serpentes, Colubridae). Mem. Inst. Butantan 53:127–134.

Marques, O.A.V. and G. Puorto. 1994. Dieta e comportamento alimentar de *Erythrolamprus aesculapii*, uma serpente ofiófaga. Rev. Brasil. Biol. 54:253–259.

Martins, M. 1991. The lizards of Balbina, Central Amazonia, Brazil. Stud. Neotrop. Fauna Environ. 26:179–190.

Martins, M. 1993. Why do snakes sleep on the vegetation in Central Amazonia? Herpetol. Rev. 24:83–84.

Martins, M. 1996. Defensive tactics in lizards and snakes: the potential contribution of the Neotropical fauna. In: Del Claro, K. (ed.), *Anais do XIV Encontro Anual de Etologia*, pp. 185–199. Sociedade Brasileira de Etologia, Universidade Federal de Uberlândia, Brasil.

Martins, M. and M. Gordo. 1993. *Bothrops atrox* (Common Lancehead). Diet. Herpetol. Rev. 24:151–152.

Martins, M. and M.E. Oliveira. 1993. The snakes of the genus *Atractus* (Reptilia: Squamata: Colubridae) from the Manaus region, central Amazonia, Brazil. Zool. Meded. 67:21–40.

Michaud, E.J. and J.R. Dixon. 1989. Prey items of 20 species of the Neotropical colubrid snake genus Liophis. Herpetol. Rev. 20:39-41.

Mole, R.R. 1924. The Trinidad snakes. Proc. Zool. London. 1924:235–278.

Mole, R.R. and F.W. Urich. 1894. Biological notes upon some of the Ophidia of Trinidad, B. W. I., with a preliminary list of the species recorded from the island. Proc. Zool. Soc. London 1894:499–518.

Montgomery, G.G. and A.S. Rand. 1978. Movements, body temperature and hunting strategy of *Boa constrictor.* Copeia 1978:532–533.

Murphy, J.C. 1997. *Amphibians and Reptiles of Trinidad and Tobago.* Krieger Publishing Company, Malabar.

Murphy, J.C. and R.W. Henderson. 1997. *Tales of Giant Snakes: A Historical Natural History of Anacondas and Pythons.* Krieger Publishing Company, Malabar.

Mushinsky, H.R. 1987. Foraging ecology. In: R.A. Seigel, J.T. Collins, and S.S. Novak (eds.), *Snakes: Ecology and Evolutionary Biology*, pp. 302–334. MacMillan Publishing Company, New York, New York.

Myers, C. W. 1974. The systematics of *Rhadinaea* (Colubridae), a genus of New World snakes. Bull. Amer. Mus. Nat. Hist. 153:1–262.

Myers, C.W. 1982. Blunt-headed vine snakes (*Imantodes*) in Panama, including a new species and other revisionary notes. Am. Mus. Novitates 2738:1–50.

Myers, C. W. and J. E. Cadle. 1994. A new genus for South American Snakes related to *Rhadinaea obtusa* Cope (Colubridae) and resurrection of *Taeniophalus* Cope for the "*Rhadinaea*" *brevirostris* group. Am. Mus. Novitates 3102:1–33.

Nascimento, F.P., T.C.S. Ávila-Pires, and O.R. Cunha. 1987. Os répteis da área de Carajás, Pará, Brasil (Squamata) II. Bol. Mus. Par. Emílio Goeldi, Sér. Zool. 3:33–65.

Nascimento, F.P., T.C.S. Ávila-Pires, and O.R. Cunha. 1988. Répteis Squamata de Rondônia e Mato Grosso coletados através do Programa Polonoroeste. Bol. Mus. Par. Emílio Goeldi, Sér. Zool. 4:21–66.

Oliver, J.A. 1948. The relationships and zoogeography of the genus *Thalerophis* Oliver. Bull. Amer. Mus. Nat. Hist. 92:157–280.

Orejas Miranda, B.R. 1969. Tres nuevos *Leptotyphlops* (Reptilia: Serpentes). Com. Zool. Mus. Hist. Nat. Montevideo 10:1–123.

O´Shea, M.T. 1989. The herpetofauna of Ilha de Maracá, State of Roraima, Northern Brazil. In: Coote J. (ed.), *Reptiles: Proceedings of the 1988 U.K. Herpetological Societies Symposium on Captive Breeding,* pp. 51–72. British Herpetological Society.

Pasteur, G. 1982. A classificatory review of mimicry systems. Ann. Rev. Ecol. Syst. 13:169–199.

Peters, J.A. 1960. The snakes of the subfamily Dipsadinae. Misc. Publ. Mus. Zool. Univ. Michigan 114:1–224.

Pope, C.H. 1961. *The giant snakes.* Alfred A. Knopf, New York, New York.

Pough, F.H. 1988. Mimicry and related phenomena. In: C. Gans and R.B. Huey (eds.), *Biology of the Reptilia, Vol. 16, Ecology B, Defense and Life History*, pp. 153–234. Alan R. Liss, New York, New York.

Prance, G.T. 1990. The floristic composition of the forests of central Amazonian Brazil. In: A.H. Gentry (ed.), *Four Neotropical Rainforests*, pp. 112–140. Yale University Press, New Haven, Connecticut.

Prudente, A.L.C, J. C. Moura-Leite, and S.A.A. Morato. 1998. Alimentação das espécies de *Siphlophis* Fitzinger (Serpentes, Colubridae, Xenodontinae, Pseudoboini). Rev. Bras. Zool. 15:375-383.

Rand, A.S. 1969. *Leptophis ahaetulla* eggs. Copeia 1969:402.

Rodríguez, L.B. and J.E. Cadle. 1990. A preliminary overview of the herpetofauna of Cocha Cashu, Manu National Park, Peru. In: A.H. Gentry (ed.), *Four Neotropical Rainforests*, pp. 410–425. Yale University Press, New Haven, Connecticut.

Rossman, D.A. 1975. Redescription of the South American colubrid snake *Helicops hagmanni* Roux. Herpetologica 31:414–418.

Roze, J.A. 1966. *La taxonomia y zoogeografía de los ofídios de Venezuela.* Edic. Bibl. Univ. Central Venezuela, Caracas.

Roze, J.A. 1982. New World coral snakes (Elapidae): a taxonomic and biological summary. Mem. Inst. Butantan 46:305–338.

Roze, J. A. 1996. *Coral Snakes of the Americas: Biology, Identification, and Venoms.* Krieger Publishing Company, Malabar, Florida.

Roze, J.A. and A. Bernal-Carlo. 1987. Las serpientes corales venenosas del género *Leptomicrurus* (Serpentes, Elapidae) de Suramérica con descripción de una nueva subespecie. Boll. Mus. Reg. Sci. Nat. Torino 5:573–608.

Sasa, M. and A. Solórzano. 1995. The reptiles and amphibians of Santa Rosa National Park, Costa Rica, with comments about herpetofauna of xerophytic areas. Herpetol. Nat. Hist. 3:113-126.

Savage, J.M. and J.B. Slowinsky. 1992. The colouration of the venomous coral snakes (family Elapidae) and their mimics (families Aniliidae and Colubridae). Biol. J. Linn. Soc. 45:235–254.

Sazima, I. and A.S. Abe. 1991. Habits of five Brazilian snakes with coral-snake pattern, including a summary of defensive tactics. Stud. Neotrop. Fauna Environ. 26:159–164.

Schmidt, K.P. 1952. The Surinam coral snake *Micrurus surinamensis*. Fieldiana Zool. 34:25–34.

Schmidt, K.P. 1953*a*. Hemprich's coral snake *Micrurus hemprichii*. Fieldiana Zool. 34:165–170.

Schmidt, K.P. 1953*b*. The Amazonian coral snake *Micrurus spixii.* Fieldiana Zool. 34:171–180.

Schmidt, K.P. 1955. Coral snakes of the genus *Micrurus* in Colombia. Fieldiana Zool. 34:337–359.

Schmidt, K.P. and R.F. Inger. 1951. Amphibians and reptiles of the Hopkins-Branner expedition to Brazil. Fieldiana Zool. 31:439–465.

Schwartz, A. and R.W. Henderson. 1991. *Amphibians and Reptiles of the West Indies: Descriptions, Distributions, and Natural History.* University of Florida Press, Gainesville, Florida.

Sexton, O.J. and H.F. Heatwole. 1965. Life history notes on some Panamanian snakes. Carib. J. Sci. 5:39–43.

Spellerberg, I.F. 1977. Marking live snakes for identification of individuals in population studies. J. Appl. Ecol. 14:137–138.

Stafford, P.J. and R.W. Henderson. 1996. Kaleidoscopic Tree Boas: The Genus *Corallus* of Tropical America. Krieger Publishing Company, Malabar.

StatSoft, 1996. *Statistica for Windows (Computer Program Manual).* StatSoft, Inc., Tulsa, Oklahoma.

Strimple, P.D. 1993. Overview of the natural history of the Green Anaconda (*Eunectes murinus*). Herpetol. Nat. Hist. 1:25–35.

Test, F.H., O.J. Sexton and H. Heatwole. 1966. Reptiles of Rancho Grande and vicinity, Estado Aragua, Venezuela. Misc. Publ. Mus. Zool. Univ. Michigan 128:1–63.

Vanzolini, P.E. 1985. *Micrurus averyi* Schmidt, 1939, in Central Amazonia (Serpentes, Elapidae). Pap. Avuls. Zool. 36:77–85.

Vanzolini, P.E. 1986. *Levantamento herpetológico da área do Estado de Rondônia sob a influência da rodovia BR 364.* Programa Polonoroeste, Subprograma Ecologia Animal, Relatório de Pesquisa no 1, CNPq, Brasília, Brasil.

Vitt, L.J. 1992. Lizard mimics millipede. Nat. Geogr. Res. Expl.8:76–95.

Vitt, L.J. 1996. Ecological observations on the tropical colubrid snake *Leptodeira annulata*. Herpetol. Nat. Hist. 4:69–76.

Wüster, W., M.G. Salomão, R.S. Thorpe, G. Puorto, M.F.D. Furtado, S.A. Hoge, R.D.G. Theakston, and D.A. Warrel. 1997. Systematics of the *Bothrops atrox* complex: new insights from multivariate analysis and mitochondrial DNA sequence information. Symp. Zool. Soc. Lond. 70:99–113.

Wüster, W., R.S. Thorpe, G. Puorto, and BBBSP. 1996. Systematics of the *Bothrops atrox* complex (Reptilia: Serpentes: Viperidae) in Brazil: a multivariate analysis. Herpetologica 52:263–271.

Yanosky, A.A., J.R. Dixon, and C. Mercolli. 1996. Ecology of the snake community at El Bagual Ecological Reserve, northeastern Argentina. Herpetol. Nat. Hist. 4:97-110.

Zaher, H. and U. Caramaschi. 1992. Sur le statut taxinomique d'*Oxyrhopus trigeminus* et *O. guibei* (Serpentes, Xenodontinae). Bull. Mus. Natl. Hist. Nat. 14:805–827.

Zaher, H. 1996. A new genus and species of pseudoboine snake, with a revision of the genus *Clelia* (Serpentes, Xenodontinae). Boll. Mus. Reg. Sci. Nat. Torino 14:289–337.

Zimmermann, B.L. and M.T. Rodrigues. 1990. Frogs, Snakes, and Lizards of the INPA/WWF reserves near Manaus, Brazil. In: A.H. Gentry (ed.), *Four Neotropical Rainforests*, pp. 426–454. Yale University Press, New Haven, Connecticut.

Zug, G.R., S.B. Hedges, and S. Sunkel. 1979. Variation in reprodutive parameters of three neotropical snakes, *Coniophanes fissidens*, *Dipsas catesbyi* and *Imantodes cenchoa*. Smithsonian Contributions to Zoology 1979:1–20.

# ERRATUM

In the article "Natural History of Snakes in Forests of the Manaus Region, Central Amazonia, Brazil" by Marcio Martins and M. Ermelinda Oliveira (Herpetological Natural History 6:78–150), an important acknowledgment was inadvertently omitted after the proofing stage. On page 144 of the article, the following paragraph must be inserted at the beginning of the Acknowledgments section:

*"The final preparation of the manuscript during the last two years, as well as most of the laboratory work on the pitvipers treated herein, were made possible through a helpful grant from the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP, grant 1995/09642-5)."*

We regret this error.