

Distribution and natural history of the Ecuadorian Toad-headed Pitvipers of the genus *Bothrocophias* (Squamata: Serpentes: Viperidae: Crotalinae)

Verbreitung und Naturgeschichte der ecuadorianischen Krötenkopf-Grubenottern
der Gattung *Bothrocophias*
(Squamata: Serpentes: Viperidae: Crotalinae)

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KURZFASSUNG

Spärlich sind die Kenntnisse über Grubenottern der Gattung *Bothrocophias*. Die vorliegende Arbeit enthält Informationen zu drei *Bothrocophias* Arten aus Ecuador: *Bothrocophias campbelli* (FREIRE LASCANO, 1991), *B. hyoprora* (AMARAL, 1935) und *B. microphthalmus* (COPE, 1875), einschließlich Angaben zur geographischen und vertikalen Verbreitung, zu Nachweisen in den Provinzen, sympatrischen Grubenotternarten, Aktivitätsmustern, Verhalten, Körpergröße, Fortpflanzungsbiologie, Nahrung und Lebensalter. *Bothrocophias campbelli* bewohnt die nördlichen, zentralen und südlichen Gebiete der pazifischen Andenabhänge Ecuadors zwischen 800 und 2000 m; *Bothrocophias hyoprora* kommt im nördlichen und südlichen Amazonastiefland und an den unteren östlichen Hängen der Anden Ecuadors zwischen 210 und 1500 m vor, *Bothrocophias microphthalmus* an deren Südosthängen zwischen 600 und 2350 m. Die Arbeit berichtet über den zweiten Fundortnachweis von *B. campbelli* in der Provinz Imbabura und den westlichsten Fundort von *B. hyoprora* im Tal des Nangaritza Flusses. Das sympatrische Vorkommen von *B. hyoprora* und *B. microphthalmus* im Makuma-Gebiet, Provinz Morona-Santiago, wird bestätigt, was die bisher bekannte obere Verbreitungsgrenze von *B. microphthalmus* auf zumindest 600 m anhebt. Das Weißbauch-Mausopossum *Marmosops noctivagus* wird erstmals als Beutetier von *B. microphthalmus* beschrieben. Die neuen Daten über die Fortpflanzungsbiologie von Grubenottern der Gattung *Bothrocophias* umfassen Wurfgröße und Körperlänge Neugeborener bei *B. hyoprora* und *B. microphthalmus*.

Weibchen der Gattung *Bothrocophias* können bis zu 47 vergrößerte Follikel produzieren; die bekannten Wurfgrößen liegen zwischen drei und 36. Das Auftreten von vergrößerten Ovarialfollikeln wurde bei *B. campbelli* im April, das von Jungtieren bei *B. microphthalmus* im Dezember und bei *B. hyoprora* von August bis September beobachtet. Die relative Gelegemasse in der Gattung *Bothrocophias* lag zwischen 0,22 (*B. microphthalmus*) und 0,30 (*B. hyoprora*).

ABSTRACT

Limited information is available for pitvipers of the genus *Bothrocophias*. This article presents information on the three species of *Bothrocophias* known to occur in Ecuador: *Bothrocophias campbelli* (FREIRE LASCANO, 1991), *B. hyoprora* (AMARAL, 1935), and *B. microphthalmus* (COPE, 1875), including geographical distribution, altitudinal range, provincial records, sympatric pitviper species, activity patterns, behavior, size, reproductive biology, diet, and longevity. *Bothrocophias campbelli* inhabits the northern, central and southern regions of the Pacific slopes of the Andes in Ecuador between 800 and 2000 m; *Bothrocophias hyoprora* occurs in the northern and southern Amazonian lowlands and low eastern slopes of the Andes in Ecuador between 210 and 1500 m; *Bothrocophias microphthalmus* occurs in the south-eastern slopes of the Andes in Ecuador between 600 and 2350 m. We report the second known locality of *B. campbelli* in the province of Imbabura and the westernmost locality of *B. hyoprora* in the Nangaritza river valley. The sympatry between *B. hyoprora* and *B. microphthalmus* is confirmed, at the Makuma area, province of Morona-Santiago, increasing the vertical distribution range of *B. microphthalmus* to at least 600 m. The White-bellied Slender Mouse Opossum *Marmosops noctivagus* is reported for the first time as a prey of *B. microphthalmus*. We herein report some novel data on the reproductive biology of *Bothrocophias* pitvipers, including litter and neonates sizes for *B. hyoprora* and *B. microphthalmus*.

Bothrocophias pitvipers can produce up to 47 enlarged follicles and known litter sizes range from three to 36 young. Enlarged ovarian follicles have been reported in April for *B. campbelli*, juveniles in December for *B. microphthalmus* and from August to September for *B. hyoprora*. The relative clutch mass values in *Bothrocophias* ranged from 0.22 (in *B. microphthalmus*) to 0.30 (in *B. hyoprora*).

KEY WORDS

Reptilia: Squamata: Serpentes: Viperidae: Crotalinae: *Bothrocophias campbelli*, *Bothrocophias hyoprora*, *Bothrocophias microphthalmus*; Ecuador; behavior; distribution; ecology, diet, natural history; reproductive biology; venomous snake

INTRODUCTION

Snakes of the subfamily Crotalinae (family Viperidae), commonly known as pit-vipers, are widely distributed in America and the Old World; with seventeen species occur-

ring in Ecuador (CAMPBELL & LAMAR 2004). Much attention has been focused on these venomous snakes because of their medical importance in comparison with other snake

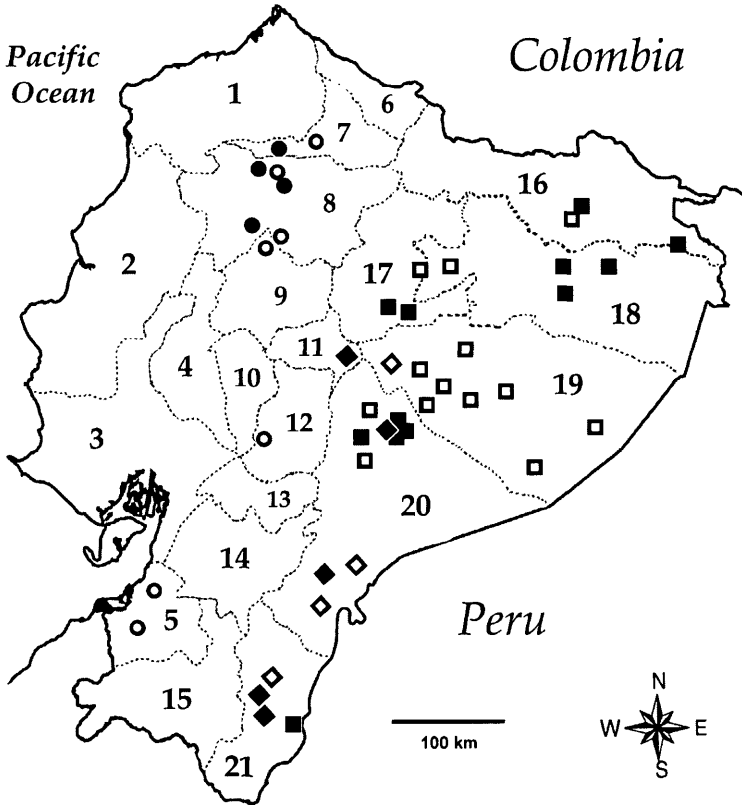


Figure 1: Distribution in Ecuador of *Bothrocophias campbelli* (FREIRE LASCANO, 1991) (● ○), *B. hyoprora* (AMARAL 1935) (■ □), and *B. microphthalmus* (COPE 1876) (◆ ◇). Examined material = (● ■ ◆); data from literature = (○ □ ◇) (ORCÉS 1943, 1948; SCHÄTTI & KRAMER 1993; TOUZET 1986; FREIRE & KUCH 2000; GUTBERLET & CAMPBELL 2001; CAMPBELL & LAMAR 2004). A symbol can represent more than one locality. Numbers correspond to the mainland Ecuadorian provinces: Esmeraldas (1), Manabí (2), Guayas (3), Los Ríos (4), El Oro (5), Carchi (6), Imbabura (7), Pichincha (8), Cotopaxi (9), Bolívar (10), Tungurahua (11), Chimborazo (12), Cañar (13), Azuay (14), Loja (15), Sucumbios (16), Napo (17), Orellana (18), Pastaza (19), Morona-Santiago (20), Zamora-Chinchi (21). Continuous thick line: international border; thin dotted line: borders of provinces.

Abb. 1: Verbreitung in Ecuador von *Bothrocophias campbelli* (FREIRE LASCANO, 1991) (● ○), *B. hyoprora* (AMARAL 1935) (■ □) und *B. microphthalmus* (COPE 1876) (◆ ◇). Untersuchtes Material = (● ■ ◆); Literaturangaben = (○ □ ◇) (ORCÉS 1943, 1948; SCHÄTTI & KRAMER 1993; TOUZET 1986; FREIRE & KUCH 2000; GUTBERLET & CAMPBELL 2001; CAMPBELL & LAMAR 2004). Ein Symbol kann mehr als einen Fundort darstellen. Die Numerierung bezieht sich auf die ecuadorianischen Festlandsprovinzen: Esmeraldas (1), Manabí (2), Guayas (3), Los Ríos (4), El Oro (5), Carchi (6), Imbabura (7), Pichincha (8), Cotopaxi (9), Bolívar (10), Tungurahua (11), Chimborazo (12), Cañar (13), Azuay (14), Loja (15), Sucumbios (16), Napo (17), Orellana (18), Pastaza (19), Morona-Santiago (20), Zamora-Chinchi (21). Ununterbrochene starke Linie: Landesgrenzen von Ecuador; punktierte Linie: Provinzgrenzen.

groups; yet our knowledge on most pitvipers species still lacks basic biological data, and only limited information on their distribution and ecology is available (CAMPBELL & LAMAR 2004). GUTBERLET & CAMPBELL (2001) described the genus *Bothrocophias* to accommodate five species of terrestrial, stout-bodied pitvipers from north-western South America. Three of these species are found in Ecuador (CAMPBELL & LAMAR 2004): *Bothrocophias campbelli* (FREIRE LASCANO, 1991), *Bothrocophias hyo-*

prora (AMARAL, 1935), and *Bothrocophias microphthalmus* (COPE, 1875).

As the greatest constraint in conservation planning for either individual species or entire snake assemblages is the fundamental lack of basic biological information on most species (DODD 1993), the aim of the present paper is to report updated information on the distribution and natural history of the Toad-headed Pitvipers of the genus *Bothrocophias* in Ecuador.

MATERIALS AND METHODS

Field data was collected at various localities in western and eastern Ecuador either by visual encounter surveys, opportunistic observations or from specimens collected by natives. Some snakes were maintained under captive conditions at the Vivarium de Quito, where records on captive-born offspring were obtained. Comparative data was obtained through examination of preserved specimens and from the literature. Measurements were taken with a meter stick and string. Body weight was recorded to the nearest 1 g using Ohaus® scales. All mean values are expressed as \pm 95% confidence interval. Museum specimens were dissected to analyze their stomach contents and to determine their reproductive status. Stomachs were removed, opened, and the content separated and spread in dishes for identification. For each species we calculated mean and ranges for litter size and neonate size, as well as relative clutch mass. Information of activity and foraging modes was based on observations in the field and

in captivity and on information from the literature. The following abbreviations are used throughout the text: FHGO (Fundación Herpetológica Gustavo Orcés' collection, Quito); FHGO-alive (animals alive at the Vivarium of Quito); DFCH-USFQ (Diego F. CISNEROS-HEREDIA's collection housed at the Universidad San Francisco de Quito); USNM (National Museum of Natural History, Smithsonian Institution, Washington, D.C.); TL (total length, from the tip of the snout to the tip of the tail); SVL (snout-vent length); RCM (relative clutch mass = total offspring mass / female total mass). Localities and their geographic coordinates and elevations were obtained from collector's field notes and museum records, and revised according to the 2000 physical map of the Republic of Ecuador published by the Instituto Geográfico Militar and NIMA (2003). In order to classify the main types of habitats at the country level, we used the vegetation formations of SIERRA (1999).

SPECIES ACCOUNTS

Bothrocophias campbelli (FREIRE LASCANO, 1991)

Distribution and sympatry. – *Bothrocophias campbelli* has been reported to occur on the Pacific versant of the Andes of Ecuador at elevations between about 1,300 and 2,000 m (GUTBERLET & CAMPBELL 2001; CAMPBELL & LAMAR 2004), with records in the provinces of Imbabura, Pichin-

cha, Cotopaxi, Chimborazo, and El Oro (ORCÉS 1948; FREIRE LASCANO 1991; CAMPBELL & LAMAR 1992; SCHÄTTI & KRAMER 1993; FREIRE & KUCH 2000). Five additional specimens are herein reported from the province of Pichincha and Imbabura (appendix 1, figure 1); two specimens from the province of Imbabura (FHGO 582, 787) represent the second known collecting locality from that province (previously

reported from the "region de Intag" by ORCÉS 1948; CAMPBELL & LAMAR 1992), and the records from Alluriquín, province of Pichincha (FHGO 109, 334) increase the lower range of altitudinal distribution to as low as 800 m (Appendix 1).

Bothrocophias campbelli is sympatric with *Bothriechis schlegelii* (BERTHOLD, 1846), *Bothrops asper* (GARMAN, 1884), and *Bothrops osbornei* FREIRE LASCANO, 1991 in the area of Mindo (Pichincha, this study) and the Cantón Pallatanga (Chimbo-razo, FREIRE LASCANO 1991).

Activity patterns and behavior. – Individuals of *B. campbelli* observed in the surroundings of Mindo and at the Mashpi Protected Forest (18 km N of San Miguel de Los Bancos, on the road between Nanegalito-Pacto-Gualea-Mashpi-Pachijal, 1100 m) were active during the late afternoon and early evening, moving on the floor among the leaf litter, inside or on the borders of primary forest (pers. obs.).

Bothrocophias hyoprora
(AMARAL, 1935)

Distribution and sympatry. – *Bothrocophias hyoprora* occurs at low elevations in equatorial forests of the Amazon basin in Colombia, eastern Ecuador, Peru, Bolivia, and western Brazil, from near sea level to at least 1000 m (CAMPBELL & LAMAR 2004). The species has been reported from all Amazonian provinces in Ecuador (Sucumbíos, Napo, Orellana, Pastaza, Morona-Santiago and Zamora-Chinchipe; ORCÉS 1943, 1948; TOUZET 1986; SCHÄTTI & KRAMER 1993). Twenty-four specimens of *B. hyoprora* were studied (appendix 1, figure 1); and one specimen (FHGO-alive 2621) from the Nangaritza river valley represents the westernmost locality of the species.

Bothrocophias hyoprora is sympatric with seven species of pitvipers in the area of Makuma (or Macuma), Province of Morona-Santiago: *Bothriopsis bilineata* (WIED-NEUWIED, 1821), *Bothriopsis pulchra* (PETERS, 1862), *Bothriopsis taeniata* (WAGLER, 1824), *Bothrocophias microphthalmus* (COPE, 1875) (see below for a discussion of this record), *Bothrops atrox* (LINNAEUS, 1758), *Bothrops brazili* HOGE, 1954, and

Lachesis muta (LINNAEUS, 1766). The area of Makuma encompasses a zone between 600 to 800 m in the south-eastern slopes of the Andes of Ecuador. Out of 156 pitvipers collected in the area of Makuma between May 1993 and December 2002, 36% were *Bothrops atrox*, 24% *Bothriopsis bilineata*, 21% *Bothrops brazili*, 11% *Bothrocophias hyoprora*, 6% *Bothriopsis taeniata*, and 1% each, *Bothriopsis pulchra*, *Bothrocophias microphthalmus*, and *Lachesis muta*.

Bothrocophias hyoprora is sympatric with at least four species of pitvipers at the Tiputini Biodiversity Station (TBS), Province of Orellana: *Bothriopsis bilineata*, *Bothriopsis taeniata*, *Bothrops atrox*, and *Lachesis muta*. TBS is located in the Amazonian lowlands between 250 to 300 m. Out of 60 pitvipers recorded at TBS between 1997 and 2003, 53% were *Bothrops atrox*, 30% *Bothrocophias hyoprora*, 10% *Bothriopsis bilineata*, 5% *Lachesis muta* and 2% *Bothriopsis taeniata*.

Activity patterns and behavior. – Individuals of *Bothrocophias hyoprora* observed at the Tiputini Biodiversity Station were active during the early and late evening, moving among the leaf litter in primary terra firme and partially flooded forest. One specimen was observed during the day (10:00 hr) inactive among dense vegetation 5 m from the border of an oxbow lake. One snake observed at the Jatun Sacha Biological Station was coiled up 2 m from a trail in secondary terra firme forest during late evening (19:00 hrs). One specimen from the Yasuní National Park was collected on primary terra firme forest, while inactive on the floor among leaf litter next to the roots of a *Ceiba* tree at 12:00 hr (F. SORNOZA field notes 17 June 1996). Various specimens from the province of Morona-Santiago were found in cultivated areas or in trails near areas inhabited by human during the morning and noon or in open areas directly on the nude floor at 17:00 hr. The specimen from Shaime (FHGO-alive 2621) was collected during the day in primary forest.

Size. – CAMPBELL & LAMAR (2004) reported the TL of adult *Bothrocophias hyoprora* to range mainly between 40 - 50 cm, and the maximum TL of females as 83.0 cm and that of males as 53.6 cm. Fourteen

adult female specimens herein analyzed had a mean total length of 62.9 ± 4.8 cm (range 45.0 - 78.0 cm), and a mean weight of 200.7 ± 55.6 g (range 52.0 - 356.0 g). Seven males had a mean total length of 46.8 ± 10.9 cm (range 35.4 - 65.1 cm, therefore increasing the known maximum TL), and five had a mean weight of 67.2 ± 60.9 g (range 21.5 - 174.5 g). All these specimens came from the province of Morona-Santiago. The differences in size between males and females are statistically significant (one-way ANOVA, $F = 13.38$, $p < 0.01$), with females being larger and heavier than males.

Reproduction. – A female *Bothrocophias hyoprora* captured at the Centro Amazonas-Makuma, Province of Morona-Santiago, on 18 August 1999, gave birth to 13 young on 2 December 1999. The female measured 66.7 cm in TL and weighed 356 g before birth. The neonates had a mean length of 18.07 ± 0.39 cm (range 17.0 - 19.0 cm), mean weight of 6.4 ± 0.6 g (range 4.5 - 7.2 g, combined mass of all young = 82.9 g), and RCM of 0.30. Four were stillborn; the other eight snakes were maintained alive for 3 to 74 days. Another female *B. hyoprora* captured at the Centro Chuwints-Makuma, Province of Morona-Santiago, on 29 September 1998, gave birth to three stillborn young on 3 January 1999. All had deformities in the vertebral column, caudal region and on the head. The female measured 56.5 cm in TL.

Longevity. – CAMPBELL & LAMAR (2004) noted the unavailability of information on the longevity of *Bothrocophias* species, stating that “*Bothrocophias* are uncommon and have not been maintained frequently in captivity”. One healthy specimen of *B. hyoprora* (FHGO-alive 2162) from the Centro Chuwints-Makuma has been held in captivity for almost six years and is still alive at the time of writing this article.

Bothrocophias microphthalmus
(COPE, 1875)

Distribution and sympatry. – *Bothrocophias microphthalmus* is distributed in the Amazonian slopes of the Andes from Colombia to Peru, between 1000 to at least 2350 m (GUTBERLET & CAMPBELL 2001; CAMPBELL & LAMAR 2004), with

records in the provinces of Pastaza, Zamora Chinchipe, Morona-Santiago and Tungurahua (SCHÄTTI & KRAMER 1993; KUCH & FREIRE 1995; GUTBERLET & CAMPBELL 2001; CAMPBELL & LAMAR 2004). CAMPBELL & LAMAR (2004: 324) suggested that *B. microphthalmus* and *B. hyoprora* may narrowly overlap in certain areas along the Amazonian versant of the Andes, but they did not have records and considered their sympatry unlikely in most areas (CAMPBELL & LAMAR 2004: 331). FONTENOT et al. (2004) stated that both species occur sympatrically in several areas along the eastern versant of the Andes. Out of ten specimens examined, two specimens of *B. microphthalmus* from the province of Morona-Santiago were collected in areas where *B. hyoprora* is known to occur (see geographic information of *B. hyoprora* in previous account), confirming its sympatry and increasing the lower range of altitudinal distribution of *B. microphthalmus* to at least 600 m (FHGO 2454, 2680). A specimen of *B. microphthalmus* (FHGO 3614) from El Topo (1200 m), province of Tungurahua, represents the second record and first preserved voucher from that province (WARREL 2004 reported a snakebite case with *B. microphthalmus* from that locality) (appendix 1, figure 1).

Activity patterns and behavior. – Information on specimens of *B. microphthalmus* indicates that this species is active during the early evening on the leaf litter in primary forest. One inactive specimen was observed during the day (15:00 hr) among the leaf litter.

Prey. – The stomach contents of two females from Namacuntza (Province of Zamora-Chinchipe) were analyzed. FHGO 669 measured 92 cm in TL (SVL 80 cm) and contained a White-bellied Slender Mouse Opossum *Marmosops noctivagus* (head-body length 68 cm, tail length 108 cm). FHGO 670 was 87 cm in TL (SVL 76 cm) and contained opossum hairs in the lower intestines that can be assigned also to *M. noctivagus* based on their microstructure.

Size. – Three adult females had total lengths of 66.6, 67.0 and 86.0 cm, and weights of 304, 115.5, and 377.7 g each. One male had a total length of 79.1 cm and weight of 126.4 g. It would appear that

females can attain bigger sizes and weights than males, as in *B. hyoprora*; however more data is needed to support this hypothesis.

Reproduction. – The reproductive status of the two specimens from Namacuntza collected in April 1999 was analyzed. The 92.0 cm female contained 37 enlarged follicles (10 mm in diameter), while the 87.0 cm female contained 47 enlarged follicles (12 mm in diameter). A female *B. microphthalmus* captured at the Centro Kiim-Makuma, province of Morona-Santiago, on

1 December 1998, gave birth to 13 young on 31 December 1998. The female measured 66.6 cm in total length and weighed 304 g before birth. The neonates had a mean length of 16.72 ± 0.85 cm (range 14.8 – 18.7 cm), mean weight of 4.2 ± 0.9 g (range 2.7 – 7.1 g, combined mass of all young = 54.7 g), and RCM of 0.22. Nine were stillborn; the other four young lived 24, 32, 55 and 930 days in captivity. The specimen that survived longest (FHGO 3194) increased its weight from initially 7.1 g to 11.5 g on 27 May 1999; it died on 18 July 2001.

DISCUSSION

New information presented in this paper along with data from the literature indicate that *Bothrocophias campbelli* occurs mainly inside or in the borders of primary and mature secondary forests in the northern, central and southern regions of the Pacific slopes of the Andes in Ecuador between 800–2000 m where it is found in the following vegetation formations: Foothill Evergreen forest, Low Montane Evergreen forest, and marginally into the Montane Cloud forest (FREIRE-LASCANO 1991; CAMPBELL & LAMAR 2004; this paper). *Bothrocophias hyoprora* occurs in a wide range of habitats, including primary forests, mature secondary forests, and cultivated areas, usually near wetlands (e.g. flooded forests, ponds, rivers, oxbow lakes), but also in terra firme forests with low hills; in the northern and southern Amazonian lowlands and low eastern slopes of the Andes in Ecuador between 210 – 1500 m. It inhabits the following vegetation formations: Lowland Evergreen Non-flooded forest, Lowland Evergreen Flooded forest by black-water rivers, Lowland Evergreen Flooded forest by white-water rivers, Foothill Evergreen forest, and Low Montane Evergreen forest (DIXON & SOINI 1986; DUELLMAN & MENDELSON 1995; CAMPBELL & LAMAR 2004; this paper). *Bothrocophias microphthalmus* occurs in primary and mature secondary forests in the south-eastern slopes of the Andes in Ecuador between 600 – 2350 m (it still remains unreported from the northern slopes, where it is expected to occur as it also inhabits south-eastern Andean Co-

lombia). It occupies the following vegetation formations: Low Montane Evergreen forest, Montane Cloud forest, and Foothill Evergreen forest (CAMPBELL & LAMAR 2004; this paper).

Bothrocophias myersi GUTBERLET & CAMPBELL, 2001 was described from southwestern Colombia, and the above authors mentioned the possibility that this species could inhabit the Ecuadorian Chocó region. Although destruction of the natural habitats in that area is extensive, especially by the illegal activities of timber companies, some undisturbed areas still remain. However, no specimens of *B. myersi* have yet been obtained from the area.

Pitvipers of the genus *Bothrocophias* prey upon rodents (FREIRE & KUCH 2000 for *Bothrocophias campbelli*; NICÉFORO-MARÍA 1938; CARRILLO DE ESPINOZA 1983; DUELLMAN & MENDELSON 1995 for *B. hyoprora*), *Atractus* snakes (D. SALAZAR pers. comm. for *B. campbelli*), gymnophthalmid lizards (CARRILLO DE ESPINOZA 1983; CAMPBELL & LAMAR 2004 for *B. hyoprora*), teiid lizards and hyliid tree frogs (PRADO & HOGE 1948 for *B. microphthalmus*), and caecilians (ZUFFI 2004 for *B. campbelli*). The report presented herein of *Bothrocophias microphthalmus* preying upon mouse opossums is the first record of predation on marsupials. Although mouse opossums are considered as mainly arboreal mammals, members of the genus *Marmosops* occupy both arboreal and terrestrial levels during their foraging activities (EMMONS & FEER 1999). Specifically, *Marmosops noctivagus* uses the floor

and the lower vegetation in the forest in areas with dense understory, especially near wetlands in primary or secondary forest (EMMONS & FEER 1999); therefore it is accessible as a prey for the terrestrial *B. microphthalmus*.

The data presented here and in the available literature (KUCH & FREIRE 1995; FREIRE & KUCH 2000; CAMPBELL & LAMAR 2004) indicate that *Bothrocophias* pitvipers can produce up to 47 enlarged follicles and known litter sizes range from three to 36. Reproductive *B. hyoprora* females had a mean TL of 63.0 cm (56.5 - 66.7 mm, $n = 3$), and offspring TL ranged between 17.0 - 19.0 cm (NEILL 1966; this paper). Reproductive *B. microphthalmus* females had a mean TL of 83.5 cm (66.6 - 92.0 cm, $n = 4$), and offspring TL ranged between 14.8 - 20.3 cm (KUCH & FREIRE 1995; this paper). The only report on *B. campbelli* indicates a

reproductive female TL of 105.7 cm (FREIRE & KUCH 2000). Enlarged ovarian follicles were reported in April for *B. campbelli* by FREIRE & KUCH (2000), juveniles in December for *B. microphthalmus* and from August to September for *B. hyoprora* (this paper). The RCM values in *Bothrocophias* ranged from 0.22 (in *B. microphthalmus*) to 0.30 (in *B. hyoprora*). Although the sample is small, *Bothrocophias* RCM values are similar to those reported for other viviparous viperids (SIEGEL & FITCH 1984). When comparing *B. hyoprora* and *B. microphthalmus*, RCM values suggest that these species follow SIEGEL et al.'s (1986) hypothesis about RCM tending to decrease with increasing body size in viviparous snakes; however the small sample size prevents further conclusions and future studies should look at this interesting tendency.

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RESUMEN

Limitada información se ha publicado sobre las serpientes venenosas del género *Bothrocophias*. Este artículo presenta información para las tres especies de *Bothrocophias* que habitan en Ecuador: *Bothrocophias campbelli* (FREIRE LASCANO, 1991), *B. hyoprora* (AMARAL, 1935), y *B. microphthalmus* (COPE, 1875); incluyendo datos sobre su distribución geográfica, rango altitudinal, registros provinciales, especies en simpatria, patrones de actividad, comportamiento, tamaño, biología reproductiva, dieta y longevidad. *Bothrocophias campbelli* habita las regiones norte, central y sur de la vertiente Pacífica de Ecuador entre 800 y 2000 m, *B. hyoprora* habita las regiones norte y sur de las tierras bajas de la Amazonía y vertientes bajas de la Cordillera Oriental entre 210 y 1500 m; y *B. microphthalmus* habita en las vertientes sureste de la Cordillera Oriental entre 600 y 2350 m. Se reporta la segunda localidad conocida para *B. campbelli* en la provincia de Imbabura y la localidad más occidental de *B. hyoprora* en el valle del Río Nangaritza. Se confirma la simpatria de *B. hyoprora* y *B. microphthalmus* en el área de Makuma, provincia de Morona-Santiago, incrementando el rango de distribución vertical de *B. microphthalmus* hasta al menos 600 m. La Raposa Chica de Vientre Blanco *Marmosops noctivagus* es reportada por primera vez como presa de *B. microphthalmus*. Se reporta nueva información sobre la biología reproductiva de *Bothrocophias*, incluyendo el tamaño de la camada y de los neonatos de *B. hyoprora* y *B. microphthalmus*.

Las serpientes *Bothrocophias* pueden producir hasta 47 folículos agrandados y el rango conocido del tamaño de las camadas incluye entre 3 a 36 individuos. Folículos agrandados en el ovario han sido reportados en Abril para *B. campbelli*, y juveniles en Diciembre para *B. microphthalmus* y entre Agosto y Septiembre para *B. hyoprora*. Los valores de la masa relativa de la puesta en *Bothrocophias* varían entre 0.22 (en *B. microphthalmus*) hasta 0.30 (en *B. hyoprora*).

APPENDIX 1 – Ecuadorian *Bothrocophias* specimens examined

Bothrocophias campbelli - Province of Pichincha: FHGO 109 from Alluriquin (00°19'48"S, 78°59'27"W, ca. 800 m), collected on 25 December 1990; FHGO 334 from Alluriquin (00°19'48"S, 78°59'27"W, ca. 800 m), collected on 25 January 1991; FHGO 1227 from Mindo (00°02'S, 78°46', 1200 m), collected on 23 July 1995. Province of Imbabura: FHGO 582 from Chontal Alto, García Moreno (00°17'12"N, 78°43'W, 1530 m), collected on 13 November 1992; FHGO 787 from Chontal Alto, García Moreno (00°17'12"N, 78°43'W, 1530 m), collected on March 1993.

Bothrocophias hyoprora - Province of Zamora-Chinchipe: FHGO-alive 2621 from Destacamento Militar Shaime (1040 m), collected on 13 September 2003. Province of Sucumbios: FHGO 1315 from Tarapoa (00°08'W, 76°24', 310 m) collected on 26 June 1995; FHGO 922 from Zancudococha (00°25'S, 75°30'W, 220 m) collected on 6 June 1994. Province of Orellana: DFCH-USFQ (3 unnumbered specimens) from Tiputini Biodiversity Station (0°37'05"S, 76°10'19"W, 250-300 m) collected between February 1998 and August 2000; FHGO 2465 from Parque Nacional Yasuni, carretera Pompeya Sur – Iro (300 m) collected on 17 June 1996. Province of Morona-Santiago: FHGO 178 from 4 km NE of Anduash (02°42'S, 77°45'W, 420 m) collected on 10 March

1996; FHGO 938, 1028, 1301, 2270, 2903 from Centro Amazonas-Makuma (02°08'S, 77°42'W, 600 m) collected between June 1993 and January 1999; USNM 165316 from "Maguma" (=Makuma); FHGO 2284-6, 2366, 2951 from Centro Chuwints-Makuma (01°59'S, 77°51'W, 600 m); FHGO 1174, 1029, 2448, 2895, 3574 from Centro Kiim-Makuma (03°00'S, 78°03'W, 600 m).

Bothrocophias microphthalmus - Province of Morona-Santiago FHGO 2680 from Centro Wisui-Makuma (02°08'S, 77°43'W, 600 m) collected on 27 March 1994; FHGO 2454 from Centro Kiim-Makuma (03°00'S, 78°03'W, 600 m) collected in December 1999. Province of Pastaza: USNM 165303 from near Puyo. Province of Morona-Santiago: FHGO 1663 from Pananza/San Miguel de Conchay (1000 m) collected on 12 October 1997. Province of Tungurahua: FHGO 3614 from El Topo (1200 m) collected on 28 August 1997. Province of Zamora-Chinchipe: FHGO 2027 from La Pituca, Cuenca del Río Curintza (04°09'S, 78°58'W, 1835 m) collected on 22 June 1998; FHGO 2300 from La Pituca, Cuenca del Río Curintza (04°09'S, 78°58'W, 1820 m) collected on 30 October 1998; FHGO 669, 670 from Namacuntza (03°59'S, 78°49'W, ca. 1400 m) collected in December 1991; FHGO 2451, 2566 from Numbami, Cuenca del Río Jambue (04°09'S, 78°55'W, ca. 1500 m) collected on 30 April 1999.

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