

NATURAL HISTORY OF THE VINE SNAKE *OXYBELIS FULGIDUS* (SERPENTES, COLUBRIDAE) FROM BRAZIL

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ABSTRACT. Aspects of natural history of the vine snake *Oxybelis fulgidus* from the northern region of Brazil were inferred based on the analysis of 106 preserved specimens (55 males and 51 females), and from a review of records in the published literature. Males mature at smaller size than females. Differences in body length and shape were also found among adult females and males: adult females are larger in mean snout-vent length and have relatively larger heads and shorter tails. Females have an extended seasonal vitellogenic cycle from April to December (mainly throughout the dry season). Oviductal eggs and egg-laying were recorded from September to December, while births occurred from January to April. Fecundity varied from four to twelve eggs or vitellogenic follicles ($n = 13$), and was positively correlated with female body length. Testicle volume is significantly larger from February to July (mainly in April and May; end of the rainy season), however the deferent ducts diameter do not differ significantly throughout the year. We hypothesized that both males and females may have an associated reproductive pattern, both synchronized in the end of the rainy season. *Oxybelis fulgidus* feeds on lizards (mainly iguanian) and passerine birds. Apparently, females feed more frequently on birds than males.

KEYWORDS. Snakes; Colubridae; tropical region; natural history; *Oxybelis fulgidus*.

INTRODUCTION

An understanding of the biology of snakes has increased rapidly over the last two decades, especially for snakes from temperate zones and Australia (Shine, 1991a; 2003; Greene, 1997; Gibbons and Dorcas, 2004). However, tropical snakes have received much less attention even though a remarkable morphological, phylogenetic, and ecological diversity exists. Despite recent efforts to study the feeding habits and reproductive biology of tropical snakes, particularly Neotropical colubrids (e.g., Fowler *et al.*, 1998; Hartmann and Marques, 2005; Pizzatto *et al.*, 2007; Pinto *et al.*, 2008; Pizzatto *et al.*, 2008a, b), it is still not possible to recognize patterns in many groups.

Vine snakes constitute a polyphyletic group of arboreal colubrids classified into two subfamilies (Montingelli, 2004): the Colubrinae *Ahaetulla* found in Asia, *Thelotornis* in Africa, and *Oxybelis* in the New World, as well as the Xenodontinae *Xenoxybelis* and *Uromacer* found in the Neotropical region. These snakes exhibit a wide variety of morphological, ecological and ethological convergent adaptations (e.g. slender body and elongated snout, large eye, binocular vision, cryptic coloration, diurnal activity and ambush foraging strategy) related to the detection and capture of active prey in arboreal habitats (Henderson and Binder, 1980; Henderson, 1982; Shine *et al.*, 1996; see also Montingelli, 2004, for a recent cladistic approach on morphological evolution of vine snakes).

The monophyletic genus *Oxybelis* (Machado, 1994; Vidal *et al.*, 2000) comprises four species, namely *O. aeneus*, *O. brevirostris*, *O. wilsoni*, and *O. fulgidus* (Peters and Orejas-Miranda, 1970; Villa and McCranie, 1995). *Oxybelis fulgidus* is widely distributed from Mexico to Central America and tropical South America (Peters and Orejas-Miranda, 1970). Although there are published data on the behavior and trophic ecology of this species (e.g., Henderson and Binder, 1980; Henderson, 1982), the available information on its reproduction, including sexual dimorphism, size at maturation and reproductive cycles, is scarce or even nonexistent. This paper describes and discusses data on natural history of *O. fulgidus* from the north region of Brazil and other Neotropical localities, in an attempt to provide a new approach for understanding its ecology.

MATERIAL AND METHODS

We analysed 106 preserved specimens of *Oxybelis fulgidus* (55 males and 51 females) housed in the herpetological collections of Instituto Butantan (IB) and Museu Paraense Emílio Goeldi (MPEG). The specimens were collected in the northern region of Brazil (states of Amapá, Amazonas, Maranhão, Mato Grosso, Pará, and Tocantins) in a range of localities between 0°02'N and 10°41'S, 43°25'E and 65°08'W (see Figure 1 and Appendix 1). The climate condi-

tion is hot throughout the year in most of the sampled localities (mainly Amazonian forest), with a dry season from May-June to October-November, with most rainfall from December to April. Mean monthly temperature usually varies from 24-28°C (minimum monthly temperature ranges from 18-23°C and maximum from 29-34°C; Nimer, 1989; INMET, 2008).

For each individual the following data were collected: (1) snout-vent length (SVL); (2) tail length (TL) (all to the nearest 1.0 mm); (3) head length (HL); (4) head width (HW) (all to the nearest 0.5 mm); (5) wet body mass (M) (to the nearest gram, after draining the excess of preservative, cf. Martins *et al.*, 2001); (6) size of the largest ovarian follicle or oviductal egg; (7) number of vitellogenic follicles (> 10 mm) or oviductal eggs to estimate fecundity; (8) maximum diameter of a deferent duct at its distal end close to the cloaca (cf. Almeida-Santos *et al.*, 2006); (9) testicle length and width (all to the nearest 0.1 mm); (10) prey item in the stomach and/or intestine (if present). Because of the potential effect of injected and absorbed preservatives we consider body mass as an estimate. Size at sexual maturity for females was based on the smallest (SVL) female with vitellogenic follicles or oviductal eggs (Shine, 1977a; Aldridge, 1979). Males were considered mature if they had enlarged and turgid testicles and thickened convoluted deferent ducts (Shine, 1977b; Almeida-Santos *et al.*, 2006). Degree of sexual size dimorphism (SSD) was found by dividing the mean adult SVL of the larger sex by the mean adult SVL of the smaller sex, minus one (Gibbons and Lovich, 1991; Shine, 1994). By convention, positive values of SSD

correspond to females larger than males and negative values correspond to males larger than females (Shine, 1994). Testicular volume was estimated as the volume of ellipsoid ($4/3\pi ab^2$; where a = half length, and b = half width) to access the spermatogenesis period (see James and Shine, 1985; Almeida-Santos *et al.*, 2006). Stomach content was removed and identified to the lowest possible taxonomic level. Additionally, each item was measured for body length and maximum circumference.

Mean SVL of both sexes was compared with a t -test. Because TL, HL, HW, and M are highly correlated with body length, statistical differences in these variables were tested between sexes (factors) using 1-way analyses of covariance (ANCOVA), with SVL, trunk length (= SVL-HL) and total length (= SVL+TL) as covariates, respectively. As testicle volume and deferent duct diameter are also related to body length, statistical differences in these variables throughout the year were tested using ANCOVA, with SVL as covariate. Reproductive cycle of mature males was examined throughout the year using the ratios of testicle volume and deferent duct diameter (dependent variables in ANCOVA) to snakes SVL (covariate). Reproductive cycle of mature females was examined throughout the year in terms of length of the largest ovarian follicle or oviductal egg. The relationship between fecundity (number of vitellogenic follicles or oviductal eggs) and female SVL was analysed by linear regression. All statistical analyses were performed using Statistica, versions 5 and 6, assuming $P < 0.05$ as the criterion for significance. The analyses were carried out according to Zar (1999) and all variables (transformed to their natural log values) were tested for normality and homoscedasticity prior to analysis.

RESULTS

The smallest mature female recorded was 900 mm in SVL, whereas the shortest mature male was 710 mm in SVL. Females and males reached sexual maturity at 84% and 72% of mean adult SVL, respectively. Mature females were significantly larger (mean SVL = 1068.8 ± 140 mm; range = 900-1.416 mm; $n = 37$) than males (mean SVL = 984.6 ± 152 mm; range = 710-1.305 mm; $n = 45$) (T-test; $t_{1,80} = 2.71$; $P < 0.01$; $n = 82$). The degree of sexual size dimorphism (SSD) was 0.09. Females had relatively larger heads (HL and HW) and shorter TL than males (ANCOVA; $F_{1,84} = 7.16$; $P < 0.01$; $n = 87$; $F_{1,71} = 18.46$; $P < 0.001$; $n = 74$, $F_{1,84} = 42.15$; $P < 0.001$; $n = 87$,

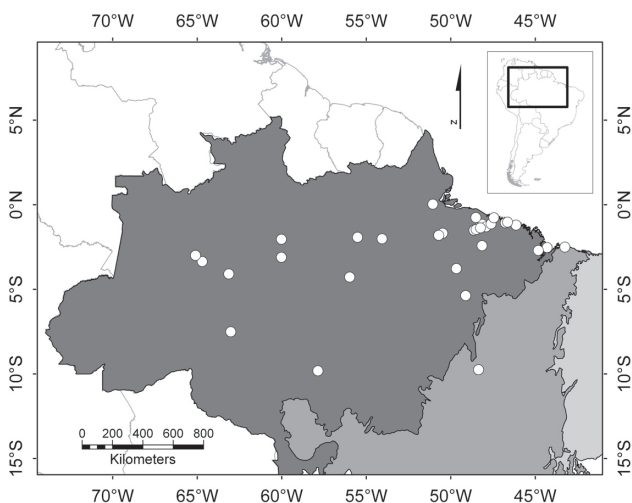


FIGURE 1. Geographical distribution of the specimens of *Oxybelis fulgidus* examined.

TABLE 1. Summary of data on female snout-vent length (SVL) and fecundity (number of vitellogenic follicles, oviductal eggs, and RCM) for *Oxybelis fulgidus*. * = vitellogenic follicles. Relative clutch mass (RCM) was calculated following Seigel and Fitch (1984), based on the original published data.

Localities	Female SVL (mm)	Fecundity	RCM	References
Pará, Brazil	900	8	—	This study
Pará, Brazil	1018	11*	—	This study
Pará, Brazil	950	4*	—	This study
Pará, Brazil	1115	10*	—	This study
Pará, Brazil	920	6*	—	This study
Amazonas, Brazil	1110	5*	—	This study
Tocantins, Brazil	1400	11	0.36	Scartozzoni <i>et al.</i> (2005)
Tocantins, Brazil	1070	9	0.35	Scartozzoni <i>et al.</i> (2005)
Tocantins, Brazil	1150	8	0.29	Scartozzoni <i>et al.</i> (2005)
Tocantins, Brazil	1420	12	0.29	Scartozzoni <i>et al.</i> (2005)
Amazonas, Brazil	—	10	—	Martins and Oliveira (1998)
Venezuela	—	6	—	Beebe (1946)
—	1150	10	0.26	Conners (1989)

respectively). Significant differences in M were not found between sexes (ANCOVA; $F_{1,51} = 0.20$, $P = 0.65$; $n = 57$).

Females of *O. fulgidus* presented an extended vitellogenic period since follicles in secondary vitellogenesis (> 10 mm) were observed from April to December (Figure 2). Oviductal eggs were found in one female collected in October (Figure 2). Egg laying was documented in September ($n = 2$), October ($n = 1$) and December ($n = 2$), while births occurred in January ($n = 1$), March ($n = 2$) and April ($n = 2$) (Figure 2). Fecundity (number of vitellogenic follicles or oviductal eggs) averaged 8.5 ± 2.5 (range = 4-12; $n = 13$) (Table 1), and about 40% of its variation was explained by female SVL ($R^2 = 0.41$; $F = 5.54$; $P < 0.05$; $n = 10$)

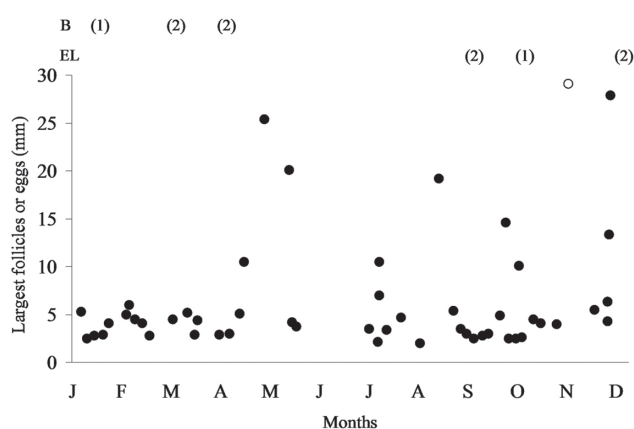


FIGURE 2. Variation throughout the year in the diameter of ovarian follicles or oviductal eggs of *Oxybelis fulgidus*. Solid circle = ovarian follicles; open circle = oviductal eggs. Literature records: Egg laying (EL; Martins and Oliveira, 1998; Scartozzoni *et al.*, 2005), births (B; Martins and Oliveira, 1998; Scartozzoni *et al.*, 2005).

(Figure 3). Relative clutch mass (RCM) ranged from 0.26 to 0.36 (mean = 0.31 ± 0.04) (Table 1).

The testicle volume was significantly larger from February to July (end of the rainy season and beginning of the dry season) (ANCOVA; $F_{1,40} = 11.33$; $P < 0.01$; $n = 43$). Ratios of testicle volume to snake SVL averaged 0.27 ± 0.04 (range = 0.23-0.32) from February to July (higher average values in April and May), and 0.18 ± 0.03 (range = 0.15-0.21) from August to January (Figure 4). The deferent duct diameter did not differ significantly throughout the year ($F_{1,40} = 2.07$; $P = 0.16$; $n = 43$). Ratios of deferent duct diameter to snake SVL averaged 0.0027 ± 0.0005 (range = 0.0020-0.0034) from February to July, and 0.0024 ± 0.0005 (range = 0.0017-0.0030) from August to January (Figure 5).

Oxybelis fulgidus feeds on lizards (53.7%, $n = 29$ items), mainly Iguanians (62.5% of the identified lizards, $n = 15$), and birds (46.3%, $n = 25$ items), mainly

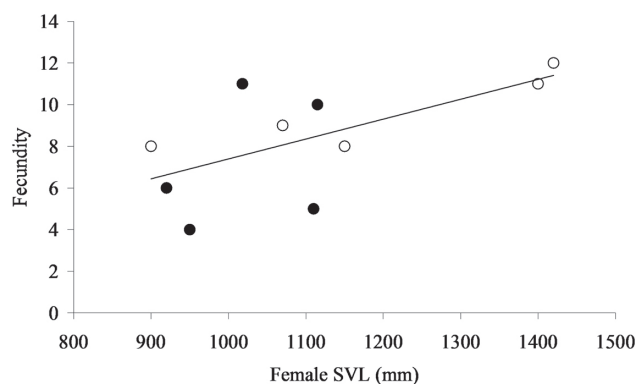


FIGURE 3. Relationship between female snout-vent length (SVL) and fecundity in *Oxybelis fulgidus*. Solid circles = vitellogenic follicles; open circles = oviductal eggs.

Passeriformes (93.7% of the identified birds, $n = 15$) (Table 2).

Among the 89 stomachs analyzed in the present study, we found 18 (20%) with prey items (Table 2). None of the snakes had ingested more than one prey item. Birds were found in 66.6% of the females with prey items ($n = 6$) and in 44.4% of the males ($n = 4$). Apparently females ate relatively larger prey than

males. For nine prey items for which the size could be determined, the relative prey-predator SVL averaged 0.12 (range = 0.07-0.19; $n = 5$) for females, and 0.07 (range = 0.05-0.10; $n = 4$) for males. The relative prey circumference (relative to snake HL) averaged 1.23 (range = 0.28-2.24; $n = 5$) for females, and 0.30 (range 0.24-0.51; $n = 4$) for males. Most prey were ingested headfirst (66.6%; $n = 6$).

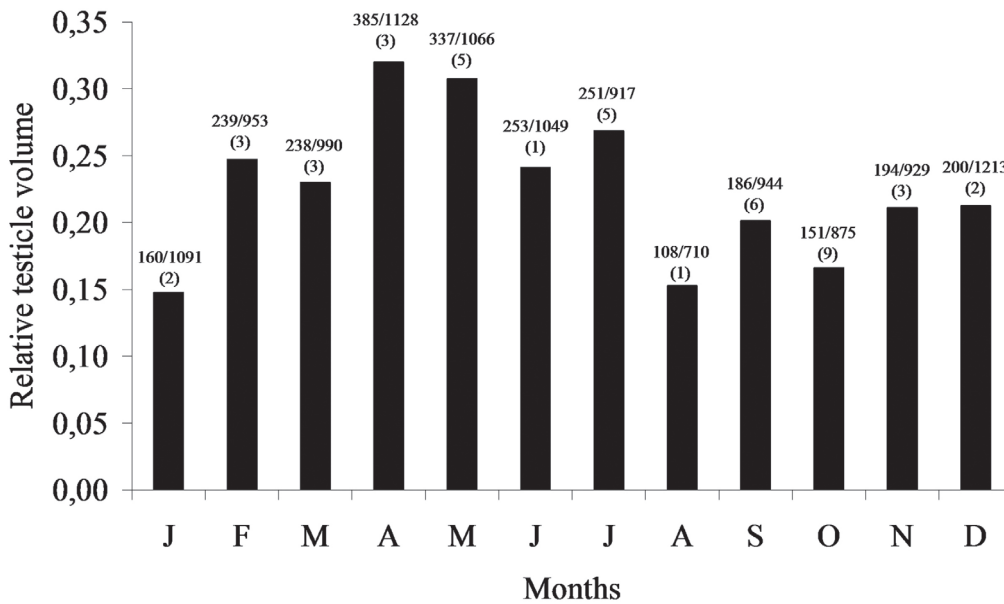


FIGURE 4. Variation throughout the year in the relative testicle volume (ratios of testicle volume to snake SVL) of adult males of *Oxybelis fulgidus*. The average testicle volume (dependent variable in ANCOVA; mm³), and average snake SVL (covariate; mm), are shown above the bars, respectively. The sample size is in parentheses.

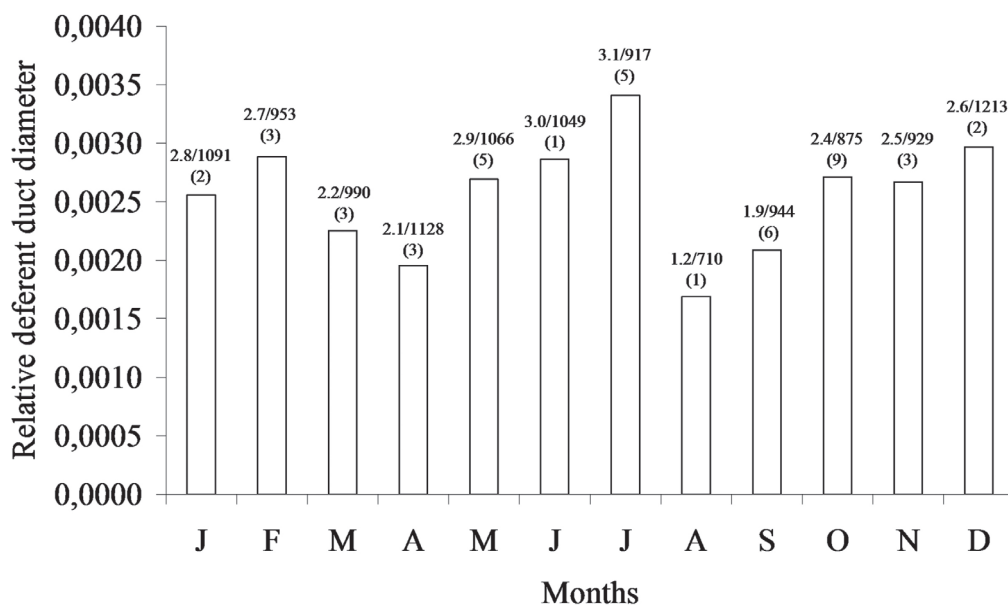


FIGURE 5. Variation throughout the year in the relative diameter of deferent duct (ratios of deferent duct diameter to snake SVL) of adult males of *Oxybelis fulgidus*. The average diameter of deferent duct (dependent variable in ANCOVA; mm) is shown above the bars as is the average snake SVL (covariate; mm). The sample size is in parentheses.

TABLE 2. Diet records for *Oxybelis fulgidus*. The number of snakes with a particular prey type and the total number of prey items recorded are given in parentheses, respectively.

Prey items	References
Lizards	
Corytophanidae	
<i>Basiliscus vittatus</i> (1;1)	Henderson and Binder (1980); Henderson (1982)
Iguanidae	
<i>Ctenosaura similis</i> (1;1)	Henderson and Binder (1980); Henderson (1982)
Phrynosomatidae	
<i>Sceloporus chrysostictus</i> (3;3)	Henderson and Binder (1980); Henderson (1982)
Polychrotidae	
<i>Anolis chrysolepis</i> (1;2)	Beebe (1946)
<i>Anolis ortonii</i> (2;2)	This study
<i>Anolis</i> sp. (3;3)	Henderson and Binder (1980); Henderson (1982)
<i>Polychrus marmoratus</i> (1;1)	This study
Tropiduridae (1;1)	This study
<i>Tropidurus oreadicus</i> (1;1)	This study
Scincidae	
<i>Mabuya guaporicola</i> (1;1)	This study
Teiidae	
<i>Ameiva</i> sp. (2;3)	Martins and Oliveira (1998)
<i>Ameiva ameiva</i> (2;3)	Nascimento <i>et al.</i> , (1988); Fischer and Gascon (1996)
<i>Ameiva undulata</i> (1;1)	Henderson and Binder (1980); Henderson (1982)
<i>Ameiva festiva</i> (1;1)	Norris and Burt (1998)
Unidentified lizard (5;5)	Beebe (1946); Henderson and Binder (1980); Henderson (1982); Martins and Oliveira (1998); this study
Birds	
Dendrocolaptidae	
<i>Dendrocincla homochroa</i> (1;1)	Leenders and Colwell (2003)
Emberizidae	
<i>Volatinia jacarina</i> (1;1)	Nascimento <i>et al.</i> , (1988)
Fringillidae	
<i>Carduelis notata</i> (1;1)	Stuart (1948)
Muscicapidae (neonate) (1;1)	This study
Parulidae (3;3)	Henderson and Binder (1980); Henderson (1982)
Thraupidae	
<i>Thraupis episcopus</i> (1;1)	Martins and Oliveira (1998)
Tyrannidae (1;1)	This study
<i>Elaenia</i> sp. (1;1)	Rodrigues <i>et al.</i> , (2005)
Unidentified Passeriformes (4;5)	Henderson and Binder (1980); Henderson (1982); Dixon and Soini (1986); this study
Bucconidae (Galbuliformes)	
<i>Monasa nigrifrons</i> (1;1)	Endo <i>et al.</i> , (2007)
Unidentified bird (9;9)	Beebe (1946); Martins and Oliveira (1998); this study

DISCUSSION

Males *O. fulgidus* mature at a smaller body length than females (SVL 710 mm versus 900 mm) as recorded in other oviparous snakes, including the congeneric *O. aeneus* (Parker and Plummer, 1987; Goldberg, 1998). Although the growth rate is not known

for *O. fulgidus*, maturation seems to be late in the genus *Oxybelis*. Male and female *O. fulgidus* mature at a large size (72% and 84% of mean adult SVL, respectively). Both sexes of *O. aeneus* also reached maturity at about 80% of mean adult SVL (Goldberg, 1998).

The larger body length in adult females, as recorded for *O. fulgidus*, is the most common situation in

snakes, probably because fecundity is size dependent (Shine, 1993; 1994). The presence or absence of male-male combat behavior may also determine the direction of sexual dimorphism in body size among snakes (Shine, 1978). The SSD (0.08) recorded for *O. fulgidus* is low, and many species of colubrids with similar SSD values (< 0.25) have been reported to exhibit male-male combat (see Shine, 1994). Despite the fact that it has not been observed in *O. fulgidus*, we draw the hypothesis that male-male combat behavior exists within this species, as reported in many other Colubrinae (e.g., *Drymarchon*, Shine, 1994; *Thelotornis*, Shine *et al.*, 1996; *Chironius*, Almeida-Santos and Marques, 2002; *Spilotes*, Pizzatto *et al.*, 2007).

Male *O. fulgidus* have longer tails than females. Sexual dimorphism in tail length (males with larger tails) is the most common condition recorded for snakes and is related to the presence of the hemipenis and retractor muscles (King, 1989). However, this dimorphism seems to be subtle in *O. fulgidus* (ratios of TL to snake SVL averaged 0.45 for females and 0.46 for males), as in many arboreal snakes, probably related to the advantages of longer tails for arboreal locomotion (Fowler and Salomão, 1994; Pizzatto and Marques, 2007). Head size dimorphism in snakes may be associated with inter-sexual dietary divergence, most probably a result of differential selection in males and females with respect to prey type and size (Shine, 1986; Shine, 1991b). The head size differences observed in *O. fulgidus* (females with larger head) could be attributed to the advantages of ingesting larger prey items. In fact, results presented here showed that females of *O. fulgidus* had eaten relatively larger prey than males (mainly birds, see Results). However, robust data on prey-size-snake-size relationships are still required for a better understanding of the direction of sexual divergence in diet and head morphology in *O. fulgidus*.

Oxybelis fulgidus exhibits an extended seasonal vitellogenic cycle from April to December (mainly throughout the dry season) in the northern region of Brazil. Oviductal eggs from preserved specimens and egg-laying occur from the end of the dry season until the beginning of the rainy season (September to December), while births were registered during the rainy season (January to April). One supposed newborn (SVL < 300 mm; MPEG 3224) was collected in the wild in March. The extended seasonal reproductive cycle observed in *O. fulgidus* is similar to that reported for other Neotropical snakes (e.g., some Xenodontinae and Dipsadinae, Martins and Oliveira, 1998; Fowler *et al.*, 1998; Pizzatto *et al.*, 2008a, b) includ-

ing other Colubrinae (e.g., *Mastigodryas* sp., Censky and McCoy, 1988; Marques and Muriel, 2007). In contrast, more seasonal climates seem to restrict the female cycles in some Colubrinae which occur in higher latitudes, such as *Thelotornis capensis* from subtropical regions in southern Africa (vitellogenesis from September to December; Shine *et al.*, 1996), and the congeneric *O. aeneus* from Mexico (vitellogenesis from March to August; Censky and McCoy, 1988; Goldberg, 1998). Fecundity in *O. fulgidus* is higher than in *O. aeneus* (see Censky and McCoy, 1988; Goldberg, 1998), probably because the latter is a smaller and more slender species (see Henderson, 1982). However, both species present a similar average relative clutch mass (mean RCM = 0.310 for *O. fulgidus* and 0.325 for *O. aeneus*; see Seigel and Fitch, 1984).

Testicular size in snakes reflects spermatogenic activity (Volsøe, 1944). The increase in testicle volume from February to July (mainly in April and May, see Figure 4) suggests that spermatogenesis in *O. fulgidus* takes place during the period in which vitellogenic follicles in females are already present (April and May – end of the rainy season – see Figure 2). The absence of significant differences in the deferent ducts throughout the year indicates that males of *O. fulgidus* do not store sperm (cf. Almeida-Santos *et al.*, 2006). Although no records of mating are available for *O. fulgidus*, we hypothesize that both males and females may have an associated reproductive pattern, both synchronized at the end of the rainy season (cf. Crews, 1984; Schuett, 1992). Testicles reached their maximum relative volume in April (0.32), a period when the deferent ducts are at one of their smallest diameters (0.02), which may be indicative of mating. If mating occurs in this period, the females may be able to store sperm since vitellogenic follicles are present until December. Associated reproductive patterns also occur in other Colubrinae (e.g., *T. capensis*, Shine *et al.*, 1996), including *O. aeneus* (Goldberg, 1998), which may indicate that this feature is conservative within *Oxybelis*. Unfortunately, the reproduction of *O. brevirostris*, *O. wilsoni*, *Xenoxylis*, *Uromacer* and *Ahaetulla* is virtually unknown, particularly concerning reproduction of males, making it difficult to generalize a reproductive pattern within the genus *Oxybelis* or even for other vine snakes.

The available information on the diet of *O. fulgidus* (Beebe, 1946; Stuart, 1948; Dixon and Soini, 1977; Cunha and Nascimento, 1978; Duellman, 1978; Henderson and Binder, 1980; Henderson, 1982; Nascimento *et al.*, 1988; Sasa and Solórzano,

1995; Fisher and Gascon, 1996; Martins and Oliveira, 1998; Norris and Burt, 1998; Leenders and Colwell, 2003; Rodrigues *et al.*, 2005; Endo *et al.*, 2007; present study) indicates that this species feeds on lizards (mainly Iguanians; e.g., Polychrotidae, *Anolis*) and birds (mainly Passeriformes; e.g., Dendrocolaptidae, Parulidae, Thraupidae). This is the first time that a Muscipidae bird, and Scincidae and Tropicuridae lizards have been recorded as prey items in the diet of *O. fulgidus*. Small rodents in the diet of *O. fulgidus*, as stated by Alvarez del Toro (1960; *apud* Henderson and Binder, 1980) may be an error or even a generalization since many Colubrinae may include rodents in the diet (Greene, 1997).

Although there is no evidence that *O. fulgidus* forages on the ground (see Martins and Oliveira, 1998), this possibility exists, since some prey items recorded in its diet are largely terrestrial (e.g., *Tropidurus oradicus*, *Mabuya guaporicola*). However it is also possible that *O. fulgidus* captures ground-dwelling prey while suspended from arboreal perches, as observed for *Uromacer frenatus* (Henderson and Horn, 1983; R. W. Henderson, personal communication, 2009) and *Xenoxylis argenteus* (Martins and Oliveira, 1998). Although Henderson and Binder (1980) and Fischer and Gascon (1996) described *O. fulgidus* as a sit-and-wait predator, the observation of a neonate bird as prey (possible while in the nest; G. R. R. Brito, personal communication, 2007) might indicate that this species may also forage actively as suggested by Martins and Oliveira (1998).

RESUMO

Aspectos da história natural da cobra cipó *Oxybelis fulgidus* proveniente da região norte do Brasil foram inferidos a partir do exame de 106 espécimes preservados e da revisão de registros publicados na literatura. Machos maturam com menor tamanho corporal. Diferenças no tamanho e forma do corpo também foram encontradas entre fêmeas e machos adultos: fêmeas adultas são mais compridas, possuem cabeças relativamente maiores e caudas relativamente mais curtas. Fêmeas possuem ciclo vitelogênico sazonal extenso de abril a dezembro (principalmente ao longo da estação seca). Ovos nos ovidutos e ovi-posturas foram registradas de setembro a dezembro, enquanto que os nascimentos ocorrem de janeiro a abril. A fecundidade variou de quatro a 12 ovos ou folículos vitelogênicos ($n = 13$) e foi positivamente correlacionada ao tamanho corporal das fêmeas.

O volume dos testículos é significativamente maior de fevereiro a julho (principalmente em abril e maio; final da estação chuvosa), entretanto não foram encontradas variações significativas ao longo do ano no diâmetro dos ductos deferentes. Machos e fêmeas devem possuir padrão reprodutivo associado, ambos sincronizados no final da estação chuvosa (abril e maio). *Oxybelis fulgidus* alimenta-se de lagartos (especialmente Iguania) e aves Passeriformes. Aparentemente, as fêmeas alimentam-se com maior frequência de aves em comparação aos machos.

ACKNOWLEDGEMENTS

We thank Robert W. Henderson, Maria E. Oliveira, Ricardo J. Sawaya and Otavio A. V. Marques for the suggestions and improvements to the manuscript; Valdir J. Germano for help in laboratory work; Guilherme R. R. Brito for identification of bird prey; Miguel T. U. Rodrigues for identification of lizard prey; Fausto E. Barbo for assistance in the map preparation; Verônica A. Barros for the English revision. Ana L. Prudente allowed the examination of specimens from the MPEG collection, and Francisco L. Franco provided access to specimens from the IB collection. FUNDAP and FAPESP provided financial support.

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Submitted 21 October 2008

Accepted 25 February 2009

APPENDIX 1

Specimens of *Oxybelis fulgidus* examined (Instituto Butantan – IB; Museu Paraense Emílio Goeldi – MPEG).

Brazil: Amapá (IB 24795, 24808); Amazonas (IB 2189, 10046, 15061, 15074, 15076, 15095, 17065, 32009, 40245, 43823, 51339, 51497, 52149, 52189; MPEG 18876, 18877, 18950, 21019); Maranhão (IB 21760, 44317, 75161; three specimens not registered); Mato Grosso (IB 24537, 74412); Pará (IB 3130, 14741-14746, 14786, 14838, 26447, 40619, 40623, 40871, 46830, 47036, 54144; MPEG 179, 727, 804, 945, 1921, 1923, 1924, 2403, 2615, 2757, 3224, 3283, 3442, 4067, 4068, 4070, 4071, 4587, 6687, 15964, 16314, 16350, 16846, 16872, 16885, 16964, 17160, 17161, 17368, 18157, 18285, 18344, 18443, 18533, 18711, 18869, 19264, 19353, 20015, 20099, 20147, 20214, 20234, 20508, 20903); Tocantins (IB 64313, 64343, 64532, 64599-64601, 64607, 64608, 64653, 64816, 64864, 64880, 65058, 65199, 65814-65816).