

Dissimilar *ab ovo*:  
Sexual dimorphism of *Philodryas*  
*nattereri* STEINDACHNER, 1870  
hatchlings and juveniles

Morphological differences among sexes constitute one of the most remarkable features in animals. Sexual divergence can be attributed to selective pressures on morphology, affecting differently the fitness of males and females (DARWIN 1871). In snakes, sexual dimorphism in body, head and tail dimensions is widely reported and may have different causes such as sexual and fecundity selections (SHINE 1994; RIVAS & BURGHARDT 2001).

The dipsadine colubrid *Philodryas nattereri* STEINDACHNER, 1870 is a medium sized snake, widely distributed in arid and semi-arid areas over South America, and one of the most abundant snake species in northeastern Brazil (AMARAL 1936). Some data regarding its reproductive biology are available (VITT & VANGILDER 1983; FOWLER et al. 1998; MESQUITA et al. 2011), however, information on its incubation and offspring are lacking. Herein, we expand knowledge on reproductive biology of *P. nattereri* through the first record of incubation time, morphometry of newborns and sexual dimorphism of hatchlings and juveniles.

On 03 August 2010, a female *P. nattereri* (snout-vent length = 980 mm) from Upanema municipality, Rio Grande do Norte state, northeastern Brazil was taken to the “Núcleo Regional de Ofiologia da Universidade Federal do Ceará” (NUROF-UFC) where it laid 14 eggs. The eggs were placed in a terrarium (10 cm × 23 cm × 34 cm) with a humid substrate of sand and leaf-litter, and monitored until hatching. The incubation occurred under the following conditions: ambient temperature - ca. 26 °C, humidity - ca. 65 % and light regime - ca. 12 h per day.

The length, diameter and mass of the eggs, measured immediately after oviposition, are presented in the format: mean ± one standard deviation (range). Body measurements (snout-vent length - SVL, tail length - TL, head length - HL, head width - HW, head height - HH) and body mass were taken immediately after hatching, and each

individual was sexed by trying to evert potentially present hemipenes. SVL and TL were measured to nearest 1 mm, egg length, egg diameter, HL, HW and HH were measured with 0.1 mm precision, and the mass was taken with 0.1 g precision.

Additionally, to increase the sample for the sexual dimorphism analysis the authors analyzed seven male and nine female immature *P. nattereri* individuals from Brazil, deposited in the scientific collection “Coleção Herpetológica da Universidade Federal do Ceará” (CHUFC) [Brazil: Rio Grande do Norte state: Mossoró municipality: CHUFC 98; Upanema municipality: CHUFC 3579; Ceará state: Fortaleza municipality: CHUFC 1605, 1632, 2178, 2279, 2942, 2943; Limoeiro do Norte municipality: CHUFC 289, 374, 375, 376; Pentecoste municipality: CHUFC 3171, 3193, 3196; Ubajara municipality: CHUFC 3269]. All these selected individuals were smaller than the minimum size of sexual maturity (480 mm for males and 520 mm for females) reported for *P. nattereri* (FOWLER & SALOMÃO 1995).

The sex differences in SVL were evaluated by analysis of variance (ANOVA). The effects of sex on TL, HL, HW, HH and mass were investigated by analysis of covariance (ANCOVA), using SVL as covariate for tail and head measurements, and total length (SVL + TL) as covariate of the cubic root of the mass.

The egg length was  $36.4 \pm 2.1$  mm ( $33.2 - 40.5$  mm), egg diameter was  $19.7 \pm 0.6$  mm ( $18.8 - 21.1$  mm) and egg mass was  $8.76 \pm 0.35$  g ( $7.92 - 9.32$  g). On 07 October 2010, newborns began to emerge and on 11 October 2010, all the juveniles had hatched. Voucher specimens were deposited at CHUFC (CHUFC 3593 and CHUFC 3594). The time of incubation ranged from 65 to 70 days. This incubation time is similar to a previous report for the congener *P. patagoniensis* (GIRARD, 1858) in which incubation lasted approximately 65 days (FOWLER et al. 1998).

Of 14 newborns analyzed, eight were males and six females. The body measurements and masses are presented in Table 1. This data includes the minimum SVL known for both the sexes of *P. nattereri* (male = 224 mm; female = 228 mm), com-

Table 1: Body measurements [mm] and masses [g] of 14 *Philodryas nattereri* STEINDACHNER, 1870 when hatched in the Núcleo Regional de Ofiologia da Universidade Federal do Ceará. SVL - Snout-vent length, TL - tail length, HL - head length, HW - head width, HH - head high, SD - standard deviation.

Sex	SVL	TL	HL	HW	HH	Mass
Female	234	76	11.6	6.8	5.3	6.1
Female	242	79	12.2	7.2	5.3	6.1
Female	244	80	12.1	7.5	5.2	6.1
Female	251	88	12.3	6.8	5.5	6.4
Female	228	70	12.2	6.6	5.3	5.5
Female	249	75	11.6	7.0	5.2	6.1
Male	224	87	11.2	6.9	5.2	6.2
Male	236	86	11.6	6.6	5.3	6.4
Male	231	89	11.7	6.4	5.2	5.7
Male	233	87	12.0	6.9	5.2	6.3
Male	236	88	12.1	6.6	5.1	6.0
Male	242	92	11.7	6.7	5.3	6.1
Male	239	90	12.1	7.0	5.2	5.9
Male	243	88	12.0	6.8	5.3	6.2
Minimum	224.0	70.0	11.2	6.4	5.1	5.5
Maximum	251.0	92.0	12.3	7.5	5.5	6.4
Mean	238.0	83.9	11.9	6.8	5.3	6.1
SD	7.7	6.7	0.3	0.3	0.1	0.3

pared with previously reported information (male = 277 mm; female = 258 mm) (FOWLER & SALOMÃO 1995).

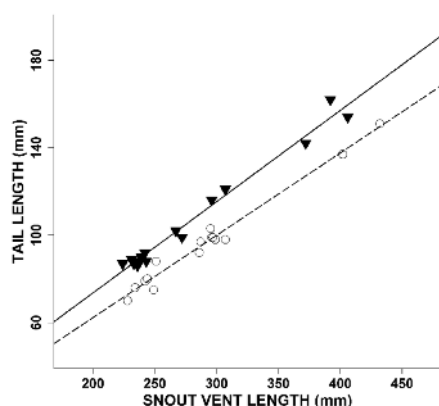


Fig. 1: Sexual dimorphism in relative tail length shown from 15 male and 15 female hatchlings of *Philodryas nattereri* STEINDACHNER, 1870.

Triangles and solid line: males, circles and dashed line: females.

Regarding sexual dimorphism analysis, there were no significant differences in SVL (ANOVA –  $F_{1,28} = 0.21$ ;  $P = 0.65$ ), HL (ANCOVA intercepts –  $F_{1,26} = 3.86$ ;  $P = 0.06$ ), HW (ANCOVA intercepts –  $F_{1,27} = 0.06$ ;  $P = 0.81$ ), HH (ANCOVA intercepts –  $F_{1,23} = 0.56$ ;  $P = 0.46$ ) and mass (ANCOVA intercepts –  $F_{1,25} = 0.09$ ;  $P = 0.77$ ). However, concerning the TL (Fig. 1), there was a significant difference among the sexes (ANCOVA intercepts –  $F_{1,27} = 117.14$ ;  $P < 0.01$ ) with males ( $N = 15$ ;  $106.87 \pm 26.2$  mm) presenting longer tails than females ( $N = 15$ ;  $96.13 \pm 22.24$  mm).

Sexual dimorphism in tail length is widespread in snakes (SHINE et al. 1999) and males typically have longer tails than females, probably as a result of the location of hemipenes and its retractor muscles (KING 1989). This pattern was already reported for adult *P. nattereri* (VITT 1980; FOWLER & SALOMÃO, 1994; MESQUITA et al. 2011). However, the present results indicated that this dimorphic trend is established prior to birth and not during sexual maturation, as suggested by MESQUITA et al. (2011). One possible explanation for this misinterpretation can reside in the small sample of juveniles ( $N = 10$ ; seven males and three

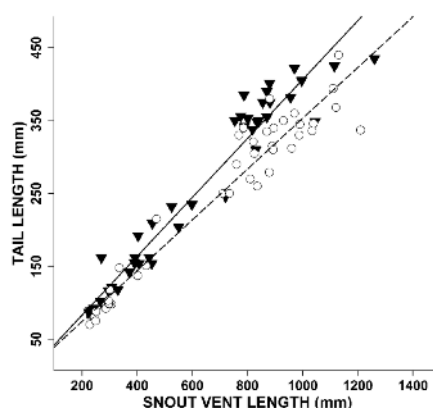


Fig. 2: Sexual dimorphism in relative tail length in *Philodryas nattereri* STEINDACHNER, 1870. Reanalysis of the combined data set from MESQUITA et al. (2011) plus neonates and hatchlings of this study. Meaning of symbols as described in Figure 1.

females) analyzed in this previous study. Reanalysis of the data set of MESQUITA et al. (2011), combined with the data used in this study, provide results consistent with those found here solely for neonates and juveniles (ANCOVA slopes –  $F_{1,86} = 7.83$ ;  $P < 0.01$ ; Figure 2). In this way, although the dimorphism is really more pronounced in adults as showed by MESQUITA et al. (2011), it is present even in hatchlings and immature life stages.

Our findings expand the conclusions of MESQUITA et al. (2011) indicating that sex differences in tail measurements develop at early ontogenetic stages of *P. nattereri*, and support the hypothesis of FOWLER & SALOMÃO (1994) that this dimorphism is a plesiomorphic character in *Philodryas*.

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**REFERENCES:** AMARAL, A. (1936): Contribuição ao conhecimento dos ophidios do Brasil. In VIII. Lista remissiva dos ophidios do Brasil. Memórias do Instituto Butantan, São Paulo; 10: 87-162. DARWIN, C. (1871): The descent of man and selection in relation to sex. London (John Murray), pp. 688. FOWLER, I. & SALOMÃO, M. G. (1994): A study of sexual dimorphism in six species from the colubrid snake genus *Philodryas*.- The Snake, Nittagun; 26: 117-122. FOWLER, I. & SALOMÃO, M. G. (1995): A new technique to distinguish immature and adult snakes between males and females in six species of the neotropical colubrid snakes *Philodryas*.- Studies on Neotropical Fauna and Environment, Abingdon, Oxon; 30: 149-157. FOWLER, I. R. & SALOMÃO, M. G. & JORDÃO, R. S. (1998): A description of the female reproductive cycle in four species from the neotropical colubrid snake *Philodryas* (Colubridae, Xenodontinae).- The Snake, Nittagun; 28: 71-78. KING, R. B. (1989): Sexual dimorphism in tail length: sexual selection, natural selection, or morphological constraint?- Biological Journal of the Linnean Society, London; 38: 133-154. MESQUITA, P. C. M. D. & BORGES-NOJOSA, D. M., PASSOS, D. C. & BEZERRA, C. H. (2011): Ecology of *Philodryas nattereri* in the Brazilian semi-arid region.- Herpetological Journal, London; 21: 193-198. RIVAS, J. A. & BURGHARDT, M. (2001): Understanding sexual size dimorphism in snakes: wearing the snake's shoes.- Animal Behaviour, Oxford; 62: F1-F6. SHINE, R. (1994): Sexual size dimorphism in snakes revisited.- Copeia, Washington; 1994: 326-346. SHINE, R. & OLSSON, M. M. & MOORE, I. T. & LEMASTER, M. P. & MASON, R. T. (1999): Why do male snakes have longer tails than females?- Proceedings of the Royal Society of London, London; 266: 2147-2151. VITT, L. J. (1980): Ecological observations on sympatric *Philodryas* (Colubridae) in northeast Brazil.- Papéis Avulsos de Zoologia, São Paulo; 34: 87-98. VITT, L. J. & VANGILDER, L. D. (1983): Ecology of a snake community in northeastern Brazil.- Amphibia-Reptilia, Leiden; 4: 273-296.

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