

SEASONAL VARIATION IN WEIGHT AND LENGTH OF THE TESTICLES AND THE QUANTITY OF ABDOMINAL FAT OF THE SNAKE *Bothrops jararaca*

Thelia R. F. JANEIRO-CINQUINI*
Frederico Fontoura LEINZ*
Eduardo Cunha FARIAS**

ABSTRACT: Seasonal variation in weight and length of the testicles, and weight of the abdominal fat of 250 specimens of snakes *Bothrops jararaca* from the southern and southeastern regions of Brazil, was observed during the period of one year. It was verified that the length, as well as the weight of the testicles, reached a maximum in Summer and a minimum in Winter. An accumulation of abdominal fat in Winter, was also verified when compared to the other seasons of the year. The presence of mobile spermatozoa within the deferent ducts of all observed animals was verified, independent of the time of the year. The authors suggest that fat accumulated in Winter might be used in Spring and Summer, when reproduction would occur.

KEYWORDS: Testicle, abdominal fat, reproduction.

INTRODUCTION

The spermatogenetic cycles in snakes vary as much in relation to the species of snake taken into consideration as to their ecology (Saint-Girons¹³; Lofts¹⁰).

In some snake species from temperate regions, the spermatozoa are produced only in Autumn, and in others, the production is interrupted during Winter, recommencing in Spring (Lofts¹⁰).

The reproductive cycle of snakes in tropical climates is less well known than in other groups of reptiles (Fitch⁶). The male tropical snakes do not present

* Laboratório de Herpetologia, Instituto Butantan, Av. Vital Brasil, 1.500 — 05503-900 — São Paulo, SP — Brasil.

** Departamento de Histologia e Embriologia, ICB — USP. Recebido para publicação em 08.12.92 e aceito em 18.11.93.

seasonality in their sexual cycle, (Seigel¹⁷), occurring the reproduction of several species during the whole year (Fitch⁶; Vitt¹⁸).

Many squamates exhibit seasonal variation in the lipid content, suggesting that this reserve will be used during hibernation (Brian³; Derickson⁴), for reproduction (Hahn⁷; Hoddenbach⁸), and also for the synthesis of steroids and spermatogenesis (Lofts⁹). For both sexes, variation in the abdominal fat reserves reflects the phase of the reproductive cycle (Fitch⁶).

In tropical viperids, the sexual cycles of males have scarcely been investigated (Mello¹²; Belluomini²; Saint-Girons¹⁴).

The objective of this paper is to contribute to the knowledge of the reproductive biology of the snake *Bothrops jararaca*, analysing the biometric seasonal variation of the testicles and the weight of the abdominal fat during the period of one year.

MATERIAL AND METHODS

During the period of one year, 250 males of *Bothrops jararaca*, recently arrived from nature, originated from the south and southeast regions of Brazil, received in the "Seção de Venenos" of the Instituto Butantan, were examined.

The snakes were measured at their snout-vent length (cm), weighed (g), and through laparotomy, the teste were measured "in situ" along their longitudinal axis with the aid of a caliper rule, and then removed and weighed. The abdominal fat was separated and weighed.

Since the specimens were different weights and lengths, we determined an "index" for the monthly variations observed, using the relationship between the testis/length of the snake x 100 and the weight of the testis/weight of the snake x 100. The same procedure was used to relate the weight of the fat/weight of the snake x 100. The montly mean of this "index" was then compared from month to month.

The presence of spermatozoa was determined by a smear of the deferent ducts.

The statistical analysis was set up by the application of the "Student-t" test, and Pearson correlation coefficient. The level of rejection adopted was $\alpha = 0.05$.

RESULTS

The observations showed that the mean "index" of testicles weight was lowest in Winter (0.22 ± 0.11) an higher in Summer (0.41 ± 0.09). When the weight found in these periods were compared, it was verified that there is a significant difference between them ($t=6.33$). Table 1.

Variation in testicles length, althought not so pronounced, occurred in the same seasons. The length was *lesser* at the end of Winter (2.9 ± 0.47), and longer in Summer (4.0 ± 0.78), there being a significant difference between them ($t=5.0$). There was a positive correlation between the length of the testicle and the length of the animal ($r=0.55$).

The largest testicle reached a length of 4.3 cm, removed from a animal of 76.5 cm snout-vent length, and the smallest was 0.9 cm removed from a specimen with a snout-vent length of 61.0 cm.

Mobile spermatozoa were seen within in the deferent duct of all the observed animals during the whole year. The smallest male examined measured 54.0 cm.

As to the weight of the abdominal fat, an inverse relation was noted, reaching a minimal weight at the end of Autumn (2.1 ± 1.45) and a maximum in Winter (5.3 ± 2.26). There was a significant difference when the two seasons were compared ($t=5.82$).

The right and left testicles behaved in the same manner in relation to weight and length.

TABLE 1

Means and standard deviation of testis's weight and lenght and weight of fat body in *Bothrops jararaca*

Months	Index Weight Testis	Index Length Testis	Index Weight Fat Body
January	0,41 \pm 0,09	4,0 \pm 0,78	3,2 \pm 1,83
February	0,29 \pm 0,09	3,8 \pm 0,90	3,2 \pm 1,72
March	0,29 \pm 0,07	3,4 \pm 0,77	3,2 \pm 1,44
April	0,26 \pm 0,09	3,4 \pm 0,92	2,4 \pm 1,38
May	0,26 \pm 0,08	3,5 \pm 0,86	2,1 \pm 1,45
June	0,25 \pm 0,10	3,5 \pm 1,03	4,3 \pm 2,83
July	0,23 \pm 0,06	3,2 \pm 0,88	5,3 \pm 2,26
August	0,22 \pm 0,08	2,9 \pm 0,47	5,3 \pm 2,26
September	0,22 \pm 0,11	3,1 \pm 0,99	3,0 \pm 2,09
October	0,24 \pm 0,17	3,2 \pm 1,21	2,3 \pm 1,99
November	0,30 \pm 0,14	3,2 \pm 0,99	2,9 \pm 2,32
December	0,40 \pm 0,13	3,3 \pm 0,39	3,6 \pm 2,48

DISCUSSION

Some reptile species of tropical regions present frequently an acyclic reproduction; however, other species may exhibit cyclic forms of reproduction (Sherbrooke¹⁶). In the male, the reproductive cycle involves changes in size and weight of the testicle and hemipenis (Fitch⁶). According to Saint-Girons¹⁵, several reptiles of tropical regions show recrudescence at the end of Spring, Summer and beginning of Autumn. Analyzing the ponderal variation of the testicle *Crotalus durissus terrificus* during the period of one year, Belluomini² verified a minimum testicular weight at the end of Winter, and a maximum at the beginning of Autumn. In *Bothrops jararaca* a similar result was found, the testicles presenting a minimum weight at the end of Winter. In Spring, an increase of the weight of the gonads starts, reaching a maximum in full Summer.

The length of the testicle, according to Volsoe¹⁹, may be a more reliable indicator of the gonadal activity than the weight. In relation to this measure, it was verified that in the species under study, seasonal variation occurred. The lenght of the testicles reached a maximum in the Summer months, and a minimum in the Winter months, although this variation is not as significant as the one that occurred within the weight.

In *Crotalus durissus terrificus*, spermatozoids were practically found during the whole year, with some exceptions during the Winter months (Mello¹²). All males of *Bothrops jararaca* examined showed spermatozoids in the ductus deferens during the whole year, independent of the season.

In both sexes of reptiles abdominal fat is present, and its increase or decrease reflects the stage of the reproductive cycle. It is larger when the gonads are small and inactive, functioning as reserve of nutrients that can be used for the production of eggs or energy for fight, courtship or exhibition (Fitch⁶).

The weight of the abdominal fat of male *Bothrops jararaca* varied significantly during the period of one year, very large increase occurring in Winter, and two periods of abrupt decrease at the beginning of Autumn and the beginning of Spring.

The rainfalls are an important factor for the reproduction of reptiles (Bacon¹), since temperature is considered the main biological time piece that affects the reproductive cycle of these animals (Marion¹¹). In tropical snakes, according to Derickson⁵, the lipids accumulated during the dry season will be used in the reproduction period.

For the species under study, the results obtained coincide with the above mentioned observations. In Winter, there was an increase of abdominal fat, coinciding with a decline of the weight and length of the testicles, while in springtime, an inverse relation was verified. For the males of *Bothrops jararaca* this suggests the existence of reproductive activity during the hot and more humid months of the year.

CONCLUSIONS

1- The variation in weight and length of the testicles indicate the existence of an annual cyclic reproduction, influenced by the seasons of the year.

2- The weight in the abdominal fat, although presenting an inverse variation to that which occurred within the testicles, would be directly related to the same.

RESUMO: Variações sazonais no peso e comprimento dos testículos e no peso da gordura abdominal de 250 exemplares de serpentes *Bothrops jararaca*, procedentes das regiões Sul e Sudeste, foram observadas durante o período de um ano. Verificou-se que tanto o comprimento quanto o peso dos testículos alcançaram um máximo no verão e um mínimo no inverno. Verificou-se também um acúmulo de gordura abdominal no inverno, quando comparado com as outras estações do ano. Constatou-se a presença de espermatozóides móveis nos ductos deferentes de todos os animais observados, independente da estação do ano. Os autores sugerem que a gordura acumulada no inverno seja utilizada na primavera e verão, quando então ocorreria a reprodução.

UNITERMOS: Testículos, gordura abdominal, reprodução.

REFERENCES

1. BACON, J. P. Some observations on the captive management of Galapagos tortoises. In: MURPHY, J. B., COLLINS, J. T., eds. *Reproductive biology and diseases of captive reptiles*. Lawrence: Society for the study of Amphibians and Reptiles, 1980, p. 97-113.

JANEIRO - CINQUINI, T.R.F., LEINZ, F.F., FARIAS, E.C. Seasonal variation in weight and length of the testicles and the quantity of abdominal fat of the snake *Bothrops jararaca*. *Mem. Inst. Butantan*, v. 55, supl. 1, p. 15-19, 1993.

2. BELLUOMINI, H. E., MELO, R. F., PENHA, A. M. S. G. Estudo citológico e ponderal do testículo de *Crotalus durissus terrificus*, durante o ciclo reprodutivo anual. *Mem. Inst. Butantan*, Simp. Inter. v. 33, n.3, p. 761-766, 1966.
3. BRIAN, B. L., GAFFENEY, F. G., FITZPATRICK, L. C., SCHOLLES, V. E. Fatty acid distribution of lipids from carcass liver and fat bodies of the lizard *Cnemidophorus tigris* prior to hibernation. *Comp. Biochem. Physiol.*, v. 41, p. 661-664, 1972.
4. DERICKSON, W. K. Lipid deposition and utilization in the seabrush lizard *Sceloporus graciosus*: its significance for reproduction and maintenance. *Comp. Biochem. Physiol.*, v. 49a, p. 267-272, 1974.
5. _____. Ecological and physiological aspects of reproductive strategies in two lizards. *Ecology*, v. 57, p. 445-458, 1976.
6. FITCH, H. S. Reproductive cycles in tropical reptiles. *Occas. Pap. Mus. Nat. Hist.*, v. 96, p. 1-53, 1982.
7. HAHN, W. E., TINKLE, D. W. Fat body cycling experimental evidence for its adaptative significance to ovarian follicle development in lizard *Uta stansburiana*. *J. Exp. Zool.*, v. 158, p. 79, 1965.
8. HODDENBACH, G.A Reproduction in the western Texas *Cnemidophorus sexlineatus* (Sauria: Taiidae). *Copeia*, p. 110-113, 1982.
9. LOFTS, R., BERN, H.A. The functional morphology of steroidogenic tissues. In: IDER, D.R., ed. *Steroids in nonmammalian vertebrates*. New York: Academic Press, 1972.
10. _____. Seasonal cycles in Reptilian testes. *Gen. Comp. Endocrinol.*, Suppl., v.2, p. 147-155, 1969.
11. MARION, K. R. Reproductive cues for gonadal development in temperature reptiles: temperature and photoperiod effects on the testicular cycle of the lizard *Sceloporus undulatus*. *Herpetologica*, v. 38, p. 26-39, 1982.
12. MELLO, R.F., BELLUOMINI, H.E. Ciclo anual da atividade testicular em *Crotalus d. terrificus*. *Ciênc. Cult.*, v. 17, n. 2, p. 223, 1965.
13. SAINT-GIRONS, H. Le cycle sexuel des serpents venimeux. *Mem. Inst. Butantan*, v. 33, n. 1, p. 105-114, 1966.
14. _____, PFEFFER, P. Le cycle sexuel des serpents du Cambodge. *Zool. Meded.*, Leiden, v. 47, p. 543-571, 1971.
15. _____. Reproductive cycles of males snakes and their relationships with climate and female reproduction cycles. *Herpetologica*, v. 38, p. 5-16, 1982.
16. SHERBROOKE, W. C. Reproductive cycle of a tropical teiid lizard *Neusticurus ecleopus*. Cope in Peru. *Biotropica*, v. 7, p. 194-207, 1975.
17. SEIGEL, R.A., FORD, N.B. Reproductive ecology. In: SEIGEL, R. A., COLLINS, J. T., NOVAK, S.S., eds. *Snakes ecology and evolutionary biology*. New York: Macmillan, 1987. p. 210-252.
18. VITT, L.J. Reproduction and sexual dimorphism in the tropical teiid lizard, *Cnemidophorus ocellifer*. *Copeia*, p. 359-366, 1983.
19. VOLSOE, H. Structure and seasonal variation of the male reproductive organs of *Vipera berus* (L). *Spolia Zool. Mus. Huan.*, v. 5, p. 1-157, 1944.

