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Body and testicular biometric parameters of the scorpion mud turtle (*Kinosternon scorpioides*)

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ABSTRACT. The reptile *Kinosternon scorpioides* is a freshwater chelonian, popularly known as jurará, and is found in the Baixada Maranhense, Maranhão State, Brazil. Due to the lack of scientific information on the reproductive biology of the species, current paper describes the body and testicular biometry and the gonad-somatic index (GSI) in adult specimens collected from the natural environment. Twenty male adults were collected in the rainy (n = 10) and dry (n = 10) seasons. Data were derived from the body, testis size and GSI and tests of correlation between these measures were performed. The body biometrics of free-living *Kinosternon scorpioides* is similar to those found in other studies for adult animals bred in captivity. The body weight was higher in animals collected in the rainy season than that in animals collected in the dry season. The testis size presents variations among animals captured during the rainy and dry season, but the gonadossomatic index did not vary between different groups of animals. Further studies were suggested related to the levels of sexual steroid hormones and behavioral studies to understand the factors related to the species´s reproductive cycle.

Keywords: chelonian, gonad-somatic index, *Kinosternon*, reptiles, testicular morphometric.

Parâmetros biométricos corporais e testiculares de tartaruga (*Kinosternon scorpioides*)

RESUMO. O réptil *Kinosternon scorpioides* é um quelônio de água doce popularmente conhecido como jurará, encontrado na Baixada Maranhense, Maranhão, Brasil. Diante da carência de informações científicas sobre a biologia reprodutiva desta espécie, objetivamos descrever a biometria testicular e corporal, assim como, e o índice gonadossomático (IGS), em espécimes adultos provenientes de habitat natural. Utilizamos 20 indivíduos machos adultos, coletados no período chuvoso (n = 10) e período seco (n = 10), dos quais extraímos informações da biometria corpórea e testicular, assim como o índice gonadossomático e testes de correlação entre estas medidas. Encontramos que a biometria corpórea de *Kinosternon scorpioides* de vida livre é semelhante ao encontrado em outros estudos com animais adultos criados em cativeiro. No entanto, o peso corpóreo foi maior em animais coletados no período chuvoso que o encontrado em animais coletados no período seco. A biometria testicular apresenta variações entre os animais de período chuvoso e seco, no entanto os índices gonadossomáticos não variaram entre os animais dos diferentes grupos, portanto sugerimos estudos relacionados a níveis de hormônios esteroides sexuais e estudos comportamentais para auxiliar na compreensão dos fatores relacionados ao ciclo reprodutivo da espécie.

Palavras-chave: quelônio, índice gonadossomático, *Kinosternon*, reptéis, morfometria testicular.

Introduction

The reptile scorpion mud turtle (*Kinosternon scorpioides*) is an aquatic species that inhabits still and running waters (PRITCHARD; TREBBAU, 1984). It belongs to the family Testudinae, with twelve genera and about forty species (ORR, 1986). It has a carapace with three sharp keels, the middle of which runs longitudinally throughout the carapace (VANZOLINI, 1996). The scorpion mud turtle has a strong jaw and a tail like a scorpion sting, from which its scientific name is derived (PRITCHARD, 1986). The known function of this corneal appendix is to assist the fixing of the female during mating (PEREIRA et al., 2007).

The meat of the *K. scorpioides* is also a much appreciated delicacy in the Baixada Maranhense, Maranhão State, Brazil. The commercial breeding of the species is possible, according to Normative Instruction of the Brazilian Institute of Environment and Renewable Resources (IBAMA, 2008) dealing with rules for breeding freshwater turtles (RODRIGUES et al., 2004).

It is a well-known fact that species that inhabit areas where the level of deforestation is intense are particularly vulnerable due to the isolation and

genetic loss associated with the fragmentation of their habitat (OLIVEIRA, 1994). The species that escape from such risks may be subjected to the effects of endogamy, which usually causes low reproductive efficiency (WILDT et al., 1987). Thus, for the establishment of morphophysiological standards and reproductive parameters, the study of testicular morphology and the spermatogenic process is necessary. In fact, it provides tools for the reproduction and breeding of threatened species (COUROT et al., 1970; FAWCETT et al., 1973; FRANÇA et al., 1991; GUERRA, 1983; LEITE; PAULA, 2003; RUNGE; GIESEL JR., 1950; ORTAVANT et al., 1997). The male *K. scorpioides* has a long tail, concave plastron to facilitate copulation, longer and curve nails, and a highly pigmented head, turning a black color (CARVALHO et al., 2010).

According to Kenagy and Trombulak (1986), behavioral and biometric data are consistently related and may show important indicative projections in reproductive physiology. Thus, a larger allocation and energy expenditure in testicular mass are seen in smaller animals when compared to animals with large body mass, and a strong influence by the mating system on the gonad-somatic index is also observed.

Although studies from our scientific team have contributed towards a deeper knowledge of *K. scorpioides* in different climatic seasons, such as researches related to epididymal (VIANA et al., 2013a) and vas deferens morphology (VIANA et al., 2014) and the duration of spermatogenesis (SOUSA et al., 2014), more scientific information on the reproductive biology of *K. scorpioides* is required. Current analysis describes for the first time the body and testicular biometry as well as the gonad-somatic index in adult specimens derived from their natural habitat, or rather, as wild specimens.

Material and methods

Twenty male adult *K. scorpioides*, captured in the rainy season (n = 10) between January and June and in the dry season (n = 10) between July and December from Baixada Maranhense, Brazil, were used. The research was authorized by the Chico Mendes Institute for Biodiversity Conservation - ICMBio / MMA, Nº 26136-1 and had the approval of the Ethics and Animal Experimentation Committee of Veterinary Medicine, State University of Maranhão (EAEC/UEMA). The animals were anesthetized with xylazine 2% (40 mg kg^{-1} IM^{-1}) and ketamine hydrochloride 1% (60 mg kg^{-1} IM^{-1}) and then euthanized with thiopental sodium 2.5% (60 mg kg^{-1} EV^{-1}) by catheterization of the cervical venous sinus, according to technique by Schumacher (1996).

The animals were weighed and measured following body biometric parameters, such as, carapace length (CL), which corresponds to the measurement between the first dorsal marginal shields (or nuchal) until the suture of the last dorsal marginal shields (or supracaudals); carapace width (CW) is the distance between the 6^{th} and 7^{th} dorsal shield from side to side; plastron length (PL) corresponds to dorsal measurements, or rather, from the anterior edge of intergular shield until the posterior point of the suture of anal shields; plastron width (PW), which corresponds to the most ventral lateral distance between the points of insertion of the pectoral and abdominal shields with the right and left marginal shields. The coelomic cavity was opened with a manual steel saw to disarticulate the bone bridge between the carapace and plastron for the removal of the intestinal viscera to remove the testicles. The testicles were weighed on a precision digital balance and measured with a caliper for length and width. Measurements are given in two decimal points. The volume was obtained via a measuring cylinder by checking the volume of water after the addition of the organ.

The weight of the two testes provided the gonad-somatic index (GSI) which refers to the percentage of body weight allocated within the gonads. Data were analyzed for mean, standard deviation and coefficient of variation of the 20 animals. The equation, $Y = a + bX$, defined the correlation between the width and length and total weight of carapace variables. Pearson´s correlation coefficient (r) and the confidence interval of 5% tests were applied, according to Sampaio (1998) and analyzed by Instat program.

Results

Table 1 shows measures for scrotal circumference and length, width and weight of each testis and testicular volume of the group collected in dry and rainy seasons. Mean body weight of *K. scorpioides* collected in rainy and dry season was 305.62±67.10 g. Mean length of carapace was 14.26±1.35 cm and plastron´s length was 12.07±0.81 cm. Mean height of the animals was 5.13±0.81 cm. Low height is a common feature of the family Chelidae.

The width/length ratio of the animals under analysis indicates that 1 cm in carapace length mean 0.64 cm in width. For weight/length ratio, the speed of weight gain is greater than length, which may suggest that the increase in weight may also be influenced b the height growth (Figure 1).

Table 1. Body biometric parameters, testicular and gonad-somatic index of adults *Kinosternon scorpioides*, from natural environment: dry season (January-June) and dry season (July–December). São Luís, Maranhão State, Brazil, 2013.

Parameters	Rainy season		Dry season	
	Mean ± standard deviation	Coefficient of variation (%)	Mean ± standard deviation	Coefficient of variation (%)
Body weight (g)	313.43 ± 45.45	14.50	297.80 ± 85.47	28.70
Carapace length - CL (cm)	14.48 ± 0.97	6.70	14.04 ± 1.74	12.45
Carapace width - CW (cm)	9.02 ± 0.51	5.66	8.55 ± 0.63	7.42
Plastron length - PL (cm)	12.38 ± 0.88	7.13	11.76 ± 0.75	6.44
Plastron width - PW (cm)	6.67 ± 0.19	2.88	6.19 ± 0.51	8.27
Height (cm)	5.00 ± 0.35	7.02	5.27 ± 1.27	24.20
Right testis length (cm)	1.39 ± 0.38	27.24	1.30 ± 0.54	41.37
Right testis width (cm)	1.00 ± 0.33	33.50	0.95 ± 0.20	21.57
Right testis weight (g)	0.83 ± 0.28	34.13	0.44 ± 0.27	60.67
Left testis length (cm)	1.27 ± 0.26	20.86	1.57 ± 0.39	24.76
Left testis width (cm)	0.87 ± 0.32	37.35	1.23 ± 0.40	32.52
Left testis weight (g)	0.74 ± 0.28	37.58	1.06 ± 0.29	21.69
Right testis volume (mL)	1.34 ± 0.41	30.59	1.43 ± 0.43	21.02
Left testis volume (mL)	1.29 ± 0.40	31.00	1.86 ± 0.35	18.81
Volume of both testes (mL)	2.63 ± 0.40	15.20	3.29 ± 0.39	11.85
Gonad-somatic index (%)	0.50 ± 0.10	20.00	0.50 ± 0.11	22.00

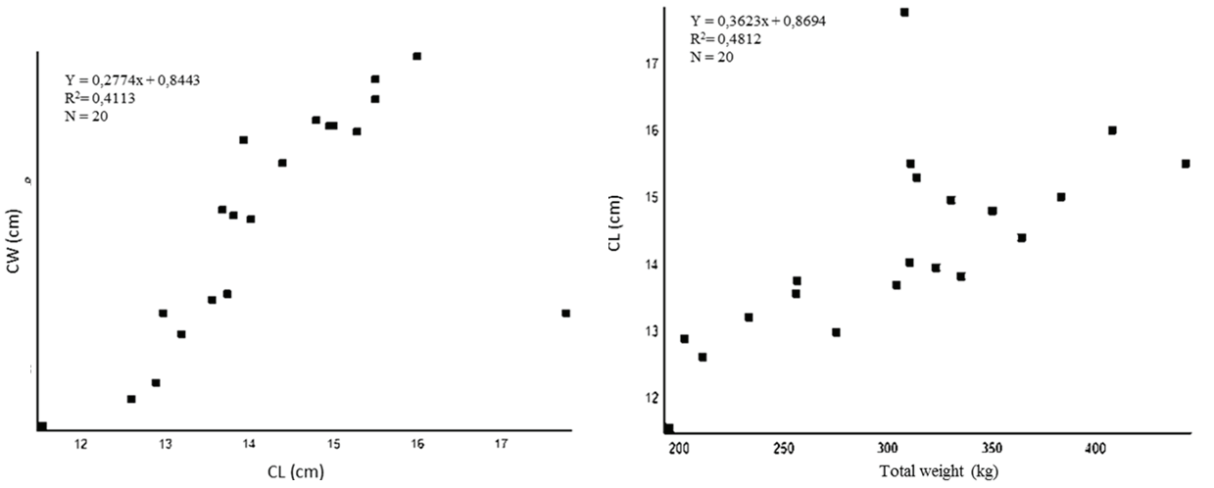

Figure 1. Regression between length measurements and between weight and length of *Kinosternon scorpioides* from Baixada Maranhense, between December 2010 and September 2011. CL: Carapace length. CW: carapace width.

Discussion

The testicles have an oval shape and are asymmetrically arranged within the coelomic cavity, surrounded by the small intestine and separated by the colon. Their color varies from pale yellow to golden yellow. They are asymmetric, with the right testicle more cranially positioned and slightly heavier than the left testicle. These observations are similar to data by Carvalho et al. (2010) for captive animals and by Viana et al. (2013a) for animals from the natural environment.

The average weight was 6.349 kg and carapace length measured 39.6 cm in turtles *Podocnemis expansa* from the natural environment (RODRIGUES et al., 2004). These data are approximately close to measurements in current research. In other turtles, such as *Chelydra serpentina*, the size variation of the carapace of sexually mature males varies between 16.8 and 17.8 cm (GLESENKAMP et al., 2003).

A comparative analysis of corporal biometric data between animals collected in the dry and rainy season was not performed due to lack of accurate information on the age of the animals. However, the group in the dry season had a lower body weight when compared to animals of the rainy season. Some factors may contribute to these differences, such as the capture in areas of abundant supply or where there is a lower animal density. Although the right testis is larger than the left, no significant difference was observed between the averages. Since samples in the dry and rainy periods featured slight variations in testes size when compared to animals at different periods, it was suggested that behavioral and hormonal studies would be helpful to understand the factors related to the species´s reproductive cycle. These data may contribute towards the formulation of hypotheses about mating, whilst

and testosterone levels related to gonadal size would indicate reproductive activity.

The weight mean of both testes was 0.65 g, corresponding to 0.21% of weight of *K. scorpioides* adults. Greater investment in testicular mass (GSI) would be expected due to its small size. Eleven fish families, totaling 21 species, have been described in the collection region inhabited by the turtle (VIANA et al., 2013b). In male fish of the species *Bryconops cf. affinis* the GSI was 0.34% (NOGUEIRA et al., 1997) and in *Rhamdia quelen* GSI was 0.22% (GHIRALDELLI et al., 2007) whereas in other mammals, such as adult African lions, the rate was 0.015% (BARROS et al., 2006), in the Brazilian panther it was 0.034% (AZEVEDO et al., 2006) and the Brazilian Black Panther GSI was 0.03% (GUIÃO-LEITE et al., 2006). The carapace length of adult males *K. scorpioides* is a reliable parameter due to the high correlation with the body weight. The GSI was 0.50%, which was higher than that found in the animals above described, which belong to other classes of vertebrates. These results reflected a reproductive behavior of free-living, and may present a polygamous tendency, since the male's territory overlaps the several females, as found in other reptiles (POUGH et al., 2008).

Conclusion

Although the body biometrics of free-living *Kinosternon scorpioides* are similar to those found in other studies with adult animals bred in captivity, the body weight was higher in animals collected in the rainy season than that in animals collected in the dry season. Although testes size presents variations between animals in the rainy and dry seasons, the gonad-somatic index did not vary between different groups of animals. Studies on sexual steroid hormones levels and behavioral studies should be undertaken to understand more extensively the factors related to the reproductive cycle.

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