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Histological evidence of reproductive activity in lizards from the APM Manso, Chapada dos Guimarães, Mato Grosso State, Brazil

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ABSTRACT. The construction of dams causes major impacts on fauna by changing or eliminating irreversibly their habitats. The resulting changes lead to deep potential modifications on reproductive biology and population structure of lizards, snakes and amphisbaenas. The reservoir in the Multiple Use Area of Manso (APM-Manso) is located near to Chapada dos Guimarães National Park, in Mato Grosso State. We analyzed comparatively the male gonads of *Anolis meridionalis*, *Colobosaura modesta*, *Cercosaura ocellata*, *Cnemidophorus ocellifer*, *Hoplocercus spinosus*, *Bachia bresslaui*, *Mabuya frenata*, *Micrablepharus atticolus* and *Tropidurus oreadicus*, from APM-Manso, aiming to verify possible changes in the reproductive success according to environmental changes. Before the impoundment *A. meridionalis*, *Colobosaura modesta*, *Cercosaura ocellata*, *M. atticolus* and *T. oreadicus* showed up reproductive. However, during the impoundment period they presented changes in seminiferous tubules, evidenced by the absence of spermatids and spermatozoids. *B. bresslaui* and *M. frenata* had no differences in the seminiferous tubules before and after the impoundment, being reproductive in both moments. The damming and the formation of the lake of Manso reservoir may have interfered on the reproduction of some lizards species, especially if the reproductive cycle is regulated by the rainfall of the habitat.

Keywords: lizards, reproduction, habitat modification, histology.

Evidências histológicas da atividade reprodutiva em lagartos da região da APM Manso, Chapada dos Guimarães, Estado do Mato Grosso, Brasil

RESUMO. A construção de barragens tem ocasionado grandes impactos sobre a fauna ao alterar ou eliminar seus habitats de forma irreversível. Alterações decorrentes exercem profundas modificações potenciais na biologia reprodutiva e na estrutura populacional de lagartos, serpentes e anfisbenas. O reservatório da Área de Aproveitamento Múltiplo de Manso (APM-Manso) localiza-se próximo ao Parque Nacional da Chapada dos Guimarães, em Mato Grosso. Foram analisadas comparativamente as gônadas masculinas de *Anolis meridionalis*, *Colobosaura modesta*, *Cercosaura ocellata*, *Cnemidophorus ocellifer*, *Hoplocercus spinosus*, *Bachia bresslaui*, *Mabuya frenata*, *Micrablepharus atticolus* e *Tropidurus oreadicus*, da APM-Manso com o objetivo de verificar se houve alterações no sucesso reprodutivo das mesmas de acordo com as modificações ocorridas no ambiente. Antes do represamento *A. meridionalis*, *Colobosaura modesta*, *Cercosaura ocellata*, *M. atticolus* e *T. oreadicus* apresentavam-se reprodutivas. No entanto, durante o período de represamento apresentaram alterações nos túbulos seminíferos evidenciadas pela ausência de espermátides e espermatozóides. *B. bresslaui* e *M. frenata* não apresentaram diferenças em seus túbulos seminíferos antes ou depois do represamento, estando reprodutivas em ambos os momentos. O represamento e a formação do lago do Manso pode ter interferido na reprodução de algumas espécies de lagartos, principalmente se o ciclo reprodutivo for regulado a partir da pluviosidade do habitat.

Palavras-chave: lagartos, reprodução, modificação de habitat, histologia.

Introduction

The process of dam construction in many Brazilian rivers has caused large impacts on the fauna by changing or eliminating their habitats irreversibly (RODRIGUES, 1999, 2005). In ecological terms, the reservoirs are semi-natural ecosystems and intermediate between rivers and lakes (TUNDISI, 1993). The impoundment of rivers causes the transformation of the original ecosystem, resulting in great changes physical, chemical, limnological and environmental, including the reproductive activity of many species (TUNDISI, 1988).

For shallow rivers with large floodplains and distinct cycles of flood, the ecosystem changes may be highly significant. The impacts resulting from changes in river flow and the natural cycle of flooding by modifying the deposition of sediments, the nutrients supply and succession of vegetation, have a deep potential impact on reproductive biology and population structure of lizards, snakes and worm snakes (RODRIGUES, 2005). Despite the importance of the three groups in the environmental changes, we will focus on lizards because, apparently, they are considered as good models for studying various aspects of the cycle and present many morphological and behavioral changes (HEULIN et al., 1997).

The testicular cycle is affected by seasonality in many species (FITCH, 1970). In tropical lizards, the cycles are quite varied (VAN SLUYS, 1993). The morphological characteristics of the testicles typically vary according to the stage of the annual reproductive cycle. There are also changes in the developmental stage of germ cells, and the amount and metabolic activity of the interstitial tissue (DEL CONTE, 1972; WILHOFT, 1963), the changes in this tissue apparently vary inversely with periods of production of germ cells (GOLDBERG, 1970).

According to Fawcett et al. (1971), reproductive success is a regular process of biochemistry and structural modification of primary cells that result in the production of sperm or oocytes.

The reservoir in the Multiple Use Area of Manso (APM-Manso) is located near to Chapada dos Guimarães, Mato Grosso State. The Manso river, where the reservoir was built, is one of the main tributaries of Cuiabá river. Closed in November 1999, the reservoir flooded, beyond Manso river upstream from the dam, the lower stretches of the rivers Casca, Palmeiras (tributaries) and Quilombo (tributary of Casca river) with a total area of 427 km² in the maximum height, with a dense drainage network and a steady rain, flowing into the Pantanal of Mato Grosso State (ALHO et al., 2000).

This study, using comparative analysis of male gonads of lizards from the region of the APM-Manso, aimed to verify whether there were changes in the reproductive success of the species according to the changes in the environment where these individuals were situated. Apparently, environmental and/or man-made factors can influence the reproductive success of these lizards' species.

Material and methods

For the histological analysis of gonads we used specimens (n = 60) deposited in the Zoological Collection of Vertebrates from the Federal University of Mato Grosso, belonging to six families, nine genera and nine species (Table 1). The animals were collected between August 1998 and May 2001.

In order to collect the individuals, we used pitfall traps in the area with direct influence from the Multiple Use Area of Manso (14°52'S, 55°48'W), located in the municipality of Chapada dos Guimarães, Mato Grosso State. The impoundment period began in November 1999, and our analysis was carried out with specimens collected before and during this period, through tracking and rescues. The sites and the collection procedure are detailed in Strüssmann (2000).

Table 1. List of specimens examined and the numbers of the sites in Zoological Collection of Vertebrates UFMT.

Family	Species	Number of the lots
Polychrotidae		
	Anolis meridionalis (Boettger, 1885)	UFMT 745, 750, 757, 764, 2312, 2316, 2570, 2574 and 2578
Gymnophthalmidae		
	Bachia bresslaui (Amaral, 1935)	UFMT 433, 434, 436, 1120, 1122, 1124, 1126 and 1127
	Cercosaura ocellata (Wagler, 1830)	UFMT 384, 387, 388, 1100, 1108, 2403, 3223, 3238, 3254 and 3255
	Colobosaura modesta (Reinhardt; Luetken, 1862)	UFMT 464, 465, 999, 1000, 1003 and 1009
	Micrablepharus atticolus (Rodrigues, 1996)	UFMT 392, 1076, 1080, 1082, 1093 and 2426
Hoplocercidae		
	Hoplocercus spinosus (Fitzinger, 1843)	UFMT 2415 and 2418
Scincidae		
	Mabuya frenata (Cope, 1862)	UFMT 394, 395, 1045, 1047, 1050, 1051, 1052, 1053, 2448 and 2449
Teiidae		
	Cnemidophorus ocellifer (Spix, 1825)	UFMT 442, 443, 444, 1011, 1014 and 1025
Tropiduridae		
	Tropidurus oreadicus (Rodrigues, 1987)	UFMT 452, 1044 and 2622

The selection of animals for histological analysis was random, and the removal of gonads for the analysis was done through an incision on the left side of the abdomen of the animal; the samples were kept in vials with 70% ethanol. For the preparation of the slides the material was dehydrated with increasing alcohol concentrations. Part of this material was cleared and paraffin-embedded, and another part was included in plastic resin glycol methacrylate type Historesin®. Sections with 5 μm for samples embedded in paraffin, and 3 μm to those included in plastic resin, were stained with toluidine blue 1% and photographed.

Results

Through an analysis of individual species, we observed how each one responded to the environmental changes caused by the damming of the Manso river.

Anolis meridionalis (Figure 1A and B) presented the tubules with abundant proportions of spermatogonia and medians proportions of spermatocytes and spermatids. For the spermatozoids, we observed a higher production in the individuals collected before the impoundment (Figure 1A). Otherwise, the interstitial tissue was reducing over the impoundment time.

In relation to *Bachia bresslaui* we observed there was no variation in the cellular composition of the tubules, even under the impoundment influence (Figure 2A and B). Thus, the tubules were composed of abundant proportions of spermatogonia and spermatocytes, few spermatids and spermatozoids, and a regular interstitial tissue

Colobosaura modesta present tubules composed by spermatogonia and spermatocytes in abundant proportions, with varied presence of spermatids and spermatozoids. In the individuals collected before the impoundment, that had not been influenced by it, the spermatids and spermatozoids were abundant (Figure 3A), but in the lizards collected during the impoundment we did not verify these cells (Figure 3B). The opposite was observed for the interstitial tissue that was present in small amount when sperm was abundant, and absent thereof, as expected.

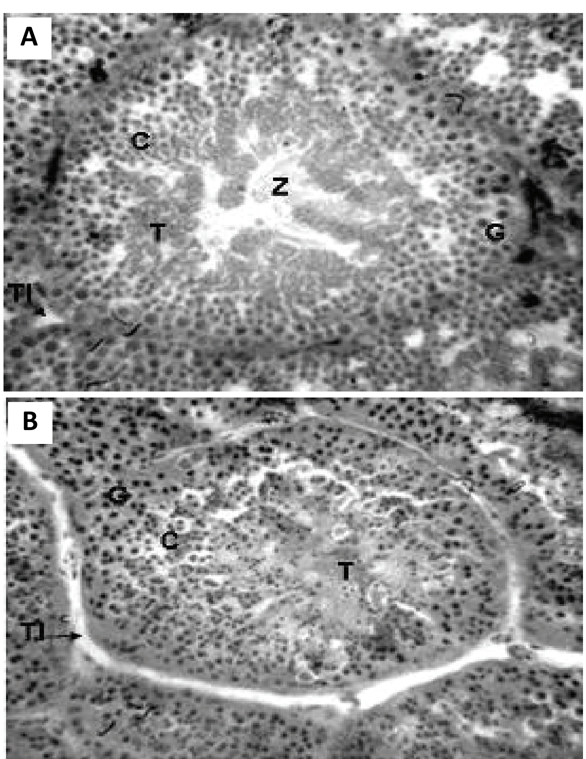

Figure 1. Histological sections of seminiferous tubules of *Anolis meridionalis* collected before (A) and during (B) the impoundment. Abbreviations: TI - interstitial tissue; G - spermatogonia; C - spermatocytes; T – spermatids; Z - spermatozoids. 600X.

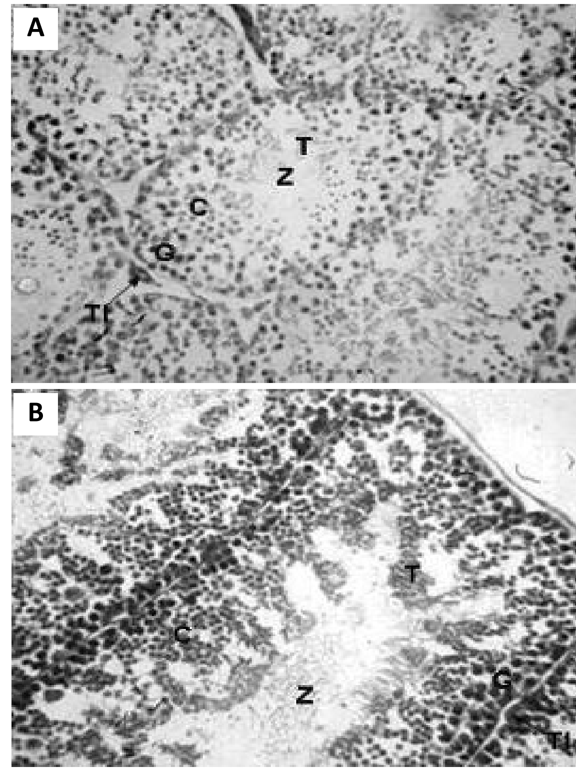

Figure 2. Histological sections of seminiferous tubules of *Bachia bresslaui* collected before (A) and during (B) the impoundment. Abbreviations: TI - interstitial tissue; G - spermatogonia; C - spermatocytes; T – spermatids; Z – spermatozoids. 600X.

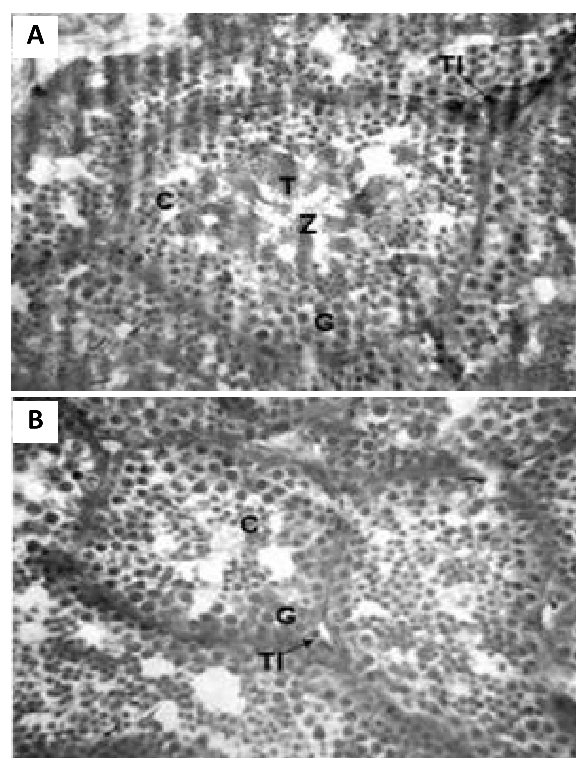

Figure 3. Histological sections of seminiferous tubules of *Colobosaura modesta* collected before (A) and during (B) the impoundment. Abbreviations: TI - interstitial tissue; G - spermatogonia; C - spermatocytes; T - spermatids; Z - spermatozoids. 600X.

Cercosaura ocellata (Figure 4A and B) presented primary cells similar to *Colobosaura modesta*, with disagreement regarding the production of spermatozoids, which were absent in all individuals sampled, regardless of the impoundment impact.

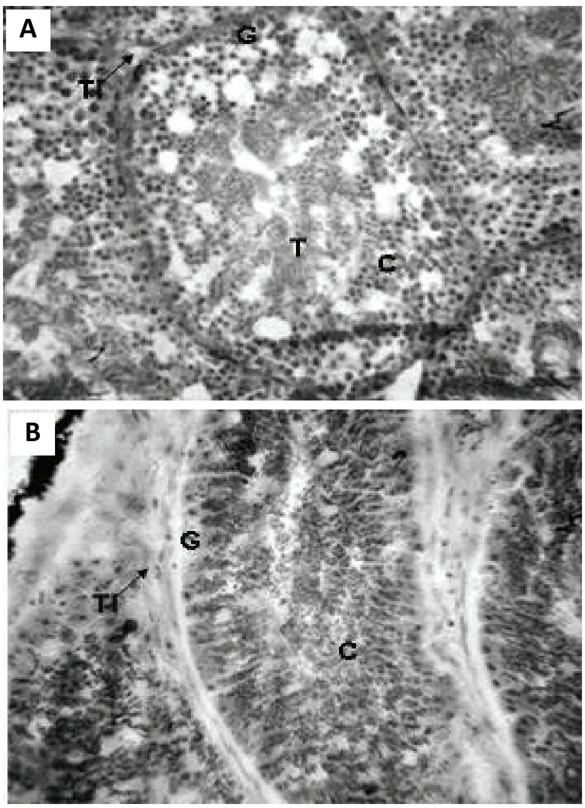

Figure 4. Histological sections of seminiferous tubules of *Cercosaura ocellata* collected before (A) and during (B) the impoundment. Abbreviations: TI - interstitial tissue; G - spermatogonia; C - spermatocytes; T - spermatids. 600X.

In *Micrablepharus atticolus*, we observed a great influence from the impoundment on spermatogenesis. For individuals that had not suffered the impoundment impact, the tubules showed a median proportion of spermatogonia and spermatocytes, abundant spermatids, spermatozoids present and decrease in interstitial tissue (Figure 5A). The lizards collected during the impoundment showed a reduction in the production of spermatids and absence of sperm (Figure 5B), as seen in *Colobosaura modesta*.

Cnemidophorus ocellifer presented tubules with spermatogonia, spermatocytes and spermatids in abundance, spermatozoids were present in a reasonable proportion, and the interstitial tissue was also abundant (Figure 6). Concerning the sampling periods, these lizards had not suffered the stress of the impoundment process.

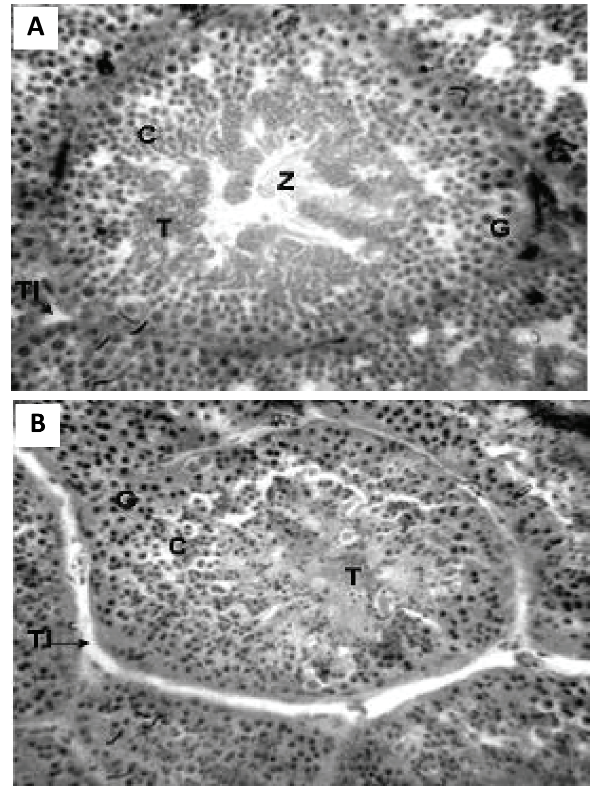

Figure 5. Histological sections of seminiferous tubules of *Micrablepharus atticolus* collected before (A) and during (B) the impoundment. Abbreviations: TI - interstitial tissue; G - spermatogonia; C - spermatocytes; T – spermatids; Z – spermatozoids. 600X.

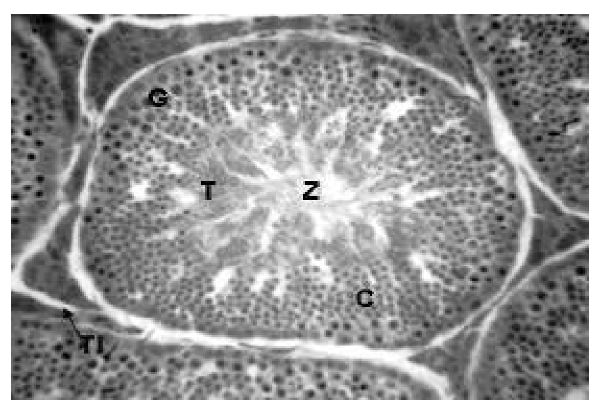

Figure 6. Histological sections of seminiferous tubules of *Cnemidophorus ocellifer* collected before the impoundment. Abbreviations: TI - interstitial tissue; G - spermatogonia; C - spermatocytes; T – spermatids; Z – spermatozoids. 600X.

In *Hoplocercus spinosus* the seminiferous tubules presented few spermatogonia and spermatocytes, spermatids in abundance, absence of spermatozoa and low abundance of interstitial tissue (Figure 7). In relation to the sampling date, these specimens were present during the reservoir filling; nevertheless apparently they did not show remarkable differences in cell types present in the gonads.

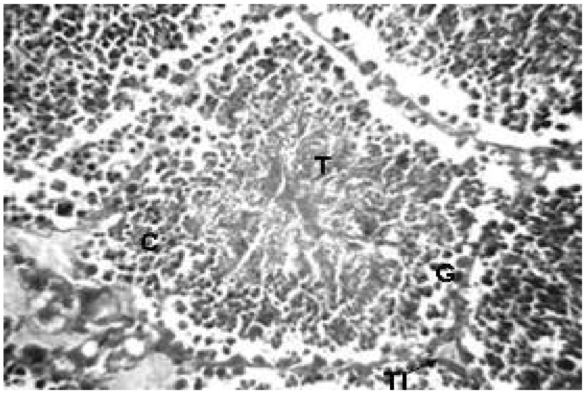

Figure 7. Histological sections of seminiferous tubules of *Hoplocercus spinosus* collected during the impoundment. Abbreviations: TI - interstitial tissue; G - spermatogonia; C - spermatocytes; T - spermatids. 600X.

Mabuya frenata did not show differences in the tubules, regarding the impoundment (Figure 8A and B). Thus, we observed spermatogonia, spermatocytes and spermatids in medians proportions and near absence of spermatozoids. Moreover, the interstitial tissue was not abundant.

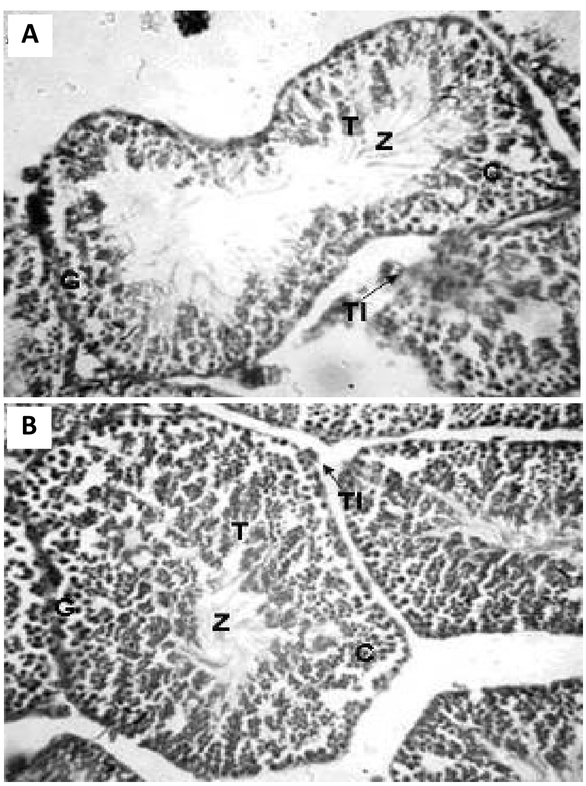

Figure 8. Histological sections of seminiferous tubules of *Mabuya frenata* collected before (A) and during (B) the impoundment. Abbreviations: TI - interstitial tissue; G - spermatogonia; C - spermatocytes; T – spermatids; Z – spermatozoids. 600X.

Tropidurus oreadicus was the species that best evidenced the impoundment influence on the gonads. The collected lizards that suffered the impact, presented seminiferous tubules filled with spermatogonia, but without all the other germ cells, and abundant interstitial tissue (Figure 9B). Regarding those ones without the impact influence, the tubules showed some recovery in the production of all stages of germ cells, including spermatozoids in abundance, and reduction of interstitial tissue (Figure 9A).

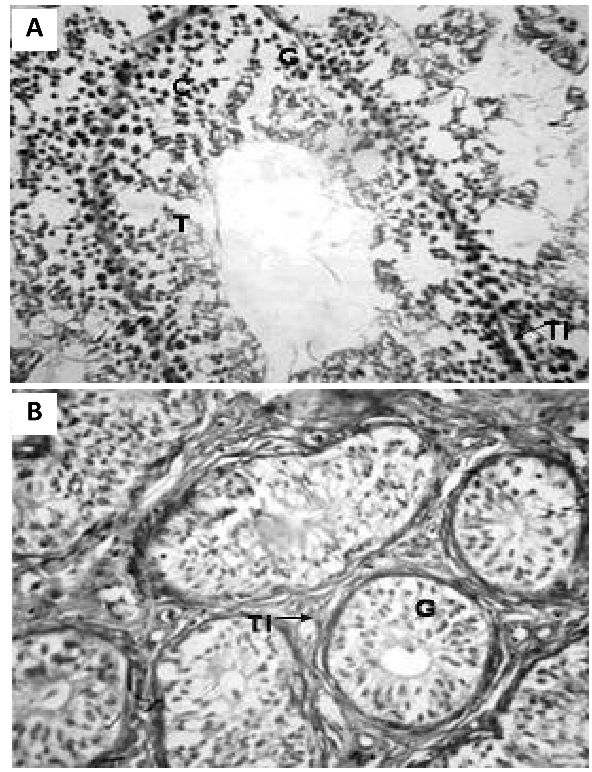

Figure 9. Histological sections of seminiferous tubules of *Tropidurus oreadicus* collected before (A) and during (B) the impoundment. Abbreviations: TI - interstitial tissue; G - spermatogonia; C - spermatocytes; T - spermatids. 600X.

Considering the groups studied, we observed that, apparently the lizards from the same family responded similarly as to the reproductive activity.

Discussion

The reproductive activities from most species of tropical lizards are reduced or interrupted during the rainy season (FITCH, 1970, 1982), evidencing seasonal reproduction. Two main hypotheses have been raised to explain the seasonal reproduction: (1) deterioration of niches for eggs laying during the rainy season, and (2) the decrease in the availability of food for adults and/or juveniles during the rainy season. Evidence for the second hypothesis arises from studies showing that food availability influences the production of offspring in lizards (ANDERSON, 1994; ANDREWS, 1982; DUNHAM, 1981; WORTHINGTON, 1982).

Recent research indicates that the reproductive cycles of tropical lizards present great variability and these cycles are not always linked to rainfall patterns (VITT, 1986). Stamps and Tanaka (1981) states that the water availability may limit the growth of *Anolis aeneus*, regardless the effects of food availability, and Rose (1982) found that for *Anolis acutus* the dietary supplement increases fat reserves, but not reproduction. Great part of the available data on tropical *Anolis* show that most reproductive peaks occur during the rainy season, and are interrupted or reduced during the dry season (ANDREWS; RAND, 1974; DUELLMAN, 1978; FITCH, 1973). Meantime, Gorman and Licht (1974) verified low correlation between rainfall patterns and ovarian cycles in *Anolis* lizards in Puerto Rico, and highlighted the temperature and, possibly, photoperiod as environmental factors that control reproduction. *Anolis meridionalis* presented variations in the reproductive aspects under the new conditions established in the habitat, and not due to precipitation, even as the flood in Manso widened due to the dams, reducing spermatozoids production, which confirms the data reported by Gorman and Licht (1974) above mentioned.

Cnemidophorus ocellifer presents early maturation with multiple descendants as described by Tinkle et al. (1970). Also reproduces continuously, although in seasonal environment in terms of precipitation (VITT, 1983). Vitt (1983) suggests that the temperature, photoperiod or their interaction can determine seasonality in *Cnemidophorus*, because when these variables are not seasonal (tropical zone), reproduction is almost continuous, and vice versa. Vitt and Breitenbach (1993) also noted that tropical species from this genus usually reproduce throughout the year, but have at least one peak in the reproductive period. The data found to *C. ocellifer* in Manso suggested a conspicuous impact due to environmental changes, since we collected specimens of this species in the rescues period, which suggests that the rainfall should be considered among the aspects determining the seasonality in this species.

Similarly, in the genus *Mabuya*, some species reproduce over the year, while others have defined their breeding seasons (VITT; BLACKBURN, 1983). Data from previous studies with these and other species (ROCHA; VRCIBRADIC, 1999; STEVAUX, 1993; VANZOLINI; REBOUÇAS-SPIEKER, 1976; VITT, 1991) indicate that the time of parturition of the Brazilian species of *Mabuya*, as a whole, tends to occur at the end of the dry season until the middle of the rainy season. Consequently, the reproductive period of the Neotropical species of *Mabuya* in general seems to be related to environmental seasonality in terms of rainfall, which has a physiological response to coincide with the advent of the season with high humidity or shortly before it, so that most of the youth development occurs during the months with greatest food abundance. Thus, the dam has promoted a greater flooding period, which is favorable for breeding of this species, which may explain the absence of differences in cellular composition of the seminiferous tubules in the analysis.

The genus *Tropidurus* is widely distributed in South America and Galapagos Islands (RODRIGUES, 1987). The reproductive cycles of some species from the genus have been described and, in general, females of these species breed during the rainy season, while males are potentially reproductive throughout the year. Males of *Tropidurus* lizards are known to be territorial (FITCH, 1981; WERNER, 1978), and lizards that reach larger sizes, would get benefit first, as obtaining territory and reproduction. In this way, the males must present growth rates higher before the reproductive season and, therefore, before the rains begin (VAN SLUYS, 1993). In the municipality of Cocalzinho, Goiás State (15°48' S and 48°45' W), a local on the Cerrado like the region of Manso, the reproduction of *T. oreadicus* is probably seasonal (MEIRA et al., 2007), occurring during the late rainy season and early dry season. In Manso, the presence of differences, at histological levels, in the gonads due to the impact can be explained by the fact that the reservoir filling could change the species reproductive rate; since the flooding period in the region was prolonged, this species used a part of the dry season to their reproductive period, corroborating with Meira et al. (2007), cited above.

There is no scientific records that describe or analyze the reproduction or influential aspects from *Bachia bresslaui*, *Colobosaura modesta*, *Cercosaura ocellata*, *Hoplocercus spinosus* and *Micrablepharus atticolus* that allow comparisons with those found in the present study, therefore our results are inedited.

Conclusion

Several sources of variation may be responsible for seasonal reproduction in tropical lizards, such as environmental factors, ecotypes adaptations and environmental constraints (BALLINGER, 1983), as well as construction of dams and the caused floodings. Nevertheless, we noted that the damming of Manso river may have interfered on the reproduction of some lizards species, especially if the reproductive cycle is regulated by the rainfall in the habitat.

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References

ALHO, C. J. R.; CONCEIÇÃO, P. N.; CONSTANTINO, R.; SCHLEMMERMEYER, T.; STRUSSMANN, C.; VASCONCELLOS, L. A. S.; OLIVEIRA, D. M. M.; SCHNEIDER, M. **Fauna Silvestre da Região do Rio Manso, MT**. Brasília: Edições Ibama/Eletronorte, 2000.

ANDERSON, R. A. Functional and population responses of the lizard *Cnemidophorus tigris* to environmental fluctuations. **American Zoologist**, v. 34, n. 3, p. 409-421, 1994.

ANDREWS, R. M. Patterns of growth in reptiles. In: GANS, C.; POUGH, F. H. (Ed.). **Biology of the Reptilia**. London: Academic Press, 1982. p. 273-320.

ANDREWS, R. M.; RAND, A. S. Reproductive effort in anoline lizards. **Ecology**, v. 55, n. 6, p. 1317-1327, 1974.

BALLINGER, R. E. Life-history variations. In: HUEY, R. B.; PIANKA, E. R.; SCHOENER, T. W. (Ed.). **Lizard Ecology**: studies of a model organism. Cambridge: Harvard University Press, 1983. p. 241-260.

DEL CONTE, E. Variación cíclica del tejido intersticial del testículo y spermiogénesis contínua en un lagarto teído tropical: *Cnemidophorus l. leminiscatus* (L.). **Acta Científica Venezolana**, v. 23, n. 5, p. 177-183, 1972.

DUELLMAN, W. E. The biology of an equatorial herpetofauna in Amazonian Ecuador. **Miscellaneous Publication - University of Kansas, Museum of Natural History**, n. 65, p. 1-352, 1978.

DUNHAM, A. E. Populations in a fluctuating environment: the comparative population ecology of the iguanid lizards *Sceloporus merriami* and *Urosaurus ornatus*. **Miscellaneous Publication - University of Michigan, Museum of Zoology**, n. 158, p. 1-72, 1981.

FAWCETT, D. W.; ANDERSON, W. A.; PHILLIPS, D. M. Morphogenetic factors influencing the shape of the sperm head. **Developmental Biology**, v. 26, n. 2, p. 220-251, 1971.

FITCH, H. S. Reproductive cycles in lizards and snakes. **Miscellaneous Publication - University of Kansas, Museum of Natural History**, n. 52, p. 1-247, 1970.

FITCH, H. S. A field study of Costa Rican lizards. **University of Kansas Science Bulletin**, n. 50, p. 39-126, 1973.

FITCH, H. S. Sexual size differences in reptiles. **Miscellaneous Publication - University of Kansas, Museum of Natural History**, n. 70, p. 42-52, 1981.

FITCH, H. S. Reproductive cycles in tropical reptiles. **Occasional Papers of the Museum of Natural History - University of Kansas**, n. 96, p. 1-53, 1982.

GOLDBERG, S. R. Seasonal ovarian histology of the ovoviviparous Iguanidae lizard *Sceloporus jarrovi* Cope. **Journal of Morphology**, v. 132, n. 3, p. 265-276, 1970.

GORMAN, G. C.; LICHT, P. Seasonality in ovarian cycles among tropical *Anolis* lizards. **Ecology**, v. 55, n. 2, p. 360-369, 1974.

HEULIN, B.; OSENEGG-LECONTE, K.; MICHEL, D. Demography of a bimodal reproductive species of lizard (*Lacerta vivipara*) survival and density characteristics of oviparous populations. **Herpetologica**, v. 53, n. 4, p. 432-444, 1997.

MEIRA, K. T. R.; FARIA, R. G.; SILVA, M. D. M.; MIRANDA, V. T.; ZAHN-SILVA, W. História natural de *Tropidurus oreadicus* em uma área central de cerrado rupestre do Brasil Central. **Biota Neotropica**, v. 7, n. 2, p. 155-163, 2007.

ROCHA, C. F. D.; VRCIBRADIC, D. Reproductive traits of two sympatric viviparous skinks (*Mabuya macrorhyncha* and *Mabuya agilis*) in a Brazilian restinga habitat. **Journal of Herpetology**, v. 9, n. 2, p. 43-53, 1999.

RODRIGUES, M. T. Sistemática, ecologia e zoogeografia dos *Tropidurus* do grupo *torquatus* ao Sul do Rio Amazonas (Sauria; Iguanidae). **Arquivos de Zoologia**, v. 31, n. 3, p. 105-230, 1987.

RODRIGUES, M. T. Impacto das hidrelétricas sobre a fauna terrestre. In: VASCONCELLOS, L. E. M. (Coord.). **O tratamento do impacto das hidrelétricas sobre a fauna terrestre**. Rio de Janeiro: Eletrobrás, 1999. p. 4-11.

RODRIGUES, M. T. Conservação dos répteis brasileiros: os desafios para um país megadiverso. **Megadiversidade**, v. 1, n. 1, p. 87-94, 2005.

ROSE, B. Food intake and reproduction in *Anolis acutus*. **Copeia**, v. 1982, n. 2, p. 322-330, 1982.

STAMPS, J.; TANAKA, S. The influence of food and water on growth rates in a tropical lizard (*Anolis aeneus*). **Ecology**, v. 62, n. 1, p. 33-40, 1981.

STEVAUX, M. N. Estratégia reprodutiva de *Mabuya* sp. (Sauria: Scincidae): um padrão geral de reprodução para o gênero na região neotropical. **Revista Nordestina de Biologia**, v. 8, n. 1, p. 61-86, 1993.

STRÜSSMANN, C. Herpetofauna. In: ALHO, C. J. R.; CONCEIÇÃO, P. N.; CONSTANTINO, R.; SCHLEMMERMEYER, T.; STRUSSMANN, C.; VASCONCELLOS, L. A. S.; OLIVEIRA, D. M. M.; SCHNEIDER, M. (Ed.). **Fauna silvestre do Manso**. Brasília: Ibama, 2000. p. 153-189.

TINKLE, D. W.; WILBUR, H. M.; TILLEY, S. Evolutionary strategies in lizard reproduction. **Evolution**, v. 24, n. 1, p. 55-74, 1970.

TUNDISI, J. G. Impactos ecológicos da construção de represas: aspectos específicos e problemas de manejo. In: TUNDISI, J. G. (Ed.). **Limnologia e manejo de represas**. São Paulo: Academia de Ciências de São Paulo, 1988. v. 1, tomo 1, p. 1-76.

TUNDISI, J. G. Theoretical basis for reservoir management. **Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie**, v. 25, n. 2, p. 1153-1156, 1993.

VAN SLUYS, M. The reproductive cycle of *Tropidurus itambere* (Sauria: Tropiduridae) in southeasthern Brazil. **Journal of Herpetology**, v. 27, n. 1, p. 28-32, 1993.

VANZOLINI, P. E.; REBOUÇAS-SPIEKER, R. Distribution and differentiation of animals along the coast and in continental islands of the state of São Paulo, Brazil. 3. Reproductive differences between *Mabuya caissara* and *Mabuya macrorhyncha* (Sauria, Scincidae). **Papéis Avulsos de Zoologia**, v. 29, n. 15, p. 95-109, 1976.

VITT, L. J. Reproduction and sexual dimorphism in the tropical teiid lizard *Cnemidophorus ocellifer*. **Copeia**, v. 1983, n. 2, p. 359-366, 1983.

VITT, L. J. Reproductive tactics of sympatric gekkonid lizards with a comment on the evolutionary and ecological consequences of invariant clutch size. **Copeia**, v. 1986, n. 3, p. 773-786, 1986.

VITT, L. J. An introduction to the ecology of Cerrado lizards. **Journal of Herpetology**, v. 25, n. 1, p. 79-90, 1991.

VITT, L. J.; BLACKBURN, D. G. Reproduction in the lizard *Mabuya hethi* (Scincidae): a commentary on viviparity in new world *Mabuya*. **Canadian Journal of Zoology**, v. 61, n. 12, p. 2798-2806, 1983.

VITT, L. J.; BREITENBACH, G. L. Life histories and reproductive tactics among lizards in the genus *Cnemidophorus* (Sauria: Teiidae). In: WRIGHT, J. W.; VITT, L. J. (Ed.). **Biology of the whiptail lizards**. Norman: Oklahoma Museum of Natural History, 1993. p. 211-243.

WERNER, D. I. On the biology of *Tropidurus delanonis*, Baur (Iguanidae). **Zeitschrift fur Tierpsychologie**, v. 47, n. 4, p. 337- 395, 1978.

WILHOFT, D. C. Gonadal histology and seasonal changes in the tropical Australian lizard, *Leiolopisma rhomboidalis*. **Journal of Morphology**, v. 113, n. 2, p. 185-203, 1963.

WORTHINGTON, R. D. Dry and wet year comparisons of clutch and adult body sizes of *Uta stansburiana stejnegeri*. **Journal of Herpetology**, v. 16, n. 3, p. 332-334, 1982.

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