Population Dynamics of *Tropidurus torquatus* (Wied, 1820) (Squamata, Tropiduridae) in Southern Brazil

Author(s): Renata Cardoso Vieira, Jéssica Francine Felappi, Rodrigo Caruccio and Laura Verrastro
Source: South American Journal of Herpetology, 6(3):215-222.
Published By: Brazilian Society of Herpetology
DOI: http://dx.doi.org/10.2994/057.006.0308
URL: http://www.bioone.org/doi/full/10.2994/057.006.0308

South American Journal of Herpetology, 6(3), 2011, 215-222

POPULATION DYNAMICS OF *TROPIDURUS TORQUATUS* (WIED, 1820) (SQUAMATA, TROPIDURIDAE) IN SOUTHERN BRAZIL

Renata Cardoso Vieira[1,2,6]; Jéssica Francine Felappi[1,3]; Rodrigo Caruccio[1,4], and Laura Verrastro[1,5]

[1.] *Departamento de Zoologia, Universidade Federal do Rio Grande do Sul. Porto Alegre, Brasil.*
[2.] *E-mail: renatacva@gmail.com*
[3.] *E-mail: jessica_ff@hotmail.com*
[4.] *E-mail: rodrigocaruccio@gmail.com*
[5.] *E-mail: lauraver@ufrgs.br*
[6.] *Corresponding author*

Abstract. Population dynamics of the lizard *Tropidurus torquatus* was studied between May 2008 and June 2009 in a rocky formation in Alegrete municipality, Rio Grande do Sul state, southern Brazil. The study was carried out using the capture, marking and recapture method, the area being randomly searched from 08:00 am to 6:00 pm. *Tropidurus torquatus* presented variation in population structure throughout the study period, with maximum biomass observed in October 2008 and maximum density occurring in November 2008 (reproductive season), both having a second peak in March 2009 (recruitment period). There was a significant difference between the number of juveniles and adults recorded, since adults were present throughout the study period while juveniles were present in the months after recruitment. The difference found between males and females may be related to a social territorial behavior of the males. The population of *Tropidurus torquatus* presented a cyclic and seasonal variation in population structure, possibly associated with the reproductive cycle of the species, with differences in the distribution of age classes and sexual proportions throughout the year.

Key-Words. *Tropidurus,* population structure, sex ratio, age classes, social behavior.

Introduction

The lizard genus *Tropidurus* comprises 21 species distributed in four groups (*spinulosus, bogerti, semitaeniatus,* and *torquatus*) (Meira *et al.,* 2007). The *torquatus* group has species that are, generally, heliophylous, diurnal, and predominantly insectivores, and these species have great ecological plasticity since they occur in wide open areas with rocky outcrops, sand dunes and savannas (Vitt and Goldberg, 1983; Rodrigues, 1987; Vitt, 1993; Zerbini, 1998; Frost *et al.,* 2001; Faria and Araújo, 2004). *Tropidurus torquatus* Wied, 1820 is popularly known as the collared lizard and belongs to the *torquatus* group (Frost, 1992; Frost *et al.* 2001). This species is distributed from south to northeast Brazil, reaching the south of Bahia State. It occurs in continental open areas, on the coast or on islands and its populations are generally abundant where it is found. In Rio Grande do Sul State, it lives on rocky outcrops in *campos* formations of the Pampa Biome, presenting diurnal habit and territorial behavior (Rodrigues, 1987; Rocha, 2000; Carreira *et al.,* 2005).

Studies with this species generally focus on ecological aspects including sexual dimorphism (Pinto *et al.,* 2005), reproduction (Gomides *et al.,* 2006; Wiederhecker *et al.,* 2002), demography (Wiederhecker *et al.,* 2003), activity patterns (Hatano *et al.,* 2001), thermal ecology (Kiefer *et al.,* 2005; Kiefer *et al.,* 2007; Nunes *et al.,* 2007; Ribeiro *et al.,* 2007), and feeding behavior (Fialho *et al.,* 2000; Carvalho *et al.,* 2007). However, all these studies have been carried out in the Central-East and Southeast regions of Brazil.

The comparison of the biology of species with wide ranges spanning different environmental conditions is important to determine adaptive biological factors (Meira *et al.,* 2007). Intraspecific variations of life history strategies have shown the importance of identifying differences of local environmental factors and the influence of these on available ecological resources, allowing one to formulate hypothesis about the evolution of life history strategies of different groups (Niewiarowski, 1994).

In addition, as the information on lizard ecology increases, it is possible to identify which parameters allow a population of a given species to occupy and perpetuate itself over time in a specific habitat (Ballinger, 1983; Huey and Pianka, 1983). Population and life history characteristics of lizards can vary among tropical and temperate species (Rocha, 1998). The parameters of life strategies (population size and density, growth, mortality, reproduction) can be related to pluviosity in species occurring in tropical, semi-arid or arid environments, while temperature can affect species occurring in temperate environments (James and Shine, 1985; Magnusson, 1987; Rocha, 1992; Clerke and Alford, 1993; Vitt and Zani, 1996; Verrastro and Krause, 1999; Verrastro, 2001; Wiederhecker et al, 2002). There is an important

phylogenetic component that shows that many lizard genera and families keep a correspondence and conservativeness in terms of life histories characteristics (Crowley, 1985; Herrel *et al.,* 1990; Colli and Paiva, 1997; Andrews, 1998; Mesquita and Colli, 2003, Kiefer *et al.,* 2005). Even if a phylogenetic tendency exists, it has been verified, in some cases, that the environment can influence the local expression of some parameters (Pianka, 1970; Hertz *et al.,* 1982; Jaksic and Schwenk, 1983; Huey *et al.,* 1977; Adolph and Porter, 1993; Andrews, 1998).

Mesquita *et al.* (2007), recorded differences in habitat utilization among different populations of the same species of *Tropidurus,* but didn't find these same differences between genera. This suggests that different evolutionary lineages respond differently to the pressure of environmental factors, and tropidurids would be more affected by ecological factors than other genera (Cruz *et al.* 1998).

The broad distribution of *T. torquatus* along different areas and environments and its adaptation to several types of open habitats such as rocky outcrops, coastal sand dunes or gallery forest borders (Vitt and Goldberg, 1983; Rodrigues, 1987; Vitt 1993; Zerbini 1998; Frost *et al.* 2001; Faria and Araújo 2004) raises a question about the existence of variation in population structure of the species along its range. The comparison of population studies encompassing several types of habitats along the species range would provide better data to answer this question. There are three studies regarding the population demography of the genus *Tropidurus* (*T. itambere* – Van-Sluys, 2000; *T. torquatus* – Wiederhecker *et al.,* 2003; Van-Sluys *et al.,* 2010). Additionally, Arruda (2009) carried out a study about reproduction and diet of a population geographically close to the one studied herein, in the southern extreme of Brazil. The literature allows a comparison of population parameters in the different regions of Brazil.

The main goal of the present study was to describe the population dynamics of the lizard *Tropidurus torquatus* (Squamata, Tropiduridae) of a population found in the southern region of Brazil, characterized by a temperate climate and a distinctive seasonality of temperature.

Material and Methods

The study was carried out in Alegrete municipality, located in the central depression region of Rio Grande do Sul State, southern Brazil. The climate is classified as humid sub-temperate, with mean annual rainfall of 1574 mm, mean annual temperature of 18.6°C (Maluf, 2000). Rainfall is distributed evenly throughout the year and seasons are easily defined by temperature (summer: mean minimum temperature of 21.2°C, mean maximum temperature of 33°C; winter: mean minimum temperature of 14°C, mean maximum temperature of 23.3°C); maximum altitude reaches 116 m.

The study site is located at 55°24'59"W, 29°58'42"S and presents two main vegetation types: grasslands with trees (native grasslands) and the alluvial deciduous seasonal forest (riparian forest) (Boldrini, 1997). The study area was specifically characterized by the presence of rocky outcrops located in a grassland environment. It has a total area of 1.9ha, 108 m in altitude and vegetation composed mainly by bushes and grasses. While the study was being carried out, this area was used for silviculture (*Eucaliptus* sp), and trees were seeded closely to the rocky outcrops, in a distance between 5-20 m.

The field work was carried out monthly between May 2008 and June 2009, with one day of field work each month. Individuals were captured by hand using the capture, marking and recapture method. The area was searched randomly between 08:00 am and 06:00 pm. Each captured lizard was marked with a field number. For each capture we recorded age class, sex, snout-vent-length (SVL, using a Mitutoyo® caliper with a precision of 0.02 mm) and mass (using Pesola® scales of 30 g and 600 g, with precisions of 0.2 g and 0.5 g, respectively).

Age classes were divided into adults and juveniles. Adults were identified according to the minimum reproductive size for the species (males: SVL > 70 mm; females: SVL > 65 mm) (Pinto *et al.,* 2005). Sex was determined only for adult individuals according to typical characteristics of each gender as indicated by Pinto *et al.* (2005): males have larger heads and slender bodies than females of similar body size. But the most distinctive characteristic between males and females of this population is the coloration. Males present colored ventral scales (yellow and black), whereas females show a spotless ventral skin. Marking was carried out with the amputation of the last phalanx corresponding to a number, following a numerical sequence (Verrastro and Krause, 1994). When specimens had natural markings, these were used in individual identification to avoid unnecessary cutting of fingers.

Mean, maximum, and minimum values of SVL and mass were determined using all captured

individuals in the study area. To estimate population size for each month, the Stochastic Methods of Jolly-Seber (Jolly, 1965; Seber, 1965; Rocha, 1998) were used. The density (in number of individuals/ha) was estimated for each month dividing the population size by the number of hectares in the study area. The biomass (in grams/ha) was estimated by multiplying the density of lizards obtained each month by the mean weight (grams) of the lizards captured in the respective month. To test sex ratio and age proportion, a χ^2 (Chi-square) test was carried out (Rocha, 1998). Recapture rate was calculated dividing the recapture number of males, females, and juveniles by the total recaptures obtained during the study.

Results

A total of 97 individuals were captured, with 27 recaptures of *T. torquatus* during the study (48 males, 28 females, and 48 juveniles). Mean SVL of adult females was 88.0 ± 9.0 mm and the largest specimen measured 101.6 mm. Mean SVL of adult males was 110.9 ± 11.9 mm and the largest specimen measured 130.5 mm SVL. Juveniles had a mean SVL of 46.8 ± 10.4 mm, and the smallest captured individual measured 30.6 mm SVL. Mean body mass for adult females was 34.3 ± 8.0 g, 62.9 ± 18.2 g for adult males, and 7.7 ± 4.7 g for juveniles. The smallest body mass recorded among juveniles was 0.25 g, for one individual captured in February 2009.

Density and biomass (Figure 1) of the population of *T. torquatus* varied markedly and similarly throughout the study. Biomass presented its greatest values in October 2008 and March 2009, diminishing markedly after these months. Values of maximum density were recorded in November 2008 and March 2009, a period in which density overcame population biomass. In January 2009, even with a low number of captures that included only adults, the lowest number of population residents and the highest body mass values were recorded. From March a significant income of juveniles was recorded,

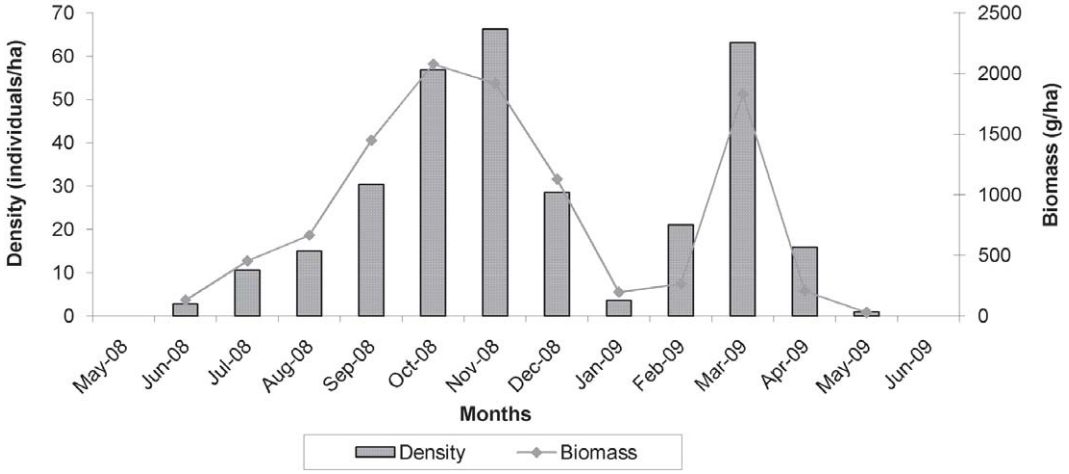

Figure 1. Annual variation in density (individuals/ha) and biomass (g/ha) in the population of *Tropidurus torquatus,* in the study area in Alegrete municipality, RS, Brazil, between May/2008 and June/2009.

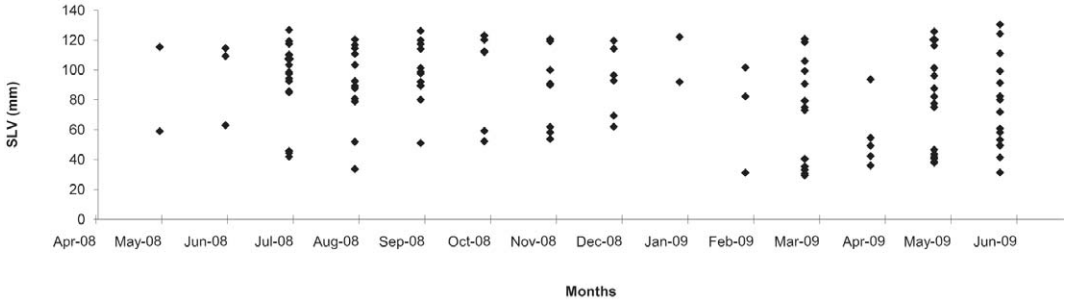

Figure 2. Distribution of SVL (snout-vent-length; mm) of *Tropidurus torquatus* in the study area in Alegrete municipality, RS, Brazil, between May/2008 and June/2009 ($\chi^2 = 224.01$; gl = 13; $p < 0.0001$).

born in the current reproductive season, modifying the population structure (Figures 1, 2 and 3). Mean density and biomass of the population throughout the study period were 26.3 ind/ha and 862.8 g/ha respectively.

Distribution of age classes varied significantly throughout the studied months ($\chi^2 = 224.01$; gl = 13; $p < 0.0001$) (Figure 2). Smallest values of SVL were recorded on February and March, and this period was characterized by species recruitment. A considerable increase in the number of juveniles in the population occurred until June. However, juvenile number was not higher than that of adults at any moment in the study (Figure 3).

Sex ratio differences were statistically significant ($\chi^2 = 529.78$; gl = 13; $p < 0.0001$). Males were present throughout the study, with a predominance of females only in February, April, and May (Figure 4). In addition, males presented higher recapture rates (Txrec = 0.74) in relation to females (Txrec = 0.19), and juveniles (Txrec = 0.07).

Discussion

Several studies have focused on spatial and temporal variation in the life histories of lizards (Ballinger, 1983; Pilorge, 1987; Kiefer *et al.,* 2005; Carvalho *et al.,* 2007; Rocha *et al.,* 2009). Population studies are widely used in the detection of ecological patterns, emphasizing the relationship between life history of the species and the habitat where they live (Ballinger, 1983).

The population of *Tropidurus torquatus* studied at Alegrete presented a marked cyclic variation in population structure, possibly associated to the reproductive cycle of the species (Wiederhecker *et al.,* 2003). an increase in number of individuals in the population was observed during the reproductive season (from September to December) and after the recruitment which becomes expressive in February and March, followed by a strong decrease after these months. Population studies for this species developed

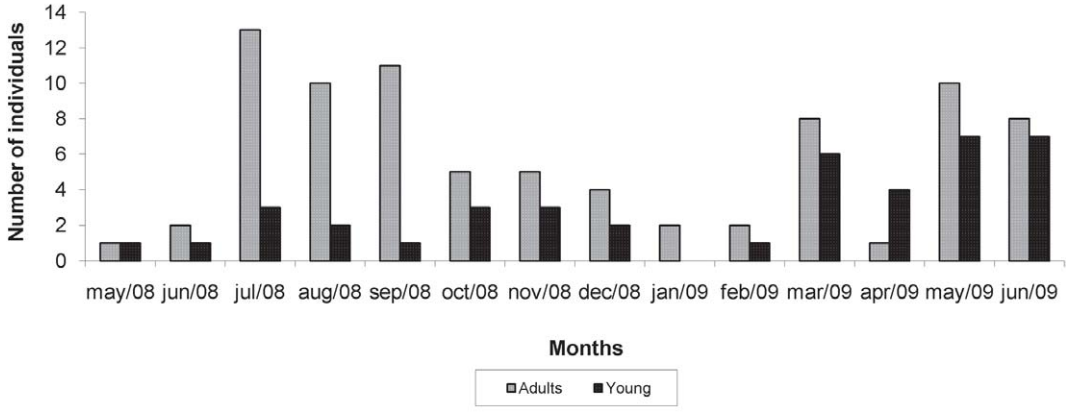

Figure 3. Monthly variation of adults and juveniles in the population of *Tropidurus torquatus,* in the study area in Alegrete municipality, RS, Brazil, between May/2008 and June/2009.

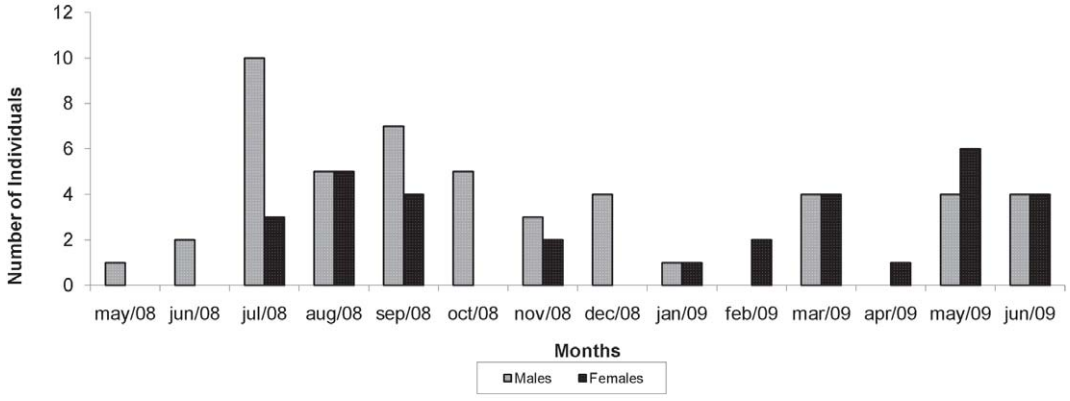

Figure 4. Monthly variation of females and males in the population of *Tropidurus torquatus,* in the study area in Alegrete municipality, RS, Brazil, between May/2008 and June/2009.

in Brasília, central Brazil (Wiederhecker *et al.,* 2002; Silva and Araujo, 2008) also described the occurrence of a similar cyclic pattern: between February and May of each year there was an effective increase of the population, a direct consequence of births (recruitment) that occur only at this time of the year. After May, the births diminished and the population presented a gradual decrease until August, when the reproductive season begins, enlarging the population density. During spring months (September, October and November) increasingly high values of population size were recorded.

The population structure observed in this study was also reported at Distrito Federal. In the beginning of the year individuals with smaller body sizes are predominant, which is explained by the presence of hatchlings, whereas larger individuals (adults) are found at the end of the year. The low values of density and biomass found in January 2009 indicate a population composed by resident adults before the emergence of the first hatchlings. Arruda (2009) verified that the reproductive period of this species goes from September to December and in February the first hatchlings are recorded. These changes can also reflect a decrease in the permanence rate during the reproductive season, apparently as a result of agonistic encounters between males in this period (Wiederhecker *et al.,* 2002; Silva and Araujo, 2008). According to Verrastro (1991), in theory, the loss of individuals from the population may occur due to two main reasons: 1) before reproduction – from October to the beginning of summer – high juvenile mortality or escape of the adults from the residency area may occur; 2) at the end of the summer – the decrease of adults would be related to mortality right after the reproductive period. According to Wiederhecker *et al.* (2003) most individuals of *T. torquatus* disappear after the first reproductive season. In addition, Van-Sluys (2000) states that the decrease in density and biomass may also reflect the inactivity of the species. In the case of the population of this study, even though a decline is recorded in the presence of animals during the winter, they remain active throughout the year, thermoregulating when it is sunny. The decrease in the population is probably more related to mortality and/or dispersion.

Van-Sluys (2000) also indicated the occurrence of a seasonal reproduction in the study of the population dynamics of another species of tropidurid, *Tropidurus itambere,* found in rocky formations in Valinhos (SP). Apparently, the eggs are laid during the rainy season and the recruitment occurs between January and April, when there is a population increase. *Tropidurus itambere* and *T. torquatus* are sympatric in the region of Brasília and have relatively similar reproductive cycles, but they use different environments (Nogueira *et al.,* 2005, Nogueira *et al.,* 2009). This reinforces the idea that population characteristics are strongly associated with the environmental features of the region. The cycle of increase and decrease of the population appears to be associated with reproduction, as it is in other species studied and, in southern Brazil, the reproduction of *T. torquatus* is correlated with the seasonal changes of temperature and photoperiod, as observed by Arruda (2009), and for other lizards at these latitudes (Verrastro, 2001; Rezende-Pinto *et al.,* 2009).

The mean biomass found for *T. torquatus* (679.68 g/ha) could be considered high when compared with other lizard species (*T. itambere,* 570 g/ha – Tropiduridae: Van-Sluys, 2000). The relative high values of biomass of this population may be related to the rare presence of other lizard species. While there are many species of lizards in the stony Pampa fields, this type of basaltic rock outcrop was occupied only by *T. torquatus,* which is abundant. This allows a greater support gr / lizard per unit of habitat, since there is almost no interspecific competition for resources (Pianka, 1982).

Age classes varied seasonally, supporting the data obtained by Wiederhecker *et al.* (2003) for this species in central Brazil. The high number of juveniles in at least one period of the year is typical of a species that presents low life span, early sexual maturity (on the first year after birth), and short life cycle (Bellinger, 1983; Tinkle, 1970; Pianka, 1970). This has been verified for the majority of tropidurids (Van-Sluys, 2000; Silva and Araújo, 2008). In this study, we observed the presence of young individuals throughout the year except for January 2009. Arruda (2009), studying the reproduction of a population of *T. torquatus* in the extreme south of Brazil, observed that juveniles grew slower during the cold season and, because of this, many did not reach sexual maturity the season after they were born, unlike the more tropical populations. The monthly distribution of the snout-vent length of the sampled individuals indicates the presence of adults throughout the year, but an increase of small bodied individuals at the beginning of each year corresponds to the recruitment time of the species, which was also observed by Arruda (2009). The difference found between age classes as a result of the adult presence – dominants

in all months and even more during the reproductive season (from September to December, Arruda (2009)) and the increase of juveniles during and after recruitment (from February to May, Arruda (2009)), also supports that the variation in population structure of this species may be related to the reproductive cycle.

The sex ratio found for *T. torquatus* was different from 1:1, males being more abundant throughout the study. This proportion is not common for lizards, since they normally present an equivalent sex ratio (Rocha, 1998). However, this result may be related to the behavior of *T. torquatus* and to sampling bias: being a territorial species (Carreira *et al.,* 2005), it is expected that the males take more risks to defend and protect their territories. This statement is supported by the analysis of recapture rates obtained in the present study, where males presented a higher recapture rate than females and juveniles, confirming their higher exposure. Thus, it is possible that the sex rate would also be 1:1 in this population of *T. torquatus,* if the adopted sampling method did not reflect the social behavior of this species and the higher detectability of males.

Body size, growth rates and age at first reproduction are important life history characteristics. Growth can be influenced by environmental and genetic factors, in addition to several intrinsic and extrinsic factors known to affect growth patterns in different lizard species (Ballinger, 1983; Van-Sluys, 1998). In the present study males reached larger mean sizes than females, reflecting the sexual dimorphism observed for the species (Pinto *et al.,* 2005). Dimorphism in body size is observed for the majority of Brazilian lizard families (Verrastro and Krause, 1994; Silva and Araújo, 2008).

Conclusions

The studied population of *Tropidurus torquatus* presented differences in the distribution of age classes and sex ratio throughout the year. However, this cyclic and seasonal variation recorded in the population structure may be associated to the reproductive cycle of the species, in this case related to temperature seasonality. The parameter found is corroborated by other studies carried out with species of the same genus in tropical regions. In these species, the recorded variations in population structure were also correlated to seasonality in reproduction, but in these cases linked to the seasonality of precipitation.

Resumo

A dinâmica populacional do lagarto *Tropidurus torquatus* foi estudada de maio de 2008 a junho de 2009 em um afloramento rochoso no município de Alegrete, RS. O estudo foi realizado através do método de captura, marcação e recaptura, com a área sendo percorrida aleatoriamente das 08h00min às 18h00min. *Tropidurus torquatus* apresentou variação na estrutura populacional ao longo do estudo, com a máxima biomassa ocorrendo em outubro de 2008 e máxima densidade ocorrendo em novembro de 2008 (estação reprodutiva), ambas tendo um segundo pico em março de 2009 (período de recrutamento). Ocorreu diferença significativa entre o número de adultos e jovens registrados, sendo os adultos presentes durante todos os meses, enquanto os jovens estiveram mais presentes nos meses após o recrutamento. A diferença encontrada entre machos e fêmeas parece estar relacionada ao comportamento social territorialista dos machos. A população de *Tropidurus torquatus* apresentou neste estudo uma estrutura populacional com uma variação cíclica e sazonal, associada possivelmente ao ciclo reprodutivo da espécie, tendo diferenças na distribuição das classes de idade e das proporções sexuais ao longo do ano.

References

Adolph, S. C. and Porter, W. P. 1993. Temperature, activity and lizard life histories. *The Americam Naturalist,* 142:273-295.

Andrews, R. M. 1998. Geographic variation in field body temperature of *Sceloporus* lizard. *Journal Thermal Biology,* 23(6):329-334.

Arruda, J. L. S. de. 2009. Ecologia de Tropidurus torquatus (Squamata:Tropiduridae) no bioma Pampa, extremo sul do Brasil. 77 p. [Dissertação de Mestrado. Programa de Pós-Graduação em Biodiversidade Animal] [Universidade Federal de Santa Maria]: Santa Maria, RS.

Ballinger, R. E. 1983. Life-history variations. Pp. 241-260. *In:* R. B. Huey, E. R.Pianka, and T. W. Schoener (eds.), Lizard Ecology – studies of a model organism. Cambridge, Massachusetts. Harvard University Press.

Boldrini, I. 1997. Campos do Rio Grande do Sul: Caracterização Fisionômica e Problemática Ocupacional. *Boletim do Instituto de Biociências,* nº 56, p. 1-39.

Carreira, S.; Meneghel, M. and Achaval, F. 2005. Reptiles del Uruguay. Universidad de la República. Montevidéu. 639 p.

Carvalho, A. L. G.; Silva, H. R.; Araújo, A. F. B.; Alves-Silva, R. and Silva-Leite, R. R. 2007. Feeding ecology of *Tropidurus torquatus* (Wied) (Squamata, Tropiduridae) in two areas with different degrees of conservation in Marambaia Island, Rio de Janeiro, Southeastern Brazil. *Revista Brasileira de Zoologia,* 24(1):222-227.

Clerke, R. B. and Alford, R. A. 1993. Reproductive biology of four species of tropical Australian lizards and coments on

the factor regulating lizard reproductive cycles. *Journal of Herpetology,* 27:400-406.

Crowley, S. R. 1985. Thermal sensitivity of sprint-running in the lizard *Sceloporus undulatus:* support for conservative view of thermal physiology. *Oecologia,* 66:219-225.

Cruz, F. B. 1998. Ecology of the lizard *Tropidurus etheridgei* (Squamata, Tropiduridae) from the dry chaco Salta, Argentina. *Herpetological Natural History,* 6(1):23-31.

Fialho, R. F.; Rocha, C. F. D. and Vrcibradic, D. 2000. Feeding Ecology of *Tropidurus torquatus:* ontogenetic shift in plant consumption and seasonal trends in diet. *Journal of Herpetology,* Louisianna, USA, v. 34, n. 2, p. 325-330.

Faria, R. G. and Araujo, A. F. B. 2004. Sintopy of two *Tropidurus* lizard species (Squamata: Tropiduridae) in a rocky cerrado habitat in Central Brazil. *Braz. J. Biol.,* 64(4):775-786.

Frost, D. R.; Rodrigues, M. T.; Grant, T. and Titus, T. A. 2001. Phylogenetics of the lizard Genus *Tropidurus* (Squamata: Tropiduridae: Tropidurinae): Direct Optimization, Descriptive efficiency, and Sensitivity Analysis of Congruence Between Molecular data and Morphology. *Mol. Phylogenet. Evol.,* 21(3):352-371.

Gomides. S. C.; Santos, A. de O. and Souza, B. M. 2006. Ecologia reprodutiva de *Tropidurus torquatus* Wied, 1820 (Squamata: Tropiduridae) em uma área do Sudeste do Brasil. Juiz de Fora. Walter Machado Couto: Resumos – XXIX Semana de Biologia e XII Mostra de Produção Científica, UFJF Diretório Acadêmico de Ciências Biológicas.

Guarino, R.; Colli, G. R. and Paiva, M. S. 1997. Estratégia de forrageamento e termorregulação em lagartos do Cerrado e Savanas Amazônicas. *In:* Leite, L. L. and Saito, C. H. (org). Contribuição ao conhecimento ecológico do Cerrado. Trabalhos seleccionados do 3º Congresso de Ecologia do Brasil (Brasilia, 06-11/10/1996). Brasília, Depto. Ecologia, UNB, p. 224-231.

Hatano, F. H.; Vrcibradic, D.; Galdino, C. A. B.; Cunha-Barros, M.; Rocha, C. F. D. and Van Sluys, M. 2001. Thermal ecology and activity patterns of the lizard community of the restinga of Jurubatiba, Macaé, RJ. *Rev. Bras. Biol.,* 61:287-294.

Hertz, P. E., Huey, R. B. and Nevo, E. 1982. Fight versus flight: body temperature influences defensive responses of lizards. *Animal Behaviour,* 30:676-679.

Huey, R. B., Pianka, E. R. and Hofman, J. A. 1977. Seasonal variation in thermoregulatory behavior and body temperature of diurnal Kalahari lizards. *Ecology,* 58:1066-1075.

Huey, R. B. and Pianka, E. R. 1983. Temporal separation of activity and interspecific dietary overlap. Pp. 281-290. *In:* R. B. Huey, E. R. Pianka and T. W. Schoener (eds.). Lizard Ecology: Studies on a Model Organism. Harvard University Press, Cambridge. 501 p.

Jaksic, F. M. and Schwenk, K. 1983. Natural history observations on *Liolaemus magellanicus,* the southernmost lizard in the world. *Herpetologica,* 39:457-46.

James, C. D. and Shine, R. 1985. The seasonal timing of reproduction: a tropical-temperate comparison in Australian lizards. *Oecologia,* 67:464-474.

Jolly, G. M. 1965. Explicit estimates from capture-recapture data with both death and immigration stochastic model. *Biometrika,* 52:225-247.

Kiefer, M. C.; Van-Sluys, M. and Rocha, C. F. D. 2005. Body temperatures of *Tropidurus torquatus* (Squamata, Tropiduridae) from coastal populations: do body temperatures vary along their geographic range?. *Journal of Thermal Biology,* 30(2005):449-456.

Kiefer, M. C.; Van-Sluys, M. and Rocha, C. F. D. 2007. Thermoregulatory behavior in *Tropidurus torquatus* (Squamata, Tropiduridae) from Brazilian coastal population: an estimate of passive and active thermoregulation in lizards. *Acta Zoologica,* 88:81-87.

Magnusson, W. E. 1987. Reproductive cycles of teiid lizards in Amazonian savannah. *Journal of Herpetology,* 21:307-316.

Maluf, J. R. T. 2000. Nova classificação climática do Estado do Rio Grande do Sul. *Rev. Bras. Agrometeorologia,* 8(1):141-150.

Meira, K. T. R.; Faria, R. G.; Silva, M. D. M.; Miranda, V. T. and Zahn-Silva, W. 2007. História natural de *Tropidurus oreadicus* em uma área de cerrado rupestre do Brasil central. *Biota Neotropica,* 7(2):155-163.

Mesquita, D. O. and Colli, G. R. 2003. The ecology of *Cnemidophorus ocellifer* (Squamata, Teiidae) in a Neotropical Savanna. *Journal of Herpetology,* 37(3):498-509.

Niewiarowski, P. H. 1994. Understanding geographic life-history variation in lizard. *In:* Vitt, L. J. and Pianka, E. R. 1994. Lizard Ecology: historical and experimental perspectives. American Society of Ichthyologists and Herpetologists, Princeton University Press. 430 p.

Nogueira, C.; Valdujo, P. H. and França, F. G. R. 2005. Habitat variation and lizard diversity in a cerrado area of central Brazil. *Studies on Neotropical Fauna and Environment,* 40, 105-112

Nogueira, C.; Colli, G. R. and Martins, M. 2009. Local richness and distribution of the lizard fauna in natural habitat mosaics of the brazilian cerrado. *Austral Ecology,* 34, 83-96

Nunes, J. V.; Elisei, T.; Lopes, J. F. S.; Gomides, S. C. and Sousa, B. M. 2007. Aspectos da ecologia termal do lagarto *Tropidurus itambere* Rodrigues, 1987 (Squamata: Tropiduridae) no Parque Estadual do Ibitipoca, Minas Gerais (dados preliminares). Anais do VIII Congresso de Ecologia do Brasil, 2007. Caxambu, MG.

Pianka, E. 1970. Comparative autoecology of the lizard *Cnemidophorus tigris* in different parts of its geographic ranger. *Ecology,* 51(4):703-720.

Pianka, E. R. 1973. The structure of lizards communities. *Annual Review of Ecology and Systematics,* 4:53-74.

Pianka, E. 1982. Evolutionary Ecology. Ed. Harper and Row, Publishers, Inc. 3ª edição. 416 p.

Pilorge, T. 1987. Density, size structure, and reproductive characteristics of three populations of *Lacerta vivípara* (Sauria: Lacertidae). *Herpetologica,* 43(3):345-356.

Pinto, A. C. S.; Wiederhecker, H. C. and Colli, G. R. 2005. Sexual dimorphismin the Neotropical lizard, *Tropidurus torquatus* (Squamata, Tropiduridae). *Amphibia-Reptilia,* 26(2005):127-137.

Rezende-Pinto, F. M.; Verrastro, L.; Zanotelli, J. C. and Barata, P. C. R. 2009. Reproductive biology and sexual dimorphism in *Cnemidophorus vacariensis* (Sauria, Teiidae) in the grasslands of the Araucaria Plateau, southern Brazil. *Iheringia, Sér. Zool.,* 99(1):82-91.

Ribeiro, L. B.; Gomides, S. C.; Santos, A. O. and Sousa, B. M. 2007. Thermoregulatory behavior of the saxicolous lizard, *Tropidurus torquatus* (Squamata, Tropiduridae), in a rocky outcrop in Minas Gerais, Brazil. *Herpetological Conservation and Biology,* 3(1):63-70.

Rocha, C. F. D.; Van Suys, M.; Vrcibradic, D.; Kiefer, M. C.; Menezes, V. A. and Siqueira, C. C. 2009. Comportamento de termorregulação em lagartos brasileiros. *Oecologia Brasiliensis,* 13:115-131.

Rocha, C. F. D. 2000. Biogeografia de répteis de restinga, Pp. 99-116. *In:* Lacerda, L. D. e Esteves, F. A. (eds.), Ecologia de Restingas e Lagoas Costeiras. NUPEM/UFRJ, Macaé, RJ.

Rocha, C. F. D. 1998. Population dynamics of the endemic tropidurid lizard *Liolaemus lutzae* in a tropical seasonal resting habitat. *Ciência e Cultura,* vol. 50(6).

Rocha, C. F. D. 1992. Reproductive and fat body cycles of the tropical sand lizard Liolaemus lutzae of southeastern Brazil. *Journal of Herpetology,* 26(1):17-23.26.

Rodrigues, M. T. 1987. Sistemática, ecologia e zoogeografia dos Tropidurus do grupo Torquatus ao Sul do rio Amazonas (Sauridae: Iguanidae). *Arq. Zool.,* 31:105-230

Seber, G. A. 1965. A note on the multiple-recapture census. *Biometrika,* 52:249-259.

Silva, V. N. E. and Araújo, A. F. B. 2008. *Ecologia dos Lagartos Brasileiros.* Technical Books Editora, Rio de Janeiro. 272 p.

Tinkle, D. W. 1967. The life and demography of side-blotched lizard, *Uta stansburiana. Misc. Publ. Mus. Zool.,* Univ. Michigan. 132:1-182.

Van Damme, R.; Bauwen, D.; Castilla, A. M. and Verheyen, R. F. 1990. Altitudinal variation of the thermal biology and running performance in the lizard *Podarcis tiliguerta. Oecologia,* 80:516-524.

Van-Sluys, M. 1998. Growth and Body Condition of the Saxicolous Lizard *Tropidurus itambere* in Southeastern Brazil. *Journal of Herpetology,* vol. 32, nº 3, pp. 359-365.

Van-Sluys, M. 2000. Population dynamics of the saxicolous lizard *Tropidurus itambere* (Tropiduridae) in a seasonal habitat of southeastern Brazil. *Herpetologica,* 56(1):55-62.

Van-Sluys, M.; Martelotte, S. B.; Kiefer, M. C. and Rocha, C. F. D. 2010. Reproduction in neotropical Tropidurus lizards (Tropiduridae): evaluating the effect of environmental factors on *T. torquatus*. *Amphibia-Reptilia,* 31:117-126.

Verrastro, L. 2001. Descrição, estratégia reprodutiva e alimentar de uma nova espécie do gênero *Liolaemus* no Rio Grande do Sul, Brasil (Iguania: Tropiduridae). 223 p. [Tese de Doutorado. Programa de Pós-Graduação em Ecologia e Recursos Naturais] [Universidade Federal de São Carlos]: São Carlos.

Verrastro, L. 1991. Aspectos ecológicos e biológicos de uma população de *Liolaemus occipitalis* Boul. 1885, nas dunas costeiras da praia Jardim Atlântico, Tramandaí, RS (Reptilia-Iguanidae). 154 p. [Dissertação de mestrado. Curso de Pós-graduação em Ecologia] [Universidade Federal do Rio Grande do Sul]: Porto Alegre.

Verrastro, L. and Krause, L. 1998. Ciclo reprodutivo de machos *Liolaemus occipitalis* Boulenger (Sauria-Tropiduridae). *Revista Brasileira de Zoologia,* 16(1):227-231.

Verrastro, L. and Krause, L. 1994. Analysis of Growth in a population of *Liolaemus occipitalis* Boul. 1885, from the coastal sand-dunes of Tramandai, RS, Brazil (Reptilia, Tropiduridae). *Studies on Neotropical Fauna and Environment,* 29(2):99-111.

Vitt, L. J. and Breitenbach, G. L. 1993. Life histories and reproductive tactics among lizards in the genus *Cnemidophorus* (Sauria: Teiidae). *In:* J. W. Wright e L. J. Vitt, (eds.), Biology of whiptail lizards (Genus *Cnemidophorus*). *Oklahoma Museum of Natural History,* p. 211-244.

Vitt, L. J. and Goldberg, S. R. 1983. Reproductive ecology of two tropical iguanid lizards: *Tropidurus torquatus* and *Platynotus semitaeniatus. Copeia,* 1983(1):131-141.

Vitt, L. J. and Zani, P. 1996. Ecology of the elusive tropical lizard *Tropidurus flaviceps* (Tropiduridae) in lowland rain forest in Ecuador. *Herpetologica,* 52:121-132.

Wiederhecker, H. C.; Pinto, A. C. S.; Paiva, M. S. and Colli, G. R. 2002. Reproductive ecology of *Tropidurus torquatus* (Squamata: Tropiduridae) in the Highly Seasonal Cerrado Biome of Central Brazil. *Journal of Herpetology*, 36(1):82-91.

Wiederhecker, H. C.; Pinto, A. C. S.; Paiva, M. S. and Colli, G. R. 2003. The demography of the lizard *Tropidurus torquatus* (Squamata, Tropiduridae) in a highly seasonal Neotropical savanna. *Phyllomedusa,* 2(1):9-19.

Zerbini, G. J. 1998. Partição de recursos por duas espécies de *Tropidurus* (Squamata: Tropiduridae) na Restinga de Praia das Neves. [Dissertação de Mestrado] [Universidade de Brasília]: Brasília.

Submitted: 01 July 2010
Accepted: 17 September 2011