# *Tropidurus jaguaribanus* (Squamata, Tropiduridae): diving, swimming, and floating behaviors

**Daniel Cunha Passos[1,*], Djan Zanchi[2] e Daniel Cassiano Lima[3,4]**

[1] *Universidade do Estado do Rio de Janeiro, Instituto de Biologia Roberto Alcântara Gomes, Programa de Pós-Graduação em Ecologia e Evolução. Pavilhão Haroldo Lisboa da Cunha, Sala 224. Rua São Francisco Xavier, 524, Maracanã, CEP 20550-013, Rio de Janeiro, RJ, Brasil.*
[2] *Universidade Federal do Ceará, Centro de Ciências, Programa de Pós-Graduação em Ecologia e Recursos Naturais. Campus do Pici, Bloco 902. Avenida Humberto Monte, s/n, CEP 60455-970, Fortaleza, CE, Brasil.*
[3] *Universidade Federal de Santa Maria, Centro de Ciências Naturais e Exatas, Programa de Pós-Graduação em Biodiversidade Animal. Bloco 17/1140-D. Camobi, km 9, CEP 97105-900, Santa Maria, RS, Brasil.*
[4] *Universidade Estadual do Ceará, Faculdade de Educação de Itapipoca. Avenida Monsenhor Tabosa, s/n, CEP 62500-000, Itapipoca, CE, Brasil.*
[*] *Author for correspondence: biologodanielpassos@gmail.com*

Beyond well known aquatic behaviors of some lizard species, such as running on the water in basilisks (*Basiliscus*), swimming in monitors (*Varanus*), and diving in iguanas (*Amblyrhynchus*), many others lizards interact intimately with water (Pianka and Vitt, 2003). In particular, aquatic behaviors like diving, swimming, and floating might constitute defensive strategies to escape from predators (Hare and Miller, 2009). These aquatic behaviors are commonly performed by semi-aquatic lizards of several families, such as Corytophanidae (Rand and Marx, 1967), Gymnophthalmidae (Vitt *et al.,* 1998), Iguanidae (Bartholomew *et al.,* 1976), Scincidae (Miller *et al.,* 2010), Teiidae (Mesquita *et al.,* 2006), Tropiduridae (Howland *et al.,* 1990), and Varanidae (Young *et al.,* 2012).

However, these aquatic behaviors have also been recorded in non-aquatic lizard species of different lineages, such as *Aspidoscelis* (formerly *Cnemidophorus*) *sexlineata* (Trauth *et al.,* 1996), *Crotaphytus collaris* (McAllister, 1983), *Gambelia wislizenii* (Medica, 2010), *Copeoglossum* (formerly *Mabuya*) *nigropunctatum* (Carvalho *et al.,* 2012), *Ophisaurus compressus* (Durso *et al.,* 2013), *Sceloporus clarkii* (Zilstra and Wise, 2010), *Scincella lateralis* (Akin and Townsend, 1998), *Tupinambis teguixin* (Olmos, 1995), and *Uma exsul* (Estrada-Rodrígues and Pacheco, 2007). Herein, we report diving, swimming and floating behaviors for *Tropidurus jaguaribanus* (Tropiduridae), a saxicolous lizard endemic to the semi-arid Caatinga biome of northeastern Brazil (Passos *et al.,* 2011, 2013).

We made the observations at the Fazenda Veneza (05°19'21"S, 38°11'58"W, GPS Datum: WGS 84), the type locality of *Tropidurus jaguaribanus,* located in São João do Jaguaribe municipality, Ceará state, northeastern Brazil. This location consists of a semi-arid Caatinga habitat with many rocky outcrops where the lizards are abundant. See Passos *et al.* (2011) for more detailed description of the locality.

In a particular area of the study site, there are many rocky outcrops at the banks and inside a large artificial pond. The number of rocks exposed above the water surface varies with the annual precipitation cycle. Nevertheless, during the wet period (January to June) there were many little islands of rocks near the edge of the pond that comprise incompletely submerged portions of outcrops (Figure 1). At this place, we made several occasional observations (*ad libitum*) of aquatic behavior of *Tropidurus jaguaribanus* during visits conducting from 2008-2012. However, in April 2012 we made specific focal sampling observations in order to photographically document the lizards' aquatic behaviors. In these occasions, we observed some adult individuals of both sexes diving, swimming, and floating.

Diving behavior was characterized by complete immersion underwater. Submerged lizards always had their eyes closed and limbs in direct contact with the immersed portion of a rocky outcrop, as reported for other tropidurids (Carvalho *et al.,* 2012). We observed lizards submerged up to 25 cm deep and the dives lasted at most about 5 min. This behavior does not seem to constitute the main escape strategy of *Tropidurus jaguaribanus,* in view of its apparent preference for flight to rocky crevices, but diving was always observed after human approach. Thus, diving behavior might constitute a defensive strategy of predator evasion.

Swimming behavior constituted displacement along the water surface. During swimming, the lizards performed a serpentine pattern of lateral undulation of the body and tail while paddling with hind and forelimbs alternately (Figure 2), similar to reports for other iguanian lizards (Estrada-Rodrígues and Pacheco, 2007; Medica, 2010). This behavior was performed



**Figure 1:** Islands of rocks near the edge of artificial pond, formed by partially submerged rocky outcrops. In foreground, an adult *Tropidurus jaguaribanus* basking in sunlight.

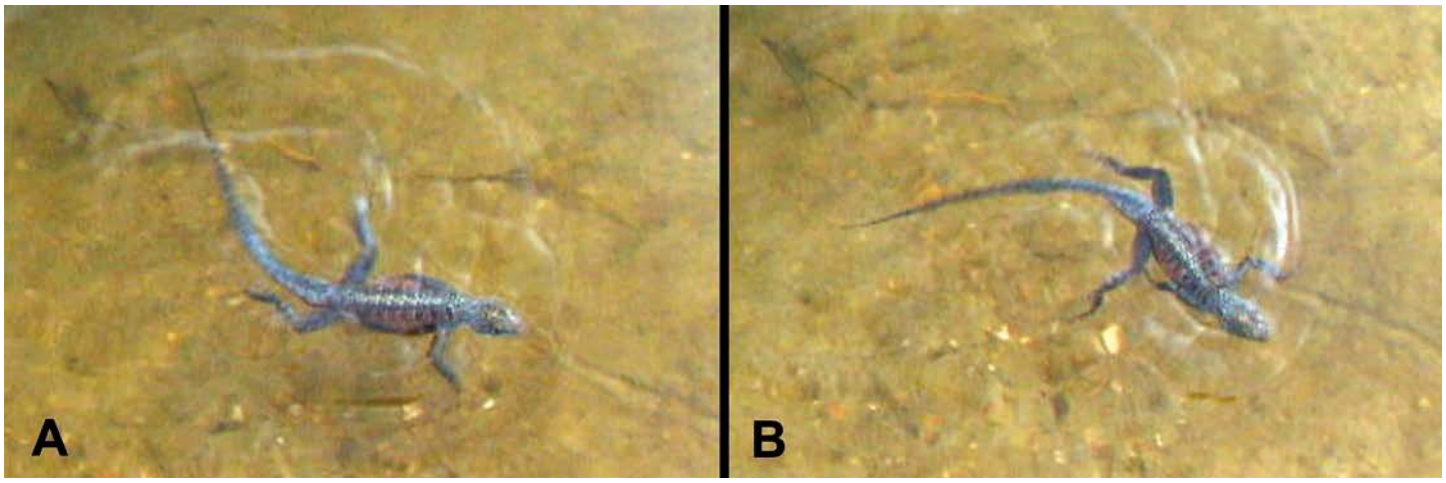


**Figure 2:** Individual of *Tropidurus jaguaribanus* swimming toward rocky outcrops at edge of pond. Detail showing the lateral tail undulation and alternate limbs paddling in (A) and (B).

often for lizard translocation among the rock islands and the outcrops at the edge of the pond. Considering the saxicolous habitat of *Tropidurus jaguaribanus* and the importance of rocky substrates for its daily activities (*e.g.,* foraging and thermoregulation), the colonization of uninhabited rocky islands might be advantageous for the exploiters, and the capacity to swim is essential to achieve this goal.

Floating behavior consisted of the lizard remaining motionless on the surface of the water. This behavior was employed between rounds of swimming, in which the lizards appeared to rest and could change direction. During this behavior the lizards presented inflated lungs, partially extended limbs and snout above the surface of the water (Figure 3). Flotation by lung inflation has also been recorded for other lizards (Baird, 2008; Medica, 2010). Despite the intrinsic risks of flotation, due to vulnerability to aquatic (fishes) and aerial (birds) predators, this behavior seems to be essential for translocation over long distances in water.

Although Carpenter and Ferguson (1977) did not consider diving, swimming, and floating as stereotyped behaviors of lizards, the aquatic abilities of *Tropidurus jaguaribanus* are performed more frequently than expected for a typically terrestrial lizard. Therefore, we suggest that aquatic behaviors might be useful for *T. jaguaribanus,* in a similar way as reported for other *Tropidurus* species (Carvalho *et al.,* 2012). Furthermore, we encourage the investigation of these kinds of behaviors to enhance our understanding of lizard behavioral repertoire.



**Figure 3:** A male *Tropidurus jaguaribanus* performing floating behavior along the crossing between the rocky islands and the banks of pond. Note the nostrils above the water surface.

## AKNOWLEDGEMENTS

DCP thanks the Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro by scholarship of master's degree and DZ thanks the Fundação Cearense de Apoio ao Desenvolvimento Científico e Tecnológico by doctorate scholarship.

## REFERENCES

**Akin, J. A. and Townsend Jr., V. R. 1998**. *Scincella lateralis* (Ground Skink). Aquatic behavior. *Herpetological Review,* 29: 43.

**Baird, T. A. 2008**. *Crotaphytus collaris* (Eastern Collared Lizard). Homming. *Herpetological Review,* 39: 88.

**Bartholomew, G. A.; Bennett, A. F. and Dawson, W. R. 1976**. Swimming, diving and lactate production of marine iguana, *Amblyrhynchus cristatus*. *Copeia,* 1976: 709-720.

**Carvalho, P. J.; Araújo, T. O. P. and Brandão, R. A. 2012**. *Mabuya nigropunctata* (Squamata: Scincidae), *Tropidurus oreadicus* e *Tropidurus torquatus* (Squamata: Tropiduridae): Mergulho na água como estratégia de fuga. *Herpetologia Brasileira,* 1: 86-87.

**Carpenter, C. C. and Ferguson, G. W. 1977**. Variation and evolution of stereotyped behaviour in reptiles; pp. 335-403. *In:* Gans and Tinkle (eds.), Biology of the Reptilia, vol. 7. Academic Press, London.

**Durso, A. M.; Mitchell, T. S.; Reedy, A. M. and Warner, D. A. 2013**. *Ophisaurus compressus* (Island Glass Lizard). Swimming. *Herpetological Review,* 44: 146.

**Estrada-Rodrígues, J. L. and Pacheco, A. V. L. 2007**. *Uma exsul* (Coahuila Fringe-Toed Lizard). Swimming. *Herpetological Review,* 38: 84-85.

**Hare, K. M. and Miller, K. A. 2009**. What dives beneath: diving as a measure of performance in lizards. *Herpetologica,* 65: 227-236.

**Howland, J. M.; Vitt, L. J. and Lopez, P. T. 1990**. Life on the edge: The ecology and life history of the tropidurine iguanid lizard *Uranoscodon superciliosum*. *Canadian Journal of Zoology,* 68: 1366-1373.

**McAllister, C. T. 1983**. Aquatic behavior of collared lizards, *Crotaphytus c. collaris,* from Arkansas. *Herpetological Review,* 14: 11.

**Medica, P. A. 2010**. *Gambelia wislizenii* (Long-Nosed Leopard Lizard). Escape behavior/ Swimming and Floating. *Herpetological Review,* 41: 354-355.

**Mesquita, D. O.; Colli, G. R.; Costa, G. C.; França, F. G. R.; Garda, A. A. and Péres-Junior, A. K. 2006**. At the water's edge: Ecology of semi-aquatic teiids in Brazilian Amazon. *Journal of Herpetology,* 40: 221-229.

**Miller, K. A.; Hare, K. M. and Nelson, N. J. 2010**. Do alternate escape tactics provide a means of compensation for impaired performance ability? *Biological Journal of the Linnean Society,* 99: 241-249.

**Olmos, F. 1995**. *Tupinambis teguixin* (Tegu Lizard). Aquatic Behavior. *Herpetological Review,* 26: 37.

**Passos, D. C.; Lima, D. C. and Borges-Nojosa, D. M. 2011**. A new species of *Tropidurus* (Squamata, Tropiduridae) of the *semitaeniatus* group from a semiarid area in Northeastern Brazil. *Zootaxa,* 2930: 60-68.

**Passos, D. C.; Lima, D. C. and Borges-Nojosa, D. M. 2013**. Clutch size, incubation time and hatchling morphometry of the largest known *Tropidurus* of the *semitaeniatus* group (Squamata, Tropiduridae), in a semi-arid area from northeastern Brazil. *Herpetological Bulletin,* 123: 23-25.

**Pianka, E. R. and Vitt, L. J. 2003**. Lizards: Windows to the evolution of diversity. University of California Press, Los Angeles, California, USA, 333 pp.

**Rand, A. S. and Marx, H. 1967**. Running speed of the lizard *Basiliscus basiliscus* on water. *Copeia,* 1967: 230-233.

**Trauth, S. E.; Wilhide, J. D.; Lewis, C. H.; Holt, A.; Klotz, T. L. and Woolbright, S. A. 1996**. *Cnemidophorus sexlineatus* (Six-Lined Racerunner). Aquatic behavior. *Herpetological Review,* 27: 20-21.

**Vitt, L. J.; Zani, P. A.; Ávila-Pires T. C. S. and Espósito, M. C. 1998**. Geographical ecology of the gymnophthalmid lizard *Neusticurus ecpleopus* in the Amazon rain forest. *Canadian Journal of Zoology,* 76: 1671-1680.

**Young, B. A.; Dumais, J.; McMahon, K. and Burnell, A. L. 2012**. A tale of two tails: Swimming mechanics in *Varanus salvator. Integrative and Comparative Biology,* 52: E354.

**Zilstra E. R. and Wise, B. D. 2010**. *Sceloporus clarkii* (Clark's Spiny Lizard). Aquatic behavior. *Herpetological Review,* 41: 86.



*Dendropsophus sarayacuensis,* Porto Velho, RO (Foto: Sérgio Muniz).