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

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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.

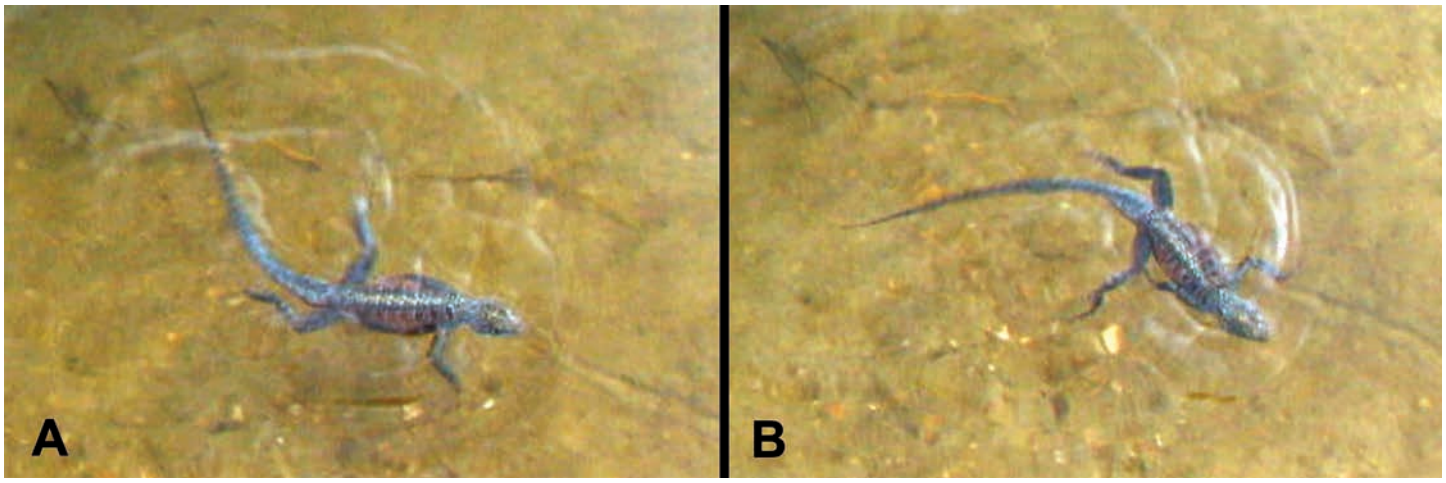

Figure 2: Individual of *Tropidurus jaguaribanus* swimming toward rocky outcrops at edge of pond. Detail showing the lateral tail undulation and alternate limbs paddling in (A) and (B).

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.

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