Diving to survive: a new escape behavior for the scansorial arboreal Amazonian lizard *Plica plica* (Squamata: Tropiduridae)

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Lizards have evolved a plethora of defensive mechanisms in response to selection pressures of predation (Pianka & Vitt 2003; McElroy 2019). These antipredator mechanisms can be characterized by the avoidance of detection through physical traits (e.g. cryptic dorsal coloration, sensory perception of predators) and or by the employment of defensive behaviors in the case of prey detection (e.g., death feigning, escape behaviors, aggressive displays) (Pough et al. 2015; McElroy 2019). Generally, escape behavior occurs when the deterrence mechanism has failed, and the costs of staying are higher than evading a close encounter with the predator; finding a refuge follows the escape behavior whereas other tactics can be used in the case of an inevitable prey-predator confrontation (McElroy 2019). To date, descriptions of defensive mechanisms remain unavailable for most species of Neotropical lizards.

Plica plica (Linnaeus, 1758) is a diurnal tropidurid lizard widespread in Amazonia, inhabiting primary and secondary terra firme forests, floodplains such as Várzea and Igapó, and also forests in Amazonian savannas (Avila-Pires 1995; Ribeiro-Júnior 2015). The species is relatively well studied with respect to

its basic ecology when compared to most lizards in the region. It is known to have aggressive behaviors associated with territoriality, and is usually found alone, in pairs, or in small groups. The species prefers tree trunks at varying heights, but it can also be observed in microhabitats on the ground. Females produce two clutches per reproductive season and lay the eggs in rotten logs and leaf litter. Clutch size varies from two to five and is correlated to the snout-vent length of females. The species is a sit-and-wait forager, and its diet is composed of arthropods with a predominance of ants (See Debusk & Glidewell 1972; Vitt 1991; Avila-Pires 1995 for summary of ecological data). Data on predators of this species are scarce, and to the best of our knowledge, *P. plica* is preyed upon by snakes: *Phrynonax poecilonotus* (Günther, 1858) and *Rhinobothryum lentiginosum* (Scopoli, 1785) (Avila-Pires 1995; Oliveira & Martins 1998). Attempted predation by the anuran *Ceratophrys cornuta* (Linnaeus, 1758) was recorded in Peru (Chávez et al. 2011).

In January 2017, we implemented a short-term herpetological survey in the municipality of Tefé, state of Amazonas, Brazil. On 19 January, a nocturnal search was conducted in a locality named Igarapé Xidarini (03°22′26″ S, 64°41′14″ W). The site is characterized by Várzea forest, with some human activities, such as timber extraction. At approximately 8:40 p.m., we found a specimen of *Plica plica* on the trunk of a large tree near a partially flooded open area. The lizard was immobile at one meter above ground but jumped to the ground when approached. It climbed the trunk again, but soon fell to the ground near the water. It then dove into the water, swam underwater towards a submerged branch approximately 40 cm below the surface, and held onto it. The lizard remained motionless in this position for 14 minutes (8:43 to 8:57 p.m.). While submerged, the lizard clearly did not breathe, but opened and closed its eyes, possibly checking for our presence (Fig. 1). It finally surfaced when one of us accidentally touched the branch and was captured. The specimen is a juvenile male of 89.3 mm snout-vent length. It was euthanized with a lethal dose of tiopental, subsequently fixed in 10% formalin for 24 hours and transferred to 70% ethanol for permanent storage in the Coleção Herpetológica Osvaldo Rodrigues da Cunha of the Museu Paraense Emílio Goeldi catalogued as MPEG 33125.

Other lizards have been documented escaping to water from perceived danger. The most remarkable case concerns *Anolis aquaticus* Taylor, 1956 from Costa Rica and Panama. This species can swim on the water surface to escape and can also dive and breathe underwater by recycling the air through the

formation of a bubble that accompanies the inhalation and exhalation from the lungs (Swierk 2019). In Amazonia, swimming to escape from predators is commonly observed for species associated with water bodies, such as Iguana iguana (Linnaeus, 1758), *Uranoscodon superciliosus* (Linnaeus, 1758), *Neusticurus* spp. *Crocodilurus amazonicus* (Spix, 1825), and *Dracaena guianensis* Daudin, 1802 (Avila-Pires 1995). However, this behavior has also been reported for strictly terrestrial species, such as the small sphaerodactylid gecko *Gonatodes humeralis* (Guichenot, 1855), which was observed to escape by running through the trunk of a partly submerged tree, submerging in the water in a mangrove forest in the state of Pará, Brazil (Fernandes et al. 2009).

Avila-Pires (1995) described some defensive mechanisms for *P. plica*: crypsis, motionlessness, and fleeing by ascending or descending circles around a tree trunk and hiding among the roots. To date, no other information on defense is known for this species. We report for the first time the escape behavior of diving, remaining submerged and motionless, and the cessation of breathing, which increases the number of known defensive mechanisms for this species. Our discovery reinforces the importance of basic studies on natural history of the lizards of Amazonia.

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Figure 1. Submerged *Plica plica* in an area of Várzea forest, Tefé, Amazonas, Brazil. Top, aerial view of lizard with eyes open. Bottom, underwater view showing the lizard with eyes closed.



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