

ANTIPREDATOR MECHANISMS DISPLAYED BY *GYMNODACTYLUS DARWINII* (SQUAMATA: PHYLLODACTYLIDAE) AND *CHATOGEKKO AMAZONICUS* (SQUAMATA: SPHAERODACTYLIDAE) WHEN HANDLED IN FIELDWORKS

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187

Abstract: Brazil is one of the richest countries in reptile fauna. However, the antipredator mechanisms regarding many of these species are not yet known. As we document new records, it may continually improve our understanding on predator-prey interactions. Here, four antipredator mechanisms are reported, the scorpion mimicry displayed by *Gymnodactylus darwinii* and *Chatogecko amazonicus*, as well as cloacal discharge, skin loss, and tail autotomy for the former.

Keywords: Amazon, Atlantic Forest, defensive behaviors, lizards.

MECANISMOS ANTIPREDATÓRIOS EXIBIDOS POR *GYMNODACTYLUS DARWINII* (SQUAMATA: PHYLLODACTYLIDAE) E *CHATOGEKKO AMAZONICUS* (SQUAMATA: SPHAERODACTYLIDAE) QUANDO MANUSEADOS EM TRABALHOS DE CAMPO

Resumo: O Brasil é um dos países mais ricos em répteis. No entanto, os mecanismos antipredatórios de muitas dessas espécies ainda não são conhecidos. Ao documentarmos novos registros, podemos continuamente melhorar nosso entendimento sobre as interações predador-presa. Aqui, quatro mecanismos antipredatórios são relatados, o mimetismo de escorpiões exibido por *Gymnodactylus darwinii* e *Chatogecko amazonicus*, bem como a descarga cloacal, perda de pele e autotomia de cauda para o primeiro.

Palavras-chave: Amazônia, Mata Atlântica, comportamentos defensivos, lagartos.

Reptiles constitute food source to a wide variety of invertebrates and vertebrates (Miranda, 2017; Schalk & Cove, 2018; Valdez, 2020). To reduce predation success during predator-prey interactions, they can display, amongst the species, several different behavioral, morphological, and physiological antipredator mechanisms (Greene, 1988; Miranda et al., 2022). Nevertheless, considering that the knowledge on antipredator mechanisms on many lizard species remains scarce (Greene, 1988), reports on undocumented defensive behaviors may continually improve our understanding on predator-prey interactions. Herein, four antipredator mechanisms are reported, the mimicry of scorpions displayed by *Gymnodactylus darwinii* (Gray, 1845) and *Chatogekko amazonicus* (Andersson, 1918), as well as skin loss, cloacal discharge, and tail autotomy for the former.

G. darwinii is a small-sized (mean SVL 51.2 ± 4.9 mm SVL; Almeida-Gomes et al. 2012), terrestrial and nocturnal lizard, endemic to the Atlantic Forest, and widely distributed from the states of São Paulo to Rio Grande do Norte (Costa et al., 2022). It inhabits a large diversity of habitats, such as restingas (coastal sand plains), rainforests and forest edges, as well as anthropogenically disturbed environments (Teixeira, 2002; Dias & Rocha, 2005; Almeida-Gomes et al., 2008; Castro & Silva-Soares, 2016). *C. amazonicus* is a miniaturized (mean SVL 21 ± 1.8 mm; Gamble et al., 2011), terrestrial and diurnal leaf-litter lizard found in a variety of undisturbed lowland forested habitats of the Amazon Forest (Vitt et al., 2005). The species is widely distributed in central and eastern Amazon, occurring in the Brazilian states of Acre, Amapá, Amazonas, Mato Grosso, Rondônia, Roraima, and Pará; as well as in the countries of French Guiana; Guyana; Suriname; the Venezuelan (Amazonas state); and northern Bolivia (Langstroth, 2005; Geurgas & Rodrigues, 2010; Ribeiro Junior, 2015; Dewynter et al., 2020).

We obtained the records of antipredator mechanism for *G. darwinii* through occasional observations during fieldwork at three localities: one at the municipality of Casimiro de Abreu, state of Rio de Janeiro (RJ), and another in the municipalities of Vitória and Serra, state of Espírito Santo (ES), all in southeastern Brazil. The record of *C. amazonicus* was observed in the Floresta Nacional (FLONA) do Tapirapé-Aquiri, in the municipalities of Marabá and São Félix do Xingu, state of Pará (PA), northern Brazil.

In the municipality of Casimiro de Abreu (RJ), we captured an adult *G. darwinii* on the leaf litter inside an Atlantic Forest remnant ($22^{\circ}29'11''$ S, $42^{\circ}13'23''$ W, datum WGS 84; elev. 14 m a.s.l.) at 17:50 h on 01 August 2010. In the field laboratory, while being handled for

photo record, it displayed the behavior of lifting up and curling the tail over the body for approximately three minutes (Fig. 1A). Moreover, this specimen also deliberately released its skin, another defensive behavior that is commonly observed in captured adults of *G. darwinii* in the states of Espírito Santo and Rio de Janeiro (T. Silva-Soares, pers. comm.). However, skin loss has not been reported for *G. darwinii*.

In the municipality of Vitória (ES), we found an adult *G. darwinii* on the ground at the Camburi ($20^{\circ}15'10''$ S, $40^{\circ}16'24''$ W, datum WGS 84; elev. 8 m a.s.l.) at 06:30 h on 5 June 2012. After placing the specimen on a *Clusia* leaf for photo record, we observed the same behavior of lifting up and curling the tail over the body for approximately two minutes (Fig. 1B). In the municipality of Serra (ES), we captured a female *G. darwinii* in pitfall traps placed in an Atlantic Forest remnant ($20^{\circ}05'48''$ S, $40^{\circ}21'11''$ W, datum WGS 84; elev. 29 m a.s.l.) on 29 September 2022. After removing the specimen from the trap, it shook himself, released cloacal discharge on the researcher's hand (Fig. 1C) and shed its skin near the right front leg (Fig. 1D). On the other day, another adult *G. darwinii* was captured in pitfall traps, and while being handled for photo record, it displayed the behavior of tail autotomy (Fig. 1E).

In the FLONA do Tapirapé-Aquiri (PA), we captured five specimens of *C. amazonicus* on the leaf litter inside an ombrophilous forest remnant ($5^{\circ}47'41''$ S, $50^{\circ}29'56''$, WGS 84; elev. 279 m a.s.l.) on 09 August 2020. In the field laboratory, a specimen displayed four times the behavior of lifting up and curling the tail over the body after being handled for photographs (Fig. 1F). Other two specimens (not photographed) also displayed the same behavior after being handled in the same photo record session. Moreover, these individuals also display the defensive behaviors short run and erratic movements.

Mimicry is a passive defence used by lizards to confuse their predators (Miranda et al., 2022). Some lizard species employ the behavior of lifting up and curling the tail over the body to mimic dangerous species, such as scorpions (Brandão & Motta, 2005). Lizards mimic a scorpion's tail to deceive predators, because they mistake the curly tail with the metasoma (tail) of scorpions (Miranda et al., 2022). In Brazil, the behavior of mimic scorpions has been reported to occur in six species of lizards: three phyllodactylid *Gymnodactylus amarali* (Barbour, 1925). *G. darwinii* and *G. geckoides* (Spix, 1825) (Colli et al., 2003; Passos et al., 2012; Miranda et al., 2022); two sphaerodactylid *Coelodactylus brachystoma* (Amaral, 1935) and *Gonatodes humeralis* (Guichenot, 1855), and one dactyloid *Norops chrysoleps* Duméril & Bibron, 1837 (Brandão & Motta, 2005; Costa et

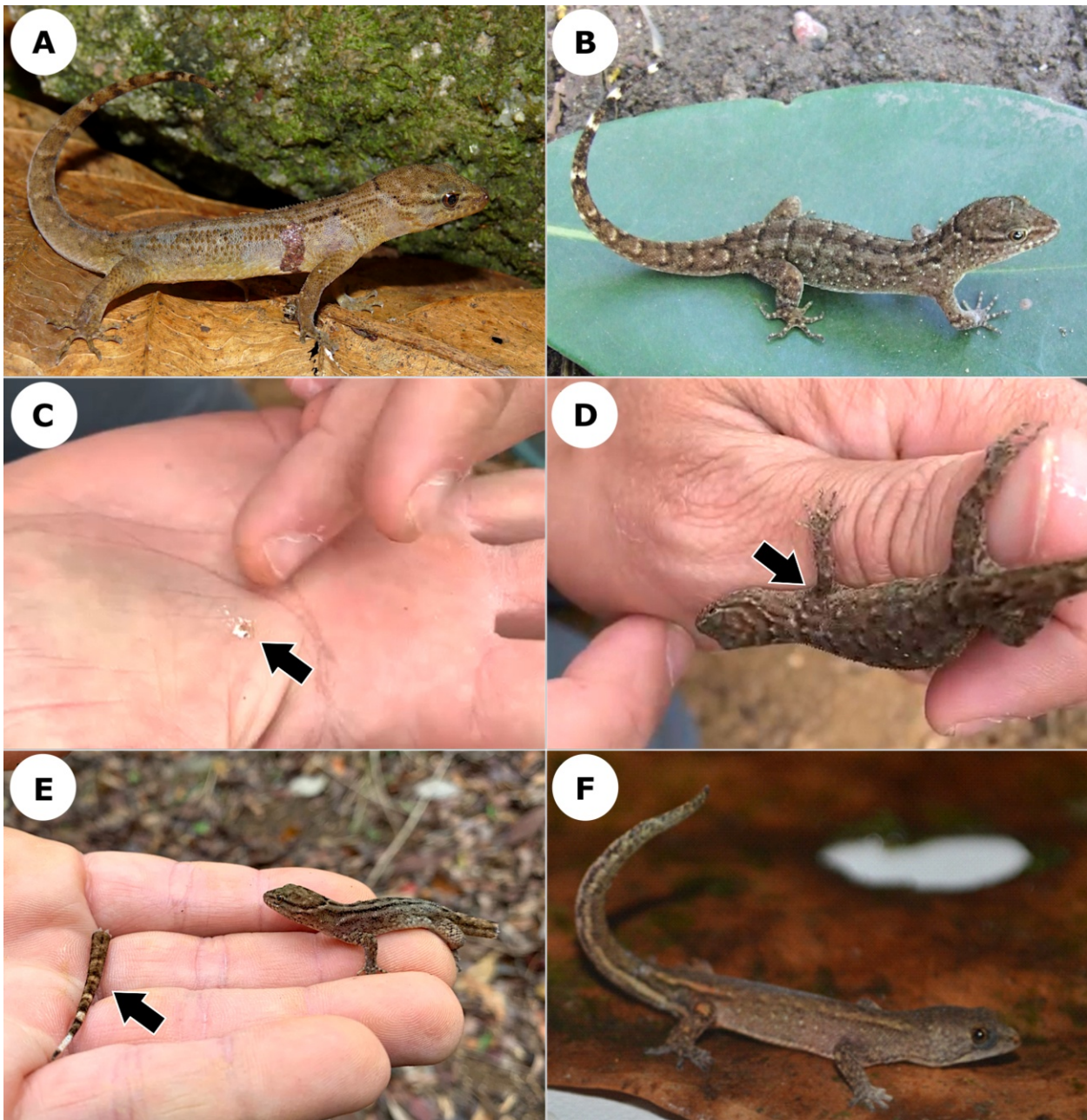


Fig. 1. Antipredator mechanisms displayed by specimens of *Gymnodactylus darwinii* (Gray, 1845) and *Chatogekko amazonicus* (Andersson, 1918). A and B. Adults *G. darwinii* displaying the behavior of lifting up and curling the tail over the body in the municipalities of Casimiro de Abreu (RJ) and Vitória (ES), both in southeastern Brazil. C. Cloacal discharge (black arrow) released by a female *G. darwinii* in the municipality of Serra (ES), southeastern Brazil. D. The same female with skin loss (black arrow). E. Another specimen of *G. darwinii* which displayed the behavior of tail autotomy (black arrow indicates the lizard's tail). F. Adult *C. amazonicus* displaying the behavior of lifting up and curling the tail over the body in the FLONA do Tapirapé-Aquiri (PA), northern Brazil. Photos A, E, F by Thiago Silva-Soares; photos C and D by Giovana Cordioli; and photo B by Bruno B. Loureiro.

al., 2009; Pinto & Costa-Campos, 2017). Field observations and laboratory tests provided evidence that specimens of *C. brachystoma* mimic the buthids scorpions *Tityus matogrossensis* (Borelli, 1901), *Anantheris balzani* (Thorell,

1891), and *Rhopalurus agamemnon* (Koch, 1839), which use the same microhabitats as this small lizard in Cerrado areas in the Serra da Mesa region, Goiás state (Brandão & Motta, 2005). The scorpion *Tityus potameis* (Lourenço

& Giupponi, 2004) is sympatric with *G. darwinii* in the Atlantic Forest remnants surveyed in the present study (T. Silva-Soares, pers. comm.). Our field observations, therefore, provide evidence that *G. darwinii* display mimicry of scorpions as an antipredator mechanism.

Cloacal discharge and tail autotomy are active defences used against predation attempts (Pianka & Vitt, 2003; Miranda et al., 2022). These antipredator mechanisms are known for *G. darwinii* (Fiuza, 2011). Others antipredator mechanisms reported for *G. darwinii* include immobility, bite, short run, death feigning, camouflage, disruptive coloration, and body rotation (Fiuza, 2011). In contrast, some lizard species have capacity of release their skin as an escape strategy of potential predators (Bauer et al., 1992, 1993). This antipredator mechanism has been documented for *C. amazonicus* (Bauer et al., 1992), but not to *G. darwinii*. Therefore, we add one more defensive behavior to *G. darwinii* and provide the second set of antipredator mechanisms to *C. amazonicus*.

Since lifting up and curling the tail over the body have been found in few species of *Gymnodactylus* (3), *Coleodactylus* (1), *Gonatodes* (1), *Norops* (1) and *Chatogekko* (1), as well as skin loss in *Gonatodes* (2), *Chatogekko* (1) and *Gymnodactylus* (1), the use of these antipredator mechanism by lizards may be underestimated and still poorly understood. Natural history observations are important to provide information on life history, fulfilling gaps on the ecology of many Brazilian lizards.

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