REPTILES & AMPHIBIANS

Toe-tapping During Amplexus by the Dry Forest Toad, *Incilius coccifer* (Cope 1866)

Alexander Moya-Valverde[1], Reyner Villalta[2], and Jose Olivares-Román[2]

[1]Escuela de Ciencias Biológicas, Universidad Nacional de Costa Rica, Heredia, Costa Rica (jolexmovalst@gmail.com [corresponding author]; https://orcid.org/0000-0002-1194-3691)
[2]Orosi, Cartago, Costa Rica (villearre@hotmail.com; joserolr86@gmail.com)

Toe-tapping and other similar toe movements (pedal luring, toe waving, toe-twitching, pedal movements) are frequently reported as predatory behaviors in anurans (Radcliffe et al. 1986; Bertoluci 2002; Hagman and Shine 2008; McFadden et al. 2010; Schulte and König 2023). This behavior is known to occur in various anuran taxa, and it has been shown to be positively correlated to feeding events in some bufonid, dendrobatid, and one pyxicephalid species (Claessens et al. 2020; Schulte and König 2023), and in the case of *Dendrobates truncatus*, toe-tapping has been proposed as a foraging behavior (Vergara-Herrera et al. 2024). Toe movements also have been observed during courtship, calling, or mating in some dendrobatid species (Claessens et al. 2020), such as a courting vibratory signal in *Dendrobates auratus* in Costa Rica (Barquero and Arguedas 2022), and Landestoy and Ortíz (2015) reported toe-tapping in male *Peltophryne fracta* and *P. guentheri*, the first tapping its toes on the hindlimb of a male *Rhinella marina* (https://youtu.be/JhiNC4ii5CI) and the second doing the same on the dorsolateral region of a male *R. marina* (https://youtu.be/RwIkrH2q5C8). The same authors noted another case of an unidentified species of toad filmed while engaged in the same behavior (https://youtu.be/PhJnQRdNFFg). Landestoy and Ortíz (2015) suggested that these behaviors were attempts at tactile stimulation of a potential mate, and Starnberger et al. (2018) indicated that similar tapping behaviors in *Hyperolius puncticulatus*, like advertisement calls, might stimulate females and deter males. Claessens et al. (2020) also noted that some individuals of *Ranitomeya ventrimaculata*, *Incilius leucomyos*, and *Phyllobates guentheri* toe-tapped during amplexus.

The Dry Forest Toad (*Incilius coccifer*) is abundant throughout its range in Costa Rica, where it has been reported both in dry and montane forest, usually in open and altered habitats (Leenders 2016). Reproductive activity peaks early in the rainy season, when males call from standing bodies of water, and amplexus is axillary (Leenders 2016). We herein report two incidents of toe-tapping by male *I. coccifer* during amplexus.

At 2100 h on 11 May 2024, we observed about a dozen toads in a roadside ditch north of the multi-use common room at Purisil, Cartago, Costa Rica (9.760556, -83.819722; elev. 1,207 m asl). Males were calling and some females were present along the edges of the ditch. The male of an amplecting pair was toe-tapping the female's hindlimb

Figure 1. The three pairs of amplecting Dry Forest Toads (*Incilius coccifer*) (https://youtu.be/-e4zCtbP0QI) displaying toe-tapping behavior. Images extracted from the video at 0:26 (left); 0:35 (center), and 0:44 (right). Video segments by Alexander Moya-Valverde (A) and Reyner Villalta (B–C).

Reptiles & Amphibians ISSN 2332-4961
https://doi.org/10.17161/randa.v31i1.22414

(from 0:00 to 0:29 in a video available at: https://youtu.be/-e4zCtbP0QI). At the beginning, possibly because it was not as disturbed by our lights, the male tapped the female more vigorously than the video shows. When approached, the female started moving and the male became less conspicuous with its movements, tapping with the fourth toe and making lateral vibrations. At this point, AMV started filming the behavior. After filming, the amplecting pair was left without any further disturbance.

At 1930 h on 17 May 2024, RV was searching for frogs in a coffee plantation west of Orosi, Cartago, Costa Rica (9.797250, -83.861111; elev. 1,145 m asl) and encountered five male *I. coccifer* calling around a small pool, two of them in amplexus. One of the two in amplexus was toe-tapping the female (Fig. 1; https://youtu.be/-e4zCtbP0QI). The first part of the two-part video (0:29–0:42) shows the amplecting pair before disturbance by the observer; the second part (0:42–0:57) shows the same pair after they had moved, which might have caused the male to tap the side of the female instead of its hindlimb. After filming, the amplecting pair was left without any further disturbance.

As other authors have proposed, this toe-tapping behavior might be stimulating the female during amplexus, and might aid in reproduction of the species. We recommend testing the latter possibility using a controlled experiment. Also, more observations of other anuran species are necessary to determine if this behavior is unique to the taxa in which it has been described.

Literature Cited

Barquero, M.D. and V. Arguedas. 2022. Mass movement and potential vibratory toe signalling in the Green and Black Poison-Dart Frog, *Dendrobates auratus* (Amphibia: Dendrobatidae). *Herpetology Notes* 15: 79–82.

Bertoluci, J. 2002. Pedal luring in the leaf-frog *Phyllomedusa burmeisteri* (Anura, Hylidae, Phyllomedusinae). *Phyllomedusa* 1: 93–95. https://doi.org/10.11606/issn.2316-9079.v1i2p93-95.

Claessens, L.S.A., N. Ganchev, M.M. Kukk, C.J. Schutte, and J. Sloggett. 2020. An investigation of toe-tapping behaviour in anurans by analysis of online video resources. *Journal of Zoology* 312: 158–162. https://doi.org/10.1111/jzo.12815.

Hagman, M. and R. Shine. 2008. Deceptive digits: The functional significance of toe waving by cannibalistic cane toads, *Chaunus marinus*. *Animal Behaviour* 75: 123–131. https://doi.org/10.1016/j.anbehav.2007.04.020.

Landestoy T., M. and R. Ortíz. 2015. Rediscovery of the Eastern Crested Toad (*Peltophryne fracta*), with comments on conservation, vocalization, and mating behavior. *Reptiles & Amphibians* 22: 50–55. https://doi.org/10.17161/randa.v22i2.14044.

Leenders, T. 2016. *Amphibians of Costa Rica: A Field Guide*. Cornell University Press, Ithaca, New York, USA.

McFadden, M., P. Harlow, S. Kozlowski, and D. Purcell. 2010. Toe-twitching during feeding in the Australian myobatrachid frog, *Pseudophryne corroboree*. *Herpetological Review* 41: 153–154.

Radcliffe, C.W., D. Chiszar, K. Estep, J.B. Murphy, and H.M. Smith. 1986. Observations on pedal luring and pedal movements in leptodactylid frogs. *Journal of Herpetology* 20: 300–306. https://doi.org/10.2307/1564496.

Schulte, L.M. and Y. König. 2023. Experimental evidence that toe-tapping behavior in the green-and-black poison frog (*Dendrobates auratus*) is related to prey detection. *Acta Ethologica* 26: 139–143. https://doi.org/10.1007/s10211-023-00422-8.

Starnberger, I., P.M. Maier, W. Hödl, and D. Preininger. 2018. Multimodal signal testing reveals gestural tapping behavior in Spotted Reed Frogs. *Herpetologica* 74: 127–134. https://doi.org/10.1655/Herpetologica-D-17-00053.1.

Vergara-Herrera, N., R. Cocroft, and L.A. Rueda-Solano. 2024. Eating to the beat of the drum: vibrational parameters of toe tapping behavior in *Dendrobates truncatus* (Anura: Dendrobatidae). *Evolutionary Ecology* 38: 781–797. https://doi.org/10.1007/s10682-023-10277-x.