



INTRODUCED SPECIES

First Record of a Caecilian (Order Gymnophiona, Family Typhlonectidae, *Typhlonectes natans*) in Florida and in the United States

Coleman M. Sheehy III¹, David C. Blackburn¹, Marcel T. Kouete¹, Kelly B. Gestring², Krissy Laurie², Austin Prechtel², Eric Suarez³, and Brooke L. Talley⁴

¹Florida Museum of Natural History, Division of Herpetology, University of Florida, Gainesville, Florida 32611, USA (coleman3@ufl.edu)

²Florida Fish and Wildlife Conservation Commission, NDivision of Habitat and Species Conservation, 10052 NW 53rd Street, Sunrise, Florida 33351, USA

³Florida Fish and Wildlife Conservation Commission, Division of Habitat and Species Conservation, 8535 Northlake Boulevard, West Palm Beach, Florida 33412, USA

⁴Florida Fish and Wildlife Conservation Commission, Division of Hunting and Game Management, 620 S. Meridian Street, Tallahassee, Florida 32399, USA

The genus *Typhlonectes* (Amphibia; Gymnophiona; Typhlonectidae) contains two species of completely aquatic freshwater caecilians. The Cayenne Caecilian, *Typhlonectes compressicauda* (Duméril and Bibron 1841), is widely distributed in the Amazonian River Basin of Brazil,

Colombia, French Guiana, Guyana, Peru, and Venezuela, whereas the Rio Cauca Caecilian, *T. natans* (Fischer 1880), has a smaller distribution within the drainage basins of the Cauca and Magdalena Rivers in Colombia and the areas surrounding the Maracaibo Basin in Venezuela (Tapley and



Fig. 1. This aquatic Rio Cauca Caecilian (*Typhlonectes natans*; UF:Herp:190000) found alive in the Tamiami Canal (C-4) in Miami-Dade County, Florida, represents the first documented record of this order of amphibians found in the United States. Photograph by Krissy Laurie.

Acosta-Galvis 2010; AmphibiaWeb 2021). The two species are similar in appearance, but can be differentiated by the relative width of the head (head wider than body in *T. natans* and narrower than body in *T. compressicauda*; Taylor 1968; Maciel and Hoogmoed 2011), tooth shape (teeth with sharp tips in *T. natans* and with broadly dilated crowns in *T. compressicauda*; Wilkinson 1991), and the number of anal denticulations (typically 9 in *T. natans* and 10–11 in *T. compressicauda*; Taylor 1968; Maciel and Hoogmoed 2011). Both species are viviparous (Kupfer 2009), as is typical of members of the family Typhlonectidae (Wells 2010).

At 1326 h on 21 October 2019, personnel with the Florida Fish and Wildlife Conservation Commission (FWC) were conducting a routine electrofishing survey of a section of the Tamiami Canal (C-4) in Miami-Dade County, Florida (25.77120°N, 80.31013°W; WGS 84) when they found a single live caecilian (Fig. 1). It was captured in water about 1 m deep along the southern shore in a box-cut stretch of canal containing a narrow fringe of aquatic vegetation (*Vallisneria americana* and *Cabomba caroliniana*). Subsequent electrofishing on 7 November 2019 in the same canal and associated lateral canal yielded no additional caecilians. Additional electrofishing in the eastern half of Tamiami Canal, from the

Coral Gables Canal that runs parallel to HWY 826 east to the salinity structure, also yielded no additional caecilians.

The caecilian appeared in good health when collected (Fig. 2), although attempts to feed it in captivity failed and the animal later died. The specimen was subsequently deposited in the Herpetology Collection at the Florida Museum of Natural History (UF:Herp:190000; adult; total length = 582 mm; suspected male based on the circular cloacal disc; Tapley and Acosta-Galvis 2010). We identified this specimen as *Typhlonectes natans* by the presence of the following morphological characters: head wider than body, teeth with sharp tips, and presence of nine anal denticulations. This identification was confirmed after analyzing 539 bp of mitochondrial ribosomal 16S (GenBank Accession No. MZ444144) amplified by PCR using 16SaL and 16SbH primers (Palumbi et al. 1996) following extraction of genomic DNA from fresh muscle tissue using a QIAGEN DNeasy Blood & Tissue Kit. Following alignment with other mitochondrial 16S rRNA sequences of typhlonectids from GenBank, this specimen is confirmed as *T. natans* by its low pairwise sequence divergence (0.0–1.8%; mean = 0.5%; n = 10) from other individuals of this species (Table 1). Furthermore, DNA from the specimen is identical to several 16S rRNA sequences in GenBank from individuals of *T. natans* from captive populations (X86290, Y10951) as well as one individual (MN555720) from northern Colombia (Acosta-Galvis et al. 2019).

To our knowledge, this represents the first record of a caecilian (order Gymnophiona) in Florida or anywhere else in the United States. Although stem caecilians are known from the fossil record of North America (Jenkins and Walsh 1993), no extant caecilians occur north of southern Mexico. As a result of this discovery, all three orders of extant amphibians are now known to occur in Florida, including many native species of frogs (Anura) and salamanders (Caudata) as well as several non-native species of frogs (Krysko et al. 2019; Goodman et al. 2021). *Typhlonectes natans* is readily available in the pet trade, and the species is bred in captivity by hobbyists as well as several zoos and aquaria (Tapley and Acosta-Galvis 2010; Churgin et al. 2013). Therefore, the presence of this caecilian in Florida is likely the result of a released or escaped individual. We cannot determine at this time whether an established population of these caecilians exists in the C-4



Fig. 2. This aquatic Rio Cauca Caecilian (*Typhlonectes natans*; UF:Herp:190000) was captured in water about 1 m in depth along a stretch of the C-4 canal near the Miami International Airport, Miami-Dade County, Florida. Photograph by Austin Prechtel.

Table 1. Mean uncorrected *p*-distances of UF:Herp:190000 to species in the family Typhlonectidae based on an analysis in MEGA X (Kumar et al. 2018) of a 518-bp alignment generated using default parameters in MAFFT (Katoh et al. 2019). GenBank data for these analyses are: *Atretochoana eiselti* (KX757082), *Chthonopereton indistinctum* (EF107202, KF540149, KX757088, NC023509), *Chthonerpeton viviparum* (KU495177), *Potomotyphlus kaupii* (KF540161, KX757083, NC023516), *Typhlonectes compressicauda* (KU495605, KX757084), and *T. natans* (AF154051, DQ283085, EU753984, KX757085, MH004286, MN555720, MN555721, NC002471, X86290, Y10951).

	<i>Typhlonectes natans</i>	<i>Typhlonectes compressicauda</i>	<i>Potomotyphlus kaupii</i>	<i>Atretochoana eiselti</i>	<i>Chthonerpeton indistinctum</i>	<i>Chthonerpeton viviparum</i>
UF:Herp:190000	0.00477	0.07950	0.09246	0.11737	0.17934	0.21411

or elsewhere in Florida. In Colombia, where the species is native, *T. natans* inhabits warm, slow-flowing waterways with abundant aquatic vegetation (Tapley and Acosta-Galvis 2010). Parts of the C-4 canal appear to resemble their native habitat and may provide an environment where this species could thrive were it to become established.

Acknowledgements

The caecilian was collected under the authority of the Florida Fish and Wildlife Conservation Commission.

Literature Cited

- Acosta-Galvis, A.R., M. Torres, and P. Pulido-Santacruz. 2019. A new species of *Caecilia* (Gymnophiona, Caeciliidae) from the Magdalena valley region of Colombia. *ZooKeys* 884: 135–157. <https://doi.org/10.3897/zookeys.884.35776>.
- AmphibiaWeb. 2021. University of California, Berkeley, California, USA. <<https://amphibiaweb.org>>.
- Churgin, S.M., B.L. Raphael, J.B. Pramuk, J.G. Trupkiewicz, and G. West. 2013. *Batrachochytrium dendrobatidis* in aquatic caecilians (*Typhlonectes natans*): a series of cases from two institutions. *Journal of Zoo and Wildlife Medicine* 44: 1002–1009. <https://doi.org/10.1638/2012-0288R1.1>.
- Goodman, C.M., G.F.M. Jongsma, J.E. Hill, E.L. Stanley, Q.M. Tuckett, D.C. Blackburn, and C.M. Romagosa. 2021. A case of mistaken identity: Genetic and anatomical evidence reveals the cryptic invasion of *Xenopus tropicalis* in central Florida. *Journal of Herpetology* 55: 62–69. <https://doi.org/10.1670/20-083>.
- Jenkins, F.A., Jr. and D.M. Walsh. 1993. An Early Jurassic caecilian with limbs. *Nature* 365: 246–250. <https://doi.org/10.1038/365246a0>.
- Katoh, K., J. Rozewicki, and K.D. Yamada. 2019. MAFFT online service: multiple sequence alignment, interactive sequence choice and visualization. *Briefings in Bioinformatics* 20: 1160–1166. <https://doi.org/10.1093/bib/bbx108>.
- Kumar, S., G. Stecher, M. Li, C. Knyaz, and K. Tamura. 2018. MEGA X: Molecular Evolutionary Genetics Analysis across computing platforms. *Molecular Biology and Evolution* 35: 1547–1549. <https://doi.org/10.1093/molbev/msy096>.
- Kupfer, A. 2009. Sexual size dimorphism in caecilian amphibians: analysis, review and directions for future research. *Zoology* 112: 362–369. <https://doi.org/10.1016/j.zool.2008.12.001>.
- Krysko, K.L., K.M. Enge, and P.E. Moler. 2019. *Amphibians and Reptiles of Florida*. University of Florida Press, Gainesville, Florida, USA.
- Maciel, A.O. and M.S. Hoogmoed. 2011. Taxonomy and distribution of caecilian amphibians (Gymnophiona) of Brazilian Amazonia, with a key to their identification. *Zootaxa* 2984: 1–53. <https://doi.org/10.11646/zootaxa.2984.1.1>.
- Palumbi, S.R. 1996. Nucleic acids II: The polymerase chain reaction, pp. 205–247. In: D.M. Hillis, C. Moritz, and B.K. Mable (eds.), *Molecular Systematics*. Second edition. Sinauer Associates, Sunderland, Massachusetts, USA.
- Tapley, B. and A.R. Acosta-Galvis. 2010. Distribution of *Typhlonectes natans* in Colombia, environmental parameters and implications for captive husbandry. *The Herpetological Bulletin* 113: 23–29.
- Taylor, E.H. 1968. *The Caecilians of the World. A Taxonomic Review*. University of Kansas Press, Lawrence, Kansas, USA.
- Wells, K.D. 2010. *The Ecology and Behavior of Amphibians*. University of Chicago Press, Chicago, Illinois, USA.
- Wilkinson, M. 1991. Adult tooth crown morphology in the Typhlonectidae (Amphibia: Gymnophiona): a reinterpretation of variation and its significance. *Zeitschrift für Zoologische Systematische und Evolutionsforschung* 29: 304–311. <https://doi.org/10.1111/j.1439-0469.1991.tb00675.x>.