

The invasive pentastome *Raillietiella orientalis* in a banded water snake from the pet trade

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Abstract. *Raillietiella orientalis* is established in Florida and rapidly spreading both geographically and in known host species. A banded water snake (*Nerodia fasciata*), purchased in Michigan at a regional reptile show, expectorated a pentastome whose morphology and DNA sequence indicated that it was *R. orientalis*. This event indicates that, through the pet trade, *R. orientalis* has been spread 1,500 km from its previously known distribution limit. Fecal sample analyses indicated that the snake was shedding large numbers of embryonated eggs for at least several months. The diversity of reptile species that are both known hosts of *R. orientalis* in Florida and are commonly sold in the pet trade indicates that this invasive pentastome may become a widespread health concern for pet owners and veterinarians.

Keywords: animal dispersal; *Pentastomida*; pets; *Raillietiella orientalis*; snakes.

Several invasive pentastome species, including *Raillietiella frenata*^{8,15} and *R. orientalis*,^{9,11} are strong conservation concerns in both Australia and the southern United States. In Florida, *R. orientalis* uses many wild squamates as definitive hosts, including species that are commonly part of the pet trade, including Burmese pythons (*Python bivittatus*), corn snakes (*Pantherophis guttatus*),¹² tegus (*Salvator meri-anae*),⁶ and tokay geckos (*Gekko gecko*).⁵ Here we report *R. orientalis* infecting a pet snake.

Pentastomes have a variety of impacts on snake health, including tissue damage caused by migrating nymphs or larvae, damage to the lung tissue by feeding adults, and secondary pneumonia and septicemia associated with this damage.¹⁴ In Florida, infection by adult *R. orientalis* has been associated with morbidity and mortality in pygmy rattlesnakes (*Sistrurus miliarius*),⁴ a banded water snake (*Nerodia fasciata*),¹⁶ and an Eastern indigo snake (*Drymarchon couperi*).¹ The life cycle of *R. orientalis* appears to involve 2 intermediate hosts, with larvae initially developing in coprophagous insects such as roaches, then residing in insectivorous anurans and lizards, until these second intermediate hosts are consumed by a definitive host.¹³ This parasite appears to have negligible health impacts on the lizards and anurans that serve as intermediate hosts.¹³ Although *R. orientalis* was initially restricted to south Florida,¹¹ it has now spread north rapidly, occupying much of peninsular Florida.^{12,16}

A concerned owner posted on a social media site in January 2022 that their pet banded water snake had expectorated a parasite while producing an audible retching sound. The snake's owner had previous experience in raising *Nerodia* and noticed that this snake had failed to grow and gain weight in the 5 mo that they had the snake, despite regular, routine feeding and no display of abnormal activity. The photo of the

parasite posted by the owner showed a pentastome that resembled *R. orientalis*. This snake was acquired at a reptile exposition in Grand Rapids, MI, USA, in August 2021 and was labeled “Florida banded watersnake.” A photo of the snake adjacent to a ruler indicated that the snake was 47.5 cm in snout-to-vent length. We contacted the snake's owner and requested that they freeze the parasite. We sent them several microcentrifuge tubes filled with 70% ethanol and requested that both the frozen parasite and several fecal samples from the snake be placed in the alcohol and shipped to us for evaluation.

Upon receiving the parasite, we examined it using a dissecting microscope (20×) and found that it was the anterior portion of a *Raillietiella* pentastome with characteristic head shape, anterior and posterior hooks, and buccal cadre. Nucleic acids were extracted from a sample of the parasite, and a portion of the small subunit ribosomal RNA gene was amplified and commercially sequenced bidirectionally, as done in prior research.¹⁶ The determined sequence was 100% identical to the *R. orientalis* sequences in GenBank. We also microscopically examined wet mounts of a 0.0104-g fraction of a small fecal sample on a series of slides and counted 1,756 embryonated pentastome eggs (Fig. 1). A second fecal sample collected in late May, 4 mo after the single pentastome was expectorated, was also examined. It also

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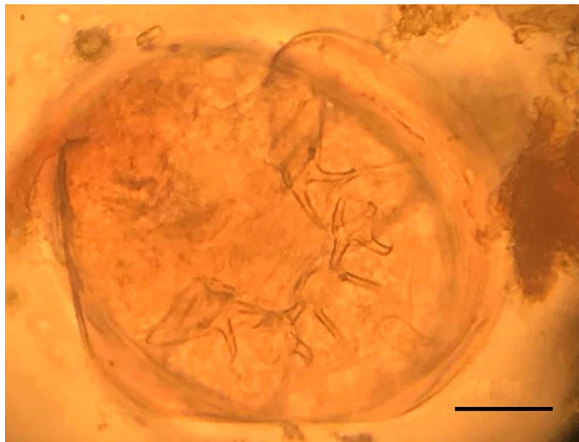


Figure 1. An embryonated *Raillietiella orientalis* egg in a wet mounted fecal sample from a banded watersnake (*Nerodia fasciata*). Bar = 20 μ m.

contained a high density of *Raillietiella* eggs, indicating a patent infection.

To our knowledge, *R. orientalis* has not been reported previously in a captive animal acquired via the pet trade. In the future, we expect more instances of this parasite in captive reptiles given that *R. orientalis* is very prevalent among wild snakes in southern Florida, exceeding 50% in several common snake species,¹² and there is often no clear demarcation between animals in the pet trade and wild reptiles and amphibians. In some cases, reptiles sold as “captive-bred” are actually wild-caught animals, as may have been true for our case. Furthermore, young snakes are often fed live wild-caught “feeder” lizards, typically Cuban brown anoles (*Anolis sagrei*), a species known to serve as an intermediate host for *R. orientalis*.¹³ The United States exported >28,000 *A. sagrei* annually from 2000 to 2010,⁷ and most of these lizards were probably wild caught in areas of Florida where *R. orientalis* now occurs, given the geographic ranges of these species.

The presence of *R. orientalis* in Michigan represents a jump of 1,500 km from its previously known northern distribution limit in North America of Alachua County, Florida.¹⁶ Human-aided transport of pet snakes represents a rapid path to great increases in geographic range for this parasite. Florida is a global hub for the reptile pet trade,³ and exports of *R. orientalis*-infected snakes and feeder lizards could result in further national and international dispersal of this invasive species. *R. orientalis* in pets could establish new wild populations through the escape or intentional release of snakes, through invertebrate consumption of pentastome eggs in discarded snake feces, or by using pentastome-infected lizards or frogs as feeders for snakes in short-term captivity.

The zoonotic potential of *R. orientalis* is unknown, but several other pentastomes that use snakes as definitive hosts can produce visceral pentastomosis in humans¹⁰ and domestic

animals.² Veterinarians and pet owners who work with wild-caught snakes or large lizards from the southeastern United States, or snakes fed live lizards and frogs from that region, should be aware of the growing prevalence of *R. orientalis* and the threat it poses to pet and wildlife health.

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References

1. Bogan JE Jr, et al. *Drymarchon couperi* (eastern indigo snake). Death associated with *Raillietiella orientalis*. *Herpetol Rev* 2022;53:147.
2. Brookins MD, et al. Massive visceral pentastomiasis caused by *Porocephalus crotali* in a dog. *Vet Pathol* 2009;46:460–463.
3. Enge KM. Commercial harvest of amphibians and reptiles in Florida for the pet trade. In: Meshak WE Jr & Babbitt KJ, eds. *Amphibians and Reptiles: Status and Conservation in Florida*. Krieger, 2005:198–211.
4. Farrell TM, et al. Spillover of pentastome parasites from invasive Burmese pythons (*Python bivittatus*) to pygmy rattlesnakes (*Sistrurus miliarius*), extending parasite range in Florida, USA. *Herpetol Rev* 2019;50:73–76.
5. Fieldsend TW, et al. First record of an Asian tongueworm, *Raillietiella orientalis* (Pentastomida: Raillietiellidae), parasitizing a tokay gecko (*Gekko gecko*, Squamata: Gekkonidae): a novel interaction between two non-native species in Florida. *Reptiles Amphib* 2021;28:255–256.
6. Goetz SM, et al. Argentine black and white tegu (*Salvator merianae*) can survive the winter under semi-natural conditions well beyond their current invasive range. *PLoS One* 2021;16:e0245877.
7. Herrel A, van der Meijden A. An analysis of the live reptile and amphibian trade in the USA compared to the global trade in endangered species. *Herpetol J* 2014;24:103–110.
8. Kelehear C, et al. Invasive parasites in multiple invasive hosts: the arrival of a new host revives a stalled prior parasite invasion. *Oikos* 2013;122:1317–1324.
9. Kelehear C, et al. Pentastomids of wild snakes in the Australian tropics. *Int J Parasitol Parasites Wildl* 2013;3:20–31.
10. Mendoza-Roldan JA, et al. Zoonotic parasites of reptiles: a crawling threat. *Trends Parasitol* 2020;36:677–687.

11. Miller MA, et al. Parasite spillover: indirect effects of invasive Burmese pythons. *Ecol Evol* 2017;8:830–840.
12. Miller MA, et al. Highly competent native snake hosts extend the range of an introduced parasite beyond its invasive Burmese python host. *Ecosphere* 2020;11:e03153.
13. Palmisano JN, et al. Infection experiments indicate that common Florida anurans and lizards may serve as intermediate hosts for the invasive pentastome parasite, *Raillietiella orientalis*. *J Herpetol* 2022;56:355–361.
14. Paré JA. An overview of pentastomiasis in reptiles and other vertebrates. *J Exot Pet Med* 2008;17:285–294.
15. Pence DB, Selcer KW. Effects of pentastome infection on reproduction in a southern Texas population of the Mediterranean gecko, *Hemidactylus turcicus*. *Copeia* 1988;1988:565–572.
16. Walden HDS, et al. Case report: invasive pentastomes, *Raillietiella orientalis* (Sambon, 1922), in a free-ranging banded water snake (*Nerodia fasciata*) in north central Florida, USA. *Front Vet Sci* 2020;7:467.