

Original Article

# First record of *Sebekia oxycephala* (Pentastomida: Sebekidae) infecting *Helicops angulatus* (Reptilia: Colubridae) in Northeast Brazil

Primeiro registro de *Sebekia oxycephala* (Pentastomida: Sebekidae) infectando *Helicops angulatus* (Reptilia: Colubridae) no Nordeste do Brasil

M. C. Oliveira<sup>a\*</sup> , C. Ferreira-Silva<sup>b</sup> , R. J. Silva<sup>b</sup> , W. O. Almeida<sup>c</sup> , F. G. R. França<sup>a</sup>   
and R. Lourenço-de-Moraes<sup>a</sup> 

<sup>a</sup>Universidade Federal da Paraíba – UFPB, Departamento de Engenharia e Meio Ambiente, Laboratório de Ecologia Animal, Programa de Pós-graduação em Ecologia e Monitoramento Ambiental, Rio Tinto, PB, Brasil

<sup>b</sup>Universidade Estadual Paulista “Júlio de Mesquita Filho” – UNESP, Instituto de Biociências, Setor de Parasitologia, Laboratório de Parasitologia de Animais Silvestres, Campus de Botucatu, Botucatu, SP, Brasil

<sup>c</sup>Universidade Regional do Cariri – URCA, Departamento de Química Biológica, Programa de Pós-graduação em Diversidade Biológica e Recursos Naturais, Crato, CE, Brasil

## Abstract

In this study, we investigated the infection by pulmonary parasites in the water snake *Helicops angulatus*. We found four nymphs of the pentastomide parasite *Sebekia oxycephala*, parasitizing two adult females *H. angulatus* collected in the municipality of Rio Tinto, Paraíba, Brazil. This occurrence is likely due to the nymphs of this parasite directly infecting aquatic intermediate hosts, such as fish. The result of this study represents the first record of pentastomid infecting *H. angulatus*.

**Keywords:** pentastomids, neotropical, parasite, snake.

## Resumo

Neste estudo investigamos a infecção por parasitos pulmonares na serpente *Helicops angulatus*. Encontramos quatro ninfas de pentastomídeos (*Sebekia oxycephala*) parasitando duas fêmeas adultas de *H. angulatus* oriundas do município de Rio Tinto, Paraíba, Brasil. A ocorrência das ninfas na serpente sugere que a transmissão ocorra através da cadeia trófica, uma vez que peixes atuam como hospedeiros intermediários do parasito e fazem parte da dieta *H. angulatus*. O resultado deste estudo representa o primeiro registro de pentastomídeos infectando *H. angulatus*.

**Palavras-chave:** pentastomídeo, neotropical, parasito, serpente.

## 1. Introduction

Pentastomids are a group of endoparasites that live in the respiratory tract of their hosts (Christoffersen and Assis, 2013). Currently, around 144 species of Pentastomida are registered and distributed in four orders: Eupentastomida, Porocephalida, Porocephaloidea, and Sebekidae (Lima et al., 2022). Some species of pentastomids are generalists (Almeida et al., 2009; Christoffersen and Assis, 2013), while others are specific hosts (Riley, 1986). Adult pentastomids are obligatory parasites found in the respiratory tract of reptiles such as snakes, lizards, crocodylians, and turtles in the tropical region (Christoffersen and Assis, 2013). On the other hand, larvae and nymphs of pentastomids are found infecting the respiratory tract of insects, amphibians, birds, fish, mammals, and even humans (Paré, 2008; Christoffersen and Assis, 2013, 2015a, b; Pavanelli et al., 2013). *Sebekia*

Sambon, 1922 is a genus of pentastomids usually associated with crocodylians (Riley et al., 1990) distributed in the regions of Neotropical, Nearctic, Ethiopian, Australian, and Oriental (Riley et al., 1990) and species of the genus *Sebekia* use fishes as intermediate hosts (Almeida et al., 2010; Pavanelli et al., 2013; Cardoso et al., 2014). The genus *Sebekia* holds significant economic importance due to its ability to induce inflammatory reactions and hemorrhaging in cultured fish (Boyce et al., 1987).

Snakes can harbor a wide variety of parasites, acting as definitive, intermediate, and paratenic hosts (Castro et al., 2020; Oliveira et al., 2021; Ferreira-Silva et al., 2022), including aquatic snakes of the genus *Helicops* Wagler, 1830 (Rego and Vicente, 1988; Silva et al., 2015; Quirino et al., 2018). *Helicops angulatus* (Linnaeus, 1758)

\*e-mail: moniqueceliao@gmail.com

Received: June 1, 2023 – Accepted: October 23, 2023



This is an Open Access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

is a water snake, widely distributed in Brazil (Uetz et al., 2023). It primarily feeds on fish and amphibians (Santos-Costa et al., 2022) although records have shown the occurrence of lizards and earthworms in its diet (Strussmann et al., 2011; Teixeira et al., 2017).

Despite the widespread distribution of *Helicops angulatus*, our understanding of its endoparasitic fauna and the ecological parasite-host relationships remains limited. Here we report for the first time the occurrence of *Sebekia oxycephala* (Diesing, 1835) parasitizing *H. angulatus*.

## 2. Material and Methods

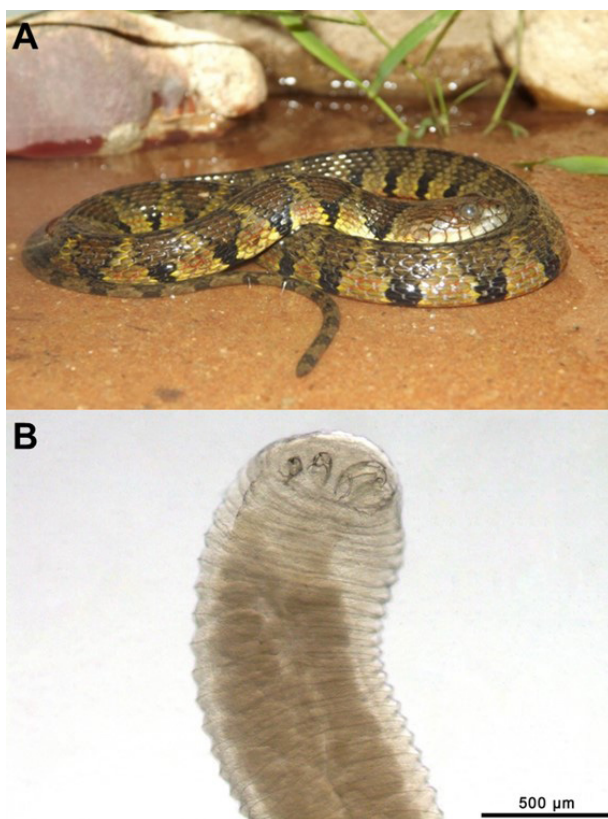
We analyzed two adult females of *H. angulatus* (Figure 1A). Both were collected during the years 2011 and 2013, under SISBIO collection permit No 22940-2, from the municipality of Rio Tinto (6°48'18.37"S, 35°4'26.75"W), state of Paraíba, Brazil. The snakes were euthanized with a lethal injection of 2% lidocaine hydrochloride. Snout-vent length (SVL) was measured with a precision caliper and weighed on a digital scale. Subsequently, they were fixed in 10% formaldehyde, preserved in 70% ethanol, and deposited in the Herpetology Collection of the Universidade Federal Paraíba (CHUFPPB 364 and 947). Snakes were dissected under a stereoscopic for the verified of the presence of parasites in respiratory and gastrointestinal tracts. The endoparasites

were counted and placed in glass vials containing 70% ethanol, and subsequently mounted on temporary slides for identification. Pentastomids were identified based on hook dimensions and body size (Almeida et al., 2010). Specimens were deposited in Parasitological Collection of the Regional University of Cariri (URCA P 1418, 1419, and 1420).

## 3. Results and Discussion

The snakes were infected by four of the nymphs of the pentastomid *Sebekia oxycephala* (Figure 1B), with one snake having two nymphs in the stomach and one in the small intestine and the other snake having one nymph in the stomach.

Infection with *Sebekia oxycephala* may be related to the semiaquatic habit and piscivorous diet of this host, since the nymphs of *Sebekia* species use fishes with intermediate hosts (Junker et al., 1998; Almeida et al., 2010; Santos-Costa et al., 2022), suggesting the use of *Helicops angulatus* as a second intermediate host in the life cycle of this parasite. The *Sebekia* species has already been registered infecting other species of *Helicops*, such as *H. leopardinus* (Schlegel, 1837) in Pantanal, state of Mato Grosso (Rego & Vicente, 1988) and *H. infrataeniatus* (Jan, 1865) in the state de São Paulo (Silva et al., 2015). In addition, there are



**Figure 1.** (A) *Helicops angulatus* from the municipality of Rio Tinto, Paraíba state, Brazil; (B) - nymph of *Sebekia oxycephala* parasite of *H. angulatus*.

**Table 1.** Bibliographic review of Pentastomid species parasitizing snakes.

PENTASTOMIDA	HOST	LOCALITY	REFERENCES
<b>Family Sebekidae Sambon, 1922</b>			
<i>Sebekia mississippiensis</i> (Overstreet, Self & Vilet, 1985)	<i>Nerodia cyclopion</i> (Duméril, Bibron & Duméril, 1854)	United States	Overstreet et al., (1985)
	<i>Nerodia erythrogaster</i> (Forster, 1771)	United States	Overstreet et al. (1985)
	<i>Nerodia fasciata</i> (Linnaeus, 1766)	United States	Overstreet et al. (1985)
	<i>Nerodia rhombifer</i> (Hallowell, 1852)	United States	Overstreet et al. (1985)
	<i>Nerodia sipedon</i> (Linnaeus, 1758)	United States	Overstreet et al., (1985)
	<i>Nerodia taxispilota</i> (Holbrook, 1838)	United States	Boyce et al. (1987)
<i>Sebekia oxycephala</i> (Diesing, 1835)	<i>Helicops infrataeniatus</i> (Jan, 1865)	Brazil	Silva et al. (2015)
	<i>Micrurus surinamensis</i> (Cuvier, 1816)	Brazil	Ávila et al. (2013)
	<i>Crotalus durissus</i> Linnaeus, 1758	United States	Leidy (1884)
	<i>Eunectes murinus</i> (Linnaeus, 1758)	United States	Lagunas-Calvo et al. (2020)
<i>Sebekia</i> sp.	<i>Helicops angulatus</i> (Linnaeus, 1758)	Brazil	<b>Present study</b>
	<i>Helicops leopardinus</i> (Schlegel, 1837)	Brazil	Rego and Vicente (1988)
	<i>Micrurus alleni</i> Schmidt, 1936	Costa Rica	Goldberg and Bursley (2004)

records of infection by *Sebekia* for other snakes such as *Micrurus alleni* Schmidt, 1936 (Goldberg and Bursley, 2004), *M. surinamensis* (Cuvier, 1816) (Ávila et al., 2013), *Crotalus durissus* Linnaeus, 1758 (Leidy, 1884), and *Eunectes murinus* (Linnaeus, 1758) (Lagunas-Calvo et al., 2020). According to the records in the literature, only two species of *Sebekia* (*S. mississippiensis* and *S. oxycephala*) parasitizing snakes are known (Table 1) (Lagunas-Calvo et al., 2020).

This is the first record of nymphs of *S. oxycephala* parasitizing *H. angulatus*. Little is known regarding the association of *Sebekia* spp. with snakes, as most published studies primarily focus on their association with definitive hosts. Consequently, there is a dearth of information regarding their ecology, life cycle, and the impact they have on their intermediate hosts. Hence, there is a crucial need research to enhance our understanding of these parasites and the potential consequences they inflict upon their intermediate hosts.

### Acknowledgements

We thank Herivelto Oliveira for the photo of *H. angulatus*. MCO thanks the Fundação de Apoio à Pesquisa do Estado da Paraíba for fellowship. RLM thanks Paraíba State Research Foundation (FAPESQ) grant 006/2020 - PDCTR-PB 2020 and CNPQ 301852/2023-5; to o Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for research grant to W. O. Almeida.

### References

ALMEIDA, W.O., SANTANA, G.G., VIEIRA, W.L.S., WANDERLEY, I.C. and RIBEIRO, S.C., 2009. Rates of pulmonary infection

by pentastomids in lizards species from a restinga habitat in northeastern Brazil. *Brazilian Journal of Biology = Revista Brasileira de Biologia*, vol. 69, no. 1, pp. 197-200. <http://dx.doi.org/10.1590/S1519-69842009000100026>. PMID:19347165.

ALMEIDA, W.O., SILVA-SOUZA, A.T. and SALES, D.L., 2010. Parasitism of *Phalloceros harpagos* (Cyprinodontiformes: Poeciliidae) by *Sebekia oxycephala* (Pentastomida: Sebekidae) in the headwaters of the Cambé River, Paraná State, Brazil. *Brazilian Journal of Biology = Revista Brasileira de Biologia*, vol. 70, no. 2, pp. 457-458. <http://dx.doi.org/10.1590/S1519-69842010005000004>. PMID:20552150.

ÁVILA, R.W., MORAIS, D.H., ANJOS, L.A., ALMEIDA, W.O. and SILVA, R.J., 2013. Endoparasites infecting the semiaquatic coral snake *Micrurus surinamensis* (Squamata: Elapidae) in the southern Amazonian region, Mato Grosso state, Brazil. *Brazilian Journal of Biology = Revista Brasileira de Biologia*, vol. 73, no. 3, pp. 645-647. <http://dx.doi.org/10.1590/S1519-69842013000300024>. PMID:24212707.

BOYCE, W.M., KAZACOS, E.A., KAZACOS, K.R. and ENGELHARDT, J.A., 1987. Pathology of pentastomid infections (*Sebekia mississippiensis*) in fish. *Journal of Wildlife Diseases*, vol. 23, no. 4, pp. 689-692. <http://dx.doi.org/10.7589/0090-3558-23.4.689>. PMID:3682099.

CARDOSO, A.M.C., SOUZA, A.J.S., MENEZES, R.C., PEREIRA, W.L.A. and TORTELLY, R., 2014. Lesões pulmonares associadas ao parasitismo por *Sebekia oxycephala* (Pentastomida) em jacarés-açu (*Melanosuchus niger* Spix, 1825) oriundos de vida livre na Amazônia brasileira. *Pesquisa Veterinária Brasileira*, vol. 34, no. 10, pp. 1002-1006. <http://dx.doi.org/10.1590/S0100-736X2014001000013>.

CASTRO, K.A., SILVA, C.S., MACHADO, H.T.S., OLIVEIRA, C.R. and ÁVILA, R.W., 2020. Endoparasitos de *Philodryas olfersii* (Lichtenstein, 1823) en ambientes de Restinga Del Delta del Río Parnaíba, Nordeste de Brasil. *Neotropical Helminthology*, vol. 14, no. 2, pp. 129-141. <http://dx.doi.org/10.24039/rnh2020142720>.

- CHRISTOFFERSEN, M. L. and ASSIS, J. E., 2015b. Class Pentastomida. *Revista IDE@-SEA*, v. 98B, pp. 1-10.
- CHRISTOFFERSEN, M.L. and ASSIS, J.E., 2015a. Class Eupentastomida Waloszek, Repetski & Maas, 2006. *The Crustacea*, vol. 5, pp. 5-75. [http://dx.doi.org/10.1163/9789004232518\\_004](http://dx.doi.org/10.1163/9789004232518_004).
- CHRISTOFFERSEN, M.L. and ASSIS, J.E., 2013. A systematic monograph of the Recent Pentastomida, with a compilation of their hosts. *Zoologische Mededelingen*, vol. 87, pp. 1-206.
- FERREIRA-SILVA, C., ALCANTARA, E.P., ÁVILA, W. and SILVA, R.J., 2022. First record of *Cosmocerca podicipinus* (Nematoda: Cosmocercidae) parasitizing *Leptodeira annulata* (Serpentes: Dipsadidae) in northeastern Brazil. *Brazilian Journal of Biology = Revista Brasileira de Biologia*, vol. 82, pp. e265583. <http://dx.doi.org/10.1590/1519-6984.265583>.
- GOLDBERG, S.R. and BURSEY, C.R., 2004. Coelomic metazoan endoparasites of 15 colubrid and two elapid snake species from Costa Rica. *Caribbean Journal of Science*, vol. 40, pp. 62-69.
- JUNKER, K., BOOMKER, J. and BOOYSE, D.G., 1998. Experimental studies on the life-cycle of *Sebekia wedli* (Pentastomida: sebekidae). *The Onderstepoort Journal of Veterinary Research*, vol. 65, no. 4, pp. 233-237. PMID:10192834.
- LAGUNAS-CALVO, O., GARCÍA-PRIETO, L., OSORIO-SARABIA, D., LEÓN-REGAGNON, V. and OCEGUERA-FIGUEROA, A., 2020. New records of Ichthyostraca *Zrzavý, Hypša & Vlášková*, 1997 (Pancrustacea) from Mexico with an annotated checklist of North America. *Zootaxa*, vol. 4755, no. 1, pp. 1-55. <http://dx.doi.org/10.11646/zootaxa.4755.1.1>. PMID:32230192.
- LEIDY, J., 1884. *Pentastomum proboscideum*. *Proceedings. Academy of Natural Sciences of Philadelphia*, vol. 36, pp. 140.
- LIMA, A.E.S., DUARTE, R.G., LACERDA, G.M.C., ALMEIDA, W.O. and RIBEIRO, S.C., 2022. First report of *Raillietiella mottae* (Pentastomida: Raillietiellidae) infecting *Rhinella diptycha* (Anura, Bufonidae) in the Brazilian Northeast. *Brazilian Journal of Biology = Revista Brasileira de Biologia*, vol. 84, pp. e247768. <http://dx.doi.org/10.1590/1519-6984.247768>. PMID:35019089.
- OLIVEIRA, M.C., DUARTE, R.G., ARAUJO FILHO, J.A., TELES, D.A. and ALMEIDA, W.O., 2021. *Erythrolamprus poecilogyrus* (Green Ground Snake). Endoparasites. *Herpetological Review*, vol. 52, pp. 665-666.
- OVERSTREET, R.M., SELF, J.T. and VLIET, K.A., 1985. The Pentastomid *Sebekia mississippiensis* sp. n. in the American Alligator and other hosts. *Proceedings of the Helminthological Society of Washington*, vol. 52, pp. 266-277.
- PARÉ, J.A., 2008. An overview of pentastomiasis in reptiles and other vertebrates. *Journal of Exotic Pet Medicine*, vol. 17, no. 4, pp. 285-294. <http://dx.doi.org/10.1053/j.jepm.2008.07.005>.
- PAVANELLI, G.C., TAKEMOTTO, R.M. and EIRAS, J.C., 2013. *Parasitologia, Peixes de água doce do Brasil*. Maringá: Eduem.
- QUIRINO, T.F., FERREIRA, A.J.M.G., SILVA, M.C., SILVA, R.J., MORAIS, D.H. and ÁVILA, R.W., 2018. New records of Helminths in Reptiles from five states of Brazil. *Brazilian Journal of Biology = Revista Brasileira de Biologia*, vol. 78, no. 4, pp. 750-754. <http://dx.doi.org/10.1590/1519-6984.175745>. PMID:29489929.
- REGO, A.A. and VICENTE, J.J., 1988. Excursão científica à Zona do Pantanal, Estado de Mato Grosso, para coletas de helmintos. *Ciencia e Cultura*, vol. 40, pp. 65-68.
- RILEY, J., 1986. The biology of pentastomids. *Advances in Parasitology*, vol. 25, pp. 45-128. [http://dx.doi.org/10.1016/S0065-308X\(08\)60342-5](http://dx.doi.org/10.1016/S0065-308X(08)60342-5). PMID:3535437.
- RILEY, J., SPRATT, D.M. and WINCH, J.M., 1990. A revision of the genus *Sebekia* Sambon, 1922 (Pentastomida) from crocodylians with descriptions of five new species. *Systematic Parasitology*, vol. 16, no. 1, pp. 1-25. <http://dx.doi.org/10.1007/BF00009598>.
- SANTOS COSTA, M.C., ABE, P.S., ALBARELLI, L.P.P., PRUDENTE, A.L.C., PINHEIRO, L.C. and BITAR, Y.O.C., 2022. Dimorfismo sexual, reproducción y biología alimentaria de *Helicops angulatus* (linnaeus, 1758) (Colubridae: Hydropsini) en la Amazonia Oriental, Brasil. *Boletín de la Sociedad Zoológica del Uruguay*, vol. 31, pp. 1-12. <http://dx.doi.org/10.26462/31.1.1>.
- SILVA, L.A., MORAIS, D.H., AGUIAR, A., ALMEIDA, W.O. and SILVA, R.J., 2015. First record of *Sebekia oxycephala* (Pentastomida: Sebekidae) infecting *Helicops infrataeniatus* (Reptilia: Colubridae), São Paulo State, Brazil. *Brazilian Journal of Biology = Revista Brasileira de Biologia*, vol. 75, no. 2, pp. 497-498. <http://dx.doi.org/10.1590/1519-6984.22613>. PMID:26132038.
- STRUSSMANN, C., BRITO, E.S. and MARQUES, O.A.V., 2011. What do water snakes eat? First report of predation by a Neotropical Hydropsini snake on giant earthworm (Glossoscolecidae). *Salamandra (Frankfurt)*, vol. 49, pp. 48-50.
- TEIXEIRA, C.C., MONTAG, L.F.A. and SANTOS-COSTA, M.C., 2017. Diet composition and foraging habitat use by three species of water snakes, *Helicops* Wagler, 1830, (Serpentes: Dipsadidae) in Eastern Brazilian Amazonia. *Journal of Herpetology*, vol. 51, no. 2, pp. 215-222. <http://dx.doi.org/10.1670/15-161>.
- UETZ, P., FREED, P., AGUILAR, R., REYES, F. and HOŠEK, J., 2023 [viewed 13 March, 2023]. *The Reptile Database* [online]. Available from: <http://www.reptiledatabase.org>.