

ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

OCCURRENCE OF *CONTRACAECCUM PELAGICUM* (JOHNSTON & MAWSON 1942) (NEMATODA: ANISAKIDAE) IN MAGELLANIC PENGUIN (*SPHENISCUS MAGELLANICUS* (FORSTER, 1837)) COLLECTED FROM NORTHEAST BRAZIL, WITH AN UPDATE ON ITS DISTRIBUTION IN THE COUNTRY

PRESENCIA DE *CONTRACAECCUM PELAGICUM* (JOHNSTON & MAWSON 1942) (NEMATODA: ANISAKIDAE) EN EL PINGÜINO MAGALLÁNICO (*SPHENISCUS MAGELLANICUS* (FORSTER, 1837)) RECOLECTADO DEL NORESTE DE BRASIL, CON ACTUALIZACIÓN DE SU DISTRIBUCIÓN EN EL PAÍS

OCORRÊNCIA DE *CONTRACAECCUM PELAGICUM* (JOHNSTON & MAWSON 1942) (NEMATODA: ANISAKIDAE) EM PINGUIM-DE-MAGALHÃES (*SPHENISCUS MAGELLANICUS* (FORSTER, 1837)) COLETADO DO NORDESTE DO BRASIL, COM ATUALIZAÇÃO DE SUA DISTRIBUIÇÃO NO PAÍS

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ABSTRACT

The study identified *Contracaecum pelagicum* (Johnston & Mawson 1942) as a parasite found in *Spheniscus magellanicus* (Forster, 1837), and a low sampling of infected hosts was observed, with a prevalence of 33.3%, average intensity of 6/host, and mean abundance of 2 ± 3.46 . This occurrence is uncommon in the Northeast region of Brazil, where previous records indicate a higher presence in the southern region of the country. This contributes to the understanding of the geographic distribution of the parasite. Anisakids, such as *C. pelagicum*, have a complex life cycle involving aquatic invertebrates, fishes, and seabirds. The presence of this parasite may indicate ecological interactions in the marine ecosystem of the region. It is important to report the discovery to relevant authorities and institutions to monitor and control the presence of the parasite. These findings are relevant to the health and conservation of seabirds and the study of marine ecosystems in Northeast Brazil.

Keywords: Anisakids – Aquatic vertebrates – Geographic distribution – Northeast Brazil – Waterbird

RESUMEN

El estudio identificó a *Contracaecum pelagicum* (Johnston & Mawson 1942) como un parásito encontrado en *Spheniscus magellanicus* (Forster, 1837), y se observó una baja muestra de hospedadores infectados, con una prevalencia del 33,3%, intensidad media de 6/hospedador y abundancia media de $2 \pm 3,46$. Esta ocurrencia es poco común en la región noreste de Brasil, donde los registros anteriores indican una mayor presencia en la región sur del país. Esto contribuye a la comprensión de la distribución geográfica del parásito. Los anisákidos, como *C. pelagicum*, tienen un ciclo de vida complejo que involucra invertebrados acuáticos, peces y aves marinas. La presencia de este parásito puede indicar interacciones ecológicas en el ecosistema marino de la región. Es importante informar el descubrimiento a las autoridades e instituciones pertinentes para monitorear y controlar la presencia del parásito. Estos hallazgos son relevantes para la salud y conservación de las aves marinas y el estudio de los ecosistemas marinos en el noreste de Brasil.

Palabras clave: Anisákidos – Vertebrados acuáticos – Distribución geográfica – Nordeste de Brasil – Aves acuáticas

RESUMO

O estudo identificou *Contracaecum pelagicum* (Johnston & Mawson 1942) como um parasita encontrado em *Spheniscus magellanicus* (Forster, 1837), e foi observada uma baixa amostragem de hospedeiros infectados, com prevalência de 33,3%, intensidade média de 6/hospedeiro e abundância média de $2 \pm 3,46$. Essa ocorrência é incomum na região Nordeste do Brasil, onde registros anteriores indicam uma presença maior na região sul do país. Isso contribui para a compreensão da distribuição geográfica do parasita. Anisakídeos, como o *C. pelagicum*, possuem um ciclo de vida complexo envolvendo invertebrados aquáticos, peixes e aves marinhas. A presença desse parasita pode indicar interações ecológicas no ecossistema marinho da região. É importante relatar a descoberta às autoridades e instituições relevantes para monitorar e controlar a presença do parasita. Essas descobertas são relevantes para a saúde e conservação das aves marinhas e o estudo dos ecossistemas marinhos no Nordeste do Brasil.

Palavras-chave: Anisakuídeos – Vertebrados aquáticos – Distribuição geográfica – Nordeste do Brasil – Aves aquáticas

INTRODUCTION

Penguins are marine birds exclusive to the oceans that have adapted their wings into flippers to suit their aquatic lifestyle. All species are restricted to the southern hemisphere. These birds are highly adapted to the marine environment, undertaking long-distance migrations in

search of food and breeding sites. In Brazil, the most frequently sighted species on the coast is the Magellanic penguin - *Spheniscus magellanicus* (Forster, 1837), and migrates from its breeding colonies in the Patagonia region, by ocean currents, in search of abundant food on the Brazilian continental shelf (ICMBio, 2010).

Magellanic penguins are marine birds that inhabit the coasts of Chile, Argentina, and the Falkland Islands in South America. They are excellent swimmers and during the southern hemisphere winter, they move along marine currents in search of prey such as fishes, cephalopods, and crustaceans, albeit in smaller quantities. (Pinto *et al.*, 2007; Ederli *et al.*, 2009; Prado *et al.*, 2011; Borges *et al.*, 2014; Campos *et al.*, 2015; Tamiasso *et al.*, 2018).

In Brazil, the occurrence of Magellanic penguins shows annual seasonality, with individuals staying in colonies in southern South America from mid-September to mid-April. Adult penguins then begin their migration northward, utilizing the continental shelf (Putz *et al.*, 2007). Juveniles have a later migration, appearing in June and remaining in Brazilian waters until November (Petry & Fonseca 2002, Mäder *et al.*, 2010), and they can wander at sea for up to four years.

Contracaecum pelagicum (Johnston & Mawson, 1942) is an anisakid nematode that uses crustaceans and fishes as intermediate hosts, and is found in its adult form parasitizing the digestive tract of a variety of vertebrate animals, including mammals and seabirds, with penguins being among their definitive hosts (Saad *et al.*, 2012; Santos *et al.*, 2013).

In the case of Magellanic penguins, it is known that this parasite can be detrimental to their health, causing inflammation, ulceration, and gastrointestinal lesions, weakening their immune system and leaving the animal vulnerable to predation and other diseases, which directly impacts their survival (Yáñez *et al.*, 2012; Campos *et al.*, 2013; Tamiasso *et al.*, 2018).

The occurrence of *C. pelagicum* has been reported in studies throughout the country; however, there is no available data on the occurrence of *C. pelagicum* in *S. magellanicus* in northeastern Brazil. Therefore, the present study aimed to report the first record for the region, contributing to an update on the localities where the occurrence of this parasite is known in the country for this penguin species.

MATERIAL AND METHODS

From July to August 2015, three juvenile specimens of Magellanic penguin (*S. magellanicus*) were found stranded and dead in the coastal regions of the states of Bahia (two specimens collected: -11.46359, -37.35242; -11.58831, -37.43504) and Sergipe (one specimen collected: -11.12005, -37.13713), specifically in Mangue Seco and Aracaju, respectively. The specimens had an average length of approximately 45 cm and weighed 4.0 kg.

All animals underwent necropsy, during which gastrointestinal content was collected by technicians from the Fundação Mamíferos Aquáticos (FMA). During the analysis of the biological material, six nematodes were visualized and collected from a single specimen of *S. magellanicus*. The parasites were then placed in Eppendorf tubes with 70° ethyl alcohol and sent for identification to the Laboratory of Animal Parasitic Diseases at the Universidade Federal de Sergipe, Sertão campus.

For morphological identification, the nematodes were clarified in Lactophenol to facilitate the visualization of their structures, and subsequently illustrated. The analyzed material is duly stored in the bank of biological samples curated by the Aquatic Mammals Foundation.

Taxonomic classification was arranged, and illustrations were made using a light microscope to aid in morphological characterization. The illustrations were prepared and converted into vector images using GIMP 2.10.34 software. The nematodes were morphologically identified according to Ederli *et al.* (2009), and, Borges *et al.* (2014).

All the research was carried out within ethical aspects, being carried out in partnership with the Aquatic Mammals Foundation (FMA). The material of animal origin referring to the carcasses of the penguins was previously collected by the FMA, which has legal permission to work in the collection and rescue of stranded animals.

RESULTS AND DISCUSSION

The parasite was identified as *Contracaecum pelagicum* (Fig. 1) and showed a prevalence of 33.3%, mean intensity of 6/host, and mean abundance of 2 ± 3.46 .

The nematodes were identified based on morphological observations of adult forms under light microscopy, which is detailed below:

Superfamily Ascaridoidea Baird, 1853

Family Anisakidae Railliet & Henry, 1912

Subfamily Anisakinae Chabaud, 1965

Genus *Contracaecum* Railliet & Henry, 1912

Species *Contracaecum pelagicum* Johnston & Mawson, 1942

Description of the Male: Nematodes clearly visible, easily distinguishable from the gastrointestinal content, ranging

from 1-2cm in length, reddish in color. Body transversely striated, especially at the anterior and posterior ends. The anterior region has a cephalic collar with anteriorly directed cuticular edges, with three well-developed lips, one dorsal lip, and two ventrolateral lips with three bifurcated triangular interlabia present (Fig. 1B). Deirids not prominent. Inverted intestinal cecum, presence of ventricular appendix, and posterior region ventrally

curved (Fig. 1A) with a conical caudal extremity (Fig. 1C) containing 25-31 pairs of pre-cloacal papillae, the first 18 proximal pairs being well visible. Three pairs of pre-cloacal papillae. Seven pairs of post-cloacal papillae: 2 large subventral para-cloacal pairs located side by side, 2 subventral pairs, 2 sublateral pairs, and 1 pair of phasmids near the distal sublateral pair of papillae. Distal end of the spicule tapered and pointed (Fig. 1D, arrow).

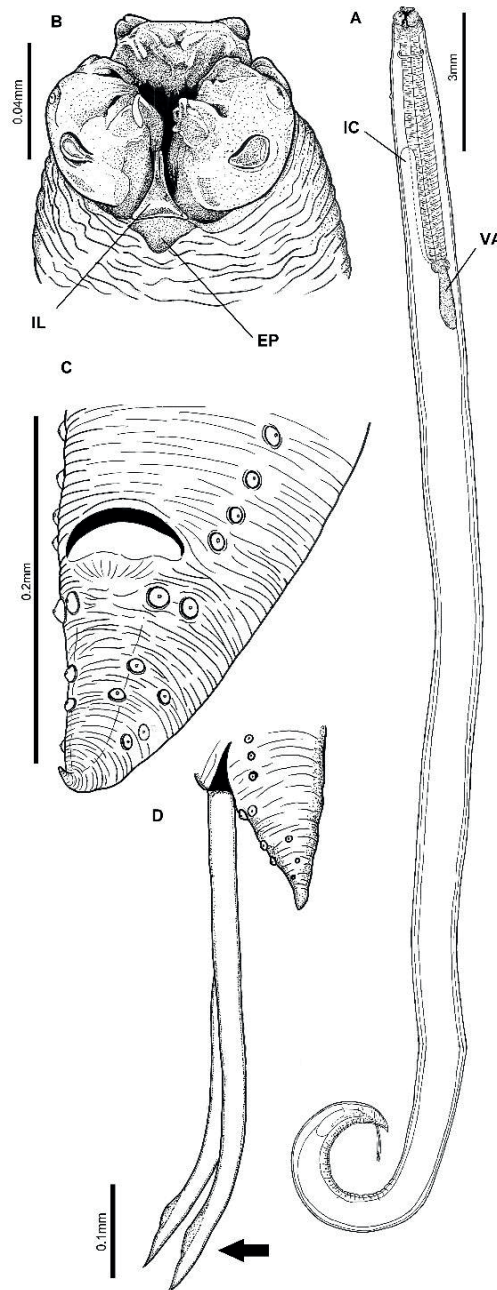


Figure 1. *Contracaecum pelagicum* collected from *Sphenicus magellanicus* in the northeastern coast of Brazil; A - morphotype of the collected adult male, highlighting the intestinal cecum (ic) and the ventricular appendix (va); B - detail of the anterior region with emphasis on the well-developed lips, highlighting one of the interlabia (il) and the excretory pore (ep); C - Detail of the posterior region highlighting the tail and caudal papillae; D - Detail of the adult male spicules.

The occurrence of *C. pelagicum* in *S. magellanicus* is a common phenomenon in Brazil, with several records over the years (Table 1).

Table 1. Records of *Contracaecum pelagicum* in *Spheniscus magellanicus* in Brazilian jurisdiction waters.

Location in Brazil	Reference
Baia de Guanabara, RJ	Santos (1984)
litoral de vitória, ES	Ederli <i>et al.</i> (2009)
Pedrinhas, Ilha Comprida, Costa Sul do estado de São Paulo, SP	Padro <i>et al.</i> (2011)
Litoral norte de São Paulo, SP	Rezende <i>et al.</i> (2013)
Costa do Rio de Janeiro, RJ	Campos <i>et al.</i> (2013)
Rio de Janeiro, RJ	Borges <i>et al.</i> (2014)
Baixada litorânea do estado do Rio de Janeiro, RJ	Campos <i>et al.</i> (2015)
Pontal do Paraná e Matinhos, costa do estado do Paraná, PR	Altrão <i>et al.</i> (2017)
Pontal do Sul, Paraná, PR	Vahoni <i>et al.</i> (2018)
Costa do Espírito Santo, ES	Tamiasso <i>et al.</i> (2018)
Litoral do Estado do Rio de Janeiro, RJ	Mutzenbecher <i>et al.</i> (2022)

In the present study, the sampling was low, with only one host infected by the nematode. However, despite previous records, the data indicate that there are no documented occurrences of *C. pelagicum* in *S. magellanicus* in the northeastern region of Brazil. So far, findings of this parasite along the Brazilian coast have been more frequent in the southern region of the country. Therefore, this study represents the first record of the presence of this parasitic nematode in the northeastern coastal region, contributing to updating the distribution of *C. pelagicum* in this host species along the Brazilian coast.

Anisakids are zoonotic, and in the environment, the life cycle of these nematodes involves the participation of aquatic invertebrates and fishes as intermediate hosts in the food chain. Additionally, fishes play an additional role as paratenic hosts, contributing to the dissemination and amplification of infection until the parasite reaches a definitive host, such as piscivorous birds and mammals, in which they reach the adult form (Bicudo *et al.*, 2005; Saad *et al.*, 2012). Recent studies on the northeastern coast of Brazil show a high presence of anisakid nematodes, including larvae of the *Contracaecum* genus, although they have shown lower prevalence compared to other taxa of Anisakiidae (see Alves *et al.*, 2020; dos Santos Ferreira *et al.*, 2020).

Contracaecum pelagicum is a nematode found parasitizing various species of seabirds and appears to have a wide geographic distribution, as it has already been described in Australia occurring in the Black-browed albatross

(*Diomedea melanophrys* Temmick, 1828) and other birds such as the brown booby (*Sula leucogaster* Boddaert, 1783) (Silva *et al.*, 2005). In Brazil, according to the data presented in Table 1, the occurrence of this nematode has been frequent in populations of *S. magellanicus*. This diversity of birds as final hosts may indicate that this nematode has low specificity, requiring its definitive host to be only a piscivorous bird.

The occurrence of this species in northeastern Brazil can be considered an interesting finding for several reasons:

1- Geographic distribution: The identification of *C. pelagicum* in northeastern Brazil may indicate an expansion of the geographic distribution of this species. It is possible that favorable environmental conditions have allowed the parasite to establish itself in a new area.

2- Fauna monitoring: The discovery of *C. pelagicum* may be relevant for monitoring the health and well-being of seabirds in northeastern Brazil. These parasites can cause health problems in birds, such as intestinal inflammation and obstruction, affecting their reproduction and survival.

3- Marine ecosystem: The presence of *C. pelagicum* may indicate complex ecological interactions in the marine ecosystem of the region. The parasite typically infects fish and crustaceans, which serve as intermediate hosts, before being consumed by seabirds. This can provide insights into food chains and relationships between different species in the area.

It is important to report this occurrence to relevant authorities and research institutions, such as animal health agencies and marine fauna research institutes. These experts will be able to further investigate the significance of this discovery and take appropriate measures, if necessary, to monitor and control the presence of the parasite.

The presence of *C. pelagicum* in northeastern Brazil can indicate different scenarios. It is possible that this parasite has been recently introduced to the region, possibly by migratory birds that feed along the northeastern coast. Another possibility is that the parasite was already present but went unnoticed until now, with this being the first time it has been detected and reported. The detection of *C. pelagicum* is important for understanding the health of seabirds and the overall health of the marine ecosystem. Additionally, it is relevant to monitor the presence of this parasite, as it may have impacts on the conservation and management of seabirds, especially those that are considered endangered.

In conclusion, the analysis of available data and records indicates that the occurrence of *C. pelagicum* in *S. magellanicus*, the Magellanic penguin, in the northeastern region of Brazil is an unprecedented event. Although this parasite has been previously reported along the Brazilian coast, findings have been more common in the southern region of the country. Therefore, this new occurrence represents the first record of the presence of *C. pelagicum* in the northeastern region, significantly contributing to the understanding and updating of the geographic distribution of this parasite in this host species along the Brazilian coast. These findings are of great importance for monitoring the health and conservation of seabirds, as well as for the study of marine ecosystems in the northeastern region of Brazil.

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