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Neoctangium travassosi (Digenea: Microscaphidiidae) in sea turtles from South America

[Neoctangium travassosi *(Digenea: Microscaphidiidae) em tartarugas marinhas da América do Sul*]

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ABSTRACT

Sea turtles are endangered animals that present cosmopolitan distribution. Anthropic actions have been considered important causes for the reduction of sea turtle population, but natural aspects such as parasitism may also contribute to their decline. This study aimed to report the occurrence of parasites in stranded dead sea turtles found in an area known as Potiguar Basin, northeastern Brazil, from 2010 to 2019. They were identified and classified according to the carapace length. At post-mortem analyses all organs were examined, parasites collected and morphologically identified. Ecological parasitic indexes as prevalence (P), mean intensity (MI) and mean abundance (MA) were calculated. A total of 80 *Chelonia mydas* and 5 *Eretmochelys imbricata* were assessed. *Neoctangium travassosi* was detected in both species presenting P = 20%, MI = 4.19 and MA = 0.84 for *C. mydas* and P = 60%, MI = 1.67 and MA = 1.0 for *E. imbricata*. This is the first report of *N. travassosi* parasitizing *E. imbricata* in South America. Finally, the retrieval of these parasites is a warning regarding the need for further studies to assess the impact of this parasitism on the health and conservation of sea turtles.

Keywords: helminthes, marine turtles, parasitic indexes, South America

RESUMO

As tartarugas marinhas são animais ameaçados de extinção que apresentam distribuição cosmopolita. Ações antrópicas têm sido consideradas causas importantes para a redução da população de tartarugas marinhas, mas aspectos naturais, como o parasitismo, também, podem contribuir para o seu declínio. Este estudo objetivou relatar a ocorrência de parasitos em tartarugas marinhas, encalhadas mortas, encontradas em uma área conhecida como Bacia Potiguar, nordeste do Brasil, de 2010 a 2019. Essas foram identificadas e classificadas de acordo com o comprimento da carapaça. Nas análises post mortem*, todos os órgãos foram examinados, e os parasitos coletados e identificados morfologicamente. Foram calculados índices parasitários ecológicos, como prevalência (P), intensidade média (IM) e abundância média (AM). Um total de 80* Chelonia mydas *e cinco* Eretmochelys imbricata *foi estudado.* Neoctangium travassosi *foi detectado em ambas as espécies, apresentando P = 20%, MI = 4,19 e MA = 0,84 para* C. mydas *e P = 60%, IM = 1,67 e AM = 1,0 para* E. imbricata. *Este é o primeiro relato de* N. travassossi *parasitando* E. imbricata *na América do Sul. Conclui-se que a recuperação desses parasitos*

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soa como um alerta para a necessidade de mais estudos para avaliar o impacto desse parasitismo na saúde e na conservação das tartarugas marinhas.

Palavras-chave: Helmintos, Tartarugas marinhas, Índices parasitológicos, América do Sul

INTRODUCTION

Sea turtles have been considered one of the most endangered species of animals in the world (Valdivia *et al*., 2019). Of cosmopolitan distribution, these reptiles are belonging to the order Testudines and represented by only seven species, in which five inhabit the Brazilian coast (i.e., *Caretta caretta*, *Chelonia mydas*, *Eretmochelys imbricata*, *Lepidochlelys olivacea* and *Dermochelys coriacea*) (Mazaris *et al*., 2017). The current perspective of conservation of these animals is worrying since several factors affect their survival (Tagliolatto *et al*., 2020), including anthropic actions (Farias *et al*., 2019; Mashkour *et al*., 2020). The main impacts are related to negative interaction with fishing activity, solid waste ingestion, disorderly and growing occupation of the coastal strip and habitat degradation (Farias *et al*., 2019; Valdivia *et al*., 2019).

However, natural aspects such as predation, ecological changes and infectious diseases caused by viruses, bacteria and/or parasites may also contribute to decline of these populations (Mashkour *et al*., 2020). The parasite fauna of sea turtle is few studied, but includes helminths, protozoa, arthropods, and annelids. These parasites are well adapted to the marine environment and Chelonians are infected during long-distance migrations to reproduce or change seasonal habitats (Mashkour *et al*., 2020). Over the last years, parasitism by trematodes such as *Neoctangium travassosi* (Family Microscaphidiidae) has been reported in these animals (Werneck *et al*., 2015a; Meira Filho *et al*., 2017), being this species (*N. travassosi*) firstly identified in a turtle (unidentified species) on the south coast of the state of São Paulo, Brazil (Ruiz, 1943). The Family Microscaphidiidae with 22 described genera, represents a group of gastrointestinal trematodes that parasitize marine and freshwater turtles (Blair, 1987).

Studies through standings in the northern coast of Rio Grande do Norte and east of Ceará (Bacia Potiguar) point this region as being of great importance for sea turtles, with records of the five species that occur in Brazil (Farias *et al*., 2019). In fact, the real impact of this kind of parasitism on the health of sea turtles is difficult to assess. However, it is believed that these parasites present minor pathological relevance, especially because in some cases a high burden of parasites has been observed in healthy animals. The aim of this study was to report the occurrence of *N. travassosi* in sea turtles stranded in the Potiguar Basin, Northestern Brazil.

MATERIAL AND METHODS

Sea turtles stranded from 2010 to 2019, in an area known as Potiguar Basin, northeastern Brazil, were used in this study. The Beach Monitoring Program in the Potiguar Basin (Programa de Monitoramento de Praias da Bacia Potiguar – PMP-BP) has been conducted by Projeto Cetáceos da Costa Branca - Universidade do Estado do Rio Grande do Norte (PCCB-UERN), and it complies with the environmental constraint enforced by the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) over the activities operated by PETROBRAS (Petróleo Brasileiro S.A., agreement number 2500.005657510.2). In addition, all procedures herein performed were authorized by the IBAMA (n. 13694-12).

All animals were morphologically identified, and measurements of carapace obtained. Curved carapace length (nuchal to notch length between supracaudal scales) was recorded using a flexible tape (Bolten, 1999).

At post-mortem examination all organs were examined, and the characteristics of lesions were recorded in clinical charts. They were carefully inspected, and parasites were manually collected. Specimens were measured, slides were prepared by the regression stain method, and finally observed under an optical microscope (40x and 100x). Photomicrographs were acquired using a digital camera (CMOS-5.0) mounted directly on the microscope (New Optics NO 226). The software TCapture 4.3 was used for the image

acquisition and measurements of parasitic structures.

All specimens were morphologically identified using the taxonomic keys (Blair, 1987; Gibson *et al*., 2002). Then, ecological parasitic indexes such as prevalence (P), mean intensity (MI) and mean abundance (MA) were calculated (Bush *et al*., 1997).

RESULTS

During the whole study period (from 2010 to 2019), a total of 80 *Chelonia mydas* and five *Eretmochelys imbricata* were studied. The species *C. mydas* presented a curvilinear carapace length (CCL) ranging from 28 to 118 cm (64.9±32.5cm), and curvilinear carapace width (CCW) varying from 26.2 to 110 cm (60.4±31.1). Conversely, the *E. imbricata* presented a curvilinear carapace length (CCL) and curvilinear carapace width (CCW) ranging from 87 to 89 cm (88±1cm), and from 75 to 85.5 cm (78.5±6cm), respectively.

The parasites herein retrieved were identified as belonging to the Family Microscaphidiidae (subclass Digenea) and species *Neoctangium travassosi* (Fig. 1).

Morphologically, they featured a lanceolate tick body. Tail-dorsal transverse edge notched in the midline and with muscle thickening at each extremity, also present in each postero-lateral margin. Terminal oral opening, with rounded to rectangular mouth cup in ventral view. The esophagus measured up to 18% of the body's length and the presence of a muscle bulb was observed at the posterior end. The caeca (intestine) were broad, wrinkled or dilated with the presence of food material, ending near the end of the body. Testicles indented, inter-caecal in the middle third of the body. Seminal vesicle beginnings in front of anterior testicle. Fibrous sac surrounding the terminal genitalia slightly developed. A ventral genital pore immediately behind the suction cup was observed. Small, ventral, sub-median ovary to the right side slightly behind the posterior testicles. The uterus was located between the Mehlis gland and the testicles. Lateral vitelline fields with anterior limit close to the point of contact between the testicles, posterior limit slightly before the ends of the head. Compact median field behind Mehlis's gland. Eggs in the uterus capped. Subterminal excretory pores, ventral to caudal crest.

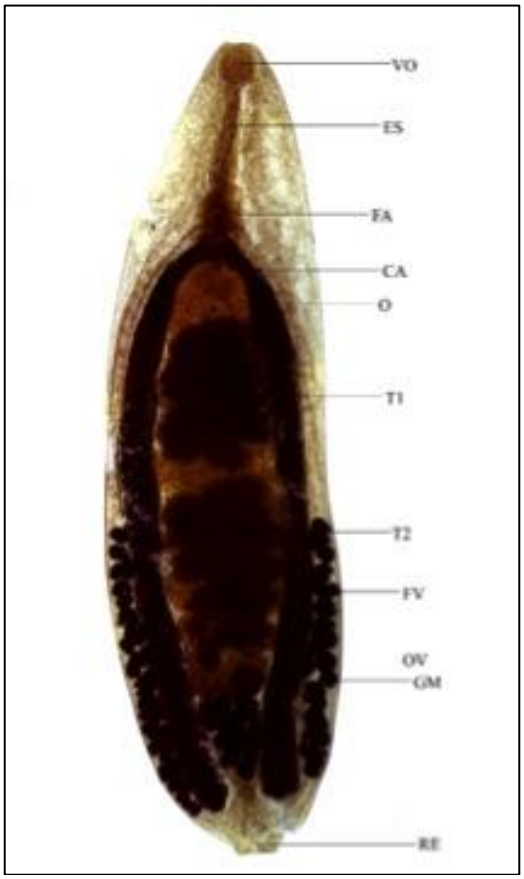

Figure 1. *Neoctangium travassosi* adult collected in the gastrointestinal tract of *Chelonia mydas*. OS, oral sucker; ES, esophagus; PH, pharynx; T1 and T2, testicles; YF, yolk follicles; CA, caeca; LE, ledge; E, eggs; OV, ovaries; GM, glandule of Mehlis

Curiously, *N. travassosi* retrieved in *C. mydas* presented distinct measures from those parasites detected in *E. imbricata* (Table 1).

The ecological parasitic indexes for *C. mydas* were P = 20%, MI = 4.19 and MA = 0.84, whereas for *E. imbricata* they were P = 60%, MI = 1.67 and MA = 1.0. It is important to highlight that only juvenile sea turtles were parasitized by *N. travassosi*.

Table 1. Comparison of measurements of specimens of *N. travassosi* retrieved in the present study and those reported in the scientific literature

Body characteristics	**Present study - Brazil**		**Blair (1987) - Panama**
	C. mydas	*E. imbricata*	*E. imbricata*
Body length	5.26-8.39	4.89-7.18	3.90-7.24
Body width	2.08-3.25	2.31-3.34	1.84-3.24
Cup suction length	0.39-0.48	0.35-0.48	0.36-0.49
Cup suction width	0.40-0.42	0.36-0.45	0.36-0.45
Esophagus length	0.81-1.17	0.73-1.08	0.70-1.10
Distance between caeca and anterior testicles	0.10-0.31	0.09-0.27	0.08-0.28
Anterior testicles length	0.55-1.59	0.52-1.12	0.45-1.13
Anterior testicles width	0.99-1.37	0.97-1.26	0.91-1.27
Posterior testicles length	0.78-1.87	0.78-1.32	0.73-1.31
Posterior testicles width	0.96-1.46	0.89-1.36	0.87-1.35
Ovaries length	0.26-0.37	0.23-0.29	0.20-0.30
Ovaries width	0.27-0.41	0.27-0.35	0.24-0.36

All measurements were expressed in millimeters (mm).

DISCUSSION

This study reported the occurrence of *N. travassosi* in sea turtles from South America and registered for the first time the presence of this parasite in *E. imbricata* in this region. The measurements of CCL and CCW for *C. mydas* and for *E. imbricata* were like those previously reported (Werneck *et al*., 2015a, 2015b). The detection of *N. travassosi* parasitizing these turtle species is very important, especially because it is believed that this genus has this single species that was firstly identified in Brazil in 1943 in a sea turtle (Blair, 1987). Interestingly, the morphometric features presented by the parasites infecting *C. mydas* were slightly distinct from those detected in *E. imbricata* (see Tab. 1). Most likely, this difference may be related to the stage of maturity presented by each parasite, or by a better adaptation of these trematodes to the species *C. mydas*, the sea turtle in which they were more developed. Nonetheless, it is important to note that the anatomical features of specimens herein reported corroborates with characteristics previously reported in a study in Panama (Blair, 1987).

The prevalence observed in this research (20% for *C. mydas* and 60% for *E. imbricata*) is similar to those detected in other studies (Binoti *et al*., 2016). However, the low values of MI and MA herein obtained indicate that most likely animals that occur in Northeastern coast of Brazil are less susceptible to the infection by this parasite species. Only juvenile turtles were parasitized. This pattern of infection has already been observed in the Brazilian coast. For instance, the helminths fauna of animals on the coast of the states of the Southeast Brazil were detected predominantly in young animals (Werneck *et al*., 2015a). Similarly, this same pattern has been observed in *E. imbricata* in the states of Ceará, Bahia, São Paulo, and Espírito Santo (Werneck *et al*., 2015a, 2015b).

It is believed that the feeding behavior dictates the nature of helminth communities, including *N. travassosi*, in sea turtle species (Werneck *et al*., 2015a). At the beginning of life, *C. mydas* are primarily omnivorous and, when adults tend towards an herbivorous diet. On the other hand, young *E. imbricata* feed predominantly on invertebrates (mollusks) and sea sponges (Werneck *et al*., 2015a). Considering mollusks have intermediate host of some digenetic parasites, these animals are highly exposed to the risk of infection in its natural habitats. In addition, these Chelonians frequented the same feeding grounds, where they possibly acquired the infective form of these trematodes (Binoti *et al*., 2016). It is worth mentioning that *C. mydas* is faithful to its foraging site close to the coast, that is, the species maintains a continuous and long-term residence in a certain location (Mashkour *et al*., 2020), which may contribute to the maintenance of the cycle of life of parasites carried by this species.

Ruiz first identified the trematode species *N. travassosi* in 1943. A few years later the genus

was renamed as *Octangium* based in some morphological features such as the presence of paired caudal papillae (Yamaguti, 1971). Subsequently, after a careful morphological examination (elongated and curved bladder, absence of rosette of diverticula and presence of ventral excretory pore) of some specimens two genera were validated (*Neoctangium* and *Octangium*) (Blair, 1987). Since there, other reports of *N. travassosi* parasitizing *C. mydas* were made in Brazil (Binoti *et al*., 2016), Caribe (Gupta and Mehrotra, 1981) and Trinidad (Gupta, 1961), as well as in *E. imbricata* on the coast of Porto Rico (Fischthal and Acholonu, 1976) and Panama (Blair, 1987).

The determination of pathogenic role of these parasites in the health of turtles is difficult to assess, especially considering that were wild stranded animals without any previous information. Undoubtedly, anthropic interactions have been considered important threats for sea turtles, being responsible for about 60% of *causa mortis*, whereas it is estimated that parasitic infections may be related in about 13% of deaths of these animals (Morais, 2018).

CONCLUSION

This study revealed the parasitism by *N. travassosi* in *C. mydas* and *E. imbricata* in the Brazilian coast. It is important to note that this is the first report of the infection by this parasite in *E. imbricata* in the South America, enlarging the occurrence area of this parasite as well as the plethora of hosts. Finally, the retrieval of these parasites represents a warning for the need of further studies to assess the role of this kind of parasitism on the health of animals, and the impact on the conservation of sea turtles.

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