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A REVIEW OF HELMINTHS OF THE GREEN TURTLE (*Chelonia mydas*) IN BRAZIL

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ABSTRACT
The study of helminths can supply information about the ecology of their hosts and support evaluations of population stocks, migration patterns and trophic ecology. However, little is known about the parasites of *Chelonia mydas*, a globally distributed endangered species, along the Brazilian coast. Here we present a review of the literature of helminth species found in green turtles along the Brazilian coast, considering their global distribution, their infection sites and their other host species. The findings show that in recent years there has been a large increase in the number of studies reporting the parasitic species of these turtles in Brazil, which consequently increased the parasite species list of the green turtle. The helminth fauna of green turtles from Brazil is composed of 31 species of digenetic trematodes of seven families, and four species of nematodes of two families. Two of these helminths species are endemic, while 33 are widely distributed. They are concentrated in particular regions, although the observed distribution is likely related to the main research centers and not the actual geographical distribution of the species. Endemism was observed only for the digenean *Ruicephalus minutus* and for the nematoda *Tonaudia freitasi*.
Keywords: endoparasites; geographic distribution; occurrence records.

INTRODUCTION

The green turtle, *Chelonia mydas* (Linnaeus 1758) occurs in tropical and subtropical seas, generally close to continental coastlines and islands (Márquez 1990), with reports from about 140 countries (Spotila 2004). Although widely distributed, it is considered an endangered species (IUCN 2016).

Considering that *C. mydas* is migratory, little is known about its movement pattern along the Brazilian coast and along the rest of the western South Atlantic Ocean. Studies of the ecology of the green turtle are necessary to formulate protective measures to preserve this species.

The study of parasites is considered an important tool to understand the ecology of host populations. Ecological analyses of the parasite-host relationship and reports of infection can help to evaluate population stocks (Mackenzie 1987, Moser 1991, Williams *et al.* 1992), migration patterns (Moser 1991, Williams *et al.* 1992) and trophic ecology (Williams *et al.* 1992) of the hosts.

The main studies of the parasite ecology of the sea turtle until 2016 refer to the helminth communities of the loggerhead turtle *Caretta caretta* (Aznar *et al.* 1998, Valente *et al.* 2009, Santoro *et al.* 2010). Santoro *et al.* (2006) were the first to study the helminth communities of *C. mydas* and Werneck & Silva (2015) first analyzed the helminth composition of juvenile green turtles found on the Brazilian coast between 2004 and 2011.

Historical overview and compilation of the data obtained for each parasite species recorded can be an important tool for future studies about population stocks, migratory routes and diet of turtle species occurring along the Brazilian coast. Here we present an overview of the studies of the parasitism of helminths of *C. mydas* in Brazil, considering their distributions.

MATERIAL AND METHODS

We examined books, scientific papers, theses, dissertations and monographs in the library collection

of Universidade Estadual de Londrina (UEL) or obtained by research of internet databases (Pubmed, Web of Science, Google Scholar and Scopus). We used the classifications proposed by Gibson *et al*. (2002) and Jones *et al*. (2005) for Digenea Carus 1863 and the one proposed by Vicente *et al*. (1993) for Nematoda. To check the validity of scientific names and their authors, we used the website WoRMS (www.marinespecies.org). Information about the world distribution of the species of parasites that infect *C. mydas* in Brazil were compiled. The relationship between the number of helminth species of *C. mydas* and the number of published records in the literature, from 1918 to 2016, is presented in a graph.

REPORTS OF THE HELMINTH FAUNA OF THE GREEN TURTLE

The first study published in Brazil about parasites of the green turtle, *Chelonia mydas*, was that of Travassos (1918), using samples from the Bacteriological Institute of São Paulo. In this study, the author presented a redescription of the nematode *Kathlania leptura* (Rudolphi 1819), which was found parasitizing *Testudo mydas* (= *C. mydas*). The site of infection was not reported by the author.

Travassos (1934) organized a synopsis about the helminths of the superfamiliy Paramphistomoidea Stiles & Goldberger, 1910 of the green turtle in the world, but there was no information about the parasites of Brazilian green turtles. This review mentioned 11 species of digenetic trematodes of *C. mydas* and their respective infection sites: *Schizamphistomoides spinulosum* (Looss 1901) in the large intestine; *Schizamphistoma scleroporum* (Creplin 1844) Looss 1912 and *Microscaphidium reticulare* (van Beneden 1859) Looss 1900 in the intestine; *Polyangium linguatula* (Looss 1899), *P. miyajimai* Kobayashi 1921 *Angiodictyum parallelum* (Looss 1901) Looss 1902, *Octangium sagitta* (Looss 1899), *O. hasta* Looss 1902, *O. takanoi* Kobayashi 1921 and *Deuterobaris proteus* (Brandes 1891) Looss 1900 in the digestive tract; and *M. aberrans* (Looss 1902), without infection site identified. The digenetic parasites were found in hosts of the Mediterranean Sea, except *S. scleroporum*, which was also recorded in the Atlantic Ocean, and *O. takanoi*, which was only obtained from specimens of the Pacific Ocean.

Freitas & Lent (1938) published the first study of parasites of *C. mydas* in Brazil, on the coast of Rio de Janeiro, deposited in the Helminthological Collection of the Oswaldo Cruz Institute (CHIOC). Many species of Pronocephalidae Looss 1902, all the species of Telorchiidae Looss 1898 and *Orchidasma amphiorchis* (Braun 1899) were found in the stomach and small intestine. The species of Paramphistomidae Fischoeder 1901 and *Polyangium linguatula* were found in the intestine. Furthermore, three specimens of digenetic trematodes were found in the small intestine, which made it possible to describe the family Metacetabulidae Freitas & Lent 1938, the genus *Metacetabulum* Freitas & Lent 1938 and the species *M. invaginatum* Freitas & Lent 1938.

Ruiz (1943) described the genus *Neoctangium* and the species *N. travassosi*, of Microscaphidiidae Looss 1900, and presented an identification key for the genera of this family. This study was carried out with trematode samples of the Butantan Institute, which were obtained from the intestine of a green turtle found in Praia Grande, Santos, São Paulo State, Brazil.

Freitas & Lent (1946) found nematode parasites of a green turtle specimen from Guanabara Bay purchased in a market in Rio de Janeiro. These nematodes were identified as *Porrocaecum sulcatum* (Rudolphi 1819) and were found attached to the wall of the stomach.

Ruiz (1946) reported a historical survey of the Brazilian species and the revision of the family Pronocephalidae. In conducting this review, he found that *Pleurogonius trigonocephalus*, described by Rudolphi (1809) as *Monostoma trigonocephalus* while examining samples from Europe, was the first species of Pronocephalidae reported in Brazil. Ruiz also noted that Diesing (1850) referred to *M. trigonocephalum* as *P. trigonocephalus*, parasites of *C. mydas* collected in Brazil and sent to Europe by Johann Natterer. According to Ruiz (1946), *M. trigonocephalum* was redescribed by Braun, in 1901, using samples from Brazil and deposited in the Vienna Museum. Looss (1902) presented a new description, classifying this species in the genus *Pleurogonius*. Ruiz (1946) concluded that the species described by

Rudolphi (1809) was *Pleurogonius trigonocephalus* (Rudolphi 1809) Looss, 1901, which he considered truly distinct from *Pronocephalus trigonocephalus* Looss, 1899, and also argued that *Pronocephalus trigonocephalus* was a synonym of *Pronocephalus obliquus* Looss 1901.

Ruiz (1946) also analyzed samples of the helminthological collections of Butantan Institute and Oswaldo Cruz Institute. The specimens evaluated from the former Institute were *Metacetabulum invaginatum, Pronocephalus trigonocephalus* (=*P. obliquus*), *Pleurogonius linearis* Looss 1901, and the new species *Pronocephalus minutus* Ruiz 1946 (Ruiz *op. cit*.), collected from a turtle found in Praia Grande, Santos, São Paulo State, Brazil. Those specimens donated by Oswaldo Cruz Institue were identified as *Pronocephalus trigonocephalus, Cricocephalus albus* (Kuhl & Hasselt 1822), *Pyelosomum crassum* (Looss 1901) Ruiz, 1946, *Pleurogonius longiusculus* Looss 1901 and *P. lobatus* (Looss 1901), parasites of green turtles of Rio de Janeiro (Ruiz 1946).

Travassos *et al*. (1969) published a detailed review of the trematode parasites of Brazilian vertebrates. In this work, they cited 13 digenetic species as parasites of *C. mydas*: *Cricocephalus albus, Glyphicephalus lobatus* Looss 1901, *Metacetabulum invaginatum, Orchidasma amphiorchis, Pleurogonius linearis, P. longiusculus* (Beneden 1859) Looss 1901, *P. trigonocephalus, Polyangium linguatula, Pronocephalus obliquus, Pyelosomum crassum, Rhytidodes gelatinosus* (Rudolphi 1819) Looss 1901, *Ruicephalus minutus* (Ruiz, 1946) Skrjabin 1955 (=*Pronocephalus minutus* Ruiz 1946) and *Neoctangium travassosi*.

In 1971, Yamaguti revised information about the various species that parasitize some groups of vertebrates, including the sea turtles. However, the author considered only seven species as parasites of the green turtle in Brazil: *Polyangium linguatula, Neoctangium travassosi, Pronocephalus obliquus, Cricocephalus albus, Pleurogonius longiusculus, Ruicephalus minutus* and *Metacetabulum invaginatum*.

Thatcher (1993) presented identification keys of families and genera of the known digenetic parasites of vertebrates of the Neotropics. Of the species listed by Travassos *et al*. (1969), nine were recognized by Thatcher (1993) as parasites of *C. mydas* in Brazil. The species *Pleurogonius longiusculus* was cited in the review of Travassos *et al*. (1969), but Thatcher (1993) reported those specimens as *Pyelosomum longiusculus* Looss, 1901. In addition, he did not cite the species *Glyphicephalus lobatus* and *Pleurogonius trigonocephalus*, which were reported by Travassos *et al*. (1969), but mentioned *Pyelosomum linearis* (=*Pleurogonius linearis*), a species not considered to occur in Brazil. Also, in 1993, Vicente *et al*. published a new report on nematodes of the green turtles of Brazil, adding *Tonaudia freitasi* Vicente & Santos 1968 and *Sulcascaris sulcata* (Rudolphi 1819) (= *Porrocaecum sulcatum*) to the parasite species list.

In 2006, Werneck *et al*. published the first record of *Learedius learedi* Price 1934, from the heart, liver, pancreas, lungs, kidneys, mesentery and body cavity of green turtles collected in Ubatuba, São Paulo State. Two years later, Werneck *et al*. (2008a) reported, for the first time in Brazil, the occurrence of *Monticellius indicum* Mehra 1939, which was found parasitizing the heart of two juvenile green turtles on the coast of São Paulo State.

A checklist of the parasites of threatened vertebrates in Brazil was published by Muniz-Pereira *et al*. (2009), using published and unpublished information obtained from the Helminthological Collection of the Oswaldo Cruz Institute. The authors listed the same nematodes reported on previous papers and added *Anisakis* sp. as a new parasite of *C. mydas*. The digenetic species *Ruicephalus minutus* and *Monticellius indicum*, already recognized in Brazil, were not cited. Also, *Pyelosomum longiusculus* and *Pleurogonius longiusculus* were cited as distinct species. However, according to Gibson (2001), they are synonyms, and *Pleurogonius longiusculus* is considered the valid name.

Werneck *et al*. (2011) reported, for the first time, the occurrence of an individual of the digenetic species *Amphiorchis solus* (Simha & Chattopadhyaya 1970) Platt 2002 in the heart of a green turtle found on the beach of Barra Nova, Ceará State, Brazil. The occurrence of another species of Spirorchiidae Stunkard 1921, *Amphiochis indicus* Mehrotra 1973 was reported, for the first time in Brazil, by Werneck

& Silva (2013). The specimens were found parasitizing the digestive tract and the liver of turtles from the southern coast of Rio de Janeiro State and the northern coast of São Paulo State. Werneck *et al*. (2013) reported the first occurrence of *Carettacola stunkardi* (Martin & Bamberger 1952) Dailey, Fast & Balazs 1992, parasitizing the heart of a green turtle found on the northern coast of Espírio Santo State.

Fernandes & Kohn (2014) published a catalographic list of the trematode parasites of amphibians and reptiles of South America. According to the authors, the 18 species of trematodes that parasitize *C. mydas* from the Brazilian coast are: *Amphiorchis indicus*, *A. solus*, *Carettacola stunkardi*, *Cricocephalus albus*, *Learedius learedi*, *Metacetabulum invaginatum*, *Monticellius indicum*, *Orchidasma amphiorchis*, *Pleurogonius linearis*, *P. lobatus*, *P. longiusculus*, *P. trigonocephalus*, *Polyangium linguatula*, *Pronocephalus obliquus*, *Pyelosomum crassum*, *P. longiusculus*, *Ruicephalus minutus*, and *Rhytidodes gelatinosus*. In this publication, *Pleurogonius longiusculus* and *Pyelosomum longiusculus* were still considered as distinct species.

Pathological changes caused by the digenetic species *Hapalotrema postorchis* Rao 1976 in a green turtle found dying on the beach of São Mateus, in Espirito Santo State, were studied by Werneck *et al*. (2015d). Six of these parasites were found within an aneurysm in the aorta, near the heart. Werneck & Silva (2015) conducted a parasitological examination of the digestive tract, urinary bladder, liver, heart, lungs, kidneys and body wash of 136 juvenile green turtles found dead between 2004 and 2011 in Rio de Janeiro and São Paulo States. The authors recorded the digenetic *Cymatocarpus solearis* Looss 1899 (Brachycoeliidae Looss 1899), *Schizamphistomum scleroporum* (Cladorchiidae Fischoeder 1901), *Cricocephalus albus*, *C. megastomus* Looss 1902, *Diaschistorchis pandus* (Braun 1901) Johstone 1913, *Metacetabulum invaginatum*, *Pleurogonius linearis*, *P. lobatus*, *P. longiusculus*, *P. trigonocephalus*, *Pronocephalus obliquus*, *Pyelosomum cochlear* Looss 1899, *P. crassum*, *Rameshwarotrema uterocrescens* Rao 1975, *Ruicephalus minutus* (Pronocephalidae), *Angiodictyum longum* Blair 1986, *A. parallelum*, *Deuterobaris proteus*, *Microscaphidium reticulare*, *Neoctangium travassosi*, *Polyangium linguatula* (Microscaphidiidae), *Rhytidodes gelatinosus* (Rhytidodidae Odhner 1926), *Learedius learedi*, *Neospirorchis* sp., *Amphiorchis indicus* and *Monticellius indicum* (Spirorchiidae), and an unidentified nematode larva. Brazil was considered a new geographical distribution site for *A. longum*, *A. parallelum*, *R. uterocrescens*, *P. cochlear*, *S. scleroporum*, *C. solearis* and *Neospirorchis* sp.

Werneck *et al*. (2015b) reported the occurrence of four specimens of *Rhytidodoides similis* Price, 1939, parasitizing the gallbladder of a green turtle, found on the coast of Espirito Santo State. No gallbladder injury could be directly associated with the infection by this adult parasite. However, granulomas were found in the liver, with eggs of trematodes similiar to spirorchiids. Finally, the most recent report was the occurrence of two specimens of *Neospirorchis schistosomatoides* Price, 1934 parasitizing the heart of a green turtle found on the coast of Espírito Santo State (Werneck *et al*. 2016).

Thus, it is evident that in the recent years, with the increase of the studies in different regions, larger sample sizes and more methodological details from samplings and screenings, there has been a large increase in the number of known species of parasites of *C. mydas* in Brazil, mainly in Digenea (Figure 1). The number of nematode species did not quite increase after 1995' studies (Figure 1). However, considering that there are still few published studies on this topic and the difficulty in obtaining helminth specimens from well preserved host samples, specially of Nematoda, it is possible that there are species of parasites yet to be recorded, mainly in organs other than those of the digestive tract.

Considering all this information, the helminth fauna of the green turtles that occur along the Brazilian coast is composed of 31 species of digenetic trematodes of seven families and four species of nematodes of two families. The parasites of *Chelonia mydas* from the Brazilian waters reported up to now have been found parasitizing several organs and tissues (Table 1). Some of these parasite species also infect other species of sea turtles, such as *Caretta caretta*, *Eretmochelys imbricata*, *Lepidochelys kempii*, and

Lepidochelys olivacea, the subespecies *Chelonia mydas agassizi* and also the terrapin *Podocnemis expansa* (Table 1). These parasites have also been found in sea turtles from all the oceans in both northern and southern hemispheres (Table 1). It is important to consider the endemism found for only one digenean species, *Ruicephalus minutus*, and one nematode species, *Tonaudia freitasi*, which according to our research, are the species that occurred only in green turtles from Brazil so far (Table 1).

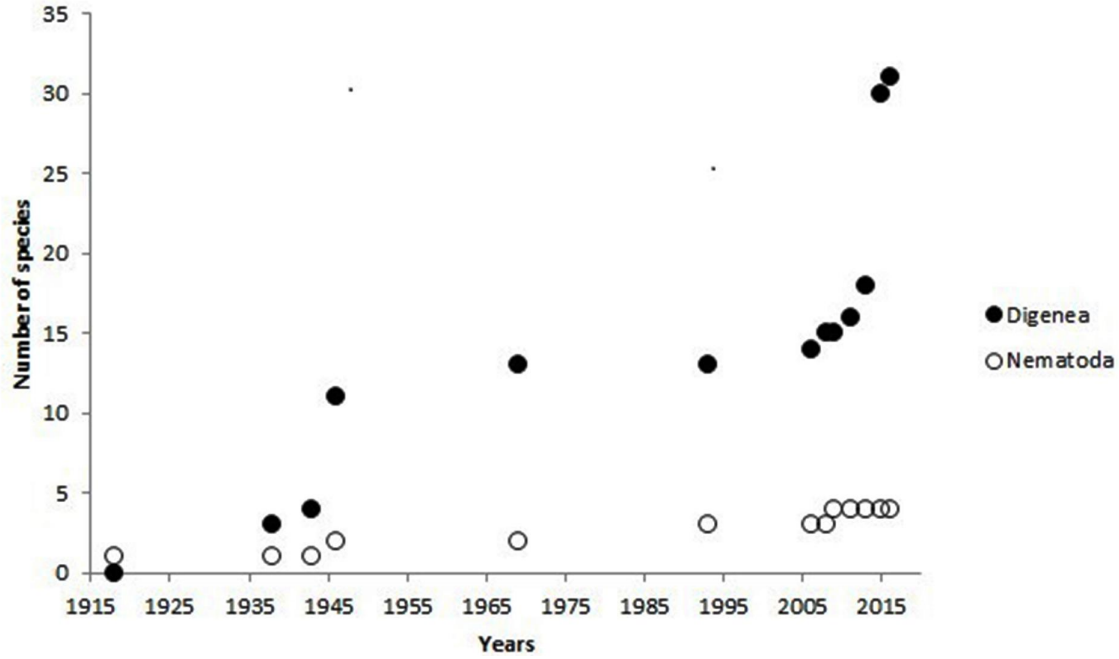

Figure 1. Relationship between the number of Digenea and Nematoda species parasitizing the digestive tract of *Chelonia mydas* along the Brazilian coast and the number of published records from 1918 to 2016.

Table 1. Infection site, geographical distribution and other hosts of the helminths of the green turtle, *Chelonia mydas*, found along the Brazilian coast.

Parasites taxa	Infection site	Geographical distribution	Hosts	References
Phylum Platyhelminthes				
Class Trematoda				
Subclass Digenea				
Order Plagiorchiida				
Family Brachycoeliidae				
Cymatocarpus solearis	In, Mi, Si, St, Ui	Au, Br, Fl, GP, Jp, MS, PM	Cc, Cm, Lk, Lo, Ei	23, 26, 28 9, 47, 57, 61
Family Cladorchiidae				
Schizamphistomum scleroporum	In, Li, Ps, St	AO, Au, Br, CR, Cu, Eu, Fl, MS, NA, PO, Tr	Cc, Cm, Ei	4, 23, 26, 37, 47, 61
Family Microscaphidiidae				
Angiodictyum longum	Li, Ps, Si	Au, Br, Ha, SL, Ma	Cm	5, 15, 47
Angiodictyum parallelum	Li, Mi	Br, Eg, Fl, PR	Cm	5, 16, 26, 47, 61
Deuterobaris proteus	Es, In, Li, Mi	Br, CS, Fl, MS, PR	Cm	16, 18, 26, 42, 47, 61
Microscaphidium reticulare	Es, In, Ps	Au, Br, CR, Cu, Eg, Fl, Gh, Jp, Ma, MS, NS, PR	Cm	5, 18, 23, 26, 36, 37, 42, 47, 61
Neoctangium travassosi	In, Mi, St	Br, CS, Fl, SP	Cm, Ei	6, 23, 25, 34, 47
Polyangium linguatula	In, Mi, Si, St	Au, Br, CR, Cu, Eg, Fl, Ha, Id, MS, PR, Sg	Cc, Cm	5, 15, 16, 18, 19, 21, 23, 26, 36, 37, 40, 41, 42, 47, 61

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Parasites taxa	Infection site	Geographical distribution	Hosts	References
Phylum Platyhelminthes				
Class Trematoda				
Subclass Digenea				
Order Plagiorchiida				
Family Pronocephalidae				
Cricocephalus albus	DT, Es, In, Li, Si, St, Ui,	Au, Br, CR, CS, Eg, Fl, Ic, Jp, MS, NA, Pn, RJ, Sg, US	Cm, Ei, Lk, Cc	10, 17, 19, 23, 25, 26, 30, 35, 37, 40, 41, 47, 57, 61
Cricocephalus megastomus	Es, St	Br, CR, Eg, Ic	Cm, Ei	26, 35, 37, 47, 61
Diaschistorchis pandus	Es, Si, St	Au, Be, Br, Cu, Fl, Jp, MG	Cc, Cm, Ei	23, 26, 35, 47, 57, 61
Metacetabulum invaginatum	In, Si, St, Ui	Br, Fl, SP	Cm, Ei	17, 19, 20, 26, 35, 41, 47, 57, 61
Pleurogonius linearis	Es, In, Si	Br, CR, Eg, Fl, Jp, Mx, SP	Cm, Ei	9, 19, 23, 26, 30, 35, 37, 40, 41, 47, 61
Pleurogonius lobatus	In, Li, Si, St	Br, CR, Cu, Eg, Fl, Jm, Jp, MO, PI, Pn, PR, RJ	Cm, Ei, Lo	10, 16, 19, 23, 30, 31, 32, 35, 37, 41, 47, 61
Pleurogonius longiusculus	In, Mi	Br, CR, Eg, Fl, Pn, RJ	Cm	11, 19, 23, 26, 35, 37, 40, 41, 47, 61
Pleurogonius trigonecephalus	Es, In, Mi, St	Au, Br, Cu, Eg, Eu, Fl, It, MS, NA, Sp, US	Cm, Ei, Lk, Cc	19, 23, 26, 29, 30, 35, 38, 41, 44, 47, 61
Pronocephalus obliquus	Es, In, Mi, St	Br, Eg, Fl, Id, Jp, Pn, RJ, SP	Cm, Ei	10, 19, 23, 26, 30, 35, 40, 41, 47, 58, 61
Pyelosomum cochlear	Cl, UB	Br, CR, Eg, Pn, PR, RG	Cm, Lo	11, 15, 16, 18, 26, 35, 37, 47, 55, 61
Pyelosomum crassum	In, Li	Br, Eg, RJ	Cc, Cm	19, 30, 35, 40, 41, 47
Rameshwarotrema uterocrescens	Es	Br, CR	Cm	37, 47
Ruicephalus minutus	In	Br, SP	Cm, Pe	19, 35, 41, 47, 61
Family Rhytidodidae				
Rhytidodes gelatinosus	In, St, Ui	AM, An, Au, Br, Cu, Eg, Eu, Fl, Id, It, MS, Mx, NA, NG, Pa, Pn, PR, RS, Sp	Cc, Cm, Ei, Lk, Pe	2, 3, 11, 19, 23, 26, 30, 38, 40, 41, 43, 44, 47, 61
Rhytidodoides similis	F, GB	Br, CR, ES, Fl, Pn, US	Cm	11, 23, 26, 37, 56
Family Telorchiidae				
Orchidasma amphiorchis	In, Li, Si, St, Ui,	Ar, Au, Br, En, Fl, Id, It, Jp, MG, MS, Mx, NA, NC, PM, Pn, PP, PR, Pu, RS, SP, Um	Ca, Cc, Cm, Ei, Lo, Pe	3, 9, 10, 19, 20, 23, 26, 29, 30, 32, 38, 41, 51, 57, 61
Order Diplostomida				
Family Spirochiidae				
Amphiorchis indicus	Es, F, In, St	Br, Id, RJ, SP	Cm	19, 24, 46, 47
Amphiorchis solus	He, In	Br, Ce, CR,	Cm	37, 52
Carettacola stunkardi	BW, GBV, L	Br, ES, Pn	Cm, Ei	10, 50, 53, 57
Hapalotrema postorchis	Aa, GV, He, LA, RA	Br, CR, ES, Fl, Au	Cm, Ei	13, 37, 39, 54, 58
Learedius learedi	Es, GB, GV, He, In, Ki, L, Lu, Me, Sp	Be, Br, CR, Fl, Ha, Pn, PR, Mx, SP, US	Cm, Ei, Ca	1, 10, 12, 14, 15, 16, 17, 19, 23, 26, 28, 30, 33, 37, 38, 47, 48, 61
Monticellius indicus	He	AS, Br, CR, ES, SP	Cm, Ei	19, 37, 47, 49, 59, 61
Neospirorchis schistosomatoides	He, Mv	Au, Br, ES, US	Cm	22, 26, 47, 60, 61
Phylum Nematoda				
Order Rhabditida				
Family Anisakidae				
Anisakis spp.	L	Br, It, MA, Sp	Cc, Cm, Ei	30, 38, 43, 57
Sulcascaris sulcata	Es, Si, St	Br, Eg, It, RJ, SP	Cc, Cm, Lk	21, 23, 30, 38, 45, 51
Family Kathlanidae				
Kathlania leptura	In, Li, St	Br, Cy, Eg, Eu, It, Sp, SP, US, Za	Cc, Cm, Lo	7, 8, 23, 27, 30, 39, 45, 51
Tonaudia freitasi	St	Br	Cm	30, 45

Infection sites: Aa=aortic aneurism; Ao=Aorta; BW=body wash; Cl=cloaca; DT=digestive tract; Es=esophagus; GB=gall

bladder; GBV=gall bladder blood vessels; He=heart; In=intestine; Ki=kidneys; LA=left aorta; Li=large intestine; L=liver; Lu=lungs; Me=mesenteries; Mi=middle intestine; Mv=meningeal venules; Ps=pseudocecum; RA=right aorta; Si=small intestine; Sp=spleen; St=stomach; UB=urinary bladder; Ui=upper intestine.
Geographical location: AS=Arabian Sea; Ar=Argentina; An=Armenia; AM=Atlantic coast of Morocco; AO=Atlantic ocean; Au=Australia; Be=Bermuda; Br=Brazil; CS=Caribbean Sea; Ce=Ceará state, Brazil; CR=Costa Rica; Cu=Cuba; Cy=Ceylon; Eg=Egypt; ES=Espírito Santo state, Brazil; En=England; Eu=Europe; Fl=Florida; Gh=Ghana; Ha=Hawaii; Id=India; Ic=Isle dês Cocotiers; It=Italy; Jm=Jamaica; Jp=Japan; MA=Madeira Archipelago; Ma=Malaysia; Mu=Mauritania; MS=Mediterranean Sea; Mx=Mexico; MG=Mexico Gulf; NG=New Guinea; NA=North America; NC=North Carolina; NS=North Sea; PM=Pacific coast of Mexico; PP=Pacific coast of Panama; PO=Pacific ocean; Pa=Pakistan; Pn=Panama; PG=Persian Gulf; Pu=Peru; PI=Philippines (Palao Islands); PR=Puerto Rico; RG=Rio Grande do Sul state, Brazil; RJ=Rio de Janeiro state, Brazil; RS=Red Sea; Sg=Singapore; Sp=Spain; SP=São Paulo state, Brazil; SL=Sri Lanka; Tr=Trindade; US=United States; Za=Zanzibar.
Hosts: Ca=*Chelonia mydas agassizi*; Cc=*Caretta caretta*; Cm=*Chelonia mydas*; Ei=*Eretmochelys imbricata*; Lk=*Lepidochelys kempii*; Lo=*Lepidochelys olivacea*; Pe=*Podocnemis expansa*.
References: 1=Aguirre *et al*. 1998; 2=Aznar et al. 1998; 3=Blair & Limpus 1982; 4=Blair 1983; 5=Blair 1986; 6=Blair 1987; 7=Brooks & Frazier 1980; 8=Bursey *et al.* 2006; 9=Caballero & Zerecero 1950; 10=Caballero *et al.* 1955; 11=Caballero 1954; 12=Cordero-Tapia *et al.* 2004; 13=Cribb & Gordon 1998; 14=Dailey & Morris 1995; 15=Dailey *et al.* 1992; 16=Dyer *et al.* 1991; 17=Dyer *et al.* 1995a; 18=Dyer *et al.* 1995b; 19=Fernandes & Kohn 2014; 20=Freitas & Lent 1938; 21=Freitas & Lent 1946; 22=Gordon *et al.* 1998; 23=Greiner 2013; 24=Gupta & Mehrotra 1981; 25=Gupta 1961; 26=Hughes *et al.* 1942; 27=Inglis 1957; 28=Inohuye-Rivera *et al.* 2004; 29=Luhman 1935; 30=Muniz-Pereira *et al.* 2009; 31=Pérez & Brooks 1995; 32=Pérez-Ponce de León *et al.* 1996; 33=Rand & Wiles 1985; 34=Ruiz 1943; 35=Ruiz 1946; 36=Santoro & Mattiuci 2009; 37=Santoro *et al.* 2006; 38=Santoro *et al.* 2010; 39=Stacy *et al.* 2010; 40=Thatcher 1993; 41=Travassos *et al.* 1969; 42=Travassos 1934; 43=Valente *et al*. 2009; 44=Viana 1924; 45=Vicente *et al*. 1993; 46=Werneck & Silva 2013; 47=Werneck & Silva 2015; 48=Werneck *et al*. 2006; 49=Werneck *et al.* 2008a; 50=Werneck *et al.* 2008b; 51=Werneck *et al.* 2008c; 52=Werneck *et al.* 2011; 53=Werneck *et al.* 2013; 54=Werneck *et al.* 2014; 55=Werneck *et al.* 2015a; 56=Werneck *et al.* 2015b; 57=Werneck *et al.* 2015c; 58=Werneck *et al.* 2015d; 59=Werneck *et al.* 2015e; 60=Werneck *et al.* 2016; 61=Yamaguti 1971.

CONCLUSION

In recent years there has been an increase of studies of helminth parasites of the digestive tract of *C. mydas* found in Brazil, which is probably related to the greater interest in understanding the ecology of this threatened species. In addition, 33 species of helminths of *C. mydas* have been found to be widely distributed, while two are apparently endemic to particular regions. The concentration of some species only in particular regions may suggest that these geographical records can be related to the location of the major research centers and do not correspond to the actual geographical distribution of these species.

Therefore, studies that evaluate the parasites of the digestive tract of green turtles in places not yet investigated are necessary to elucidate the life cycles of the helminths and the geographic distribution of parasites and hosts, and to define population stocks and migratory routes. Furthermore, it is necessary to confirm if indeed few nematode species parasitize green turtles.

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