Marine Biodiversity Records, page 1 of 4. © Marine Biological Association of the United Kingdom, 2013
doi:10.1017/S1755267213000432; Vol. 6; e69; 2013 Published online

New records of *Opechona* sp. metacercariae (Digenea: Trematoda) on hydromedusae from south Brazil

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Six new records of hydromedusae are reported as secondary hosts of Opechona *sp. (Lepocreadiidae) for the Brazilian coast. Among the 392 hydromedusae sampled, 43 (~11%) were harbouring metacercaria. Prevalence (P) and intensity of infection (I) of* Opechona *sp. varied considerably among the different host species.* Gossea brachymera *(Limnomedusae) was highly parasitized (P = 30%; I = 1–7), while the other five hydromedusae species were not (P = 1.5–10; I = 1–2). The high parasitism in* G. brachymera *suggests the importance of this species in the transmission of* Opechona *sp. to fish, the definitive hosts, and highlights the hydromedusae as a probable noteworthy food item for zooplanktivorous fish in the area.*

Keywords: parasitism, Hydrozoa, jellyfish, flatworm, *Gossea brachymera*, Lepocreadiidae, prevalence, intensity of infection, South Atlantic

Submitted 11 November 2012; accepted 20 April 2013

INTRODUCTION

Trematodes (Digenea) have complex life cycles usually involving two invertebrates as intermediate hosts, and one vertebrate as the final host. Species of some digenean genera such as *Opechona* Looss 1907 (Lepocreadiidae) use several hydromedusae, scyphomedusae and ctenophores as secondary hosts, turning these gelatinous organisms into important links in the transmission of these parasites to fish (Køie, 1975; Ohtsuka *et al.*, 2009; Martell-Hernández *et al.*, 2011; Diaz-Briz *et al.*, 2012). Digenean life cycles often involve predator–prey interactions between the hosts (Marcogliese, 1995, 2002), consequently if medusae are found as intermediate hosts of these fish parasites, trophic interactions between medusae and fish can be indirectly inferred.

For the Brazilian coast there is only sparse information about the issue. It is known that the most common coastal ctenophores and scyphomedusae species may host metacercariae (Morandini *et al.*, 2005). Information on hydromedusae as host is available only from the report of a single parasitized specimen of *Aequorea* sp. and *Liriope tetraphylla* (Chamisso & Eysenhardt, 1821) in offshore waters off south Brazil in a study that focused on areas from Argentina (Diaz-Briz *et al.*, 2012). In the present study we intend to expand this knowledge by reporting six new records of hydromedusae as host of metacercariae from the Brazilian coast.

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MATERIALS AND METHODS

The hydromedusae were sampled from shallow open waters (8–12 m depth; Figure 1) in front of Guaratuba Bay, Paraná State (south Brazil), between February 2003 and December 2004 with demersal trawls, nets with 1 or 2 cm mesh size in a total of 110 trawls (see Nogueira & Haddad, 2008 for more details on sampling procedures). After the retrieval of the nets, medusae were separated on-board and preserved in 4% formaldehyde solution in seawater. In the laboratory, they were identified, their bell diameter was measured and they were checked for parasites under the stereomicroscope. The metacercariae found were removed from the medusae tissues with the aid of dissecting needles. Then, they were stained with Gill's haematoxylin, dehydrated in an ethanol series, cleared in clove oil and mounted in natural Canada balsam to be identified at the lowest taxonomic level possible. Voucher slides with metacercariae were deposited at the platyhelminthes collection from the Museu de Zoologia da Universidade de São Paulo (MZUSP PL-1182).

Prevalence (P) and intensity of infection (I) were calculated following recommendations of Bush *et al.* (1997) and Rózsa *et al.* (2000).

RESULTS

A total of 392 hydromedusae of six species were sampled in this study and 43 of them (~11%) were parasitized by the metacercariae of *Opechona* sp. (Figure 2). Metacercariae were mostly observed in the mesoglea, gonads, manubrium

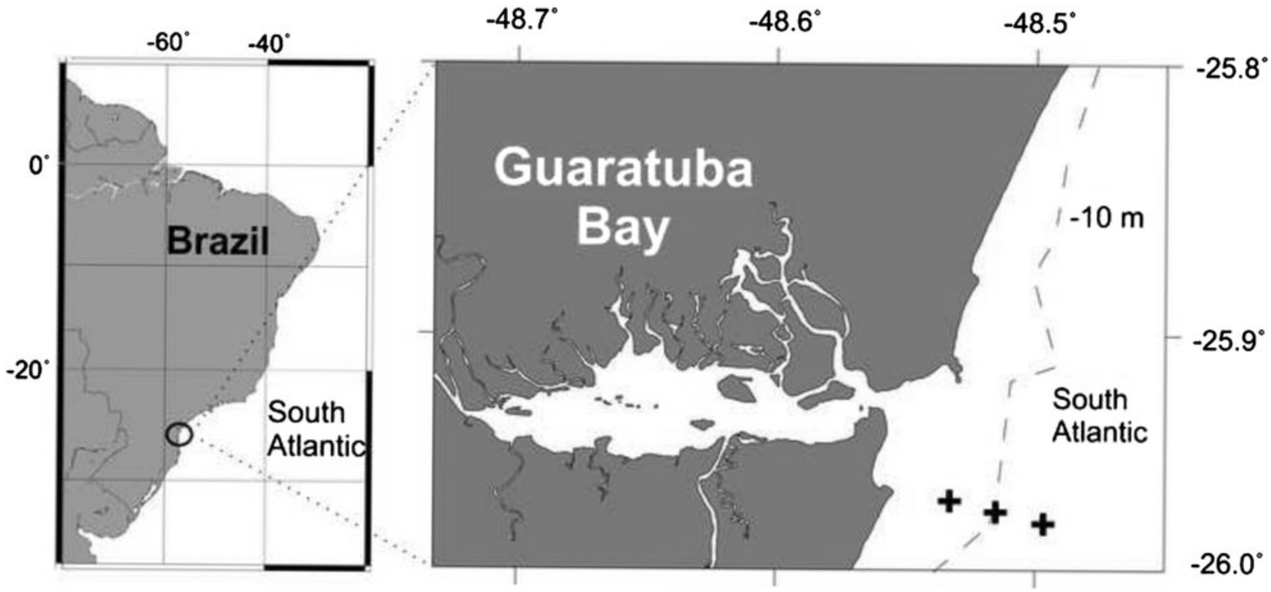

Fig. 1. Map of Brazil and the coast of Paraná State in detail showing the stations sampled (crosses) between February 2003 and December 2004 (generated using Ocean Data View software; Schlitzer, 2012).

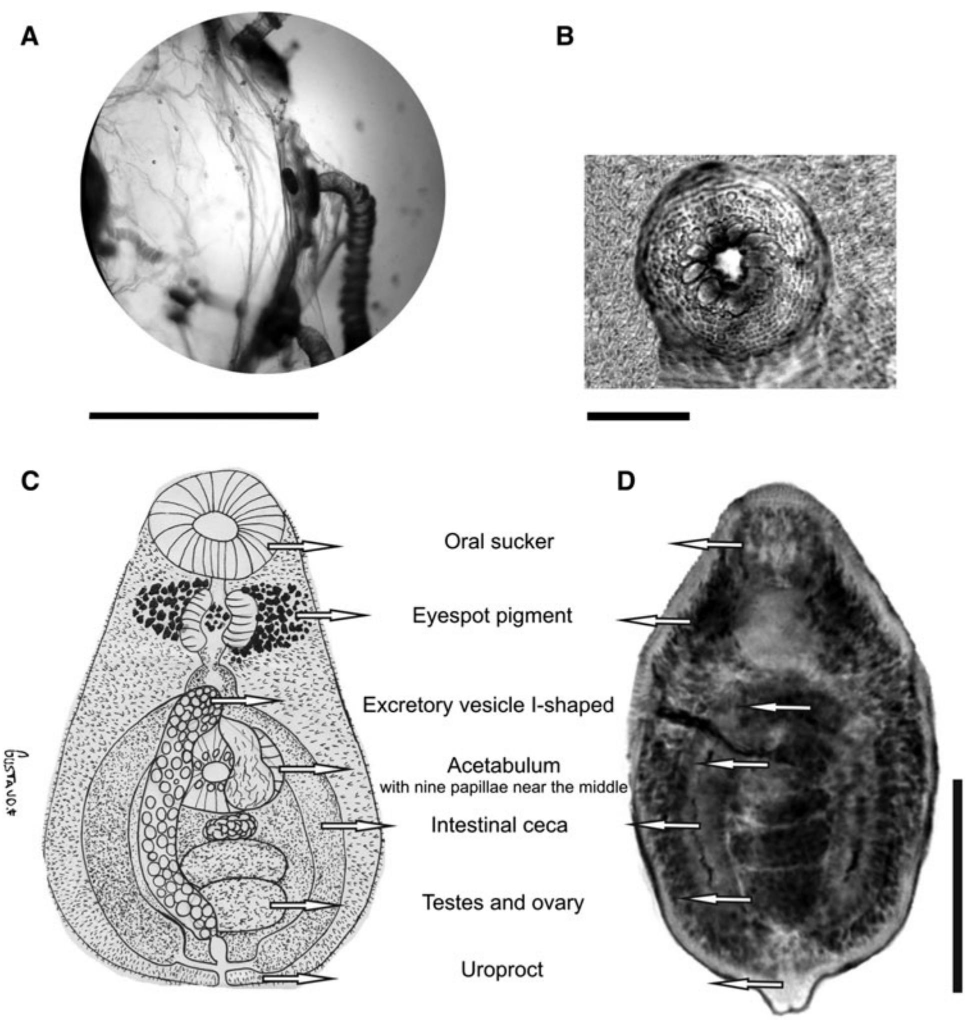

Fig. 2. *Opechona* sp. metacercariae near the margin of the hydromedusa *Gossea brachymera* (A); microscopic view of acetabulum (B); drawing of *Opechona* sp. based on five mounted specimens (C); photograph of a microscopic slide of *Opechona* sp. (D). Scale bars: A, 5 mm; B, 10 μm; C, D, 100 μm.

Table 1. List of hydromedusae species sampled form Paraná State coast, south Brazil showing the number of specimens examined (N), bell diameter range of medusae (BD), prevalence (P), intensity of infection (I) and location of *Opechona* sp. metacercariae on the hydromedusae.

Species	N	BD (mm)	P (%)	I	Location in the medusae
Hydrozoa					
Anthoathecata					
Bougainvillia pagesi Nogueira *et al.*, 2013	184	5–17	5.4	1–2	Mesoglea
Leptothecata					
Aequorea forskalea (Péron & Lesueur, 1810)	20	14–32	10.0	1	Base of the manubrium
Rhacostoma atlanticum L. Agassiz, 1850	13	22–53	7.7	2	Manubrium; sub-umbrella
Eucheilota maculata Hartlaub, 1894	16	3–10	6.2	1	Sub-umbrella near the margin
Limnomedusae					
Gossea brachymera Bigelow, 1909	92	5–20	30.4	1–7	Mesoglea; manubrium; gastric peduncle; gonads; radial canals; near margin
Olindias sambaquiensis Müller, 1861	67	9–46	1.5	2	Radial canals; sub-umbrella
Total	392		11.0	1–7	

or radial canals (Table 1). All the metacercariae found were assigned to the genus *Opechona*, family Lepocreadiidae.

Although all the six hydromedusae species sampled harboured at least one *Opechona* sp. metacercaria, the Limnomedusae *Gossea brachymera* was the most infested, with P reaching up to 30%, and I up to 7 (averaging 1.8 ± 1.6). The metacercariae were usually in its thick mesoglea, being eventually found also in the manubrium, gastric peduncle, gonads, or near the margin (Table 1; Figure 2A). The other analysed hydromedusae, namely *Aequorea forskalea*, *Bougainvillia pagesi*, *Eucheilota maculata*, *Olindias sambaquiensis* and *Rhacostoma atlanticum*, had very low values of P and I (Table 1).

DISCUSSION

All the metacercariae found were assigned to the genus *Opechona*, family Lepocreadiidae, due to the leftovers of eye-spots on each side of the pharynx, I-shaped excretory bladder, spinous integument and presence of uroproct (Bray & Gibson, 1990). The morphological features of these metacercariae (Figure 2) as well as their measurements were similar to *Opechona* sp. described by Morandini *et al.* (2005). It is not possible to link the present metacercariae to any species of the genus because the complete life cycle of these parasites is not known yet, but high P and I of adults *Opechona* sp., *O. bacillaris*, *O. chloroscombri* and *O. orientalis* has been repeatedly reported in fish from tropical and subtropical shallow waters of the south-western Atlantic (see review in Kohn *et al.*, 2007). Therefore the metaercariae studied very probably belong to one of these species.

The six hydromedusae species sampled were harbouring *Opechona* sp. Although this metacercaria has already been reported for the area (Morandini *et al.*, 2005) our finding represents new records of hydromedusae used as secondary hosts for this parasite on the Brazilian coast. These results indicate that this parasite–medusae interaction is more common than previously supposed in coastal Brazil. The medusae become infected on contacting the mollusc first intermediate host. The infection, however, does not necessarily need to rely on ingestion since free-living cercariae of the lepodcreadiids, such as *Opechona bacillaris*, can actively penetrate its intermediate host (Køie, 1975). In the south-western Atlantic Ocean, *Opechona* metacercariae are known to use several species of jellyfish from diverse taxonomic groups as secondary hosts (i.e. hydromedusae, scyphomedusae and ctenophores; Martorelli, 2001; Morandini *et al.*, 2005; Diaz-Briz *et al.*, 2012; present study). This low specificity concerning the intermediate host is common for most parasites using zooplankton components in their life cycles (Marcogliese, 1995).

The P values of metacercariae on medusae may vary considerably depending on several environmental and biological factors (Martell-Hernández *et al.*, 2011). The high percentage (30%) of *Gossea brachymera* medusae infected in the present investigation is amongst the highest values already recorded for *Opechona* metacercariae on hydromedusae (Martorelli, 2001; Gómez del Prado-Rosas *et al.*, 2000; Martell-Hernández *et al.*, 2011; Diaz-Briz *et al.*, 2012). This would suggest that this medusa is a true secondary host of *Opechona* sp., and therefore an important part of the life cycle of this parasite for the region. The high P observed herein may also suggest that the shallow area sampled, in front of an estuary, offers good opportunities to the parasite life-cycle development, with high chances of encounters amongst the different hosts (i.e. molluscs, jellyfish and fish) (Diaz-Briz *et al.*, 2012).

The parasites use their intermediate hosts as a basis where the following stage develops before infesting the next host (an ecological requirement to ensure the species' auto-perpetuation; Marcogliese, 1995). They ensure that their transmission takes advantage of the trophic relationships that occur among the different hosts involved in their complex life cycles (Marcogliese, 1995, 2002). Thus, the fact that the medusae are commonly used as secondary hosts by digenean parasites of fish indirectly supports the idea that fish predate on these jellyfish, since this trophic interaction is necessary for these parasites to complete their life history. Therefore, we suggest that *G. brachymera* could have an important role in the transmission of *Opechona* sp. to the zooplanktivorous fish that inhabit the coastal area surveyed, many of which are known to harbour the adult stages of *Opechona* spp. (Kohn *et al.*, 2007). In this context, parasitology may be an indirect way to evaluate the predation of fish over gelatinous organisms, as already suggested by Mianzan *et al.* (1996), being a complementary tool for the traditional methods used in trophic ecology researches (stomach contents and stable isotopes analysis of fish).

ACKNOWLEDGEMENTS

Gustavo Felipe Milleo kindly made the line drawing (2c). M.N.J. had financial support from the Conselho Nacional do Desenvolvimento Científico e Tecnológico (CNPq; PhD grant No. 140945/2007-5) and from the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP; post-doctoral grant No. 2011/09880-8).

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