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NOTE

Digenetic trematode *Ogmogaster antarcticus* (Notocotylidae) in a fin whale *Balaenoptera physalus* (Balaenopteridae) stranded in the Baltic Sea

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ABSTRACT: On 28 August 2015, a dead fin whale *Balaenoptera physalus* (Linnaeus, 1758) was collected from the waters of the Gulf of Gdańsk (Baltic Sea). The individual was a male in a poor nutritional condition with an empty stomach. Over 34 000 *Ogmogaster antarcticus* flukes were found in the colon and rectum. This is the first observation of *O. antarcticus* in the Baltic Sea.

KEY WORDS: *Ogmogaster antarcticus* · Digenea · Parasite · *Balaenoptera physalus* · Cetacea · Mammals · Baltic Sea

1. INTRODUCTION

The parasitofauna of marine mammals is only fragmentarily understood. Among cetaceans, more data on the diversity and aggregations of endoparasites is available for the smaller toothed whales (Odontoceti) than for large baleen whales (Mysticeti). This could be attributed to the fact that opportunities for conducting necropsies or coproscopy analyses on baleen whales are limited and that only few carcasses are available for complete parasitological studies. Although there are some scattered observations of several parasite species in Mysticeti, these are too scarce to understand the mechanisms behind the formation of parasitofauna communities and the functioning of host–parasite relationships (Raga et al. 1986, Hoberg & Adams 2000, Fraija-Fernández et al. 2015). However, the presence of parasites may have an impact on the health and condition of their hosts (Geraci & Aubin 1987, Notarbartolo-di-Sciara et al. 2003).

Baleen whales are not native to the Baltic Sea; however, individual whale appearances have been noted there (Jensen & Kinze 2011). This also includes fin whales *Balaenoptera physalus* (Linnaeus, 1758), which are widely distributed globally, though rare in the Baltic Sea. One such sighting was in 2005, when a fin whale was observed near the German coast (Rügen) (Harder et al. 2011). In 2015, a dead fin whale was found near Stegna (Poland); this individual was examined for the presence of parasites and the results are presented here. Parasitological analyses of marine mammal carcasses not only constitute a source of data on natural communities of parasitofauna, but also provide information on new species of parasites in the Baltic Sea environment.

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2. MATERIALS AND METHODS

A dead fin whale *Balaenoptera physalus* was collected on 28 August 2015 from the Gulf of Gdańsk (at Stegna, 54.3479° N, 19.1160° E) in the Baltic Sea. The carcass was in a state of putrefaction. The animal's stomach was empty. Samples of the blubber, muscles and skeleton of the animal were stored for further analysis at the Professor Krzysztof Skóra Hel Marine Station in Hel, Poland.

The parasitological inspection included examinations of the kidney, liver, pancreas, lungs with the trachea, and the gastrointestinal tract, including the stomach and certain parts of the intestines (12 m of the anterior, median and posterior sections of the small intestine, the cecum, 3 m of the colon and 3 m of the rectum; total length of the intestine unknown). To examine the contents of the digestive tract, a decanting method was used. Any parasites collected were preserved in 70% ethanol.

For the purposes of taxonomic identification and morpho-anatomical and metrical analysis, microscope preparations were produced from randomly selected flukes (600 specimens and 6000 eggs). To this end, the parasites were stained in alcohol-borax carmine, dehydrated in an alcohol series (80, 90, 2 × 99%) and cleared in benzyl alcohol. The trematodes were measured in a drop of benzyl alcohol, prior to being embedded in Canadian balsam (Rolbiecki 2007).

The morphological characteristics of the remaining fluke specimens were examined using a stereoscopic microscope under reflected and/or transmitted light; this enabled observation of the longitudinal ventral ridges, the shape of the ovary and testes, the topography of the cirrus-sac, the testicles, ovaries, uterus and intestinal loops.

3. RESULTS

3.1. Gross findings

Examination of the fin whale revealed only *Ogmogaster antarcticus* Johnston, 1931 (Trematoda: Notocotylidae) flukes. Of the 34 495 flukes found, 31 041 specimens were in the rectum and 3454 in the colon. The flukes were found in the intestine lumen and attached to the walls of the intestines (Fig. 1). No lesions associated with their presence were observed; however, it should be noted that the process of autolysis of the intestine tissues prevented more detailed study. Since this was the first time *O. antarcticus* was found in *B. physalus* in the Baltic Sea, a description and the morphological measurements are presented in the following.

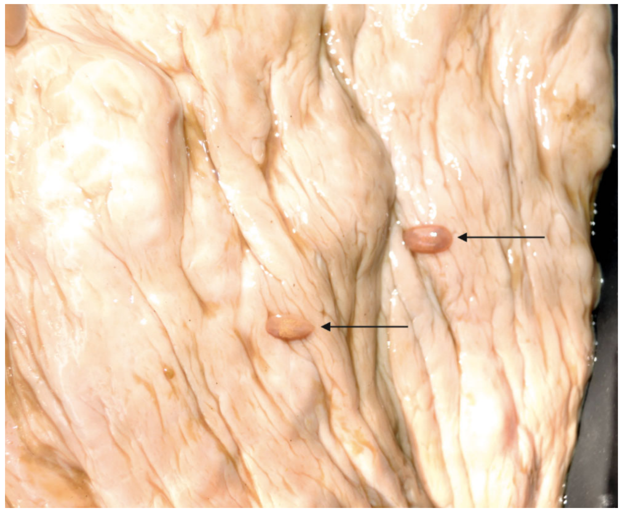

Fig. 1. *Ogmogaster antarcticus* on the intestine of *Balaenoptera physalus*

3.2. Description

The description is based on 300 flukes from the rectum, 300 from the colon, and additional measurements from 10 eggs from each fluke with correctly developed (i.e. n = 2) filaments. Eggs are sometimes found with 1, 3 or 4 filaments (Table 1, Figs. 2 & 3). Body oval, pyriform; on the ventral side longitudinal, parallel ridges, longer towards the median line; on the margin, crenulations which curve dorsoventrally. Oral sucker subterminal, ventral sucker absent. The intestinal ceca create 4–5 loops, which terminate clearly posteriorly to the testes, typically reaching the rear ends of the longitudinal ventral ridges. Within the cirrus-sac, ceca form faintly developed, shallow loops (mostly 2, sometimes 3), and below the cirrus-sac deep loops (mostly 3, less frequently 2); the deepest loops incorporate the testes. Cirrus-sac well developed; cirrus tubular, retracted. Two testes, deeply lobed, located in posterior part of body in the intestinal loops. Ovary lobed, located between testes, rather below their median line; sometimes, the posterior margin of the ovary reaches slightly behind the posterior margin of the testes. Vitelline follicles loosely scattered clearly below the posterior margin of cirrus-sac and anterior margins of testes, sometimes slightly overlapping the anterior level of the testes. Mehli's gland spherical, located medially,

Table 1. Morphometric comparison, mean ± SD, min.–max., between *Ogmogaster antarcticus* found in *Balaenoptera physalus* in the present study and in various hosts in previous records. All measurements are in mm unless otherwise stated

Source	Present data	Johnston (1931)	Skrjabin (1953)	Delyamure (1955)	Rausch & Fay (1966)	Shults (1979)	Raga et al. (1986)	Malatesta et al. (1998)	Muniz-Pereira et al. (1999)	Kuramochi et al. (2017)
Host	*Balaenoptera physalus* (Linnaeus, 1758)	*Leptonychotes weddellii* (Lesson, 1826)	*Balaenoptera physalus*	*Balaenoptera musculus* (Linnaeus, 1758)	*Leptonychotes weddellii*	*Balaea mysticetus* Linnaeus, 1758	*Balaenoptera physalus*	*Balaenoptera physalus*	*Balaenoptera borealis* Lesson, 1828	*Eschrichtius robustus* (Lilljeborg, 1861)
Locality	Baltic Sea	Antarctic	Pacific Ocean	Antarctic	Antarctic	Arctic Sea, Alaska	North Atlantic	Mediterranean Sea	Brazilian coast	Pacific coast of Japan
Sex, length, weight of host	Male, 16.17 m, 23 tonnes	–	–	–	–	–	Female, 20 m	Male, 12.8 m	–	–
No. of measured flukes and eggs	600 flukes and 6000 eggs	–	–	7 flukes	–	1 fluke	66 flukes[a]	–	6 flukes	–
No. of longitudinal ventral ridges	13 ± 1 (11–15)	13	13–14	13–14	13–15	16	15 (12–17)	13 (11–13)	11–17	15–17
No. of crenulations	37 ± 1 (33–39)	18–20 on each side	15–17 on each side	–	–	–	38–40	31–39	30–40	28–31
Body length	7.30 ± 0.63 (5.45–8.50)	5.0–6.7	5.9–6.8	7.0–8.0	4.0–5.5	5.3	7.23 (5.57–8.19)	6.78 ± 0.95 (4.7–8.15)	7.77 (6.97–8.50)	6.10–7.45
Body width	3.30 ± 0.31 (2.55–3.95)	3.5–5.5	4.2–4.5	3.0–3.5	2.0–3.0	3.2	5.19 (3.98–5.8)	3.53 ± 0.33 (2.8–4.1)	3.09 (2.79–3.40)	3.24–4.51
Body width to length ratio	1:0.45 ± 1:0.04 (1:0.35–0.56)	–	–	–	–	1:0.6[b]	1:0.72[b]	1:0.53 (0.37–0.83)[c]	–	–
Oral sucker length	0.53 ± 0.09 (0.36–0.70)	0.5 diam.	0.5–0.58 diam.	0.44	0.42–0.56[c]	–	0.53 (0.39–0.62)[c,d]	0.60 ± 0.07 (0.46–0.71) diam.	0.63 (0.50 0.76)[c] diam.	–
Oral sucker width	0.65 ± 0.07 (0.45–0.76)	–	–	0.53[c]	0.53–0.66[c]	–	0.68 (0.56–0.77)[c,d]	–	–	–
Cirrus-sac length	2.57 ± 0.31 (1.80–3.35)	1.8	2.0–2.3	1.8–2.0	1.25–1.64	–	2.80 (2.08–3.32)[b,c]	2.48 ± 0.61 (1.8–4.07)	2.85 (2.55–3.13)	–
Cirrus-sac width	0.41 ± 0.05 (0.27–0.53)	0.34	0.5–0.55	0.36–0.43	0.21–0.37[c]	–	0.53 (0.44–0.62)[c,d]	0.51 ± 0.09 (0.3–0.6)	–	–
Cirrus length	1.66 ± 0.81 (0.40–4.00)	–	–	–	–	–	–	2.75	–	–
Cirrus width	0.19 ± 0.03 (0.11–0.26)	–	–	–	–	–	–	0.1	–	–
Cirrus-sac length to body length ratio	1:0.36 ± 1:0.05 (1:0.24–0.49)	ca 1/3	–	–	–	–	1:0.39[b]	1:0.36 (0.3–0.5:1)	–	–
Testes length	1.20 ± 0.17 (0.75–1.50) and 1.20 ± 0.16 (0.80–1.57)	0.7–0.9	1.25–1.6	1.03–1.09	0.84–0.96[c]	–	0.48 (0.37–0.63) and 0.44 (0.31–0.57)[c,d]	–	–	–
Testes width	1.12 ± 0.16 (0.75–1.42) and 1.12 ± 0.17 (0.65–1.35)	0.6–0.7	1.25–1.4	1.07–1.1	0.62–0.72[c]	–	0.40 (0.28–0.47) and 0.30 (0.21–0.38)[c,d]	–	–	–
Ovary length	0.48 ± 0.07 (0.32–0.76)	0.4	0.35	0.43–0.50	0.20–0.41[c]	–	0.20 (0.13–0.29)[c,d]	–	–	–
Ovary width	0.70 ± 0.12 (0.45–0.98)	0.6	1.25	0.67–0.75	0.56–0.91[c]	–	0.31 (0.14–0.40)[c,d]	–	–	–
No. of follicles	16 ± 2 (10–19) and 15 ± 1 (10–18)	10–18 on each side	–	16–18 on each side	–	–	–	–	–	–

Table 1 continued on next page

Table 1. (continued)

Source	Present data	Johnston (1931)	Skrjabin (1953)	Delyamure (1955)	Rausch & Fay (1966)	Shults (1979)	Raga et al. (1986)	Malatesta et al. (1998)	Muniz-Pereira et al. (1999)	Kuramochi et al. (2017)
Mehli's gland length	0.41 ± 0.07 (0.22–0.55)	–	–	0.45–0.47 diam.	–	–	0.49 (0.41–0.53)[c,d]	–	–	–
Mehli's gland width	0.37 ± 0.07 (0.21–0.53)	–	–	–	–	–	0.56 (0.52–0.67)[c,d]	–	–	–
Egg length	0.022 ± 0.002 (0.015–0.028)	0.02	0.02–0.023	0.019–0.02	0.018–0.025	–	0.017 (0.015–0.02)[d]	0.024 ± 0.005 (0.02–0.035)[d]	0.02 (0.018–0.022)	0.018–0.019[d]
Egg width	0.01 ± 0.001 (0.009–0.015)	0.012	0.01–0.012	0.012	0.01–0.012	–	0.01 (0.007–0.012)[d]	0.012 ± 0.04 (0.01–0.02)[d]	0.01 (0.007–0.011)	0.01–0.012[d]
Polar filament length	0.146 ± 0.018 (0.09–0.2)	0.18[e]	above 0.5	0.16–0.18[e]	0.15	–	0.149 (0.16–0.235)[d]	0.169 ± 0.002 (0.11–0.230)[d]	0.101 (0.09–0.111)	0.19–0.28[d]
Egg length to width ratio	2.177 ± 0.266 (1:1.300–2.875)	1.667[b]	–	–	–	–	1.7[b]	2.0[b]	2.0[b]	–

[a]Authors do not state whether they measured all the flukes found. [b]Based on means calculated from the original results. [c]Measurements rounded to the second decimal place from the original results. [d]Units have been standardized. [e]Length of the egg including filaments, as in the original record

above ovary and between testes. Excretory vesicle Y/T-shaped. The uterus is located below the anterior margin of the cirrus-sac and the anterior margin of the testes, sometimes slightly reaching over the testes; it frequently creates asymmetrical loops on both sides of the cirrus-sac.

4. DISCUSSION

Digenetic trematodes, tapeworms, acanthocephalans and nematodes have been found in the host, as confirmed by literature data on the parasitic helminth fauna of the fin whale (e.g. Raga et al. 2018). The present parasitological section of the young male enabled detection of only one parasite species, *Ogmogaster antarcticus*, a digenetic trematode. It is a representative of the Notocotylidae, a family incorporating parasites common to the digestive tracts of mammals and birds (Barton & Blair 2005). The genus *Ogmogaster,* associated with several species of marine mammals, is represented by 7 species, of which *O. grandis* Skrjabin, 1969, *O. plicatus* (Creplin, 1829), *O. trilineatus* Rausch & Rice, 1970 and the *O. antarcticus* detected here have been found in the fin whale (e.g. Skrjabin 1953, 1969, Rausch & Fay 1966, Rausch & Rice 1970, Malatesta et al. 1998). The present data on the mass occurrence of flukes is analogous to that obtained from a study of a young male *Balaenoptera physalus* found in the Mediterranean Sea near Italy (Malatesta et al. 1998), in which a large number of individual flukes, estimated in the thousands, were found in the cecum and colon. However, only superficial, shallow lesions caused by the presence of the flukes were determined (Malatesta et al. 1998). As the fin whale is the second largest mammal in the world, it is likely that such a large number of parasites could remain within the tolerance range of the host and not cause a hazardous pathogenic condition.

While our present findings are indeed similar to those published by other authors from a meristic and quantitative perspective (Table 1), some divergence was nonetheless found in certain features. This may stem from natural differences between the infrapopulations of these trematodes originating from different hosts. However, a detailed analysis is difficult to conduct, as studies have included varying counts of trematodes and selected features.

The present study is the first record of *O. antarcticus* in the Baltic Sea. As the life cycle of *O. antarcticus* (and hence its requirements of an intermediate host) is largely unknown, it is unclear whether suit-

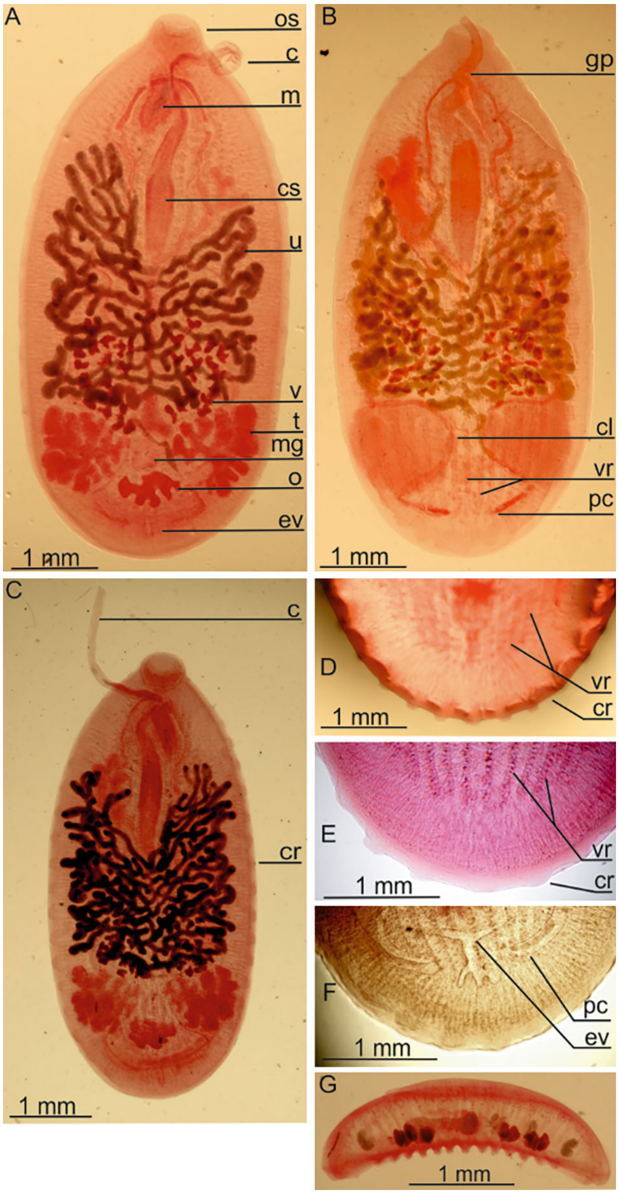

Fig. 2. *Ogmogaster antarcticus*. (A–C) Total view. (D,E) Ventral ridges in ventral surface and crenulations on margin. (F) Posterior end of intestinal cecum and excretory vesicle. (G) Longitudinal ridges on ventral surface, transverse section. (c) Cirrus, (cl) cecum loop, (cr) crenulation, (cs) cirrus sac, (ev) excretory vesicle, (gp) genital pore, (m) metraterm, (mg) Mehlis' gland, (o) ovary, (os) oral sucker, (pc) posterior end of cecum, (t) testis, (u) uterus, (v) vitellarium, (vr) ventral ridges

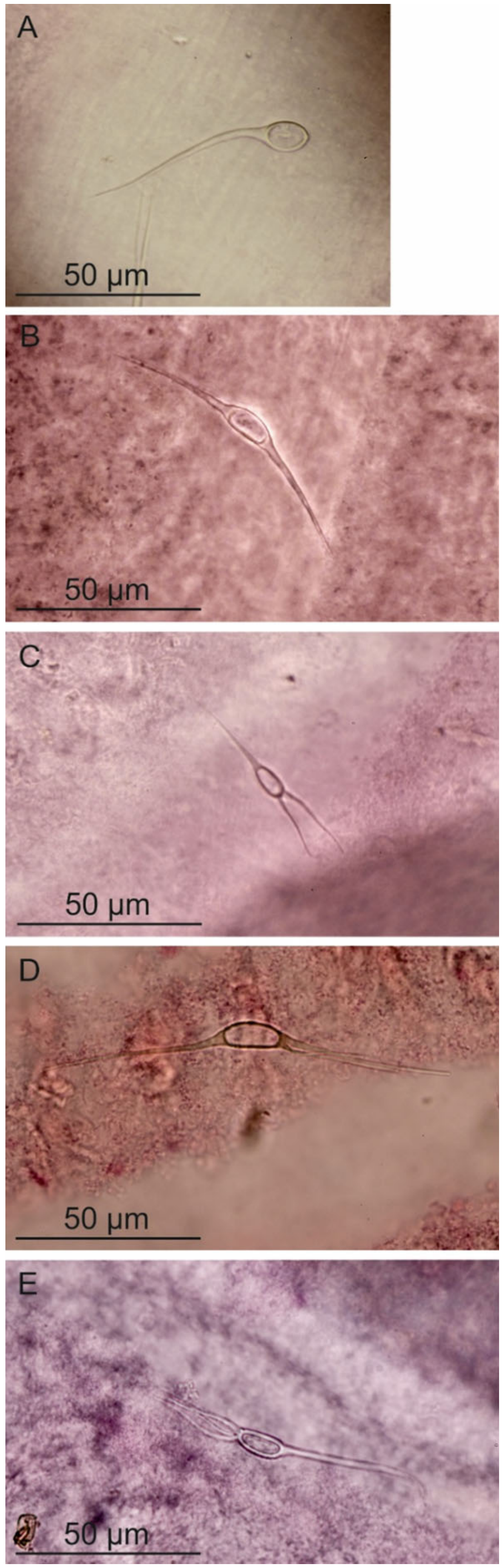

Fig. 3. *Ogmogaster antarcticus*. (A) Egg with 1 filament. (B) Egg with 2 filaments. (C,D) Eggs with 3 filaments. (E) Egg with 4 filaments

able hosts exist in the Baltic Sea and thus whether the parasite is able to complete its life cycle there. It is a widely distributed fluke, observed in both hemispheres and in a broad range of hosts. Typical final hosts for the adult stages are marine mammals, mostly baleen whales, but it has also been observed in pinnipeds (e.g. Skrjabin 1953, Shults 1979, Malatesta et al. 1998, Luque et al. 2010); however, there is no data on intermediate hosts. Nevertheless, on the basis of studies on other members of the Notocotylidae associated with marine animals (Stunkard 1966), Dailey et al. (2000) suggest that this part of the life cycle of *Ogmogaster* spp. may consist of cercariae developing in prosobranch snails. The number of prosobranchs associated with the Baltic Sea is low, although marine Hydrobiidae and Rissoidae have been found there (Wenne 1989). It is worth noting that Dailey et al. (2000) describe *O. pentalineatus* Rausch & Fay, 1966 from the gray whale *E. robustus*, which, unlike the fin whale, feeds on the bottom, where other potential hosts may occur, and not in the open sea. However, the wide distribution of these flukes suggests that they are highly adaptable and may have quite a large group of hosts; the widespread occurrence of the flukes may thus be associated with the biology of the final hosts, including their migratory capabilities and wide distribution range. It is likely that the source of infection in the final hosts is their food, which in the case of the fin whale consists of small invertebrates, schooling fishes, and squid (Jefferson et al. 1994). Although the food is collected by filtering, other animals/species may also be consumed, depending on the composition of the local fauna. Unfortunately, as the fin whale examined in the present study lacked any stomach contents, it was impossible to attempt to identify the possible sources of infection.

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