Digenea in notothenioid fish in the Beagle Channel (Magellanic sub-region, sub-Antarctica)

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Abstract

Fish of five species of Notothenioidei (104 specimens), Cottoperca trigloides, Patagonotothen brevicauda, P. longipes, P. tessellata and Champsocephalus esox, caught in the Beagle Channel (Magellanic sub-region, sub-Antarctica) were infected with Digenea of nine species (1130 specimens). Faunistic data on the occurrence of all nine parasites are provided. The most abundant digenean species was Macvicaria magellanica found in the intestine of three host species of the genus Patagonotothen. The second most abundant digenean species was Elytrophalloides oatesi found in the stomach of four host species, with exception of P. brevicauda. Three digenean species: Stenakron kerguelense, Whitegonimus ozoufai and Genolinea bowersi, were more abundant in fish caught at the harbor of Ushuaia (depth 7–9 m), remaining six species: M. magellanica, Neolepidapedoides subantarcticus, Postmonorchis variabilis, Derogenes varicus, E. oatesi and Lecithaster macrocotyle, in the eastern mouth of the Beagle Channel (depth 30 m).

Keywords

Beagle Channel, Digenea, infection, notothenioid fish, sub-Antarctica

Introduction

Fish of the sub-order Notothenioidei are endemic to Antarctica and sub-Antarctica and common in the Magellanic sub-region of sub-Antarctica (Gon and Heemstra 1990). Digeneans were recorded in the Magellanic sub-region in fish belonging to five notothenioid species: Cottoperca gobio (Günther, 1861), Dissostichus eleginoides Smitt, 1898, Lepidotothen kempi (Norman, 1937), L. macrophthalma (Norman, 1937) and Patagonotothen ramsayi (Regan,1913) occurring at the Falkland-Patagonian shelf and South Georgia (Kovaljova and Gaevskaya 1974; Gibson 1976; Gaevskaya and Kovaljova 1977; 1978; Gaevskaya and Rodjuk 1983; Gaevskaya, Kovaljova and Rodjuk 1985; Gaevskaya, Rodjuk and Parukhin 1990; Rodrigues and George-Nascimento 1996; Zdzitowiecki 1997; 1999; Bray and Zdzitowiecki 2000). The only report of parasites of the sub-coastal fish, Eleginops maclovinus (Cuvier in Cuvier et Valenciennes 1830), was based on the examination by Szidat (1950) of fish caught near the eastern mouth of the Beagle Channel (Aguirre Bay). The present report is based on the examination of other notothenioid fish caught in the Beagle Channel. Three digenean species Whitegonimus ozoufai Jeżewski et al. 2009, Neolepidapedoides subantarcticus Jeżewski et al. 2011 and Macvicaria magellanica Laskowski et al. 2013, were found to be new and were described separately. One further species, Stenakron kerguelense Prudhoe et Bray, 1973, is presently re-described and morphologically documented. Data on the morphology of five next species Derogenes varicus Elytrophalloides oatesi, Genolinea boweri, Lecithaster macrocotyle, Postmonorchis variabilis, are restricted to some diagnostic remarks that are accompanied with zoogeographic data.

Materials and Methods

Investigations were carried out during the Seventh Ukrainian Antarctic Expedition in the summer and autumn of 2002. Collection of fish parasites in sub-Antarctica took place in January 25–29 and March 25–27 2002. Fish were caught using a fishing rod at two sites – at the eastern mouth of the Beagle Channel (54°59’S, 66°45’W, depth 30 m) and at the harbor of Ushuaia (54°49’S, 68°18’W, depth 7–9 m). In total, 104 notothenioid fish of five species were examined immediately after being caught using a stereo-microscope (Table I).

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All digeneans were found in the lumen of the stomach and intestine. All specimens were washed in fresh water, killed by heat, fixed in 50% ethanol and stored in 70% ethanol. Most of the specimens were dehydrated in graded ethanol (85%, 96% and 99%), cleared in benzyl alcohol and identified using a light microscope. Selected specimens were washed in fresh water, stained in carmine alum, washed again, dehydrated in graded ethanol, cleared in benzyl alcohol and examined using a light microscope as total mounts in Canada balsam. Dimensions are given in micrometers, unless otherwise indicated.

Three indices of infections are given: prevalence (percent of fish infected), intensity range and mean abundance (number of parasites per number of fish examined).

**Results**

**Systematic Review**

In total, 1130 digeneans of nine species were found. They are listed below in systematic order. Data on infection are given in Table II, separately for each locality- in the Eastern mouth of the Beagle Channel (E.M.), depth 30 m, and in the harbor of Ushuaia (U.), depth 7–9 m.

<table>
<thead>
<tr>
<th>Host</th>
<th>Place</th>
<th>n</th>
<th>S.L. range (mean)</th>
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<tbody>
<tr>
<td><strong>Bovichtidae</strong></td>
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<tr>
<td>Cottoperca trigoloides (Forster, 1801)</td>
<td>E.M.</td>
<td>4</td>
<td>10.2–19.8 (14.4)</td>
</tr>
<tr>
<td><strong>Nototheniidae</strong></td>
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<tr>
<td>Patagonotothen brevicauda (Lönberg, 1905)</td>
<td>E.M.</td>
<td>1</td>
<td>13.2</td>
</tr>
<tr>
<td></td>
<td>U.</td>
<td>6</td>
<td>9.0–10.7 (9.6)</td>
</tr>
<tr>
<td>Patagonotothen longipes (Steindachner, 1876)</td>
<td>E.M.</td>
<td>20</td>
<td>13.2–20.0 (16.2)</td>
</tr>
<tr>
<td></td>
<td>U.</td>
<td>20</td>
<td>12.0–22.8 (17.0)</td>
</tr>
<tr>
<td>Patagonotothen tessellata (Richardson, 1845)</td>
<td>E.M.</td>
<td>20</td>
<td>13.3–20.8 (16.7)</td>
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<tr>
<td></td>
<td>U.</td>
<td>13</td>
<td>8.4–17.2 (13.0)</td>
</tr>
<tr>
<td><strong>Channichthyidae</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Champsocephalus esox (Günther, 1861)</td>
<td>E.M.</td>
<td>20</td>
<td>23.5–35.0 (27.1)</td>
</tr>
</tbody>
</table>

**Macvicaria magellanica** Laskowski, Jeżewski et Zdzitowiecki, 2013 (Table II)

Hosts: *Patagonotothen brevicauda, P. longipes* (type host), *P. tessellata*.


Site of infection: ileum – 315 specimens (61.4%), pyloric ceca – 57 specimens (11.1%), jejunum – 106 specimens (20.7%) and rectum – 35 specimens (6.8%), in total 513 specimens (45.4% of all Digenea).

Remarks. *M. magellanica* is the third representative of the genus *Macvicaria* Gibson et Bray, 1982 recorded in the Magellanic sub-region. The species was found in *P. longipes* in Beagle Channel (Laskowski et al. 2013).

*M. magellanica* is a parasite of sub-coastal notothenioid fish, whereas two other representatives of the same genus recorded in the same sub-region, *M. antarctica* (Kovaljova et Gaevskaya, 1974) and *M. skorai* Zdzitowiecki, 1999, were found in fish from open sea shelves. The former was recorded at South Georgia (Gaevskaya and Kovaljova 1976; Zdzitowiecki 1990, 1997), at the North Scotia Ridge (Zdzitowiecki 1999) and in the Kerguelen sub-region of sub-Antarctica (Parukhin and Lyadov 1981; 1982; Parukhin and Zaitsev 1984; Lyadov 1985; Parukhin 1986; 1989). The latter was found only at the North Scotia Ridge (Falkland – Patagonian Shelf) (Zdzitowiecki 1999). *M. magellanica* is the most numerous digenean species recorded in the Beagle Channel (513 specimens – 45.4% of total number of Digenea). However, it was present only in *Patagonotothen* spp. (Nototheniidae) and absent in *Champsocephalus esox* (Channichthyidae) and *Cottoperca trigoloides* (Bovichtidae).

**Stenakron kerguelense** Prudhoe et Bray, 1973 (Table II, Fig. 1 – 3)

Hosts: *Cottoperca trigoloides, Patagonotothen longipes* (new hosts).


Site of infection: ileum – 14 specimens (87.5%), jejunum – 2 specimens (12.5%), in total 16 specimens.

Description. Body claviform, 0.52–1.46 × 0.15–0.28 (mean 0.99 × 0.23). Length/width ratio 3.30–6.10 : 1 (4.37 : 1). Oral sucker sub-terminal, rounded, 98–182 × 98–172 (144 × 145). Prepharynx not observed. Pharynx globular, 36–69 × 36–69 (54 × 59). Oesophagus 27–61 (46) in length. Intestinal bifurcation nearly before ventral sucker. Intestinal ceca reaching to anterior margins of testes, dextral cecum is longer. Forebody 0.26–0.35 (30%) of body length. Ventral sucker 108–164 × 89–162 (141 × 135), its center at 0.33–0.45 (38%) of body length. Oral/ventral sucker ratio 1 : 0.86–1.10 (1 : 1). Oral sucker/pharynx ratio 1 : 0.36–0.44 (1 : 0.40). Excretory pore at body end. Excretory vesicle tubular, reaching at posterior margin of ventral sucker.
Testes in hind body, nearly before posterior body end, rounded to oval, generally in tandem, but more or less oblique. Anterior testis sinistral, 68–220 × 78–196 (143 × 120). Posterior testis 80–224 × 82–176 (159 × 127). Distance between posterior testis and body end 0.03–0.12 (6%) of body length.

Genital pore antero-sinistral to intestinal bifurcation. Cirrus sac claviform, 155–238 × 33–48, reaching posterior beyond ventral sucker, containing internal seminal vesicle, pars prostatica and ejaculatory duct. Ovary dextral to anterior margin of anterior testis, globular to ellipsoidal, considerably smaller than testes, 51–125 × 43–71 (78 × 60). Vitelline follicles situated mainly dorsally and laterally from pharynx to level of center of anterior testis, confluent in fore body and between uterus and testes. Distance from anterior extremity to vitelline follicles 0.13–0.23 (18%) of body length; distance between vitelline follicles and posterior extremity 0.21–0.33 (24%) of body length.

Uterus with eggs dorsal and postero-dorsal to ventral sucker. Eggs few (up to 12 in number) or absent, 70–96 × 41–52 (83 × 47).

Remarks. The morphology of specimens from the Beagle Channel fits well with the original description of Prudhoe and Bray (1973). However, specimens are not fusiform but claviform and have testes arranged in tandem, not almost symmetrically. Taking into account that Prudhoe and Bray (1973)

<table>
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<th>Parasite/host</th>
<th>Beagle Channel</th>
<th>Harbor Ushuaia</th>
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<tr>
<td></td>
<td>n</td>
<td>P%</td>
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<tr>
<td>Macvicaria magellanica</td>
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<tr>
<td>Patagonotothen brevicauda</td>
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<td>P. longipes</td>
<td>20</td>
<td>95.00</td>
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<td>P. tesselata</td>
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<td>50.00</td>
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<tr>
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<td>P. longipes</td>
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<tr>
<td>Lecithaster macrocotyle</td>
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<tr>
<td>P. longipes</td>
<td>20</td>
<td>40.00</td>
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<tr>
<td>P. tesselata</td>
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</table>

Prevalence calculated only for n more than 10 fish specimens. P – Prevalence (%), A – Mean abundance, IR – Intensity range.
Fig. 1. *Stenakron kerguelense* – ventral view, scheme

Fig. 2. *Stenakron kerguelense* – ventral view, photography
described badly fixed specimens, these differences result from the contraction of worms.

*S. kerguelense* seems to be endemic of sub-Antarctica occurring circum Antarctic. It is recorded in the Magellanic sub region for the first time. Previously it was reported only from the Kerguelen sub-region in three notothenioids, *Notothenia coriiceps* Richardson, 1844, *N. cyanobrancha* Richardson, 1844 and *Champsocephalus gunnari* Lönnberg, 1905 (Prudhoe and Bray 1973), and in *Zanclorhynchus spinifer* Günther, 1880 (Congiopodidae) (Zdzitowiecki and Pisano 1996). The last authors examined five *Z. spinifer* caught at the Heard Island which were strongly infected (16–139, mean 51 worms).

**Neolepidapedoides subantarcticus** Jeżewski, Zdzitowiecki et Laskowski, 2011 (Table II)

Hosts: *Champsocephalus esox*, *Patagonotothen brevicauda*, *P. longipes* (type host), *P. tessellata*.


Site of infection: pyloric caeca – 127 specimens (73.8%), jejunum – 40 specimens (23.3%), ileum – 4 specimens (2.3%) and rectum – 1 specimen (0.6%), in total 172 specimens.

Remarks. Most of representatives of *Neolepidapedoides* occur in fish in the tropical area. *N. subantarcticus* is the first species of this genus found in sub-Antarctica. It is the third most abundant species (172 specimens – 15.22 % of all Digenea) in sub-coastal notothenioids in the Beagle Channel.

**Postmonorchis variabilis** Prudhoe et Bray, 1973 (Table II)

Hosts: *Patagonotothen longipes*, *P. tessellata* (new hosts).


Site of infection: pyloric caeca – 86 specimens (92.4%), ileum – 5 specimens (5.4%) and jejunum – 2 specimens (2.2%), in total 93 specimens.

Remarks. The morphology of specimens from the Beagle Channel is similar to that of specimens found in the Kerguelen sub-region of sub-Antarctica (Prudhoe and Bray 1973) and South Georgia (Zdzitowiecki 1997). The species occurs within the circum Antarctic and it was found in the Magellanic sub-region for the first time. Previously, it was recorded at shelves and in the fjord at South Georgia (Lyadov 1985; Rodjuk 1985; Zdzitowiecki 1991; Zdzitowiecki and White 1992) and in the Kerguelen sub-region at the Kerguelen Island, Ob Bank and Lena Bank (Prudhoe and Bray 1973; Parukhin and Lyadov 1981; 1982; Parukhin and Zaitsev 1984; Lyadov 1985; Parukhin 1986; 1989).

**Whitegonimus ozoufae** Jeżewski, Zdzitowiecki et Laskowski, 2009 (Table II)

Host: *Patagonotothen tessellata* (type host).

Date of collection: January 25 2002.

Place: at harbor of Ushuaia, depth 7–9 m.

Site of infection: uncertain (possibly bile duct) – 2 specimens.

Remarks. Only two specimens were found in a single fish in the harbor of Ushuaia.

**Genolinea bowersi** (Leiper et Atkinson, 1914) (Table II)


Hosts: *Champsocephalus esox*, *Patagonotothen brevicauda*, *P. longipes*, *P. tessellata* (new hosts).


Site of infection: stomach – 55 specimens.

Remarks. *Genolinea bowersi* is an abundant parasite occurring within the circum Antarctic and sub-Antarctic in sub-coastal notothenioid fish. This species was occasionally found.
in the gadid fish, *Macrourus carinatus* (Günther, 1878), at the shelf at the Falkland Islands (Gaevskaya and Rodjuk 1988a; 1988b). The species is recorded for the first time in sub-coastal fish in the Magellanic sub-region.

*Derogenes varicus* (Müller, 1784) (Table II)

**Synonyms:** *Derogenes parvus* Szidat, 1950.

**Hosts:** *Champsocephalus esox, Patagonotothen longipes* (new hosts).


**Site of infection:** stomach – 7 specimens.

**Remarks.** This species represents the most common cosmopolitan fish digenean in the world (Keie 1979). Recorded in sub-Antarctica by many authors in fish belonging to different orders (see Zdzitowiecki 1997). Described as *D. parvus* from the notothenioid fish, *Eleginops maclovinus*, caught in Aguirre Bay, nearly to the Beagle Channel (Szidat 1950).

*Elytrophalloides oatesi* (Leiper et Atkinson, 1914) (Table II)


**Hosts:** *Champsocephalus esox, Cottoperca trigloides, Patagonotothen longipes, P. tessellata* (new hosts).


**Site of infection:** stomach – 223 specimens.

**Remarks.** The species occurs at shelves of Antarctica, sub-Antarctica and merely zones of the southern hemisphere in fish of different orders and has been recorded by many authors (see Zdzitowiecki 1997). It was found in *Eleginops maclovinus* in the Aguirre Bay near to the Beagle Channel and reported as *Plerurus* sp. (Szidat 1950). Szidat (1955) was the first author who found it in the gadid fish, *Merlucius hubbsi*, at the Falkland–Patagonian Shelf (the name *E. merlucii* was used). Gaevskaya *et al.* (1990) recorded the parasite in the same area in the nototheniid fish *Dissostichichus eleginoides*.

*Lecithaster macrocotyle* Szidat et Graefe, 1967 (Table II)

**Synonyms:** *Lecithaster australis* Prudhoe et Bray, 1973, *Aponurus* sp. of Szidat (1950).

**Hosts:** *Patagonotothen brevicauda, P. longipes, P. tessellata* (new hosts).

**Dates of collection:** January 25–29 2002.

**Site of infection:** ileum – 43 (87.8%), rarely jejunum – 4 (8.2%) and rectum – 2 (4.1%), in total 49 specimens.

**Remarks.** According to Zdzitowiecki (1992) *Lecithaster macrocotyle* occurs in fish circum Antarctic in Antarctica and sub-Antarctica (see also descriptions published by Prudhoe and Bray 1973 and Zdzitowiecki 1997). Szidat (1950, Fig. 9) described and documented in lateral position a digenean *Aponurus* sp. similar to *L. macrocotyle*, but the morphology of its ovary is neither described nor documented. Representatives of the genus *Lecithaster* have the ovary that consists of four compact lobes. Other features shown by Szidat (1950) are in agreement with those of *L. macrocotyle*. Taking into account the presence of this species in other nototheniids in the Beagle Channel nearly to Aguirre Bay (the place of Szidat’s investigations), the present authors consider identity of both forms mentioned.

**Discussion**

Of nine digenean species found in notothenioid fish in the Beagle Channel, two hemiuroids, *Derogenes varicus* and *Elytrophalloides oatesi*, have wide host specificity and geographic distribution not restricted to Antarctica and sub-Antarctica. Almost all other species are specific for Notothenioidei. The exception is one sub-Antarctic endemic species, *Stenakron kerguelense*, recorded at the Heard Island in *Zanclorhynchus spinifer* (Congiopodidae). Two hemiuroids, *Genolinea bowersi* (occasionally found in a gadid host) and *Lecithaster macrocotyle*, occur within the circum Antarctic and sub-Antarctic. Of four hemiuroids, three (with exception for *G. bowersi*) were found near to the Beagle Channel by Szidat (1950). However, the author mentioned used other names.

One species, *Postmonorchis variabilis*, is almost endemic to sub-Antarctica, but was found also at South Georgia (intermediate province between Antarctica and sub-Antarctica). Three other presently identified species, *Macvicaria magellanica, Neolepidapedoides subantarcticus* and *Whitegonimus ozoufae*, and two or three species recorded by Szidat (1950), *Monorchides popovicii* Szidat, 1950 and *Postmonorchides maclovini* Szidat, 1950 (the doubtful form is *Lepocreadium sp.*), are potentially endemic to the Magellanic sub-region.

Six digenean species were more abundant at the mouth of the Beagle Channel than at the harbor of Ushuaia (Table II). However, one rare species, *W. ozoufae*, was found only in one fish specimen (*P. tessellate*) at Ushuaia, and two other species, *S. kerguelense* (*P. longipes*) and *G. bowersii* (*C. trigloides*), were more abundant in the latter locality. Lower infections with six digenean species in fish caught in the harbor could be a result of more shallow and dirty water.

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