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Occurrence of Acanthocephala in intermediate hosts, Amphipoda, in Admiralty Bay, South Shetland Islands, Antarctica

ABSTRACT: In total, 8511 amphipods of 12 species caught in Admiralty Bay were examined for the presence of acanthocephalans using them as intermediate hosts. Only 27 specimens of eight species were infected (total prevalence 0.32%). Acanthellae and cystacanths of four species using fishes as either definitive or paratenic hosts were found. Normally, single parasites occurred; in one case two acanthocephalans were present in one specimen of *Bovallia gigantea*. This host species was the most strongly infected, with the prevalence 3.41%. Six other amphipod species were infected with the prevalence 0.08–0.66%. One of two *Jassa ingens* examined was also infected. Over 50% of acanthocephalans belonged to one echinorhynchid species maturing in fishes, *Aspersentis megarhynchus*, which occurred in five host species of four amphipod families, *B. gigantea*, *Gondogeneia antarctica*, *J. ingens*, *Hippomedon kergueleni* and *Orchomenella rotundifrons*. Two polymorphid species maturing in seals, *Corynosoma hamanni* and *C. pseudohamanni*, were found in a single host species each, *Prostebbingia brevicornis* and *Cheirimedon femoratus*, respectively. Three parasite species mentioned occurred exclusively in sub-littoral host species, at the depth 0–30 m. The third polymorphid species, *C. bullosum*, was the only species occurring in the amphipod, *Waldeckia obesa*, living in the deeper water (infected specimen was caught at the depth 60 m), but was found also in *B. gigantea*. Differences between infections of Amphipoda and fishes with echinorhynchids and polymorphids are discussed.

Key words: Antarctica, Acanthocephala, Amphipoda, intermediate hosts, parasites.

Introduction

In total, 26 species of Acanthocephala have been reported from definitive and paratenic hosts occurring or probably occurring in the Antarctica (Zdzitowiecki 1991). Data on the occurrence of acanthocephalans in intermediate hosts in this re-

gion are limited. Immature specimens, probably in the cystacanth stage of development, were reported from amphipods from the Western Antarctica collected at the South Shetland Islands, South Orkney Islands and Antarctic Peninsula (Bone 1972, Richardson in Hoogesteger and White 1981, Feiler 1984, Hoberg 1986). Only Hoberg (1986) determined parasites as *Corynosoma pseudohamanni*, but the host was determined only as *Pontogeneiella* (probably = *Prostebbingia*) sp. *Bovallia gigantea* and *Pontogeneia* (= *Gondogeneia*) *antarctica* were reported as hosts of undetermined acanthocephalans (Bone *op. cit.*, Richardson *op. cit.*, respectively). According to Bone, acanthocephalans occurred in *B. gigantea* at the South Orkney Islands with a prevalence 2.67%, while Feiler (*op. cit.*) found at the South Shetland Islands a total prevalence of 1.1% of undetermined acanthocephalans in amphipods of nine species (names not given). Recently, the senior author (Zdzitowiecki 2001) examined amphipods of 12 species collected in Admiralty Bay (at the South Shetland Islands) and found acanthellae and cystacanths of four species, *Aspersentis megarhynchus* (Linstow, 1892), *Corynosoma bullosum* (Linstow, 1892), *C. hamanni* (Linstow, 1892) and *C. pseudohamanni* Zdzitowiecki, 1984. Morphological data and lists of hosts of each species were given (Zdzitowiecki 2001). The present paper is based on the same material and concerns data on the occurrence of acanthocephalans in each amphipod species examined.

Material and methods

In total, 8511 amphipod specimens of 12 species were available for the examination. All specimens were collected in Admiralty Bay. Over 99% specimens were received from Professor K. Jażdżewski and his co-workers from the University of Łódź, but 55 specimens were from Dr. P. Borsuk from the University of Warszawa. They were identified by Professor Jażdżewski, Mrs. E. Presler, M.Sc. and Mrs. M. Pudlarz, M.Sc. A list of amphipods and depths of collection are given in the Table 1. Names are given according to De Broyer and Jażdżewski (1993).

All examined Lysianassoidea are necrophagous species and they were caught in traps baited with meat (Presler 1986). *Gondogeneia antarctica* occurs mainly on macro-algae and was collected near the coast line. This species is known as primarily herbivorous, feeding on micro-algae and secondarily on macro-algae, but also eating small Crustacea and detritus material (Richardson and Whitaker 1979, Jażdżewski *et al.* 2000). It was sampled using a cylindrical sampler described by Jażdżewski *et al.* (2000). Other species were available in limited numbers (Table 1). 123 specimens of *B. gigantea*, which according to Bone (1972) is the predator/omnivore species, were collected from traps at the depth 5–15 m together with necrophagic species and *Prostebbingia brevicornis*. All *Eurymera monticulosa*, which is herbivorous/omnivore species (Jażdżewski *et al.* 2000), and 29 *B. gigantea* were caught at the coast line using a cylindrical sampler at a low tide. Remaining 53 specimens of *B. gigantea* and two of *Jassa ingens* were caught at vari-

Table 1

A list of amphipods examined and depths of collections.

Amphipods	n	Depth (m)
Eusiridae		
Bovallia gigantea Pfeffer, 1888	205	0–30
Eurymera monticulosa Pfeffer, 1888	85	0
Prostebbingia brevicornis (Chevreux, 1906)	602	5–30
Exoedicerotidae		
Methalimedon nordenskjoeldi Schellenberg, 1931	42	10
Gammarellidae		
Gondogeneia antarctica (Chevreux, 1906)	1223	0–5
Ischyroceridae		
Jassa ingens Pfeffer, 1888	2	15–30
Lysianassoidea		
Abyssorchomene plebs (Hurley, 1965)	1204	30–60
Cheirimedon femoratus (Pfeffer, 1888)	1431	5–15
Hippomedon kergueleni (Miers, 1875)	1211	5
Orchomenella rotundifrons (K.H. Barnard, 1932)	1234	5–15
Waldeckia obesa (Chevreux, 1905)	1204	60–90
Phoxocephalidae		
Heterophoxus videns K.H. Barnard, 1930	68	20

ous depths (mainly 15–30 m, but possibly some specimens somewhat deeper) using a bottom dredge. *Methalimedon nordenskjoeldi* and *Heterophoxus videns* prefer mud and muddy sand substrates (Thurston 1974) and some individuals of these species were caught using a Tvärminne-type bottom sampler and SCUBA-diving technique.

All amphipods were fixed and stored in 4% formalin and re-fixed in 70% ethanol. They were examined for the presence of acanthocephalans using a stereo-microscope (magnitude 10x). All of mesosome and metasome segments were separately opened and acanthocephalans present in the haemocoeloma were collected. Their morphology and taxonomy have been described and discussed separately (Zdzitowiecki 2001). Voucher specimens are deposited in the Natural History Museum in London (BMNH 2001.3.15.1-9) and in the Museum of Zoology in Warszawa (MZPW 7/2001). In the present paper three young acanthellae lacking taxonomic features are considered to belong to the same species as cystacanths and advanced acanthellae found in the same host species.

Results

Only 27 of 8511 amphipods were infected with acanthocephalans (0.32%). Normally, single parasites were found; in one case two specimens of *Aspersentis*

Table 2

Infection of amphipods in Admiralty Bay, with depths of collection of infected specimens.

Host species	Parasite species	Prevalence (%)	Relative density	Depth (m)
B. gigantea	*Aspersentis megarhynchus*	2.93	0.034	0–30
	Corynosoma bullosum	0.49	0.005	15–30
	Total	3.41	0.039	0–30
P. brevicornis	*Corynosoma hamanni*	0.66	0.007	5–15
G. antarctica	*Aspersentis megarhynchus*	0.25	0.002	0
J. ingens	*Aspersentis megarhynchus*	1 of 2		15–30
C. femoratus	*Corynosoma pseudohamanni*	0.42	0.004	5–15
H. kergueleni	*Aspersentis megarhynchus*	0.25	0.002	5
O. rotundifrons	*Aspersentis megarhynchus*	0.16	0.002	5–15
W. obesa	*Corynosoma bullosum*	0.08	0.001	60

megarhynchus occurred in one specimen of *Bovallia gigantea* caught at the coast line. In total, 28 acanthocephalans have been collected.

Four amphipod species, *Abyssorchomene plebs, Eurymera monticulosa, Heterophoxus videns* and *Methalimedon nordenskjoeldi*, were not infected. However, only the first species was examined in sufficient number of specimens (1204). A lack of positive results for remaining species can be associated with the small sample size (less than 100 specimens of each species).

Data on the infection of eight host species are shown in the Table 2. The most strongly infected species (prevalence exceeding 3%) was the predatory/omnivorous species *B. gigantea*. Six other species were much less strongly infected, with a prevalence between 0.08% and 0.66%. Only two specimens of *Jassa ingens* were examined (one specimen infected) and nothing can be said on the real level of its infection. Of eight infected species of amphipods, seven were collected at depths between 0 and 30 m. Of the two species examined occurring deeper, only one, *Waldeckia obesa,* was infected, but only one parasite was found in 1204 specimens examined (the lowest infection found). The second species occurring in the deeper water, *A. plebs,* was not infected (see above).

Of 28 acanthocephalans, 16 specimens belong to the echinorhynchid species, *Aspersentis megarhynchus* (syn. *A. austrinus*), maturing in many species of notothenioid fish (Zdzitowiecki and Rokosz 1986). It was the only parasite found in four sub-coastal host species belonging to three families and one of two species occurring in *B. gigantea* belonging to a fourth family. Thus its specificity is wide. It was accompanied in *B. gigantea* with one specimen of the polymorphid species, *Corynosoma bullosum*, maturing in elephant seals and using fish as paratenic hosts. The latter was the only species and specimen found in an amphipod caught in the deeper water (60 m). Its intermediate hosts belong to two different families.

Two other polymorphid species maturing in Weddell seals and leopard seals, *Corynosoma hamanni* (four specimens found) and *C. pseudohamanni* (six specimens found) appear to be specific parasites of *Prostebbingia brevicornis* and *Cheirimedon femoratus*, respectively. Both intermediate hosts occur mainly in sub-coastal waters (specimens examined were caught at the depth 5–15 m) and were free of other acanthocephalans.

Discussion

In total, 11 acanthocephalan species occur in fishes in Admiralty Bay (Zdzitowiecki 1986a, 1986b, Zdzitowiecki and Rokosz 1986; see Table 3). Six species of Echinorhynchida use fishes as definitive hosts, whereas five species of Polymorphida of the genus *Corynosoma* use them as paratenic hosts. Representatives of both these orders were found in amphipod intermediate hosts.

A. megarhynchus was the dominant echinorhynchid species in amphipods, as well as in some small and large sub-littoral fishes (Table 3). Of 11977 specimens of echinorhynchids collected by the senior author from bony fishes (523 specimens of various benthic and bentho-pelagic fish species were examined) in Admiralty Bay in 1978/79 and 1986, 10167 acanthocephalans (85%) belonged to this species. It occurred in almost all specimens of the large sub-littoral fish *Notothenia coriiceps* (syn. *N. neglecta*) (see Zdzitowiecki and Rokosz 1986 and Table 3) and even in 25% of small *Harpagifer antarcticus* (see Zdzitowiecki and Zadróżny 1999 and Table 3). Therefore, it is not strange that over 50% of acanthocephalan specimens found in intermediate hosts belonged to this species. Other echinorhynchids were not found in amphipods. Three of them, *Heterosentis heteracanthus, Metacanthocephalus campbelli* and *Echinorhynchus petrotschenkoi*, are rare even in fishes. *Metacanthocephalus dalmori* and *M. johnstoni* are abundant in *N. coriiceps* and some other fishes (Zdzitowiecki 1986b). They probably use other amphipods or even other Crustacea (?Isopoda) as intermediate hosts. Fishes become infected with all these echinorhynchids by feeding on intermediate hosts.

In total, 22268 cystacanths of polymorphids of the genus *Corynosoma* were found by the senior author in the same fishes in Admiralty Bay. Of them, 8668 specimens were *C. hamanni* and 12319 were *C. pseudohamanni*. Fishes can acquire these parasites using two ways. The first way is, of course, the same as in the case of echinorhynchids (feeding on Crustacea), but predators can be infected also by feeding on smaller infected fishes and the accumulation of cystacanths in large fishes takes place (Zdzitowiecki 1986a). Thus, relatively smaller number of interactions between infected intermediate hosts (crustaceans) and large fishes is enough for the presence of massive infections of paratenic hosts. The infection of *N. coriiceps* with both the most abundant polymorphids was similar with that with *A. megarhynchus*, but the infection of amphipods with polymorphids seems to be

Table 3

Comparison between infections with Acanthocephala of infected species of Amphipoda and sublittoral small (*Harpagifer antarcticus*) and large (*Notothenia coriiceps*) fishes in Admiralty Bay based on the prevalence (%) and relative density.

Acanthocephala	Various Amphipoda*	*Harpagifer antarcticus***	*Notothenia coriiceps****
	n = 205–1431	n = 44	n = 248
Aspersentis megarhynchus	0.16–2.93%; 0.002–0.034	25%; 0.30	99.2%; 33.5
Heterosentis heteracanthus	–	–	0.8%; 0.012
Metacanthocephalus campbelli	–	–	–
Metacanthocephalus dalmori	–	2%; 0.02	27.0%; 1.57
Metacanthocephalus johnstoni	–	–	57.7%; 3.31
Echinorhynchus petrotschenkoi	–	–	0.4%; 0.004
Corynosoma arctocephali	–	2%; 0.02	13.7%; 0.3
Corynosoma bullosum	0.08–0.49%; 0.001–0.005	–	40.7%; 0.8
Corynosoma hamanni	0.66%; 0.007	–	96.3%; 24.3
Corynosoma pseudohamanni	0.42%; 0.004	9%; 0.09	99.6%; 36.2
Corynosoma shackletoni	–	–	8.9%; 0.1

* Present data; ** according to Zdzitowiecki and Zadróżny (1999); *** according to Zdzitowiecki (1986a, 1986b) and Zdzitowiecki and Rokosz (1986).

lower than that with echinorhynchids (Table 2). Both abundant polymorphids mentioned were found in amphipods, but each parasite species only in one host species, whereas *A. megarhynchus* occurred in five host species.

According to Hoberg (1985, 1986) and Zdzitowiecki (1986a, 1986b, 1990) most of acanthocephalan species occurring in the Western Antarctica are associated with the environment of relatively shallow waters, mainly with the fjord environment. According to Zdzitowiecki (1990, 1996), *Corynosoma bullosum* occurs mainly in fishes living over the open sea shelf, deeper than other abundant species. The present data confirm this opinion, as *C. bullosum* was the only acanthocephalan species found in amphipods collected deeper than 50 m. But this association is not obligatory, because the second specimen of this species was found in the typical sub-littoral amphipod, *B. gigantea*. Cystacanths of *Corynosoma arctocephali* (a parasite of fur seals and leopard seals) and *C. shackletoni* (a parasite of penguins) are relatively rare in fishes in Admiralty Bay and were not found in amphipods.

It should be noted, that not less than 451 benthic amphipod species occur in the Antarctica (De Broyer and Jażdżewski 1993), of which over 100 occur in Admiralty Bay (Jażdżewski *et al.* 1992), whereas the present data are based on the examination of 12 species, of which only eight seem to be examined in sufficient numbers of specimens (see Table 1). The species composition of the sample examined

is dependent upon methods of sampling and limited possibilities of examination of amphipods. Most of specimens examined are necrophages.

Many millions of amphipods live in Admiralty Bay and they form a significant part of the prey of fish and other animals (Jażdżewski 1981, Linkowski *et al.* 1983, Jażdżewski and Konopacka 1999). Taking into account the abundance of benthic amphipods in Admiralty Bay (Jażdżewski *et al.* 1986, 1991) and the fact that most fish species feed on them (Linkowski *et al.* 1983), the level of infection (0.32% of all examined amphipods together) is high enough to explain the high acanthocephalan infections of many fishes, especially predators. It should be noted, that the only previous data on the prevalence of infection of Antarctic amphipods published by Bone (1972) (the infection of *B. gigantea* at the South Orkney Islands with a prevalence 2.7%) and Feiler (1984) (the infection of various amphipods at King George Island with a total prevalence 1.1%) are not drastically different from the present data.

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