INTRODUCTION

In the second half of the 1970s the interest of the world fisheries was focused on the living resources of Antarctic. Along with the intensification of the catches the scientific research efforts increased on the size of resources, the biology of exploited species, and their parasites.

Parasitic copepod *Eubrachiella antarctica* (Quidor, 1906) of the family Lernaeopodidae Olsson, 1869 has been one of external parasites more frequently occurring on the Antarctic fishes.

Data on the fish infection with this parasites were published by Kock and Möller (1977), Kock (1979), Siegel (1980, 1980a), Sosiński and Janusz (1986), Rokicki and Skóra
Jerzy Janusz, Józef Sosiński


In the season of 1978/79, during the IVth Polish Marine Antarctic Expedition on R/V Profesor Siedlecki (Sosiński 1979) in the frames of biological studies observations were conducted on the occurrence of Eubrachiella antarctica (Quidor, 1906) in selected fish species. The results acquired during the above-mentioned expedition were published on five fish species representing the family Channichthyidae (Sosiński and Janusz 1986) and Notothenia (Gobionotothen) gibberifrons Lönberg, 1905 of the family Nototheniidae (Rokicki and Skóra 1986).

The present paper contains data on the hitherto unpublished results on the infection with the above-mentioned parasite of the remaining six fishes of the family Nototheniidae which were studied during that cruise, namely Dissostichus eleginoides Smitt, 1898, Notothenia (Notothenia) rossi Richardson, 1884, Notothenia (Notothenia) neglecta Nybelin, 1951; Notothenia (Lepidonotothen) kempi Norman, 1937; Patagonotothen brevicauda guntheri (Norman, 1937), andPagothenia hansoni (Boulenger, 1902).

MATERIAL AND METHODS

The present survey was carried out within 1978–1979 (December 1978 to March 1979) in the Atlantic sector of Antarctic (Fig. 1). The samples were taken by R/V Profesor Siedlecki during the Fourth Polish Marine Antarctic Expedition. A total of 1 290 fishes were examined for presence of Eubrachiella antarctica. Detailed numbers of the fishes studied on individual fishing grounds is given in Tab. 1.

<table>
<thead>
<tr>
<th>Species</th>
<th>Date</th>
<th>Fishing area</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissostichus eleginoides</td>
<td>Jan, Mar 79</td>
<td>Shag Rocks, South Georgia, Elephant Islands, South Shetland</td>
<td>169</td>
</tr>
<tr>
<td>Notothenia (Notothenia) rossi</td>
<td>Jan, Mar 79</td>
<td>68</td>
<td>101</td>
</tr>
<tr>
<td>Notothenia (Notothenia) neglecta</td>
<td>Mar 79</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Notothenia (Lepidonotothen) kempi</td>
<td>Feb 79</td>
<td>100</td>
<td>300</td>
</tr>
<tr>
<td>Patagonotothen brevicauda guntheri</td>
<td>Jan, Mar 79</td>
<td>200</td>
<td>288</td>
</tr>
<tr>
<td>Pagothenia hansoni</td>
<td>Mar 79</td>
<td>288</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>268</td>
<td>591</td>
</tr>
</tbody>
</table>
Fig. 1. The areas of study
Immediately after capture the fishes were subjected to routine ichthyological procedures followed by the search for the parasite. Distribution as well as numbers of the copepods on different body parts (buccal cavity, gills, skin, and individual fins) was recorded, and the basic infection parameters such as prevalence and intensity, were calculated. Two fish species exhibiting particularly highly parasitized were studied for possible relationship between the infection level and their total length. The fish were measured to the nearest 1 cm.

To make the biological description of the studied fish populations more complete, their gonad maturity was determined using 8 degree Maier scale.

The names of the fishes follow the key of FAO/CCAMLR (Fisher and Hureau 1958).

RESULTS

**Dissostichus eleginoides** Smitt, 1898

The observations were carried out in January 1979 on the Shag Rock fishing grounds and in March—off South Georgia.

Shag Rocks. The length of the studied fish ranged from 30 to 145 cm. The majority of them were 37 to 42 cm long. The fish were sexually immature with their gonads in 1st or 2nd stage. Only four specimens exceeding 100 cm had gonads in 3rd and 4th stage. The population studied was highly parasitized with the prevalence amounting to 79.4% and the mean intensity of 3.6 (Tab. 2). The parasites were found in the buccal cavity only (Tab. 3).

South Georgia. The specimens caught in this area were relatively bigger. Their length ranged from 45 to 136 cm. Their mean modal length was 55 cm. Similarly as the fish from the Shag Rock they had their gonads representing 1st and 2nd stage. Only the gonads of four largest specimens were in 3rd and 4th stage. The infection level was higher than on the Shag Rock fishing ground. The prevalence was 84.2% while the mean intensity was 4.0 (Tab. 2). All parasites were located in the buccal cavity only (Tab. 3).

The combined prevalence and mean intensity for both fishing grounds calculated separately for each length class is shown on Fig. 2. No clear relationship between the infection parameters and the fish length is visible. It may be a result of a small number of the fish longer than 65 cm.

**Notothenia (Notothenia) rossi** Richardson, 1884

The observations were carried out in January and March 1979 off South Georgia. In both periods the length structure of the fish was similar, ranging from 34 to 70 cm. The specimens caught in March were more sexually mature. More than 50% of them had gonads in stages 4th and 5th. The infection parameters of this species were relatively high with prevalence amounting to 59.4% and mean intensity of 18.9 (Tab. 2). The fish caught in
January were relatively more parasitized. Within the entire period of study the parasites occurred in the buccal cavity only (Tab. 3).

Fig. 3 shows a positive correlation between the fish length and the prevalence. The correlation coefficient, however, is low ($r = 0.3486$). More distinct is the increase of the intensity (abundance) associated with the fish length ($r = 0.6507$). This relationship is best described by a multinomial curve of the determination coefficient $r^2 = 0.4722$.

*Notothenia (Notothenia) neglecta* Nybelin, 1951

This species occurs on the fishing grounds located more south. Only 31 specimens of this fish caught in March 1979 were surveyed. They were collected off King George Island within South Shetland Islands. Their length ranged from 35 to 53 cm and their gonads were in stage 4, which indicated preparations for spawning. The prevalence was 29% while mean intensity was 2.6 (Tab. 2). All parasites were attached in the mouth cavity (Tab. 3).

*Notothenia (Lepidonotothen) kempi* Norman, 1937

The studies covered the specimens caught in February 1979 off Elephant and South Shetland Islands. The fish surveyed were sexually immature with gonads in 1st and 2nd stage. Out of 100 specimens collected off Elephant Island no one harbored *E. antarctica*. Out of 300 fish collected off South Shetland Island only one had two parasites on its caudal fin (Tabs. 2, 3).

*Patagonototen brevicauda guntheri* (Norman, 1937)

The survey was carried out off Shag Rocks in January and March 1979. Out of 100 fish examined in January and 100 in March, only a single fish in each month was infected with *E. antarctica* attached to the fins (Tab. 3). The length of the fish ranged from 10 to 22 cm. The fish caught in January showed maturation of the gonads in progress. About 37% of the specimens had gonads at 3rd stage of maturity. In March as many as 54% of the fish had their gonads at 3rd and 4th stage.

*PaJ[Othenia hansonii* (Boulenger, 1902)

The observations were conducted in March 1979 off South Georgia Island. The fish represented length classes from 16 to 40 cm. In this period, accelerated process of gonad maturation was observed. While in mid March 21% of the fish had gonads in 3rd and 4th maturity stage—by the end of March, the gonads of as many as 31% of specimens were at 3rd, 4th, 5th, and 6th stage. The population surveyed was characterized by a low prevalence (5.3%) and intensity (2.2). The parasites were located mainly on the caudal fin. (Tab. 3).
Table 2

Prevalence and mean intensity of infection of the nototheniid fishes with *Eubrachiella antarctica*

<table>
<thead>
<tr>
<th>Species</th>
<th>Fishing area</th>
<th>Shag Rocks</th>
<th>South Georgia</th>
<th>Elephant Islands</th>
<th>South Shetland</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>P</td>
<td>I</td>
<td>P</td>
<td>I</td>
</tr>
<tr>
<td>Dissostichus elonginoides</td>
<td></td>
<td>79.4</td>
<td>3.6</td>
<td>84.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Notothenia (Notothenia) rossi</td>
<td></td>
<td>59.4</td>
<td>18.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notothenia (Notothenia) neglecta</td>
<td></td>
<td>29.0</td>
<td>2.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notogonothithia (Lepidonotothen) kempi</td>
<td></td>
<td>0.0</td>
<td></td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Patagonotothen brevicauda guntheri</td>
<td></td>
<td>5.3</td>
<td>2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pagothenia hansoni</td>
<td></td>
<td>1.0</td>
<td>1.5</td>
<td>59.4</td>
<td>18.9</td>
</tr>
</tbody>
</table>

P—prevalence; I—mean intensity of infection

Table 3

Prevalence of *Eubrachiella antarctica* on the nototheniid fishes

<table>
<thead>
<tr>
<th>Species</th>
<th>Area</th>
<th>Prevention (%)</th>
<th>No. of parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissostichus elonginoides</td>
<td>Shag Rocks</td>
<td>100.0</td>
<td>196</td>
</tr>
<tr>
<td>Dissostichus elonginoides</td>
<td>South Georgia</td>
<td>100.0</td>
<td>338</td>
</tr>
<tr>
<td>Notothenia (Notothenia) rossi</td>
<td>South Georgia</td>
<td>100.0</td>
<td>2264</td>
</tr>
<tr>
<td>Notothenia (Notothenia) neglecta</td>
<td>South Shetland</td>
<td>100.0</td>
<td>23</td>
</tr>
<tr>
<td>Patagonotothen brevicauda guntheri</td>
<td>Shag Rocks</td>
<td>100.0</td>
<td>3</td>
</tr>
<tr>
<td>Pagothenia hansoni</td>
<td>South Georgia</td>
<td>100.0</td>
<td>33</td>
</tr>
</tbody>
</table>
Fig. 2. Prevalence and mean intensity of infection of *Dissostichus eleginoides* with *Eubrachiella antarctica* in individual length classes

Fig. 3. Correlation between the prevalence and mean intensity of infection of *Notothenia rossi* with *Eubrachiella antarctica* in individual length classes
RECAPITULATION AND CONCLUSIONS

The present survey conducted in the Atlantic sector of Antarctic in the season of 1978/79 revealed that six species of the family Nototheniidae showed substantial differences in the infection levels with *Eubrachiella antarctica* (Quidor, 1906). The highest infection rate was demonstrated by *Dissostichus eleginoides* Smitt, 1898 and *Notothenia (Notothenia) rossi* Richardson, 1884. Slightly less parasitized was *Notothenia (Notothenia) neglecta* Nybelin, 1951. *Pagothenia hansoni* (Boulenger, 1902) showed low infection levels. The remaining species i.e. *Notothenia (Lepidonotothen) kempi* Norman, 1937 and *Patagonotothen brevicauda guntheri* (Norman, 1937), depending on the collection site, did not have the parasites at all or their prevalence was close to 1%.

The parasites were distributed on different body parts of the fishes. A characteristic feature was observed, that the fish species of low infection rates had the parasites attached only to their fins, while in heavily parasitized fish species, the infection was limited to the mouth cavity.

Two of the presently discussed fish species of the family Nototheniidae were also widely studied for their parasites in other seasons, which makes the results comparable.

The occurrence of *E. antarctica* on *Dissostichus eleginoides* in the Atlantic sector of Antarctic was studied in the seasons of 1975/76 (Kock and Möller 1977); 1977/78 (Siegel 1980; El Mehlawy et al. 1993); 1978/79 (the present work); 1986/87 (El Mehlawy et al. 1979). The surveys were carried out on the Burdwood Bank, off Shag Rocks, and off South Georgia. The results indicated that the infection rates in these areas was high and it exceeded 80%. Only off South Georgia in the season of 1986/87 the infection rate was lower (66.1%). In the same area, in the season of 1975/1976 the prevalence was from 56 to 67% (Kock and Möller 1977) which could have been a result of a small number of the fish studied (21).

The presently determined (1978/79) intensity of infection in individual length classes was similar to the valued determined for the season of 1977/78 (Siegel 1980). At that time also the highest mean intensity (4.0–5.0) was observed in the fish 50–70 cm long.

While comparing the infection levels of *Notothenia (Notothenia) rossi* with *E. antarctica* on the shelf of South Georgia in different seasons (1977/78—Rokitki and Zdzitowiecki 1991; 1978/79—present work; and 1986/87—Rokitki and Zdzitowiecki 1991) it is evident that the prevalence decreased (93.4%, 59.4%, and 9.1% respectively). Low level of the infection in the last of the above-mentioned seasons might have been a result of examining previously frozen fish, which has also been indicated by the authors (Rokitki and Zdzitowiecki 1991). A similar decreasing tendency was observed in the values of the mean infection intensity which were 43.3; 18.9, and 2.4 respectively. In each season surveyed, the increase of the mean intensity of infection was positively correlated with the fish length.
ACKNOWLEDGEMENTS

The present work as well as the previous one (Sosiński and Janusz 1986) was made possible by our colleague, the late Zdzisław Formela, who collected the material during the cruise of R/V Profesor Siedlecki in the season of 1978/79.

REFERENCES


STAN ZARAŻENIA NIEKTÓRYCH GATUNKÓW RYB Z RODZINY NOTOTHENIIDAE WIDŁONOGIEM EUBRACHIHELLA ANTRACYTICA (QUIDOR, 1906) (COPEPODA)

STRESZCZENIE


W niniejszej pracy przedstawiono wyniki badań nad ekstensywnością i intensywnością inwazji pasożytniczej na sześciu gatunkach z rodziny Nototheniidae. Ogółem przebadano 1290 ryb. Stwierdzono, że najbardziej zapasożyczone były ryby z gatunku Dissostichus eleginoides (84,2% i 79,4% w zależności od łowiska) i Notothenia (Notothenia) rossi (59,4%). Stosunkowo dużym zapasożyceniem charakteryzowała się Notothenia (Notothenia) neglecta (29,0%). Najmniej zarażone były ryby z gatunku Pagophenax hansi (5,3%), Notothenia (Lepidonotothen) kempi (0,3% i 0,0% – w zależności od łowiska) oraz Patagonotothen brevicauda guntheri (1,0%).

Najwyższą średnią intensywność zarażenia zanotowano u Notothenia (Notothenia) rossi (18,9 pasożyta na jedną zarażoną rybę), najmniejszą u Patagonotothen brevicauda guntheri (1,5). U Notothenia (Notothenia) rossi stwierdzono tendencję wzrostu intensywności zarażenia wraz z długością ryb.

Analiza rozmieszczenia Eubrachiella antarctica na różnych częściach ciała ryb wykazała, że u gatunków o dużym zapasożyceniu 100% pasożytów umiejscowionych było w jamie gębowej, zaś u gatunków ryb o małym zapasożyceniu na płetwach.

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