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Parasitology

THE INFLUENCE OF ENVIRONMENTAL FACTORS ON THE  
EXTERNAL PARASITES OF SAITHE *POLLACHIUS VIRENS* (L.)  
WPŁYW ŚRODOWISKA NA PASOŻYTY ZEWNĘTRZNE CZARNIAKA  
*POLLACHIUS VIRENS* (L.)

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The influence of age, length and migration pattern of saithe *Pollachius virens* in relation to infection with external parasites has been studied in three different areas on the west coast of Sweden. A total of six species of parasites were found. The degree of infection was closely connected to the body length and the migration pattern of the saithe. A high degree of infection with *Diclidophora deniculata*, *Caligus elongatus*, *Lepeophtheirus pollachius* and *Clavella adunca* was found at the two deeper stations (76 and 71% resp.) while the fish at shallow stations inside the Gullmar Fiord exhibited very few cases of parasites.

## INTRODUCTION

Quantitative parasitological studies are important because they provide supplementary information on the biology and ecology of the host infected. Parasites may serve in such cases as biological tags. Consequently, one can interpret certain biological events related to migration or to the host's affinities. External parasites of the saithe also cause considerable economic problems in fish-farming (Hodneland and Nilsen 1992; Berland 1993).

Accounts on the occurrence of parasites on saithe from the North Sea have previously been published by e.g. Oorde-de Lint and Schuurmans Stekhoven (1936), Boxhall (1974), Reinsch (1976) and Rokicki and Strömberg (1991). The present paper describes the occurrence of external parasites on saithe caught in the Gullmar Fiord, western Sweden and from the open waters of the Skagerrak. The parasites are described in relation to the total length and age of the hosts at three different localities.

## MATERIAL AND METHODS

This comparison of external parasites of saithe is based on material collected in: a) shallow waters of the Gullmar Fiord, b) the mouth area of the fiord and c) the open waters of Skagerrak (Fig. 1).



Fig. 1. Location of the Gullmar Fjord - (x) marks the points where fish were caught

Sampling in the shallow waters of the fjord and at the mouth of the fjord was carried out in July 1990 and August 1995. At the station in the open waters of the Skagerrak the saithe were caught in September 1986. In 1990 and 1995 the fish are dissected immediately after capture. In 1986 however, the saithe were frozen and then thawed prior to examination.

In the shallow waters of the fjord, 53 specimens were examined. Of these, 38 were in the size range of 14–17 cm (mean 15.4 cm) and the mean weight was 30.3 g. From otolith analysis they were found to be one-year-old. Fifteen specimens were in the size range of 29–32 cm (mean 30.2 cm). They were determined as two-year-old.

At the mouth of the fjord, 88 specimens were caught. The length was within the range of 31–72 cm (mean 47.5 cm) and they were 2 to 7 years old.

The sample from the open waters of Skagerrak consisted of 150 specimens. The length was within the range of 42–75 cm (mean 56.0 cm) and the age 3 to 7 years.

The length of the collected saithe was measured to the nearest centimeter. Only the fresh material was used for weighting (to the nearest 5 g).

## RESULTS

A total of six species of external parasites was found on the saithe. Out of 291 specimens examined, 180 were infected with parasites.

### Gullmar Fjord, shallow waters (53 saithe examined, 11.3 % infected)

#### Monogenea

*Gyrodactylus arcuatus* Bychowsky sensu Bychowsky et Poljansky, 1953 syn. *G. bychowsky* Sproston, 1946

Location: skin. Infection: one specimen was found

#### Digenea

*Cryptocotyle lingua* (Creplin, 1825) metacercariae

Location: under the skin. Infection: three fish were infected, mean intensity was 5.6 specimens

#### Copepoda

*Clavella adunca* (Strom, 1762)

Location: mouth. Infection: two saithes were infected, mean intensity 1 specimen

Mouth area of the Gullmar Fiord (88 saithe examined, 76.1% infected)

#### Monogenea

*Diclidophora denticulata* (Olsson, 1876)

Location: gills. Infection: prevalence 15.9%, mean intensity 1.3

#### Copepoda

*Caligus elongatus* Nordmann, 1832

Location: mouth and skin. Infection: prevalence 3.4%, mean intensity 2.6

*Lepeophtheirus pollachius* Bassett-Smith, 1896

Location: mouth, mainly on the tongue. Infection: prevalence 14.7%, mean intensity 2.6

*Clavella adunca* (Strom, 1762)

Location: gills' filaments, operculum and in the mouth near the tongue. Infection: prevalence 30.6%, mean intensity 2.8

Open waters of Skagerrak (150 saithe examined, 71.3% infected)

#### Monogenea

*Diclidophora denticulata* (Olsson, 1876)

Location: gills. Infection: prevalence 1.3%, mean intensity 2.0

#### Copepoda

*Caligus elongatus* Nordmann, 1832

Location: mouth. Infection: prevalence 2.0%, mean intensity 1.2

*Lepeophtheirus pollachius* Bassett-Smith, 1896

Location: mouth. Infection: prevalence 14.0%, mean intensity 1.5

*Clavella adunca* (Strom, 1762)

Location: gills. Infection: prevalence 57.3%, mean intensity 3.0

### DISCUSSION

The degree of infection with external parasites on saithe varies depending on the age of the fish and the environment in which it lives. The examined fish in the shallow waters of the Gullmar Fiord showed only low prevalence of infection. Only three species of parasites were found. Two of them, *Gyrodactylus arcuatus* and *Cryptocotyle lingua*, are characteristic for coastal waters and the third, *Clavella adunca* is a truly marine species.

The principal host of *Gyrodactylus arcuatus* in Gullmar Fiord is the three-spined stickleback *Gasterosteus aculeatus* (cf. Malmberg 1970). However, the parasite can at times also infect, live and breed on other fish species. This investigation has shown that saithe can be such an additional host for *G. arcuatus*.

Three one-year-old saithe were infected by metacercariae of *Cryptocotyle lingua*. It is a common parasite of fishes in the coastal zone (Thulin et al. 1989). The life-cycle of that parasite is connected with the gastropod *Littorina littorea*.

*Clavella adunca* was found only on two 2-year-old saithe. This copepod is common on many marine fish species (Boxshall 1974) including the saithe in the North Sea (Rokicki and Strömberg 1991).

The young, 1–2-year-old saithe, seem to be protected ecologically from the invasion of young *Gyrodactylus arcuatus* and cercariae of *Cryptocotyle lingua* because of a little possibility of contacts between hosts and parasites. The fish mentioned occupy deeper water (more than 5 meters deep) than the environment in which *L. littorea* and *G. aculeatus* live (0–5 m deep).

Older fish found in the open waters and at the mouth of the fiord, were infected with four species of parasites; *Diclidophora denticulata*, *Caligus elongatus*, *Lepeophtheirus pollachius* and *Clavella adunca*.

The prevalence of *Diclidophora denticulata* on saithe is higher in the mouth area of the fiord compared to the open waters of Skagerrak (15.9% and 1.3% resp. Fig. 2). This

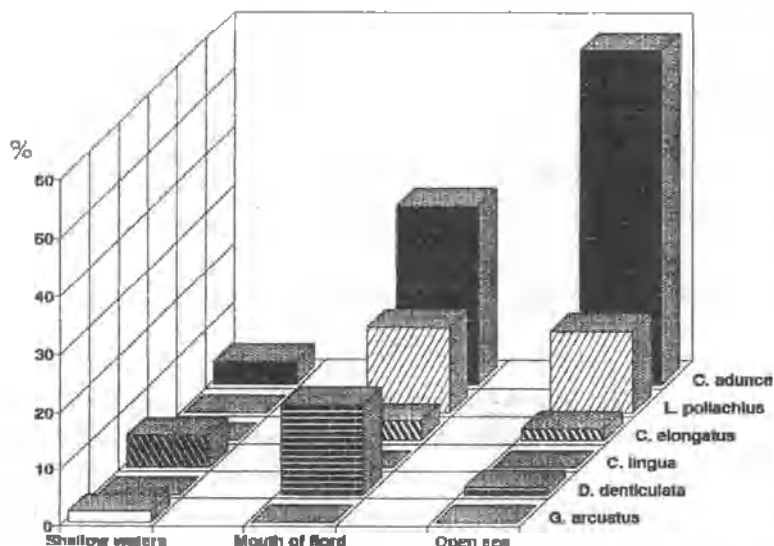


Fig. 2. Prevalence of infection of saithe from different areas

can be compared with an average value of 5.7% found by Rokicki and Strömberg (1991) in the North Sea and the Norwegian Sea.

The prevalence of *Caligus elongatus* and *Lepeophtheirus pollachius* is also higher at the mouth of the fiord compared to the open waters (Fig. 2). However, the opposite is true for the infection by *Clavella adunca*. For this species, the degree of infection was 30.6% at the mouth of the fiord and 57.3% in the open waters (Fig. 2). These values also correspond well with those found by Rokicki and Strömberg (1991) in the North Sea and the Norwegian Sea.

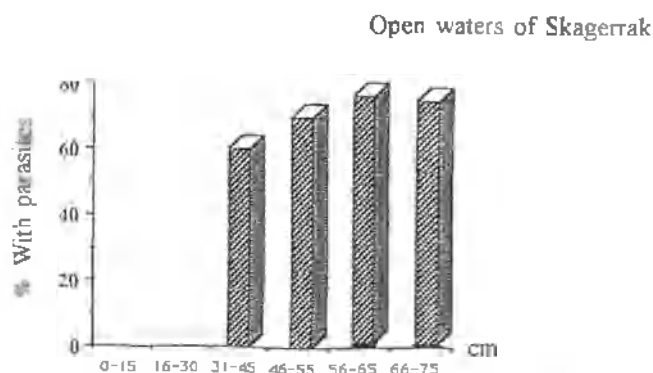
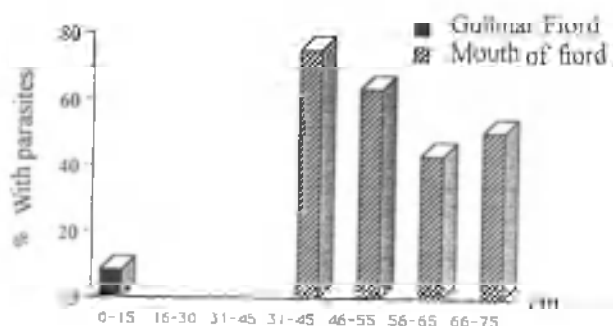


Fig. 3. Prevalence in relation to the fish length

a number of specimens, particularly *Lepeophtheirus pollachius* and *Caligus elongatus*, because of their comparatively weak attachment to the body of host.

The differences between the three areas investigated in regard to the number of external parasites on saithe seem to be closely connected with the migration behaviour of the host fish in the region. The youngest and thus the shortest saithe are found in the shallow areas in the fiord. Very few of these fish were infected with parasites. As the fish grow, they

This investigation has shown that the prevalence of parasites in relation to the length of the saithe differs when the open waters of Skagerrak are compared with the mouth area of the fiord. It can be easily concluded from Fig. 3 that the highest degree of infection at the mouth area of the fiord is found on fish of the size-range 31–45 cm, while in the open waters on fish of 56–65 cm. In both of these areas *Clavella adunca* was the most abundant species (Fig. 2). It is, however, important to mention that the process of freezing and then thawing of the material from the open waters of Skagerrak, might have caused the loss of a

start to migrate to deeper waters outside the fiord. At the mouth area of the fiord, the younger mix with older, sexually mature saithe which migrate from deeper areas to spawn at 90–100 metres of depth. This creates conditions favourable for infective stages of Monogenea and Copepoda to settle on younger fish. At this area, the percentage of infected saithe was also slightly higher than it was in the open waters (76 and 71% resp.).

Sea lice are parasitic copepods which typically infest the external surface of marine and brackish-water fish. Sea lice are a serious problem for commercial salmon farming (Boxhall and Defaye 1993). *Caligus elongatus* is one of the most important ectoparasites of salmon *Salmo salar* L. and is a non-specific parasite of many fish species (Piasecki 1995). In Gullmar Fiord there are few salmon farms, for which infected saithe can be a source of infection with copepods.

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#### WPLYW ŚRODOWISKA NA PASOZYTY ZEWNĘTRZNE CZARNIAKA *POLLACHIUS VIRENS* (L.)

#### STRESZCZENIE

U 291 zbitych czarniaków *Pollachius virens*, złowionych w Skagerraku i Gullmar Fiord, znaleziono 6 gatunków pasożytów zewnętrznych: *Gyrodactylus arcuatus*, *Diclidophora denticulata*,

*Cryptocotyle lingua*, *Caligus elongatus*, *Lepeophtheirus pollachius*, *Clavella adunca*. Zarazenie czarniaka pasożytami zależne było od wieku, długości i miejsca połowu ryb. Ryby łowione w wodach głębszych wykazywały wysoki stopień infekcji (76,1 i 71,3%). Natomiast młode czarniaki z wód płytkich były zarazone tylko w niewielkim stopniu (11,3%).

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