

INFESTATION DYNAMICS OF EXTERNAL PARASITES OF SAITHE
(*POLLACHIUS VIRENS*) FROM THE NORTH AND NORWEGIAN
SEAS*

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DYNAMIKA INFESTACJI PASOŻYTAMI ZEWNĘTRZNYMI CZARNIAKA
(*POLLACHIUS VIRENS*) Z MORZA PÓŁNOCNEGO I NORWESKIEGO

Abstract. An attempt has been made to examine the saithe's external parasites with respect to host age and the reproduction time of *Clavella adunca* in the North Sea. 1896 specimens of *Pollachius virens* caught in 1976-1980 and 1986 were examined. They were infested with *Diclidophora denticulata*, *Udonella caligorum* (*Monogenea*) and *Clavella adunca*, *Lepeophtheirus pollachius*, *Caligus elongatus* (*Copepoda*). The large number of adult females of *C. adunca* in winter and spring, the juvenile forms in summer and forms of 4th developmental phase autumn suggest that the reproduction cycle runs over the year in the North Sea with the peak between the late spring and early summer. The intensity values of infestation are highest for sexually mature fish but fall in older ones.

Rare data are given on the dynamics of the occurrence of parasites on saithe from the North Sea (Oorde-de Lint and Schuurmans Stekhoven 1936, Boxshall 1974). Reinsch (1976) mentioned only *Lernaeocera branchialis* parasite of this species. The Barents Sea saithe has been described parasitologically by Polianskij (1955). The present paper lists external parasites of saithe according to the age of hosts and season of their catches. Attempts have been made to establish the reproduction periods of *Clavella adunca*.

Material and methods

1896 individuals of *Pollachius virens* (L.) from the North Sea were examined in two annual cycles of 1976/77 and 1979/80 (fig. 1). The samples from the Norwegian

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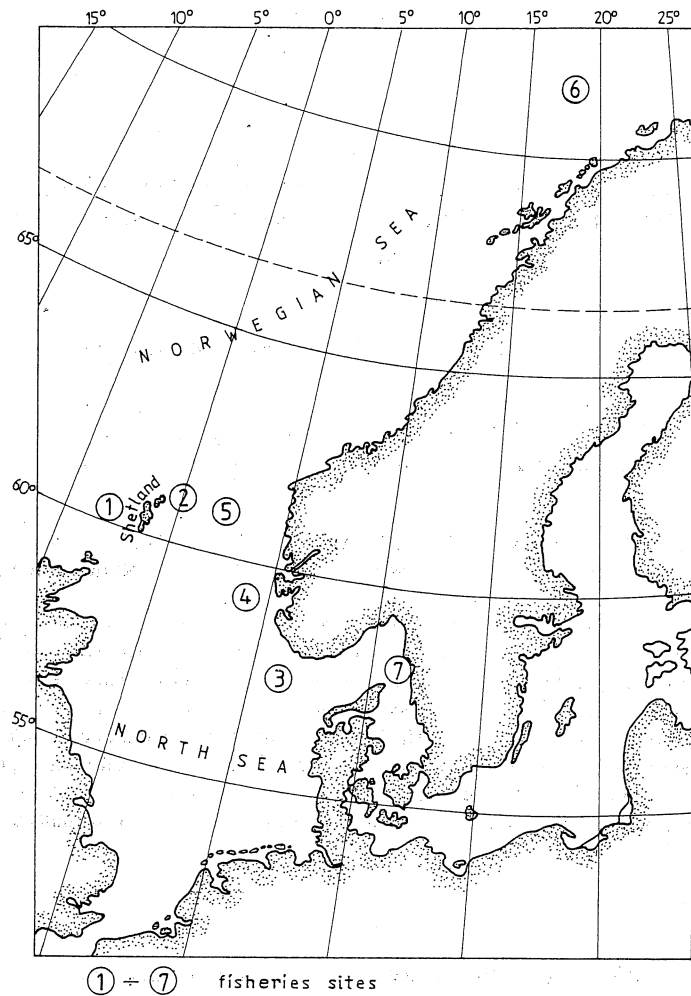


Fig. 1. The area of *Pollachius virens* fisheries

Sea (71°56' N and 15°46' E) of 1978 and also from Skagerrak – Gullmar Fiord (58°18' N and 11°32' E) – 1986 were taken only in summer.

The fish were brought in deep freeze and then thawed to be then examined in the laboratory for presence of external parasites. Because of the hard freezing and sorting conditions it was possible to take the external parasites only out of the mouth and branchial cavity of the fish.

Results

Monogenea

Diclidophora denticulata (Olsson, 1876). Location: gills of 3-4 year old saithe. Extensity and intensity of infestation in table.

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Udonella caligorum (Johnston, 1835). Location: on trunk near ovisacs and genital appendage of *Lepeophtheirus pollachius* females (12); mean intensity was 178 specimens.

Copepoda

Clavella adunca (Strøm, 1762). Location: gill filaments, operculum of saithe. Extensity and intensity of infestation in table and fig. 3. The highest extensity percentage of was found in autumn and the lowest in summer. Also in summer the intensity was the lowest 2.1 specimens, and the highest rate — 3.6 specimens, occurred in spring (fig. 2).

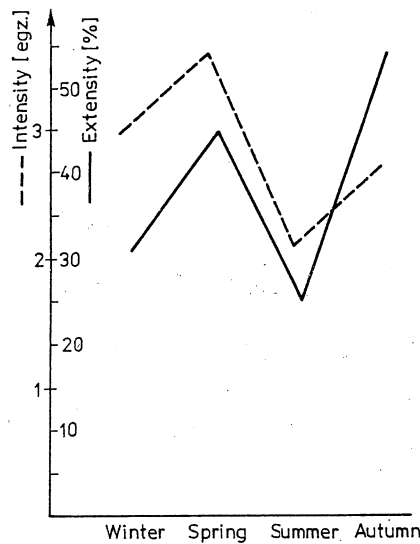
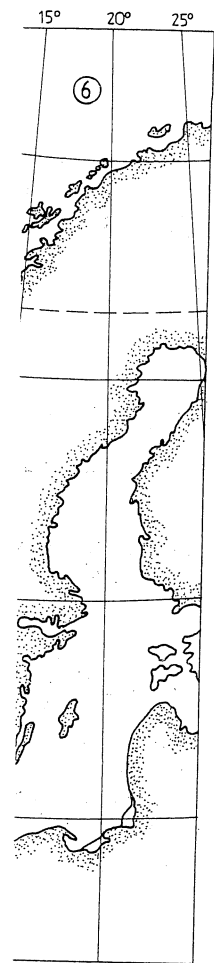


Fig. 2. Seasonality of occurrence of *Clavella adunca*

According to Heegaard (1947), Shotter (1971) and our own observations 6 subsequent developmental phases of the females can be distinguished:

- female after the last larva sloughing — in appearance and size resembles the mature male 0.5 mm long;
- relatively long (3.00 mm) cephalothorax, underdeveloped trunk (1.5 mm) and vaguely marked genital appendage (0.3 mm);
- cephalothorax slightly longer (3.3 mm) than the trunk (2.00 mm), genital appendage (0.5 mm) quite well developed;
- they are of size of fully developed individuals, lacking ovisacs. This is the last phase distinguished by Heegaard (1947) and a “mature adult” according to Shotter (1971);
- ovisacs contain white-transparent, premature eggs;
- ovisacs of yellow-brown colour with embryo of advanced development.



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Most of infected fishes were among 4-5 year old and the fewest among older fishes (fig. 4). Adult *C. adunca* females in the 5th and 6th phase of development occur all the year round and are present in great quantities in every season (fig. 3). They are most numerous in winter (59,5% and 29,7%) and

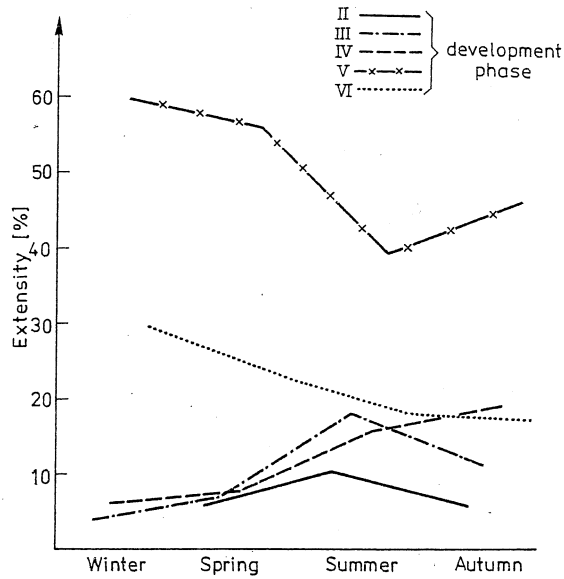


Fig. 3. *Clavella adunca* female's participation (%) in respective developmental phases at different times of the year.

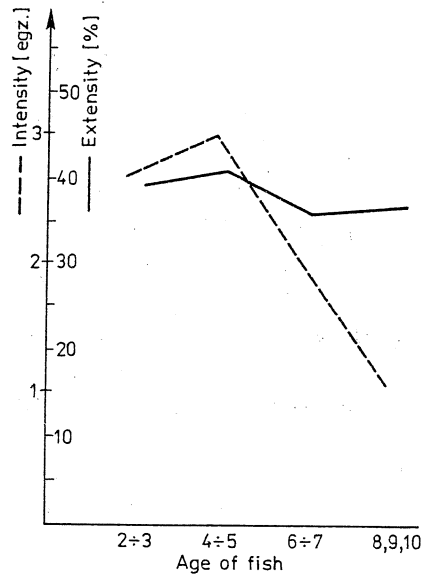


Fig. 4. Occurrence of *Clavella adunca* vs. fish's age

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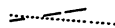
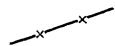
in spring (56% and 23%). The adolescent phases of the females occur in
greatest quantity in summer (10,9% and 17,4%). Individuals in their
4th developmental phase were present in great numbers in autumn (19%).

The dwarfed males not more than 9 were found attached to females, most
often around their genital appendage but also on the cephalothorax and trunk.
The rate of females to males was 9:1 (fig. 5).

Lepeophtheirus pollachius Bassett-Smith, 1896. Location: mouth, mainly
on palatinum and behind the pharyngeal bones. The highest extensity of
infestation was found in summer (31.4%) and the lowest in winter (2.9%). The
intensity in spring and in summer was highest (2.2 specimens) (fig. 6). The most
infested were 2-3 year old fish; the least 4-7 year old ones (fig. 7).

Caligus elongatus Nordmann, 1832. Location: mouth, operculum. Incidence
and intensity of infestation: the highest percentage of infested fish (15.7%) was
found in summer; the lowest in spring (0.5%) along with the lowest intensity
(1 specimen); the highest (1.97) was in autumn.

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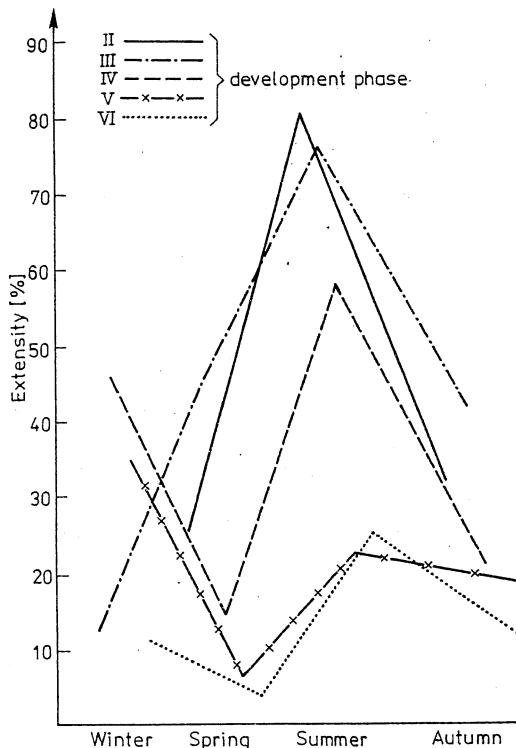


Fig. 5. Occurrence of *Clavella adunca* females with attached males depending on developmental phases and seasons

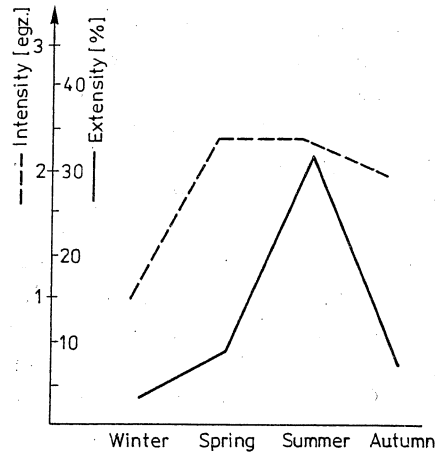


Fig. 6. Seasonality of *Lepeophtheirus pollachius* occurrence

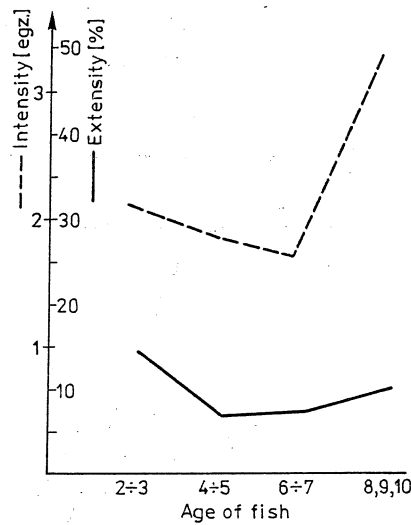


Fig. 7. Occurrence of *Lepeophtheirus pollachius* vs. the age of fish

Discussion

The presence of 4 species of external parasites on *Pollachius virens* is partially confirmed in the literature. Boxshall (1974) does not mention *Lepeophtheirus pollachius* but, along with Oorde-de Lint and Schuurmans Stekhoven (1936), describes *Caligus curtus*. This parasite was found on the surface of the fish trunk and could be acquired only just after the catching. In course of routine processing on board of the ship the fish usually lost those copepods. *L. pollachius* and *Caligus elongatus* have not been reported from the already well studied saithe from the Barents Sea (Poljanskij 1955). Reinsch (1976) mentioned only *Lernaeocera branchialis*, which occurs extremely rarely on *P. virens* (Boxshall 1974).

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Extensivity of infestation 50.7% of *P. virens* from the North and Norwegian Seas by *C. adunca* is much higher than the rate (10%) given by Boxshall (1974) for the same species of fish from the North Sea. It is also higher than the Poljanskij's results (1955) for the saithe from the Barents Sea (7.5%). Infestation intensity of *C. adunca* found in this research is 1-28 specimens (average 2.7 spec.) and is much higher than the results of Boxshall (1.8 spec.) and Poljanskij (1-7 spec.).

The highest rate of fish infestation was registered in autumn and the lowest in summer. Shotter (1971, 1973) who studied *C. adunca* from *Merlangus merlangus* (L.) from the Irish Sea, found no seasonal variation. Gjølseter (1987) showed that the extensivity of infection with *C. adunca* on Polar cod from the Barents Sea is the highest during the winter. It has been observed that both young and adult females of *C. adunca* occur during all seasons which suggests that this species can reproduce all year round. This agrees with Shotter's statements (1971) who claims that moreover, in the reproduction cycle of *C. adunca* there is possibly no clear climax. The present research has shown that the population of this species consists of old fish in winter and spring while in summer the adolescent forms occur in greatest number. It may be presumed that this species reproduces in the North Sea all over the year with the climax between late spring and early summer. It is contradictory to Heegaard's observations (1947) who supposed that in early winter there are fewer *C. adunca* adult females with eggs. Basing on the duration of older developmental phases of *C. adunca* females described by Shotter (1971) it may be supposed that young females (in the 2nd and 3rd developmental phases) which occur are abundant in summer (mid-July) turn into adult specimens between mid-October and mid-November. In winter material was collected in the beginning of November and in mid-January and was most rich in adult forms than at other time.

Individuals in the 4th developmental phase who mostly occur in autumn (19%) (fig. 3) will give a population consisting mostly of adult parasites in winter.

TABLE
Intensity and extensivity of infestation of fish *Pollachius virens*

Parasite		Number of fish		Infestation rate (%)	Intensity (n)
		examined	infested		
<i>Monogenea</i>	<i>D. denticulata</i>	1896	109	5.7	1-3
	<i>C. adunca</i>		962	50.7	1-28
<i>Copepoda</i>	<i>L. pollachius</i>		226	11.9	1-7
	<i>C. elongatus</i>		44	2.3	1-3

Autumn
Pollachius occurrence

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sites on *Pollachius virens* is (1974) does not mention e-de Lint and Schuurmans parasite was found on the ily just after the catching. In p the fish usually lost those e not been reported from the a (Poljanskij 1955). Reinsch hich occurs extremely rarely

Examining the dependence of infestation extensity and intensity on the fish's age one may state that the rate is the highest in the sexually mature fish and falls in older ones (fig. 4). This is inconerent with Poljanskij's results (1955) for the Barents Sea saithe whose infestation increases along with the fish age. However, Poljanskij investigated the dynamics of the parasites' occurrence on the fry, one- and two-year old fishes, and older specimens, not having stated the age limit and used only 16 specimens of *P. virens* for the last two tests. Kabata (1960) and Shotter (1971) noted similar results to the present ones for the family *Gadidae* infested with *C. adunca*. The present speculations may thus be consistent with their observations. Janusz (1979) found that the infestation of cod increased up to an age of 7 and 8 years, and then decreased. Schram (1980) found the highest rate of infestation on Polar cod of middle age.

It is almost impossible to compare the results for *L. pollachius* with the published data for there are no papers on its biology. The present extensiveness 11.9% (tab.) is greater than that given by Sproston and Hartley (1941) for another fish of the *Gadidae* family — *Gadus pollachius* from Plymouth (6.05%). The extensity of *L. pollachius* invasion decreases along with the age of fish but then increases a little in 8-10 year old fish (fig. 7).

Caligus elongatus occurred in great number on saithe (Boxshall 1974). However, it is very mobile, relatively losely attached to its host.

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