PARASITIC METAZOA OF PIKE-PERCH (*STIZOSTEDION LUCIOPERCA* L.) IN THE GULF OF GDANSK

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ABSTRACT

In 189 specimens of pike-perch (*Stizostedion lucioperca* L.) caught over one year period (1991-1992) in the Gulf of Gdańsk (area Krynica - Jantar) the following parasite species were found: *Achtheres percarum* Nordmann, 1832, *Ancyrocephalus paradoxus* Creplin, 1839, *Argulus foliaceus* (Linnaeus, 1758), *Azygia lucii* Mueller, 1776, *Bothriocephalus* sp., plerocercoid, (*scorpii*?), Mueller, 1776), *Brachyphallus crenatus* (Rudolphi, 1802), *Bucephalus polymorphus* Baer, 1827, *Bunodera luciopercae* (Mueller, 1776), *Camallanus lacustris* (Zoega, 1776), *C. truncatus* (Rudolphi, 1814), *Corynosoma semerme* (Forssell, 1904), *Diplostomum spathaceum,* metacercaria (Rudolphi, 1819), *Ergasilus sieboldi* Nordmann, 1832, *Hysterothylacium auctum* (Rudolphi, 1802), *Ichthyocotylurus platycephalus* (Creplin, 1825), *Neoechinorhynchus rutili* (Mueller, 1780), *Piscicola geometra* (Linnaeus, 1761), *Pomphorhynchus laevis* (Mueller, 1776), *Tylodelphys clavata,* metacercaria (Nordmann, 1832).

Dependence of parasite occurrence on the season and fish body length was evidenced. Distribution pattern of the monogenean *Ancyrocephalus paradoxus* on different fish gills has been described.

KEY WORDS: parasites, pike-perch *Stizostedion lucioperca*, Gulf of Gdańsk, Baltic Sea.

INTRODUCTION

The pike-perch (*Stizostedion lucioperca* L.) is a commercial fish occurring both in fresh waters and in brackish estuaries and lagoons of the Baltic. It is appreciated for its rapid growth rate and delicious taste. Pike-perch in Poland is caught in the Gulf of Gdańsk and in the Pomeranian Bay as it wanders there after spawning in adjacent rivers.

The list of parasites found up-today in pike-perch of Polish inland and marine waters was shorter than ours as former investigations were merely sporadic and limited to selected aspects. For example, Wiśniewski (1958) investigated dispersion of parasites among the whole host fauna of the Drużno Lake including the pike-perch. Pojmańska et al. (1980) and Pojmańska (1985) studied the dependence of pike-perch parasite fauna upon the water temperature in reservoirs with waste heated water. Waluga & Własow (1988) made observations on the influence of parasites upon the health condition of pike-perch and other fishes.

A number of foreign papers describe the parasite fauna of pike-perch in various water areas: the Sea of Azov (Soloncenko 1982), the Volga River (Stepanova & Vjuskova 1985), the Szczecin Lagoon and the Greifswald Bay (Walter 1988).

In the Gulf of Gdańk only 35 pike-perch specimens were surveyed by Rokicki in the years 1967-1971 (Rokicki 1975).

The aim of this paper is to establish the species composition of pike-perch parasite fauna in the Gulf of Gdańsk, to check the seasonal changes in parasitic infection, to examine the dependence of infection on the age (length) of fish, to describe peculiarities of some parasites and finally to evidence the bioindicative significance of the parasite fauna with concern to wandering of this fish species.

MATERIAL AND METHODS

The fish were caught in coastal waters of the Gulf of Gdańsk at about 1.5 n.m. off the Vistula spit, between the villages of Krynica Morska and Jantar. The material was being collected and examined every month, from December 1991 to December 1992. In total 189 specimens were surveyed. Length of the fishes ranged from 14.0 to 84.5 cm; the weight was from 17.6 g to 6100 g. Only heads and visceral organs were used for examinations. After about 12 hours from the fish catch, head, gills, mouth cavity, eyes and visceral organs: stomach, intestines, liver, heart, gonads, kidney, and gall bladder were surveyed by means of stereoscopic microscope. Total slides were made to determine the parasite species. Monogenea, without earlier fixing, were placed in lactophenol or in glycerine jelly. Digenea and Nematoda were killed by heat and fixed in Berland fluid (glacial acetic acid + formalin, 95:5), coloured with red consumable pigment then exposed to lactophenol and placed in glycerine jelly. Metacercariae, earlier killed by heat, and Acanthocephala, were fixed in 70% alcohol then coloured in acid carmine alun and dehydrated successively in 50%, 70%, 85% and two times in 96% alcohol, exposed to creosote and closed in Canada balsam. Other parasite species were fixed in 70% alcohol. Mouth parts of Copepoda were placed in lactophenol or glycerine jelly on slides.

Determination of parasite species was performed according to Baer (1985; 1987).

RESULTS

A total of 189 pike-perch specimens were examined. The parasites collected belonged to 19 species: 1 Monogenea, 7 Digenea, 3 Nematoda, 3 Acanthocephala, 1 Cestoda, 1 Hirudinea, 2 Copepoda and 1 Branchiura.

MONOGENEA:

Ancyrocephalus paradoxus Creplin, 1839.

Location: gill filaments. Prevalence and intensity of infection were 43.9% and 4.5, respectively. The highest prevalence and intensity occurred in summer, lower in spring and autumn and the lowest in winter (Fig.l). It was found that the highest infection (58%) was in fish 45.5 60.0 cm

long and the smallest one (12%) in fish of 14.0 - 30.0 cm (Fig.2).
Considering the frequency of Monogenea observed on the subsequent gills, the highest prevalence

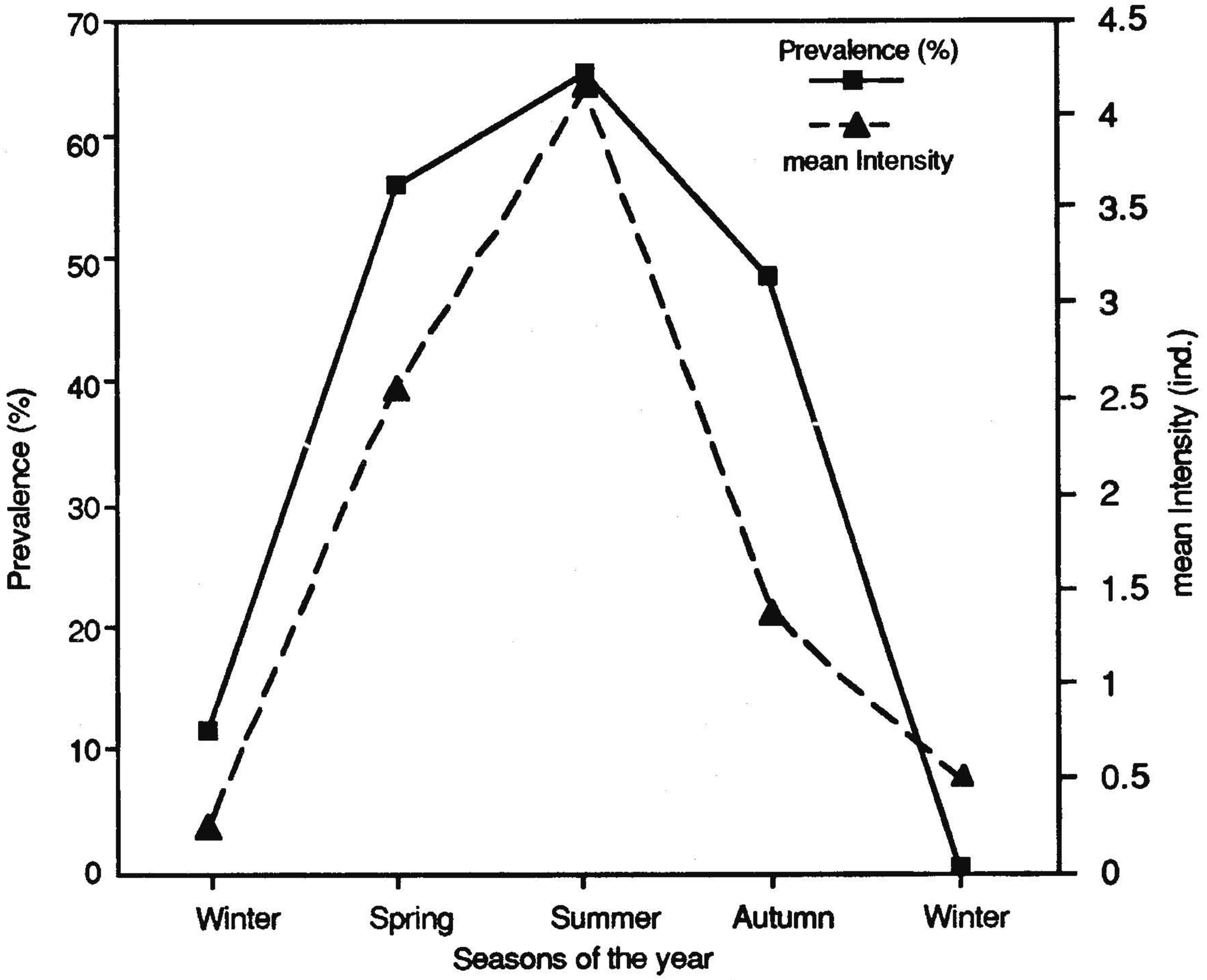

Fig.1. Seasonality of occurrence of *Ancyrocephalus paradoxus* in the pike-perch from the Gulf of Gdańsk.

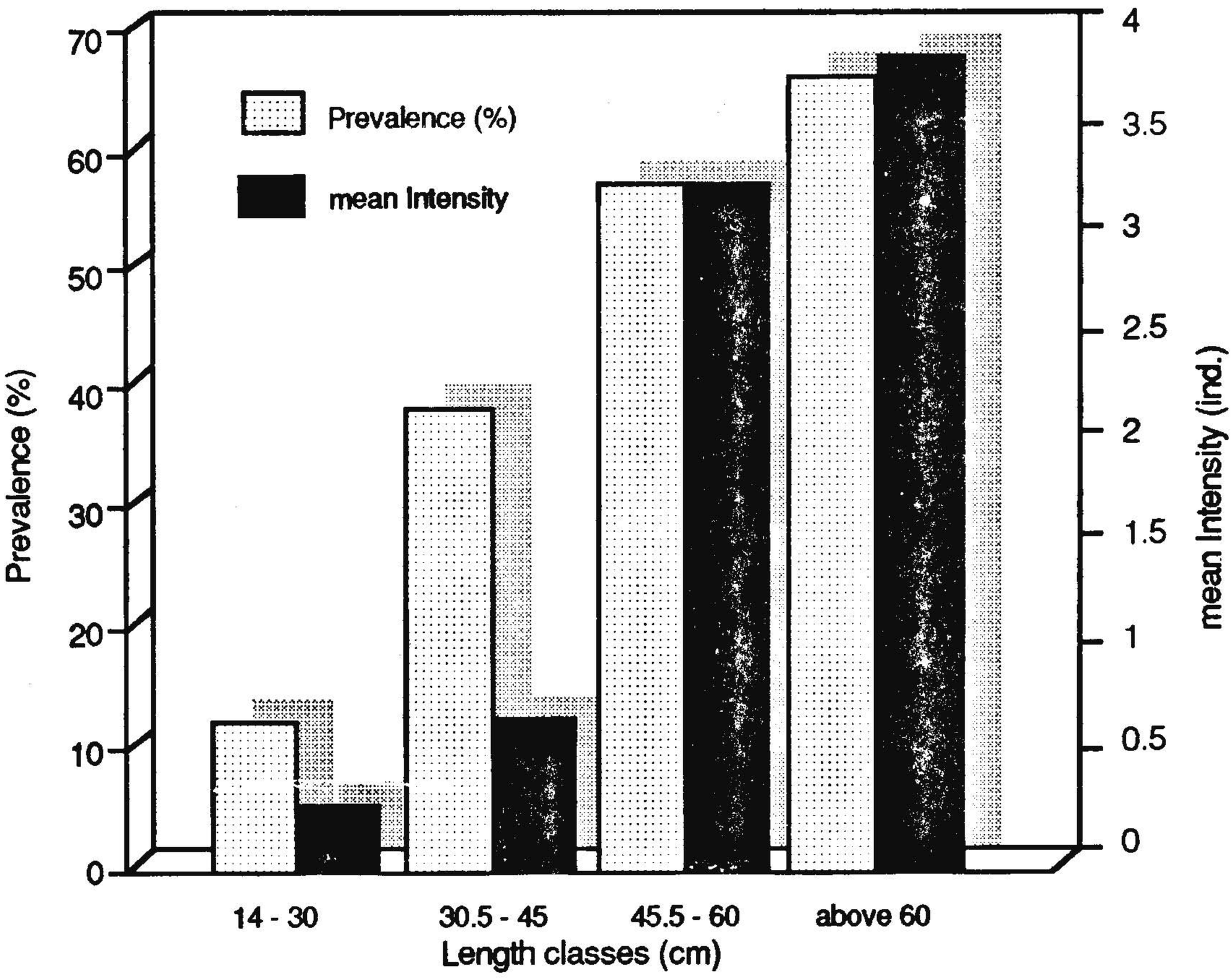

Fig. 2. Infection rate of *Stizostedion lucioperca* with *Ancyrocephalus paradoxus* versus fish body length.

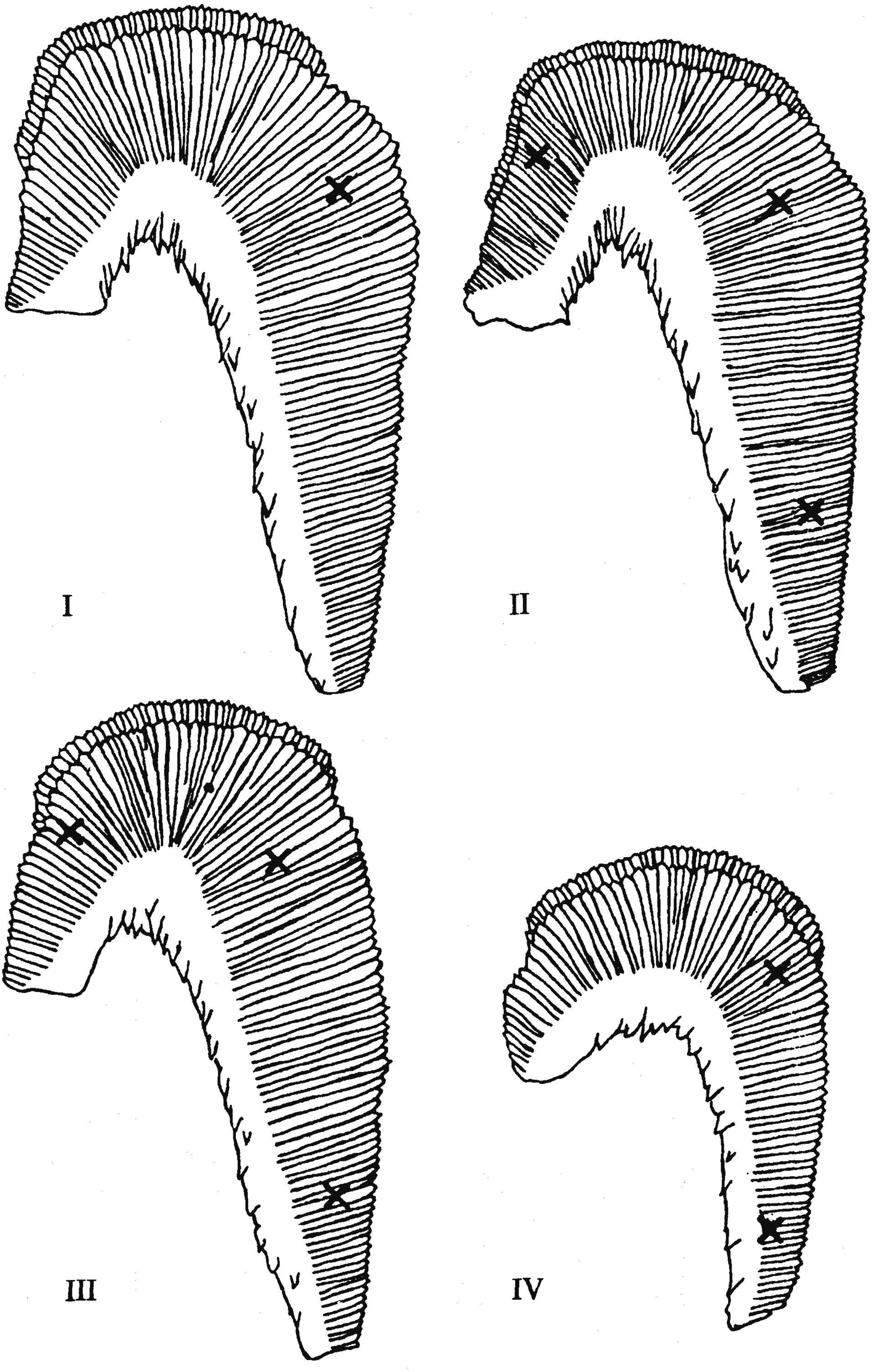

Fig. 3. Location of *Ancyrocephalus paradoxus* on gills. I-IV: number of successive gill; X: place of settlement.

(43%) was noted on the IVth gill and the lowest (2.12%) on the Ist gill.
Special location of *Ancyrocephalus paradoxus* on gills was noted (Fig.3). On the filaments of the fold on gill IV in the central part of the arch in total 300 monogeneans were found and only 3 on the basis of the gill. On the filaments of gill III there were noted 18 specimens (10 parasites on the basis of the gill). In the central part of gill II: 19 specimens, 4 at the basis and 6 at the dorsal part. At least, in the central part of the gill I there were found only 9 specimens. On gill IV monogeneans were present all year round; on gills III and IV - from May to October; and on gill I - from August to September.

DIGENEA:
Bucephalus polymorphus Baer, 1827.
Location: intestine and stomach. Prevalence and intensity of infection were 29.6% and 5.4, respectively. The highest prevalence and intensity occurred in autumn (prevalence 95.3%, and mean intensity 5.5), lower in summer and the lowest in spring and winter (Fig.4). The highest infection was in fish longer than 60 cm (Fig.5).
Brachyphallus crenatus (Rudolphi, 1802).
Location: stomach. Only 3 parasites were found in May and June.
Bunodera luciopercae (Mueller, 1776).
Location: intestine and pyloric caeca. Parasite specimens were noted in April, May and October. Prevalence 7.4%, intensity 1.4.
Azygia lucii Mueller, 1776.
Location: stomach. Only one fish examined in December was infected with 3 parasite specimens.
Diplostomum spathaceum (Rudolphi, 1819) metacercaria.
Location: eyes - lens. They occurred in spring and autumn.
Tylodelphys clavata (Nordmann, 1932) metacercaria.
Location: eyes - *corpus vitreum.*
Ichthyocotylurus platycephalus (Creplin, 1825) metacercaria.
Location: on heart wall and gills. The parasites were noted in September and November.

CESTODA
Bothriocephalus **sp.** (*scorpii* ?) (Mueller, 1776) plerocercoid.
Location: intestine. Prevalence 13.2%, intensity 1.1.

NEMATODA
Camallanus lacustris (Zoega, 1776).
Location: intestine. Only a single parasite specimen was found in September.
C. ***truncatus*** (Rudolphi, 1814).
Location: stomach, intestine and pyloric caeca. Prevalence 40.2%, intensity 3.7. Both indices distinctly depend on the season (Fig.6) and fish body lenght. The highest infection was recorded in fish longer than 60 cm (Fig.7).
Hysterothylacium auctum (Rudolphi, 1802).
Location: intestine. Only 3 specimens were found in spring.

ACANTHOCEPHALA
Neoechinorhynchus rutili (Mueller, 1780).
Location: intestine. One specimen (female) was found in April.
Corynosoma semerme (Forssell, 1904).
Location: intestine. One specimen (male) was found in April.
Pomphorhynchus laevis (Mueller, 1776).
Location: intestine. One specimen (male) was found in December.

COPEPODA
Ergasilus sieboldi Nordmann, 1832.

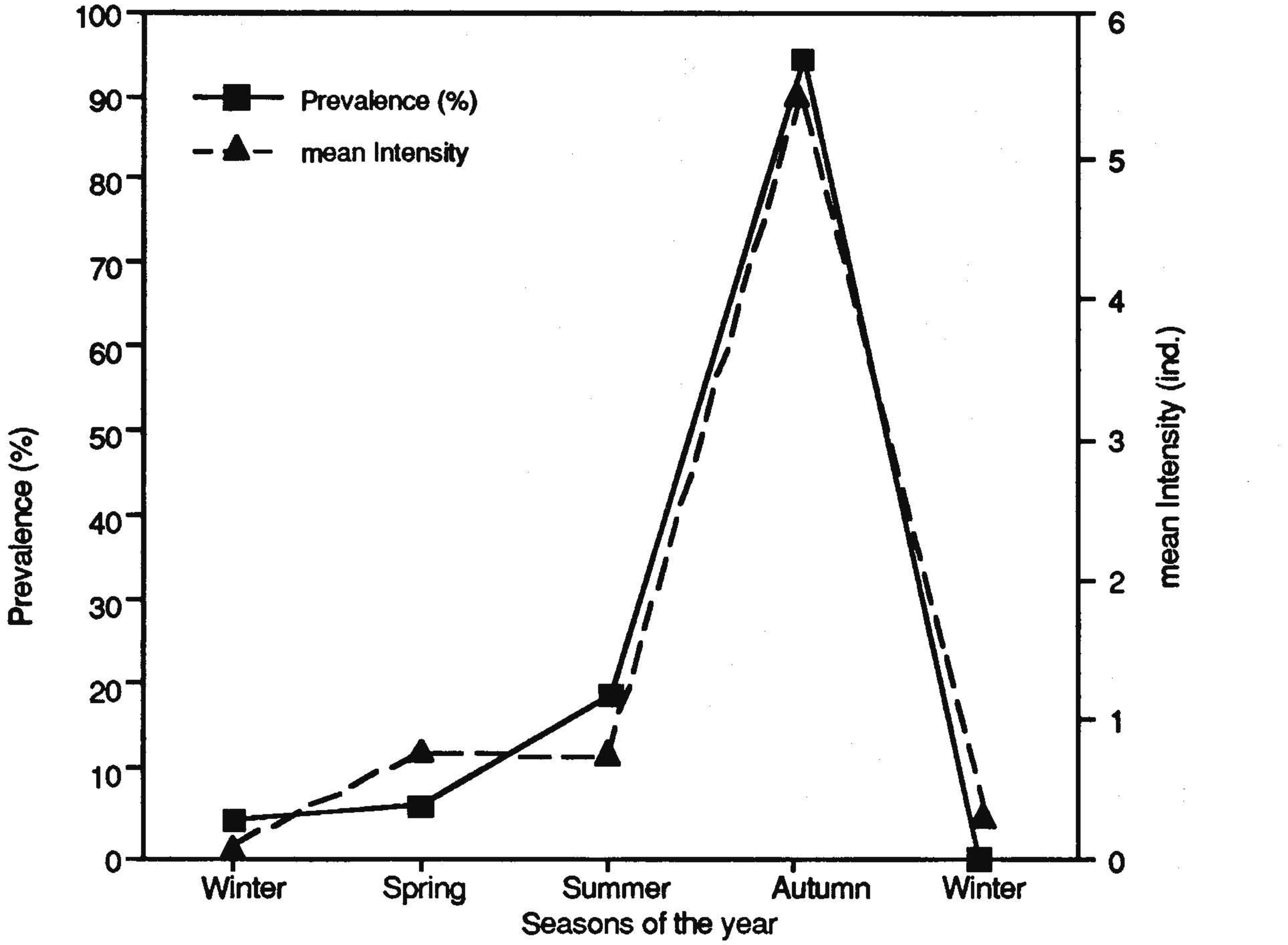

Fig. 4. Seasonality of occurrence of *Bucephalus polymorphus* in the pike-perch from the Gulf of Gdańsk.

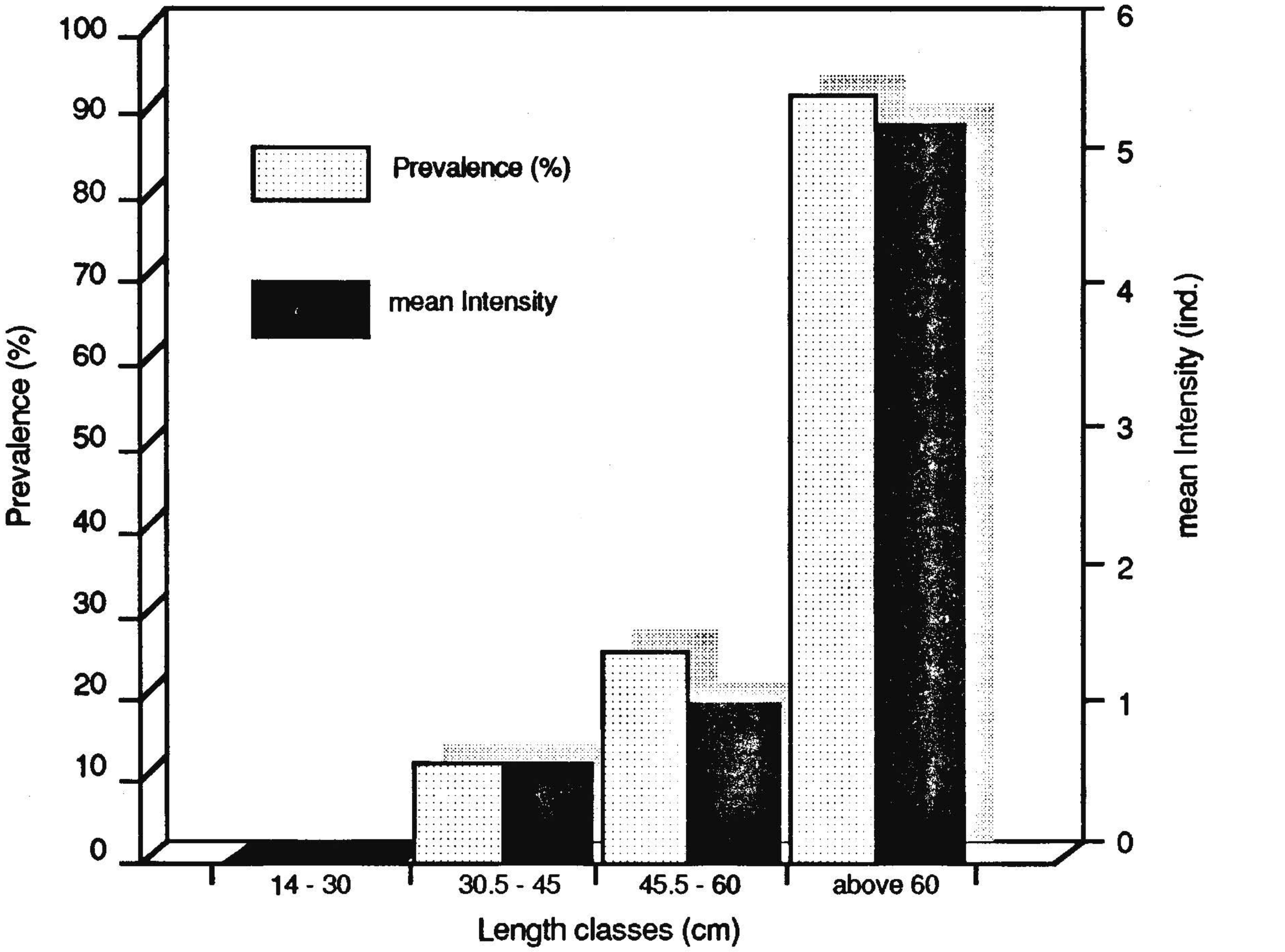

Fig.5. Infection rate of *Stizostedion lucioperca* with *Bucephalus polymorphus* versus fish body length.

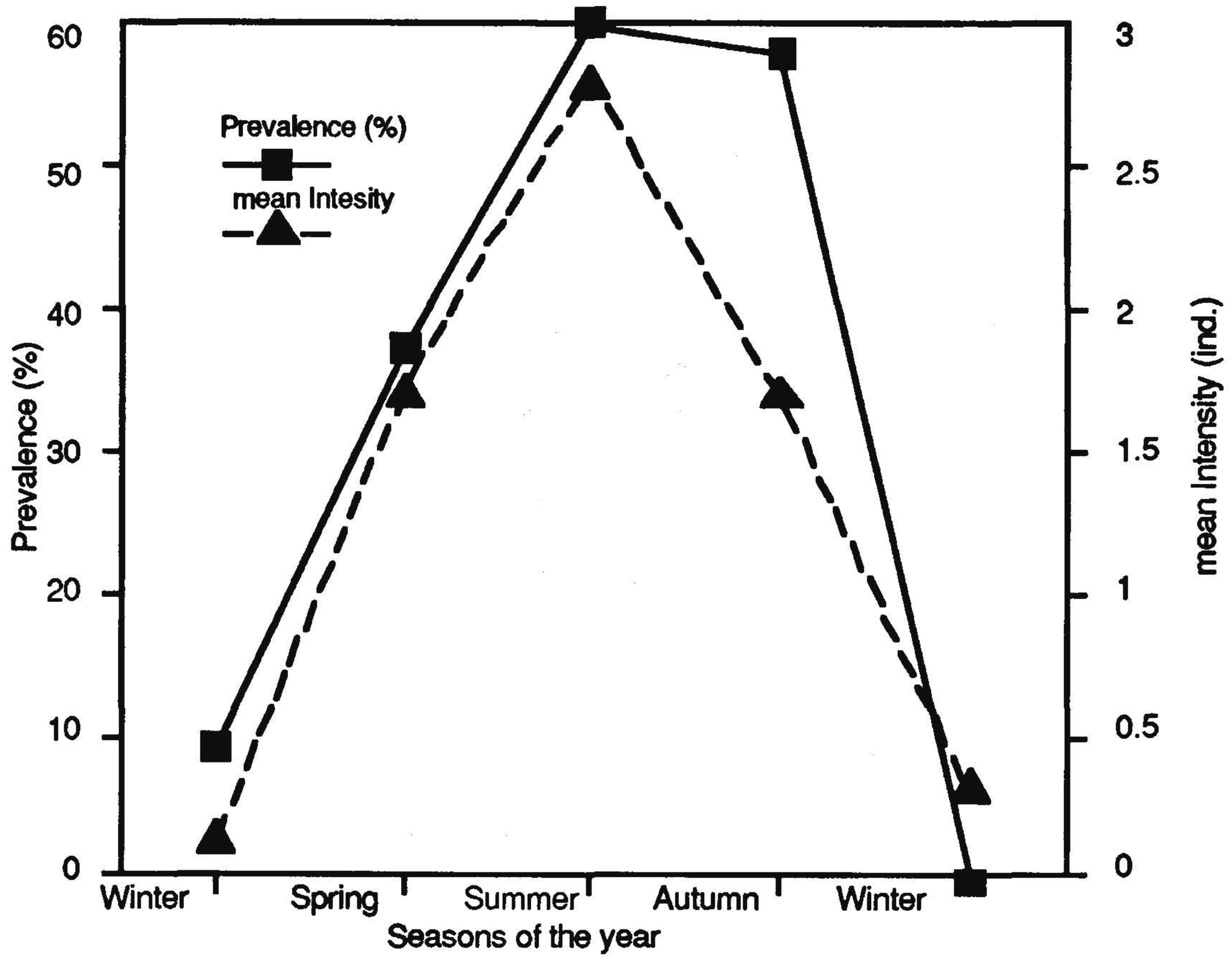

Fig.6. Seasonality of occurrence of *Camallanus truncatus* in the pike-perch from the Gulf of Gdańsk.

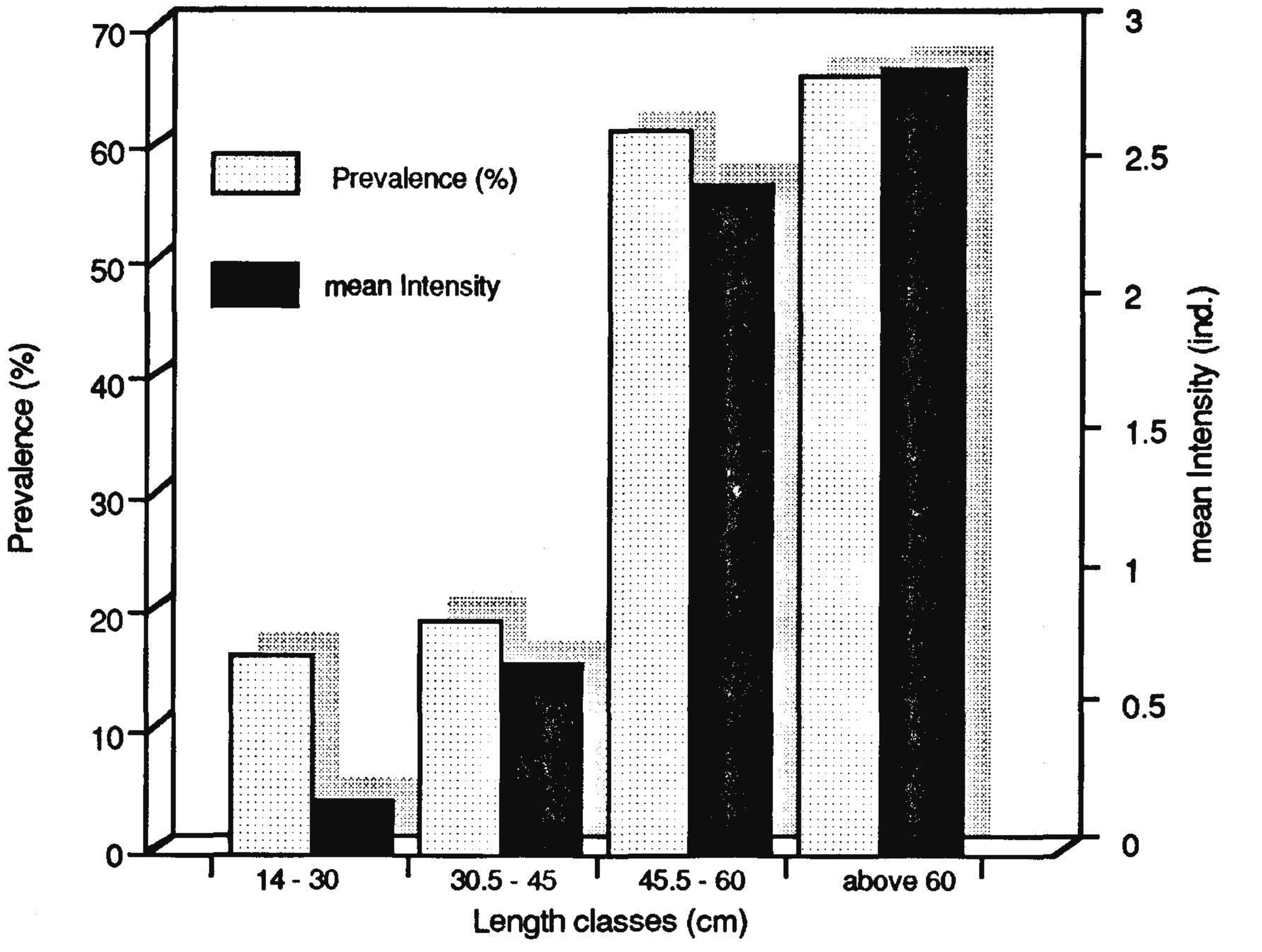

Fig.7. Infection rate of *Stizostedion lucioperca* with *Camallanus truncatus* versus fish body length.

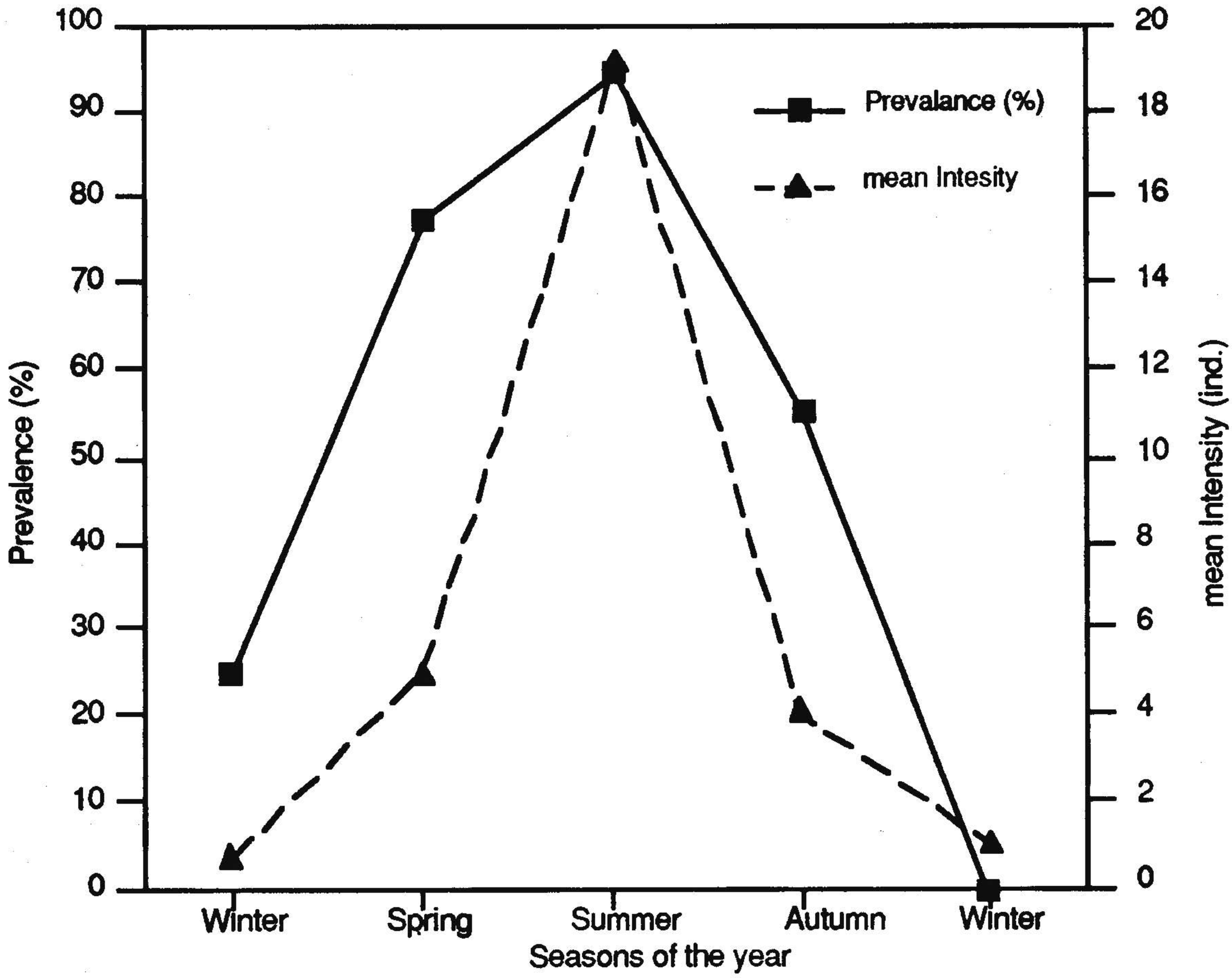

Fig.8. Seasonality of occurrence of *Achtheres percarum* in the pike-perch from the Gulf of Gdańsk.

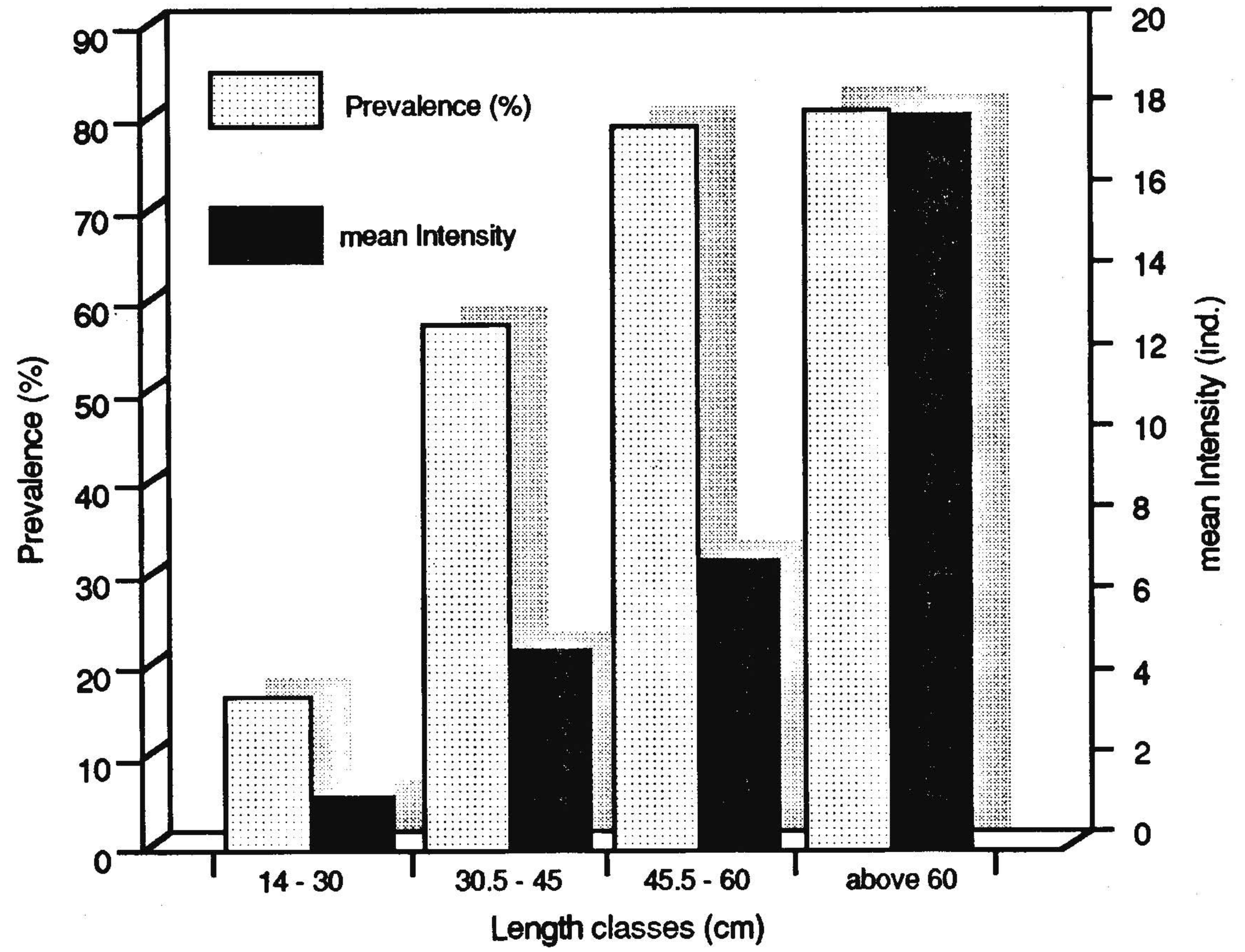

Fig. 9. Infection rate of *Stizostedion lucioperca* with *Achtheres percarum* versus fish body length.

Location: gills, The copepods were noted in August and November with egg sacks and one specimen in December without egg sacks.

Achtheres percarum Nordmann, 1832.

Location: gills and mouth cavity. Only female specimens were found. Prevalence 59.8%, intensity 12.3. The highest prevalence and intensity was in summer and the lowest in winter (Fig.8). Comparing the level of infection with the length of fish it was recognized that longer (i.e. older) fishes were more infected (Fig. 9).

On the basis of our own material and Claus's description (1862) the following phases and stages of development of settled *A. percarum* have been distinguished:

I - filamentum frontale present on second maxilla
II - young female with a slender pereon
III - thick pereon eggs inside non visible
IV - thick pereon, eggs inside visible
V - adult female with egg sacks. Eggs of milky yellow colour, 5-20 in a row
VI - adult female with egg sacks; the developing embryos contain pigment
VII- female with nearly empty or empty egg sacs

Phases III and IV are introduced in this paper. In the present study the predominance of females in phase V was noted (1040 individuals). They were observed between April and December with maximum numbers in July and August. The second most numerous group were phase IV 140 individuals recorded between August and December. Then followed the phase VII individuals (68), found between September and December with a maximum in November. The next group according to abundance were phase IV: 58 individuals, and III: 55. They were noted all year round. Phase III group was most abundant in March, April and November. Phase IV group was predominating in March, April and December. Phase II group was collected in the number of 26 specimens. The individuals were found in February, July, September, October and December. In phase I there were only 3 individuals found in April and May.

On gill rakers there were settled 44 copepods (phase III); 961 on gill filaments (phase I, II, IV, V, VI, aid VII), and 385 in the mouth cavity (phase II, III, IV and V).

BRANCHIURA

Argulus foliaceus (Linnaeus, 1758).

Location: gills. One specimen was found in August.

DISCUSSION

1. The dependence of parasite occurrence on the season and fish length.

In four species of parasites with high predominance, a distinct dependence of their occurrence on season and on fish length has been recorded.

For *Ancyrocephalus paradoxus* (Monogenea), *Camallanus truncatus* (Nematoda) and *Achtheres percarum* (Copepoda) the highest prevalence observed in summer (in August).

The infection rate of pike-perch in separate season correlated well with water temperature what is rather obvious with regard to fish feeding activity and annual life cycles of respective parasites. In our case, over the annual period 1991-92, the average water temperatures in the Gulf of Gdańsk according to the data from the State Institute of Meteorology and Water Management were as follows: in winter 1991/92 +3°C; in spring 1992 +9.3°C; in summer +17.6°C; in autumn +9.4°C and in winter 1992/93 again +3°C. It is know that environmental temperature below 4 °C inhibits anabolic processes and development in majority of poikilotherms of the temperate zone.

In *Achtheres percarum,* according to Kozikowska et al. (1956), number of generations and speed of development during the season depend on the water temperature. In our own material there were detached two generations per one year. It is supposed that *A. percarum* overwinters as phase III or IV. The III-rd phase individuals were found only on the gill rackers and in the mouth cavity, i.e. in places poorer in food what suggests that these copepods eat less or nothing in winder time. With the coming of the warm months they start to develop. The development of overwintering females in

Table 1.
Developmental phases of *Achtheres percarum* recorded on the pike perch (original).

Date	Stages and phases of development							
	I	II	III	IV	V	VI	VII	Total
December 1991	-	1	5	4	-	-	-	10
January 1992	-	-	2	4	-	-	-	6
February	-	1	5	4	-	-	-	10
March	-	-	14	17	-	-	-	31
April	1	8	8	7	18	-	-	42
May	2	11	1	5	38	-	-	57
June	-	-	2	3	190	-	-	195
July	-	1	1	1	290	-	-	293
August	-	-	2	2	349	56	-	409
September	-	1	2	1	102	60	9	175
October	-	2	1	1	38	15	25	82
November	-	-	9	1	10	8	33	61
December 1992	-	1	3	8	5	1	1	19
Total	3	26	55	58	1040	140	68	1390

phase III and IV starts in autumn and is finished in spring next year. In spring the next generation begins to develop from eggs laid by V phase adults and its development ends in autumn (Table 1). V phase females with full egg sacs were observed in a fresh water body of south-west Poland just in June (Kozikowska et al. 1956); we observed the same phase in the Gulf of Gdańsk as late as in August what may be easily explained by lower temperatures of the marine habitat.

The highest prevalence and intensity of infection with *Bucephalus polymorhus* (Fig.4) was noted in autumn (in October).

According to Brylińska (1986) in different seasons of the year the pike-perch predates on different fish species. The pike perch from the Gulf of Gdańsk predates mainly on *Abramis brama* and *Rutilus rutilus* (Kuczyński, personal information). Thus these two cyprinid fishes as the hosts of metacercariae of *B.polymorphus* are the main source of infection with this trematode in the examined pike-perches.

Comparing quantitative occurrence of *Ancyrocephalus paradoxus* (Monogenea), *Bucephalus polymorphus* (Digenea), *Camallanus truncatus* (Nematoda) and *Achtheres percarum* (Copepoda) with the size of fish there was noted an increase of incidence with the incresed length of the fish body.

Pike-perch become infected by the monogenean *A. paradoxus* through the mouth during respiratory motions of gill opercula. Bigger fishes show higher infection indices (Fig.4) because they pump more water through gills during respiration.

This effect of water stream washing the gills on infection level is conformable also with Kozikowska et al. (1956) observation that bigger fishes have been more infected with the copepod *Achtheres percarum*. She divided the examined fish population into two length classes: 1-25 cm and >25-60 cm. The second length class showed higher infection indices and the highest indices were noticed in fish over 60 cm long. According to the above authors the period in which mostly occurs infection of fish with parasitic copepods is the spawning time.

In our case, the pike-perch after having spawned in the Vistula River and the Vistula Lagoon in May and June, migrated to the Gulf of Gdańsk and thus the large fishes were getting infection on their return to the Gulf in post-spawning months of the year.

The infection rates with the nematode *Camallanus truncatus* were also related to the size of fish. The pike-perch may be infected with *C. truncatus* in two ways: by predating on infected

crustaceans or on infected cyprinid fish which are paratenic hosts for this nematode. Our results may indicate that the pike-perch larger than 45 cm feeds mainly on cyprinid fish.

2. Location of *Ancyrocephalus paradoxus* on the gills.

A. paradoxus demonstrated a specific location of settlement. All Monogenea were found on gill filaments. Of 374 collected *Ancyrocephalus paradoxus,* 346 (92.5%) were located in the central part of gills; and 300 from the same number of 347, i.e. 80.2%, on the IVth gill. At the dorsal part of the gill II and III there were 11 (2.9%) monogeneans and on ventral part of II, III, and IV gill -17 (4.5%).

Starovoytov et. al. (1985) also noted monogeneans in the central part of the IVth gill and much fewer on other gills. Such a location of *A. paradoxus* on separate gills is caused most probably by the way the water stream flows between the gills. In the process of respiration it flows from the mouth to the gill cavity mainly between the second and the third gill, later goes vertically through the gill slits. A small number of monogeneans found at gills' ends (both at ventral and dorsal part) results from vertical movement of rinsing water thus washing them out from the second and third gill. Larval stages of Monogenea reach a fish while they are present in the water stream between the second and the third gill from where they have to wander to the next gill and the precedent gills (IV and I) in order not to be washed out.

Starovoytov (1985) mentioned that *A. paradoxus* may change its location along with fish ageing (i.e. bigger size). In young pike-perch, about 8 cm long, about 95 % monogeneans are located on the membrane connecting the right and left gills. The remaining 5% live on gill filaments. This dependence changes with age and growth of gills. The number of monogeneans on gill filaments increases with a simultaneous decrease in number of those settled on the membrane connecting the right gill to the left one. In fish 8 to 20 cm long, Starovoytov noted 52% of monogeneans on this membrane, and only 1.2% in fish longer than 50 cm. In our examinations all the monogeneans were located only on gill filaments. However this might have been caused by a total lack in our material of small fishes up to 8 cm long and also a small number of fishes from 8 up to 20 cm long.

3. Dependence of pike-perch parasite fauna on its post-spawning wandering.

Pike-perch after spawning in May-June in the Vistula Lagoon and the Vistula River wander to the Gulf of Gdańsk where they spend summer and autumn. At the end of the year pike-perch return to fresh or slightly brackish waters of the river and the lagoon (Borowski, personal information). Some cyprinid fish like roach and bream which make the basic food for pike-perch also enter the Gulf from the Vistula River and the Vistula Lagoon.

4 out of 19 parasite species collected from the examined pike-perch, namely: *Brachyphallus crenatus, Bothriocephalus* sp., *Corynosoma semerme* and *Hysterothylacium auctum* are marine ones. Pike-perch gets infection with these species exclusively in the Gulf. Other parasite species are fresh water ones. For some of them their intermediate hosts live exclusively in fresh water. E.g. for *Bunodera luciopercae* there are no intermediate hosts in the Gulf. These are: *Daphnia pulex* (De Geer), *Simocephalus expinosus* (Koch), *Sphaerium corneum* L. and *Sphaerium rivicola* Lam. (acc. to Grabda 1971). For *Azygia lucii* there is again no intermediate host in the Gulf nor in the Vistula Lagoon (gastropod *Galba palustris* Mueller, ibidem). The gastropod *Valvata piscinalis* Mueller being the intermediate host for *Ichthyocotylurus platycephalus* (acc. to Bauer 1987), occurs both in the Vistula River and the Vistula Lagoon. According to Baturo-Warszawska (1976) the first intermediate host for *Bucephalus polymorphus* is the bivalve *Dreissena polymorpha* Pallas which also occurs in the Vistula River and the Vistula Lagoon (Fall 1993; Majewski 1990). Pike-perch gets infection with this parasite while predating on cyprinid fish which enter the Gulf from the Vistula River and are paratenic hosts for this parasite.

Other parasites met in pike-perch are able to live and to develop their life cycles in all three water bodies: the Gulf, the Vistula Lagoon and the Vistula River. To this group belongs, for example, *Camallanus truncatus* which are one of the most frequently occurring parasites of the pike-perch. Also *Achtheres percarum* occur both in fresh and brackish water and are most often encountered in the examined pike-perch. Although our pike-perch specimens were caught in brackish waters of

the Gulf (with average salinity of 7 ppt) the composition of their parasite fauna indicates clearly fish wandering between the Gulf, the Vistula Lagoon and the Vistula River.

CONCLUSIONS

1. In *Stizostedion lucioperca* (L.) there were found 19 species of parasites: 5 external and 14 internal. *Ichthyocotylurus platycephalus* (metacercaria) was found on gills, heart and liver. *Achtheres percarum* (frequency 56%) predominated. Frequently encountered were: *Ancyrocephalus paradoxus* (15%), *Bucephalus polymorphus* (12.3%) and *Camallanus truncatus* (11.5%), respectively. Plerocercoid *Bothriocephalus* sp. occurred rarely (1%). Occassionally there were also been found the following parasites: *Azygia lucii, Bunodera luciopercae, Brachyphallus crenatus, Diplostomum spathaceum* (metacercaria), *Tylodelphys clavata* (metacercaria), *Ichthyocotylurus platycephalus, Camallanus lacustris, Hysterothylacium auctum, Neoechinorhynchus rutili, Corynosoma semerme, Pomphorhynchus laevis, Piscicola geometra, Ergasilus sieboldi* and *Argulus foliaceus.*
2.. *Hysterothylatium auctum* was found in pike-perch for the first time in Poland. Apart from the mentioned nematode there were other parasite species noted in this fish for the first time in this country: *Ichthyocotylurus platycephalus, Neoechinorhynchus rutili, Corynosoma semerme, Pomphorhynchus laevis.*
3. Quantitative occurrence of such common parasites as: *Achtheres percarum, Ancyrocephalus paradoxus, Camallanus truncatus* and *Bucephalus polymorphus* reveals a dependence on the season and the size of fish. In the first three species the highest infection was found in summer while in *B. polymorphus* in autumn. Large fishes (over 45 cm long) were more infected than smaller ones.
4. In the pike-perch from the Gulf of Gdańsk there was recorded a parasite fauna of different origin (freshwater and marine). Those freshwater species which are able to tolerance of oligohaline brackish environment were predominating.
5. Monogenean *Ancyrocephalus paradoxus* was distributed in a characteristic way on gills.

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Ewa Styczyńska-Jurewicz
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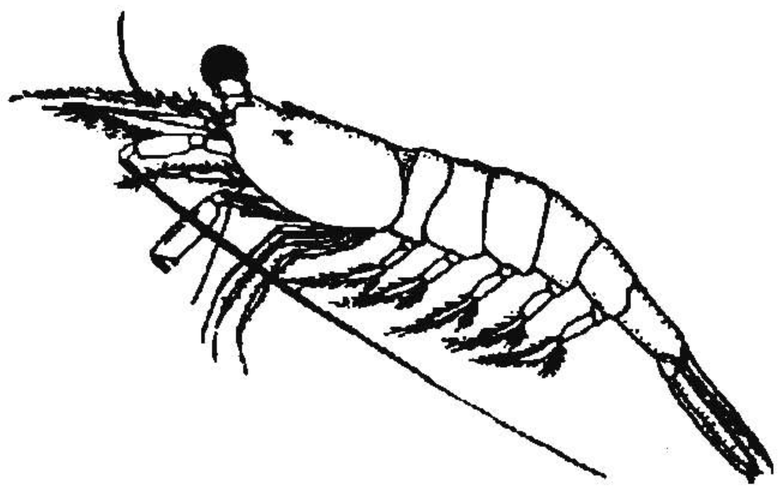

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