ECOLOGICAL COMPARATIVE ANALYSIS OF PARASITE FAUNA OF Rutilus rutilus L. AND COREGONUS ALBULA L. FROM WATERS OF THE EUROPEAN PART OF THE ARCTIC OCEAN PROVINCE

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Abstract. The differences between the parasite fauna of Rutilus rutilus L. and Coregonus albula L. are caused by the fact that the former host is more warm-requiring and the conditions in waters of the Arctic Ocean Province of the Circumpolar Subregion are less favourable to it. On the other hand, C. albula, which is a northern species, lives here under optimal conditions. R. rutilus is bentophytophagous and C. albula planktophagous species, which results in the differences in species composition of their parasites. Also differences in the growth and seasonal and annual changes of their parasite fauna have been observed.

We have studied the ecology of the parasite fauna of Rutilus rutilus L. and Coregonus albula L. occurring in the Kuyto Lakes, bodies of water of Northern Karelia, belonging to the European part of the Arctic Ocean Province (Rumyantsev 1966, 1967, 1973). These two fish species differ from one another in their systematics, biology and living conditions, which are optimal for C. albula and less favourable to R. rutilus, since this locality represents the northern border of its distribution area.

GENERAL CHARACTER OF PARASITE FAUNA

The parasite fauna of R. rutilus is less numerous in Kuyto Lakes than in the southern regions and the species composition of monogeneans, Myxosporidia and intestinal parasites is less variegated. This is due to the fact that the living conditions of Northern Karelia, near the border of distribution area of R. rutilus, are less favourable not only to this fish, but also to its specific and unspecific parasite and their intermediate hosts. On the other hand, a characteristic feature of C. albula from Kuyto Lakes is a variety of parasite species and a large number of species specific of Salmonidae. The number of parasite species decreases towards the south. Since the North Karelia is the most favourable locality for C. albula, the living conditions are optimum also for its specific parasites and the infection rate is very high.

The differences between the parasite fauna of R. rutilus and C. albula are caused by the fact that the former species is more warm-requiring and the waters of the Arctic Ocean Province of the Circumpolar Subregion are less favourable to it than to C. albula, which is a northern species and the living conditions are therefore optimum for it.

The character of infection of R. rutilus corresponds to the wide spectrum of its food, which is composed mostly of benthic plants. The groups of parasites associated in some way with benthos are most diverse. The infection pattern of this host is correlated with its feeding on zooplankton. The highest incidence and intensity of infection showed
the parasites of the groups employing the plankton crustaceans as intermediate hosts.

The differences in the character of parasite fauna of R. rutillus and C. albula are therefore due to the fact that the former is bentophytophagous and the latter planktophagous.

GROWTH CHANGES OF PARASITE FAUNA

In the oldest R. rutillus, infected by feeding, the number of parasites requiring intermediate hosts is somewhat lowered. However, this does not concern the parasites with a direct life cycle, as Monogenea, Crustacea and Myxosporidia. On the other hand, the food spectrum of C. albula is widening throughout its whole life. Therefore the diversity and quantity of food which may include intermediate hosts of parasites are increasing with age and result in the enrichment of parasite fauna and increase of both intensity and incidence of infection.

At the age of two years R. rutillus starts to feed on benthos and the species composition of its parasite fauna is changing simultaneously. There appear the species bound in some way with benthos. C. albula does not change the character of its food during its life and therefore no changes of parasites requiring intermediate host occur. Only in the oldest age groups the zooplankton is exchanged, to some extent, for larger food components — benthos, especially a relict crustacean Pontoporeia affinis. This is evidenced by the finding of the nematode Cystidicola farionis and aechnococephalan Metecinorhynchus salmonis in this fish species. Judging from the infection, the adult specimens of C. albula select more their food, which consists of larger components.

The young and adult specimens of R. rutillus live in a close contact with one another and therefore no marked exchange of parasites with direct life cycle was observed in them. At comparatively early age (of one month), in addition to such “baby” parasites as protozoans Apiosoma and Trichodina, there occur also monogeneans Dactylogyrus navus and D. crucifer and myxosporidians Myxidium rhodei and Myxobolus pseudodispar, which are characteristic parasites of adult R. rutillus.

In C. albula, the species composition of parasites with direct life cycle is changing with the growth, which is due to particular ecology of young and adult fishes. The young fishes after hatching keep near the coast, they are not in contact with the adults and become infected with non-specific parasites of other fishes. Sometimes this isolation (spatial disconnection) of the youngs from the adults leads to a rather late infection of C. albula with its specific parasites, at the age of about one year. Due to the fact that the feeding places of young and adult C. albula are different in large lakes (of the Kuyto type), there is a sufficient quantity of food for the whole population.

Both C. albula and R. rutillus are first infected with the parasites with direct life cycle or those which actively infect the host. Their larvae are infected with Infusoria Apiosoma and Trichodina and the trematode Diplostomum during the first week after hatching. Later on, there appear the parasites which penetrate in the body of their hosts with ingested intermediate hosts. Since C. albula feeds more intensively than R. rutillus, it becomes infected with these parasites sooner than the latter species. At the age of one month C. albula was found to harbour two such species, namely Diphyllolothrium ditremum and Proteocephalus exiguis.

Maximum infection of young fishes with Apiosoma and Trichodina occurs at the time when the water warmed and the young keep the places where the water is warmest. At the time when the fishes start to live in deeper and colder parts of the lake, the warm-requiring Infusoria disappear. Since the young R. rutillus keep in better warmed coastal zone for a longer time, they remain infected with Infusoria longer than C. albula. In 3-month-old C. albula they disappear in July, whereas the young specimens of R. rutillus are still infected with them at this time.
SEASONAL CHANGES OF PARASITE FAUNA

In the north, *R. rutilus* undergoes great changes in its life during the year (decrease of feeding activity in winter). Its specific parasites are more warm-requiring than those of *C. albula*. The seasonal changes of infection are therefore more marked in *R. rutilus*.

Most distinct seasonal changes appear in those parasites whose life cycles are repeated many times during the year and which propagate and develop in spring and summer. *C. albula* harbours lower number of these parasites than *R. rutilus*. It may be due to the fact that in the north, where the spring-summer season of warming of water is shorter, such a character of life cycle is less frequent.

The highest intensity of infection of *R. rutilus* with *Diplostomum* was observed in the end of summer. At this time a maximum of active cercariae appear. According to Gvozdev (1971), who made investigations in this locality, the first peak of molluse infection was observed in mid August and is caused by mature cercariae which developed in molluses infected in the preceding year. A relatively low infection of *C. albula* with *Diplostomum* and *Cotylurus* in the end of summer may be related to the pelagic mode of its life, which prevents it from the contact with the first intermediate hosts, the molluses.

CHANGES OF PARASITE FAUNA IN DIFFERENT YEARS

These changes are rather small in *C. albula*. Its specific parasites are more cold-requiring and are not very dependent on the fluctuations of the temperature. On the other hand, *R. rutilus* and its specific parasites are much dependent on low temperatures and the parasite fauna, therefore, undergoes greater changes in different years.

Marked differences in infection were observed with the parasites repeating this life cycle within one year, propagating and developing in spring and summer period (*Dactylogyrus*, *Gyrodactylus*, *Apiosoma*, *Trichodina*). It was most distinct with Monogenea. The species of the genus *Dactylogyrus* show more seasonal changes of infection of *R. rutilus* than *Diplozoon*, whose life cycle does not repeat during the year.

PARASITE FAUNA OF LOCAL STOCKS

When comparing the parasite fauna of *C. albula* and *R. rutilus* from different regions of Central Kuyto Lakes, nearly indistinct differences in intensity of infection were found in *C. albula*, whereas in *R. rutilus* these differences were more pronounced. It may be explained by the fact that *R. rutilus* occurs mostly in the coastal regions and does not migrate so much. Besides, the microclimatic conditions of these regions are more diverse than in the central parts of the lake mostly inhabited by *C. albula*.

ЭКОЛОГИЧЕСКИЙ АНАЛИЗ ПАРАЗИТОФАУНЫ ПЛОТВЫ (RUTILUS RUTILUS L.) И РЯПУШКИ (COREGONUS ALBULA L.) ВОДОЕМОВ ЕВРОПЕЙСКОГО ОКРУГА ЛЕДОВИТОМОРСКОЙ ПРОВИНЦИИ

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Резюме. Различия в паразитофагусе плотвы и ряпушки обусловлены тем, что первая из них является более теплолюбивой и находится в водоемах Ледовитоморской провинции Циркунинской подобласти в менее оптимальных условиях, а вторая, будучи северной рыбой, обитает здесь в оптимальной среде. Разная картина зараженности плотвы и ряпушки
NEW HOST RECORDS AND LOCATIONS OF HEPATOJOHAKARUS BANDICOTI SOOD ET PARSHAD, 1973
(TRICHOSTRONGYLIDAE: NEMATODA)

Hepatojohakarbus bandicoti Sood et Parshad, 1973 was originally reported from field rats and mice. Bandicota bengalensis, Millardia multida, Tatera indica and Mus musculus bactrianus. Further studies have revealed Mus booduga and Golunda elliottii as additional hosts for H. bandicoti. The sites of collection for these hosts were same as already reported (M. L. Sood, V. R. Parshad, Parasitology 68: 19-21, 1973). However, in no case the house rats and mice, namely Rattus rattus, R. norvegicus and Mus musculus examined were found to be infected. Thus to conclude, the infection of H. bandicoti is so far restricted to the field rats and mice only.

In addition to the usual habitat, i.e., the bile ducts, gall bladders of B. bengalensis and T. indica, small intestine of M. multida and body cavity of T. indica were also found to have the infection. In the small intestine and body cavity, the infection seems to be accidental as in each case only two worms, one male and one female, could be recovered. Death of some individuals of B. bengalensis in the laboratory seemed to be due to this parasite as evidenced by its high infection rate. In such fatal cases, the inferior vena cava was heavily infested. Pathogenicity of this worm interpreted from the massive tissue changes in the liver parenchyma and biliary system will be described elsewhere.

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