The effect of sewage on the rate of infestation of fingerling fish by *Diphyllobothrium latum* plerocercoids in the Kama reservoir

by A. S. Artamoshin and V. I. Khodakova

Original title: O vliyanii stochnykh vod na zarazhennost' segoletkov ryb kamskogo vodokhranilishcha plerotserkoidami shirokogo lentetsa


Translated by the Translation Bureau (WRi)
Multilingual Services Division
Department of the Secretary of State of Canada

Department of Fisheries and the Environment
Fisheries and Marine Service
Pacific Biological Station
Nanaimo, B.C.

1977

7 pages typescript
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**Title in English**
The effect of sewage on the rate of infestation of fingerling fish by *Diphyllobothrium latum* plerocercoids in the Kama reservoir.

**Title in Foreign Language**
О влиянии сточных вод на зараженность сеголетков рыб камского водохранилища плероцеркой широкого лентеця

**Reference in Foreign Language**
*Gidrobiologicheskii zhurnal*

**Reference in English**
*Journal of Hydrobiology*

<table>
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<tr>
<th>Publisher</th>
<th>Date of Publication</th>
<th>Page Numbers in Original</th>
</tr>
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<td>89 - 91 7</td>
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**Requesting Department**
Environment

**Translation Bureau No.**
1448497

**Translator (Initials)**
Wri

**Your Number**
5053-1

**Date of Request**
September 26, 1977
The effect of sewage on the rate of infestation of fingerling fish by *Diphyllobothrium latum* plerocercoids in the Kama reservoir.

By A.S. Artamoshin and V.I. Khodakova

In any study of the relationship between fish parasites and various environmental factors it is important to examine the effect of man's economic activity, in particular the effect of industrial and domestic sewage on the species and quantitative composition of the parasitic organisms and on the population numbers of their hosts [9].

We know that industrial sewage has a deleterious effect on fish. Sewage is also harmful to the lower crustaceans which can be the interim hosts for a number of helminths, for example, *Daphnia* [6].

The changes in the extent to which fish are infested with parasites have been traced in the case of the pollution of bodies of water by industrial effluent and chemicals [1,3-5,8,12], however, infestation by *Diphyllobothrium latum* (L. 1758)** plerocercoids has not been sufficiently investigated; moreover, the available data are contradictory. Thus, in one case a higher rate...
of infestation of fishes by the above-mentioned parasite in the Volgograd reservoir (in the region of the town of Saratov) has been linked with the discharge of domestic sewage from the town sewers into the reservoir [10]. In another case, on the contrary, it has been noted that in the Volga, in an area where there is a discharge of fecal sewage the infestation of fish by Diphyllobothrium latum plerocercoids is limited and is less than, for example, around the wharves of the town of Cheboksary [11]. These studies were conducted in bodies of water where domestic sewage was already mixed with industrial effluents and also with petroleum products and so on. What would be interesting would be to know what effect sewage has on the rate of fish infestation before it is mixed with industrial effluents.

The subject of our research was the fingerlings of the secondary hosts of Diphyllobothrium latum - perch (Perca fluviatilis L.), the pike (Ecox lucius L.) and the ruff (Acerina cernua (L.)). It is easier to trace the likelihood that fish have been infested in the current year using fingerlings. In mature fish the problem is complicated by the fact that over a number of years there is an accumulation of Cestoda larvae in them.

The fish were caught in the summer and autumn of 1973 in the Kama reservoir and in its tributaries in the region of the towns of Solikamsh and Usol'e which is situated 35 kilometers downstream from Solikamsk and on the opposite bank from the town of Berezniki. Industrial firms (including chemical plants) and residential areas in the towns of Solikamsk and Berezniki dump a considerable amount of insufficiently purified or completely unpurified industrial and domestic sewage into tributaries of the reservoir. En route to the reservoir the main bulk of the domestic sewage mixes with the chemical effluents which are dumped into the same tributaries which have already become what are essentially industrial drains for dumping sewage.
Examples of this are the rivers Glotikha and Chernaya. Domestic sewage passes through the river Usolka which lies between the two rivers mentioned above at a distance of 2 kilometers from both of them and does not mix with chemical effluents.

The fingerlings were caught in the reservoir itself, in its bays, channels and in the mouths of its tributaries. Only on the river Usolka were the fish caught in an area some 2 to 3 kilometers above the mouth of the river. (At this point the river is about 50 meters wide and there are fairly large bays).

The fish were caught in a kapron drag net 6 meters long in shallow water areas (up to 1.5-2 meters deep) off the banks and islands. We used the conventional method of incomplete helminthological dissection for Diphyllobothrium latum plerocercoid infestation. The body cavity, musculature and internal organs were examined. Since the majority of the fish which were dissected were perch the yearlings of this species will be used in comparing the extent to which the fish were infested in various parts of the reservoir.

It can be seen from the results given (see the Table) that in the region of the town of Solikamsk the river Usolka was the worst affected. It is into this stream that unpurified domestic sewage is discharged without being mixed with chemical effluents. The rate of infestation of the perch in this stream came to 4.5%, that of the pike, 66%.

In the bays of the islands which lie some 500-600 meters opposite the mouth of the river Glotikhi, in a backwater 500 meters below the mouth of the river Chernaya and also in the channels and bays 2 kilometers below the mouth of this river no affected perch fingerlings were recorded. We believe this to be due to the effect of the chemical effluents flowing into the reservoir on the copepod crustaceans which are the interim hosts of the
The rate of infestation of fingerlings by Diphyllobothrium latum plerocercoids in the Kama reservoir and its tributary the river Usolka (around the towns of Solikamsk and Usol'e).

<table>
<thead>
<tr>
<th>Where caught*</th>
<th>Perch</th>
<th></th>
<th>Pike</th>
<th></th>
<th>Ruff</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. dissected</td>
<td>No. infested</td>
<td>Infestation rate</td>
<td>No. dissected</td>
<td>No. infested</td>
<td>Infestation rate</td>
</tr>
<tr>
<td>Around the town of Solikamsk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 kilometers above the mouth of the river Glotikhi</td>
<td>163</td>
<td>2</td>
<td>1.2</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>500 meters above the mouth of the river Glotikhi</td>
<td>185</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>between the islands facing the mouth of the river Glotikhi</td>
<td>125</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>the mouth of the river Usolka</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the river Usolka 2-3 kilometers above the river mouth</td>
<td>109</td>
<td>5</td>
<td>4.5</td>
<td>18</td>
<td>12</td>
<td>66.6</td>
</tr>
<tr>
<td>backwater into which the river Chernaya empties**</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2 kilometers below the mouth of the river Chernaya</td>
<td>111</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Around the town of Usol'e</td>
<td>327</td>
<td>32</td>
<td>9.7</td>
<td>9</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

* sites given in downstream order

** Of the 63 Perch yearlings caught here only one specimen (1.5%) was infested.
tape worm. Thus, in two plankton samples taken 150 meters above the mouth of the river Glotkhi, no planktonic organisms including copepod crustaceans were found, and there were also no fish juveniles. In three samples of the bottom and the water, taken at the same site non-viable tapeworm eggs were found (up to 27 in one sample). This shows the noxious effect of the chemical effluents in the river Glotikhi which contain a large amount of chlorine, hydrogen sulfide, nitrogen and other compounds, have on the eggs of the broad fish tapeworm * and on its interim and secondary hosts.

The rate of infestation of perch fingerlings in the reservoir was recorded at sites above where the effluents are discharged into the river. It should be noted the effect of industrial effluents spreads not only downstream but also to a certain distance upstream. Thus, among the perch fingerlings caught in a bay of the reservoir 500 meters above the mouth of the river Glotikhi (on the same bank) the rate of infestation was 0.5% while 3 kilometers upstream in a bay of a large island the infestation rate had increased to 1.2%.

A comparison of the rate of infestation indices for perch fingerlings in various parts of the reservoir in the region of the town of Solikamsk shows that the discharge of domestic sewage containing the eggs of the broad fish tapeworm into the Usolka raises the possibility that the fish in this area will be infected with the plerocercoids of this helminth.

An area of the reservoir 35-45 kilometers downstream from the town of Solikamsk which is somewhat more like a lake in character, is polluted by the domestic sewage of the town of Berezniki. Around the town of Usol'e, * The question of the effect of chemical industrial effluents on the eggs of the broad fish tapeworm will be discussed in detail in our next report.
which is situated on the bank opposite the town of Berezniki, the rate of infestation of the perch fingerlings in two nearby bays averaged 9.7%.

5-9 kilometers below Usol'e (the vicinity of the settlements of Ogurdino and Orel) in fishing areas that are similar in respect of ecological conditions and likelihood of contamination by tapeworm eggs (the bays of the islands near the channel part of the reservoir) the rate of infestation of the perch fingerlings reached an average of 44% (more than 300 specimens were dissected). Around the settlements of Orel and Ogurdino perch fingerlings were affected at approximately the same rate in previous years as well [2].

Thus, the discharge into a water body of untreated domestic sewage containing the eggs of the broad fish tapeworm leads to the infestation of the fish by the plerocercoids of this helminth. The greater the impact of urban sewage containing noxious chemical substances the lower the rate at which fingerling fish are affected with *Diphyllobothrium latum* plerocercoids.

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Received May 16, 1974.