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SPECIES COMPOSITION OF HELMINTHES OF FISH IN WATER BODIES OF BUKHARA REGION IN UZBEKISTAN

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Annotation
According to the results of helminthological studies, 32 species of helminthes were identified in 13 species of fish in the Bukhara region of Uzbekistan, including 12 species of cestodes, 6 species of trematodes, 12 species of nematodes and 2 species of acanthocephalans. Of these, 15 species were recorded in the sexually mature form, and 17 in the larval form. The acanthocephalans species *Acantocephalus lucii* has been found for the first time in this area, and the carp (*Cyprinus cyprinus*) is the new host of this parasite. The nematode of *Philometra kotlani*, first recorded in the fish of Uzbekistan. Infection of the studied 13 fish species averaged: cestodes: prevalence is 16.8%, intensive infection is 1-63 specimens; trematodes: prevalence - 2.1%, intensive infection - 1-6 specimens; nematodes: prevalence - 14.8%, intensive infection - 1-14 specimens and acanthocephalans: prevalence - 1.2%, intensive infection - 1-4 specimens. The total percentage of infection of fish with helminthes is 8.7%. The number of parasites per fish ranges from 1 to 63 specimens.

Introduction

The ichthyofauna of Uzbekistan includes 71 species of fish, of which 48 species are aboriginal, 17 are endemic to the Aral Sea basin, 27 are introduced species, and 29 are commercial species [1]. The ichthyofauna of the Zarafshan basin includes 36 species and subspecies of fish [2]. As in other basins of the rivers of Central Asia, the formation and development of the ichthyofauna of watercourses and reservoirs of Zarafshan is mainly due to historical reasons, and recently also by human activity. The historical composition of the fish in the reservoirs of the basin has undergone changes as a result of the reconstruction of the hydrographic network and acclimatization work. According to the results of studies previously carried out in the reservoirs of the Bukhara region Uzbekistan, the ichthyofauna is dominated by representatives of the cyprinid fish family, which are very popular with the population and are of local commercial importance.

It is also necessary to note the quantitative and qualitative changes in recent years that have occurred in aquatic ecosystems, the emergence of parasitic diseases of fish and aquatic organisms, a decrease in the number of valuable fish species caused by intensive human activities and adversely affecting the epizootic situation of reservoirs. Fish parasites cause significant economic damage and can be a hazard to human health [3, 4].

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According to the data of S.O. Osmanov [5, 6], who summarized faunal materials, 102 species of parasites were identified in the water bodies of the Zarafshan basin, of which 33 species belong to protozoa, 42 species are monogeneans, 10 are cestodes, 5 are trematodes, 6 are nematodes, 1 - acanthocephala, 2 - leeches and 4 species of crustaceans. In the regional aspect, fish parasites of the Amudarya basin (within Uzbekistan) were studied in the Surkhandarya region, where 161 species of parasites were found. The noted parasites belong to 11 classes, of which 11 are cestodes, 7 are trematodes, 13 are nematodes, and 3 are acanthocephala [7]. R.M.Karaev [8] researched 171 species of parasites in fish from reservoirs of Kashkadarya region. Of these, flatworms make up 10 species, nematodes - 9 and acanthocephalans - 3 species. A large amount of research has been carried out in the Republic of Karakalpakstan, in the Amudarya delta and reservoirs [9-13]. From 25 to 140 species of parasites have been recorded in fish in various species of water bodies.

The study of parasitic diseases of fish, in particular, their infestation with helminthes, the study of their species composition based on modern research methods, as well as the development of measures to prevent an increase in the number of epizootically dangerous parasite species is one of the urgent requirements of the present.

The purpose of our study is to study the species composition of fish helminthes in the reservoirs of the of the Bukhara region of Uzbekistan and their infestation with parasites.

Materials and Methods

In 2020-2022, we collected helminthological material of fish in the reservoirs of the lower reaches of the Zarafshan river, including the Shurkul and Tudakul reservoirs and the Ayakagitma, Dengizkul, Korakir reservoirs located in the Bukhara and Navoiy regions of Uzbekistan; in particular, carp and carp - (*Cyprinus cyprinus* and carp) - 317 specimens, crucian carp (*Carassius auratus gibelio*) - 318, roach (*Rutilus rutilus*) - 222, eastern bream *(Hemiculter leucisculus*) - 298, eastern bream (*Abramis brama*) - 158; grass carp (*Ctenopharyngodon idella*) - 122, zander (Sander lucioperca) - 212; silver carp (*Hypophthalmichthys molitrix*) - 214, bighead carp (*Arystichthys nobilis*) - 100, catfish (*Silurus glanis*) -112, Turkestan barbel (*Barbus capito conocephalus*) - 42 and redfin (*Scardinius erythrophthalmus*) - 201.

The autopsy was carried out according to the generally accepted method [14], when determining the types of parasites, the “Key to parasites of freshwater fish of the fauna of the USSR” [15] and monographs of other authors [16, 17] were used.

The examined surfaces and the organs themselves were carefully examined from the outside for the detection of parasites, body cavities - for the presence of tapeworm larvae, flukes, roundworms and acanthocephalus. When parasites were found, it was indicated in which organ and where they were concentrated. In the study of internal organs (especially the intestines), all large parasites visible to the naked eye were selected with tweezers or needles, placed in clean water or saline (for nematodes), then they were fixed in 70° alcohol.

To detect small parasites and larval forms, the organs were examined by the compressor method. Scrapings were taken from a part of the organ (if it is large), the whole organ (if it is small), from the

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walls of the intestine or its contents, in small parts they were placed between two glasses (6 x 12 cm in size, 3-4 mm thick) and with some addition of water flattened to the transparency of the resulting thin layer. By successively viewing the glasses under a magnifying glass (moving the glass from left to right), even very small parasites can be detected. Then the parasites were counted and their taxonomic groups were determined. The parasites were studied using a MEIJI 2000 microscope (Japan) with a digital camera.

In addition, the collection material of parasites, located at the Institute of Zoology of the Academy of Sciences of the Republic of Uzbekistan, was analyzed.

Traditional indicators of infestation were used in the work: extensiveness of infection or prevalence - the number of host individuals infected with a certain parasite species divided by the number of hosts (EI, %); intensity of infection (average) – the sum of individuals of a parasite of a certain species in the studied hosts, divided by the number of infected individuals in the sample (II).

Statistical processing of morphometric data was carried out using the BioStat 2018 software and Microsoft Office Excel 2010.

Results and its Discussion

This paper presents preliminary results of the collection of ichthyo-parasitological material, carried out mainly in water bodies of the Bukhara region.

Currently, there is no single point of view on the system of parasitic worms. The systems proposed by various researchers differ significantly in terms of both the volume included in the corresponding classes - Cestoda, Trematoda, Acanthocephala and Nematoda, and the order of their location. We use the system adopted by the "Key to parasites of freshwater fish" [14]. A systematic review of helminthes of the common marinka (with the indicated localization, places of detection, extensiveness and intensity of invasion) is compiled in the following order: classes, orders, families, genera and species.

Based on the research results and in accordance with the information given by the authors of previous studies of the water bodies of the Bukhara region, we noted 32 species of fish helminthes belonging to 4 classes, 12 orders, 21 families and 30 genera. Of these, 12 species belong to the class of cestodes, 6 species - trematodes, 12 - nematodes and 2 species of acanthocephalus, presented in the following systematic order:

Class Cestoda Rudolphi, 1808

Order Caryophyllidea van Beneden in Carus, 1863

Family Caryophyllaeidae Leuckart, 1878

Genus *Caryophyllaeus* Muller, 1787

1. *Caryophyllaeus laticeps* Pallas, 1781

The species was found in the intestines of carp caught in the Shurkul reservoir, the prevalence of invasion (EI) is 5.3%, the intensity of invasion (II) is 1–12 specimens (ind.).

The cycle of development proceeds with one intermediate host, oligochaeta worms (Oligochaeta), in the body cavity of which the larval phase, the procercoid, develops [15].

2. Caryophyllaeus fimbriceps Annenkova–Chlopina, 1919

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In our collections, this species was found in the intestines of carp caught in the Shurkul reservoir, with EI-7.1% and AI 1-13 ind.

Genus *Biacetabulum* Hunter, 1927

3. *Biacetabulum appendiculatum* Szidat, 1937

The species was found for the first time in the Ayakagitma reservoir and recorded in the intestines of carp with EI values of 12.5%, AI values of 1–4 specimens.

Family Litocestidae Hunter, 1927

Genus *Khawia* Hsü, 1935

4. *Khawia sinensis* Hsü, 1935

The species was recorded in the intestines of carps in the Ayakagitma reservoir. Relatively large worms, with EI - 3.3% and AI - 1-6 specimens. In the conditions of pond farms, it can cause the death of juvenile fish.

Order Pseudophyllidea Carus, 1863

Family Amphicotylidae Ariola, 1899

Genus *Bathybothrium* Luhe, 1902

5. *Bathybothrium rectangulum* Bloch, 1782

The species was found in the intestines of the Turkestan longhorned beetle caught in the Ayakagitma reservoir; the EI index was 18.6%;

The development cycle occurs with the participation of an intermediate host, the cyclops Acantocyclops viridis and Macrocyclops albidus [15].

Family Bothriocephalidae Blanchard, 1849

Genus *Bothriocephalus* Rudolphi, 1808

6. *Bothriocephalus opsariichthydis* Yamaguti, 1934

This species was first found in the Dengizkul reservoir and found in the intestines of carp. Extensiveness of invasion - 9.2%, intensity of invasion - 1-6 specimens.

Development cycle with one intermediate host – copepods (Cyclops, Acanthocyclops, Mesocyclops and Eucyclops) [18].

Family Ligulidae Claus, 1885

Subfamily Ligulinae Monticelli et Grety, 1891

Genus *Ligula* Bloch, 1782

7. *Ligula intestinalis* Linnaeus, 1758 larvae

Plerocercoids were noted in the body cavity of the crucian carp in the Shurkul reservoir. The extensiveness of invasion in crucian carp is 28.6%, with an intensity of invasion of 4-21 ind.

Adult worms are localized in the intestines of fish-eating birds - gulls, ducks, terns and grebes; plerocercoids in the body cavity of many species of cyprinids; the procercoid phase occurs in the body cavity of copepods [15]. At the plerocercoid phase, it is a dangerous parasite and causes epizootics among cyprinids, especially in slow-flowing water bodies and reservoirs.

Genus *Digramma* Cholodkovsky, 1914

8. *Digramma interupta* Rudolphi, 1810 larvae

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The species was found in the body cavity of roach and crucian carp in the Shurkul reservoir, with EI - 20.7% and AI - 2-23 specimens.
Order Proteocephalidea Mola, 1928
Family Proteocephalidae La Rue, 1911
Genus *Proteocephalus* Weinland, 1858
9. *Proteocephalus osculatus* Goeze, 1782
This species was recorded in the intestines of catfish from the Shurkul Reservoir for the first time, with EI - 22.0% and AI - 1-4 specimens.
The development cycle occurs with the participation of an intermediate host, the copepods Diaptomus castor, Cyclops strenuus, and Eucyclops serrulatus [15].
Order Cyclophyllidea Braun, 1900
Family Dilepididae Fuhrmann, 1907
Genus Neogryporhynchus Baeret Bona, 1960
10. Neogryporhynchus cheilancristrotus Wedl, 1855 larvae
Plerocercoids were found in the intestinal walls of carp in the lower reaches of the Zarafshan River and the Tudakul reservoir, IE-4.3%, IE 1-3 specimens.
The first intermediate host is Mesocyclops oithonoides (Jarecka, 1970), adult worms in the intestines of birds [15].
Genus *Gryporhynchus* von Nordmann, 1832
11. *Gryporhynchus pusillum* Nordman, 1932 larvae
Plerocercoids were noted in the anterior intestine of the Turkestan barbel in the Ayakagitma reservoir of Uzbekistan. IE - 10.1%, II - 1 specimen.
Genus *Valipora* Linton, 1927
12. *Valipora campylancristrota* Rudolphi, 1819 larvae
Plerocercoids have been recorded in the intestines of the silver carp in the Shurkul reservoir. IE - 2.8%, II - 1-4 specimens. Plerocercoids can have a negative effect on fish weight and growth.
Class Trematoda Rudolphi, 1808
Order Sanguinicolida Odening, 1960
Family Sanguinicolidae Graff, 1907
Genus *Sanguinicola* Plehn, 1905
13. *Sanguinicola inermis* Plehn, 1905
The species was found in the blood vessels of carp caught in the lower reaches of the Zarafshan and the Tudakul reservoir, with EI-1.8%, SI 1-3 specimens.

Order Fasciolida Skrjabin et Shulz, 1937
Family Orientocreadiidae Skrjabin et Kowal, 1960
Genus *Orientocreadium* Tubangui, 1931
14. *Orientocreadium siluri* Bychowsky et Dubinina, 1954

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This species has been recorded in the intestines of carp in the Tudakul reservoir. EI was 1.6% and AI 1-2 specimens.

The lung snails of the genus Lymnaea are the first intermediate host, and several species of fish and mollusks (experimental) can act as the second intermediate host [19].

Family Allocreadiidae Looss, 1902

Genus *Allocreadium* Looss, 1900

15. *Allocreadium isoporum* Looss, 1894

The species was found in the Tudakul reservoir in the intestines of carp with EI-3.1%, AI-1-8 specimens. It is known from the literature data that the first stages of development of *A.isoporum* larvae take place in molluscs of the genus *Sphaerium*. Additional hosts are larvae of aquatic insects of the genera Ephemera, Anabolia, and Choetopteryx [15].

Family Diplostomatidae Poirier, 1886

Genus *Diplostomum* Nordman, 1832

16. *Diplostomum spathaceum* Rudolphi, 1819 larvae

This species was found in the Shurkul reservoir. Trematode larvae were found in the lens of the eye of the silver carp. EI - 5.0%, II - 1-5 specimens.

Genus *Tylodelphys* Diesing, 1850

17. *Tylodelphys clavata* Nordman, 1832 larvae

In our collections, this species was recorded for the first time in the Shurkulya reservoir. Worms were found in the vitreous body of the crucian eye, EI - 6.4%, II - 2-5 specimens.

Genus *Bolboforus* Dubois, 1935

18. *Bolboforus confusus* Krause, 1914 larvae

In our collections, this species was recorded for the first time in the Karakir reservoir. Worms were found in the musculature of zander, EI - 2.4%, II - 1-4 specimens.

Class Nematoda Rudolphi, 1808

Order Trichocephalidae Skrjabin et Schulz, 1928

Family Capillaridae Neveu–Lemaire, 1936

Genus *Capillaria*, Zeder 1800

19. *Capillaria tomentosa* Dujardin, 1843

In our collections, this species was recorded for the first time in the Tudakul reservoir. Worms were found in the intestines of roach, EI - 12.5%, AI - 1-4 specimens.

Order Dioctophymida Skrjabin, 1927

Family Dioctophymidae Railliet, 1915

Genus *Dioctophyme* Collet-Meygret, 1802

20. *Dioctophyme renale* Goeze, 1782 larvae

This species was first encountered in the Shurkul reservoir and found in the intestinal walls of roach. EI was 4.5% and AI was 1-4 specimens.

For this species of larvae, fish act as reservoir hosts; in adulthood, they parasitize in the kidneys of wild and domestic mammals and occasionally infect humans [17].

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Order Spirurida Chitwood, 1933
Family Rhabdochonidae Skrjabin, 1946
Genus *Rhabdochona* Railliet, 1916
21. *Rhabdochona denudata* Dujardin, 1845
This nematode is widespread in the Tudakul reservoir. Parasites were found in the intestines of carp with EI - 8.8% and AI - 1-3 ind.
Development proceeds with the participation of mayflies of the genera Heptagenia and Ephemerella, and larvae of Hydropsyche (Trichoptera) [18, 19].
Family Desmidocercidae Cram, 1927
Genus *Desmidocercella* Yorke et Maplestone, 1926
22. *Desmidocercella numidica* Seurat, 1920 larvae
Found in the vitreous body of the eye of the eastern bream caught in the Tudakul reservoir, with EI - 12.5%, AI - 1-4 specimens.
Family Camallanidae Raillet et Henry, 1915
Genus *Camallanus* Raillet et Henry, 1915
23. *Camallanus truncatus* Rudolphi, 1814
This species was found by us in the intestines of pike perch in the Tudakul reservoir, with EI values of 14.7% and AI values of 5–13 specimens. The species is specific to zander.
The development cycle takes place with the participation of the intermediate host - cyclops, possibly the participation of reservoir hosts - non-predatory cyprinids. The definitive hosts of this nematode species are predatory fish [15].
24. *Camallanus lacustris* Zoega, 1776
Shurkul was discovered in the reservoir for the first time. Found in the intestines of pike with EI - 7.8% and IS - 1-16 specimens.
Family Philometridae Baylis et Daubney, 1926
Genus *Philometra* Costa, 1845
25. *Philometra kotlani* Molnar, 1969
This species was found for the first time in the body cavity of an oriental bream in the Shurkul reservoir. With EI -17.4% and AI - 2-4 specimens.
The life cycle takes place with the participation of an intermediate host, cyclops of the genera Cyclops, Macrocyclops, and Acantocyclops [15].
Family Gnathostomatidae Railliet, 1895 oilasi
Genus *Gnathostoma* Owen, 1936 Avlodi
26. *Gnathostomata hispidum* Fedtschenko, 1872 larvae
Found in the intestines and body cavities of carp in the Ayakagitma reservoir. EI - 2.6%, II - 1-4 specimens. It was registered in this reservoir for the first time.
The development cycle proceeds with the participation of the first intermediate host - cyclops. Fish, birds, amphibians, mammals are reservoir hosts, wild and domestic pigs, less often bulls are the final hosts. It also parasitizes in humans [15].

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Order Ascaridida Skrjabin et Schulz, 1940
Family Anisakidae Skrjabin et Karokhin, 1945
Genus *Contracaecum* Raillet et Henry, 1912
27. *Contracaecum spiculigerum* Rudolphi, 1809 larvae
This species was found in the body cavity of the redfin in the Shurkul reservoir. With EI -10.2% and AI - 1-8 specimens.
28. *Contracaecum rudolphi*, Hartwich, 1964 larvae
This species was found for the first time in the body cavity of a catfish in the Shurkul reservoir. With EI -8.2% and AI - 2-4 specimens.
Genus *Porrocaecum* Raillet et Henry, 1912
29. *Porrocaecum reticulatum* Linstow, 1890 larvae
This species was found in the muscle tissue of carp in the Shurkul reservoir. With EI -1.6% and AI - 1-22 specimens.
Genus *Raphidascaris* Raillet et Henry, 1915
30. *Raphidascaris acus* Bloch, 1779 larvae
The species was found in the stomach and intestines of pike and carp in the Shurkul reservoir, with EI values of 3.1%, AI values of 1–3 specimens. Typical parasite of pike, rarer than other predatory fish.
The development cycle proceeds with the participation of the first (oligochaetes, copepods and other groups of invertebrates), the second (dragonfly larvae, caddis flies, beetles, cyprinids) and definitive hosts.
Class Acanthocephala Rudolphi, 1808
Order Palaeacanthocephala Meyer, 1925
Family Pomphorhynchidae, Yamaguti, 1939
Genus *Pomphorhynchus* Monticelli, 1905
31. *Pomphorhynchus laevis* Muller, 1776
It is one of the most common parasites of cyprinids and was first discovered in the Shurkul reservoir. The species was found in the intestines of carp, with EI 6.0% and SI - 1-63 specimens.
The first intermediate host is various amphipods, including Gammarus pulex, Gammarus lacustris, etc. [15].
Family Echinorhynchidae Cobbold, 1879
Genus *Acantocephalus* Koelreuther, 1771
32. *Acantocephalus lucii* Muller, 1776
Found in the intestines of carp in the Tudakul reservoir. EI - 6.0%, II - 1-40 copies. This species was found for the first time in this area and is new to the host.
Conclusion. 32 species of helminthes were found in cyprinids of the surveyed reservoirs of the lower reaches of the Zarafshan. Of these, 15 species were recorded in the sexually mature form, and 17 in the larval form. The identified helminths belong to 30 genera, 21 families, 12 orders, 4 classes, of which 12 species belong to the class of cestodes, 6 trematode species, 12 nematode species and 2 acanthocephalic species. Among the helminthes in fish, cestodes dominate, of which 3 species parasitize in the larval

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stage. Trematodes are represented by 3 species of adult forms, for which fish are the definitive host. 3 species of trematodes parasitize in the larval stage, for which fish serve as an intermediate host. The fish nematode fauna of the lower Zarafshan basin is very poor. We found only eight species of roundworms, of which 4 parasitize fish in the larval stage. Even S.O. Osmonov [6, 17] noted a weak infestation and poverty of the species composition of helminths in fish from the Zarafshan River basin compared to other water bodies. Here we discovered for the first time two species of acanthocephalus: Acantocephalus lucii, first recorded in carp, which is the new host of this parasite, and Pomphorhynchus laevis.

Infestation of the studied 12 fish species averaged: cestodes: extensive infection - 16.8%, intensive infection - 1-63 specimens; trematodes: extensive infection - 2.1%, intensive i infection - 1-6 specimens; nematodes: extensive infection - 14.8%, intensive infection - 1-14 specimens and acanthocephala: extensive infection - 1.2%, intensive infection - 1-4 specimens. The total percentage of infection of fish with helminthes is 8.7%. The number of parasites per fish ranges from 1 to 63 specimens.

Our data on the quantitative composition of fish helminths in the lower reaches of the Zarafshan River in Uzbekistan allow us to distinguish 2 groups of communities:

1) Helminths using cyprinids as definitive hosts: *Caryophyllaeus laticeps, C. fimbriceps, Khawia sinensis, Biacetabulum appendiculatum, Bathybothrium rectangulum, Bothriocephalus opsariichthydis* and *Proteocephalus osculatus* (cestodes), *Sanguinicola inermis, Orientocreadium siluri, Allocreadium isoporum (trematodes), Rhabdoch denudata, Camallanus truncatus, C. lacustris, Philometra kotlani* (nematodes) and *Pomphorhynchus laevis, Acantocephalus lucii* (acanthocephalus). Infection of fish occurs mainly through the food channels of the hosts;

2) helminths using fish as intermediate hosts: 2 species of cestodes *Ligula intestinalis, Digramma interupta* and nematodes *Dioctophyme renale, Raphidascaris acus*. The final hosts (predatory fish, piscivorous birds and mammals) become infected by eating cyprinids infested with helminth larvae. An analysis of the parasite fauna of fish shows that the majority of fish parasites in the water bodies of the lower reaches of the Zarafshan are characterized by dixenous life cycles that have developed in the relationships between the components of the parasitic system.

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