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INVESTIGATION ON PARASITOFAUNA OF SOME FRESHWATER FISH FROM SUPERIOR AND MIDLE AREA OF ROMANIAN DANUBE RIVER SECTOR

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Abstract

During the years 2019-2020, research was carried out on the assessment of the health status of fish in the upper Danube sector of Romania. Fish species belonging to the families Ciprinidae, Siluridae, Esocidae, Percidae, Clupeidae and Acipenseridae were analyzed. Fish were sampled from two stations: Station 1- km 1048, near Moldova Nouă and Station 2- km 493, near Giurgiu. The parasitological analyzes were performed in the laboratory of the Institute of Research and Development for Aquatic Ecology, Fishing, and Aquaculture (ICDEAPA), Galati, Romania. Analyzes were performed on fresh fish using well-known methods. In station 1, 14 species of parasites belonging to eight systematic groups were identified: Nematode, Monogenea, Trematode, Ciliata, Acanthocephala, Protozoa, Cestoda, Crustacea, while in station 2, 11 species of parasites belonging to six systematic groups were identified: Monogenea, Ciliata, Trematoda, Nematoda, Acanthocephala, Cestoda. The species Sander lucioperca and Abramis brama presented most often polyparasitoses but with a low degree of infestation. The most present group of parasites in station 1 was represented by nematodes and in station 2 by monogenic worms.

***Key words**: Danube river, fish parasites, parasitological analysis, wild fish.*

INTRODUCTION

In recent decades, aquatic ecosystems have been subjected to increasing anthropogenic pressure. Aquatic organisms are frequently exposed to several stressors, natural and artificial, such as physical variations and chemical parameters of the environment (rainfall, temperature, and salinity), changes in food and habitat availability, and increased exposure to contaminants. in nutrient intake (eutrophication) (Adams & Greeley, 2000).
Therefore, the methodologies that increase our understanding of these phenomena of pressure on aquatic organisms have great importance.
To assess and quantify the effect of environmental stressors on the health of aquatic systems, researchers used bioindicators, defined as organisms or communities whose vital functions are so closely correlated with certain environmental factors that they can be used as indicators in the assessment of a particular area (Markert et al., 2003).
Field approaches are vital for an integrated assessment of these ecosystems, allowing the detection of the cumulative and/or synergistic effects of the impact on the environment and the community of organisms (Adams et al., 1999).
The parasite fauna of aquatic organisms is it is pervasive and is a hidden component of ecological communities, which are closely linked to several characteristics of the biotic and the abiotic environment in which they live.
Thus, fish parasites have attracted increasing interest from researchers as potential indicators of environmental quality, due to the variety of forms that respond to anthropogenic pollution, such as eutrophication, oil spills, heavy metals, acid rain, sewage leaks, agricultural and industrial pollution (Landsberg et al., 1998; Sures, 2004).
The effects of stressors on parasite communities are varied and can be positive or negative: pollution can increase parasitism and can be fatal for certain species, leading to a decrease in the number of parasites. Abiotic

factors such as temperature, dissolved oxygen, salinity, and pH can influence the appearance of parasites temporally and spatially, especially helminth parasites of fish (Chubb, 1979)

Stressors can promote parasitism, for example, if the host's defense mechanisms are adversely affected, thereby increasing the host's susceptibility, or simply by increasing the density on the final and intermediate host, such as eutrophication, usually favors invertebrates as intermediate hosts in the life cycle of digenic helminths (Sures, 2004). For example, eutrophication can increase parasitism, while heavy metals can reduce it. Ciliates and nematodes are sensitive indicators of eutrophication and thermal effluents, while digens worm and acanthocephalus are good indicators of heavy metals (Lafferty, 1997). Poulin (1992) showed that parasite fauna is indirectly influenced by pollutants that are toxic to fish and intermediate hosts and directly by environmental factors that are toxic to parasites and their free life forms.

The present paper has the role of highlighting an image of the fish parasite fauna from the upper and middle sectors of the Danube river km 1048 - Moldova Nouă area and km 493 - Giurgiu.

MATERIALS AND METHODS

Over the years 2019-2020, we sampled the fish community from the upper and middle Danube River sector (Moldova Nouă area km 1048 and Giurgiu area km 493) belonging to the following species: *Carassius auratus gibelio* (Bloch, 1782), *Hypophthalmichthys molitrix* (Valenciennes, 1844), *Cyprinus carpio* (Linnaeus, 1758), *Abramis brama danubii* (Linnaeus, 1758), *Rutilus rutilus carpatorossicus* (Linnaeus, 1758), *Scardinius erythrophtamus* (Linnaeus, 1758), *Leuciscus idus* (Linnaeus, 1758), *Ballenus sapa* (Pallas, 1814), *Alburnus alburnus* (Linnaeus, 1758), *Aspius aspius* (Linnaeus, 1758*), Perca fluviatilis* (Linnaeus, 1758)*, Silurus glanis* (Linnaeus,1758)*, Esox lucius* (Linnaeus,1758)*, Sander lucioperca* (Linnaeus, 1758), *Acipenser ruthenus* (Linnaeus, 1758), *Alosa immaculata* (Bennett,1835).

The fishing area was represented by a sector of the Danube River with a surface of 16.15 km^2 (L = 9.5 km, l = 1.7 km). The scientific fishing activity was carried out over a length of 2-3 km, with the fishing net wall. The fish were weighed (g) and their total length was measured (cm).

Fish were transported to the Institute of Research and Development for Aquatic Ecology, Fishing and Aquaculture Galați laboratory where parasitological analyses were carried out.

The sampled fish were examined for both ectoparasites and endoparasites using standard parasitological procedures. The taxonomic classification and identification of the observed parasites were done based on Munteanu & Bogatu (2003), Bauer (1984), Bauer (1985), Bauer (1987). The external surface of the fish was examined thoroughly using a hand lens. Areas around the fins, nostrils, operculum, and the buccal cavity were examined for external parasites (monogeneans and crustaceans). Each fish was opened dorso-ventrally and its internal organs were examined for parasites. The entire digestive system was removed and placed in a Petri dish with physiological saline, and the gut was divided into sections. For isolation, selection, and identification of the parasite fauna of wild fish from the Danube river, we used a Zeiss microscope. We also analyzed the extensity and intensity of parasitic infestation of the fish specimens according to Bush (1997).

RESULTS AND DISCUSSIONS

In Station 1, area Moldova Nouă km 1048, 15 species grouped in 5 families were captured: Cyprinidae, Esocidae, Percidae, Siluridae, Acipenseridae. From the 15 species captured, lots were set up for ichthyo-pathological research (3-5 fish) of the following fish species*: Carassius auratus gibelio* (gibel carp), *Hypophthalmichthys molitrix* (silver carp)*, Cyprinus carpio* (carp), *Abramis brama danubii* (carp bream), *Rutilus rutilus carpatorossicus* (roach), *Scardinius erythrophtamus* (common rudd), *Leuciscus idus* (ide), *Ballenus sapa* (White-eye bream), *Alburnus alburnus* (bleak), *Aspius aspius* (asp), *Acipenser ruthenus* (sterlet), *Perca fluviatilis* (European perch), *Silurus glanis* (catfish), *Esox lucius* (pikepeach), *Stizosteidon lucioperca* (zander).

Table 1. Species of parasites identified in the upper Danube River sector km 1048 (Moldova Nouă area)

No. crt.	Identified parasitic species	Parasitic species	Affected organ	Degree of infestation
1.	*Achtheres percarum*	*Sander lucioperca*	G	weak
2.	*Ichthyocotylurus pileatus*	*Sander lucioperca*	I	weak
3.	*Apophallus donicum*	*Sander lucioperca*	T	weak
		Perca fluviatilis	G	weak
4.	*Bunodera luciopercae*	*Perca fluviatilis*	I	weak
5.	*Trichodina domerguei*	*Hypophthalmychtis molitrix*	G	weak
		Cyprinus carpio,	G	weak
		Leuciscus idus	G	weak
6.	*Trichodinella epizootica*	*Sander lucioperca*	G	weak
7.	*Myxobolus macrocapsularis*	*Rutilus rutilus*	G	weak
8.	*Myxobolus obesus*	*Alburnus alburnus*	G	weak
9.	*Dactylogirus vastator*	*Carasus auratus gibelio*	G	weak
		Cyprinus carpio	G	weak
		Abramis brama danubii	G	weak
		Ballerus sapa	G	weak
10.	*Diplozoon paradoxus*	*Abramis brama danubii*	G	weak
		Rutilus rutilus carpathorossicus	G	weak
		Scardinus erythrophthamus	G	weak
11.	*Triaenophorus nodulosus (lucii),*	*Esox lucius*	I	medium
12.	*Eustrongylides excisus*	*Perca fluviatilis*	M	weak
		Sander lucioperca	M	weak
		Silurus glanis	M	weak
		Esox lucius	M	weak
		Aspius aspius	M	weak
13.	*Pomphorhynchus leavis*	*Silurus glanis*	I	weak
14.	*Acanthocephalus anguillae*	*Acipenser ruthenus*	I	weak

Note: T-tegument;G-gills; I-intestine; L-liver; E-eye; M-muscles.

Achtheres percarum, crustacean copepod that was found parasitizing gills on the *Stizostedion lucioperca*. Hypertrophies and agglutination of the gill lamellae were observed, which became fusiform and whitish. The parasite was observed fixed on the pharyngeal teeth.

Pomphorhynchus leavis, is an acanthocephalus that has 18-20 rows of 12 hooks each. It was found in the intestine at catfish (*Silurus glanis),* and barbell (*Barbus barbus*). No intestinal lesions were observed. This parasite is a common acanthocephalus of fish in the Danube Delta, being a typical southern euryhaline form (Docan et al., 2019).

Eustrongylides excisus - nematode with red larvae and clockwise shape, were frequently found in the abdominal cavity and the muscles at *Perca fluviatilis, Stizostedion lucioperca, Silurus glanis*, *Esox lucius,* and *Aspius aspius*. The presence of this parasite is was reported in similar hosts by Cojocaru (2003).

Triaenophorus nodulosus (lucii) cestode, recognized by the pair of three-forked hooks at the level of the scolex it was found at pikeperch (*Esox lucius*). Only at one pikepech fish it was found in autumn ten specimens of parasite without any changes in the general condition of the fish. But the intestinal mucosa has ulcerations and nodules.

Bunodera luciopercae (2-3 mm long trematode with a well-developed anterior triangular suction cup) were found in the gut of perch (*Perca fluviatilis*). The parasites were found in autumn (September-October).

Ichthyocotylurus pileatus - trematode that produces whitish spherical cysts and disseminated on serous (especially on the pericardium, but also on the esophageal wall) to the common shawl (*Stizostedion lucioperca*). The cysts contain a metacercaria which, to be highlighted, must be washed several times after extraction from the cyst.

Apophallus donicum, trematode produces black cysts the size of needle dung scattered on the swimmer, but also the epidermis. They identified themselves at the shawl *(Stizostedion lucioperca)* and perch *(Perca fluviatilis)* fish from the Danube. It is one of the most widespread parasitic diseases, both in freshwater fish and saltwater, and is caused by *Trichodina* species (Totoiu, 2018)

Trichodinella epizootica - ciliated - identified in the gill scrapes performed at the shawl *(Stizostedion lucioperca).*

Trichodina domerguei - ciliated - identified in the gill scrapes of the species: *Hypophthalmychtis molitrix, Cyprinus carpio* and *Leuciscus idus* from the study area.

Myxobolus. macrocapsularis and *Myxobolus obesus* are protozoa that produce whitish cysts, elongated by 1-2 mm disseminated on the gill lamellae in the roach (*Rutilus rutilus*) and bleak (*Alburnus alburnus*), respectively.

Of the total specimens that constituted the lots for the parasitological examination, 79% have weak poly-parasitosis, of which: 25% produced by nematodes (*Eustrongylides excisus*), 24% by monogenic worms (*Dactylogirus vastator* and *Diplozoon paradoxus*), 14% by trematods (*Bunodera luciopercae, Ichthyocotylurus pileatus, Apophallus donicum*), 16% by ciliated (*Trichodina domerguei* and *Trichodinella epizootica*), 11% by acanthocephalus (*Pomphorhynchus leavis and Acanthocephalus anguillae*), 5% by protozoa (*Myxobolus. macrocapsularis and Myxobolus obesus*), 2.5% by cestode (*Triaenophorus nodulosus* (lucii), 2.5% by copepods (*Achtheres percarum*).

Table 2. Species of parasites identified in the middle Danube River sector km 493 (Giurgiu area)

No. crt.	Identified parasitic species	Parasitic species	Affected organ	Degree of infestation
1.	*Trichodina domerguei*	*Carasus auratus gibelio*	G	weak
		Sander lucioperca	G	weak
		Cyprinus carpio	G	weak
2.	*Trichodinella epizootica*	*Abramis brama*	G	weak
		Sander lucioperca	G	weak
3.	*Dactylogirus vastator*	*Carasus auratus gibelio*	G	weak
		Cyprinus carpio	G	weak
		Abramis brama	G	weak
4.	*Diplozoon paradoxus*	*Abramis brama*	G	weak
		Rutilus rutilus	G	weak
		Scardinus erythrophthamus	G	weak
5.	*Diplostomum spathaceum*	*Rutilus rutilus*	E	weak
		Hypophthalmychtis molitrix	E	weak
6.	*Ligula intestinalis*	*Cyprinus carpio*	I	weak
		Rutilus rutilus	I	weak
7.	*Myxobolus carassi*	*Carasus auratus gibelio*	G	weak
8.	*Allocreadium isoporum*	*Scardinius erythrophtalmus*	I	weak
		Abramis brama danubii	I	weak
9.	*Contracecum aduncum*	*Alosa immaculata*	I	medium
10.	*Mazocraes alosae*	*Alosa innaculata*	G	weak
11.	*Pomphorhynchus leavis*	*Silurus glanis*	I	weak
		Barbus barbus	I	medium

Note: T-tegument; G-gills; I-intestine; L-liver; E-eye; M-muscles.

At the Station 2 of the Danube River km 493 - Giurgiu area - 10 species of fish grouped in 4 families were caught: Cyprinidae, Percidae, Siluridae, Clupeidae. Drom the ten species caught, lots were set up for ichthyo-pathological research (3-5 specimens) of the following fish species: C*arassius auratus gibelio* (gibel carp)*, Hypophthalmichthys molitrix* (silver carp)*, Cyprinus carpio* (carp), *Abramis brama danubii* (carp bream), *Rutilus rutilus carpatorossicus* (roach), *Scardinius erythrophthalmus* (common rudd)*, Barbus barbus* (common barbel), *Silurus glanis* (catfish) and *Alosa immaculata* (Pontic shad).

Allocreadium isoporum it was found in intestine at common rudd (*Scardinius erythrophtalmus*) at the begging of the summer. According to Cojocaru (2003) the adults probably die after laying eggs, and larval development does not end until the following spring. They are small trematodes (0.7 mm long).

Mazocraes alosae belongs to the class of monogenic flatworms and was found weakly parasitizing (5-10 specimens/fish) in the gills of Pontic shad.

Contracecum aduncum belongs to the class of nematods and was found in the intestine of Danube ash trees in the number of 30-50 specimens/intestine.

Lingula intestinalis, belongs to the class of cestoses and were found in spring and summer, weakly parasitizing the intestine of cyprinids.

Of the total specimens that constituted the lots for the parasitological examination, 87% have weak and medium polyparasitosis, from which: 35% by monogenic worms (*Dactylogirus vastator, Mazocraes alosae* and *Diplozoon paradoxus*), 30% by cilliated (*Trichodina domerguei* and *Trichodinella epizootica*), 15% by trematods (*Allocreadium isoporum, Diplostomum spathaceum*), 5% by nematods (*Contracoecum aduncum*) 5% by acanthocephalus (*Pomphorhynchus leavis*), 5% by protozoa (*Myxobolus carassi*), 5% by cestods (*Ligula intestinalis*).

CONCLUSIONS

From our investigations conducted in the research, we can say that there were no parasitic epizootic diseases that cause loss of fish species with economic value.

In Station 1, 14 species of parasites belonging to eight systematic groups were identified: Nematode, Monogenea, Trematode, Ciliata, Acanthocephala, Protozoa, Cestoda, Crustacea, while in Station 2, 11 species of parasites belonging to six systematic groups were identified: Monogenea, Ciliata, Trematoda, Nematoda, Acanthocephala, Cestoda.

The species *Sander lucioperca* and *Abramis brama* presented most often poly-parasitoses but with a low degree of infestation.

The most present group of parasites in Station 1 was represented by nematodes and in Station 2 by monogenic worms.

The presence of a relatively varied parasitosis, but with a low degree of infestation indicates a weaker effect of stressors, but to confirm these aspects we need future researchers.

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REFERENCES

Adams, S.M., & Greeley, M.S. (2000) Ecotoxicological indicators of water quality: using multi-response indicators to assess the health of aquatic ecosystems.*Water, Air, and Soil Pollution,* 123, 103–115.

Adams, S.M., Bevelhimer, M.S., Greeley, M.S., Levine, D.A., & Teh, S.J. (1999). Ecological risk assessment in a large river-reservoir: 6. Bioindicators of fish population health. *Environmental Toxicology and Chemistry*, 18, 540–628.

Bauer, O.N. (1984). *Guide for identification of parasites of the freshwater. Fish Fauna of the USSR*, Vol 1. Zoological Institute, Academy of Sciences of the USSR, Leningrad

Bauer, O.N. (1985). *Guide for identification of parasites of the freshwater. Fish Fauna of the USSR*, Vol 2. Zoological Institute, Academy of Sciences of the USSR, Leningrad.

Bauer, O.N. (1987). *Guide for identification of parasites of the freshwater. Fish Fauna of the USSR*, Vol 3. Zoological Institute, Academy of Sciences of the USSR, Leningrad.

Bush, A.O., Lafferty, K.D., Lotz, J.M., & Shostak, A.W. (1997). Parasitology meets ecology on its own terms: Margolis et al. revisited. *Journal of Parasitology*, 65, 667–669.

Cojocaru, C. (2003). Research about ichtyoparasitical fauna of Banat region, *Annals of West University of Timisoara, ser. Biology*, 1–30.

Chubb, J.C. (1979). Seasonal occurrence of helminths in freshwater fishes. Part II. Trematoda. *Advances in Parasitology* 17, 141–313.

Docan, A., Grecu, I., Dediu, L., & Ionescu, T. (2019) Health profile of Prut ichthyofauna- a brief study. *Scientific Papers-Animal Science Series: Lucrări Ştiinţifice - Seria Zootehnie*, 72, 183–187.

Lafferty, K.D. (1997) Environmental parasitology: what can parasites tell us about human impact on the environment? *Parasitology Today*, 13, 251–255.

Landsberg, J.H., Blakesley, B.A., Reese, R.O., Mcrae, G., & Forstchen, P.R. (1998). Parasites of fish as indicators of environmental stress. *Environmental Monitoring and Assessment*, 51, 211–232.

Markert, B.A., Breure, A.M., & Zechmeister, H.G. (2003). Bioindicators and biomonitors: Principles, concepts, and applications. 997 pp. Oxford, Elsevier.

Munteanu, G., & Bogatu, D. (2003). *Treaty of Ichthyopathology (in romanian).* Timisoara, RO: Excelsior Art Publishing House

Poulin, R. (1992) Toxic pollution and parasitism in freshwater fish. *Parasitology Today*, 8, 58–61.

Totoiu, A, Patriche, N. (2018). Assessing the inter-relations between fish health and stock status of the main commercial fish species, Agriculture for life conferince proceeding, 1(1), 168–175.

Sures, B. (2004). Environmental parasitology: relevancy of parasites in monitoring environmental pollution. *Trends in Parasitology*, 20, 170–177.