COMPARATIVE PARASITOLOGICAL STUDY OF CERTAIN FISHES IN THE UPSTREAM AND DOWNSTREAM OF THE HYDROPOWER PLANTS ON THE DNIESTER AND PRUT RIVERS (REPUBLIC OF MOLDOVA)

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Abstract

The study realized on two rivers of Moldova – Dniester and Prut, - had the scope to determine the impact of hydropower dams, constructed in the plain parts of the basins, and rivers regulation to the parameters of fish infestation with parasites including those having a potential impact on the health of humans and other mammals and birds. It is determined that both varieties of species of parasites and the intensity of infestation are about twice higher in the regulated sectors of the rivers compared with free downstream parts. Fishes from reservoirs are more infected with parasites that can cause helminthiases in warm-blooded animals and humans. This parasitologic factor should be taken into account during the evaluation of losses of ecosystem services resulting from the hydropower on rivers.

Keywords: *parasites, fishes, monitoring, hydropower dam, Dniester, Prut*

1. INTRODUCTION

The significant hydromorphological changes, caused by hydropower plants, are responsible for the failure to reach the good ecological status of water bodies under the WFD in Europe. These changes are listed as the most common pressure on freshwater ecosystems according to the European Environment Agency. Dams are the most important deterioration factor for river continuity for biota and sediment. Impoundments affect long reaches upstream and turn rivers into reservoirs with partially stagnant conditions [1]. Because the damming deeply changes the river ecosystem, it also influences the composition of water wildlife. One of the effects is the modification of the invertebrates' composition. Due to the fact that many invertebrates belonging to different groups play a role as the intermediate hosts of fish parasites, the segmentation of the rivers could play an important role in supporting the spreading of fish parasites, especially those having a complex cycle. The objective of the current research, realized in the frames of the "HydroEcoNex" Project of the EU Black Sea Operational Programme, was to determine the impacts of the hydropower plants (HPP) established on the plain parts of the Dniester and Prut rivers on the composition of fish parasitic fauna in their dammed and free flow sectors, to evaluate the potential role of fish parasites as the indicators in the bio-monitoring of HPP construction consequences.

Based on this, the relevance of determining the qualitative, quantitative, and epizootological characteristics of the parasitic fauna (component communities of parasites) of fish in reservoirs and downstream sections of plain parts of the rivers, with a promising goal of using them in biomonitoring and in assessing the impact of hydroelectric power plants on the biota of rivers, separated by dams, is obvious.

2. MATERIALS AND METHODS

When conducting this parasitological research, we were guided by the following methodological principles: simplicity of methods and their field applicability; the ability to carry out the mass determination of the parasites for a sufficient fish hosts; simplicity of sampling and material preparation for analysis; relatively easily measurable indicators; efficiency, accuracy and

reproducibility of the methods; simple and minimal equipment needed; low cost and time consuming; no need of special requirements for personnel qualifications; the possibility of analysis and making conclusions without the use of hydrobiological and hydrochemical data.

The Dubasari HPP in the plain part of the Dniester River was constructed in 1951-1954 while the Stanca-Costesti HPP, shared by Moldova and Romania - also in the plain part of the Prut River - was erected in 1974-1978. The fish sampling in the upstream and downstream of HPPs of the Dniester and Prut rivers was effectuated correspondingly at 8 and 4 sampling stations (all on the territory of the Republic of Moldova), respectively: Dubasari reservoir [23 km section between Oxentea village and Dubasari HPP, and in the lower reach of the Dniester River [44 km section from Dubasari HPP to Dubasarii Vechi village]; Stanca-Costesti reservoir [8 km section from Dumeni village to Stanca-Costesti HPP] and in the lower reach of the Prut River [46 km section from Stanca-Costesti HPP to Bisericani village] (Fig. 1). Catching of fish was carried out at approximately the same stations. The aquatic stations where our studies were carried out had heterogeneous characteristics (rocky, sandy, clayey or silt bottoms, without or overgrown with hydrophytes, with weakening current velocities or large circulations, etc.), which undoubtedly affected not only the diversity and biomass of their hydrobionts, but also reflected the parasitological data obtained. The collection time covers the warm period (spring – summer – autumn), excepting the winter (in the Dniester - between September 2018 and November 2021, in the Prut – between June and October 2019-2020).

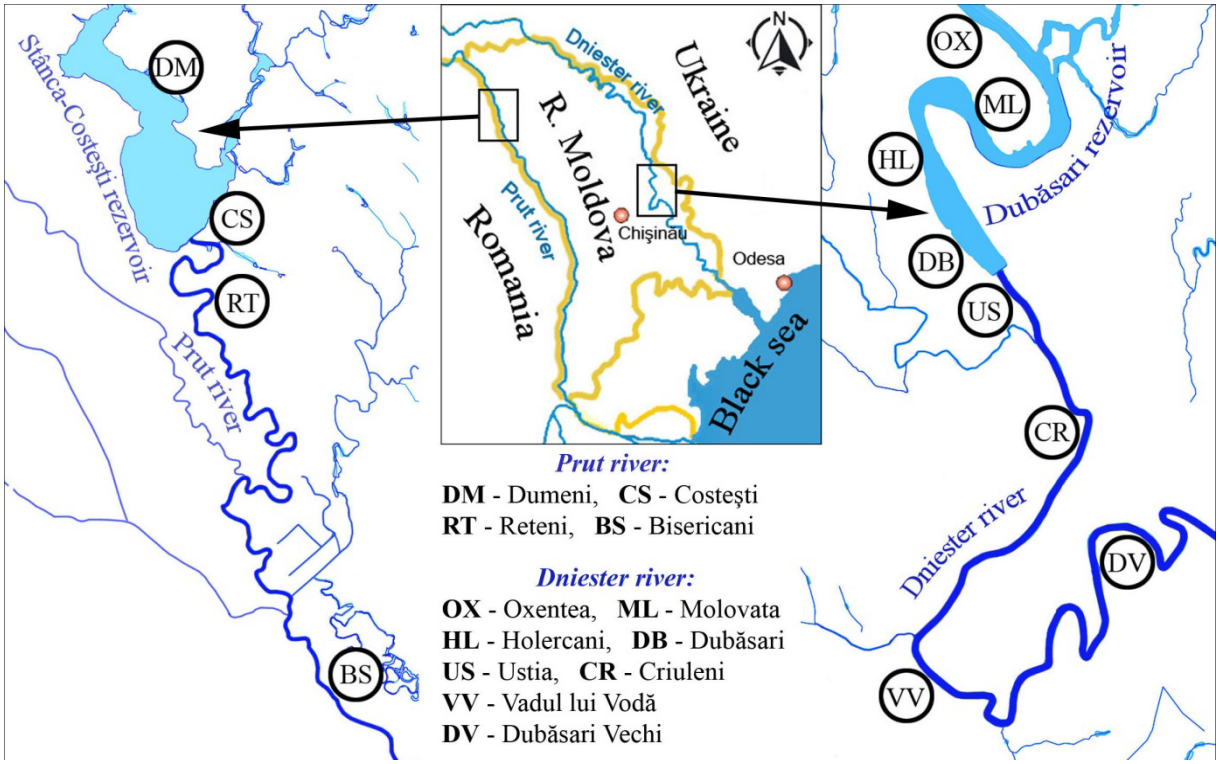


Fig. 1. Maps showing the study area with marked sampling stations.

The composition of fish hosts selected for parasitological research consisted of 8 species belonging to 3 families (Cyprinidae, Percidae and Gobiidae): common bleak *Alburnus alburnus* (Linnaeus, 1758), common roach *Rutilus rutilus* (Linnaeus, 1758), Pontian roach, or vyrezub *R.frisii* (Nordmann, 1840), Euroasian river perch *Perca fluviatilis* Linnaeus, 1758, monkey goby *Neogobius fluviatilis* (Pallas, 1814), round goby *N.melanostomus* (Pallas, 1814), racer goby *Babka gymnotrachelus* (Kessler, 1857), and bighead goby *Ponticola kessleri* (Günther, 1861). Current species were chosen because they are numerous and widespread in investigating water bodies, are easy to catch in any season, and have different ecological plasticity and dietary features, which creates a good option for monitoring. A total

of 2473 fish specimens from the Dniester biotopes (n=2087: reservoir 1061, lower reaches of the river 1026) and the Prut biotopes (n=386: reservoir 205, lower reaches of the river 181) were examined on parasites (Tab. 1). Initially (during the first year) the samples were taken monthly, later – once in a season (February, May, July and October). The fish sample sizes for research consisted of at least 10 individuals both of each species per station. The age-size group composition of fish samples from each hydrobiotope was almost equal, represented by fish aged 1^{+}-3^{+}years, with average body length TL = 65-120 mm.

Table 1. Number of dissected fish from the biotopes of the upstream and downstream Dubasari and Stanca-Costesti HPPs

Fish-hosts	**Dubasari HPP – Dniester River**		**Stanca-Costesti HPP – Prut River**	
	Upstream stretch	**Downstream stretch**	**Upstream stretch**	**Downstream stretch**
Alburnus alburnus	193	196	48	42
Rutilus rutilus	155	174	32	26
Rutilus frisii	76	52	-	-
Perca fluviatilis	156	149	25	27
Neogobius fluviatilis	136	144	35	33
Neogobius melanostomus	91	81	24	19
Babka gymnotrachelus	117	104	21	16
Ponticola kessleri	137	126	20	18
Total:	**1061**	**1026**	**205**	**181**

Fish catches were performed with various fish rods, a fry dragnet (6.0 mm mesh size, 1.5 m height, 5.0 m length), the gillnets (mesh size of 12 to 16 mm, 1.8 m height, 30 m length), the fyke nets, as well as float and bottom fishing rods. In the research process, we have been guided by widely using ichthyologic methods and techniques [2].

For the autopsy mainly alive fish specimens, in some cases freshly chilled fish, were used. The complete parasitological dissection of fish, subsequent cameral processing and study of parasites were carried out using a light microscope. The parasitological material was routinely processed according to traditional procedures [3,4,5], taking into account the introduced additions and improvements, using numerous monographic summaries and thorough articles. Based on the type of object, various methods were used while preference was given to those (not excessive and justified, especially in the field) that significantly reduce labor costs and time, not changing the proper diagnostic value of the fauna study. Species identification of parasites was established using appropriate keys [6,7,8,9,10,11], and other literature.

The degree of similarity in the species composition of fish parasite faunas from compared sampling hydrobiotopes (lakes and lower reach of the rivers) was evaluated using the Sørensen-Czekanowski ($I_{S\text{-}C}$, %) and Jacquard (I_J, %) indices [complete similarity 65–100%, high similarity 40–64%, low similarity 20–39%, no similarity <20%]. The Jaccard index is calculated by the formula $I_J = j/(a+b-j)$ and the Sørensen-Czekanowski one is calculated by the formula $I_{SC} = 2j/(a+b)$, where j is the total number of species in the two compared lists, a and b is the number of species in each of the compared lists [12]. These indices take into account only the similarity of species composition and do not reflect differences in the abundance of species. The Sørensen-Czekanowski index is considered more

informative and convenient to use, the Jacquard one has an increased sensitivity to minor differences and it is advisable to use when more than two biotas are compared, the level of similarity between which is approximately the same [13].

3. RESULTS

As a result of the studies, it was found that the fauna of fish parasites in the Dubasari HPP reservoir is characterized by high species richness, which is comparable to that of the lower section of the river. The same situation for the Prut River is observed too. In all cases, the greater taxonomical diversity of fish parasites from both reservoirs was registered (Tab. 2).

Table 2. Taxonomic diversity of fish parasites in the upstream and downstream biotopes of the Dubasari and Stanca-Costesti HHPs

Parasites higher taxa	**Dubasari HPP – Dniester River**		**Stanca-Costesti HPP - Prut River**	
	Upstream stretch	**Downstream stretch**	**Upstream stretch**	**Downstream stretch**
Metamonada	2	1	0	0
Euglenozoa	9	5	5	3
Ciliophora	60	39	46	19
Dinoflagellata	1	1	0	0
Sporozoea	18	9	8	6
Amoebozoa	4	1	2	1
Mesomycetozoa	3	0	1	0
Microsporidia	8	2	3	1
Chytridiomycota	1	0	1	0
Oomycota	3	1	1	0
Cnidaria	73	42	43	21
Plathelminthes	93	44	47	31
Nemathelminthes	30	12	13	7
Acanthocephales	8	3	2	1
Annelida	3	1	2	1
Mollusca	5	3	4	3
Arthropoda	8	3	4	2
Total:	**326**	**168**	**182**	**96**
Similarity (I_J):	**51.5%**		**52.7%**	

Our studies have shown that a number of fish (about 70 species) of water bodies of the analyzed territory are carriers of larval stages of helminths, pathogens of ichthyozooanthroponoses, which belong to 23 (our data), and 39 (according to the literature) species taxa: class Trematoda (digenetic flukes) - 15 (25) species: *Metorchis bilis* (in 23 fish species), *M.xantosomus* (13), *Opisthorchis felineus* (10), *Pseudamphistomum truncatum* (18), *Metagonimus yokogawai* (6), *Apophallus donicus*

(18), *Echinochasmus perfoliatiis* (22), *E.liliputanus* (5), *E.mordax* (13), *E.beleocephalus* (2), *Isthmiophora melis* (6), *Echinostoma revolutum (1), Mesorchis pseudoechinatus (1), M.denticulatus (1), Mesostephanus appendiculatus* (18), *Paracoenogonimus ovatus* (20), *Clinostomum complanatum* (5), *Pygidiopsis genata* (1), *Cryptocotyle concava* (2), *C. lingua* (2), *Cyathocotylidae gen. sp.* (1), *Plagioporus sp.* (2), *Galactosomum lacteum* (1), *Amphimerus sp.* (1), *Ichthyocotylurus pileatus* (3); • class Cestoda (tapeworms) – 2 species: *Diphyllobothrium latum* (3), *Diphyllobothrium sp.* (3); • class Nematoda (roundworms) – 7(12) species: *Eustrongylides excisus* (34), *E.tubifex* (21), *E.mergorum* (5), *Desmidocerella numidica* (5), *Streptocara crassicauda* (6), *S.incognita* (3), *Raphidascaris acus* (15), *Spiroxys contortus* (6), *Contracaecum spiculigerum* (3), *C.microcephalum* (3), *Contracaecum sp.* (2), *Anisakis sp.* (one). And if we take into account the information in the literature on the region and the unverified data we have received, then in the region of fish, 67 species of helminths are potentially dangerous for birds, mammals and humans (flukes - 47, tapeworms - 2 and roundworms - 18). The following species of nematodes and trematodes turned out to be the most common in the fish of the region: *Eustrongylides excisus* (in 34 fish species), *Metorchis bilis* (23), *Echinochasmus perfoliatiis* (22), *Eustrongylides tubifex* (21), *Paracoenogonimus ovatus* (20), *Pseudamphistomum truncatum, Apophallus donicus* and *Mesostephanus appendiculatus* (18 each), *Raphidascaris acus* (15 each), *Echinochasmus mordax* and *Metorchis xantosomus* (13 each).

The taxon-richest fauna of parasites is observed in *R.rutilus*, *P.fluviatilis*, *A.alburnus* and *N.melanostomus*, followed by *R.frisii*, *P.kessleri*, *N.fluviatilis* and *B.gymnotrachelus* (Tab. 3). The species diversity of parasites upstream of the HPP dams is about twice more reach compared with free-flowing downstream parts of the rivers.

Table 3. The number of parasite species and similarity of their communities composition in the fishes from the biotopes of the upper and lower beefs of the Dubasari and Stanca-Costesti HPPs

Patasites taxa	**Total**	**Dubasari HPP – Dniester River***		**Total**	**Stanca-Costesti HPP - Prut River**	
		Upstream stretch	**Downstream stretch**		**Upstream stretch**	**Downstream stretch**
Alburnus alburnus						
Euglenozoa	3	3	1	2	2	1
Ciliophora	32	32	27	23	23	14
Dinoflagellata	1	1	0	0	0	0
Sporozoea	10	8	8	7	6	7
Amoebozoa	1	1	1	1	1	0
Mesomycetozoa	1	1	0	1	1	0
Microsporidia	2	2	1	1	1	0
Chytridiomycota	1	1	1	1	1	0
Oomycota	2	2	1	1	1	0
Cnidaria	48	45	39	25	25	18
Plathelminthes	66	66	49	38	38	17
Nemathelminthes	14	14	11	7	7	5
Acanthocephales	5	3	3	2	2	2
Annelida	3	3	2	2	2	1

Mollusca	3	3	3	3	3	2
Arthropoda	6	5	4	2	2	1
Total:	**198**	**187**	**109**	**116**	**115**	**69**
***I*$_{S-C}$ & *I*$_J$**	**73 & 58%**			**81 & 57%**		
Rutilus rutilus						
Metamonada	1	1	0	0	0	0
Euglenozoa	5	5	3	3	3	2
Ciliophora	36	36	28	22	22	15
Dinoflagellata	1	1	1	1	1	1
Sporozoea	6	6	5	4	4	4
Amoebozoa	1	1	1	1	1	1
Mesomycetozoa	1	1	0	0	0	0
Microsporidia	3	3	1	1	1	1
Chytridiomycota	1	1	1	1	1	1
Oomycota	4	4	2	2	2	1
Cnidaria	46	46	44	41	39	33
Plathelminthes	78	71	65	50	50	36
Nemathelminthes	18	18	12	9	9	6
Acanthocephales	7	7	7	4	4	3
Annelida	2	2	2	2	2	2
Mollusca	5	5	5	5	5	5
Arthropoda	6	5	6	4	4	2
Total:	**221**	**214**	**183**	**150**	**148**	**113**
***I*$_{S-C}$ & *I*$_J$**	**58 &41%**			**68 & 58%**		
Rutilus frisii						
Metamonada	1	1	0	-	-	-
Euglenozoa	2	2	1	-	-	-
Ciliophora	19	18	11	-	-	-
Sporozoea	3	3	2	-	-	-
Amoebozoa	1	1	1	-	-	-
Microsporidia	1	1	0	-	-	-
Cnidaria	24	24	18	-	-	-
Plathelminthes	20	19	11	-	-	-
Nemathelminthes	4	4	3	-	-	-
Acanthocephales	1	1	1	-	-	-

Annelida	2	2	1	-	-	-
Mollusca	2	2	2	-	-	-
Arthropoda	3	3	1	-	-	-
Total:	**83**	**83**	**55**	-	-	-
I_{S-C} & I_J	**78 & 64%**			-		
Perca fluviatilis						
Euglenozoa	6	6	4	3	3	2
Ciliophora	46	46	34	33	33	29
Sporozoea	3	3	3	3	3	2
Amoebozoa	1	1	1	1	1	0
Mesomycetozoa	2	2	1	1	1	0
Microsporidia	2	2	1	1	1	0
Chytridiomycota	1	1	0	1	1	0
Oomycota	1	1	1	1	1	0
Cnidaria	27	27	16	19	19	12
Plathelminthes	71	62	51	34	34	26
Nemathelminthes	21	21	13	5	5	5
Acanthocephales	8	8	7	4	4	4
Annelida	3	3	3	3	3	4
Mollusca	6	6	6	5	5	5
Arthropoda	7	7	4	5	5	5
Total:	**205**	**186**	**145**	**129**	**129**	**99**
I_{S-C} & I_J	**56 & 39%**			**64 & 44%**		
Neogobius fluviatilis						
Euglenozoa	2	2	2	2	2	1
Ciliophora	8	8	8	5	5	3
Sporozoea	3	3	3	2	2	2
Microsporidia	1	1	1	1	1	0
Cnidaria	2	2	0	1	1	0
Plathelminthes	20	20	12	11	11	8
Nemathelminthes	11	11	6	5	5	4
Acanthocephales	4	4	4	3	3	2
Annelida	1	1	1	1	1	1
Mollusca	4	4	4	4	4	4
Arthropoda	3	3	3	2	2	2

Total:	**59**	**59**	**44**	**37**	**37**	**27**
$I_{S\text{-}C}$ & I_J	**68 & 48%**			**66 & 56%**		
Neogobius melanostomus						
Euglenozoa	3	3	3	3	3	3
Ciliophora	17	17	17	15	15	10
Dinoflagellata	1	1	1	1	1	1
Sporozoea	5	5	5	5	5	4
Amoebozoa	1	1	1	1	1	1
Mesomycetozoa	1	1	1	1	1	1
Microsporidia	3	3	3	3	3	3
Cnidaria	4	4	4	3	4	4
Plathelminthes	35	35	35	31	31	23
Nemathelminthes	15	15	15	11	11	8
Acanthocephales	5	5	5	5	5	5
Annelida	2	2	2	2	2	2
Mollusca	6	6	6	6	6	6
Arthropoda	6	6	6	6	6	6
Total:	**102**	**102**	**93**	**86**	**86**	**76**
$I_{S\text{-}C}$ & I_J	**66 & 49%**			**68 & 51%**		
Babka gymnotrachelus						
Euglenozoa	3	3	2	2	2	2
Ciliophora	13	13	10	9	9	6
Dinoflagellata	1	1	1	1	1	0
Sporozoea	2	2	2	2	2	2
Microsporidia	1	1	1	1	1	1
Cnidaria	2	2	2	1	1	0
Plathelminthes	11	10	8	7	7	6
Nemathelminthes	6	6	5	5	5	3
Acanthocephales	3	3	2	2	2	1
Annelida	1	1	1	1	1	1
Mollusca	3	3	3	3	3	3
Arthropoda	3	3	2	2	2	1
Total:	**49**	**48**	**37**	**35**	**35**	**25**
$I_{S\text{-}C}$ & I_J	**49 & 41%**			**44 & 41%**		

Ponticola kessleri						
Euglenozoa	4	4	2	2	2	2
Ciliophora	8	8	7	7	7	6
Sporozoea	4	4	2	2	2	1
Amoebozoa	1	1	0	0	0	0
Microsporidia	1	1	0	0	0	0
Chytridiomycota	1	1	0	0	0	0
Oomycota	2	2	0	0	0	0
Cnidaria	2	2	0	0	0	0
Plathelminthes	25	22	13	11	11	7
Nemathelminthes	11	10	7	6	6	4
Acanthocephales	3	3	3	2	2	1
Annelida	2	2	2	2	2	0
Mollusca	5	5	4	4	4	3
Arthropoda	4	4	4	2	2	1
Total:	**73**	**69**	**44**	**38**	**38**	**25**
I_{S-C} & I_J	**61 & 44%**			**66 & 47%**		

According to the external morphological characteristics, it is usually very difficult to determine the species or genus affiliation of some groups of parasites, which could be realized by only parasitologists specializing in concrete groups. Therefore, for the practical reasons of the monitoring we propose to determine the majority of detected parasites to the phylum, and the flatworms - to the class. This will be enough at the beginning of the monitoring work.

To identify and select the ecological/taxonomical groups of parasites for monitoring purposes, we took to account their life cycle, host specificity, localization, spreading, seasonality, prevalence and abundance, resistance, and pathogenicity. The ecological (often taxonomic) groups of parasite species have a similar nature of the relationship of their members with the environment, i.e. they have almost similar ecological needs, and the influence of factors will be more or less the same on them. It is also proposed to be based mainly on widespread eurybiontic parasites.

From the diversity of parasites found in fish the most suitable groups for monitoring, assessing the state of the aquatic environment and host fish were the species/associations of Ciliophora, Cnidospora, Sporozoea, Euglenozoa, Monogenea, Trematoda, Nemathelminthes, Acanthocephales and Arthropoda.

The total prevalence of invasion in examined fish constituted 100%. But most parasite species rarely reach high rates of fish infestation. In prevalence (and sometimes in numerical abundance) in fish from all stations, the predominant species are cnidosporeans, ciliates, trematodes and monogeneans (Tab. 4).

Table 4. The prevalence of invasion (%) of the main taxonomic groups of parasites in each fish species from the upstream and downstream biotopes of the Dubasari and Stanca-Costesti HPPs

Parasites higher taxa	**Dubasari HPP – Dniester River***								**Stanca-Costesti HPP – Prut River**			
	Upstream stretch				**Downstream stretch**				**Upstream stretch**		**Downstream stretch**	
	OX	**ML**	**HL**	**DB**	**US**	**CR**	**VV**	**DV**	**DM**	**CS**	**RT**	**BS**
Alburnus alburnus												
Euglenozoa	22	38.2	43	43.3	25	4	1	0.8	32	11.2	89	1.2
Ciliophora	100	100	100	100	100	83	78	74.2	100	83	77.8	72
Sporozoea	43	44.1	48	40	38	16	16	10	100	96	100	86.3
Cnidaria	100	100	100	100	97	81	56	74	100	77	88.3	56.5
Monogenea	43	32	30	49	36	43	39	33	100	100	100	57
Trematoda	100	100	100	100	78	76	55	58	100	100	67.4	84.3
Cestoda	2	5	8	6	6,2	2	0.1	1,4	1	1	0.3	0
Nemathelminthes	76	72.3	87.3	87	32	24	30	24.3	100	72.3	56	56
Acanthocephales	2	0.3	0	0	0.1	0	0.2	0.9	5.1.	3.3	5	6
Arthropoda	63	66	53	56	43	11	6	3	44.4	21	13	2.4
Rutilus rutilus												
Euglenozoa	65	67	73	73.3	24	1.3	0.6	0.8	87.4	76	76.3	32
Ciliophora	100	100	100	100	98	79	67	53	100	100	65	41.5
Sporozoea	76	84	85	86.3	56	43	40	34	100	100	98	81
Cnidaria	100	100	100	100	100	84	80	76	100	100	83	80.3
Monogenea	66	34	40	56	98	98	100	89	100	100	76	100
Trematoda	100	100	100	100	100	73	65	68	100	100	18	67
Cestoda	9	6.3	3.4	1.1	1	3	12	4	6	7.7	3	0
Nemathelminthes	3	3	5.3	5.6	4	4	4.4	5	55.3	34.7	31	36
Acanthocephales	2	2	0.1	0	0	5	2	1.2	0	4	13	0.8
Arthropoda	24	32	33.6	31	21	4	4	3	88	100	32	23
Rutilus frisii												
Euglenozoa	53.3	50	54.4	33.3	72.7	66.7	66.7	75	-	-	-	-
Ciliophora	100	100	100	100	100	100	100	100	-	-	-	-
Sporozoea	100	100	100	100	78.5	75	100	75	-	-	-	-
Cnidaria	100	100	100	100	100	100	100	100	-	-	-	-
Plathelminthes	100	100	100	100	100	100	100	100	-	-	-	-
Nemathelminthes	30	31	36.4	33.3	57.1	41.7	50	75	-	-	-	-

Acanthocephales	26.7	15	9.1	16.6	14.3	16.7	33.3	25	-	-	-	-
Arthropoda	26.6	25	18.2	16.7	21.4	16.7	16.7	25	-	-	-	-
Perca fluviatilis												
Euglenozoa	87	100	100	100	100	100	100	93	72	88	97	58
Ciliophora	100	100	100	100	100	65	76.3	100	100	100	100	100
Sporozoea	67	17	31	65.3	65	15	16	21.1	88	100	100	69
Cnidaria	26	45	100	100	100	100	100	74.4	100	100	85	93.3
Monogenea	87	34	40	56	98	69	41.7	89	100	65	76.3	100
Trematoda	78	100	96	100	100	100	79	98	74	40	56	98
Cestoda	32	13	0	1.6	0	5.6	0.6	12	11	0.8	2.6	0
Nemathelminthes	98	34	40	56	98	98	100	89	100	100	43	21.5
Acanthocephales	69	23	0	0	1.2	3	0.7	0	0	0/2	2	0
Arthropoda	67	32	32	12	34	29	45	46.5	54	47	12	1.8
Neogobius fluviatilis												
Euglenozoa	100	100	100	100	100	65.4	67	88	100	100	67	66.5
Ciliophora	100	100	100	100	100	100	100	100	100	100	78	81.3
Sporozoea	100	89	88	88	91	100	100	100	86	87	100	100
Cnidaria	10	0	12	9	8	4	6	6.3	2	0	0	1.7
Monogenea	100	76	87	38	80	87	54	100	65	65	51	23.4
Trematoda	100	100	100	100	100	100	100	76.8	44	37.8	40	36
Cestoda	43	32	12	100	76	11	0	12	100	97.7	72	32
Nemathelminthes	100	100	100	100	100	92	100	79	98	98.3	65	41.3
Acanthocephales	23	11	11.4	10	13	14	14	0.9	9	3	2	10
Arthropoda	67	60.2	13	9	15	12	10	3.4	7	7.1	4	2
Neogobius melanostomus												
Euglenozoa	34	100	100	100	100	100	100	100	100	89	69	72
Ciliophora	100	100	100	100	100	100	100	100	100	100	100	100
Sporozoea	100	100	100	100	100	100	100	100	100	100	100	100
Cnidaria	23	13	10	8	9	14	14.2	13	0	3	2	0.2
Monogenea	100	100	100	100	100	100	100	100	100	100	100	100
Trematoda	100	100	100	100	100	100	100	100	100	100	100	100
Cestoda	0.4	0	0	0	0	4	4	6.2	75	77	70	35
Nemathelminthes	54	67	66	67	54	50	56	56	100	100	100	100
Acanthocephales	66	46	61	62.3	51	58	56	59.1	61	38	22	18.7
Arthropoda	43.5	13	10	8	9	14	14	14.2	13	23	13	10.2

Babka gymnotrachelus												
Euglenozoa	12.3	12	4.8	34	23	23.7	24	20	27	37	32	18
Ciliophora	100	100	100	100	100	100	100	100	100	100	93	10
Sporozoea	100	100	100	87.9	100	100	100	99	100	100	100	76
Cnidaria	4.4	0	2	0	0	3	1	5	1	1	0	0.3
Monogenea	62.2	60	75	72	56	54	61	50	32	28	22	26
Trematoda	100	100	100	100	100	100	100	100	100	100	100	100
Cestoda	4.2	1.2	0	2	1.3	1.4	1.6	1.1	0	2.3	2	4.2
Nemathelminthes	100	100	100	100	100	100	100	100	100	100	100	100
Acanthocephales	55	21	25	23	22	21	31	27	21	12	12	23
Arthropoda	20	12.2	12	10	7	9	10	13	1.6	2.1	2.3	3.3
Ponticola kessleri												
Euglenozoa	43.3	34	34	34	34	32	17	23	23	23.7	24	20
Ciliophora	100	100	100	100	100	100	100	100	100	100	100	100
Sporozoea	100	100	100	100	100	100	100	100	100	100	100	100
Cnidaria	0.3	100	100	100	100	67	27	19	1	0	1.8	3
Monogenea	44	0	4	4	6.2	21	33	38	32	33	33.3	27.4
Trematoda	100	100	100	100	100	98	100	100	100	100	100	100
Cestoda	1.3	0	1	1.6	0	2	1.2	1.6	1	1.8	1.4	1,1
Nemathelminthes	100	100	100	100	100	100	100	100	100	100	100	100
Acanthocephales	21	23	23.7	24	20	20	11	6.7	4	13	14	18.3
Arthropoda	21.3	12	23	21	21	25	23	22	21	12.8	19	23

***** The names of sampling sites are indicated in Fig. 1.

4. DISCUSSION

We proceed from the fact that the quantitative abundance of different species/communities of parasites is very indicative and is a more reliable indicator of the concrete water biotope than the abundance of one species. Unfortunately, the accurate determination of the abundance of most parasites in fish is largely difficult due to some objective obstacles. First, the abundance of most populations is large, and the size of individual organisms is disproportionately small in comparison with the area of the biotope (= host organism) occupied by them. Secondly, the impact of various abiotic and biotic factors leads to an extremely uneven distribution of parasites in the biotope (host) causing the so-called aggregation, which also manifests itself at several horologic levels. That is why, to estimate the size of the parasite population, the density of their population should be used, that is, the ratio of the number of organisms to the amount of living space they occupy. To accurately determine the parasites' abundance, it is necessary to take into account the density of different hosts and extrapolate the data on all, taking into account the uneven distribution of organisms. The higher quantity of parasites was related to the presence of ciliates, cnidosporeans and digenetic metacercariae were recovered.

It should be noted that an increase in the abundance (intensity of invasion) of some parasite species does not change the general picture of the almost ubiquitous enrichment of the entire fauna of parasites and the prevalence of the fish of the compared hydrobiotopes.

An increase in the intensity of fish invasion by some species of parasites (by species of parasites and species of fish, by biotopes of the reservoir and river) does not change the overall picture of the almost ubiquitous enrichment of the entire ichthyoparasitic fauna from compared hydrobiotopes.

In addition, it should be taken into account the fact that the unequal number of parasite species and the different levels of infection of fish in different water bodies may be the result of abiotic and biotic features formed there.

Moreover, the widespread and prevalence of mixed invasions is especially characteristic of fish in the reservoir. In general, in the reservoir, the fish parasitocenoses are richer and more complex than in the river.

The obtained materials indicate that at present, a limnophilous parasitocenosis complex has formed in the regulated sectors of both rivers, with pathological nosological units characteristic and determining for these aquatic ecosystems. But no nosological units were found during the fish research period. In most cases, their infestation with pathogenic parasites (about 40% species) was not accompanied by clinical manifestations of disease or mortality, but only by some submicroscopic disorders. The presence of larval stages of 25 species of helminths (trematodes *Metorchis bilis, M.xanthosomus, Pseudamphistomum truncatum, Metagonimus yokogawai, Apophallus donicus, A.muehlingi, Mesorchis denticulomatis, Pygidiopsis genata, Cryptocotyle concavum, C.jejuna, Echinochasmus perfoliatiis, E.liliputanus, E.mordax, Paracoenogommus ovatus, Mesostephanus appendiculatus, Spiroxys contortus* and nematodes - *Eustrongylides excisus, E.tubifex, E.mergorum, Streptocara crassicauda, Desmidocerella numidica, Contracaecum spiculigerum, C.microcephalum*), which pose a potential hazard to the health of warm-blooded animals, including humans, suggest unfavorable epizootic and epidemiological situation in these biotopes. In general, the parasitological situation in the reservoirs remains tense. The epizootological state of the ichthyocenosis of the reservoirs directly depends on the level of anthropogenic load associated with the operation of the HPPs, distribution of pollution sources and wastewater entering it. The main factors determining the high infection rate of fish by parasites are the variability of the thermal regime, hydrochemistry and hydrobiology of the reservoir, the rich qualitative and quantitative composition of intermediate hosts of parasites, and the distribution/abundance of fish in biotopes.

5. CONCLUSIONS

Both rivers - the Prut and the Dniester, having a high diversity of fish populations, are characterized by different biotopes, and hydro construction has supplemented the diversity of these biotopes with stagnant water bodies, where conditions are especially favorable for many species of invertebrates that play the role of intermediate hosts of helminths, the final hosts of which are warm-blooded animals - birds and mammals, including humans.

The impact of HPP on the ecosystems of lowland rivers is extremely diverse. Since HPPs are the obstacle to fish migration, they prevent solid runoff, cause secondary pollution of the downstream part of the river, provoke the siltation of the dam upstream and deeply change the ecosystem. Processes that contribute to the limnification of regulated sections of rivers are of particular importance. The transformation of a river ecosystem into a lake leads to a radical change in the species composition of the biotope, including a sharp increase in the number of invertebrates - intermediate hosts of fish parasites in HPP upstream. On the other hand, in connection with the process of eutrophication, favorable conditions are created for numerous protozoa, which are often commensals of fish. Because of this, the construction of the HPS usually leads to an increase in the risk of parasitic diseases when humans consume fish from reservoirs in the plain parts of the rivers. On the other hand, a high infestation of fish with parasites, especially helminths, provoking diseases of mammals, including humans, may indicate its origin from stagnant water bodies. Thus, when calculating the loss of

ecosystem services during the construction and operation of HPP, this factor should also be taken into account.

None of the parasitological parameters analyzed allows us to confidently distinguish between eutrophication of the natural and anthropogenic origin. The only criterion that determines their differences can be the rate of development of the ontogenetic formation of parasitic fauna, which could be confirmed by long-term monitoring.

Our study shows the perspective of attracting parasitological information for distinguishing between fish parasite faunas of regulated plain parts of the rivers.

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