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ORIGINAL ARTICLE

Analysis of surface water quality and crustacean diseases in fish (the Ustya River basin, Ukraine)

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Background: The local population uses water bodies in the Ustya River basin (a small river in the Prypiat River basin, a left-bank tributary of the Goryn River) for amateur and sport fishing. Objects of fishing are common and numerous representatives of the ichthyofauna: Prussian carp (*Carassius gibelio* Bloch) and common roach (*Rutilus rutilus* L.). The caught fish is not always thermally processed, which is dangerous for some reasons. In particular, there is the danger of infecting humans and domestic animals by parasitic organisms; besides, the low quality of surface waters affects fish meat quality.
Aim: To study the relationship between indicators of the ecological state of surface waters and indicators of parasite crustaceans population on widespread fish species.
Material and methods: Hydrochemical and ichthyoparasitological studies were carried out in 2013-2019. Water quality was evaluated according to the method of ecological assessment by integral ecological index (Ie), which includes three block indices – salt indicators (I1), trophic-saprobic indicators (I2), specific indicators (I3). Three parasitological indices were used: prevalence (P), the intensity of infection (II), and mean abundance (M). To clarify the relationship between indices, a correlation analysis was carried out.
New findings: Parasitological studies showed that the prevalence of argulosis invasion of *Carassius gibelio* is higher than that of *Rutilus rutilus* – 8.04 vs. 7.88%. On the contrary, the intensity of infection and mean abundance are higher in *R. rutilus* – 1.63 vs. 1.24 and 0.16 vs. 0.13, respectively. Analysis established the negative correlations for all parasitological indices: strong with the trophic-saprobic block index (I2), and weak or absent with the salt block index (I1) and specific indicators block index (I3). The increase in water bodies' trophic state is associated with the decrease in fish morbidity with argulosis.
Keywords: Water quality; ecological assessment; ecological index; argulosis; parasitological indices; correlation analysis

Introduction

In the second part of the XX century quality of surface water in Ukraine deteriorated significantly due to human impact; the process is continuing now, in particular, some water bodies in the Pripyat river basin are polluted and much polluted (Romanenko et al., 2004; Klimenko et al., 2012; Vasenko et al., 2016; Melnik, Tolochik, 2017). Ichthyofauna is suffering from the negative impact of pollution: the diversity and productivity decrease (Klimenko et al., 2017; Prichepa, 2019; Grokhovska, Konontsev, 2020; Khudiiash et al., 2020); fish accumulate toxic substances in the bodies and become dangerous for consumption (Aslam, Yousafzai, 2017; Kovalenko et al., 2019). Besides, fish have natural enemies and parasites, like they have other living things in ecosystems, negatively influencing their health and abundance (Aalberg et al., 2016; Goncharova et al., 2019). The combination of these two factors - anthropogenic pollution and fish diseases caused by crustaceans, is relatively little studied by scientists (Dzika and Wylic, 2009-2010; Blanar et al., 2009; Sures et al., 2017), especially from the point of view that parasitic crustaceans live in the polluted aquatic environment and are also affected.

The research aims to study the relationship between indicators of the ecological state of surface waters and indicators of the number of parasitic crustaceans on widespread fish species. The study explores the possibility of combining two negative ecological factors and uncovers new perspectives for bioindication.

In the second part of the XX century, the Ustya River basin (a small river in the Prypiat River basin, a right-bank tributary of the Goryn River) was used for fishing and technical purposes, and recreation. Most water bodies are currently not used for economic activity; the local population uses them for recreation. There is no commercial fishing, but amateur and sport fishing is developed here. Common and numerous representatives of the ichthyofauna - Prussian carp (*Carassius gibelio* Bloch) and the common roach (*Rutilus rutilus* L.) are the fishing objects. The caught fish is used as food and as feed for pets. An oral survey of fishers made it possible to establish that the caught fish is not always thermally processed; it is used to make dried fish, it is fed to animals in its raw form, which is dangerous for several reasons. In particular, there is the danger of infecting humans and domestic animals by parasitic organisms (Pukalo, Shekk, 2018). Also, the Ustya River basin's surface waters' low quality affects fish meat quality (Katjuha, Voznjuk, 2016). It was established that one of the most common ectoparasites of fish from the studied reservoirs was representatives of parasitic crustaceans – *Argulus* sp. (Parfeniuk, 2017). A correlation analysis was carried out to clarify the relationship between the incidence rates of fish for argulosis and surface water quality.

Materials and Methods

Study area

Investigated waterbodies. The Ustya River is located in the north-western part of Ukraine. It is a small river (68 km length) in the Prypiat River basin, a left-bank tributary of the Goryn River. On the river banks, Rivne and Zdolbuniv cities are located together with urban-type settlements – Kvasyliv and Orzhiv. Agricultural land is 71.4% of the area of the basin. This river is one of the most polluted by industrial and domestic wastewaters in the Pripyat River basin (Romanenko et al., 2004).
Hydrochemical and ichthyoparasitological studies were carried out in 2013-2019, according to current methods (Romanenko et al., 1998; Yatsyk et al., 2006; Golovina et al., 2017) at 12 control sites located in the Rivne and Zdolbuniv Raions (districts) of the Rivne Oblast (province) (Table 1, Fig. 1).
Water quality analysis and assessment. Surface water quality indicators (the content of chlorides, sulfates, mineralization, pH, ammonium nitrogen, nitrate and nitrite nitrogen, phosphorus phosphates, dissolved oxygen, COD, iron, copper, zinc, manganese, petroleum products) were determined following the current governing normative documents by the department of instrumental laboratory control of the State Environmental Inspection in the Rivne Oblast.
Water quality and the aquatic environment state were evaluated according to the ecological assessment of surface water quality in the relevant categories (Romanenko et al., 1998; Yatsyk et al., 2006), the quantitative generalization of which is the integral ecological index (Ie), which was set by three blocks indices according to formula (1):

$$I_e = \frac{I_1 + I_2 + I_3}{3}, \quad (1),$$

I1 – index of salt composition indicators; I_2 – index of trophic and saprobic indicators (ecological and sanitary); I_3 – index of indicators of specific toxic substances.
The water quality indices were determined by the mean and worst values.

Collecting and examination of fish and ectoparasites. A Survey of the crustacean diseases in fish was conducted during 2013-2018 at the Rivne Research Station of Epizootology of the Institute of Veterinary Medicine and Departments of ecology and water bioresources National University of Water and Environmental Engineering. The survey was conducted according to recommendations (Golovina et al., 2017).
Amateur fishing gear was used for catching fish, surveys of amateur fishers catches were carried out, and floating crafts of the fish patrol of the State Agency of Fisheries of Ukraine were involved in the framework of the research topic. Objects were studied and processed directly in the field at the sampling sites; part of the ichthyologic material was sent to the laboratory for detailed analysis. Materials sent for laboratory processing had been recorded and labeled.
Three primary quantitative descriptors of parasite population (or parasitological indices) were used in the research; they are widely used in parasitology (Bush et al., 1997):

Table 1. Control sites in the water bodies of the Ustya river basin.

Site	Administrative location and site description	The geographic coordinates	
1	Pond near village Ivachkiv in Zdolbuniv raion	50.462	26.296
2	Pond near village Novomylsk in Zdolbuniv raion	50.504	26.287
3	Pond (1) in Zdolbuniv on the Ustya River, communal beach	50.516	26.270
4	Pond (2) in Zdolbuniv on the Ustya River, communal beach for children	50.518	26.262
5	Hydropark (3) in Zdolbuniv	50.527	26.244
6	Pond (4) in Zdolbuniv	50.552	26.246
7	The Ustya River, 3.92km upstream from the city of Rivne	50.584	26.254
8	The Basiv Kut reservoir, communal beach, the city of Rivne	50.597	26.252
9	The Basiv Kut reservoir outlet, the city of Rivne	50.604	26.254
10	The Ustya River, hydropark in Rivne	50.615	26.238
11	The Ustya River, village Malyi Oleksyn in Rivne raion, 2 km downstream from the city of Rivne	50.672	26.218
12	Pond near village Zoziv in Rivne raion	50.674	26.202

Fig. 1. Control sites location (1-12).

Prevalence (P) - the number of hosts infected with one or more individuals of a particular parasite species divided by the number of hosts examined for that parasite, expressed as a percentage, formula (2):

$$P = \frac{N_p}{n} \times 100\% \qquad (2),$$

where Np – number of infected fish, n – total number of examined fish.

The intensity of infection (II) – the number of individuals of a particular parasite species in a single infected host, formula (3):

$$II = \frac{m}{n} \qquad (3),$$

where m – number of particular parasite species; n – number of infected host species.

Mean abundance (M) – the average abundance of a parasite species among all members of a particular host population, formula (4):

$$M = \frac{m}{N} \qquad (4),$$

where m – number of particular parasite species; N – total number of examined host species (including infected and uninfected).

Correlation analysis. A value of r, greater than 0.66, was considered a strong correlation, anything between 0.33 and 0.66 is a moderate correlation, and anything less than 0.33 is considered a weak correlation.

Results and Discussion

The first stage of research assessed the water bodies' current ecological state in the Ustya River basin using the integral ecological index (Ie). According to the results of the assessment of water quality by three blocks of indicators, it was established that the waters in 11 out of 12 control sites belong to the III quality class in terms of average indicators (4.0-4.5), and they are characterized as "slightly polluted" - "moderately polluted" (Table 2, Fig. 2).

Table 2. Surface water quality assessment by average values (2009 -2019).

Site No	I1	I2	I3	Ie	Quality class	Quality category	Water quality assessment Degree of cleanness (pollution) (by class)	Degree of cleanness (pollution) (by category)
1	3	4.8	4.6	4.1	III	4.0	polluted	slightly polluted
2	2.33	3.7	3.25	3.1	II	3.0	clean	fairly clean
3	3.33	3.8	4.2	3.8	III	4.0	polluted	slightly polluted
4	3	4	3.75	3.6	III	4.0	polluted	slightly polluted
5	3.33	4.8	3.4	3.8	III	4.0	polluted	slightly polluted
6	3	4.7	5.0	4.2	III	4.0	polluted	slightly polluted
7	3.0	5.0	5.6	4.5	III	4.5	polluted	slightly polluted - moderately polluted
8	3	4.8	3.8	3.9	III	4.0	polluted	slightly polluted
9	2.67	4.8	3.5	3.7	III	4.0	polluted	slightly polluted
10	3.0	4.6	3.67	3.8	III	4.0	polluted	slightly polluted
11	3.0	4.5	3.67	3.7	III	4.0	polluted	slightly polluted
12	3.0	5.2	3.4	3.9	III	4.0	polluted	slightly polluted

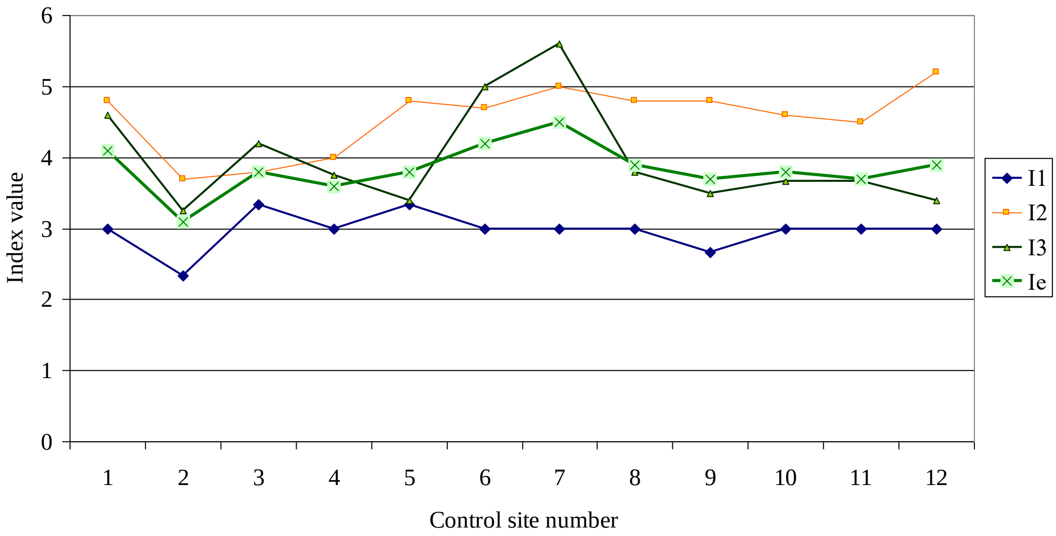


Fig. 2. Profiles of ecological indices of surface water quality: index of indicators of salt composition (I1); index of trophic and saprobic indicators (I2); index of specific toxic substances (I3); integral ecological index (Ie).

The Ustya River's water upstream from large settlements and industrial enterprises has a reasonably good water quality (II, III quality class). Deterioration in water quality begins below the city of Zdolbuniv and further downstream. Results of the ecological assessment according to the worst indicators showed that surface waters belong to the III-IV classes (5-6 categories), and the following characteristics - "slightly polluted" - "moderately polluted" - "dirty" (Table 3).

It was established that according to the criteria of salt composition (block 1, I1), the water bodies belong to III class by the average values, and to III-IV classes by the worst values (due to the high content of chlorides and sulfates in the most control sites).

According to the trophic and saprobic criteria (block 2, I2), the surface waters belong to II-IV classes by average values and IV-V classes by the worst values. The 7th category of water quality (dirty) was often established based on nitrates and nitrites content, less often - on phosphates. The worst indicators (category 7) were indicated in the trophic and saprobic blocks.

According to the indicators of the content of specific toxic substances (block 3, I3), the surface waters belong to 5-7 quality categories by the worst values. The worst block indicators were petroleum products content – 0.29 mg/dm³ (quality category 6) and a high copper concentration – 0.18 mg/dm³ (category 7). We detected a high concentration of manganese – 3.071 mg/dm³ and zinc – 0.229 mg/dm³ (category 7) in the river sections above large settlements.

Thus, the ichthyofauna of the Ustya River basin is significantly affected by water pollution, as evidenced by the assessment results. In most control points in the early 2000s, there was a good water quality (II, occasionally III class, clean or moderately polluted waters) (Klimenko et al., 2012; Klimenko; Grokhovska, 2014). The pollution of the region's surface waters has continued for decades, and in recent years the water quality in some points has even deteriorated.

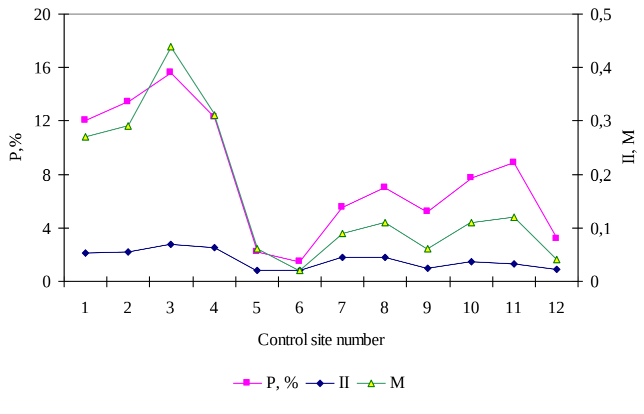
Table 3. Surface water quality assessment by the worst values (2009-2019).

Site No	I_1	The worst indicators	I_2	The worst indicators	I_3	The worst indicators	Ie	Water quality class	Water quality category	Degree of cleanness (pollution) by class	Degree of cleanness (pollution) by category
1	3	chloride, sulfate	6	COD, phosphorus phosphates,	7	Mn, Cu	5.3	III	5.3	polluted	moderately polluted

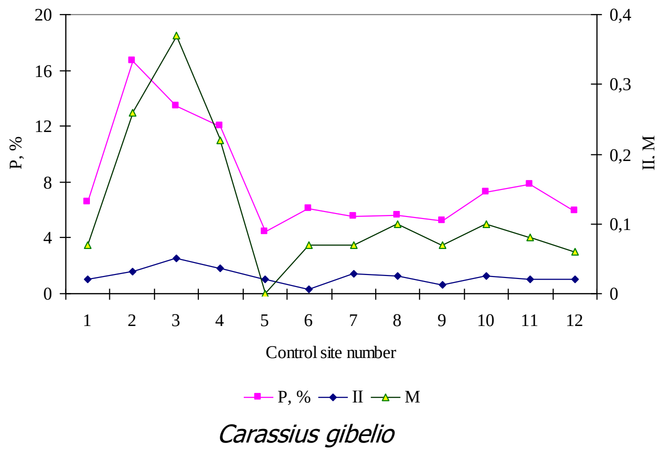
				nitrate, and nitrite nitrogen							
2	3	chloride	6	nitrate nitrogen	5	Cu	5	III	5.0	polluted	moderately polluted
3	5	chloride	7	nitrate nitrogen	6	Cu	6	IV	6.0	dirty	dirty
4	3	total mineralization, chloride, sulfate	7	nitrate and nitrite nitrogen	5	Fe	5	III	5.0	polluted	moderately polluted
5	4	sulfate	7	nitrate nitrogen	6	petroleum products	5.7	IV	6.0	dirty	dirty
6	3	total mineralization, chloride, sulfate	7	nitrate and nitrite nitrogen	6	petroleum products	5.3	III	5.0	polluted	moderately polluted
7	4	sulfate	7	COD, phosphorus phosphates, dissolved oxygen	7	Cu Mn Zn	6	IV	6.0	dirty	dirty
8	3	total mineralization, chloride, sulfate	7	nitrate and nitrite nitrogen, phosphorus phosphates	6	petroleum products	5.3	III	5.0	polluted	moderately polluted
9	3	total mineralization, sulfate	7	nitrate and nitrite nitrogen	6	petroleum products	5.3	III	5.0	polluted	moderately polluted
10	3	total mineralization, chloride, sulfate	7	nitrate and nitrite nitrogen	6	petroleum products	5.3	III	5.0	polluted	moderately polluted
11	3	total mineralization, chloride, sulfate	7	nitrate and nitrite nitrogen	6	petroleum products	5.3	III	5.0	polluted	moderately polluted
12	4	sulfate	7	nitrate and nitrite nitrogen, phosphorus phosphates	5	Cu, petroleum products	5.3	III	5.0	polluted	moderately polluted

The next step of the research was assessment the level of infection of the ichthyofauna, namely the most widespread and numerous of its representatives – Prussian carp (*Carassius gibelio* Bloch) and common roach (*Rutilus rutilus* L.), with parasitic crustaceans. We found that *Argulus foliaceus* L. (Crustacea: Branchiura: Arguloida) is a common agent of fish disease in the region, which causes argulosis. Fish affected by *Lernaea cyprinacea* L. (Crustacea: Copepoda: Cyclopoida), the causative agent of lerneosis, occurred much less frequently. In recent years (2017-2019), we did not find the fish affected by this parasite in reservoirs.

We established that the prevalence of *Argulus foliaceus* on *R. rutilus* ranged from 1.5 to 15.6%, the intensity of invasion was 0.9-2.8, and the mean abundance index was 0.02-0.44. The prevalence on *C. gibelio* was from 4.4 to 16.7%, invasion intensity – 0.33-2.56, and the abundance index – 0.06-0.37. On average, the parasite prevalence on *C. gibelio* is higher than on *R. rutilus* – 8.04 vs. 7.88%. The intensity of invasion and the abundance index, on the contrary, are higher on *R. rutilus* - 1.63 to 1.24 and 0.16 to 0.13, respectively (Table 4, Fig. 3).



Rutilus rutilus



Carassius gibelio

Fig. 3. Profiles of parasitological indices of argulosis: prevalence (P), the intensity of infection (II), and mean abundance (M).

Table 4. Incidence rates of argulosis (2009 -2019).

Site No	Parasitological indices					
	P, %	II	M	P, %	II	M
	Rutilus rutilus			*Carassius gibelio*		
1	12	2.1	0.27	6.6	1	0.07
2	13.4	2.2	0.29	16.7	1.57	0.26
3	15.6	2.8	0.44	13.4	2.56	0.37
4	12.3	2.5	0.31	12	1.85	0.22
5	2.2	0.8	0.06	4.4	1	0.07
6	1.5	0.8	0.02	6.1	0.33	0.07
7	5.5	1.8	0.09	5.5	1.4	0.07
8	7	1.8	0.11	5.6	1.25	0.1
9	5.2	1	0.06	5.2	0.67	0.07
10	7.7	1.5	0.11	7.3	1.3	0.1
11	8.9	1.3	0.12	7.8	1	0.08
12	3.2	0.9	0.04	5.9	1	0.06
Mean value	7.88	1.63	0.16	8.04	1.24	0.13

We observed the highest parasitological indices in areas with a low concentration of nutrients in surface waters. Correlation analysis of the relationship between surface water quality indicators and fish morbidity rate was carried out in the following sequence:

- with the values of ecological indices for three blocks (I1, I2, I3),
- with individual indicators of surface water quality,
- with the values of the integral ecological index (Ie).

The analysis showed a strong negative correlation between the index of the trophic-saprobic block (I2) and all parasitological indices: from r = -0.689 by the intensity to -0.94 by the prevalence for Prussian carp (*C. gibelio*), and to -0.816 by mean abundance for common roach (*R. rutilus*). This correlation is statistically significant. The correlation between parasitological indices and the rest of the block indices (I1, I3) was weak or absent; the relationship is not significant (Table 5).

Thus, a strong negative correlation could indicate that surface water quality affects fish disease incidence by argulosis. Namely, water bodies' pollution with nutrients and organic matter, which is manifested in increased eutrophication, is associated with a decrease in fish morbidity incidence (Fig. 4).

Table 5. Correlation analysis between surface water quality indices by mean values and crustacean diseases in fish by parasitological indices of *Argulus foliaceus*.

Correlation indicators	Indices (parasitological and water quality)					
	P, %	II	M	P, %	II	M
	Rutilus rutilus			*Carassius gibelio*		
Index of indicators of salt composition, I1						
r	-0.159	-0.032	0.014	-0.383	0.195	0.056
Sr	0.312	0.316	0.316	0.292	0.310	0.316
tr	-0.510	-0.101	0.043	-1.312	0.628	0.176
Correlation	weak	weak	weak	weak	weak	weak
Statistical significance	not significant	not significant	not significant	not significant	not significant	not significant
Index of trophic and saprobic indicators, I2						
r	-0.797	-0.713	-0.816	-0.940	-0.689	-0.902
Sr	0.191	0.222	0.183	0.108	0.229	0.137
tr	-4.173	-3.220	-4.462	-8.706	-3.004	-6.605
Correlation	strong	strong	strong	strong	strong	strong
Statistical significance	significant	significant	significant	significant	significant	significant
Index of indicators of the content of specific toxic substances, I3						
r	-0.107	0.124	-0.041	-0.245	-0.066	-0.212
Sr	0.314	0.314	0.316	0.307	0.316	0.309
tr	-0.340	0.396	-0.129	-0.801	-0.209	-0.687
Correlation	weak	Weak	weak	weak	weak	weak
Statistical significance	not significant	not significant	not significant	not significant	not significant	not significant

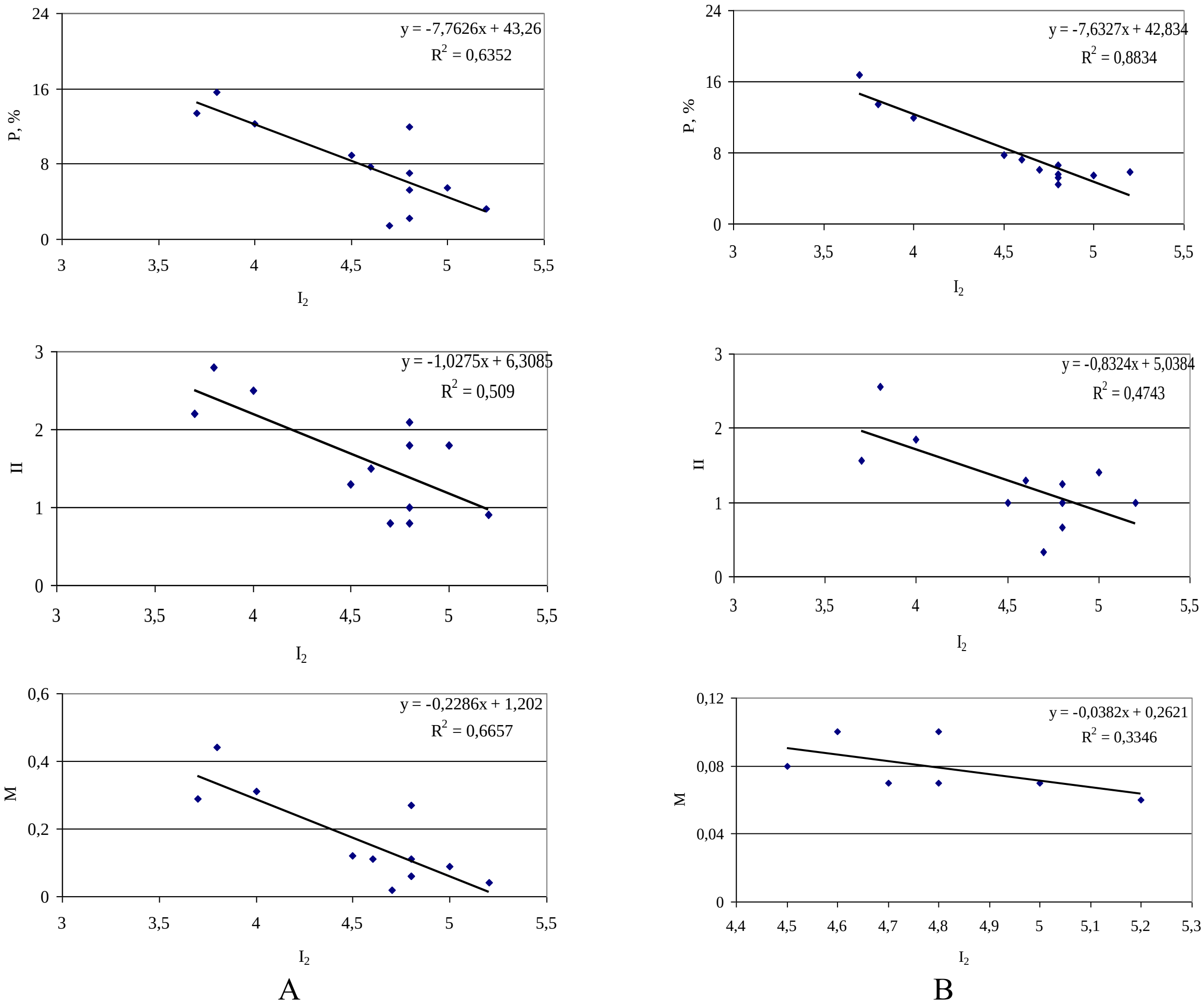


Fig. 4. Relationships between the index of trophic and saprobic indicators of surface water quality (I2) and the prevalence (P), the intensity of infection (II), and the mean abundance (M) of *Argulus foliaceus* on *Rutilus rutilus* (A) and *Carassius gibelio* (B).

Checking the correlation between parasitological indices and environmental indices, which were established according to the worst indicators of water quality, showed a weak and medium insignificant relationship (Table 6).

After establishing a strong significant relationship between the index of the trophic-saprobic block and parasitological indices, the next step was to analyze a correlation with individual indicators of the block. As a result, a negative correlation was revealed in particular, medium and strong with the pH, medium with the content of ammonium nitrogen and phosphorus phosphates, weak and medium with nitrate nitrogen and COD (Table 7). A positive weak and medium correlation was established between the parasitological indices and the content of dissolved oxygen and suspended matter.

Analysis of the relationship between the integral ecological index of surface water quality (Ie) and the parasitological indices relate to *R. rutilus* showed weak and medium negative correlation; the relationship is not significant. Analysis of the relationship between the ecological index and the parasite prevalence on *Carassius gibelio* has shown a strong negative correlation; the relationship is significant. There is a weak and medium negative correlation between the rest of the parasitological indices relate to *Carassius gibelio* and the ecological index; the relationship is not significant (Table 8).

Consequently, the incidence of argulosis in *Carassius gibelio* can be considered one indicator of surface water quality. The species is the most widespread and abundant in the region; it can withstand significant water pollution; therefore, it can serve as an organism-monitor of the aquatic environment's quality. The study of ectoparasites occurrence and the general state of fish skin, scales, and fins allow one to indirectly judge the aquatic environment and substantiate the need for further research.

Table 6. Correlation analysis between surface water quality indices by the worst values and crustacean diseases in fish by parasitological indices of *Argulus foliaceus*.

Correlation indicators	Indices (parasitological and water quality)					
	P, %	II	M	P, %	II	M
		Rutilus rutilus			*Carassius gibelio*	
Index of indicators of water salt composition, I1(the worst)						
r	0.080	0.194	0.275	0.084	0.544	0.483
Sr	0.315	0.310	0.304	0.315	0.265	0.277
tr	0.254	0.624	0.906	0.267172	2.049049	1.745039
Correlation	weak	weak	weak	weak	weak	Weak
Index of trophic and saprobic indicators, I2(the worst)						

r	-0.486	-0.358	-0.421	-0.436	-0.033	-0.151
Sr	0.276	0.295	0.287	0.285	0.316	0.313
tr	-1.76053	-1.2123	-1.46585	-1.53337	-0.10497	-0.48165
Correlation	moderate	moderate	moderate	moderate	weak	weak
Index of indicators of the content of specific toxic substances, I3(the worst)						
r	-0.103	-0.015	-0.122	-0.509	-0.183	-0.369
Sr	0.315	0.316	0.314	0.272	0.311	0.294
tr	-0.32891	-0.04708	-0.39009	-1.86965	-0.59029	-1.25609
Correlation	weak	weak	weak	weak	weak	weak

Table 7. Correlation coefficients between indicators of the trophic-saprobic block of water quality and parasitological indices*.

Parasitological indices	Water quality indicators								
	Suspended substances, mg / dm³	pH	Ammonium nitrogen mg/dm³	Nitrate nitrogen mg/dm³	Nitrite nitrogen mg/dm³	Phosphate phosphorus, mg/dm³	Dissolved Oxygen, mg/dm³	BOD5, mg/dm³	COD5, mg/dm³
Rutilus rutilus									
P, %	0.287	-0.579	-0.585	-0.042	-0.266	-0.485	0.397	-0.162	-0.401
II	0.143	-0.665	-0.620	-0.09	-0.327	-0.358	0.256	0.079	-0.192
M	0.380	-0.534	-0.573	0.135	-0.336	-0.500	0.443	-0.133	-0.411
Carassius gibelio									
P, %	0.308	-0.594	-0.575	0.096	-0.328	-0.483	0.528	-0.209	-0.495
II	0.319	-0.684	-0.361	0.223	-0.356	-0.224	0.131	0.040	-0.207
M	0.407	-0.578	-0.549	0.257	-0.424	-0.500	0.439	-0.131	-0.500

* all the values are non-significant

Table 8. Correlation analysis of the relationship between the integral ecological index of surface water quality (Ie) and parasitological indices.

Correlation indicators	Indices (parasitological and water quality)					
	P, %	II	M	P, %	II	M
	Rutilus rutilus			*Carassius gibelio*		
Integral ecological index, Ie						
r	-0.465	-0.234	-0.391	-0.687	-0.287	-0.525
Sr	0.280	0.307	0.291	0.230	0.303	0.269
tr	-1.662	-0.760	-1.341	-2.988	-0.947	-1.948
Correlation	moderate	weak	moderate	moderate	weak	moderate
Statistical significance	not significant	not significant	not significant	significant	not significant	not significant
Integral ecological index, Ie (the worst)						
r	-0.184	-0.018	-0.055	-0.407	0.205	0.005
Sr	0.311	0.316	0.316	0.289	0.310	0.316
tr	-0.592	-0.056	-0.174	-1.410	0.661	0.017
Correlation	weak	weak	weak	weak	weak	weak
Statistical significance	not significant	not significant	not significant	not significant	not significant	not significant

Conclusion

The study showed that the ichthyofauna of the Ustya River basin experiences a significant impact of anthropogenic pollution, as evidenced by the ecological assessment of surface water quality in the relevant categories. According to average indicators, the overwhelming majority of water bodies belong to III class (4.0-4.5 categories); they are characterized as "slightly polluted" - "moderately polluted". According to the worst indicators – to III-IV classes (5-6 categories), and are characterized as "slightly polluted" - "moderately polluted" - "dirty". The worst indicators (category 7 for the content of phosphates, nitrate, and nitrite nitrogen, COD) are in the trophic-saprobic block. Parasitological studies of the most common fish species (*Rutilus rutilus*, *Carassius gibelio*) showed that, on average, the prevalence of argulosis invasion of *C. gibelio* is higher than that of *R. rutilus* - 8.04 vs. 7.88%. On the contrary, the intensity of infection and mean abundance are higher in *R. rutilus* - 1.63 vs. 1.24 and 0.16 vs. 0.13, respectively.

Correlation analysis established the relationship between the argulosis parasitological indices and the surface water quality. Negative correlations for all parasitological indices were determined: strong with the trophic-saprobic block index (I2), weak or absent with the salt block index (I1), and specific indicators block index (I3). Consequently, the quality of surface waters, namely, water bodies' pollution with biogenic and organic substances, affects fish morbidity with argulosis. The increase in water bodies' trophic state is associated with a decrease in fish morbidity incidence with argulosis.

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