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Research Article

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The Diversity of Parasite Fauna and Characteristics of Ichthyoparasitocenoses in Fish from Fish Farming Ponds of the Republic of Moldova

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ABSTRACT

The ecological condition of fish farming water bodies in the Republic of Moldova has significantly deteriorated due to water deficit, reduction of water surface and depth, siltation, overexploitation, and excessive anthropogenic pollution. These factors negatively affect aquatic ecosystems and contribute to increased morbidity and mortality in fish populations. Parasitic diseases represent one of the major causes of economic losses in aquaculture, especially under conditions of intensified fish farming characterized by high stocking densities, fertilization of ponds, and increased feeding practices.

The present study was based on ichthyopathological material collected from various fish ponds and reservoirs across the Republic of Moldova. Several fish species were examined, including

common carp, silver carp, bighead carp, grass carp, crucian carp, catfish, pike, and pike-perch. Parasitological dissections and hydro chemical analyses of water were conducted using standard ichthyopathological research methods.

A total of 168 parasite species and unidentified forms were recorded, belonging to 15 taxonomic groups. The most representative groups were Ciliophora, Cnidospora, Monogenea, Trematoda, Nematoda, and Sporozoa. More than 40 species were identified as having epizootic significance. Certain fish species showed higher susceptibility to specific parasitic infections, such as argulosis, lernaeosis, ergasilosis, and eustrongylidosis.

The results indicate that the diversity and intensity of parasite infestations are strongly influenced by ecological conditions and hydrobiological characteristics of the studied water bodies. The study highlights the importance of ichthyo parasitological monitoring for assessing fish health and improving disease management strategies in aquaculture.

Keywords: Aquaculture, Fish Parasites, Ichthyo parasites, Parasitic Diseases, Parasite Diversity

Introduction

Currently, the ecological situation in aquaculture ponds in the Republic of Moldova is significantly aggravated due to water scarcity, reductions in pond surface area and depth, overexploitation of aquatic resources, siltation processes, and excessive anthropogenic pollution. These phenomena negatively affect aquatic ecosystems and threaten fish populations as well as the overall functionality of hydro fauna.

The ongoing degradation of the aquatic environment implicitly leads to increased morbidity and mortality in fish populations within aquaculture facilities. The agents of these processes include various species or groups of parasites, as well as their associations. In this context, diseases represent one of the main causes of economic losses in the aquaculture sector.

The intensification of aquaculture — manifested through polyculture farming at high stocking densities, the use of concentrated feeds, and pond fertilization — generates numerous stress factors in production technologies. These factors,

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combined with critical environmental conditions, negatively influence the physiological state and resistance capacity of fish, promoting the occurrence of diseases of various etiologies.

Under the conditions of substantial changes in the characteristics of aquatic ecosystems in Moldovan aquaculture ponds, the epizootic status of cultured fish populations becomes difficult to predict. Research indicates that, under the current conditions of aquaculture intensification and environmental degradation, certain parasite groups find favorable conditions for development and spread. Against the backdrop of reduced host resistance, these parasitic organisms can significantly increase in abundance and virulence, frequently causing morbidity or mortality in juvenile fish stocks.

Available data on the epizootic status of fish farms indicate that a significant number of aquaculture enterprises are unfavorable in terms of contagious parasitic diseases. Thus, the epizootic state of many ponds and farms remains unsatisfactory.

Maintaining fish at high densities in relatively small volumes of water, usually comprising a limited number of species and a single age group, often creates conditions conducive to disease outbreaks. In such situations, parasite populations can increase rapidly within a short period. With reduced fish resistance, these epizootics can lead to the mortality of most individuals in a pond or even across an entire aquaculture unit.

Losses are particularly frequent during the early developmental stages of fish, when mortality often goes unnoticed and remains officially unreported. At the same time, state sanitary-veterinary and ecological control over aquaculture water bodies is often conducted formally, and the coverage of farms by diagnostic studies remains low.

Cases of incorrect diagnosis have also been recorded, where the diagnosis is established without conducting microbiological investigations or ichthyopathological examinations of fish. In practice, although numerous chemical preparations are used to control fish diseases, their effectiveness is limited. Currently, none of the existing medicinal methods for treating ichthyoparasitoses has proven fully effective [1].

Moreover, many of the chemical substances previously used are no longer produced, are difficult to obtain, or have become costly. Furthermore, a significant portion of these substances cannot be considered ecologically harmless to fish and other aquatic organisms. For these reasons, numerous substances have been banned in aquaculture within the European Union and the Republic of Moldova due to noncompliance with ecological and sanitary requirements [2].

Under these conditions, aquaculture specialists mainly rely on comprehensive antiepizootic measures, which include zoo-hygienic, aquaculture-improvement, and sanitary-veterinary actions aimed at disease prevention and control.

One of the most effective measures to ensure sanitary-parasitological safety and the quality of aquaculture production is the implementation of an internal control system within aquaculture enterprises. This system should be based on risk analysis, including the risk of transmissible and non-transmissible diseases, with the goal of preventing, reducing to an acceptable level, or eradicating these diseases at all stages of the fish life cycle.

Material and Methods

Ichthyopathological material was collected during the study period from various types of aquaculture ponds located in several regions of the Republic of Moldova. Investigations were conducted in ponds, fish reservoirs, and accumulation lakes in the localities of Talmaza and Căplani (Ștefan Vodă District), Sărata Nouă (Leova District, the pond and reservoirs of Peslig-Com SRL), Vasileuți and Moșeni (Rîșcani District), Brânzeni and Corpaci (Edineț District), Ignăței (Rezina District), and Drăsliceni (Criuleni District) [3].

Samples of fish from multiple economically important species, of varying sizes, ages, and sexes, were subjected to ichthyopathological examination and either total or partial parasitological dissection. The species analyzed included Cyprinus carpio, Hypophthalmichthys molitrix, Hypophthalmichthys nobilis, Ctenopharyngodon idella, Carassius gibelio, Sander lucioperca, Esox lucius and Silurus glanis [4,5].

The research was primarily conducted on live biological material obtained from as many hosts as possible, representing different species and age categories within various ecological groups, with particular attention given to juvenile fish. Parasitological examination included the analysis of body surfaces, fins, gills, nasal cavities, and internal organs, including the renal system, as these structures provide informative sites for parasite detection and identification [6].

Within the study, the characteristics of parasitic protist fauna, the ecological-trophic structure of parasite communities, host specificity, localization and micro-localization within the host organism, morphometric variability, distribution and frequency of associated parasitism, as well as the spatiotemporal succession of parasite communities, were analyzed. Additionally, the tolerance of these organisms to anthropogenic stress factors and the degree of tissue modification in the host were evaluated [7,8].

The reactions of parasitic protists were studied at the level of individual hosts and populations and, as far as possible, at the biocenotic level over time, taking into account the host species, its age, and the hydrobiological and hydrochemical parameters of the studied habitat. The assessment of parasite communities was based on the premise that the quantitative [9].

development of different species or the entire ecological community of parasites is a more relevant indicator of the epizootic state than the numerical analysis of a single parasite species. In this context, the analysis of invasion intensity was considered more informative than the evaluation of invasion prevalence.

Collection of biological material in the field and its processing in the laboratory were carried out following widely used procedures and techniques in ichthyopathology and fish parasitology research, as described in specialized literature (Мусселиус et al., 1983; Быховская-Павловская, 1985).

Table 1: Distribution of parasites by taxonomic groups in investigated fish species from the Republic of Moldova

Parasite Group	Total Species	Cyprinus carpio	Hypophthalmichthys molitrix	Hypophthalmichthys nobilis	Ctenopharyngodon idella	Carassius gibelio	Silurus glanis	Esox lucius	Sander lucioperca
Metamonada	3	1	1	1	1	2	0	0	0
Euglenozoa	5	4	2	2	3	4	1	2	3
Sporozoea	9	4	3	3	2	3	0	1	1
Amoebozoa	7	3	2	2	2	3	1	2	1
Microsporidia	3	2	0	0	0	0	0	1	0
Cnidospora	30	28	8	5	8	23	2	6	11
Ciliophora	49	39	28	24	23	36	8	14	25
Plathelminthes	38	14	12	11	14	29	3	3	11
Total	168	105	65	53	61	114	19	39	57

Results and Discussions

Parasitological investigations of fish from aquaculture ponds in the Republic of Moldova identified a total of 168 parasite species and forms not previously identified at the species level, classified into 15 taxonomic groups. Analysis of the parasite fauna structure indicated that, in terms of prevalence, species diversity, and, in some cases, numerical abundance, the most representative groups were ciliates, cnidosporidians, monogeneans, trematodes, nematodes, and sporozoans, while other taxonomic groups were represented by relatively few species (Table 1).

Among the identified parasites, over 40 species have epizootiological significance, potentially affecting the health status of cultured fish populations. The highest parasite species diversity was recorded in Carassius gibelio and Cyprinus carpio, indicating high susceptibility to parasitic infestations, likely due to ecological characteristics and pond management practices.

Different types of infestations were characteristic of the species studied. Cyprinus carpio was predominantly affected by argulosis and piscicolosis, with an invasion intensity of approximately 2–5 and 1–3 parasites per individual, respectively. Predatory species, such as Sander lucioperca and perch, exhibited eustrongylidosis, with 5–7 parasites per individual.

In Hypophthalmichthys molitrix, postdiplostomosis was observed, with an infestation intensity of 5–9 parasites per fish. Ctenopharyngodon idella showed mixed infestations characterized by lerneosis (3–7 parasites) and ergasiliosis (11–17 parasites), indicating intense infestations of the skin and gills. Carassius gibelio presented lerneosis (3–7 parasites per individual), while bream exhibited postdiplostomosis with higher intensity (7–11 parasites per fish).

In Hypophthalmichthys nobilis, no parasites were detected, suggesting either higher biological resistance or environmental conditions limiting parasite development. Overall, these results indicate that certain fish species are more susceptible to specific parasites, while others experience multiple infestations or higher invasion intensity. These patterns are influenced by host biology, pond community structure, and hydrobiological conditions.

The taxonomic composition of fish parasite fauna in the studied water bodies is generally characterized by relative homogeneity, determined by the hydrobiological characteristics of the aquatic ecosystems. However, higher species diversity was observed in accumulation lakes and silted ponds, where eutrophication processes favor the development of parasite communities.

In addition to common taxonomic features, significant qualitative differences in parasite group distribution among host species were noted, depending on invasion prevalence. These differences are largely determined by the ecological characteristics of each aquatic pond, including the diversity and numerical abundance of the hydrobiont community, hydrological regime, thermal conditions, and water chemistry.

Analysis of ectobiotic protists revealed significant morphological variability in species from the genera Epistylis and Apiosoma, manifested in differences in stalk length, body morphometry, and colonial versus solitary organization. These variations were primarily correlated with the degree of pond eutrophication.

Ectobiotic species of Trichodina showed pronounced morphometric variability, influenced by host species, parasite location on the host, and habitat conditions. Shape was largely determined by host characteristics, while size was affected by environmental factors such as water temperature, quality, and nutrient availability.

Endoparasitic cnidosporidians can serve as important ecological indicators of eutrophication levels and the development of toxic-resistant zoobenthos. In physiologically healthy hosts, spores of these parasites exhibit relatively large, stable morphometry. In hosts under environmental stress or in poor health, spore size decreases and morphometric variability increases.

Parasite localization within the host also provides relevant information on host physiological status. In healthy fish, parasites are localized in immunologically neutral zones, separated from host tissues by a capsule. In weakened or environmentally stressed fish, parasites may invade vital tissues and organs, show diffuse distribution and reflect reduced host defense capacity.

Thus, analysis of morphometry, localization, and community structure of parasitic protists is a valuable tool for monitoring ecological dynamics of aquatic ecosystems and assessing the impact of eutrophication processes on water bodies, contributing to sustainable management of fish resources.

Conclusions

The study conducted on the diversity of fish parasite fauna in aquaculture basins of the Republic of Moldova highlights a complex taxonomic structure and a high level of species diversity, with 168 parasitic species and forms identified, belonging to 15 phyla. The most representative groups were ciliates, cnidosporidians, monogeneans, and trematodes, confirming the major role of these taxa in shaping parasitic communities in anthropogenically influenced aquatic ecosystems.

The results demonstrate that the species Cyprinus carpio and Carassius gibelio exhibit the highest parasitic diversity, indicating increased susceptibility to infestations, determined both by ecological characteristics and aquaculture rearing conditions. At the same time, certain species, such as Hypophthalmichthys nobilis, showed low or absent parasite incidence, suggesting possible biological resistance or environmental conditions less favorable for parasite development.

It was found that the intensification of aquaculture and the degradation of ecological conditions in aquatic basins promote the development and spread of parasites of epizootic importance. More than 40 identified species can cause disease outbreaks and significant mortality, particularly among juveniles, highlighting their major impact on aquaculture productivity.

The analysis of ichthyoparasitocenoses demonstrated that their structure and dynamics are closely correlated with environmental factors such as eutrophication, water quality, and fish population density. The morphological and morphometric variability of parasitic protists, as well as their localization patterns within the host organism, reflect the physiological condition of fish and the level of ecological stress.

Cnidosporidians and other groups of endoparasites can be considered valuable bioindicators of aquatic ecosystem health, providing relevant information on the degree of environmental degradation and the adaptive capacity of host organisms. Furthermore, it has been confirmed that the analysis of infection intensity provides a more accurate assessment of the epizootic status than the simple evaluation of prevalence.

In the context of limited effective therapeutic methods and restrictions on the use of chemical substances, the implementation of integrated prevention strategies is required, based on zoohygienic, sanitary-veterinary, and ecological management measures. Continuous monitoring of parasitic communities and assessment of epizootic risks represent essential tools for maintaining fish population health and ensuring the sustainable development of the aquaculture sector.

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