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DEGRADATION OF FISH FAUNA IN THE PONDS OF THE SOUTHERN REGION OF MOLDOVA

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Abstract

The paper proposes the presentation of research on the quantitative and qualitative characteristics of surface waters in the Southern Region of the Republic of Moldova. The main purpose of the research is the study of ponds with aquaculture potential, based on complex analyses of impact factors, natural and anthropogenic. The information was collected from two ponds with significant fishing potential, located in the villages of Pelinei and Libidenco. The basins are located near the national road (30 m and 200 m, respectively) and 16 km from the city of Cahul, a development node for the Southern Region of the Republic of Moldova. Research has shown that the direct impact of the population is smaller compared to that of agricultural technologies, based on the intensive use of chemical fertilizers. This study is part of a complex research on the implementation of an efficient monitoring and control system of surface water quality in the Republic of Moldova, with the main objective of reducing the impact of low anthropogenic factor by at least 10% for each pond of Southern Region.

***Key words**: aquaculture, fisheries, pond, quality, water.*

INTRODUCTION

The polluted ponds contain waste, sand, soil particles, clay inclusions, mineral oils, as well as toxic chemical substances detected only in the laboratory (nitrites, nitrates, phenols) etc. The physical, chemical or biological components, as anthropic result, have a toxic effect upon the biota (live organisms), effect which can be considered pollutant (Pronina, 2013).

One of the acceptable and universal manners to control the pollution is the involvement of the pond in a man-controlled biological process, and a certain formation of some basic ideas regarding the metabolic adaptation plant and animal mechanism to the anthropic impact, the degradation degree of the pond, considering the regional conditions, nature and concentration of pollutants ending up in the pond (Munteanu Pila and Stanciu, 2019a).

Thus appears the need to use in a more rational manner of the areas surrounding the ponds, eliminating the possible cases which affects the quality of the ponds' water, as well as the waste cleaning, as required, leading to the massive overcrowding, worsening the self-cleaning system of the pond. Another extremely harmful factor is the use of the pond water as the agricultural land irrigation source representing a direct anthropic pollution, and is a combination between the supply sources and the used water evacuation sources, in a vicious circle because through a circuit, the water once again reaches the pond once again affecting the fish culture.

A special importance in the used water division is the analysis of the vital activity of the live organism din the pond (plant and animals), and of the aquatic biocoenosis, reported to the degree the pond was anthropically affected pond (nitrites, nitrates, metals, phenols).

A pond is considered bio-effectively when within it is found a variety of aquatic plants and vegetation, besides the fact that it represents the food for many species of herbivore fish, it can fulfil also oxidative functions, taking place the detoxification of the organic pollutants (the plants accumulate the toxic substances and transform them in non-toxic substances) – photosynthesis, as a result the water is enriched with oxygen (Munteanu Pila and Stanciu, 2018a).

Among the aquatic plants three groups are distinguished: plants floating on water surfaces, plants growing and floating in the water mass and fully submerged plants. If I were to compare

the entire food chain, aquatic plants are the most resistant in the anthropic pollutions.
Some research shows that using the water *Hyacinth* (*Eichornia*) helps the treatment of used household water. In US, populating the ponds with this plant established a purification degree up to 97-98 %; in China, the polluted waters during the purification decreased by 98.6%, and in Russia, in the aquatic basins, the nitrogen and ammonium concentration decreased from 30-50 mg/L to 4-5 mg/L, and the concentration of the dissolved oxygen increased from 0.5 to 2-5 mg O_2/L (Vetrov, 2013).
The pond pollution is divided in two groups: minerals, whose content is approximately 42% and organic up to 58%, including biological and bacterial (Novikov, 2013). Some microorganisms such as bacteria, aquatic mushrooms and, moreover, some algae can participate in the decomposition of some organic substances, using as supply source – self-cleaning process. For example, the protozoa (*Ciliate sp.*) feed on bacteria, and each can destroy up to 30,000 bacterial cells. Although of small dimensions, the filtrations organisms (molluscs, daphnia etc.), can filtrate through their body large water volumes, filtrating particles suspended in the pond, and leaving the lump-like particles dropping at the bottom of the pond – natural fertiliser (Korjagina, 2013).

MATERIALS AND METHODS

The work was carried out on the basis of research on the functional state of hydro-biota, as well as by establishing quantitative and qualitative analyses of surface waters in the Southern Region of the Republic of Moldova.
This study was based on the establishment of the causes leading to the degradation of the aquatic circuit – resulting in swamping, fishery mortality, damaged ponds.
Water was collected from the ponds in two localities (Pelinei and Libidenco), area with fishery growth potential and capitalisation in order to establish the anthropic degradation degree.
The analyses were carried out in the Aquatic Resources Research and Exploration laboratory at the "Dunărea de Jos" University, Faculty of Food Sciences and Engineering, by using kit Merck-type using the Spectroquant, NOVA 60 spectrophotometer.
Some data was collected from specialty books and works and compared with real data (personal research) for an adequate interpretation.
The collected data were sorted, processed by statistical methods and represented graphically.

RESULTS AND DISCUSSIONS

The intensive and continuous pollution of the water sources in the Republic of Moldova became a severe issue among the fishery capitalisation. Thus, it resulted only 1% of the waters (ponds) in the Southern region of the Republic of Moldova correspond to the 1st quality class, and 17% do not correspond even to the 3rd quality class for capitalisation and fish increase in the intensive system (polyculture) (Munteanu Pila and Stanciu, 2019b).
The household anthropic waste increases annually due to the agriculture practice around the pond, as well as the mass-scale usage of fertilisers, pesticides and other harmful products, endangering the pond.
At the same time with the annual rains, these substances wash from the land treated surface and leak in the pond, endangering the ichthyofauna, resulting in fish dying and those resisting endangering the human health through the accumulation of toxic substances in the fish meat. In various localities in the Southern Area of the Republic of Moldova, the water composition will be different.
There are 31 ponds in the southern area of the Republic of Moldova, of which 19 are not functioned (damaged), 3 ponds have dried up and were abandoned, and other 9 ponds are dedicated the growth of fish in the intensive system (polyculture) (Figure 1).
The cause of the pond aquatic fauna degradation in the Republic of Moldova is their placement near some metallurgic, machine building and petrol waste, in other countries mineral pollution of enterprises (e.g. Giurgiulesti, Moldova) (Munteanu Pila and Stanciu, 2018b).
Those having nearby animal raising farms, polluted with waste leaking in the pond, have a high nitrogen -organic pollution content.
In water, the nitrogen is present in the following forms: molecular nitrogen (N_2), absorbed from

the air; nitrogen organic compounds partially resulted from the decomposition of the organic material; ammonium nitrogen (NH_4, NH_4OH); nitrites (NO_2, HNO_2) and nitrates (NO_3 up to 10-15 kg/ha nitrogen per year), originating from the atmospheric precipitations.

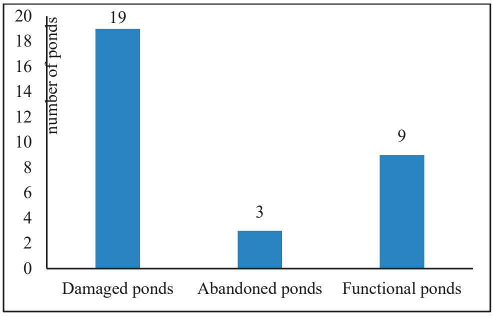

Figure 1. Ponds in the Southern Republic of Moldova
Source: Author research

The organic pollution takes place also following the drain of some chemical substances (pesticides), originated from the agricultural lands in the pond's surroundings – the chemical substance of this type of pollution is carbon.

After the disappearance of many fish species, and the partial swamping, the pond is fully populated only by microorganisms (Munteanu Pila and Stanciu, 2018a).

The pond can carry out the biotic activity only after a mechanical cleaning, and a later removal of the organic material absorbing all the nutritious substances in the pond: nitrogen, phosphor, potassium, calcium, magnesium, manganese, sulphur – mineralisation process.

Some plants such as the reed, a form of tall plants, with thick stalks found in many pounds in the region, can accumulate many mineral substances toxic for the fish, yet it is easy to renew after mowing.

In its turn, the used water contains two main groups of pollutants: conservatory which are not easily included in the chemical reactions and practically are not biodegradable (examples type are heavy metals, phenols, pesticides); and non-conservatory, pollutants which can suffer self-cleaning processes.

For this purpose, it was collected water from the pond in two localities located in the Southern Region in the Republic of Moldova, Pelinei (Pond 1) and Libidenco (Pond 2), in order to establish the status and quality of the ichthyofauna aquatic, the elimination of the fishery illness or death risk in the area – the development factor of the fishery productivity in the South Region.

The following physical and chemical parameters of water were analysed: phosphates, nitrates, nitrites, ammonium and organic substance (mg/L). Average values for results have been represented in Table 1 (Pond 1, Pelinei), respectively in Table 2 (Pond 2, Libidenco).

Table 1. Water parameters of Pond 1 (Pelinei)

Parameters / Station	pH (pH units)	$P\text{-}PO_4^{3-}$ (mg/L)	$N\text{-}NO_3^-$ (mg/L)	$N\text{-}NO_2^-$ (mg/L)	$N\text{-}NH_4^+$ (mg/L)	C-CoCr (mg/L org.comp.)
Supply	7.57	0.70	0.60	0.11	0.01	152.00
Evacuation	7.56	0.42	0.70	0.08	0.05	40.00
Middle basin	7.73	0.68	1.10	0.10	0.07	
Interior basin	7.66	0.33	0.60	-	-	
Surface basin	7.41	0.44	0.80	0.07	0.00	
Moldovan regulations	6.5-8.5	5.00	10.00	1.00	2.00	500.00
Romanian standards	SR ISO 10523-97	STAS 10064-1975	SR EN ISO 13395:2002	SR EN 26777:2002	SR ISO 5664: 2001	SR ISO 6060/96

Source: Author research

Results of laboratory analysis of water samples from pond 1 (Pelinei), are according to the Regulatory regarding the establishment of the industrial and urban used water loading polluting limits at the evacuation of the natural receptors, NTPA-001/2002; Regulatory regarding the used water evacuation conditions in the sewerage networks of the localities and directly in the treatment stations, NTPA-002/2002, namely the Resolution no. 352 dated April 21st 2005 regarding the amendment and fulfilling of the Government's Resolution no. 188/2002 for the approval of some norms regarding the used water unloading conditions in the aquatic environment (with the later amendments) for the indicators foreseen in the "control monitoring" section – except the supply source organic substances, C-CoCr – 152 mg/L (Table 1).

Results of laboratory analysis of water samples from Pond 2 (Libidenco), are according to the Regulatory regarding the establishment of the industrial and urban used water loading polluting limits at the evacuation of the natural receptors, NTPA-001/2002; Regulatory regarding the used water evacuation conditions in the sewerage networks of the localities and directly in the treatment stations, NTPA-002/2002, namely the Resolution no. 352 dated April 21st 2005 regarding the amendment and fulfilling of the Government's Resolution no. 188/2002 for the approval of some norms regarding the used water unloading conditions in the aquatic environment (the last amendments) for the indicators foreseen in the "control monitoring" section- exception: Middle basic station - regarding the pH value (8.77) (Table 2).

Table 2. Water parameters of pond 2 (Libidenco)

Parameters / Station	pH (pH units)	$P\text{-}PO_4^{3-}$ (mg/L)	$N\text{-}NO_3^-$ (mg/L)	$N\text{-}NO_2^-$ (mg/L)	$N\text{-}NH_4^+$ (mg/L)	C-CoCr (mg/L org. comp.)
Supply	7.38	0.38	7.6	0.14	0.25	31.0
Evacuation	7.43	0.34	1.1	0.08	0.03	49.0
Middle basin	**8.77**	0.46	2.1	0.07	0.01	
Interior basin	7.10	0.30	2.1	0.06	0.01	
Surface basin	7.38	0.60	2.1	0.09	0.04	
Moldovan regulations	6.5-8.5	5.00	10.00	1.00	2.00	500.00
Romanian standards	SR ISO 10523-97	STAS 10064-1975	SR EN ISO 13395:2002	SR EN 26777:2002	SR ISO 5664:2001	SR ISO 6060/96

Source: Author research

The mass development of the cyanobacteria of the *Microcystis, Anabaena, Nodularia, Nostoc, Aphanizomenon, Oscillatoria*, causes great damages to the eutrophic ponds, hindering the water supply process and the fish, when in pond there are more than 40-50% de cyanobacteria, fish populations and aquatic birds die as a result of toxin poisoning. The issue can be solved by adding, for example, nitrogen compounds, for the suppression of the cyanobacteria and microalgae blooming in the pond or the introduction of phytoplankton-eating fish, for example silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Hypophthalmichthys nobilis*) (Levich and Bulgakov, 1993). The algae absorb the nitrogen in the water mainly in the form of nitrates (NO_3) and ammonium compounds (NH_4). For the development of the algae, especially the phytoplankton – the main oxygen supplier dissolved in water – the best nitrogen concentration is of 2 mg/L and phosphor (P_2O_5) – 0.5mg/L (Figure 2). Without nitrogen in water the phosphorus would not be absorbed. A nitrogen deficit in the pond is much worse than the phosphorus deficit because this dramatically reduces the increase and maturation of the aquatic plants (food for herbivore fishes), and as a result, it lowers the capacity of the plants to consume the CO_2 in the water. The slow increase of the aquatic plants is a sign of the nitrogen lack in the pond (under normal illumination and CO2), the NO_3 level is zero and the presence of phosphates PO_4 is 0.1 mg/L, (PO_4> = 0.1 mg/L).

Generally, the fish nutrition is calculated according to the phosphorus quantity because it is considered the grow limitative factor. The optimal PO4 dosage depends on the intensity of the light permeating the pond, as well as on the quantity and the growth rate of the aquatic plants and can start at 0.2-5.0 mg/L (Figure 2). The phosphorus plays an important role in the photosynthesis process, being an energy regulator included in the componence of all the organisms. In the water, the phosphorus is found in the form of phosphates.

The aquatic vegetation cannot use the organic phosphorus PO_4 (fish excrements), without this being mineralized – decomposed by bacteria – KH_2PO_4 an inorganic compound used by plants - aquatic circuit – self-cleaning process.

And when the potassium is lacking in the water, the aquatic vegetation acquires a yellow-brown colour, and develops harder – the potassium deficit becomes the reason for slowing the photosynthesis process (affecting also the herbivore fish populations), the norm being of 0.90 mg/L (Figure 2).

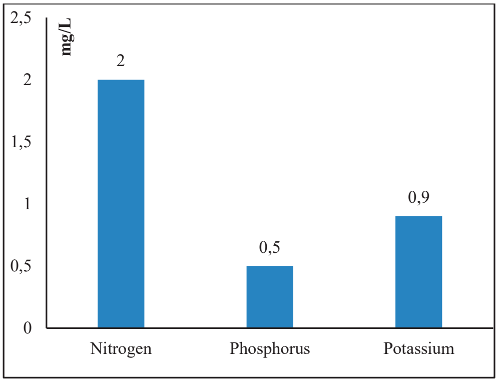

Figure 2. Physical and chemical concentration for phytoplankton in the pond
Source: Authors, by using Korjagina (2013)

In order to evaluate the physiological state of the surface waters (ponds) and of the organisms (aquatic organisms) living in the water: fish, crayfishes, some molluscs species, aquatic vegetation is necessary:

- Carrying out annually the water analyses and the control of the pond's damage degree;

- The control and improvement of the reproduction process of the valuable fish species;
- The possibility to adapt and acclimatize the area to the environment factors (drought, low temperatures);
- Early detection of the pathology (laboratory analyses).

CONCLUSIONS

Fishing basins face significant anthropogenic stress, which is also the cause of the environmental degradation of the various water bodies and thus takes place the destruction of their biota. It must be emphasised the fact that the ponds in this region, as well as other eutrophic ponds, face a large anthropic load. Carrying out an environmental survey regarding the aquatic circuit will establish the actual status of the pond and will allow for the development of some improvement measures in order to prevent the death of the fishery populations and of the aquatic vegetation. These locations were chosen because the impact of the anthropogenic factor is strong, due to the proximity to the populated area. Chemical analyses of water quality were performed and the quantity and quality of aquatic fauna was assessed. Water from Libidenco Pond has been characterized by a higher share of nitrite in the water, with a strong negative impact on aquatic fauna. The research highlighted the existence of differences between the two systems analysed, mainly due to the proximity of agricultural areas with different plant cultivation techniques. Thus, the intensive use of chemical fertilizers in neighbouring agricultural areas has led to different values of chemical parameters of surface water. In order to increase the use of the natural potential of ponds, it is necessary to optimize the growing conditions of different species of fish, adapting fishing technologies and reducing the action of factors that have a negative impact on surface water quality.

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