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STUDY OF FISH FAUNA AND NATURAL FISH PRODUCTIVITY IN HOLBINA 1 ECOLOGICAL RECONSTRUCTION AREA, PART OF WETLAND DANUBE DELTA

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Abstract

The general objective of the study is to benefit by sustainable management of fish from one pilot reconstruction area of Danube delta, Holbina 1. In order to achieve this objective, the project team proposed to determine the fish ecological status after ecological reconstruction, also determine natural fish potential of the respective aquatic basin, a territory within the Danube Delta Biosphere Reserve (DDBR). The summary activities of the participating team are to analyse the results obtained during one year of study in different seasons, after field sampling campaigns from the perspective of fish productivity calculation (water quality, phytoplankton, zooplankton, benthos, macrophytes and ichthyofaunal). Our investigations revealed the average values of 14 biotic and abiotic parameters used to calculate biogenic capacity of Holbina 1 environment, but also the value for K coefficient was determined in the studied area, their product conducting to natural fish productivity calculation. In all seasons during studied year results 25 captured fish species (one missing compared to 10 years ago) and a medium water productivity of fish potential, but must be specify that probably monthly samplings campaigns could have more accurate results, but in this case more financial support is needed.

Keywords: fish fauna, natural fish productivity, wetland, Holbina 1

1. INTRODUCTION

Wetlands have been considered for a long time to be worthless, which has led to their continued degradation, in particular through dams and draining. This was also the case for the Danube meadow and Danube Delta, the landscaping works contributing to the destruction of large areas of wetlands. With the beginning of understanding the importance and role of wetlands globally, action was taken to stop the destruction and, in some cases, to recover some wetland areas. One of the methods used in this process was the ecological reconstruction of wetlands degraded by human activities. However, ecological reconstruction, viewed as a return of a degraded ecosystem to a state closest to its pristine/initial state, has been the subject of many projects implemented in different places around the globe with some expected results and sometimes with failures.

Human interventions in the Danube Delta are consequences of different land use policies throughout history, depending on priorities and knowledge. The first major measures taken in the Danube Delta, those to improve navigation at the end of the 19th century, have not been shown to have major effects on the delta, especially inflating the distribution of flows on the arms. Between 1903 and 1960, in the so-called "period of fish", new channels (such as Dunavat, Mustaca) were built or widened in order to activate water circulation within the delta and improve fish production. The 1960s (1960-1970) are considered as the "reed period" in the exploitation of natural resources in the Danube Delta. The 1970s (1970 - 1980) are part of the Danube Delta drama as a period of fishing and subordinate agriculture and farming. During this period, the resurfacing facilities of the previous period (Rusca, Balteni, Maliuc, Obretin) were reprofilated and those from Popina, Chilia Veche, Stipoc, Dunavat, Holbina 1 Holbina 2, Periteasca, Perişor, Ceamurlia were build, totaling 40,000 ha. The 1980s (1980-1989) are marked by the Program for the Development and Exploitation of Natural Resources in the Danube Delta, elaborated and legislated by a Decree of the State Council of 1983 with arrangements for agriculture and livestock breeding. Period after 1990 Decree no. 103 of February 7, 1990, regarding the cease of Danube Delta landscaping, issued by the FSN Council stipulated that in order to ensure the ecological equilibrium of the Danube Delta, Danube Delta landscaping works, as well as any other works that affect the environment in this area, and calls for a study to show the necessary measures for the economic use of the Danube Delta, in conditions to restore and maintain ecological balance (Tudor, 2009, 2010, 2011). Much of the fish we consume depends on the wetlands in some phases of the life cycle (Snodgrass 2004), some authors pointing out that this part is up to two-thirds (2/3) (Barbier, Acreman et al., 1997). Many fish species are reproduced exclusively in floodplains, with a direct proportional relationship between the floodplain surface and the fish yields (Staras 1998).

In Romania, in 1993, the Administration of the Danube Delta Biosphere Reserve (ARBDD) and the Danube Delta National Institute (DDNI) started a program of restoration of the Danube Delta. As a result of the activities of these institutions, facilities have been identified and analysed the abandoned or ineffective agricultural and fishery arrangements for ecological reconstruction. Initially, 63,000 ha of them were provided for the restoration of wetlands (Gomoiu and Baboianu, 1992). In 1994, the first Babina (2,100 ha) area was restored, followed in 1996 by Cernovca (1580 ha), in 2000 Popina (3,600 ha) in 2001 Fortuna (2115 ha) and in 2008 polders Holbina-Dunavat (5630 ha). A large number of other developments have been extensively studied, but the work leading to ecological restoration has not yet begun due to constraints arising from the right to manage land in the delta (Tudor, 2009, 2010, 2011).

The Dunavat-Dranov region is a large, peat-covered depression between the two channels (Dunavăţ and Dranov), which connect the Sfântu Gheorghe arm with the former lagoon area Razim-Dunăvăţ and Dranov. In the 20th century, the region was heavily influenced by human activity. Razim lagoon was separated from the Black Sea and became a freshwater reservoir with a high water level. The isolated peat central area was opened to the naval transport and the connection to the river water was ensured through a system of artificial channels. Danube water intake has led to a strong increase in nutrient content, causing eutrophication of valuable mesotrophic aquatic systems. Fish farming basins were created by building contour and subdivision dams, pumping stations, high voltage power lines, fish collection platforms and administrative buildings. The reed and turbot soil in the fish ponds were destroyed by burning, causing a landfall of 0.50-1.0 meters. Plans for Holbina-Dunavat area have passed over the last 15 years through successive stages of isolation / reconnection to / to the adjacent channel network. Following the synthesis of previous results and the updating of the data on water transparency in 2009, it has been shown that transparency is the most sensitive parameter in the course of changes in hydrology and aquatic vegetation over time, and this is the first to respond to changes in environmental conditions (Tudor, 2009, 2010).

Renewed fish ponds can become efficient as fishing areas, especially for economically valuable species such as pike, as limnophylous species.Therefore, this paper offer a synthesis on restoration wetland area Holbina 1 part of Danube delta and determines the results for natural fish productivity and present fish coenosis in the area.

2. MATERIAL AND METHODS

2.1 Study Area

Holbina 1 wetland as a part of Danube delta (**Figure 1**) is located in Est part of Razim lake, between Mustaca canal (in North) and near Holbina gulf (in South) belonging to Razim lake; this studied wetland is a closed fish farm, opened by monks to increase water level when is necessary. Geographic coordinates are between 44,861467 and 44,897159 North latitude and 29,054753 and 29,101251 Eastern Longitude.

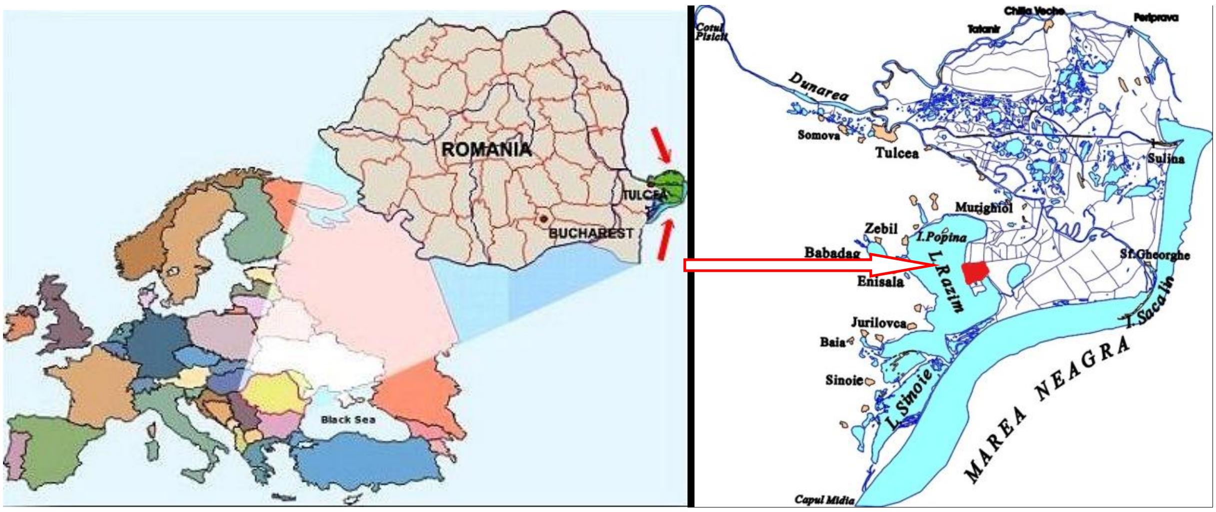

Figure 1 Studied area (Holbina 1 from Danube Delta Biosphere Reserve of Romania)

2.2 Sampling

Holbina 1 was studied during one year period 2016-2017 in all 4 different seasons (autumn in November; in winter when isn't frozen at the beginning of December; in spring in May and in summer to the end of June) of temperate clime from Danube Delta Biosphere Reserve (DDBR).

Fish sampling: is done by two complementary methods, such as electric fishing and relon or nylon gillnets fishing (Nordic or commercial), when gillnets fishing is done in night in open and deep water of lakes, while the electric fishing is done by day in shallow waters with abundant vegetation. Fish sampling is in accordance with EU fish sampling (***CEN/TC, 2002).

Water samples for *chemistry analyses* were collected according with SR ISO 5667-2 / 2002, which is the action consisting in taking part of the water considered as representative for the purpose of examining certain characteristics. The physical-chemical analyses were performed in the DDNI Chemistry Laboratory, RENAR certified, following the specific procedures for sampling, preservation, storage and analyse. The quality indicators, considerate relevant for the present study, were selected: temperature, pH, transparency, calcium /magnesium, total hardness of water, total alkalinity, dissolved oxygen, nitrites, nitrates and phosphates. In situ measurements were made for the water transparency, using the Secchi disk and temperature using the temperature sensor of the multiparameter Hach. Different methods were used for the determination of the specific physical and chemical indicators: potentiometric methods (pH), volumetric methods (dissolved oxygen, calcium / magnesium, total hardness, total alkalinity), molecular spectrometry (nitrites, nitrates, phosphates).

Phytoplankton sampling in five stations located in Holbina 1 premises the samples were taken in plastic containers of capacity 1 liter (l) from a depth of about 10-15 cm. Sample fixation consisted of adding 5 ml of lugol and mixing them. After a sedimentation of 7 days in glass cylinders, the contents were made to about 70 ml of which 15 ml were extracted for microscope analysis. Determination of the species was achieved by the use of specialized determiners. For collection of *zooplankton* at each station, 30 liters sample was filtered through a planktonic net with 55 µm mesh size. The sample was then fixed with 96° alcohol. In the laboratory, samples were saponified and then identified by microscope.

With regard to benthic fauna, *zoobenthos* samples were collected with a side 15 cm bottom collector dredge with a surface area of 0.025 m². For the separation benthic organisms of substrate, the dredge contents was washed in a 500 µm sieve (micrometres) and the resulting material was placed in plastic bags over which 70° ethyl alcohol was poured for attachment. After transportation to the laboratory, the samples were sorted and individuals were identified up to the species level, with the exception of oligochaetes/tubificidae (at the class level) and larvae of Diptera, Trichoptera, annelids and flatworms, which due to the relatively small number of individuals and lack of taxonomic expertise, were grouped in the "other" category (between the Diptera, Chironomidae were identified up to the species level).

2.3 Statistical analysis

Fish ecology

Fish species identification according literature (Bănărescu, 1964, Kottelat, 1997; Kottelat and Freyhof, 2007; Nelson, 2006; Oţel 2007, Froese and Pauly, 2018, Năvodaru and Năstase 2011), the relative abundance and biomass are expressed by Capture Per Unit Effort (CPUE), description of ichthyocoenosis using analytical and synthetic ecological indicators: dominance, constancy, ecological significance (**Table 1**) and biodiversity index (Shannon-Wiener and Evenness) (Odum, 1975, Gomoiu and Skolka, 2001, Sarbu and Benedek, 2004) are analysed for ecological status of fish fauna.

Table 1 Dominance, constancy, ecological significance classes and percentage

Dominance (D)		Constancy (C)		Ecological significance (W)	
Class	%	Class	%	Class	%
sporadic	D1< 1	Very rare	C1=0-10	Accidental	W1< 0,1
subrecedent	D2=1-2	rare	C2=10,1-25	accessory	W2=0,1-1
recedent	D3=2-4	accesory	C3=25,1-45	associate	W3=1-5
subdominant	D4=4-8	constant	C4=45,1-70	complementary	W4=5-10
dominant	D5=8-16	euconstant	C5=70,1-100	characteristic	W5=10-20
eudominant	D6>16			main	W6>20

Natural fish productivity

The general and common definitions given to the term production are: "action to produce, what is produced", and for productivity "the ability to produce, the state of what is produced, a quantifiable relationship between a given production and one or a combination of factors which act at the same time. Production is a capital and productivity is the interest of capital. In fishery terms, production is the actual quantity of fish produced in the unit of time, in biomass units, sometimes on individuals when production is homogeneous, per unit area, and sometimes per unit of length. Productions expressed in units / ha*year, or in kg/km*year are always accompanied by their value in kg/ha*year. Productivity will be the potential, the possibility of production: what that lake or that watercourse can produce, taking into account a known value of all its organic or inorganic components.

The most used method of calculating natural fish productivity (PN) is Leger, Huet and Arrignon 1970 (Arrignon 1976, Voican et al., 1981):

PN = L x K x B

Where: PN = annual theoretical productivity in kg per km of river or ha of pond, B = Biogenic Capacity (I to X), L = length of water flow (running water) or basin / slope area (N / 10, where N = number of ari of basin, 1 ar = 100 m²) (for stagnant waters L = 10), K = productivity coefficient.

Coefficient K (1-15.75) result from the product of several factors (**Table 2**): K = K1 x K2 x K3 x K4 x K5

Table 2 Calculation of productivity coefficient (K) (Leger, Huet and Arrignon 1970 (Arrignon 1976, Voican et al., 1981, Staraș 1985)

<table>
<tr><th colspan="2">K1
The physical characters of the habitat
(1)</th><th colspan="2">K2
The chemical characters of the habitat
(2)</th><th colspan="2">K3
Fish type</th><th colspan="2">K4
Fish age
(3)</th><th colspan="2">K5
Characterize
(4)</th></tr>
<tr><td>The temperate region
(10 ^{o}C)</td><td>1</td><td rowspan="2">Acidic waters</td><td rowspan="2">1</td><td>Salmonids</td><td>1</td><td rowspan="2">More than 6 months</td><td rowspan="2">1</td><td>urban type continuous</td><td>0,2 – 0,5</td></tr>
<tr><td>The warm temperate region
(16 ^{o}C)</td><td>2</td><td>Cyprinids reophylous</td><td>1,5</td><td>urban type diffuse</td><td>0,5 – 1</td></tr>
<tr><td rowspan="4">The intertropical region
(22 ^{o}C)</td><td rowspan="4">3</td><td rowspan="8">Alkaline waters</td><td rowspan="8">1,5</td><td rowspan="4">Cyprinids limnophylous</td><td rowspan="4">2</td><td rowspan="8">Less than 6 months</td><td rowspan="8">1,5</td><td colspan="2">Pastoral type</td></tr>
<tr><td>Valley 1b</td><td>1,1</td></tr>
<tr><td>Valley 1c</td><td>1,2</td></tr>
<tr><td>Valley 2</td><td>1,3</td></tr>
<tr><td rowspan="4">Equatorial region
(24 ^{o}C)</td><td rowspan="4">4</td><td rowspan="4"></td><td rowspan="4"></td><td colspan="2">Herbal type</td></tr>
<tr><td>Valley 1c</td><td>1,4</td></tr>
<tr><td>Valley 2</td><td>1,5</td></tr>
<tr><td>Valley 3</td><td>1,6 – 1,8</td></tr>
<tr><td colspan="10">(1) Average annual air temperature
(2) Acidity or alkalinity of water
(3) Coefficient involving individuals less than 6 months of nurseries and juvenile breeding pools
(4) urban continuity type: major waterbeds busy by municipalities, waterproofing (bitumen), canals, drainage of rainwater directly</td></tr>
</table>

3. RESULTS AND DISCUSSION

Holbina 1 as part of Holbina-Dunăvăț ecological restoration program accomplished in 2008 seems to be recovered as a wetland area and operates as its own. In support of this, wetland area Holbina 1 are encountered with typical habitats of the Danube Delta with compact reed, clear water, organic soil, good condition for increased biodiversity and a rich submerged macrophytes vegetation, sometimes at decreased water level the monks are opened and Mustaca canal discharge turbid water coming from Danube (Sf. Gheorghe arm) to supply water basin. Also waters from Mustaca canal discharge into the Razim lake.

Regarding fish species richness, in Holbina 1 are present 26 species, 1 missing as against 2007 and other 9 was found only in 2016-2017 (**Table 3**) dominant is Cyprinidae family, mostly being limnophylous species. Main fish species eudominant, euconstant is *Scardinius erythrophthalmus* followed by characteristic species *Rutilus rutilus* and *Blicca bjoerkna*, but *Esox lucius* is associate species (W3) much more than Danube delta where it is accessory species (W2). From total number, 13 commercial species are captured in Holbina 1.

In 2016 was captured for the first time *Perccottus glenii* in Holbina 1, new recorded fish species in Danube delta first time in 2007 (Năstase 2007, 2009), which means conquering new territories in large area of distribution for this species in less than 10 years. New record in the area shows interconnected of Holbina 1 with neighbourhood canals, so is not totally disconnected, which offer possibilities to others native or non-native fish species to enter in this area. Already 5 non-native species are present here, species like *H. molitrix, H. nobilis, C. idella* and unwished harmful *Lepomis gibbosus* and *Perccottus glenii*, but for the good of fish fauna it is recommended not to increase number of non-native fish species in Holbina 1 and also from entire Danube delta (according to Water Frame Directive for Good condition it is necessary to conserve, maintain or less damages for natural and pristine conditions populated with native species).

In Holbina 1 are well conserved 7 national and community interest fish species (marked with bold in **Table 3**) especially some vulnerable species (in European Red List) like *Umbra krameri*.

Biodiversity indices have increased values, more than medium, indicate a stable ecosystem regarding fish fauna, with little differences between methods of sampling showing a constant ichthyocoenosis in all Holbina 1 water basin. Shannon indices value of 2.371 at electric fishing is bigger compared with others, but also Evenness indicate increase till to a high value of 0.855 (**Table 4**).

According to fish natural productivity calculation using biogenic capacity we can observe different values between seasons (3.9 less value in the beginning of the winter till to frozen and 6.2 bigger in late spring), for sure are differences between months or even in the same month when environmental conditions are change. Therefore for an appropriate calculation annual average is used as a results of many possible different and exchangeable environmental conditions that can appears, usually monthly observed.

Regarding water chemistry annual average for water temperatures is 14°C (between 2.5°C in the beginning in winter and 25°C in summer, probably more in torrid summer days), 7.3 mg/l Oxygen concentration, ph around 8, alkalinity 5.2, nitrites 0.03 mg/l, nitrates 0.91 mg/l and phosphates 0.043 mg/l (**Tabel 5**). Biological parameters are scored between 5 (benthos) and 9 (submerged macrophyte vegetation) (**Tabel 5**).

With differences of biogenic capacity between seasons and constant coefficient K=3, natural fish productivity value is around 159 kg/ha/year (**Table 5**). The value in Holbina 1 is appropriate to Razim lake natural fish productivity 144-166 kg/ha/year in 3 studied years, in the same time near to 177.1 kg/ha/year for experimental calculation in the wild for Razim lake (Staraș 1985). According to Staraș 1985 it is easier and less expensive to calculate natural fish productivity using biogenic capacity than using experimental calculation, with more costs and time. The values of fish productivity are not very different between for both biogenic capacity calculation on the one hand and the natural experimental process calculation on the other.

Very important to obtain 159 kg/ha/year fish natural productivity value is the ability of the environment to produce what can quantifiable produce using relationship between all organic and inorganic components, but for maximum performance avoid negative impact in fish fauna (e.g. introduction of a new non-native species with new viable parasites, etc.) when imbalances/disturbing can appears and from total of potentially 159 kg/ha/years a less value can be used as fish meat (effective resulting production). As a result for a long-data changes can appears irreversible and negative impacts in fish fauna.

One of the most important factor for the next fisheries studies in this kind of waters is residence time (lake retention time; water age or flushing time) is a calculated quantity expressing the mean time that water (or some dissolved substance) spends in a particular lake, in our case it is necessary to calculate it in the next studies. At its simplest, this figure is the result of dividing the lake volume by the flow in or flow out of the lake. It roughly expresses the amount of time taken for a substance introduced into a lake to flow out again.

Table 3 Species richness and dominance (D), constancy (C), ecological significance (W) classes of fish species captured in Holbina 1 in 2007 and 2016-2017 (with bold species of Community or national interest from Habitats Directive and Romanian low) (Family: Cy=Cyprinidae, Co=Cobitidae, Es=Esocidae, Um=Umbridae, Ce=Centrarchidae, Pe=Percidae, Od=Odontobutidae, Ga=Gasterosteidae, Go=Gobiidae, Si=Siluridae, Sy=Syngnathidae) (1=present species)

		Holbina 1_2007	Holbina 1_2016-2017	**Commercial gillnets**	**Nordic gillnets relon**			**Nordic gillnets nylon**			**electric**		
Family	Species				D class	C class	W class	D class	C class	W class	D class	C class	W class
Cy	*Abramis brama*	1	1	1	D1	C1	W1						
	Alburnus alburnus	1	1		D2	C3	W2	D3	C4	W3	D3	C2	W2
	Blicca bjoerkna	1	1	1	D4	C4	W3	D6	C5	W6			
	Carassius carassius	**1**	**1**		**D2**	**C3**	**W2**				**D6**	**C2**	**W3**
	Carassius gibelio	1	1	1	D1	C2	W1	D2	C5	W3	D2	C1	W1
	Ctenopharyngodon idella		1	1							D2	C1	W1
	Cyprinus carpio		1	1									
	Hypophthalmichthys molitrix		1	1									
	Hypophthalmichthys nobilis		1	1									
	Leucaspius delineatus	1	1					D1	C2	W1	D5	C2	W3
	Petroleuciscus borysthenicus	**1**	**1**		**D3**	**C3**	**W3**	**D4**	**C5**	**W4**			
	Rhodeus amarus	**1**	**1**		**D4**	**C3**	**W3**	**D4**	**C5**	**W4**	**D5**	**C3**	**W3**
	Rutilus rutilus	**1**	**1**	1	D5	C4	W4	D6	C5	W6	D3	C1	W2
	Scardinius erythrophthalmus	1	1	1	D6	C5	W6	D6	C5	W6	D5	C3	W3
	Tinca tinca	1	1	1	D2	C3	W2				D3	C2	W2
Co	***Cobitis elongatoides***	1	1		**D2**	**C1**	**W2**						
	Misgurnus fossilis	**1**									**D1**	**C1**	**W1**
Es	*Esox lucius*	1	1	1	D2	C3	W2	D2	C5	W3	D6	C4	W4
Um	***Umbra krameri***		**1**								**D5**	**C3**	**W3**
Ce	*Lepomis gibbosus*	1	1		D3	C3	W2						
Pe	*Perca fluviatilis*	1	1	1	D4	C4	W3	D5	C5	W4	D2	C1	W1
Od	*Perccottus glenii*		1								D3	C1	W2
Ga	*Pungitius platygaster*		1		D1	C1	W1				D3	C1	W2
Go	***Proterorhinus marmoratus***		**1**		**D1**	**C1**	**W1**				**D3**	**C2**	**W2**
Si	*Silurus glanis*		1	1									
Sy	*Syngnathus abaster*		1		D1	C1	W1				D2	C1	W1
	TOTAL	16	25	13									

Tabel 4 Biodiversity indices values (annual average) (SN=Nordic gillnets, H=Shannon-Wiener index, Hmax=maximal biodiversity, E=Evenness index)

	SN relon	**SN nylon**	**electric**
H	1.733	1.77	2.371
Hmax	2.833	2.302	2.773
E	0.612	0.769	0.855

Table 5 Natural Fish Productivity in Holbina 1 under the conditions of 2016-2017

Parameters	VALUES OR PERCENTAGES FROM THE FIELD AND ANNUAL AVERAGE					SCORE (Economic value)				
	Autumn	Start in Winter	Spring	Summer	Annual average	Autumn	Start in Winter	Spring	Summer	Annual average
Average water	11.3	2.5	18.7	25	14	2	1	7	10	5
Concentration O2	8.3	7.8	8.6	4.5	7.3	8	8	8	5	7
Average pH	8.0	7.6	8.1	8.2	8.0	5	7	1	1	4
Water Transparency	100	200	98	108	127	5	1	5	1	3
Rapport Ca^{2+}/Mg^{2+}	1.21	1.10	0.96	1.06	1.08	2	2	2	2	2
Total hardness of	19.6	20.8	18.7	16.4	18.9	10	1	9	8	7
Alkalinity	5.98	6.5	2.8	5.6	5.2	7	1	9	6	6
Nitrites (mg/l)	0.04	0.04	0.02	0.01	0.03	7	7	7	7	7
Nitrates (mg/l)	0.98	0.85	1.28	0.54	0.91	4	4	8	3	5
Phosphates (mg/l)	0.004	0.058	0.038	0.071	0.043	1	2	1	2	2
Phytoplankton	73	23	18	33	36.75	7	6	6	6	6
Zooplankton (%	78	60	93	66	74	8	6	9	6	7
Benthos (%	75	10	42	61	47	8	1	5	6	5
Submerged	abundantly	Poorly	abundantly	abundantly.	abundantly	8	7	10	10	9
Biogenic Capacity						5,9	3,9	6,2	5,1	5,3
Coefficient K										3
Natural										159

4. CONCLUSION

Presently, a typical habitats of ponds with predominantly clear water and rich vegetation are preserved in Holbina 1, sometimes with turbid water entering from Mustaca canal (same canal which discharge in Razim lake), using the monks rise for increasing water level, filtered by the compact reed, in this conditions residence time is very important in future studies for fisheries in the area.

In the studied period, 26 species of fish were identified, but *Misgurnus fossilis* was not found like 10 years ago (2007), while 9 other species were first time captured in 2016-2017, mostly are typical limnophilous, included main raptor sport fishing species *Esox lucius* and vulnerable species such as *Carassius carassius* and *Umbra krameri*.

Noteworthy is the appearance of a new species in 2007 in the DDBR - *Perccottus glenii,* which also was recorded for the first time in Holbina 1 in 2016, showing that isolation from the rest of the aquatic bodies in the delta is not complete and whenever biological material exchange between aquatic basins can occur.

The ecological indicators calculated according with standardization in CPUE (Catch per Unit Effort) show that *Scardinius erythrophthalmus* is the eudominant, euconstant and main species in the area, the next species being *Rutilus rutilus* and *Blicca bjoerkna*, than complementary or associated are *Perca fluviatilis, Petroleuciscus borysthenicus, Rhodeus amarus*, even *Esox lucius* (pike), with some differences between sampling methods.

The values of the biodiversity indicators show an increased ichthyodiversity values, with an average of above 0.5 (stable), with higher values in the shoreline area where a large number of species and individuals coexist.

Natural fish productivity value is around 159 kg/ha/year (medium productive water basin) with differences of biogenic capacity values between seasons, but for accurate values monthly samplings are more suitable, but involve much more financial support.

To obtain maximum performance of natural fish productivity in this kind of water basin must be using support capacity of aquatic environmental and well-known fish farming interventions (water flow alimentation, desilting), also to minimize anthropogenic unpleasant disturbances.

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