ECOLOGICAL ASPECTS OF THE ICHTHYOFAUNA FROM FUNDU MARE ISLAND AND CRAVIA ARMS

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Abstract

This paper presents the results of an ecological study on fish communities from island Fundu Mare and the Cravia arm (Danube) between 7-11 July 2006. Fishing was done both in pool and nearly the river banks using different gear: cornel tree baskets, gill nets from different materials and mesh. The purpose of the paper is the fish community structure assessment from area, ichthyofauna's diversity and an assessment of this aquatic investigated ecosystem. In order to appreciate the ichthyocenoses structure were used different ecological indices (the abundance, the constancy, the dominance, the significance ecological) and ichthyodiversity analysis was realized by calculating the area of biodiversity indices: Shannon - Wiener, Simpson diversity. Based on the obtained results it can be concluded that the Danube ichthyofauna from this area has an equilibrated ecological structure, biodiversity indexes values are quite good which shows as a good condition of the ecosystem even if they exhibit negative anthropogenic influences are being manifested against the aquatic habitats.

Key words: fish, ichthyofauna, fish communities, ecological indicators, diversity

INTRODUCTION

Starting with 1900, but mainly in the last 20 years, the characteristics of the fishing communities has been used as a measure of the relative health of the aquatic ecosystems [9], because a healthy environment has a higher economic value. Biological communities can be damaged, reduced in area and number of species, where the ecosystem value decreases, but as long as the original species survive, communities still have potential for regeneration. [6].

The diversity is a functional and structural parameter of the ecosystems a descriptor for their health [5]. The most obvious characteristic of the ecosystem's diversity is the richness of the species, represented by the total number of the species.

However, this parameter is insufficient to determine the diversity of an ecosystem. In literature we can find a number of indices by which biodiversity can be calculated, some of which take account only of the total number of species (S) and the total number of individuals present in the samples (N) (of whom the most used indices are: Monk, Gleason, Margalef, Menhinic, Willis), and another class of indices which take account the proportion of representation of each specie (the Gini index, theMcIntosh index, the Simpson index and also indexes which derive from information theory such as Shannon index and Brillouin index).

Fundu Mare island is the most northern island of the seven of Small Wetland of Braila Natural Park - one of the few remaining areas in natural flood regime.

Fundu Mare Island has an area of 1945 ha of which 930 hectares are aquatic habitats, represented by two lakes: Chiriloaia (300 ha) and Misaila (630 ha). The second lake at low water of the Danube is divided into 3 smaller lakes: Stan, Bordeiele and Bercaru.

Fig. 1
Fundu Mare Island

The total aquatic area of the four lakes (cca.49% of the total area of the island) make from this island an important place for breeding and feeding the semimigratory ichthyofauna of the Danube.

The scientific fishing was done in the Chiriloaia Lake, the supply-exhaust channel of island and near the river banks.

MATERIAL AND METHODS

The scientific fishing was made with trap and gill type served by a boat of 17 crivace. The tools used were specific habitat type, as follows: in the pond have used *cornel tree baskets* (varse in romanian) from fishermen's string (with a = 28 mm) and *static gillnets* with different meshes from fishermen's string with different meshes (a = 40 mm, 50 mm) and in the channel river, *gillnets* from relon and monofilament (with a = 12 mm, a = 32 mm, a = 25 mm).

The scientific fishing was realized in 6 - 11 July period 2006, and the number of individuals caught was of 1232.

After the collection, the specimens were separated in species and identified [2], [1]. After identifying the captured specimens were examined to biometric and gravimetric measurements.

Also, it had been obtained a series of quantitative and qualitative data on fish's populations in the area of the Danube.

The obtained data were statistically processed using statistical ecology program *Multi Variate Statistical Package (MVSP).*

Relations used by the program were:

Shannon index $H'=-\sum_{i=1}^{S} pi \ln pi$,

pi – the proportion representation of each species.

Simpson index $D=1-\sum_{i=1}^{S} pi^2$,

pi – the proportion representation of each species.

For a correct analysis of ichthyodiversity must calculate the range of each index. Thus, we must define the minimum and maximum value for the two indices in the conditions offered by each habitat.

So we have two cases:

a) If S=N, S>1, N>1

H'max=log N, Dmax=1

b) If 1<S<N

$$H'max=\log S,\ Dmax=1-\frac{N-S}{S(N-1)}$$

(N-the total number of individuals; S-the total number of species).

We should note that the logarithm base for which is calculated minimum and maximum should be the same as that used in the initial calculation relations [3].

RESULTS AND DISCUSSION

In table no 1 is presented the taxonomic diversity of fish communities in the area studied.

Table 1 Taxonomic structure of community fisheries area studied

No.	Species	Name popular	Eco status	
			Native species	Acclimatized species
	Ord.Cypriniformes Fam. Cyprinidae			
1.	***Rutilus rutilus*** *(Linnaeus,1758)*-	Roach	*	
2.	***R. r. heckeli*** *(Nordmann, 1840*	Taranca	*	
3.	***L. idus*** *(Linnaeus,1758*	Ide	*	
4.	***Scardinius erythrophthalmus*** *(Linnaeus,1758)*	Rudd	*	
5.	***Aspius aspius*** *(Linnaeus,1758)*	Asp	*	
6.	***Barbus barbus*** *(Linnaeus, 1758*	Barbel	*	
7.	***Alburnus alburnus*** *(Linnaeus, 1758)*	Bleak	*	
8.	***Blicca bjoerkna*** *(Linnaeus, 1758*	White bream	*	
9.	***Abramis brama*** *(Linnaeus, 1758)*	Common bream	*	
10.	***Abramis sapa*** *(Pallas, 1814)*	White-eye bream	*	
11.	***Vimba vimba*** *(Linnaeus, 1758)*	Vimba	*	
12.	***Pelecus cultratus*** *(Linnaeus, 1758)*	Ziege	*	
13.	***Carassius carassius*** *(Linnaeus, 1758)*	Crucian carp	*	
14.	***Carassius gibelio*** *(Bloch, 1782)*	Prussian carp	*	
15.	***Cyprinus carpio*** *(Linnaeus,1758*	Carp	*	
	Fam. Siluridae			
16.	***Silurus glanis*** *(Linnaeus,1758)*	Wels catfish	*	
	Fam. Percidae			
17.	***Perca fluviatilis*** *(Linnaeus,1758)*	European perch	*	
18.	***Gymnocephalus cernuus*** *(Linnaeus, 1758)*	Ruffe	*	
18.	***Gymnocephalus schraetser*** *(Linnaeus, 1758)*	Schraetzer	*	
20.	***Sander lucioperca*** *(Linnaeus,1758)*	Pike-perch	*	
21.	***Zingel zingel*** *(Linnaeus, 1766)*	Zingel	*	
	Ord.Clupeiformes **Fam.Esocidae**			
22.	***Esox lucius*** *(Linnaeus,1758)*	Northern pike	*	
	Fam. Clupeidae			
23.	***Alosa immaculata*** *(Bennett,1835))*	Pontic shad	*	
	Ord.Acipenseriformes Fam.Acipenseridae			
24.	***Huso huso*** *(Linnaeus, 1758)*	Beluga sturgeon	*	

It's being noted that the species that were caught are just native species.

On the taxonomic the caught specimens are join in 3 orders, 6 families and 24 species the best represented order is *Cypriniformes* with 3 families and 21 species followed by the *Clupeiformes* order with 2 families and 2 species and 1 species *Acipenseriformes* order.

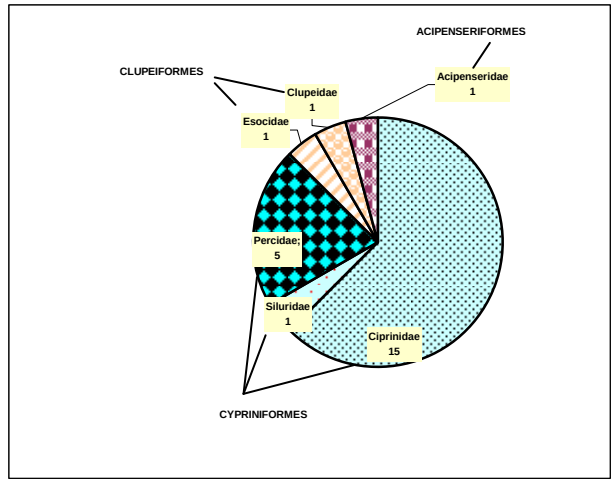

Fig.nr.2 The taxonomic distribution for fish's population

To assess the current ecological status of the studied area one of the ecological indices calculated was the absolute numerical abundance. It was also established biomass for each specie and for each the fishing day.

All entire fishing period has been captured a total number of 1232 exemplars with a total biomass of 142 908 g.

In the table no 2 is reveled a numerical abundance was ranged between 1 and 520 copies / species, and in terms of biomass that ranged between 112 g / specie and 37,716 g.

Ecological significance index (W) which eloquently reflects the position of a species in a biocenosis is determined according to the values of the two indices: *the constancy-C* (structural index) and *dominance-D* (production index) [10].

The classification according to calculated indices is presented in table number 3.

Depending on the values obtained for each index could be characterize the fish communities as follows:

- In terms of constancy:
  - The species best adapted to the biotop studied are: bream, prussian carp, wels catfish and perch are the species euconstants.
  - From the constant class species are the: roach, ide, and northern pike - those with a high adaptability.
  - From the accessory class species are the rheofile species such as: the white-bream, the pike-perch, the asp, the vimba and the schraetzer.
  - Half of the caught species belong to the category of the accidentally species.
- From the dominance point of view
  - The bleak and white-eye bream are eudominant species -these having the biggest potential in fish productivity of the studied ecosystem
  - The dominant species roach, prussian carp, perch, bream are species with a significant contribution to biomass production
  - The species subdominant: wels catfish.
  - The species subrecedent: european perch, pike-perch, asp.
  - The subrecedent species are the best represented species, being in number of 14.
- The index of ecological significance reflects eloquently the position of a specie in a biocoenosis thus the prussian carp and the bleak are characteristic for the studied species

Table 2 The absolute abundance and weight of fish species for each sample

No.	Specie	6.07		7.07		8.07		9.07		10.07		11.07		Total indiv / species	Total biomass/ species (g)
		Abundance		Abundance		Abundance		Abundance		Abundance		Abundance			
		Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight	Number	Weight		
1.	Roach							14	2184	20	3087	56	7168	90	12439
2.	Taranca							2	250					2	250
3.	Ide					1	856	1	585	1	725			3	2166
4.	Rudd	2	220											2	220
5.	Asp	20	2575									1	608	21	3183
6.	Barbel	1	230											1	230
7.	Bleak							520	6300					520	6300
8.	White bream					8	2657					1	168	9	2825
9.	Common bream	7	357	3	1586			7	840	3	344	49	5078	69	8205
10.	White-eye bream	250	8826	2	197	1	110							253	9133
11.	Vimba	6	448	1	192									7	640
12.	Ziege	2	178											2	178
13.	Crucian carp							1	324					1	324
14.	Prussian carp			36	9334	14	3984	3	772	32	8002	13	3070	98	25162
15.	Carp			4	4074	2	1956	1	325	2	618	2	798	11	7771
16.	Wels catfish			26	20607	18	10295			1	254	15	6560	60	37716
17.	European perch			10	1316	1	271			2	332	10	1697	23	3616
18.	Ruffe	2	146											2	146
19.	Schraetzer	6	354	1	106									7	460
20.	Pike-perch	21	2546	2	1679							2	1121	25	5346
21.	Zingel	8	1320											8	1320
22.	Northen pike			8	11154					3	2480	1	996	12	14630
23.	Pontic shad	3	536											3	536
24.	Beluga sturgeon			3	112									3	112
Total individuals		*328*		*96*		*45*		*549*		*64*		*150*		*1232*	
Total biomass			17736		50357		20129		11580		15842		27264		142908

Table 3 Indices of ecological communities of the fish from Fundu Mare Island

No.	*SPECIES*	*Absolute abundance (A)*	*ECOLOGICAL INDICES*					
			Constancy C		*Dominance D*		*Ecological significance W*	
			%	***Clasa***	***%***	***Clasa***	***%***	***Clasa***
1.	Roach	90	60	C3 constant	7,3	D4 dominant	4,38	W3 associate
2.	Ide	3	60	C3 constant	0,24	D1 subrecedent	0,14	W2 accessory
3.	Rudd	2	20	C1 accidental	0,16	D1 subrecedent	0,03	W2 accessory
4.	White bream	9	40	C2 accessory	0,73	D1 subrecedent	0,29	W2 accessory
5.	Common bream	69	83,33	C4 euconstant	5,46	D4 dominant	4,55	W3 associate
6.	Crucian carp	1	20	C1 accidental	0,08	D1 subrecedent	0,016	W2 accessory
7.	Prussian carp	98	100	C4 euconstant	7,95	D4 dominant	7,95	W4 characteristic
8.	Carp	11	100	C4 euconstant	0,89	D1 subrecedent	0,89	W2 accessory
9.	Wels catfish	60	80	C4 euconstant	4,87	D3 subdominant	3,89	W3 associate
10.	European perch	23	80	C4 euconstant	1,86	D2 recedent	1,48	W3 associate
11.	Pike-perch	25	33,33	C2 accessory	2,02	D2 recedent	0,67	W2 accessory
12.	Northern pike	12	60	C3 constant	0,97	D1 subrecedent	0,58	W2 accessory
13.	Taranca	2	16,66	C1 accidental	0,16	D1 subrecedent	0,026	W1 accidental
14.	Asp	21	33,33	C2 accessory	1,7	D2 recedent	0,56	W2 accessory
15.	Barbel	1	16,66	C1 accidental	0,08	D1 subrecedent	0,013	W2 accessory
16.	Bleak	520	16,66	C1 accidental	42,20	D5 eudominant	7,03	W4 characteristic
17.	White-eye bream	253	16,66	C1 accidental	20,53	D5 eudominant	3,42	W3 associate
18.	Vimba	7	33,33	C2 accessory	0,56	D1 subrecedent	0,186	W2 accessory
19.	Ziege	2	16,66	C1 accidental	0,162	D1 subrecedent	0,027	W1 accidental
20.	Ruffe	2	16,66	C1 accidental	0,162	D1 subrecedent	0,027	W1 accidental
21.	Schraetzer	7	33,33	C2 accessory	0,56	D1 subrecedent	0,186	W2 accessory
22.	Zingel	8	16,66	C1 accidental	0,64	D1 subrecedent	0,106	W2 accessory
23.	Pontic shad	3	16,66	C1 accidental	0,24	D1 subrecedent	0,04	W1 accidental
24.	Beluga sturgeon	3	16,66	C1 accidental	0,24	D1 subrecedent	0,04	W1 accidental

The structure of fish communities of this area is reproduced in Table 4

Table 4 Associations of fish in the area studied

No .	*Groups*	*Species*	*Value of the ecological significance – W*
	The leading species (W_5=>10%)		-
1.	The characteristic species (W_4=5, 1-10%)	Prussian carp	7,95
2.		Bleak	7,03
3.	The complementary species (W_3=1, 1-5%)	Roach	4,38
4.		Common bream	4,55
5.		Wels catfish	3,89
6.		White eye bream	3,42
7.		European perch	1,48
8.	The associated species (W_2=0, 1-1%)	Ide	0,14
9.		Rudd	0,03
10.		White bream	0,29
11.		Crucian carp	0,016
12.		Carp	0,89
13.		Pike perch	0,67
14.		Northern pike	0,58
15.		Asp	0,56
16.		Barbel	0,013
17.		Vimba	0,186
18.		Schraetzer	0,186
19.		Zingel	0,106
20.	The accidental species (W_1=>0, 1%)	Pontic shad	0,04
21.		Beluga sturgeon	0,04
22.		Ruffe	0,027
23.		Ziege	0,027
24.		Taranca	0,026

The biodiversity indices

For an accurate assessment of the biodiversity of fish fauna we have used the calculation of Simpson diversity index (1-D) and Shannon informational index (H ').

Ito and Sato (2002) [4] recommend the use of both indices because: the Simpson index belongs to type II-indices which are more sensitive to changes of the number of individuals which are dominant species. Shannon index belongs to Type I indices which are more sensitive to the changes in the number of rare species [7].

The range of variation

The Shannon index takes the 0 value only if there is only a single species in the sample and reaches the maximum when all species in the sample are represented by the same values of abundances. After Washington [11], H 'does not appear to exceed the practical value of 5.

The range of Simpson index is between 0 and 1.

In Table 5 are given the values of the two indices for each habitat type, but the maximum theoretical values which might reach in the conditions when the biocenosis it reaches the maximum number of specie

Table No. 5 The values of diversity indices

	Shannon Index		**Simpson Index**	
	Observed	Theoretical maximum value	Observed	Theoretical maximum value
Fundu Mare	1,857	2,397	0,812	0,91
Dunăre	1,116	2,708	0,546	0,93

Index values show a good diversity of pond condition and from the river calculated value shows of moderate state the ecosystem diversity.

Variation of the two indices of diversity comparative to the maximum value can be observed in Figures 3 and 4.

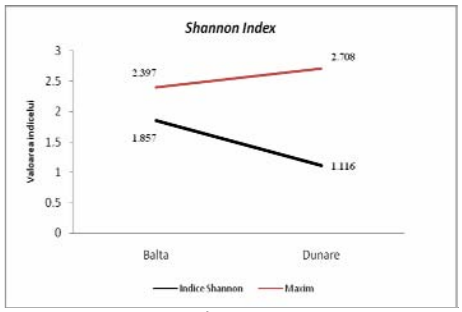

Figure 3
Shannon index variation

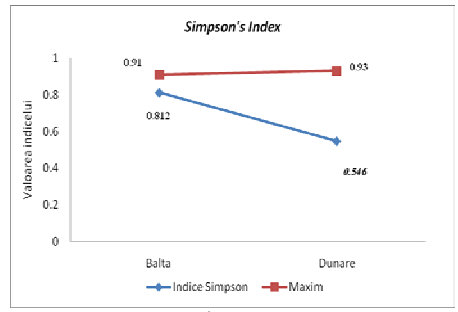

Figure 4
Simpson index variation

CONCLUSIONS

The ichthyofauna of the studied zone consists of 24 native species which belong to 6 families and 3 orders, most belonging to the ciprinidae family.

Following the ecological analysis, the calculation of indices (C, D, W) it's being observed that the best adapted species to living in this area and which bring an important contribution to the productivity area are: prussian carp and bleak in higher percentage (over 7%) and roach, bream, catfish, white eye bream, perch (in percentage below 5%). So, the specific fishery associations are the indifferent species (which live in both types of aquatic habitats) and semimigratory species.

The diversity of fish communities in the area studied can be considered well, so:

- the pools of the two indices of diversity values are quite close to the theoretical maximum values thus: H ' observed is 77.5% from H'max and D observed is 89.23% from Dmax;
- diversity index values for river reaches half the maximum theoretical values thus:

H ' observed is 41, 21 % from H'max and D observed is 58, 71 % from Dmax.

These values of diversity indices show us that also the degree of the structural stability of the ihtiocenoses is relatively good, so the environmental conditions from this area of the river are good to allow a sufficient number of species to live and develop normally.

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