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Evaluating the Aquatic Habitats Quality using the Fish Wildlife in the Hydrographic Area Banat

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ABSTRACT

Background: The Hydrographic Area Banat is located in the southwestern part of Romania, covering a surface from the south of Maros to the confluence of Cerna River with the Danube River, a surace of 18 393,15 km^2, which represents 7,7% of Romania's territory. When the sampling points were chosen several factors such as river typology, altitude, pollution sources, habitat types, were taken into account. **Objective:** The aim of this paper is to present the results from investigation campaigns on ichtyofauna from the Catchement Space Banat. **Results:** The study results were used to characterize the water and ichtyofauna quality in an area of the Catchement Space Banat where, naturally, the habitat included endemic and endangered species.

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INTRODUCTION

The Hydrographic Area Banat is located in the southwestern part of Romania, between 20˚18` and 22˚52` east longitude and between 44˚26` and 46˚08` north latitude. The surface of the Hydrographic Area Banat is stretching from the south of Maros upt to the confluence of Cerna River with the Danube, totalizing 18393, 15 km^2, which represents 7,7% of Romania's territory [1]. The rivers gathering waters from this territory have characteristics specific to the southwest part of the country, yet they also individualized as river systems with other specific characteristics for each river basin. Banat Hydrographic Area has a length of river network of 6245 km and an average density of 0,34 km/km^2. About 30% of the length of his hydrographic network manifests the drying phenomenon.

The areas proposed for habitats or species protection and where improving the water quality is an important factor are established under the 92/43/EEC Directive [2] which promotes the protection of natural heritage of the European Community transposed into Romanian legislation through the Law no. 462/2001 [3].

In this category of protected areas were included in Law 5/2000 [4] the areas that relate to water and are of national interest: wetlands, Natural Parks and national Parks, Ramsar areas (Convention on Wetlands of International Importance especially as waterfowl habitats).

In the Hydrographic Area Banat were identified a total of 19 protected areas of which 4 represents the National Parks and Natural Parks (Table 1).

There are currently no areas designated for the protection of aquatic species from an economic point of vue, except for the natural areas with fast and clear rivers where salmonids live and where steps are making to be designated as protected areas (Fig. 1). The total length of rivers in these protected areas represents 14% of the total length of watercourses. Areas to protect habitat or species where water is an important factor are designated based on Romanian law: Law 13/1993 [5] and Law 462/2001 [3].

In order to protect the nature and to maintain the natural resources needed for socio-economic development of society in Europe was established a network of protected natural areas called "Natura 2000". It includes a representative sample of wildlife and natural habitats of Community interest [6]. Protected areas are the specific zones included in a hydrographic network which have been designated under the special protection rules required by EU legislation.

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Improving water status is an important factor in areas proposed for the protection of habitats or species. Law no. 49/2011 [7] on the regime of protected natural habitats, flora and fauna represent the most current Romanian legislation transposing Directive 92/43/EEC [2], relating to this issue.

We must specify that Romania shelters more than half of the Carpathian Mountains, the widest and wildest mountains of Europe, identified as one of the most important ecoregions globally, which is home to nearly half the population of large carnivores in Europe (bear, wolf, lynx), and the Danube Delta, which is the most important wetland in Europe, sheltering colonies of pelicans and hundreds of species of birds. On The European Union territories (EU27) were identified nine biogeographical regions. Among the EU member and candidate countries, Romania has the largest biogeographical diversity [8]. In Romania there are five biogeographical regions: Mainland (most common), Alpine (in countries with mountainous areas), Pannonian (found in Hungary and neighboring countries), Black Sea (only in Romania and Bulgaria), steppe (only in Romania).

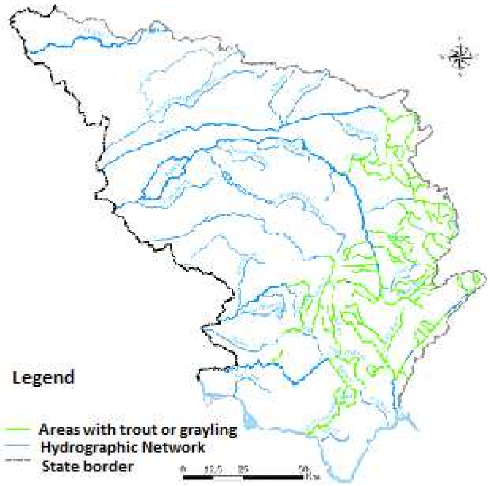

Fig. 1: Designated area for aquatic habitat protection in the Hydrographical Area Banat territory.

Table 1: Romanian National Park located in The Hydrographical Area Banat.

National Parks and Natural Parks	Surface(ha)	Location totally/partial on the County territory
Cheile Nerei - Beusnita	37.100,00	totally on Caras-Severin county
Domogled - Valea Cernei	60.100,00	on the territory of Caras-Severin, Mehedinti and Gorj County
Portile de Fier	115.655,80	on the territory of Caras-Severin and Mehedinti County
Semenic - Cheile Carasului	36.664,00	totally on Caras-Severin County
TOTAL	212.419,80	-

MATERIALS AND METHODS

Biondicators Used In Evaluating Water Quality:

Bioindicators are species, populations or groups of species that due to their variability (biochemical, physiological, ethological or ecological) allow characterizing the state of a system and emphasizing, as early as possible, his natural or anthropogenic changes [9], being susceptible or tolerant to different kinds of stress.

The term bioindicator is often used with different meanings. Some authors show that the bioindicators are molecular parameters used in ecology, physiology, environmental microbiology and other fields to detect and quantify the action of a stress factors and environmental conditions on their cell or organism.

McCarty Munkittrick, 1996 [10] define bioindicators as responses anthropogenically induced from the biomolecular, biochemical or physiological parameters bodies, with biological effects on individual organization level (body), but also with environmental effects over the levels (population, community, ecosystem). Other authors show that bioindicators are used in quality monitoring ecosystems bodies [11].

The idea of bioindicator species is discussed since the last century, when it was observed the lichens indicating capacity in terms of air composition, purity and humidity.

In the second half of the twentieth century, research has generally focused on finding indicators and the development of methods to provide information related to pollutants (of air, soil, water).

Later, following the emergence of concerns for other types of ecosystem degradation was seeked the identification of bio-indicators to provide information about the ecosystems stability, the maintenance of biodiversity, the sustainable management of forest and agricultural ecosystems or information related to the response of ecosystems to global climate changes.

Regarding the pollution indicators, they are:
- sensitive species that indicaties the presence of a pollutant by the appearance of lesions or malformations;
- accumulator species, which concentrates pollutant in their bodies;
- species that proliferate and become abundant in polluted areas.

Pollution bioindicators have the advantage, compared to the instrument monitoring, that can provide a response to the combined effect of certain pollutants, (as opposed to instruments that measure separately the quantities of each pollutant) and can give indications after tissues analysis related to the of very low quantity of environmental pollution and the evolution in time of the pollutant, for longer periods.

Following Romania's EU integration it was imposed the necesity to use biological methods of monitoring water quality using the ichtyofauna indicator (as required by the Water Framework Directive).

The natural and anthropical transformations submit the fish fauna situation from the natural outlets to withstand considerable external pressures and therefore finding solutions for warning the dangers constitutes a major requirement both in terms of fisheries resources management and as measures to conservate and protect ichtyofauna.

Monitoring water quality represents continue and long-term activity of standardized measurements and observations for knowledge and assessment of the water parameters characteristic and defining his state and its evolution [12]. Knowledge of water quality constitutes the starting point in establishing the necessary measures for their protection, the priorities at every stage and systematic measures used for verification and correction along the way.

The ecological state, characterized on the basis of the most critical situation encountered, was evaluated by using classification systems in accordance with the reglementations of the Water Framework Directive. Environmental status assessment was done in quality classes in accordance to regulations on classification of surface water quality to determine the ecological status of water bodies, approved by Order M.M.G.A. no. 161/2006 [13], corelating biological evaluation results with chemicals evaluation results.

According to the Framework Directive [14] the essential descriptors are:
- species composition,
- abundance,
- typical species,
- the age composition

Table 2: Criteria for classification of water quality for fish fauna under the Water Framework Directive [14].

Element	Very good state	Good state	Moderate state
Fish Fauna	The composition and abundance correspond totally or nearly totally to undisturbed conditions. All type specific species sensitive to disturbance are present. The age structure of fish communities can show a little sign of anthropogenic disturbance but does not indicate a failure in the reproduction or development of any particular species. .	There are slight changes in species composition and abundance compared to type-specific communities, attributable to anthropogenic impacts on physico-chemical and morphological quality. The age structure of fish communities show signs of disturbance attributable to anthropogenic impacts on physico-chemical and hydromorphological quality elements. In some circumstances it may indicate a failure in the reproduction, or development of particular species, to the extent that some age classes may be missing.	The composition and abundance of fish species differ moderately from type-specific communities attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements. The age structure of fish communities show important signs of anthropogenic disturbance to the extent that a moderate proportion of the type specific species are either absent or have a very low abundance.

To ensure that the data on abundance and age structure are valid a sufficient number of evidence needs to be collected. The size of samples number depends on the differences between different stations (stations should include all types of habitats) and, if necessary, we may consider a follow-up of changes in the population (for migratory species population sizes vary greatly in time).

The minimum number of stations depends on the coefficient of variation between stations (CV).

The Coeffcient of variation is the ratio between the standard deviation and average of abundance. Abundance is the number of fish/station [15].

CV = SD / MD,

where:

MD –medium value of the D data set;

SD – standard deviation of the D data set.

The coefficient of variation allows the comparison of statistical series in terms of standard deviation. A lower coefficient of variation indicates a better grouping around the average value.

Table 3: Minimum number of station, according to the variation coefficient [16].

The coefficient of variation CV	Minimum number of station n
0,2	3
0,4	4
0,6	9
0,8	16

Table 4: The surface of samples depends on the water body size and the diversity of water habitats. Minimum length route taken for a sample [17].

River size	Minimum length route taken
Small rivers width <5 m	20 m on the entire width
Small rivers width 5-15 m	50 m on the entire width
Rivers and channels width >15 m	>50 m in one or both edges
Large waters (rivers, lakes) shallow<70 cm	200 m^2
Deep lakes > 1m	>50 m from the littoral area

RESULTS AND DISCUSSIONS

It is important to remember that Romania benefits form the largest ecological diversity, having the highest number of terrestrial and limnozoogeografic ecoregions from the member countries, 4 ecoregions . This reality has the consequence the necessity to calibrate and diferent interpretations of the results of biological index for each ecoregion.

The aquatic ecology studies of various authors indicate a number of specific characters of fish populations that make them particularly useful in assessing environmental degradation:

a) fish are present in all aquatic environments, often in highly polluted waters;
b) generally they have stable populations and are not subject to very strong seasonal fluctuations (like many invertebrates);
c) the fish are other compartments of ecosystem responses integrators because they depend on them for reproduction, for food or shelter as follows:
- fish take food from different levels of the food chains thus integrating all components of the ecosystem; their biomass production depends on primary and secondary production;
- fish have a relatively long life, population age structure analysis and calculation of the growth rate provides data about the population history;

d) the fish are easily identifiable on the ground and allow a rapid appreciation of the ecological quality;
e) there is more information about the biology of fish and numerous institutions that collects data on them;
f) the interest for policy makers and the public towards the state of fish populations is higher than that of microorganisms or to invertebrates.

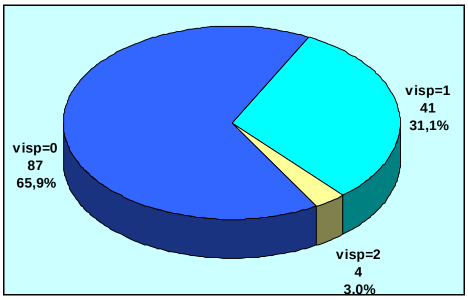

Fig. 2: The distribution of sites depending on the number of very intolerant species to pollution (VISP) of water.

We can observe that in the studied area a third of the studied sites present species of fish less tolerant to pollution.

Among the many changes in the ecosystems parameters where this species enter, we highlight the impact of changes in water quality. Fish species with migration potential that in our studied sites reach up to 70% arrived in a biotope altered regarding to the natural life conditions and they may be eliminated due to non-specific characteristics of their habitat. This can lead to an impoverishment of the biota, the decline of biodiversity, breaking the balance of the ecosystem and/or disappearance of endemic species or endangered with extinction. Another problem is the decrease in production and productivity of natural river or coastal farm, which causes economic damage to producers and harm fisheries, environment.

Conclusions:

The study aimed to characterize the state of water and ichtyofauna in a territory from The Hydrographic Area Banat where, naturally, are included habitats of endemic and endangered species. At the same time, the study sought to find usable scientifically parts for a sustainable management of the studied ecosystem integrity. The impact of anthropogenic changes on ecosystem quality tolerance it reflects on the specific biota.

Table 5: Evaluation of the water courses in The Hidrographical Area Banat depending on the fish type.

No. Crt.	Section	River	Longitude	Latitude	Altitude (m)	Type
1	Upstream Luncanii de Jos locality	Bega	22,31693	45,7188	115	Cyprinid
2	Upstream Cladova locality	Cladova	21,96612	45,8764	26	Cyprinid
3	Balint locality	Bega	21,85332	45,81117	84	Cyprinid
4	Saceni locality - auto bridge Surducu Mic	Săraz	22,07144	45,76743	440	Cyprinid
5	Upstream Timisoara locality	Bega	21,26676	45,75761	33	Cyprinid
6	Otelec locality	Bega	20,84636	45,61934	114	Cyprinid
7	Pischia locality - Upstream CFR bridge	Bega Veche	21,35565	45,90881	156	Cyprinid
8	Downstream. Slatina confluence- CFR bridge	Apa Mare	21,04984	45,96014	161	Cyprinid
9	Becicherecu Mic locality – auto bridge Biled	Apa Mare	21,03753	45,8334	192	Cyprinid
10	Cenei locality	Bega Veche	20,9094	45,71329	130	Cyprinid
11	Upstream Hididel confluence	Pârâul Rece	22,47312	45,17644	17	Salmonid
12	Upstream Sadova Veche locality	Timis	22,29986	45,2421	182	Salmonid
13	Downstream Potoc confluence	Timis	22,20725	45,42708	37	Cyprinid
14	Downstream Paraul Lupului confluence	Bistra	22,66099	45,5004	33	Salmonid
15	Upstream Otelu Rosu caption	Bistra Mărului	22,42478	45,49226	85	Salmonid
16	Obreja locality	Bistra	22,25103	45,48474	45	Salmonid
17	Lugoj locality - CFR bridge	Timis	21,8902	45,69596	36	Cyprinid
18	Upstream Timisana confluence	Timis	21,62053	45,71635	248	Cyprinid
19	Cheveresu Mare locality	Surgani	21,4834	45,66268	45	Cyprinid
20	Otvesti locality – auto bridge	Pogăniş	21,43121	45,61856	378	Cyprinid
21	Sag locality	Timiş	21,17934	45,64586	273	Cyprinid
22	Ghilad locality – auto bridge	Lanca Birda	21,15945	45,46005	161	Cyprinid
23	Graniceri locality	Timis	20,88621	45,44716	80	Cyprinid
24	Upstream Gozna-Crivaia accumulation	Bârzava	22,01151	45,19719	17	Salmonid
25	Downstream Resita-Moniom locality	Bârzava	21,83444	45,3503	65	Cyprinid
26	Berzovia locality – auto bridge Vermes	Bârzava	21,62831	45,43131	110	Cyprinid
27	Partos locality	Bârzava	21,11339	45,33869	18	Cyprinid
28	Moravita- auto bridge Gherman	Moravi	21,29497	45,26237	35	Cyprinid
29	Carasova locality	Caraş	21,8703	45,20158	222	Salmonid
30	Upstream CARAS confluence	Gârlişte	21,81796	45,17462	245	Salmonid
31	Upstream Gelug confluence	Nermed	21,82365	45,20731	128	Cyprinid
32	Upstream CARAS confluence	Jitin	21,71391	45,14571	167	Salmonid
33	Upstream Lisava-Brosteni confluence	Oraviţa	21,63753	45,05452	290	Cyprinid
34	Upstream .cf. CARAS-Varadia	Lişava	21,55255	45,08199	326	Cyprinid
35	Av. Lisava-Varadia confluence	Caraş	21,54869	45,07979	260	Cyprinid
36	Upstream Ciclova Romana locality	Ciclova	21,74205	45,02759	30	Cyprinid
37	Upstream Patasel confluence	Nera	22,10018	44,96872	130	Salmonid
38	Upstream Putna locality	Nera	22,18131	44,93397	26	Salmonid
39	Upstream Bania confluence - auto bridgeBozovici	Nera	22,01749	44,91809	110	Salmonid
40	Upstream Minis confluence	Steier	21,86539	45,04889	2	Salmonid
41	Upstream Taria confluence	Miniş	21,98175	44,97948	170	Salmonid
42	Upstream 1km Trout Fishery Bei	Bei	21,77459	44,92236	80	Salmonid
43	Sasca Romana locality	Nera	21,72125	44,89905	58	Salmonid
44	Naidas locality	Nera	21,57068	44,88696	223	Cyprinid
45	Upstream Bosneag confluence	Valea Mare	21,67613	44,73021	43	Salmonid

Table 6: The distribution of sites depending on the native migratory species (NMSP).

Native migratory species (NMSP)		Sites number	%
Migratory species	0	94	71,21%
Little Migratory species	1	36	27,27%
Non-Migratory species	2	2	1,52%
Total		132	100,00%

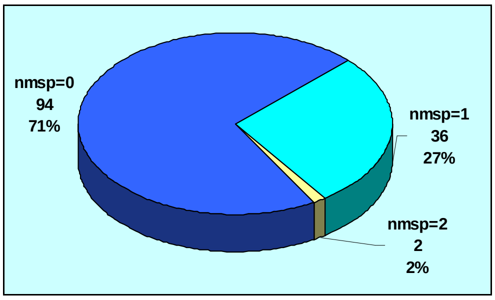

Fig. 3: The distribution of sites depending on the native migratory species (NMSP).

The purpose of this supervision was mainly for the early detection of possible changes in the functioning and composition of biological systems that could lead them ultimately to disorganization, collapse, or they might engage in a unfavorable direction. Alerting the time specialists enables decision makers to take action to remedy the situation before irreversible negative effects occur.

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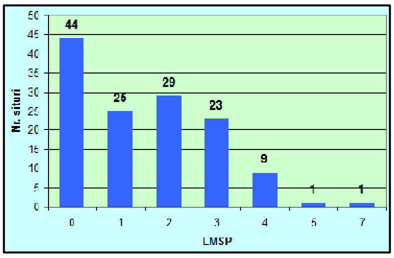
Secondly, it aims studying biosystems reaction and response to global environmental change, which remains a reality, despite international efforts began to be made to achieve sustainable development, which involves simultaneously and environmental conservation. The information obtained from surveillance systems are stored in databases, in order to allow for comparison over time. Considering the importance of the Hydrographic Area Banat inside the Natura 2000 sites and the fact that it shelters five biogeographical regions from the UE total of nine biogeographical regions the results can constitute a database for further research aiming at finding some changes to the structure and function of fish communities in the area, due to environmental factors and anthropogenic influences.

Research, both in the sampling and data processing and evaluation phase results were achieved with respect for the modern principles, agreed nationally and internationally.

Table 7: The distribution of sites depending on the number of native matured species with age between 0- 3 years (LMSP).

Fish grouped by age	LMSP	Sites number	%
Fishes with age between 0-1 year	0	44	33,33%
Fishes with age between 1-1,5 year	1	25	18,94%
Fishes with age between 1,5-2 year	2	29	21,97%
Fishes with age between 2,5-3 year	3	23	17,42%
Fishes with age between 3-3,5 year	4	9	6,82%
Fishes with age between 3,5-4 year	5	1	0,76%
Fishes with age over 4 years	6	1	0,76%
Total		132	100,00%



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