PhD THESIS

Research on biodiversity and morpho-physiological indices of Someșul Cald River ichthyofauna

(SUMMARY OF Ph.D. THESIS)

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INTRODUCTION

The analysis of ichthyofauna in Romania, from a publicist point of view, is limited to a small number of works, compared to the rest of Europe. In 1964, Petru Bănărescu published " Fauna Republicii Populare Romîne, Volumul XIII. Pisces - Osteichthyes (pești ganoizi și osoși)". The paper is probably the most comprehensive synthesis on fish in Romanian waters, being cited in the most prestigious publications worldwide. In 2007, Dr. Vasile Oţel published the Atlas of Fish from the Danube Delta Biosphere Reserve, a publication that brings up-to-date information on the ichthyofauna of this universal heritage (UNESCO), Danube Delta. It can be seen that at the beginning of the twentieth century the interest for ichthyofauna, biodiversity and conservation grew. Currently, interest in ichthyology and conservation of ichthyofauna biodiversity is declining. The low interest for this topic can be quantified by the small number of researchers, the small number of publications, but also the difficult access to funding sources. The context of global warming, anthropogenic activities, deforestation and pollution act with increased intensity, and their effects can be measured by biodiversity. "Water is not (only) H2O" said Eng. Togor Andrei in one of the ichthyofaunistic rehabilitation campaigns of the rivers in the Trascău Mountains. If I have to give a personal definition of water, then water is the universal solvent of life. Limitations on knowledge about fish species obviously exist. Jörg Freyhof and Maurice Kottelat (2007) find that the study of salmonid taxonomy is "a shame to European ichthyology". Of course, this statement comes in the context of species identification errors by ignoring classical or modern methodologies for identifying fish species.

SCOPE AND RESEARCH OBJECTIVES

The purpose of this paper is fully found in its title: "Research on biodiversity and morpho-physiological indices of Someșul Cald River ichthyofauna". The variability of aquatic ecosystems, especially those affected by anthropogenicity, can provide information and hypotheses related to the evolution and distribution of fish species. The welfare of fish species raised in aquaculture is based on medial parameters of wild species or varieties.

The objectives of the thesis are represented by:

1. **Systematization and grouping of data from the literature on fish species in the mountain area.**

   To achieve this objective, bibliographic materials from related fields were analyzed: ichthyology, biology, trout farming, bio-geography, scientific fishing, industrial fishing, morphometry, statistics, aquatic ecology, etc. The systematization of these materials is defining for the organization of the experimental design.

2. **Organizing the experimental design and staging the activities.**

The specific objectives that formed the basis of the experimental dsign were: mapping the minor riverbed and collecting hydrographic data for the Someșul Cald River, description of fishing communities, description of inventory methods, description of biological sampling methods and statistical analysis of collected data.

3. Research on the influence of dams and reservoirs on ichthyofauna.

Specific objectives: diversity of fish species, comparisons of body size indices according to the area of fish material collection and limitation of upstream fish migrations caused by the presence of hydrotechnical constructions.

4. Research on hematological parameters and biomarkers of oxidative stress in brown trout (*Salmo trutta* Linnaues, 1758) (Pisces: Salmonidae) from Someșul Cald River before and after the spawning period.

Specific objectives: In-situ sampling of biological samples (blood) from *Salmo trutta,* obtaining a reference database with species hematology for the precursor to spawning period but also for the period preceding spawning of *Salmo trutta*.

5. Research on the signaling of some species not mentioned in the Someș Cald area in the specialized literature.

Specific objectives: identification of fish species present in Someșul Cald River, signaling of new species for this area (given that the inventory of species has not been made after 1964).

6. Research on body size indices for species in the Someș Cald River.

Specific objectives: performing the usual body measurements on fish, determining the body format indices based on the measurements performed, grouping the data in order to prepare a database for the body format of all fish species present on Someșul Cald River

7. Evaluation of Someș Cald River water quality during the pre and post spawning period of brown trout.

Specific objectives: sampling and analysis of physico-chemical parameters of Someș Cald water.

8. The influence of hydrographic parameters on the diversity of fish populations.

Specific objectives: sampling and calculation of the most important hydrographic indicators for Someșul Cald, analysis of the presence or absence of some fish species depending on the particularities of the sectors or sections analyzed.

DOCTORATE THESIS STRUCTURE

The doctoral thesis entitled "Research on biodiversity and morpho-physiological indices of Someșul Cald River ichthyofauna " comprises a number of 180 pages, 61 figures, 81 tables and is structured according to the rules of word processing in two parts: Part I - Current state of knowledge and Part II - Personal contribution.

Part I - Current stage of knowledge

Part I contains 5 chapters and represents the synthesis and summary of knowledge about the mountain ichthyofauna of Romania, the characterization of the ecological sub-areas of trout and grayling, the inventory techniques of ichthyofauna, mathematical and statistical methods used to characterize ichthyofauna, elements of morphology and morphology description of the hydrographic basin of Someșul Cald (geographic area of community and national interest).

Chapter I is entitled "General considerations on fish species in the mountain waters of Romania" and includes 3 subchapters: Ecological subzone of grayling, ecological subzone of trout and fish species in mountain areas, protected at European and national level.

Chapter II is entitled "Techniques for inventory and analysis of ichthyofauna" and includes a subchapter entitled "Classification of techniques and methods for inventory of ichthyofauna".

Chapter III is entitled "Mathematical and statistical methods used in the analysis of fish populations" and deals with current issues regarding the possibilities of ichthyofauna analysis.

Chapter IV is entitled "Elements of morpho-physiology in ichthyology" and deals with current issues regarding the main concepts of morpho-physiological analysis in fish.

Chapter V is entitled "Someșul Cald, geographical area of community and national interest" in which the history of the river basin for Someșul Cald River is described.

Part II - Personal contribution

Part II contains 5 chapters and represents the personal contribution. These chapters include the purpose and objectives of the research, the material and methods used, the results obtained, the general conclusions, the recommendations extracted from the research and the elements of originality of the thesis.

Chapter VI is entitled "The purpose and objectives of research", which describes the 8 main objectives and specific objectives of the thesis.

Chapter VII is entitled "Material and method" and is structured and systematized in 11 subchapters in which all the methods used are described, starting from the elements of bio-geography to the analysis of hematological parameters and oxidative stress biomarkers in indigenous trout.

Chapter VIII is entitled "Results and discussions" and is structured and systematized on 18 subchapters in which the results obtained during the study are presented. This chapter contains the results of the mapping of the Someșul Cald riverbed, the results of water analyzes for the pre- and post-boar period, the α, β and γ diversities for the analyzed river sections, the degrees of dominance of the inventoried fish species

(Tischler scale), comparisons of indices of diversity, the results of morphometric and myphological analyzes for all species found and the results of blood parameters and oxidative stress in brown trout.

Chapter IX is entitled "General conclusions and recommendations" and summarizes the conclusions of our study and recommendations for future research, which are intended to improve fundamental research.

Chapter X is entitled "Originality and innovative contributions of the thesis" and summarizes the unique and original elements of the thesis and the innovative contribution of newly implemented methods for morpho-physiological analysis of mountain ichthyofauna.

RESEARCH RESULTS

Organization of the experimental device

The morpho-physiological analysis of the fish species took place on the Someșul Cad River. It is part of the Someș River basin. Together with Someșul Rece River, with which it joins Gilău, it forms Someșul Mic River. Someșul Mic (with springs in the Apuseni mountains) joins with Someșul Mare (with springs in the Rodna mountains) in Mica (upstream of Dej) where it forms the Someș River with a length of about 465 km of which about 375 km are on the territory Romania. It flows into the Tisa River, which in turn flows into the Danube. Somesul Cald River springs from the Bihariei-Vlădeasa massif (Bihor County), just below the Piatra Grăitoare-Cârligatele peak from an altitude of approximately 1550m (Figure 1).

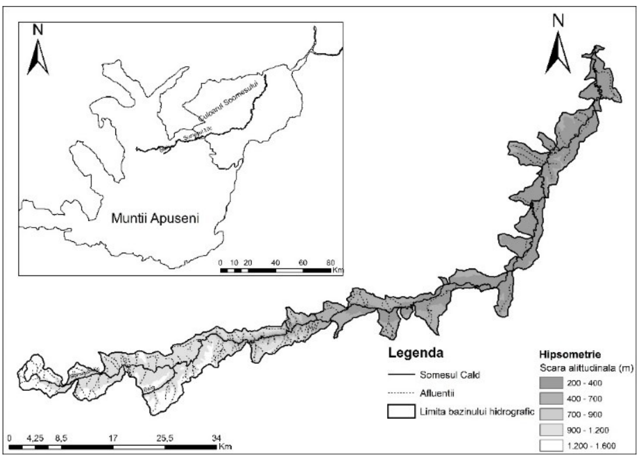

Figure 1. Map of Someșul Cald River catchment-original

The Someșul Cald River has a high degree of fragmentation due to the accumulation lakes on its riverbed (especially the Tarnița accumulation lake and the

Beliș-Fântânele accumulation). In this sense, 2 work sections were set up, separated by the Beliș-Fântânele accumulation lake.

Table 1.

GPS coordinates, altitude and length of sectors in the analyzed sections (T1 and T2)

T1	Downstream	Upstream	Alt AV	Alt AM	Alt Medie	Diff. Alt	L/Sect
T1-S1	N46° 42.413' E23° 12.932'	N46° 42.454' E23° 12.816'	**516**	521	518.5	5	171.04
T1-S2	N46° 41.914' E23° 10.990'	N46° 42.005' E23° 10.902'	576	579	577.5	3	221.4
T1-S3	N46° 41.892' E23° 09.538'	N46° 41.926' E23° 09.286'	615	620	617.5	5	337.1
T1-S4	N46° 42.023' E23° 08.125'	N46° 42.013' E23° 07.991'	652	658	655	6	174.07
T1-S5	N46° 42.080' E23° 07.781'	N46° 42.153' E23° 07.672'	693	699	696	6	221.73
T1-S6	N46° 42.495' E23° 07.029'	N46° 42.578' E23° 06.906'	724	726	725	2	220.2
T1-S7	N46° 42.609' E23° 06.465'	N46° 42.612' E23° 06.363'	729	735	732	6	168.29
T1-S8	N46° 41.925' E23° 04.602'	N46° 41.959' E23° 04.825'	830	**834**	832	4	297.76
T2	**Downstream**	**Upstream**	**Alt AV**	**Alt AM**	**Alt Medie**	**Diff. Alt**	**L/Sect**
T2-S1	N46° 38.766' E22° 52.112'	N46° 38.787' E22° 51.952'	**999**	1004	1001.5	5	210.28
T2-S2	N46° 38.818' E22° 51.837'	N46° 38.832' E22° 51.622'	1005	1006	1005.5	1	169.31
T2-S3	N46° 38.834' E22° 51.457'	N46° 38.786' E22° 51.326'	1007	1009	1008	2	254.15
T2-S4	N46° 38.589' E22° 50.581'	N46° 38.498' E22° 50.221'	1013	1014	1013.5	1	499.54
T2-S5	N46° 38.429' E22° 49.409'	N46° 38.378' E22° 49.323'	1018	1021	1019.5	3	191.13
T2-S6	N46° 38.301' E22° 49.060'	N46° 38.216' E22° 48.755'	1024	1030	1027	6	445.47
T2-S7	N46° 37.955' E22° 48.284'	N46° 37.814' E22° 48.080'	1036	1045	1040.5	9	452.12
T2-S8	N46° 37.770' E22° 46.407'	N46° 37.813' E22° 46.327'	1068	1069	1068.5	1	149.28
T2-S9	N46° 38.092' E22° 45.022'	N46° 38.112' E22° 44.932'	1108	1115	1111.5	7	161.34
T2-S10	N46° 38.485' E22° 44.067'	N46° 38.532' E22° 43.995'	1122	1128	1125	6	162.66
T2-S11	N46° 38.653' E22° 43.712'	N46° 38.649' E22° 43.616'	1131	1140	1135.5	9	149.26
T2-S12	N46° 38.356' E22° 43.138'	N46° 38.310' E22° 43.131'	1149	**1158**	1153.5	9	141.46

Legend: T1 and T2-sections analyzed; S-sector of the section; Downstream-downstream in the sector; Upstream-upstream in the sector; Alt AV-altitude of the downstream point of the sector; Alt AM-altitude upstream of the sector; Alt Average-average altitude of the sector; Diff. Alt-altitude difference between the downstream point and the upstream point of the sector; L / Sect-length of the analyzed sector.

Section T1 (lower) is located between the tail of Lake Tarnița and the dam of the Beliș-Fântânele reservoir and section T2 (upper) is between the tail of Lake Beliș-

Fântânele and the springs of Someș Cald. On the T1 section, 8 sectors / inventory stations were performed and on the T2 section, 12 sectors / inventory stations were performed (Table 1).

The average length of the sectors in section T1 was 226.44 m and of the sectors in section T2 was 248.83 m. The species downstream of the dam cannot migrate upstream of the dam because the height of the dam is greater than 90 m and there are no passages fish. The lowest altitude was recorded in sector S1 of section T1 (516 m) and the highest altitude was recorded in sector S12 of section T2 (1158 m). The average altitude difference between the sectors of the T1 section was 4.6 m and in the case of the T2 section 4.91 m.

For each analyzed sector, 5 ***riverbed depth*** measurements were performed (one measurement on the downstream boundary, one measurement on the upstream boundary and 3 intermediate measurements). For section T1, the deepest area was recorded in sector S5 (13 cm) and the deepest area was recorded in section S1 (141 cm). The average depth on the T1 section was 37.2 cm and on the T2 section 28.11 cm. The highest variability of the depth was determined in sector S1 of section T1 (89.80623%) and the lowest variability was recorded in sector S9 of section T2 (2.608203%). Depth variations can be explained in terms of the structure of the substrate, the slope or the degree of sinuosity (meandering). In both sections of the river we find areas with deep water and areas with little water due to substrate erosion. Downstream of the waterfalls, in their immediate vicinity, the water is deeper precisely due to erosion. The variable depth of the riverbed is important for fish species. They can find refuges, feeding or breeding areas according to their biological requirements.

The ***water speed*** can influence fish communities in a habitat. The greater the variability of the water flow rate, the greater the diversity of habitats. For each sector analyzed, 5 measurements were made for the water flow rate (one measurement on the downstream boundary, one measurement on the upstream boundary and 3 intermediate measurements). For each sector analyzed, 5 water flow rate measurements were performed (one measurement on the downstream boundary, one measurement on the upstream boundary and 3 intermediate measurements). On section T1 the lowest flow rate was measured in sectors S1, S2 and S6 (0.1 m / s) and the highest speed in sectors S3, S4, S5, S6 and S7 (0.5 m / s). On section T2 the lowest speed was recorded in sectors S5, S6 and S8 (0.2 m / s) and the highest speed in sectors S2, S7 and S11). The average speed of water flow in section T1 is 0.34 m / s and in section T2 is 0.36 m / s. Sector S12 in section T2 recorded identical work for the determinations made in the 5 points.

The ***water temperature*** at the date of collection of the biological samples (before and after the spawning period) ranged between 11.40 ° C and 5.10 ° C. The temperature difference was 6.3 ° C. The pH values were similar (6.80 vs. 7.20). TDS and salinity had almost identical values (0.04 vs. 0.05 mg / L; 0.04 vs. 0.04 g / L). The transparency of the water was higher in November, due to the reduction of precipitation. Water hardness recorded similar values, specific for mountain waters and generally for clean waters (3.70 vs. 2.98 ° dGH). Nitrate levels were higher in September (13.86 vs. 9.21 mg / L), but their values fall within the biological limits of the species (S. trutta). Nitrites were not detected during the two collection moments. Ammonia recorded similar values (0.0003 vs. 0.0002 mg / L), which fall within the biological limits of the species.

On the lower ***section T1*** there are two eudominant species: *Salmo trutta* and *Phoxinus phoxinus* (65.5716% and 13.7976%). *Cottus gobio* and *Squalius cephalus* are the dominant species (8.9356% and 5.9133%). *Barbus carpathicus* is the only subdominant species on the T1 section and *Barbatula barbatula* is the only recedent species. *Eudontomyzon dafordi, Thymallus thymallus* and *Cobitis elongatoides* are predominant species. It should be noted that the number of *Salmo trutta* exceeds the sum of the other species together. The population of *Thymallus thymallus* is poorly represented, although the altitude is optimal for this species.

On the upper ***section T2*** *Salmo trutta, Thymallus thymallus, Cottus gobio* and *Phoxinus phoxinus* are eudominant species (41.0506%, 25.3891%, 10.6031% and 10.0195%). The only dominant species is *Squalius cephalus* (9.3385%). *Barbus carpathicus* is the only subdominant species, the rest of the species (*Eudontomyzon danfordi, Perca fluviatilis, Salmo labrax, Barbatula barbatula, Rutilus rutilus,* and *Cobitis elongatoides*) being subrecedent species.

The abundance of species, but also of fish families differs on the two sections. Although the abundance of species increases inversely with altitude, we note that the number of species in T1 is lower than in T2. We observe the same trend in the case of the number of families present in the 2 sections of the river.

Comparisons of alpha diversity indices for T1 vs. T2 sections

In order to be able to analyze the diversity of the two sections, the α diversity indices for the two river sections were compared. The mathematical models of diversity analysis, expressed by the indices Simpson (D, 1-D, 1 / D), Shannon (H '), Berger-Parker (d), Margalef (Md) and Uniformity (J') show the differences between the two sections. The Simpson D index has values between 1 and 0. One represents the lack of diversity and zero represents infinite diversity. The 1-D form of the index changes the interpretation of the calculated value, 1 being infinite diversity and 0 being its lack. The values for Simson's Mutual Index (1 / D) start at 1 (the lowest possible value of the index, when the analyzed community contains a single species).

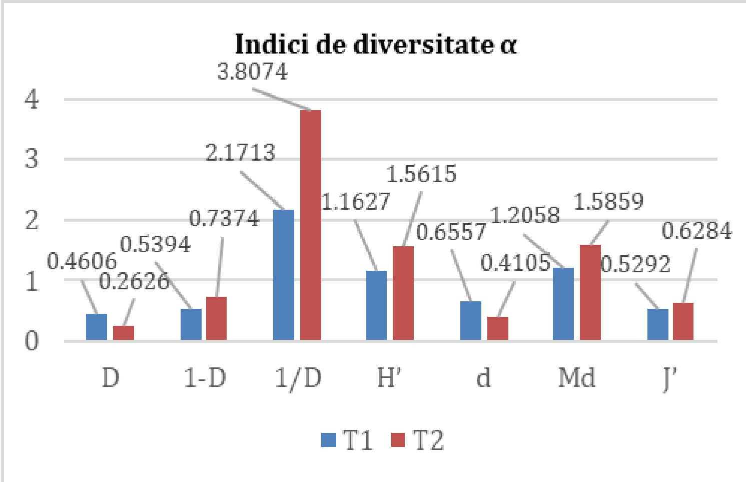

Figure 2. Comparisons of α diversity indices for T1 and T2 sections-original

Figure 2 shows the calculated values for both sections. All forms of the Simpson diversity index show that the upper T2 section has a greater fish diversity than the T2 section. This is due to the higher number of species in T2, but also to its uniformity.

The Black Sea trout *Salmo labrax* has never been reported in the inland waters of Romania (Oțel V. 2007; Lațiu et. Al 2020). During the course of our study, only one specimen of this species was captured, however, we collected a database of images with specimens captured in previous years, both on the upper section of the Someș Cald River and on the Beliș-Fântânele accumulation lake. The captured specimen weighed 99.90 g and had a total length of 244 mm, a standard length of 212.8 mm, a commercial length of 152.1 mm, a fork length of 225.7 mm, a maximum height of 41.2 mm, a minimum height of 16.4 mm, a head length of 47.4 mm, caudal peduncle length 46.2 mm and eye diameter 6.8 mm (Figure 3).

Figure 3 *Salmo labrax* (Someșul Cald River)-original photo

Based on specific meristic and morphological elements Salmo labrax, such as the number of scales from the dorsal fin to the lateral line (D / LL = 19 in the specimen in figure 3), but also on the descriptive characters of the species (silver body, black spots, lack of red spots, marginal caudal fin and dark posterior margin), we concluded that the specimen belongs to the species *Salmo labrax* (Table 2).

Table 2.

Meristic characters in the brown trout Salmo trutta and the Black Sea trout Salmo labrax

Common name »»	Brown trout	Black Sea trout
Species»»	*Salmo trutta*	*Salmo labrax*
	Caractere meristice	
D	III-V 9-10(11) [a, d]	(III)[e]- IV 9-10 [a, c, e, h, i]
A	II-IV (7) 8-9 [a]	III-IV 8 (10) [a, c, e, i]
V	I 7-9 [a, d]	I-8 [a, c, e, h, i]
P	I 12-13 (14) [c]	I 11-12 [e, h]
LL	110-132 [c] 118-130 [d]	112-122 [a, h, i]; 119-132 [c] 116-135 [e]
Sc A	25-26 [c]	25-31 [c]
Sc B	20-23 [c]	22-30 [c, e]
D/LL	**12-17 [a]**	**16-23 [a]**
Ad/LL	15 (17) [d]	18 (19) [c, d]
Ver	56-61 [d]	57-60 [a, c, h]
GR	13-18 (14-16) [d]	(16) 17-18 (19-21) [a, b, c, d, e, h, i]
Brs R	10 [g]	10-12 [c]

Superscript: *a*-Petru Bănărescu (1964); *b*-Kottelat and Freyhof (2007); *c*-Cărăuşu (1952); *d*-Svetovidov (1984); *e*-Holčík and Stefanov (2008); *f*-Buşniţă and Alexandrescu (1963); g-Page and Burr (1991); *h*-Oţel (2007); *i*-Popescu-Gorj and Dimitriu (1956)

Legend: D- dorsal fins; A- anal fins; V- ventral fin; P- Pectoral fin; LL- Scales on the lateral line; Sc A- Scales above the lateral line; Sc B- Scales below the lateral line; D / LL-number of scales from the dorsal fin to the lateral line; Ad / LL- diagonal scales from the adipose fin to the lateral line; Ver-Vertebre; GR-gill spines on the first arch; Brs-R brachiostegal rays.

Hematology and oxidative stress

For hematological parameters, the descriptive statistics suggest a significant difference between the recorded values, before and after the spawning period. The mean values recorded for RBC and Hb showed increased values in the pre-spawning period. The average values of VEM are higher before the spawning period, while Ht, HEM and CHEM have very similar values. The *t* test showed significant differences for all hematological parameters ($p < 0.05$). The same evolutionary trend was registered for parameters determined for the evaluation of oxidative stress. For both dosed biomarkers (SOD and GPx), the mean values are higher before the spawning period than after the spawning period. The results of the *t* test show that the differences are statistically significant ($p < 0.05$).

Correlations of hydrographic parameters and fish species from Someșul Cald River

In the case of the brown trout *S. trutta*, strong positive correlations are observed with the Romanian barbel *B. carpathicus* (r = 0.83; p = 0.010; CI95% 0.3129 - 0.9691). For *T. thymallus*, no strong correlations were determined with any of the inventoried species. The presence of clean *S. cephalus* registers strong positive correlations with the presence of *B. barbatula* (r = 0.93; p = 0.001; CI95% 0.6345 - 0.9867) and Romanian barbel *B. carpathicus* (r = 0.88; p = 0.004; CI95% 0.4707 - 0.9786). The presence of Romanian barbel *B. carpathicus* registers strong positive correlations with the presence of *B. barbatula* (p = 0.81; p = 0.016; CI95% 0.2348 - 0.9635), *S. cephalus* (r = 0.88; p = 0.004; CI95% 0.4707 - 0.9786) and of the brown trout (r = 0.83; p = 0.010; CI95% 0.3129 - 0.9691). The presence of *P. phoxinus* is not strongly correlated with any of the species present in the T1 section. The presence of *C. elongatoides* is strongly and positively correlated with the presence of *E. danfordi* (r = 0.97; p <0.05 CI95% 0.8315 - 0.9945). The presence of *C. gobio* does not strongly correlate with the presence of other species in the T1 section. The presence of brown trout is not correlated with the presence of other species. The presence of Black Sea trout *S. labrax*, although poorly represented numerically is strongly and positively correlated with the presence of *E. danfordi* (r = 0.70; p = 0.011; CI95% 0.2151 - 0.9096), of *C. gobio* (r = 0.63; p = 0.027; CI95% 0.09344 - 0.8854), of the *B. barbatula* (r = 1; p = 0; CI95% 1-1), of the *R. rutilus* (r = 1; p = 0; CI95% 1-1), of the Romanian barbel (r = 0.97; p <0.05; CI95% 0.8781 - 0.9905) and *S. cephalus* (r = 0.95; p <0.05; CI95% 0.8411 - 0.9874). With the exception of Romanian barbel, the presence of species that have shown strong positive correlations with *Salmo labrax* prefers habitats with low water flow or even slow regime. The presence of grayling does not correlate with the presence of other species (except for perch *Perca fluviatilis*). The presence of the chub is positively correlated with the presence of *E. danfordi* (r = 0.71; p = 0.010; CI95% 0.2312 - 0.9125), *C. gobio* (r = 0.64; p = 0.024; CI95% 0.1082 - 0.8886), *B. barbatula* (r = 0.95; p <0.05; CI95% 0.8411 - 0.9874), *R. rutilus* (r = 0.95; p <0.05; CI95% 0.8411 - 0.9874), *B. carpathicus* (r = 0.95; p <0.05; CI95% 0.8357 - 0.9870). The presence of Romanian barbel is positively correlated with the presence of *E. danfordi* (r = 0.64; p = 0.024; CI95% 0.1127 - 0.8896), *C. gobio* (r = 0.61; p = 0.034; CI95% 0.05855 - 0.8776), hail (r = 0.97; p <0.05; CI95% 0.8781 - 0.9905), and *R. rutilus* (r = 0.97; p <0.05; CI95% 0.8781 - 0.9905). The presence of the *P. phoxinus* is positively correlated only with the presence of *C. elongatoides* (r = 0.84; p = 0.001; CI95% 0.5069 - 0.9532). The presence of *R. rutilus* is positively correlated with the presence of *E. danfordi*, *C. gobio* (r = 0.63; p = 0.027; CI95% 0.09344 - 0.8854) and *B. barbatula* (r = 1; p = 0; CI95% 1-1). The presence of *B. barbatula* is positively correlated with the presence of *E. danfordi* (r = 0.70; p = 0.011; CI95% 0.2151 - 0.9096) and *C. gobio* (r = 0.63; p = 0.027; CI95% 0.09344 - 0.8854).

Recommendations

Periodic inventory of ichthyofauna must become a zero priority. The evolution and distribution of fish communities and water management in Romania are not currently at European level. The lack of data and literature on fish species in our country can be seen in international databases by the small number of publications and the small number of species reported compared to other EU countries. The quality bibliographic references remain the ones provided by Petru Bănărescu in 1964 or by Vasile Oțel in 2007. The identification of the species and the taxonomy represent the alphabet of the ichthyological researches. Research in fish genetics is negatively influenced by taxonomic data or erroneously assigned taxa.

The main recommendation we base is the continuation of ichthyofaunistic inventory studies together with all its components (morphology, morphometry, mapping, analysis of biological samples, grouping of databases). Fish welfare is currently a secondary component in both aquaculture and wildlife. Working protocols have not changed in the last two decades, but technology allows us to approach different methods of analysis to improve the way we work and thus the welfare of fish. Regarding salmonids and their taxonomy, we recommend the establishment of a bank of genetic material for species of the genus Salmo at national level. The phenotypic variability of the Salmo trutta species raises problems at the nodal level, so the need for a genetic database of the whole genus is a necessity.

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