GEOGRAPHICAL AND HUMAN IMPACT ELEMENTS INFLUENCE ON THE FISH FAUNA OF THE OLTEȚ RIVER (ROMANIA)

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ABSTRACT

A white spot regarding the fish fauna of the upper and middle Olteț River was covered and the significant changes appeared in this respect and in the lower course were identified. In general the passing of the river from one type of geographical/relief type unit to another, induce the changing of the ichthyological zone and the increasing of the fish species number. There where this natural situation did not appear is because different human impact causes create unnatural variations in fish communities' compositions and individuals' number. The presence of a various human impact especially downstream the mountain area makes to exist here a relative unbalanced fish fauna structure, in comparison with the mountainous sector. Overall, the geographical and human impact elements, and a result of them, the self cleaning capacity of river, are main driving forces which induce the fish fauna composition variability.

ZUSAMMENFASSUNG: Der Einfluss geographischer Faktoren und menschlicher bedingter Faktoren auf die Fischfauna des Olteț-Flusses (Rumänien).

Mit vorliegender Arbeit wurde ein weißer Fleck bezüglich der Fischfauna des oberen und mittleren Olteț-Flusses ausgefüllt und dabei auch die dadurch aufgetretenen, signifikanten Veränderungen am Unterlauf identifiziert. Im allgemeinen führt der Übergang des Flusses von einer geographischen Einheit bzw. von einem Relieftyp zu einem anderen zu einem Wechsel der ichtyologischen Zone und einem Anwachsen der Anzahl von Fischarten. Warum diese natürliche Situation nicht auftritt, ergibt sich aus unterschiedlichen, menschlich bedingten Eingriffen, die unnatürliche Variationen in der Zusammensetzung der Fischgemeinschaften und Individuenzahl verursachen. Das Vorhandensein unterschiedlicher, menschlich bedingter Veränderungen, vor allem unterhalb des Gebirgsabschnittes führt dazu, dass hier im Vergleich zu den oberen Abschnitten des Flusses eine relativ unausgewogene Fischfaunastruktur vorzufinden ist. Überall sind die geographischen und menschlich bedingten Elemente und das Ergebnis ihrer Auswirkungen auf die Selbstreinigungskapazität des Flusses die Hauptkräfte, die Variabilität der Zusammensetzung der Fischfauna bestimmen.

REZUMAT: Influența elementelor geografice și antropice de impact asupra ihtiofaunei din râul Olteț (România).

A fost studiată ihtiofauna din cursul superior și mijlociu al râului Olteț, o zonă necercetată din acest punct de vedere până în prezent, de asemenea au fost evaluate schimbările în structura comunităților de pești față de situația de acum 50 de ani (Bănărescu, 1964) în cazul cursului inferior, evidențiindu-se modificări semnificative. În general, trecerea unui curs de apă de la un tip de unitate geografică sau de relief la alta face ca diversitatea ihtiocenozelor să crească spre aval. În zonele afectate de diverse tipuri de impact antropic, această tendință naturală nu se manifestă, iar structura comunităților de pești prezintă deviații majore de la starea naturală (în ceea ce privește compoziția specifică

și numărul de indivizi). Prezența unei palete largi de tipuri de impact antropic, în special, în aval de zona montană duce la o structură a ihtiocenozelor relativ dezechilibrată prin comparație cu sectorul montan. Ca tendință generală, factorii de influență geografici și antropici și rezultanta lor, capacitatea de autoepurare a râului sunt principalele forțe care condiționează variabilitatea structurii comunităților de pești.

INTRODUCTION

Grigore Antipa (1867-1944) the first great Romanian ichthyologist, realized the fact that Romania should have a nationwide territory approach in the fish fauna study. In order to help manage this very important natural resource, the first publication regarding the fish fauna of Romania was created (Antipa, 1909).

Petru Mihai Bănărescu (1921-2009), the greatest Romanian ichthyologist, deepened and extended this national approach, realizing the astonishingly publication regarding the fish fauna of Romania (Bănărescu, 1964), with an impressive quantity and quality of data, many of these data actual even today, after a half of a century.

Many researchers have worked, in this field of study, and have tried to complete this work, but the task is far from over due to relatively big Romanian national territory and mostly due to its high geographical variability. This variability induces a relatively high variability of the aquatic biotopes and of their ichthyocenosis, and due to the continuous and various human impacts on fish fauna habitats, the fish fauna variability also increases.

In this general context, it is easy to accept the need and the actuality of such inventory/assessment ichthyological studies, especially in rivers where: no data are available, rivers where long/significant sectors have no data available, or where the human impact and/or climate changes induced modifications in the fish habitats. Thus, new qualitative and quantitative fish fauna related aspects have appeared. Essentially, the fish communities' assessment, monitoring, management, protection, conservation, etc., cannot be done properly without such complete ichthyological surveys, as they are an initial data base for future comparisons. The numerous protected areas proposed and "managed" on fake data regarding their fish fauna is just an example of some of the unfortunate assessment, monitoring, management, protection and conservation of fish "on paper".

The Olteț River fish fauna fits this type of situation, it was studied by Bănărescu (1964) in its very low sector; a sector which suffered intensive human impact, especially in the last half of the XXth century. Upstream, this relatively short studied lower sector (Balș locality - Olteț-Olt rivers confluence), a sector negatively affected by pollution, hidrotechnical works and habitats change. Until now, no ichthyologist has studied the river in the rest of its significant length. In spite of this situation, for example, and based on "theoretical" fish data, the "Cheile Oltețului"/"Oltețului Gorge" Protected Natural Area was proposed and designated to conserve fish species which never lived there.

This intensive (two years long sampling campaign) and extensive (the distance between the sampling stations are between one to three and a half km) ichthyological study, serves as the first data base, for this important Carpathian river.

The Olteț River is the main tributary of the 615 km long Olt River, one of the biggest affluent of the lower Danube River. The Olt Watershed (24.439 km²; 10.1% of the Romanian national territory) is situated in the central and southern part of Romania; springing in the Oriental Romanian Carpathians, passing to the west the Transylvanian Depression, south of the Meridional Romanian Carpathians, in the southern Romanian subcarpathians and the Romanian Plain until the convergence with the Danube (Diaconu and Stănculescu, 1971; Roșu, 1980; Posea, 1982; Badea, 1983; Sommerwerk et al., 2009).

The upper and middle Olt Basin fish fauna was studied recently (Bănăduc, 1999, 2000, 2001; Bănăduc and Curtean-Bănăduc, 2002; Curtean-Bănăduc and Bănăduc 2004; Curtean-Bănăduc et al., 2014), the situation being significantly different in the lower part of the basin.

The Olteț River springs in the Căpățâni Mountains, which belong to the Parâng Massif and to the Romanian Meridional Carpathians; the mountainous area is limited at the east by the Olt River and in the west by the Jiu River (Velcea and Savu, 1982). It has a length of 615 km and a basin surface of 24,000 km² (Posea et al., 1982).

The Olteț River basin is situated in the south-southwest part of Romania (Fig. 1), flowing from north to south in its upper sector and from north-west to south-east in its middle and especially in its lower part, passing the administrative units Gorj, Vâlcea and Olt.

The Olteț Valley geology is a varied one (different crystalline rocks, old and new eruptive rocks, sedimentary rocks, etc.) (Velcea and Savu, 1982), and is reason for which this river has a relatively high natural relief units variability (Fig. 2) and riverbed biotopes/habitats variability from its springs to the confluence with the Olt River.

The Olteț Basin shelter also some of the oldest (Quaternary) prehistoric man tools in the Romanian territory (Pebble-Culture) (Mutihac, 1990), the continuous presence of man in this basin being reflected mostly due to the later human developments.

The **mountainous sector** (●) with crystalline schists, volcanic and calcareous rocks, is characterized by a typical mountainous lotic habitats with steep slopes, deepened and accentuated "V" and "U" profiles of the valley, big stones in the riverbed, waterfalls, and very fast flowing water. The Jurassic calcareous massif in the northern proximity of Polovragi locality, allows for the possibility of this river to cut one of the most spectacular gorges in the Carpathians, the "Cheile Oltețului"/"Oltețului Gorge" (Ujvári, 1972).

Figure 1: Localization of the Olteț and Olt basins, in the Romanian national territory.

Figure 2: Relief units and sampling stations in the Olteţ River basin area.

Downstream the "Cheile Oltețului"/"Oltețului Gorge", the river passes the **subcarpathian Polovragi Depression/Depresiunea Polovragi sector (2)**, with Meotian clay in the geological substrate (Tufescu, 1966), and boulders and stones in the riverbed due to the continuous erosion and transport of these materials from the upper near mountain sector of the valley. The "V/U" shaped valley still allows the water to flow fast.

Downstream the subcarpathian Polovragi Depression the valley passes on to the **Getic Depression/Depresiunea Getică sector (3)**; the river eroded a big gravel geological substratum known as "Pietrișuri de Căndești"/"Căndești Gravels" and deposited there in a lotic-lentic regime (Roșu, 1973). The river is in a submountainous (fast velocity) regime.

Downstream, the river passes through the unit named **Getic Piedmont/Piemontul Getic sector (4)**. Characterized by gravels, sands and in some sectors, conglomerates, (Tufescu, 1966), the water flow speed becomes moderate.

The final sector of the Olteț River, before its confluence with the Olt River and, in the proximity of Fălcoiu Commune, is a plain relief belonging to the **Romanian Plain/Câmpia Română sector (5)**. Characterized by Pliocen and Cuaternary, old sedimentary sands, gravels, clay and loess, the water flow speed becomes low, even stagnant in some areas near banks.

MATERIALS AND METHODS

This ichthyological study was realized on the whole 175 km length of the Olteț River, from its mountainous area to the confluence with the Olt River, in 2011-2012.

The distances between two consecutive sampling stations were around between one to three and a half km, 56 sampling stations (55 quantitative and one qualitative) were done.

The fishing method which was used was the electrofishing in time/effort unit (30 minutes). The device which was used was an Aquatech IG 600, 30 A, 0.65/1.2 kw, with two net stoppers. All the sampled fish were identified, counted and released immediately in situ.

For the fish associations, localization was used a "Garmin GPS map 62s".

The Carpathian Fish Index of Biotic Integrity (CF-IBI) (Bănăduc and Curteanu-Bănăduc, 2002) was used in discriminating human induced degradation effects on ichthyofauna integrity, based on life history and feeding relationships selected metrics.

RESULTS

1 The most upper Olteț River area, in the **mountainous sector**, from its springs to the exit of the "Oltețului Gorge"/"Cheile Oltețului" belongs to the upper trout zone (O₁-O₁₃). Here only *Salmo trutta fario* (Tab. 1) individuals were sampled, the explanation being based on the habitat characteristics like rapids, waterfalls, stony river bed, "V" shaped slopes, etc., belonging to two mountainous relief units namely Parâng and Căpățânii mountains (Figs. 2, 3 and 4). Despite the valley being very narrow, there are few small lateral natural water accumulations (Fig. 5), with their permanent springs or formed by small tributaries in which fish associations of *Phoxinus phoxinus* and *Squalius cephalus* are present. The CF-IBI 45 score on the river reflects exceptional assemblage of fish species, comparable to pristine areas. The individual trout numbers and the presence of all age classes in the sampling sections reveal an excellent state of the river. The lower number of individuals in the station O₁₃ can be explained by the fact that sometimes at low water levels, the riverbed dries out completely and the water sometimes will flow only underground through a well developed carstic substrata. The very difficult accessibility to the river due to high and steep slopes results in very low human impact which therefore induces an excellent state fish fauna.

Figure 3: Mountainous rocky stream sector characteristic habitat.

Figure 4: Olteț Valley steep “V/U” shape slopes in the Cheile Oltețului/Oltețului Gorge.

Table 1: The upper trout zone area of Olteț River (O₁-O₇); *Salmo trutta fario* - *S.t.f.*

Sampling stations	Sampling station localization and description	Species	Number of individuals	Abundance (%)
O ₁	N - 45.3314 E - 23.7903 5 km upstream the confluence with Ungurelul tributary. Riverbed length maximum 3.1 m and minimum 2.1 m. Maximum water depth 13 cm.	<i>S.t.f.</i>	30	100
O ₂	N - 45.3230 E - 23.7939 4 km upstream the confluence with Ungurelul tributary. Riverbed length maximum 3.3 m and minimum 2.2 m. Maximum water depth of 14 cm.	<i>S.t.f.</i>	42	100
O ₃	N - 45.3061 E - 23.7907 3 km upstream the confluence with Ungurelul tributary. Riverbed length maximum 3.3 m and minimum 3.1 m. Maximum water depth of 21 cm.	<i>S.t.f.</i>	73	100
O ₄	N - 45.3139 E - 23.7907 2 km upstream the confluence with Ungurelul tributary. Riverbed length maximum 4.1 m and minimum 2.9 m. Maximum water depth of 25 cm.	<i>S.t.f.</i>	68	100
O ₅	N - 45.2971 E - 23.7868 1 km upstream the confluence with Ungurelul tributary. Riverbed length maximum 4.9 m and minimum 3.1 m. Maximum water depth of 32 cm.	<i>S.t.f.</i>	99	100
O ₆	N - 45.2901 E - 23.7788 Downstream the confluence of Olteț and Ungurelul rivers. Riverbed length maximum 5.2 m and minimum 3.6 m. Maximum water depth 33 cm.	<i>S.t.f.</i>	33	100
O ₇	N - 45.2717 E - 23.7705 1 km downstream the confluence of Olteț and Ungurelul rivers. Riverbed length maximum 8.4 m and minimum 4.9 m. Maximum water depth 39 cm.	<i>S.t.f.</i>	82	100

Table 1 (continuing): The upper trout zone area of Olteț River (O₈-O₁₃); *Salmo trutta fario* - *S.t.f.*

Sampling stations	Sampling station localization and description	Species	Number of individuals	Abundance (%)
O ₈	N - 45.2609 E - 23.7707 2 km downstream the confluence of Olteț and Ungurelul rivers. Riverbed length maximum 9.3 m and minimum 7.6 m. Maximum water depth 45 cm.	<i>S.t.f.</i>	60	100
O ₉	N - 45.2536 E - 23.7667 3 km downstream the confluence of Olteț and Ungurelul rivers. Riverbed length maximum 9.9 m and minimum 7.8 m. Maximum water depth 43 cm.	<i>S.t.f.</i>	71	100
O ₁₀	N - 45.2449 E - 23.7654 4 km downstream the confluence of Olteț and Ungurelul rivers. Riverbed length maximum 9.5 m and minimum 7.4 m. Water maximum depth 44 cm.	<i>S.t.f.</i>	51	100
O ₁₁	N - 45.2364 E - 23.7702 5 km downstream the confluence of Olteț and Ungurelul rivers. Riverbed length maximum 7.3 m and minimum 5.1 m. Maximum water depth 60 cm.	<i>S.t.f.</i>	59	100
O ₁₂	N - 45.2280 E - 23.7698 6 km downstream the confluence of Olteț and Ungurelul rivers. Riverbed length maximum 1.2 m and minimum 8.5 m. Maximum water depth 24 cm.	<i>S.t.f.</i>	61	100
O ₁₃	N - 45.2190 E - 23.7725 7 km downstream the confluence of Olteț and Ungurelul rivers. Riverbed length maximum 8 m and minimum 4.2 m. Maximum water depth 80 cm.	<i>S.t.f.</i>	15	100

Figure 5: Small natural lateral water accumulation in the Olteț upper basin.

② Downstream the “Oltețului Gorge”, where the river passes in the **subcarpathian Polovragi Depression sector** (O_{14} - O_{16}), is the lower trout zone, and *Salmo trutta fario* remains dominant with a decreasing trend to the lower sectors, but still influence the downstream zone due to the excellent state of the ichthyofauna in the mountainous area.

The upper part (O_{14} - O_{15}) is in a natural mountain-submontane transition condition (CF-IBI 45) regarding the present habitats (Figs. 6 and 7), reflected in a high number of trouts (Tab. 2). In O_{16} sector near Polovragi Commune, due to a chaotic exploitation of the riverbed minerals (Fig. 8), the CF-IBI score is 2 and reflects extreme few species and individuals present; tolerant species being dominant. The *Salmo trutta fario* disappeared and only few *Orthrias barbatulus* individuals were sampled in small lateral artificial cavities in the left riverbed/banks area (Fig. 9) that remained after the riverbed exploitation activities. The persistence of this species here is problematic due to aggressive human impact.

A large dam (Fig. 10) is near Polovragi Commune, in Polovragi Depression (O_{17}). A dam which deflects in a subterranean large pipe where the majority of the water flows for a series of two medium size downstream hydro power plants; sometimes in the summer and autumn the dam deflects all the water into this pipe (Fig. 11). Downstream the dam and due to the significant habitats modification, it appears as *Phoxinus phoxinus* is the dominant species, followed by *Salmo trutta fario* and accidentally *Barbus meridionalis* (Tab. 2). The CF-IBI score (27) reveals some expected species are rare and tolerant species as dominant.

On the O_{18} sector the river passes in a new relief unit type (Mateești and Sârbești hills area). The near upstream dam is a negative influence and downstream there is the appearance of more types of human impact categories (riverbed minerals overexploitation till the clay substratum (Figs. 12 and 13), affecting the macroinvertebrates food of fish; the pollution from mineral exploitations; roads presence in the riverbed (Fig. 14); and a two m high barrage (Fig. 15) with no fish leather which interrupt the fish populations connectivity), diminishing the river quality; till Ciupercenii de Olteț locality CF-IBI value is only 2.

Figure 6: The Olteț River valley at the entrance in the Polovragi Depression.

Figure 7: Natural lotic habitat in the upper sector of Polovragi Depression.

Table 2: The sampled fish material, in the lower trout zone area of Olteț River (O₁₄-O₁₈); *Salmo trutta fario* - *S.t.f.*; *Phoxinus phoxinus* - *P.p.*; *Orthrias barbatulus* - *O.b.*; *Barbus meridionalis* - *B.m.*

Sampling stations	Sampling station localization and description	Species	Number of individuals	Abundance (%)
O ₁₄	N - 45.2029 E - 23.7807 8 km downstream the confluence of Olteț and Ungurelul rivers. 200-300 m downstream the Cheile Oltețului Gorge. Riverbed length maximum 8 m and minimum 4 m. Maximum water depth 100 cm.	<i>S.t.f.</i>	66	100
O ₁₅	N - 45.1836 E - 23.7859 9 km downstream the confluence of Olteț and Ungurelul rivers. 1 km downstream the Cheile Oltețului Gorge. Riverbed length maximum 8 m and minimum 4 m. Maximum water depth 100 cm.	<i>S.t.f.</i>	83	100
O ₁₆	N - 45.1792 E - 23.7856 10 km downstream the confluence of Olteț and Ungurelul rivers. 2 km downstream the Cheile Oltețului Gorge. Riverbed length maximum 8 m and minimum 4 m. Maximum water depth 100 cm.	<i>O.b.</i>	5	100
O ₁₇	N - 45.1555 E - 23.7905 1 km downstream the dam and 10 km downstream the sonfluence of Olteț and Ungurelul rivers. 3 km downstream the Cheile Oltețului Gorge. Riverbed length maximum 8 m and minimum 4 m. Maximum water depth 100 cm.	<i>S.t.f.</i> <i>P.p.</i> <i>B.m.</i>	23 55 1	29.11 69.62 1.26
O ₁₈	N - 45.1387 E - 23.7931 2 km downstream the dam and 11 km downstream the sonfluence of Olteț and Ungurelul rivers. 4 km downstream the Cheile Oltețului Gorge. Riverbed length maximum 8 m and minimum 4 m. Maximum water depth 100 cm.	<i>B.m.</i>	3	100

Figure 8: Disturbed lotic habitat due to the local riverbed minerals chaotic exploitation.

Figure 9: Artificial cavity where few *Orthrias barbatulus* were sampled.

Figure 10: The dam fragmented this rivers sector lotic continuum.

Figure 11: Almost drought riverbed downstream the dam.

Figure 12: Clay river substratum with no more sand, gravels and boulders.

Figure 13: Clay substratum and erosion on riverbed after mineral overexploitation.

Figure 14: Road in the riverbed.

Figure 15: Concrete barrage with no fish leather.

A pre-Common nase zone is present. Due to complex, significant and continuous human impact on this depression area, the Grayling and Meridional Barbel ichthyological zone is not present. A lot of species characteristic for this ichthyological zone in Romanian Carpathians (Bănărescu, 1964) are missing (*Thymallus thymallus*, *Cottus gobio*, *Alburnoides bipunctatus*, *Cobitis romanica*, *Cobitis aurata*) and the present ones are there in short sectors and with a relatively low number of individuals (*Phoxinus phoxinus*, *Orthrias barbatulus* - accidental, *Barbus meridionalis* - accidental). The only three juveniles of *Barbus meridionalis* sampled in the lower sector of this depression area reveal also a very low ecological status of the ichthyofauna. This depression area fish fauna conservation status decreases significantly from its excellent status in its upper zone, to average/low in its middle zone, to very bad conservation status in its lower zone, due to the human impact effects.

❸ The **Podişul Getic - northern sector**, can be considered as being from the ichthyological point of view in majority to the Common nase zone as a continuity of the upper pre-Common nase zone, with the exception of the first sampling stations (O₁₉-O₂₃), which are in the Grayling and Mediterranean barbell zone influence, but also represent a transition zone to the next ichthyological zone; this is the first appearance of the *Alburnoides bipunctatus* and *Squalius cephalus* species. The upper diverse and high human impact presence induces an obvious fish fauna destructuring and a strong deviation of transition of ichthyofauna from the natural similar lotic sectors. After the recovering of all the water flow from the upstream two medium size power plants subterranean pipes, with a general substratum with boulders but also small patches with gravel, sand or even clay, the downstream lotic habitats can be considered as becoming again typical for this ichthyological zone, in conformity with Bănărescu zonation (1964). Excepting the *Chondrostoma nasus* whose absence is not clear as a natural one or rather induced by the human impact, the fish associations' structure reveal the presence of its ichthyological zone.

Table 3a: The sampled fish material, in the pre-Common nase zone area of Olteţ River (O₁₉-O₂₃); *Phoxinus phoxinus* - P.p.; *Barbus meridionalis* - B.m.; *Alburnoides bipunctatus* - A.b.; *Squalius cephalus* - S.c.; *Orthrias barbatulus* - O.b.; maximum riverbed length - max.r.l., minimum riverbed length - min.r.l., maximum water depth - max.w.d.

O ₁₉	N - 45.1309, E - 23.7926, max.r.l. - 15 m, min.r.l. - 5.5 m, max.w.d. - 1.5 m S. 14 (Ciupercienii de Olteţ aval de pragurile de beton)	P.p.	2	22.22%
		B.m.	7	77.77%
O ₂₀	N - 45.1196, E - 23.7939, max.r.l. - 9 m, min.r.l. - 6 m, max.w.d. - 80 cm S. 15 (Sârbeşti)	P.p.	26	41.93%
		A.b.	34	54.83%
		B.m.	2	3.22%
O ₂₁	N - 45.1029, E - 23.7979, max.r.l. - 9.5 m, min.r.l. - 5 m, max.w.d. - 74 cm S. 16 (Alimpeşti)	S.c.	2	20%
		P.p.	8	80%
O ₂₂	N - 45.0836, E - 23.8006, max.r.l. - 11 m, min.r.l. - 5 m, max.w.d. - 63 cm S. 17 (Alimpeşti II)	S.c.	4	44.44%
		A.b.	5	55.55%
O ₂₃	N - 45.0703, E - 23.8043, max.r.l. - 10 m, min.r.l. - 7 m, max.w.d. - 60 cm S. 18 (Nistoreşti)	S.c.	1	4.16%
		A.b.	20	83.33%
		B.m.	2	8.33%
		O.b.	1	4.16%

In O₁₈ the significant upstream human impact are still visible in the low number of species and individuals, in contradiction with the passing of the river in a new geographical unit category (Mateești and Sârbești hills area) which should induce an increase in fish species number. In O₁₉ the second station of this sector, the river quality is recovering and the upper Mediterranean barbel species are still present and dominant. Downstream, the Common nase zone characteristic fish associations structure reveal a medium human impact on the natural habitats (Fig. 16), due to lotic habitat's fragmentation (Figs. 17-19), industrial (coal exploitation) pollution and riverine localities waste waters pollution (Tabs. 3a, b). CF-IBI score vary between 30 and 24, reflecting some expected species to be absent or rare, omnivores and tolerant species as dominant. The passing of the river in the next hills area (Cerna and Amaradia hills) induce/increase/double the fish species number (Tab. 3b).

Table 3b: The sampled fish, in Common nase zone (O₂₄-O₃₂); *Barbus meridionalis* - *B.m.*; *Alburnoides bipunctatus* - *A.b.*; *Squalius cephalus* - *S.c.*; *Orthrias barbatulus* - *O.b.*; *Gobio uranoscopus* - *G.u.*; *Gobio gobio* - *G.g.*; *Sabanejewia romanica* - *S.r.*

O ₂₄	N - 45.0489, E - 23.8053, max.r.l. - 11 m, min.r.l. - 8 m, max.w.d. - 1 m S. 19 (Alun Dam)	<i>S.c.</i>	1	7.69%
		<i>A.b.</i>	7	53.84%
		<i>B.m.</i>	5	38.46%
O ₂₅	N - 45.0359, E - 23.8158, max.r.l. - 14 m, min.r.l. - 7 m, max.w.d. - 60 cm S. 20 (Alun)	<i>S.c.</i>	1	10%
		<i>A.b.</i>	9	90%
O ₂₆	N - 45.0049, E - 23.8227, max.r.l. - 12.5 m, min.r.l. - 7 m, max.w.d. - 54 cm S. 21 (Alun coal exploitation)	<i>S.c.</i>	5	15.15%
		<i>A.b.</i>	20	60.60%
		<i>G.u.</i>	1	3.03%
		<i>B.m.</i>	7	21.21%
O ₂₇	N - 44.9823, E - 23.8247, max.r.l. - 10 m, min.r.l. - 4 m, max.w.d. - 90 cm S. 22 (Alun IV)	<i>A.b.</i>	24	72.72%
		<i>G.u.</i>	2	6.06%
		<i>B.m.</i>	7	21.21%
O ₂₈	N - 44.9723, E - 23.8205, max.r.l. - 7.8 m, min.r.l. - 7.3 m, max.w.d. - 1 m S. 23 (Colțești)	<i>A.b.</i>	1	3.33%
		<i>G.g.</i>	1	3.33%
		<i>G.u.</i>	6	20%
		<i>B.m.</i>	10	33.33%
		<i>S.r.</i>	12	36.36%
O ₂₉	N - 44.9432, E - 23.8349, max.r.l. - 10 m, min.r.l. - 3 m, max.w.d. - 40 cm S. 24 (Between Popești and Sinești)	<i>S.c.</i>	56	48.69%
		<i>A.b.</i>	11	9.56%
		<i>G.u.</i>	5	4.34%
		<i>B.m.</i>	13	11.30%
		<i>O.b.</i>	2	1.73%
		<i>S.r.</i>	28	24.34%
O ₃₀	N - 44.9151, E - 23.8293, max.r.l. - 9 m, min.r.l. - 5 m, max.w.d. - 42 cm S. 25 (Urzica)	<i>Sc</i>	21	28.76%
		<i>Ab</i>	8	10.95%
		<i>Gu</i>	2	2.73%
		<i>Bm</i>	4	5.47%
		<i>Sr</i>	38	52.05%
O ₃₁	N - 44.8811, E - 23.8327, max.r.l. - 15 m, min.r.l. - 6 m, max.w.d. - 1.5 m S. 26 (Grădiștea)	<i>Sc</i>	14	21.87%
		<i>Ab</i>	3	4.68%
		<i>Gu</i>	31	48.43%
		<i>Bm</i>	4	6.25%
		<i>Sr</i>	12	18.75%
O ₃₂	N - 44.8485, E - 23.8359, max.r.l. - 13 m, min.r.l. - 6 m max.w.d. - 77 cm S. 27 (Tina)	<i>Sc</i>	34	35.78%
		<i>Ab</i>	21	22.10%
		<i>Gu</i>	34	35.78%
		<i>Bm</i>	2	2.10%
		<i>Sr</i>	4	4.21%

Figure 16: Natural habitat of the river in the Common nase area.

Figure 17: Stone steps which do not permit the fish to migrate.

Figure 18: Unnatural lentic habitat and sand accumulation due to a downstream dam.

Figure 19: Dam which creates upstream unnatural lentic sectors.

④ Downstream, the river flows from the hills area (Amaradia and Cerna hills) to the plateau area (Beicăi and Teslui plateaus) passing the **Podișul Getic - southern sector**, and in this sector the ichthyofauna structure is shifting to the Barbel zone (Tab. 4a, b), in conformity with the Bănărescu ichthyological zonation (1964). CF-IBI score vary between 32 and 25, reflecting a decrease in the abundance of sensitive species, some expected species absent or rare, omnivores and tolerant species as dominant.

Table 4a: The sampled fish material, in the upper barbell zone area of Olteț River (O₃₃-O₄₀); *Squalius cephalus* - S.c.; *Barbus meridionalis* - B.m.; *Alburnoides bipunctatus* - A.b.; *Gobio gobio* - G.g.; *Gobio uranoscopus* - G.u.; *Barbus barbus* - B.b.; *Sabanejewia romanica* - S.r.; *Alburnus alburnus* - A.a.

O ₃₃	N - 44.8182, E - 23.8326, max.r.l. - 17 m, min.r.l. - 12 m, max.w.d. - 53 cm	Sc	5	12.82%
		Ab	4	10.25%
		Gg	1	2.56%
		Gu	22	56.41%
		Bb	1	2.56%
		Bm	5	12.82%
		Sr	1	2.56%
O ₃₄	N - 44.7897, E - 23.8417, max.r.l. - 17.3 m, min.r.l. - 12 m, max.w.d. - 40 cm	Sc	12	34.28%
		Aa	1	2.85%
		Ab	9	25.71%
		Gg	1	2.85%
		Gu	9	25.71%
		Bm	1	2.85%
		Sr	2	5.71%
O ₃₅	N - 44.7794, E - 23.8578, max.r.l. - 31.8 m, min.r.l. - 19.1 m, max.w.d. - 54 cm	Sc	15	37.5%
		Ab	10	25%
		Gu	13	32.5%
		Bm	1	2.5%
		Sr	1	2.5%
O ₃₆	N - 44.7140, E - 23.9067, max.r.l. - 45.8 m, min.r.l. - 28.8 m, max.w.d. - 75.2 cm S.	Sc	32	51.61%
		Aa	8	12.90%
		Ab	5	8.06%
		Gu	15	24.19%
		Bm	2	3.22%
O ₃₇	N - 44.6661, E - 23.9254, max.r.l. - 43 m, min.r.l. - 32.5 m, max.w.d. - 30 cm	Sc	68	45.94%
		Aa	1	0.67%
		Ab	55	37.16%
		Gu	15	10.13%
		Bm	5	3.37%
		Sr	4	2.70%
O ₃₈	N - 44.6364, E - 23.9560, max.r.l. - 37 m, min.r.l. - 24 m, max.w.d. - 44 cm	Sc	32	76.19%
		Ab	6	14.28%
		Gg	1	2.38%
		Gu	1	2.38%
		Bm	1	2.38%
		Sr	1	2.38%

Table 4a (continuing): The sampled fish material, in the upper barbell zone area of Olteț River (O₃₉-O₄₀); *Squalius cephalus* - S.c.; *Alburnoides bipunctatus* - A.b.; *Gobio gobio* - G.g.; *Gobio uranoscopus* - G.u.; *Sabanejewia romanica* - S.r.; *Alburnus alburnus* - A.a.

O ₃₉	N - 44.6120, E - 23.9606, max.r.l. - 53.4 m, min.r.l. - 46 m, max.w.d. - 64 cm	Sc	44	83.01%
		Gg	1	1.88%
		Bm	4	7.54%
		Sr	4	7.54%
O ₄₀	N - 44.5653, E - 23.9800, max.r.l. - 88.7 m, min.r.l. - 64 m, max.w.d. - 50 cm	Sc	33	73.33%
		Aa	1	2.22%
		Ab	4	8.88%
		Gu	1	2.22%
		Bm	4	8.88%
		Sr	2	4.44%

Table 4b: The sampled fish material, in the lower barbell zone area of Olteț River (O₄₁-O₄₃); *Squalius cephalus* - S.c.; *Alburnoides bipunctatus* - A.b.; *Rhodeus sericeus amarus* - R.s.a.; *Carasius auratus gibelio* - C.a.g.; *Barbus barbus* - B.b.; *Sabanejewia romanica* - S.r.; *Sabanejewia aurata* - S.a.; *Pseudorasbora parva* - P.pa.; *Alburnus alburnus* - A.a.; *Romanogobio kessleri* - R.k.

O ₄₁	N - 44.5338, E - 23.9996, max.r.l. - 61 m, min.r.l., max.w.d. - 61 cm	Ab	7	58.33%
		Rsa	2	12.66%
		Pp	1	8.33%
		Cag	2	12.66%
O ₄₂	N - 44.5158, E - 24.0252, max.r.l. - 55 m, min.r.l., max.w.d. - 40 cm	Sc	73	35.96%
		Aa	1	0.49%
		Rsa	12	5.91%
		Rk	20	9.85%
		Bb	14	6.89%
		Sr	3	1.47%
O ₄₃	N - 44.4845, E - 24.0806, max.r.l. - 60 m, min.r.l. - 28 m, max.w.d. - 50 cm	Sa	80	39.40%
		Sc	105	52.23%
		Aa	1	0.49%
		Rsa	1	0.49%
		Rk	25	12.43%
		Bb	6	2.98%
		Sa	63	31.34%

Table 4b (continuing): The sampled fish material, in the lower barbell zone area of Olteț River (O₄₄-O₄₇); *Squalius cephalus* - S.c.; *Rhodeus sericeus amarus* - R.s.a.; *Carasius auratus gibelio* - C.a.g.; *Gobio gobio* - G.g.; *Barbus b* - B.b.; *Sabanejewia romanica* - S.r.; *Sabanejewia aurata* - S.a.; *Pseudorasbora parva* - P.pa.; *Romanogobio kessleri* - R.k.

O ₄₄	N - 44.4611, E - 24.0951, max.r.l. - 40 m, min.r.l. - 21 m, max.w.d. - 40 cm	Sc	235	74.73%
		Rsa	3	0.82%
		Rk	25	6.88%
		Bb	16	4.40%
		Sr	1	0.27%
		Sa	83	22.86%
O ₄₅	N - 44.4487, E - 24.1105, max.r.l. - 46 m; min.r.l. - 25 m, max.w.d. - 60 cm	Sc	180	64.05%
		Rsa	8	2.84%
		Gg	5	1.77%
		Rk	13	4.62%
		Bb	6	2.13%
		Cag	1	0.35%
		Sr	2	0.71%
		Sa	66	23.48%
O ₄₆	N - 44.4208, E - 24.1069, max.r.l. - 60 cm, min.r.l. - 20 m, max.w.d. - 56 cm	Sc	263	78.74%
		Rsa	6	1.79%
		Gg	2	0.59%
		Rk	10	2.99%
		Bb	15	4.49%
		Sa	38	11.37%
O ₄₇	N - 44.3936, E - 24.1121, max.r.l. - 46 m, min.r.l. - 32 m, max.w.d. - 60 cm	Sc	146	50%
		Rsa	16	5.47%
		Gg	5	1.71%
		Rk	3	1.02%
		Ppa	1	0.34%
		Bb	2	0.68%
		Cag	1	0.34%
		Sa	118	40.41%

The river passing from hills area to plateau area, the significant increasing of the Olteț River water volume due to some important tributaries (Fig. 20) and the dominance of fine sand river bed sectors (Fig. 21) is the natural explanation for the local ichthyofauna shifting to the Barbel zone.

The deviations of the ichthyofauna structure from the natural Barbel zone one in the Romanian Carpathians (Bănărescu, 1964) in these sectors can be explained by the local human impacts like: pollution, habitat modifications (Fig. 23), roads in the riverbed and illegal fishing (Fig. 22).

Figure 20: Confluence of Olteț River with Cerna River (Olteț River biggest tributary).

Figure 21: The appearance of massive fine sandy riverbeds and banks areas.

Figure 22: Roads in the river.

Figure 23: River linearization using rockfill banks; near the Dinculești locality.

⑤ Downstream the river flows in and passes (48-55 sampling stations) the **Câmpia Română/Romanian Plain sector**, (Caracal Plain and Olt River meadow) sector which has an ichthyofauna structure that is shifting to the Carp zone, in conformity with the Bănărescu ichthyological zonation (1964).

Table 5: The sampled fish material, in the Carp zone area of Olteț River (O₄₈-O₅₆); *Squalius cephalus* - S.c.; *Rhodeus sericeus amarus* - R.s.a.; *Gobio gobio* - G.g.; *Romanogobio kesleri* - R.k.; *Barbus meridionalis* - B.m.; *Barbus barbus* - B.b.; *Carasius auratus gibelio* - C.a.g.; *Sabanejewia romanica* - S.r.; *Sabanejewia aurata* - S.a.; *Lepomis gibosus* - L.g.; *Alburnus alburnus* - A.a.; *Perca fluviatilis* - P.f.; *Pelecus cultratus* - P.c.; *Silurus glanis* - S.g.; 48-55 - quantitative samplings, 56 - qualitative samplings.

O ₄₈	N - 44.3715, E - 24.1108, max.r.l. - 55 m, min.r.l. - 35 m, max.w.d. - 35 cm.	Sc	63	56.25%
		Rsa	9	8.03%
		Gg	15	13.39%
		Rk	8	7.14%
		Bm	1	0.89%
		Cag	1	0.89%
		Sr	1	0.89%
		Sa	8	7.14%
O ₄₉	N - 44.3448, E - 24.1015, max.r.l. - 39 m, min.r.l. - 22 m, max.w.d. - 50 cm	Lg	2	1.78%
		Sc	62	50%
		Rsa	2	1.61%
		Gg	3	2.41%
		Rk	12	9.67%
		Bm	1	0.80%
		Cag	2	1.61%
O ₅₀	N - 44.3207, E - 24.1217, max.r.l. - 60 m, min.r.l. - 39 m, max.w.d. - 55 cm.	Sa	42	33.87%
		Sc	5	3.75%
		Rsa	3	2.25%
		Gg	2	1.50%
		Rk	77	57.89%
		Cag	1	0.75%
		Sr	1	0.75%
O ₅₁	N - 44.2855, E - 24.2213, max.r.l. - 72 m, min.r.l. - 35 m, max.w.d. - 55 cm.	Sa	44	33.08%
		Sc	48	31.78%
		Aa	1	0.66%
		Rsa	2	1.32%
		Gg	2	1.32%
		Rk	18	11.92%
		Bb	1	0.66%
		Bm	1	0.66%
		Cag	7	4.63%
		Sr	1	0.66%
		Sa	70	46.35%

O ₅₂	N - 44.2844, E - 24.2446, max.r.l. - 66 m, min.r.l. - 25 m, max.w.d. - 60 cm	<i>Sc</i>	7	2.37%
		<i>Rsa</i>	1	0.33%
		<i>Rk</i>	51	17.28%
		<i>Cag</i>	1	0.33%
		<i>Sa</i>	235	79.66%
O ₅₃	N - 44.2331, E - 24.3396, max.r.l. - 50 m, min.r.l. - 20 m, max.w.d. - 70 cm	<i>Sc</i>	42	33.07%
		<i>Aa</i>	1	0.78%
		<i>Gg</i>	2	1.57%
		<i>Rk</i>	40	31.49%
		<i>Bm</i>	1	0.78%
		<i>Cag</i>	5	3.93%
O ₅₄	N - 44.2332, E - 24.3649, max.r.l. - 42 m, min.r.l. - 13 m, max.w.d. - 1.5 m	<i>Sa</i>	36	28.34%
		<i>Sc</i>	17	4.76%
		<i>Aa</i>	2	0.56%
		<i>Ab</i>	1	0.28%
		<i>Rk</i>	7	1.96%
		<i>Cag</i>	325	91.03%
O ₅₅	N - 44.2296, E - 24.3978, max.r.l. - 47 m, min.r.l. - 24 m, max.w.d. - 1 m	<i>Sa</i>	5	1.40%
		<i>Sc</i>	4	10%
		<i>Aa</i>	7	17.5%
		<i>Rk</i>	25	62.5%
		<i>Cag</i>	1	2.5%
		<i>Lg</i>	1	2.5%
O ₅₆	N - 44.2231, E - 24.4359, max.r.l. - 95 m, min.r.l. - 80 m, max.w.d. - 2.5	<i>Ac</i>	2	5%
		<i>Sc</i>	3	2.14%
		<i>Aa</i>	17	12.14%
		<i>Rk</i>	15	10.71%
		<i>Cc</i>	1	0.71%
		<i>Cag</i>	99	70.71%
O ₅₆	N - 44.2231, E - 24.4359, max.r.l. - 95 m, min.r.l. - 80 m, Maximum water depth - 2.5 m	<i>Lg</i>	3	2.14%
		<i>Ac</i>	2	1.42%
		<i>El</i>	+	+
		<i>Abr</i>	+	+
		<i>Aa</i>	+	+
		<i>Rsa</i>	+	+
		<i>Ppa</i>	+	+
		<i>Pf</i>	+	+
O ₅₆		<i>Pc</i>	+	+
		<i>Sg</i>	+	+

The high river water volume (Fig. 24), the presence of only fine sand river bed sectors (Fig. 26), the lowland aquatic plants areas, the slow water speed and the relatively meandered course are the natural explanation for the local fish fauna shifting to the carp zone.

The deviations of the ichthyofauna structure from the natural ones (Bănărescu, 1964) in these sectors can be explained by the local human impacts like: pollution, habitat modifications (Figs. 28 and 29), improper wastes management (Fig. 25) and illegal fishing.

CF-IBI score vary between 30 and 22, reflecting a decrease abundance of sensitive species, some expected species absent or rare, omnivores and tolerant species dominant.

Figure 24: Characteristic habitat in the lower sector of Olteț River.

Figure 25: The constant presence of solid waste on the river banks.

Figure 26: Lower course of Olteț River.

Figure 27: Direct polluted spills in the river in Balș urban area.

Figure 28: Olteț River, four km from its confluence with Olt River.

Figure 29: Natural flow of Olteț River at one km from the confluence with Olt River.

DISCUSSION

From the perspective of the local fish ichthyofauna associations, the O₁₋₁₅ sector represents the upper trout zone in a relatively pristine area. O₅₄₋₅₆ sections represent the most typical habitats for the plain macro habitats of Olteț River, the exception of O₅₅ sector is caused by the human impact in the locality Fălcoiu (O₅₅). O₁₆₋₁₇₋₂₁ has a close degree of similarity because the local fish ichthyocenoses react to the effects of the riverbed exploitations. O₅₀₋₅₂₋₅₅ has a close degree of similarity because the local fish ichthyocenoses react to a certain communal (Barza, Șopârlița and Fălcoiu) human impact in a low land macro habitats type. O₁₋₁₃ is in a typically mountainous/Carpathian area and O₁₄₋₁₈ is in a typically submountainous/subcarpathian zone, its lower part, O₁₆₋₁₈ sector, being strongly influenced by the human impact. O₁₈₋₁₉ has a close degree of similarity because the local fish ichthyocenoses react to the presence of concrete medium sized (two m) dams.

Using the graph (Fig. 30) where the interrupted columns represent the stations where the number of species increases from the previous station, the black columns represent the number of species that decrease from the previous station and the grey columns represent those stations that have the same number of species with the previous station; we can emphasize the fact that there are many variations in species number, either because of the basic natural/geographic causes or due to anthropogenic causes.

Figure 30: Fluctuations of fish species in each station on the course of Olteț River.

The increasing of fish species number in 16-17, 19-20, 26, 29, 40, 47-48, 53, 56, sampling sectors reveal the natural changing of the ichthyological zone due to the river passing from one type of **geographical**/relief unit category to another category.

The unnatural decreasing of fish species number in the 18, 21, 24-25, 27, 30, 35, 39, 41, 43, 46, 49, 52, 54, sampling sectors have a **human** activities impact origin.

Other cases of river sectors (23, 28, 33, 37, 40, 42, 45, 51) where the fish species number increase without a connection with the geographical/relief units changing, is represented through **recovering** of the river habitats quality due to natural self-cleaning processes downstream of some anthropogenically impacted river sectors. It can be noticed that the recovery period, based on distances on the downstream sectors with problems, are faster in the upper ichthyological zones and slower in the lower ichthyological zones. This meaning that the fish communities' characteristics for the lower course of the river are easier to be negatively affected by the human impact than the upper one, at least in the Olteț River case. The slower self-cleaning capacity of the river and the much easier natural access of the humans to the river (localities, activities, etc.) can be explanations.

The fish communities' similarity in the 56 sampled lotic sectors along the Olteț River, based on the relative abundance of the component fish species, reveal the relation among the ichthyologic zones (Bănărescu, 1964) and some specific habitats presence, related also with significant different geographical units (Fig. 31).

In general, the passing of the river from one type of geographical/relief type unit to another induces the changing of the ichthyological zone and the increase of the fish species number. The cases where this situation did not appear are because different human impacts create unnatural variations in fish communities' compositions and individuals' number. It highlighted the fact that the geographical elements, human impact and the self-cleaning capacity of the river are the main driving forces which induce the fish fauna variability.

Figure 31: The fish communities' similarity along Olteț River, based on the component species relative abundance.

A half of the century which passes from the Bănărescu fish fauna study (1964) of the Olteţ River lower sector, reveals significant modifications in ichthyofauna structure (Tab. 6) mainly due to significant habitat changes such as the creation of an important lenitic area at the Olteţ-Olt confluence.

Table 6: Ichthyofauna (1960s/present) in the Balş city to the Olteţ-Olt rivers confluence sector.

	1960s	Present
1.	<i>Gobio kessleri</i>	<i>Gobio kessleri</i>
2.	<i>Sabanejewia aurata balcanica</i>	<i>Sabanejewia aurata</i>
3.	<i>Sabanejewia romanica</i>	<i>Sabanejewia romanica</i>
4.	<i>Gobio gobio</i>	<i>Gobio gobio</i>
5.	<i>Leuciscus cephalus</i>	<i>Leuciscus cephalus</i>
6.	<i>Carassius auratus gibelio</i>	<i>Carrasius auratus gibelio</i>
7.	<i>Barbus barbus</i>	<i>Barbus barbus</i>
8.	<i>Alburnus alburnus</i>	<i>Alburnus alburnus</i>
9.	<i>Exos lucius</i>	<i>Exos lucius</i>
10.	<i>Cyprinus carpio</i>	<i>Cyprinus carpio</i>
11.	<i>Cobitis taenia</i>	<i>Cobitis taenia</i>
12.	-	<i>Barbus meridionalis</i>
13.	-	<i>Rodeus sericeus amarus</i>
14.	-	<i>Alburnoides bipunctatus</i>
15.	-	<i>Acerina cernua</i>
16.	-	<i>Lepomis gibosus</i>
17.	-	<i>Abramis brama</i>
18.	-	<i>Aspius aspius</i>
19.	-	<i>Perca fluviatilis</i>
20.	-	<i>Pelecus cultratus</i>
21.	-	<i>Silurus glanis</i>

Despite the fact that more than half of a century has passed from the moment when Mr. Bănărescu M. P. proposed a zonation of the fish fauna on the Romanian national territory specific natural conditions (a zonation which is generally valuable even today), there were no other applied studies which reveal more than a relation between the fish associations and the major relief units (mountain, hills, plain) respectively to some gradients induced by the altitudinal variation. On the other hand, the Carpathian Fish Index of Biotic Integrity (CF-IBI), and other such biotic indexes, can highlight the fish communities' ecological state variation, but cannot explain it. This study highlighted the possibility to explain the fish fauna variation in relation with smaller relief units presence and variation, smaller relief units characterized by distinct geological and geomorphologic (biotope) conditions (even sometimes overlapped in their neighbouring areas) of the lotic sectors.

Naturally, there where the passing from one geographical/geological unit which appeared sharply, the ichthyological changes happened in relatively short sectors, and there where the biotopes characteristics changing gradually, gradually will appear the changes of ichthyofauna structure. In the last cases (e.g. Podişul Getic) it is more appropriate to work with ichthyological subzones, not only with ichthyological zones.

Even if the relation among geologic substrata (G) - relief units (R) - preponderant aquatic macro habitat types (A) - ichthyologic structures (F), (GRAF) is relatively obvious for Olteţ River, the necessity of this type of approach through identifying the trends and gradients among these elements than rigid and arbitrary limiting separations along the river should be understood.

The degree of relativeness of the relations among geologic substrata - relief units - preponderant aquatic macro habitat types - ichthyologic structures (GRAF), increase in general under the increasing impact of many human impact categories, in these cases/sectors the interpretation of the fish fauna distribution and structure should be rather easy to interpretate.

The field effort (the relatively high number of sampling stations) necessary to such an approach is significantly higher than the majority of the fish inventory, assessment and monitoring types realized in the present Carpathians rivers.

In the less human influenced sectors, the ichthyologic classic zones (sensu Bănărescu 1964), have a better overlapping with the existent relief units which usually change together (mountain zones).

In the significant human influenced sectors, the ichthyologic classic zones (sensu Bănărescu 1964), have a relative overlapping with the existent relief units, the ichthyofauna changing are usually not immediate like in the mountainous zones (e.g. Polovraci Depression).

As far as the relief energy decrease, from high altitudes to low altitudes, the passing from one ichthyologic zone to the next one is far from the limit of one relief unit to the next one.

The natural passing from one ichthyologic zone to the next one can hardly be observed if the human impact is diversely present in those areas.

CONCLUSIONS

A white spot regarding the fish fauna of the upper and middle Olteţ River was covered and the changes appeared in this respect and in the lower course were identified.

The passing of the river from one type of geographical/relief type unit to another induces the changing of the ichthyological zone and the increasing of the fish species number.

There where this natural situation did not appear is because different human impacts create unnatural variations in fish communities' compositions and individual numbers. The presence of various human impact, especially downstream the mountain area, make a relatively unbalanced fish fauna structure, in comparison with the mountainous sector.

Overall, the geographical and human impact elements, and a result of them, the self-cleaning capacity of the river, are the main driving forces which induce the fish fauna composition variability.

If such studies will be repeated in other Carpathian rivers, a new index of relative overlapping ichthyofauna-relief units categories which highlights and explains the missing/presence/importance of the human impact on fish fauna structure can be proposed.

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