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RESEARCH ON ARGES RIVER FISH FAUNA IN BUDEASA-GOLESTI AREA

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Abstract
Arges River was subject to periodic ichthyologic, hydrobiological and hydrological research. By its content and approach the present paper shows a series of research on fish fauna in Budeasa-Golesti area of Arges River, Pitesti.
By research presented in the study we sought to evaluate the state and evolution of fish fauna in the city reservoirs, Pitesti area, over the last 30 years, trying to highlight the causes that led to the current situation and to propose measures for the conservation of natural fish fauna in the future. Fish fauna in Pitesti area currently consists of 14 species belonging to four families: Cyprinidae (9 species), Cobitidae (1 species), Esocidae (1 species) and Percidae (3 species). Most species live naturally in lakes studied except for one species Pseudorasbora parva which was introduced accidentally. The research undertaken to reflect changes in the fish fauna in the last 30 years, indicates an increase in the number of species, either through deliberate stocking for sport fishing purposes or due to changes in biotope favouring the development of certain species which were accidental in the past.

Keywords: fish fauna, Budeasa – Golesti area of Arges River

1. INTRODUCTION

Arges River starts from Lake Vidraru (Ujvári, 1972) and has a length of 350 km. It springs from Fagaras Mountains, with its two sources Capra and Buda, which form Argeș River. The main tributaries, following the hydrographic basin are: Valsan, Doamnei (the highest flow), Targul River, Carcinov, Neajlov, Dambovnic, Calnistea, Glavacioc, Sabar and Dambovita River (the longest).
Arges River is supplied asymmetrically, the tributaries on the left with a flow rate 6 times higher than those on the right. The main tributaries of the left (Valsan, Doamnei, Dambovita) form their basins in the subalpine area, where there is pluvio-nival and underground supply with more uniform state on seasons. The only important tributary on the right is Neajlov which has seasonal drainage with high differences during the year (PMBH, 2010).
Argeș Basin first large-scale work began with Vidraru harnessing (1965 - 1971). With a height of 166.6 m, it is the highest dam in Romania (V = 465 million m^3). The complex scheme of Argeș River (Fig. 1) harnessing (up to Golesti) comprises a chain of 11 basins (Vidraru, Oesti, Cerbureni, Curtea de Arges, Zigoneni, Valcele, Budeasa, Bascov, Pitesti, Prundu and Golesti), 16 electric power stations, and other derivations (Doamnei-Valsan-Arges (Vidraru), Topolog-Arges (Vidraru) (Mititelu, 2010).

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In Arges basin there are 7 storage reservoirs with complex use of which the most important is Vidraru, followed by Zigoneni, Valcele, Budeasa, Golesti and Mihailesti lakes (PMBH, 2010).
Arges River has a wide basin on the large amphitheater between peaks of the Carpathians and the Danube, on an area of more than 12.000 square km. It gathers a dense water network and is the typical representative of hydrographic systems in Wallachia (Ujvári, 1972).
In the geographical space of our country, Argeş basin is distinguished by its origin from our most imposing massif – Fagaras - and its picturesque landscapes, following a wide variety of landforms, from the high peaks of the mountains up to Romanian Plain at the junction with Danube.
Arges River, with its tributaries, is one of the major hydrographic systems of the country in terms of hydropower potential and water supply for villages and towns, industrial units and agricultural land.
Arges River was subject to periodic ichthyologic, hydrobiological and hydrological research. Such research has a particular importance to understand the factors that affect the evolution and features of aquatic ecosystems, and to know the specific composition and dynamics of fish fauna, which is one of Romania's riches.

Figure 1. General scheme for harnessing Argeş River (Mititelu, 2010)

This basin shelters a diverse fish fauna, especially *Romanichthys valsanicola* paleoendemism, the only representative of Percidae family in the mountain waters and species with the smallest habitat in Romanian and European rheophile fish fauna (Vladutu, 2008).
Anthropogenic influence along the main course of the river has revealed this increasingly acute phenomenon. River harnessing, poaching, pollution, exploitation of material from the river bed, meadows bordering the water have increased degradation of the ecosystem from one year to another. Numerous dams and reservoirs built on Arges River undoubtedly brought economic benefits but have profoundly changed the river's ecosystem, causing alterations in the normal trophic structure with harmful effects on the fish flora and not only. As a result, some fish species have disappeared or have been brought to the brink of extinction, while others have found favorable conditions to multiply in the reservoirs built on Argeş River (Ionescu, 2001).
Human intervention was felt not only by harnessing the water course, but also by overfishing and through continuous discharge of waste consisting of sewage, contaminated water from various economic units etc., which led to eutrophication and water poisoning. These actions could only have harmful effects on the aquatic ecosystem of the river (Ionescu, 2001).

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By its content and approach the present paper shows a series of research on fish fauna in Budeasa-Golesti area of Arges River, Pitesti.
By research presented in the study we sought to evaluate the state and evolution of fish fauna in the city reservoirs, Pitesti area, over the last 30 years, trying to highlight the causes that led to the current situation and to propose measures for the conservation of natural fish fauna in the future.
To achieve this goal, the following objectives were regarded:

- inventory of fish fauna in Pitesti area basins;
- characterization of fish species that live on Arges River, Budeasa-Golesti area;
- identification of changes for the fish fauna in the area studied in the past 30 years, and causes that led to the current situation;
- proposing a set of measures for the conservation and protection of fish fauna.

2. MATERIALS AND METHODS

To carry out a comprehensive and thorough research of fish fauna in Argeş River Budeasa-Golesti area, we did some field work in April, June and October, 2012.
To catch fish, we used fishing rods, nets and a more popular method among fishermen called *hand fishing*. All samples caught were identified and then released back into the water. (Fig.2)
To determine changes in the structure of fish fauna in the last 30 years there has been used the survey investigating the experienced fishermen who frequent the study area. It contains questions about species existing before 1990, species that are being currently caught, and questions that highlight the perception of fishermen on changes in the composition of fish fauna in the study area over the past 30 years. It also proposes a set of measures for conservation and protection of current fish fauna.

Figure 2. Rod Fishing, net fishing and fish release in the lakes in the study area (original photo)

3. RESULTS AND DISCUSSIONS

As mentioned in the previous chapter, we did some field work, in April, June and October, 2012. There have been established four research areas for sampling fish species: Budeasa, Bascov, Pitesti and Golesti.

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Following research in the field we have identified 14 fish species (Tables 1 – 4), belonging to four families (Fig. 3).
Data analysis (Table 1) shows the identification of 9 species of cyprinides, one species of cobitidae, one species of esocidae and three species of percidae (Fig. 3). Data on the percentage of species and ecological spectrum of families are shown in Figure 4 – 7.
Alburnus alburnus (bleak) is present in all sectors, recording the lowest values in October, 115 samples in Golesti, and the highest values in June, 205 samples in Bascov.
Barbus barbus (barbell) and *Barbus meridionalis petenyi* are present in only one sector, both identified at the mouth of Pitesti basin.
Barbus meridionalis petenyi is very low in number, 1-2 samples, which means the species is accidental in this area of Arges River.

Table 1. Family distribution of fish species in Budeasa-Golesti area

Order	Family	Species
Cypriniformes	**Cyprinidae**	*Alburnus alburnus* Linnaeus, 1758
		Barbus barbus Linnaeus, 1758
		Barbus meridionalis petenyi Risso, 1826
		Carassius auratus gibelio Bloch, 1782
		Gobio gobio Linnaeus, 1758
		Squalis (Leuciscus)) cephalus Linnaeus, 1758
		Rutilus rutilus Linnaeus, 1758
		Rhodeus amarus Pallas, 1776
		Pseudorasbora parva Temminck&Schleger, 1846
	Cobitidae	*Cobitis taenia* Linnaeus, 1758
Esociformes	**Esocidae**	*Esox lucius* Linnaeus, 1758
Perciformes	**Percidae**	*Perca fluviatilis* Linnaeus, 1758
		Lepomis gibbosus Linnaeus, 1758
		Sander (Stizostedion) lucioperca Linnaeus, 1758

Figure 3. The species identified in Budeasa – Golesti area (original photo)

Carassius auratus gibelio (silver crucian) is present in all sectors, with the lowest values in Budeasa, 12 samples in April, and the highest values in Pitesti, 48 samples in June.

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Table 2. Number and percentage of species and distribution of fish fauna on Arges River, Budeasa-Golesti area APRILIE 2012

SPECIES	SAMPLING STATIONS								TOTAL	%
	BUDEASA		BASCOV		PITEȘTI		GOLEȘTI			
	NR. IND.	%	NR. IND.	%	NR. IND.	%	NR. IND.	%		
I. FAM. CYPRINIDAE										
Alburnus alburnus	178	16.06	160	14.59	120	14.81	173	22.4	631	16.66
Barbus barbus	-	-	-	-	-	-	-	-	-	-
Barbus meridionalis petenyi	-	-	-	-	-	-	2	0.25	2	0.05
Carassius auratus gibelio	12	1.08	18	1.64	45	5.55	25	3.23	100	2.64
Gobio gobio	28	2.52	55	5.01	30	3.7	20	2.59	133	3.51
Squalius (Leuciscus) cephalus	12	1.08	8	0.72	27	3.33	38	4.92	85	2.24
Rutilus rutilus	118	10.64	80	7.29	87	10.74	30	3.88	315	8.32
Rhodeus amarus	328	29.6	276	25.18	184	22.71	125	16.19	913	24.11
Pseudorasbora parva	24	2.16	28	2.55	32	3.95	18	2.33	102	2.69
II. FAM COBITIDAE										
Cobitis taenia	-	-	-	-	-	-	-	-	-	-
III. FAM ESOCIDAE										
Esox lucius	3	0.27	3	0.27	8	0.98	13	1.68	27	0.71
IV. FAM PERCIDAE										
Perca fluviatilis	310	27.97	380	34.67	240	29.62	278	36.01	1208	31.9
Lepomis gibbosus	95	8.57	88	8.02	35	4.32	42	5.44	260	6.86
Sander (Stizostedion) lucioperca	-	-	-	-	2	0.24	8	1.03	10	0.26
TOTAL	**1108**	**100**	**1096**	**100**	**810**	**100**	**772**	**100**	**3786**	**100**

Table 3 Number and percentage of species and distribution of fish fauna on Arges River, Budeasa-Golesti area JUNE 2012

SPECIES	SAMPLING STATIONS								TOTAL	%
	BUDEASA		BASCOV		PITEȘTI		GOLEȘTI			
	NR. IND.	%	NR. IND.	%	NR. IND.	%	NR. IND.	%		
I. FAM. CYPRINIDAE										
Alburnus alburnus	175	16.47	205	18.38	167	18.25	129	15.43	676	*17.2*
Barbus barbus	-	-	-	-	-	-	-	-	-	-
Barbus meridionalis petenyi	-	-	-	-	-	-	-	-	-	-
Carassius auratus gibelio	22	2.07	18	1.61	48	5.24	40	4.78	128	*3.25*
Gobio gobio	35	3.29	55	4.93	40	4.37	32	3.82	162	*4.12*
Squalius (Leuciscus) cephalus	13	1.22	16	1.43	60	6.55	40	4.78	129	*3.28*
Rutilus rutilus	80	7.53	110	9.86	75	8.19	84	10.04	349	*8.88*
Rhodeus amarus	289	27.21	267	23.94	135	14.75	137	16.38	828	*21.07*
Pseudorasbora parva	32	3.01	30	2.69	37	4.04	20	2.39	119	*3.02*
II. FAM COBITIDAE										
Cobitis taenia	-	-	-	-	-	-	-	-	-	-
III. FAM ESOCIDAE										
Esox lucius	8	0.75	12	1.07	15	1.63	11	1.31	46	*1.17*
IV. FAM PERCIDAE										
Perca fluviatilis	328	30.88	305	27.35	278	30.38	290	10.76	1201	*30.57*
Lepomis gibbosus	80	7.53	97	8.69	55	6.01	38	4.54	270	*6.87*
Sander (Stizostedion) lucioperca	-	-	-	-	5	0.54	15	1.79	20	*0.50*
TOTAL	***1062***	***100***	***1115***	***100***	***915***	***100***	***836***	***100***	***3928***	***100***

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Gobio gobio (gudgeon) was caught in all lakes, recording the lowest values in Golesti, 20 samples in April, and the highest number of samples in Bascov, 55 samples for each month April and June.
Squalis (Leuciscus) cephalus (chub) is present in all the sectors studied, showing the lowest values in Budeasa, 8 samples in October, and Bascov, 8 samples in April.
Rutilus rutilus (roach) is found in all research stations, recording the lowest values in Golesti 30 samples in April, and the highest number in Budeasa, 118 samples in April.
Rhodeus amarus is present in all sectors, with the lowest values in Golesti, 125 samples in April, and the highest values in Budeasa, 328 samples in April.
Pseudorasbora parva was caught in all basins, recording the lowest values in Golesti in April and Budeasa in October. Both sectors had the same number of samples (18), with the highest values in Piteşti, 18 samples in October.

Table 4. Number and percentage of species and distribution of fish fauna on Argeş River, Budeasa-Goleşti area OCTOBER 2012

SPECIES	SAMPLING STATIONS								TOTAL	%
	BUDEASA		BASCOV		PITEŞTI		GOLEŞTI			
	NR. IND.	%	NR. IND.	%	NR. IND.	%	NR. IND.	%		
I. FAM. CYPRINIDAE										
Alburnus alburnus	180	21.42	165	15.12	128	14.62	115	11.95	588	15.6
Barbus barbus	-	-	-	-	-	-	25	2.59	25	0.66
Barbus meridionalis petenyi	-	-	-	-	-	-	1	0.10	1	0.026
Carassius auratus gibelio	23	2.73	18	1.64	30	3.42	44	4.57	115	3.05
Gobio gobio	28	3.33	48	4.39	36	4.11	28	2.91	140	3.71
Squalius (Leuciscus) cephalus	8	0.95	18	1.64	28	3.2	33	3.43	87	2.3
Rutilus rutilus	48	5.71	70	6.41	89	10.17	50	5.19	257	6.82
Rhodeus amarus	250	29.76	300	27.49	180	20.57	135	14.03	865	22.95
Pseudorasbora parva	18	2.14	22	2.01	38	4.34	30	3.11	108	2.86
II. FAM COBITIDAE										
Cobitis taenia	-	-	-	-	-	-	25	2.59	25	0.66
III. FAM ESOCIDAE										
Esox lucius	15	1.78	30	2.74	15	1.71	33	3.43	93	2.46
IV. FAM PERCIDAE										
Perca fluviatilis	180	21.42	300	27.49	250	28.57	340	35.34	1070	28.39
Lepomis gibbosus	90	10.71	120	10.99	80	9.14	78	8.1	368	9.76
Sander (Stizostedion) lucioperca	-	-	-	-	1	0.11	25	2.59	26	0.69
TOTAL	**840**	**100**	**1091**	**100**	**875**	**100**	**962**	**100**	**3768**	**100**

Table 4 shows that *Cobitis taenia* (groundling) is present in only one sector, from Piteşti basin inflow up to Goleşti.
Esox lucius (pike) was caught in all sectors, with the lowest values in Budeasa and Bascov in April. Three samples were caught in each area. Pike recorded the highest values in Golesti, 33 samples in October.
Of percidae, *Sander lucioperca* (perch) is currently present in Goleşti and Piteşti, 8 samples being identified in the latter.
Perca fluviatilis (bass) is present in all lakes, recording the lowest values in Budeasa, 180 samples in October, and the highest number of individuals in Bascov, 380 samples in April.
Lepomis gibbosus is present in all sectors, with the lowest values in Pitesti, 35 samples in April, and the highest number in Bascov, 120 samples in October.

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The most numerous samples were recorded for *Rhodeus amarus*, Budeasa, 328 samples in April, *Alburnus alburnus*, Bascov, 205 samples in June, and *Perca fluviatilis*, Bascov, 380 samples in April. The three species are present in all research sectors studied.
In terms of frequency (Table 5), statistics shows the highest values (100%) for euconstant species *Alburnus alburnus, Carassius auratus gibelio, Gobio gobio, Squalis cephalus, Rhodeus amarus, Rutilus rutilus, Pseudorasbora parva, Esox lucius, Perca fluviatilis and Lepomis gibbosus*, followed by accessory species *Sander lucioperca* (50%). The lowest values (25%) were recorded for accidental species *Barbus barbus*, *Barbus meridionalis petenyi* and *Cobitis taenia*.

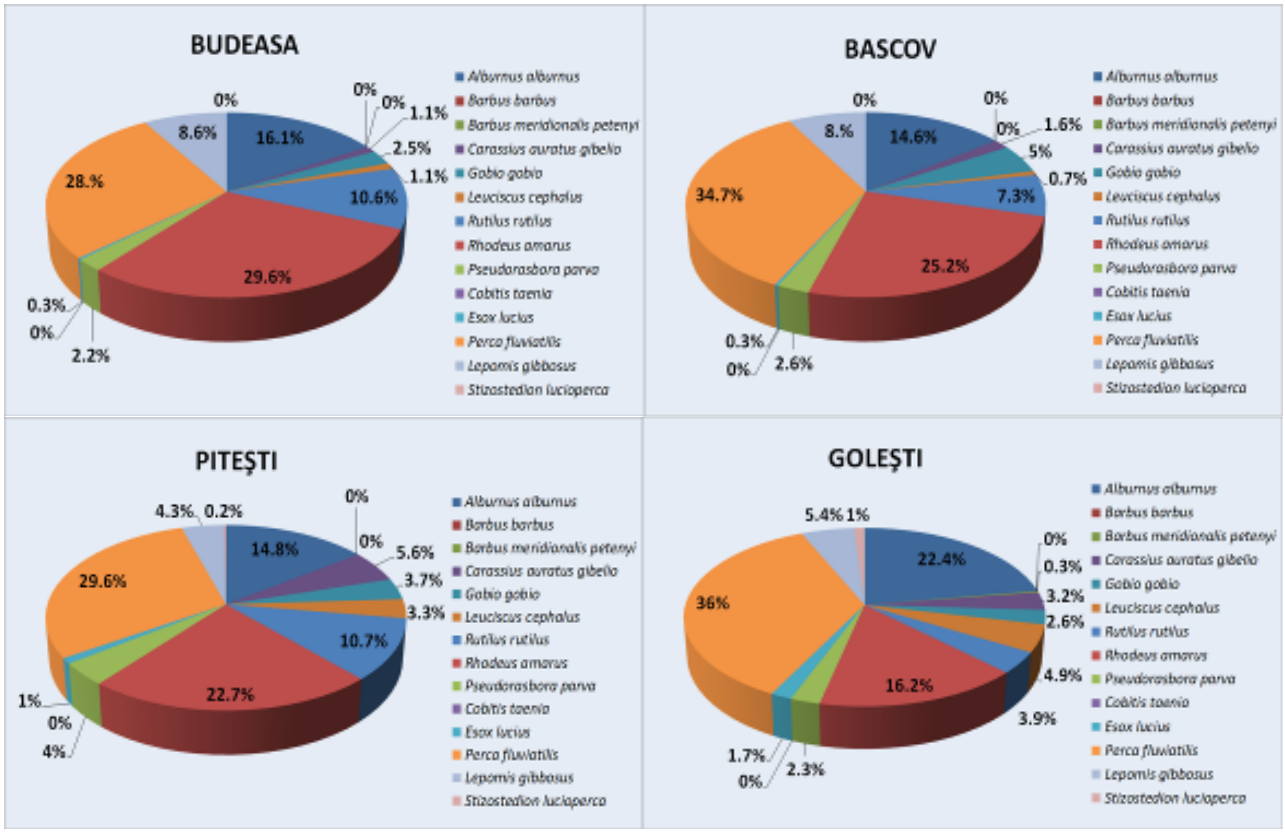

Figure 4. Percentage of species in April 2012

In terms of global abundance, the highest values were recorded for *Perca fluviatilis* - 30.29 - followed by *Rhodeus amarus* - 22.69 and the lowest values for *Sander lucioperca* - 0.48, *Barbus barbus, Cobitis taenia* – 0.21 each, and *Barbus meridionalis petenyi* 0.02.
According to personal data, 14 fish species were found in Budeasa-Golesti area. As mentioned in chapter "Materials and methods" we used the survey to determine the changes in the structure of fish fauna in the past 30 years, asking experienced fishermen who visited the area under study.
Following information received from fishermen, 8 fish species used to be caught before 1990: *Alburnus alburnus, Barbus barbus, Carassius auratus gibelio, Cyprinus carpio, Esox lucius, Squalis cephalus, Rutilus rutilus* and *Perca fluviatilis*.

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These data reveal that percidae *Sander lucioperca* was recently introduced in Argeş waters and cyprinid *Cyprinus carpio* was frequently fished before 1990. It should be noted that this species was not identified by research carried out in 2012.

Table 5. Frequency, constancy and abundance of species identified

SPECIES	Frequency	Constancy sp.	Abundance
Alburnus alburnus	100	EUCONSTANT	16,5
Barbus barbus	25	ACCIDENTAL	0,21
Barbus meridionalis petenyi	25	ACCIDENTAL	0,02
Carassius auratus gibelio	100	EUCONSTANT	2,98
Gobio gobio	100	EUCONSTANT	3,78
Squalius cephalus	100	EUCONSTANT	2,62
Rutilus rutilus	100	EUCONSTANT	8,02
Rhodeus amarus	100	EUCONSTANT	22,69
Pseudorasbora parva	100	EUCONSTANT	2,86
Cobitis taenia	25	ACCIDENTAL	0,21
Esox lucius	100	EUCONSTANT	1,44
Perca fluviatilis	100	EUCONSTANT	30,29
Lepomis gibbosus	100	EUCONSTANT	7,82
Sander lucioperca	50	ACCESORY	0,48

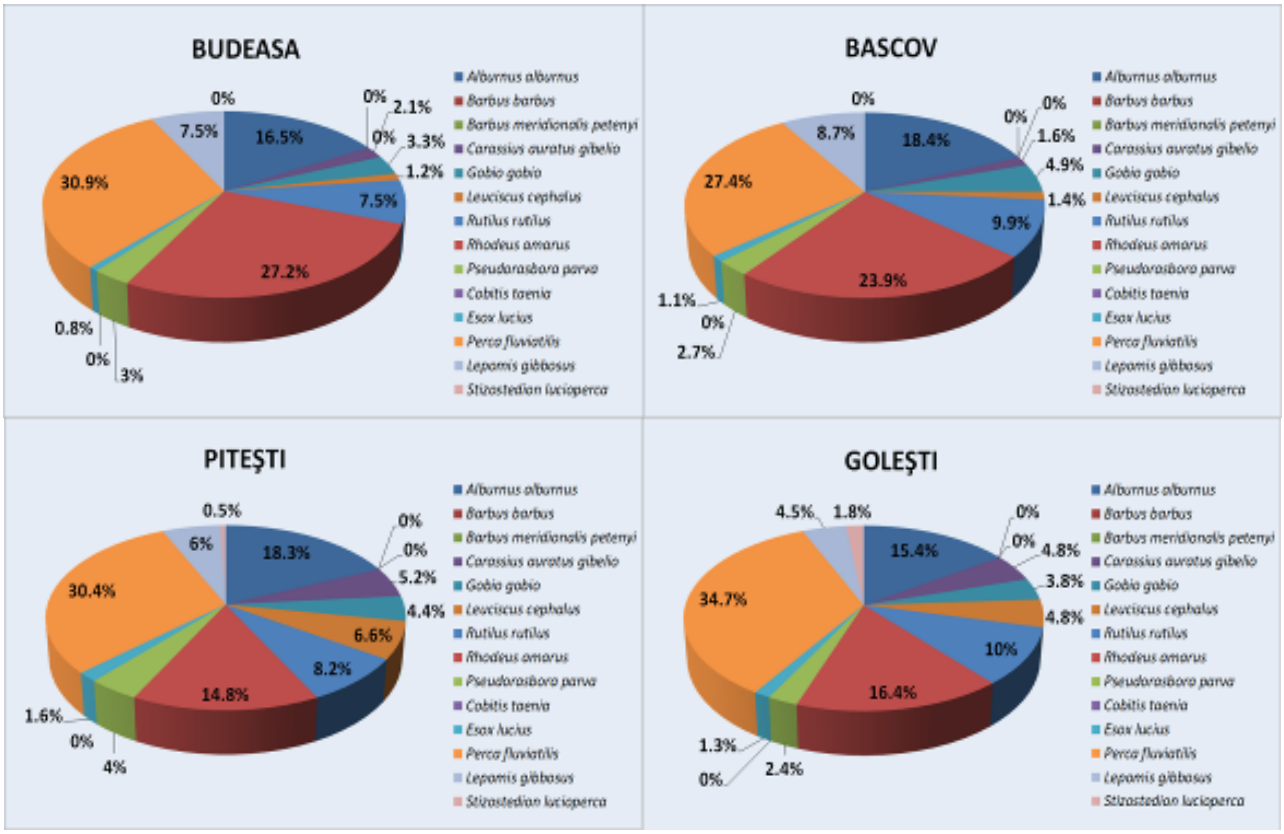

Figure 5. Percentage of species in June 2012

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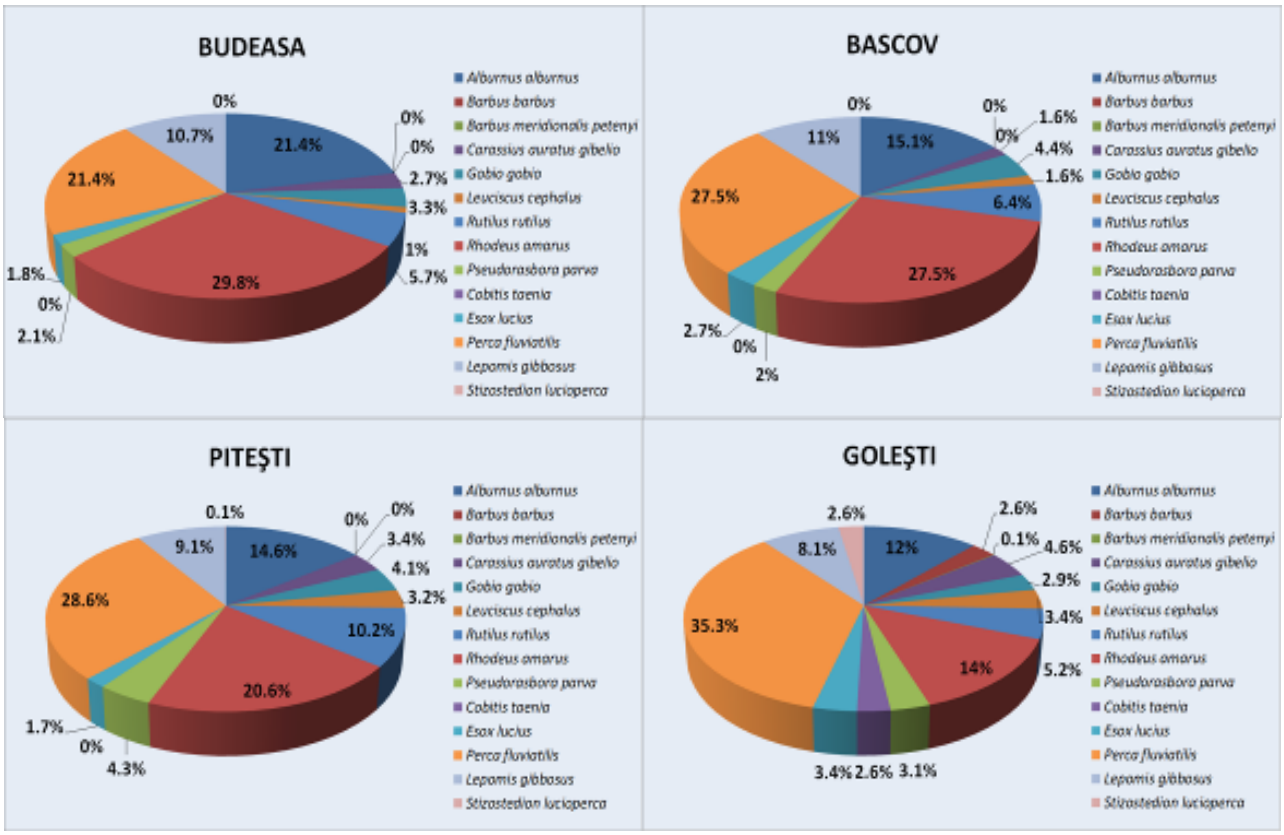

Figure 6. Percentage of species in October 2012

Causes that led to changes in fish fauna, Piteşti area:

1. emptying dams without protecting fish fauna;
2. modifying reservoir bed by removing the gravel;
3. pollution;

Measures to develop fish fauna in reservoirs in Pitesti area:

1. ensuring a proper auxiliary flow so that downstream lakes receive a sufficient supply of water;
2. control of gravel pit to have draining lakes and to operate properly;
3. discovery of pollution sources and their disposal;
4. education and youth involvement in environmental protection.
5. unsilting reservoirs;
6. fish restocking.

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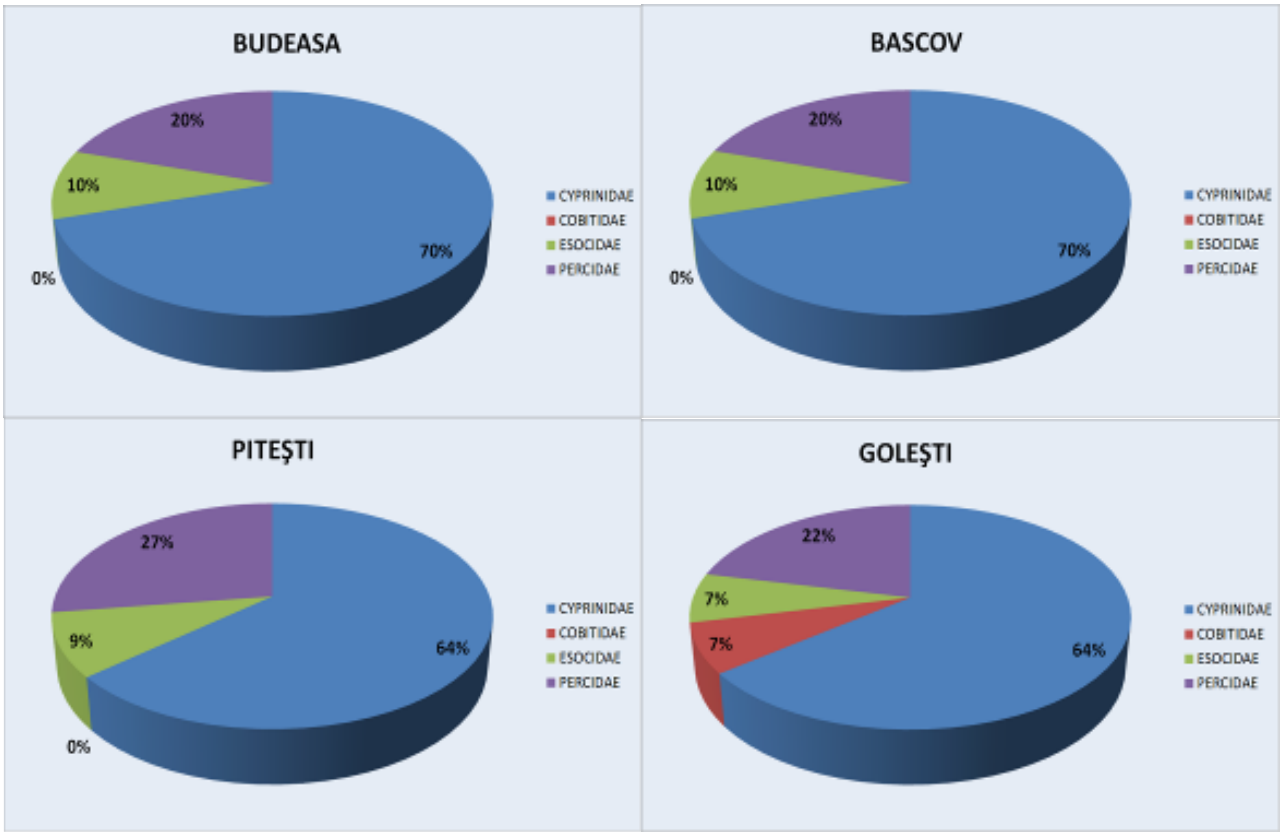

Figure 7. Ecological spectrum of families represented on the Budeasa Golesti area

4. CONCLUSIONS

1. Fish fauna in Piteşti area currently consists of 14 species belonging to four families: Cyprinidae (9 species), Cobitidae (1 species), Esocidae (1 species) and Percidae (3 species).
2. Most species live naturally in lakes studied except for one species *Pseudorasbora parva* which was introduced accidentally.
3. Fish fauna in reservoirs studied is made up of species characteristic to lentic ecosystems with the exception of *Barbus barbus* and *Barbus meridionalis petenyi*, eurytopic species found both in rhithron and potamon area, on streams, but they were identified as accidental.
4. The research undertaken to reflect changes in the fish fauna in the last 30 years, both by consulting specialized studies and by processing information from fishermen indicates an increase in the number of species, either through deliberate stocking for sport fishing purposes or due to changes in biotope favouring the development of certain species which were accidental in the past.
5. Competent bodies should take measures to conserve biodiversity of fish fauna in Piteşti basins.

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