THE HUMAN POPULATIONS DYNAMIC IN UKRAINEAN VILLAGES OF MARAMUREŞ COUNTY

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KEYWORDS: Romania, Maramureş County, human population, dynamic.

ABSTRACT

In 2011, the Ukrainian minority in Romania ranked fourth place in the national composition of the population after Romanians, Hungarians and Rroma. Ukrainians live compactly in four regions - Bucovina, Maramureș, Dobrogea and Banat. In 1992, there were 66.833. According to the census of 2002, the Ukrainian population was 61.091 people. During the period from 1992 to 2002, the Ukrainian population in Romania decreased by 5.742 persons. The last census, held in 2011, showed that only 50.920 Ukrainians still living in Romania. In 19 years, their number decreased by 15.913 persons.

The largest number of Ukrainians are in Maramureș – 30.786 persons (60.46% of the total), in Bucovina there are only 10.000 people (19.64%), and the rest live in Dobrogea and Banat.

REZUMAT: Dinamica populației umane din satele ucrainene din județul Maramureș.

In 2011, minoritatea ucraineană ocupa locul patru în compoziția generală a populației, după români, maghiari și rromi. Ucrainenii locuiesc grupați în patru regiuni - Bucovina, Maramureș, Dobrogea și Banat. În 1992, minoritatea ucraineană avea 66,833 persoane. La recensământul din 2002, populația ucraineană era de 61,091 persoane. Din 1992 până în 2002 populația ucraineană din România a scăzut cu 5,742 persoane. La ultimul recensământ din 2011, datele au arătat că în România mai trăiesc doar 50,920 ucraineni. În 19 ani, numărul lor a scăzut cu 15,913 persoane.

Populația cea mai numeroasă de ucraineni se găsește în Maramureș – 30786 persoane (60,46% din total), urmată de Bucovina – cu numai zece mii de oameni (19,64%) restul locuind în Dobrogea și Banat.

ZUSAMMENFASSUNG: Die Bevölkerungsdynamik in den ukrainischen Dörfern des Kreises Maramuresch (Rumänien).

Die ukrainische Minderheit in Rumänien befindet sich nach der Zählung von 2011 an vierter Stelle im Anteil an der Gesamtbevölkerung des Landes. Sie folgt den Rumänen, Ungarn und den Rroma. Die Ukrainer leben in geschlossenen Gruppen in vier Regionen und zwar in der Bukowina, der Maramuresch, der Dobrutscha (Dobrogea) und dem Banat, wobei Ihre Bevölkerungszahl 1992 mit 66.833. angegeben ist. Nach der Volkszählung von 2002 wurde eine Zahl von 61.091 ermittelt. Während der Jahre 1992 – 2002 sank die Bevölkerung um 5.742 Personen. Die letzte 2011 stattgefundene Zählung ergab, dass bloß 50.920 UKrainer in Rumänien leben. Damit wurde deutlich, dass ihre Zahl innerhalb von 19 Jahren um 15.913 Personen abgenommen hat. Der größte Teil der Ukrainer, mit einer Personenzahl von 30786 lebt in der Maramuresch, das sind 60.46% der Gesamtzahl der ukrainischen Minderheit. In der Bukowina leben 10.000 Ukrainer (19.64%) und die restlichen verteilen sich auf die Dobrutscha und das Banat.

INTRODUCTION

The Maramureş region is a historical and geographical area on the border of Romania and Ukraine. Maramureş is one of the representative areas of Ukrainian population in Romania. In this region, there are 30.786 Ukrainians, 60.46% of the total number of Ukrainians (50.920 Ukrainians according to census in 2011).

The region is situated on the northwestern region of Eastern Romanian Carpathians, the so-called Maramureş hollow, along the upper Tisa River with a natural overlook on the castle.

Essential for determining the dynamics of natural population increase is quantitative characteristics of marriages and divorces.

In recent years, there has been a decrease in number of marriages and an increase in divorce rate. While analyzing ethno-demography situation in Maramureş County, we have taken into account the problem of migration of the Ukrainian population. Simultaneously, with population migration, the processes of natural assimilation intensifies.

The study of population of the Ukrainian settlements in Maramureş during the period 1857 – 1905 presents the complexity due to changes in the territorial structure. According to the Austro-Hungarian population census in 1857, in Maramureş County there lived 184 thousand persons. The data quoted in the context of large settlements with populations of more than 2000 people each.

In 1857, in the village of Russka Polyana there lived 3.306 people, and in the village Velykyi Bychkiv 2.464 (Bevolkerung und den Viehstand von Osterreich. - Wien: Staatsdruckerel, 1859 – 390). Austro-Hungarian statistics of that time have not recorded the population on a national basis in these settlements.

MATERIAL AND METHODS

The article uses statistics of the Austro-Hungarian and Romanian censuses, which give the opportunity to highlight the most essential demographic aspects of the Ukrainian population of Maramureş County. Our goal was to determine population dynamics, to analyze important demographic indicators (births, deaths, marriages, divorces and so on), figure out the migration processes, and the main causes of natural assimilation. Most importantly, the main attention is focused on the study processes of population reproduction (births and deaths), geographical mobility, and general population growth (Kureleak, 2001).

RESULTS AND DISCUSSION

In 1905 the population in Maramureş was 309 thousand persons, including Ukrainians – 143.6 thousand people (46.4 % of the total population). For 48 years it has increased by 125 thousand persons. Only in the Ukrainian settlements of the Romanian Maramures there lived 22 thousand people, 64.5% of them were Ukrainians (Tab. 1) (Tomashivskyi, 1910)

The change in human population size and density depends primarily on its natural and mechanical movement. Population dynamics in the Ukrainian settlements of Maramureş County is specifically illustrated in table 2 and in figure 1.

Table 1a: Population structure of Ukrainian and Romanian settlements in Maramureş by language and religion in 1905 (by S. Tomashivskyi).

Capital. County. Community	Total number of populations	Native language					
		Ruska person %		Slovak	Hungarian	German	Other
Maramureş capital	309,598	143,621	46.4	545	42,403	74,978	47,449
Velykyi Bychkiv	5,294	2,589	48.9	6	1,530	50	1,093
Luh	1,961	1,638	83.5	-	99	12	209
Borşa	7,758	125	1.6	-	403	5,251	1,979
Vişeu de Sus	7,562	271	3.6	3	938	2,158	4,191
Leordina	1,451	24	1.7	-	6	1,124	297
Petrova	3,350	1,126	33.6	-	66	1,465	693
Repedea (Ruska Kryvyi)	1,593	1,349	84.6	-	11	4	229
Poienile de sub Munte (Ruska Polyana)	4,807	3,608	75.0	-	90	27	1,082
Ruskova	2,409	1,352	56.0	-	28	14	1,015
Dovhopole	2,350	341	14.5	-	1,782	88	138
Koshtil	1,536	5	0.32	-	1,513	6	11
Krychuniv	2,201	842	38.2	1	61	31	1,265
Mykova	643	230	35.7	1	207	108	97
Rona de Sus Runa Vyshnia	2,900	2,489	85.8	3	162	86	95
Sapyntsa	2,658	25	0.94	25	60	1,730	817
Sarasau	1,103	18	1.6	-	52	1,033	-
Sighet	17,445	701	4.1	17	12,658	1,697	2,329
Yapa	1,672	16	0.9	-	41	1,222	389
Luh	1,294	1,276	98.6	-	14	1	3
Guta. Piatra	299	28	9.4	4	70	39	157
Remety	960	597	63.2	1	18	31	313
Tiachevo	4,550	1,216	26.7	5	2,913	32	367

Table 1b: Population structure of Ukrainian and Romanian settlements in Maramureş by language and religion in 1905 (by S. Tomashivskyi).

Capital. County. Community	Total number of populations	Religion				
		Greek Catholic person %	Roman Catholic	Protestant	Jewish	Other
Maramureş capital	309,598	220,917	23,430	9,228	56,006	117
Velykyi Bychkiv	5,294	2,843	1,251	142	1,054	4
Luh	1,961	1,665	73	15	208	-
Borşa	7,758	5,392	381	12	1,972	1
Vişeu de Sus	7,562	2,500	2,492	67	2,499	4
Leordina	1,451	1,150	6	-	295	-
Petrova	3,350	2,604	37	1	708	-
Repedea (Ruska Kryvyi)	1,593	1,364	-	-	229	-
Poienile de sub Munte (Ruska Polyana)	4,807	3,671	90	2	1,044	-
Ruskova	2,409	1,379	26	-	1,004	-
Dovhopole	2,350	783	341	973	250	3
Koshtil	1,536	674	827	28	7	-
Krychuniv	2,201	892	23	1	1,285	-
Mykova	643	360	176	23	84	-
Rona de Sus Runa Vyshnia	2,900	2,235	187	12	465	1
Sapyntsa	2,658	1,755	94	12	797	-
Sarasau	1,103	917	31	19	142	-
Sighet	17,445	4,586	4,314	2,137	6,375	33
Yapa	1,672	1,200	17	8	447	-
Luh	1,294	1,179	8	-	107	-
Guta. Piatra	299	64	159	32	43	1
Remety	960	635	9	4	312	-
Tiachevo	4,550	1,748	447	1,764	591	-

Table 2: The population of the Ukrainian communes of Maramureş County in 1905-2011, number of people.

Settlements	Year									
	1905	1930	1956	1966	1977	1992	1994	1995	2002	2011
Bistra (Bystryi)	1,126	1,922	4,424	5,473	5,062	4,902	4,940	4,868	4,423	4,174
Bochkoiu Mare (Velykyi Bychkiv)	2,589	4,662	3,612	4,035	4,585	4,681	4,435	4,417	4,468	3,818
Poienile de Sub Munte (Ruska Polyana, Polyany)	4,807	5,644	6,298	7,651	8,776	10,561	10,833	10,824	10,033	10,073
Remeci (Remety)	960	2,544	2,602	2,741	3,003	3,241	3,387	3,389	3,058	3,040
Repedea (Ruska Kryvyi, Kryvyi)	1,593	1,743	2,877	3,400	4,074	4,853	5,008	5,035	4,761	4,716
Rona de Sus (Vyshnia Rivnia, Verkhnia Rivnia)	2,900	4,154	4,331	4,773	5,124	4,982	5,016	4,977	4,698	3,855
Ruskova	2,409	3,158	3,164	3,741	4,324	5,183	5,536	5,539	4,854	5,541
Total	16,384	23,827	27,308	31,814	35,148	38,403	39,155	39,049	36,295	35,217

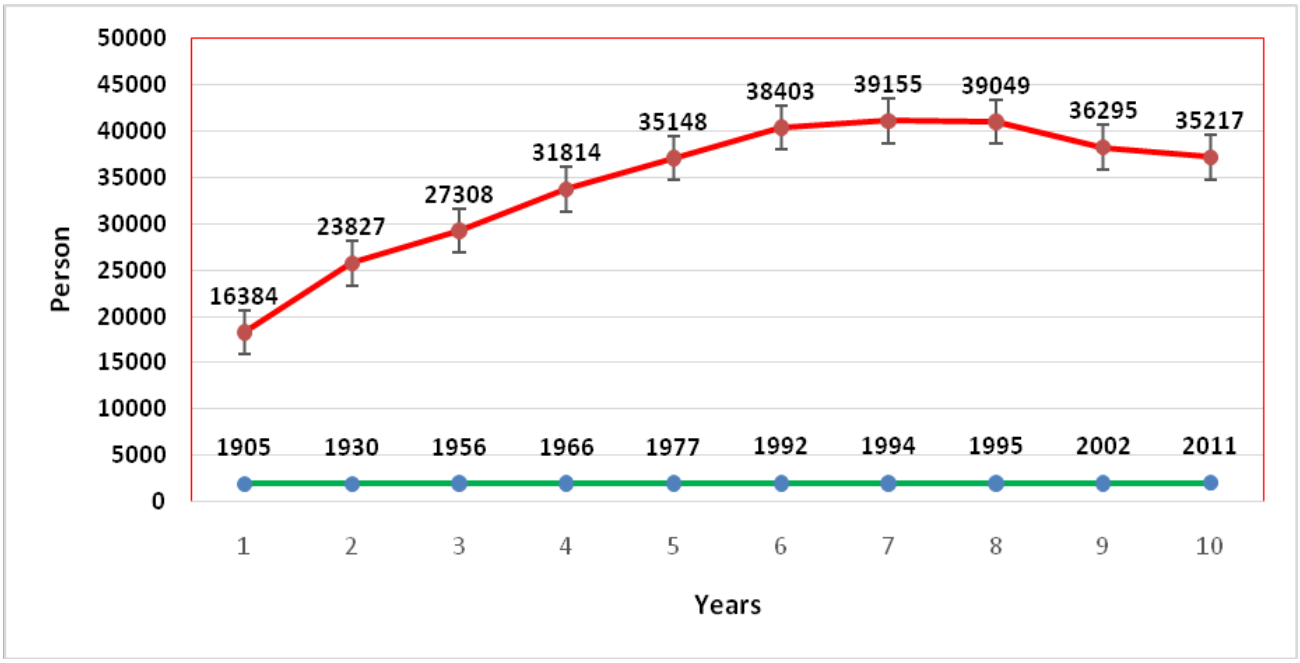

Figure 1: Numerical evolution of population of Ukrainian villages from Maramureş County between 1905-2011.

The total number of the total population in the Ukrainian settlements in Maramureș/Marmarashen 1905-2011 grew 18,833 persons. The slow increase in the number of Ukrainians is explained by the events of the Second World War and economic turmoil. In 1947 there was the hunger in Romania which caused the increased mortality, especially among children. In 1956-1966, the Ukrainian population in Maramureş had increased to 4506, and in 1966-1977, to 3334 persons. In 1965 in Romania a law was adopted prohibiting abortions, this government decision significantly influenced the sex and age structure of the population. During the period 1977-1992,
the population had increased to 3255 persons.

The growth in the number of Ukrainians from 1905-1995 occurred due to the high rate of natural increase. In 1977-1992, the population in the Ukrainian settlements in Maramureş increased to 3,255 people (Kureleak, 2001). For the period 1992-1995, it had increased by 646 people.

After 1995 the dynamics of the population in the Ukrainian villages tended to slowly decrease. During the period 1992-2002, the number of population had decreased by 2,108 people. In 2002-2011, the Ukrainian population had decreased by 1,078 people. During the period 1992-2011, the Ukrainian population had decreased to 3,186 people.

The number of Ukrainian population depends on natural growth, particularly the difference between the number of births and deaths. The population reproduction is influenced by various factors, among which the most typical are natural, biological, socio-economic, religious, socio-cultural and psychological. The amount of natural movement depends on sex-age structure, marriage and divorce rates, female fertility, and other factors.

The natural increase in the Ukrainian population between 1991-1992 had become notable. In 1994 it was 10‰, however the natural increase in the total population of Maramureş County at this time was significantly lower (by 1.2‰). The mortality rate among Ukrainians did not exceed 10‰, while the average rate in the County was 11.2‰ (Tab. 3, Fig. 2). In 2002, natural population had increased by 7.29‰. The last census of 2011 showed a declining trend in natural population growth by 2.27‰ (Tab. 3).

The dynamics of population and its natural growth was negatively affected by high levels of stillborn children and a large number of deaths of children under one year of age. In 1991-1992 the number of stillborn children had a tendency to decrease. The indicator of stillborn children per 1000 births had acquired the greatest value (of 16.6‰) in 1993. In 1993-1994, this figure dropped to 12.1‰. In 2002, we note a low rate of stillborn children, which amounted to 7.29‰. (According to the latest census data in 2011 – of 2.27‰.) The greatest amount of stillborn children was being observed in the villages Poienile de sub Munte, Repedea, Bistra, and Ruskova. In 1991-1992 the dynamics of mortality of children aged under one year had a trend for decreasing, and in 1994 the rate was 33.6‰ (According to the latest census in 2011 – 15.91‰.) in Ukrainian villages like Poienile de sub Munte (Glade), Repedea (Kryvyi), Ruskova (Ruskova), and Bacicou Mare (Velykyi Bychkiv).

Table 3: Reproduction of population in the Ukrainian settlements of Maramures County between 1991-2011.

Settlements	Year	Born		Death		Natural increase		Stillborn children		Died at the age of one year	
		person	‰	pers.	‰	pers.	‰	pers.	‰	pers.	‰
Bistra	1991	113	20.7	36	6.6	77	14.1	1	8.8	8	26.5
	1992	122	24.4	59	11.8	63	12.6	1	8.1	1	8.2
	1993	103	20.7	52	10.5	51	10.2	1	9.6	6	58.3
	1994	77	15.6	43	8.7	34	6.2	1	12.8	–	–
	2002	63	14.24	57	12.89	6	1.35	2	31.75	1	15.87
	2011	54	12.93	41	9.82	13	3.11	–	–	–	–
Bochkoiu Mare	1991	67	13.9	56	11.6	11	2.3	–	–	3	44.8
	1992	80	17.8	48	10.7	32	7.1	–	–	1	12.5
	1993	57	12.7	69	15.4	-12	-2.7	–	17.2	2	35.1
	1994	46	10.3	61	13.6	-15	-3.3	1	–	2	43.5
	2002	50	11.19	54	12.09	- 4	- 0.9	–	–	–	–
	2011	38	9.95	50	13.09	-12	-3.14	–	–	–	–
Poienile de sub Munte	1991	288	25.8	95	8.5	193	17.3	8	27	12	41.7
	1992	294	27.3	98	9.1	196	18.2	6	20	13	44.2
	1993	275	25.4	89	8.2	186	17.2	6	21.4	16	58.2
	1994	286	26.5	88	8.2	198	18.3	2	6.9	16	55.9
	2002	209	20.83	84	8.37	125	12.46	2	9.57	6	28.71
	2011	144	14.29	91	9.03	53	5.26	–	–	4	27.78
Remeţi	1991	57	16.6	40	11.6	17	5.0	–	–	3	52.6
	1992	54	16.0	29	8.6	25	7.04	–	–	3	55.6
	1993	35	10.4	31	9.2	4	1.02	–	–	–	–
	1994	47	13.9	36	10.6	11	3.3	–	–	3	63.8
	2002	38	12.42	34	11.12	4	1.3	–	–	2	52.6
	2011	34	11.18	31	10.19	3	0.99	–	–	–	–
Repedea	1991	148	27.2	37	6.8	111	20.4	1	6.7	8	54.1
	1992	126	25.4	32	6.5	94	18.9	1	7.9	1	7.9
	1993	133	26.8	41	8.3	92	18.5	3	22.1	6	45.1
	1994	112	22.5	34	6.8	78	15.7	4	34.5	2	17.9
	2002	76	15.96	42	8.82	34	7.14	–	–	4	52.63
	2011	74	15.69	27	5.72	47	9.97	–	–	3	40.54
Rona de Sus	1991	87	15.8	62	11.3	25	4.5	–	–	3	34.5
	1992	78	15.2	45	8.8	33	6.4	1	12.7	1	12.8
	1993	59	11.6	66	13.0	-7	-1.4	1	16.7	–	–
	1994	71	14.9	59	11.7	12	2.4	1	13.9	1	14.1
	2002	53	11.28	64	13.62	-11	-2.34	–	–	–	–
	2011	37	9.6	53	13.74	-16	-4.14	–	–	–	–
Ruscova	1991	118	20.2	39	6.7	79	13.5	2	16.7	4	33.9
	1992	121	22.2	46	8.4	75	13.8	–	–	5	41.3
	1993	119	21.6	36	6.5	83	15.1	1	8.3	4	39.6
	1994	105	19.0	32	9.4	53	9.6	1	9.4	1	9.1
	2002	59	12.15	30	6.18	29	5.97	–	–	–	–
	2011	59	10.65	50	9.02	9	1.63	1	16.95	–	–
Total	1991	878	21.1	365	8.8	513	12.3	12	13.7	41	46.7
	1992	875	22.3	357	9.1	518	13.1	9	10.3	25	28.6
	1993	781	19.9	384	9.8	397	10.1	13	16.6	34	43.5
	1994	744	19.0	353	9.0	391	10.0	9	12.1	25	33.6
	2002	548	15.10	365	10.06	183	5.04	4	7.29	13	23.72
	2011	440	12.49	343	9.74	97	2.75	1	2.27	7	15.91

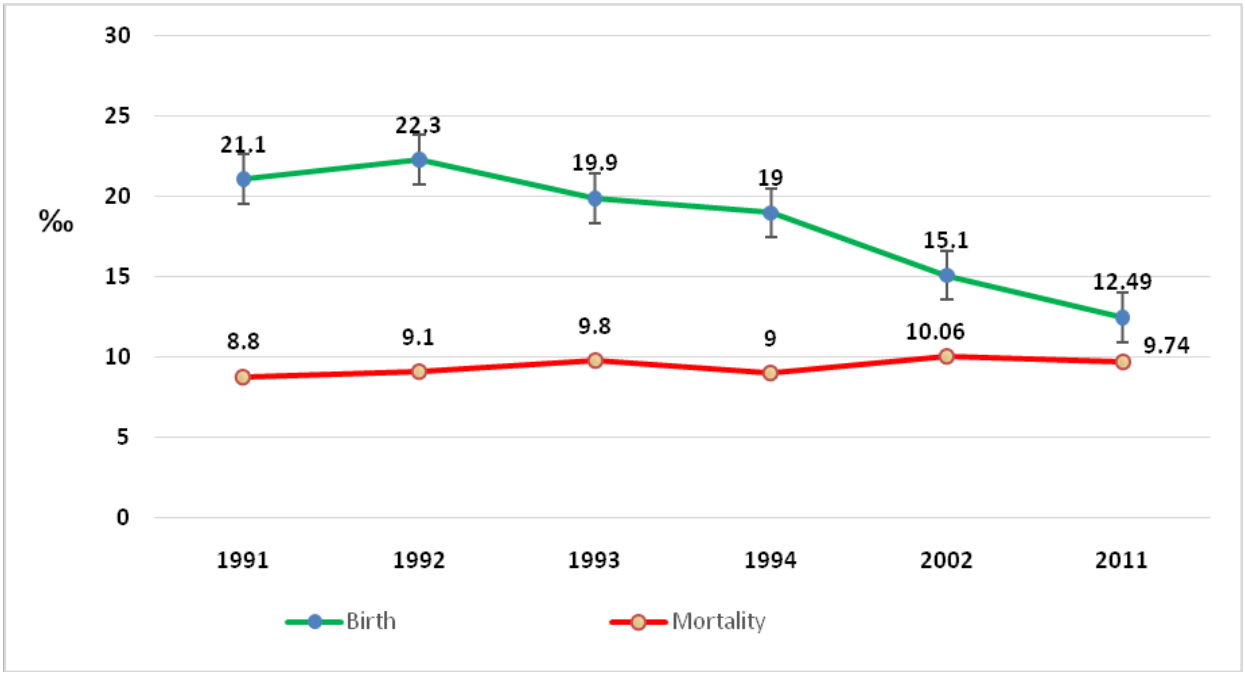

Figure 2: The natural birth and mortality of the Ukrainian population in villages from Maramureş County between 1991-2011.

Note the high mortality rates of children under one, among the Ukrainian villages which are much lower in communes in Rona de Sus (Verkhnia Rivna) and Remez (Remety). The high rate of stillborn children is determined by factors such as insufficient level of medical knowledge among Ukrainian women, culture, medical care, etc.

The dynamics of population reproduction in the Ukrainian settlements of Maramureş County is characterised by territorial differences. Mountainous areas in the Ukrainian villages (Poienile de sub Munte, Repedea, Bistra, Ruskova) had high fertility and low mortality rates. In hilly suburban villages of the region – Bochikou Mare, Rona de Sus and Remeţi, the rates of natural increase are low. In 2002 in the commune of Rona de Sus, the rate of natural population increase was negative (-2.34 ‰). Already, in 2011, this indicator received the highest negative value (-4.14‰) among the Ukrainian villages of Maramureş County.

One of the factors that significantly affected the amount of natural population growth rate was the number of marriages and divorces. Absolute and relative performance of marriages and divorces are shown in table 4 and figures 3 and 4.

Table 4: Marriages and divorces in the Ukrainian communes of Maramureş County registered in 1991-1994.

Commune	Year	Marriage		Divorce	
		Total	‰	Total	‰
Bistra	1991	44	8.1	5	0.92
	1992	45	9.0	3	0.60
	1993	33	6.6	1	0.20
	1994	29	5.9	5	1.01
	2002	30	6.8	3	0.68
	2011	27	6.5	9	2.15
Bochkou Mare	1991	31	6.4	4	0.83
	1992	25	5.6	3	0.67
	1993	30	6.7	6	1.34
	1994	24	5.4	2	0.45
	2002	29	6.2	4	0.89
	2011	26	6.8	10	2.62
Poienile de sub Munte	1991	85	7.6	2	0.18
	1992	93	8.6	4	0.37
	1993	86	8.0	5	0.46
	1994	85	7.9	6	0.56
	2002	73	7.3	7	0.69
	2011	56	5.6	9	0.89
Remeţi	1991	29	8.4	2	0.58
	1992	18	5.3	3	0.89
	1993	19	5.6	-	-
	1994	23	6.8	7	2.06
	2002	14	4.6	6	1.96
	2011	21	6.9	4	1.31
Repedea	1991	25	4.6	4	0.73
	1992	35	7.1	2	0.40
	1993	30	6.1	5	1.01
	1994	27	5.4	2	0.40
	2002	30	6.3	2	0.42
	2011	34	7.2	8	1.70
Rona de Sus	1991	42	7.6	10	1.82
	1992	40	7.8	3	0.58
	1993	37	7.3	6	1.18
	1994	51	10.1	16	3.17
	2002	50	10.6	7	1.49
	2011	37	9.6	8	2.07
Ruskova	1991	38	6.5	4	0.69
	1992	55	10.1	2	0.37
	1993	46	8.4	7	1.27
	1994	39	7.1	3	0.54
	2002	45	9.3	10	2.06
	2011	33	5.9	9	1.62
Total	1991	294	7.1	31	0.74
	1992	331	8.5	20	0.51
	1993	281	7.2	30	0.77
	1994	268	6.9	41	1.05
	2002	271	7.5	39	1.07
	2011	234	6.6	57	1.62

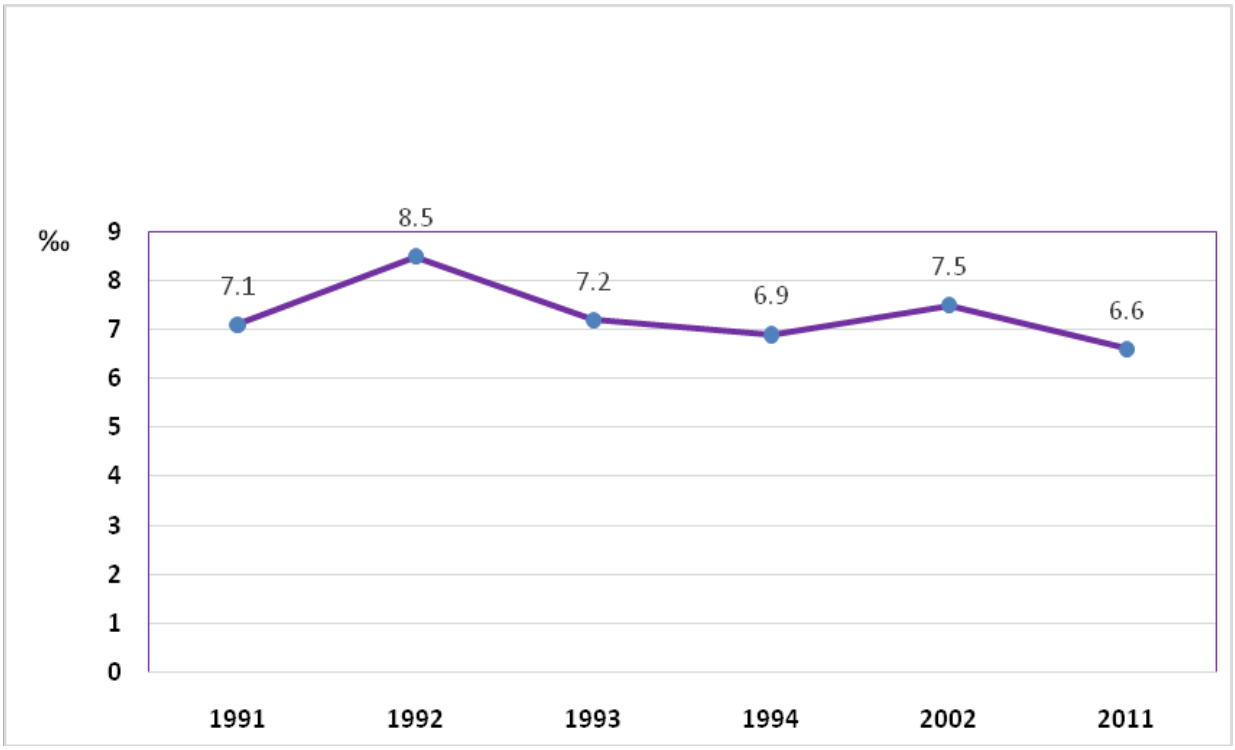

Figure 3: The population dynamics of marriages in the Ukrainian villages from Maramureş County between 1991-2011.

The dynamics of marriages in different periods were different. Thus, in 1991-1992, the number was increasing, and in 1992-1994 tended to decrease. The dynamics of divorce are peculiar to the opposite trend. In Rona de Sus, there were noted the highest rates of marriages and divorces in comparison with other Ukrainian settlements of Maramureş County. In Poienile de sub Munte (Poliana), Repedea (Kryvyi), Ruskova (Ruskova), and Bistra (Bystryi), there have been observed the lowest rates of divorces.

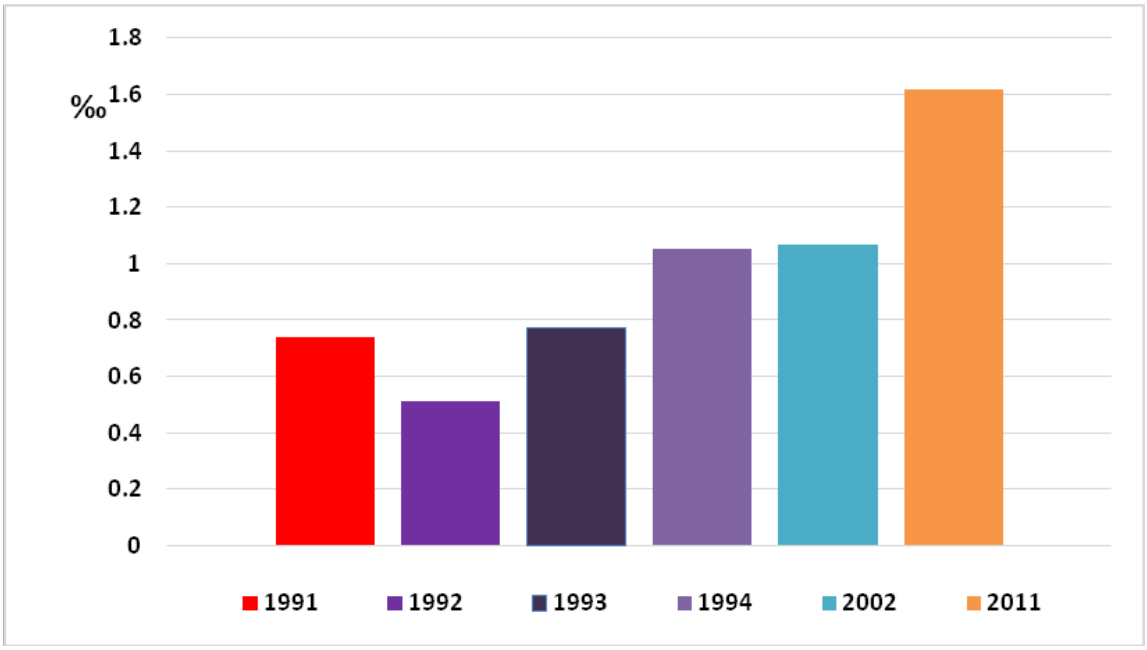

Figure 4: The population dynamics of divorce in the Ukrainian Maramureş County between 1991-2011.

The Ukrainians inhabit the isolated mountainous part of the Carpathians Maramureş. They are in economic difficulty, which, of course, affects the migration process. The only way to solve the problem of the population in the area is to "search for a better life" and employment in other, more profitable, regions of the country and abroad. For the period 1930-1995, the population in the Ukrainian settlements of Maramureş County had slowly increased, creating a surplus of labor force.

During the Austro-Hungarian rule, among the local population, there had been an artificial migration (deportation of Ukrainians and settlement on their habitat of the Hungarians, for example the village Campulung la Tisa (Dovhe Pole)). This has led to increased assimilating process in the Ukrainian settlements of Maramureş.

In the late 19th century, the emigration of Ukrainians to the South-Western part of Romania – Banaty had started. There gradually emerged a new area of residence of the Ukrainian population. Also in Banaty, Ukrainians emigrated from Transcarpathia, southern Bukovyna, and Galicia. After the establishment, the state border between Romania and Czechoslovakia in 1919, migration from Ukraine to Maramureş and Banat stopped.

In the interwar period the Ukrainians external and internal emigration continued.

During the Second World War, Maramureş territory and the Northern part of Transylvania, were captured by Hungary. It's a known fact that many Ukrainians were forced to labor in Germany and Hungary and only a small number returned to their native land while others remained in exile, or couldn't be found.

After the Second World War, the pace of migration processes had decreased. Currently, the most common are seasonal migrations. The population of the Ukrainian settlements in Maramureş mainly emigrated for seasonal work associated with agriculture, logging, or construction.

Pendular migration is a movement of the population from one locality to another to work/study without changing permanent residence. The main directions of this migration are village-town or small town – big city. The prevalent circular migration have been noted in peri-urban areas of secondary towns (Sighetu Marmaţiei, Vişeu de Sus, Borşa). Here, migration contributed to a balanced and rational use of labor resources in urban and rural settlements. The internal resettlements affected the redistribution of labor resources between urban and rural areas. For Ukrainian settlements of Maramureş, temporary migration is commonly seen (Tab. 5).

In 1991-2011, negative natural migration was characteristic for Ukrainians, especially in 1991-1992 (Tab. 5, Fig. 5).

Table 5: Migration of Ukrainian settlements in Maramureş in 1991-1995.

Settlements	Year	Arrived		Departure		Migration increase	
		persons	‰	persons	‰	persons	‰
Bistra	1991	18	3.3	128	23.3	-109	-20
	1992	3	0.6	169	33.8	-166	-33.2
	1993	-	-	69	13.9	-69	-13.9
	1994	11	2.2	62	12.6	-51	-10.4
	1995	20	4.0	126	25.5	-106	-21.5
	2002	7	1.58	65	14.69	-58	-13.11
	2011	13	3.11	29	6.95	-16	-3.84
Bicioiu Mare	1991	39	8.1	71	14.7	-32	-6.6
	1992	41	9.1	72	16.0	-31	-6.9
	1993	45	10.1	66	14.7	-21	-4.6
	1994	58	13.0	70	15.7	-12	-2.7
	1995	29	6.5	44	9.9	-15	-3.4
	2002	71	15.89	36	8.05	**35**	**7.74**
	2011	10	2.62	29	7.59	-19	-4.97

Table 5 (continued): Migration of Ukrainian settlements in Maramureş in 1991-1995.

Settlements	Year	Arrived		Departure		Migration increase	
		persons	‰	persons	‰	persons	‰
Poienile de sub Munte	1991	24	2.1	235	21.0	-211	-18.9
	1992	18	1.7	150	13.9	-132	-12.2
	1993	9	0.8	196	18.1	-187	-17.3
	1994	22	2.0	212	19.7	-190	-17.7
	1995	28	2.6	250	23.0	-222	-20.4
	2002	6	0.59	81	8.07	-75	-7.48
	2011	14	1.39	69	6.85	-55	-5.46
Remeţi	1991	22	6.4	50	14.5	-28	-8.1
	1992	27	8.0	43	12.7	-16	-4.7
	1993	12	3.6	45	13.4	-33	-9.8
	1994	64	18.9	41	12.1	23	6.8
	1995	43	12.7	39	11.5	4	1.2
	2002	15	4.90	20	6.54	-5	-1.64
	2011	10	3.29	21	6.91	-11	-3.62
Repedea	1991	14	2.6	68	12.5	-54	-9.9
	1992	15	3.0	112	22.6	-97	-19.6
	1993	19	3.8	69	13.9	-50	-10.1
	1994	22	4.4	88	16.5	-60	-12.1
	1995	41	8.1	87	17.4	-46	-9.2
	2002	6	1.26	47	9.87	-41	-8.61
	2011	3	0.63	28	5.94	-25	-5.31
Rona de Sus	1991	-	-	71	12.9	-71	-12.9
	1992	22	4.3	91	17.1	-69	-13.4
	1993	13	2.6	66	13.0	-53	-10.4
	1994	12	2.4	68	13.5	-56	-11.1
	1995	19	3.8	51	10.2	-32	-6.4
	2002	5	1.06	47	10.00	-42	-8.94
	2011	8	2.07	31	8.04	-23	-5.97
Ruskova	1991	24	4.1	82	14.1	-58	-10
	1992	12	2.2	85	15.6	-73	-13.4
	1993	33	6.0	72	13.1	-39	-7.1
	1994	38	6.9	68	12.3	-30	-5.4
	1995	28	5.1	95	17.2	-67	-12.1
	2002	-	-	67	13.8	-67	-13.8
	2011	3	0.54	29	5.23	-26	-4.69
Total	1991	141	3.40	705	16.9	-564	-13.50
	1992	138	3.59	722	18.8	-584	-15.21
	1993	131	3.30	583	14.90	-452	- 11.60
	1994	227	5.79	609	15.55	-382	-9.76
	1995	212	5.43	692	17.72	-480	-12.29
	2002	110	3.03	363	10.00	-253	-6.97
	2011	61	1.73	236	6.70	-175	-4.97

During this period, from all Ukrainian settlements, there had moved 3,910 people, and had arrived 1,020 people.

Mechanical movement affected the number of Ukrainian population, which in 1991-1995 tended to decrease. In the Ruscova Basin, there had been observed a return in migration increase, due to economic reasons.

From Poienile de sub Munte, Repedea, and Ruscova, in 1991-2011, there moved 2190 persons, 56.0% of all emigrants' of Ukrainian settlements on Maramures. There had arrived only 379 people (37.15 % of all arrivals).

The low quotient of arrivals is due to the remoteness of villages from urban settlements and the low level of development in economy. From the commune Poienele de sub Munte (Ruska Poliana) during this period had moved 1,193 persons (30.51 % of all departures), and had arrived only 121 people (11.86 %). On average, during the year, 199 people had left. In all of the Ukrainian communes during this period, migration growth was negative and only in the commune Remez in 1993-1995 was it positive.

Within the Ukrainian ethnic territory among the Ukrainian population, there has been observed an external migration in Western Europe (Spain, Portugal, Belgium, Italy, United Kingdom of Great Britain, Austria, Germany, France, Hungary), and America. In 1995, first place in the number of emigrants was taken by the commune Remeti (Remety-15 persons). In the village Ruskova (Ruskova) there emigrated 6, Rona de Sus (Verkhnia Rivna) had 2, and in other villages, one person. According to official sources, in 1995, of all Ukrainian settlements, 26 people left. In an illegal way, a significantly bigger number of Ukrainians had left to Western Europe for employment and residence. The Romanian government did not take any steps to official employment abroad, so all the illegal external migration was at risk. After Romania entered the European Union, the migration movements increased.

In the Ukrainian settlements in Maramureş, there are representatives of other nationalities, particularly Hungarians and Germans; all external migration are common. For example, in 30 years of the 20th century, there lived six thousand Jews (23.1% of the total population). Nowadays in the Ukrainian villages there are no representatives of the Jewish nationality. In the last decade there has been migration among the Hungarian population, which had either returned to Hungary or moved to towns.

External and internal migrations affected the population growth in the Ukrainian settlements in Maramureş. Such migration processes are not welcome in the Ukrainian Diaspora. In addition, they have also affected the sex-age structure of the population and its natural increase.

An important role in the population dynamics of the Ukrainian settlements in Maramureş is being played by its population, which is the sum of natural and migratory movement (Tab. 6).

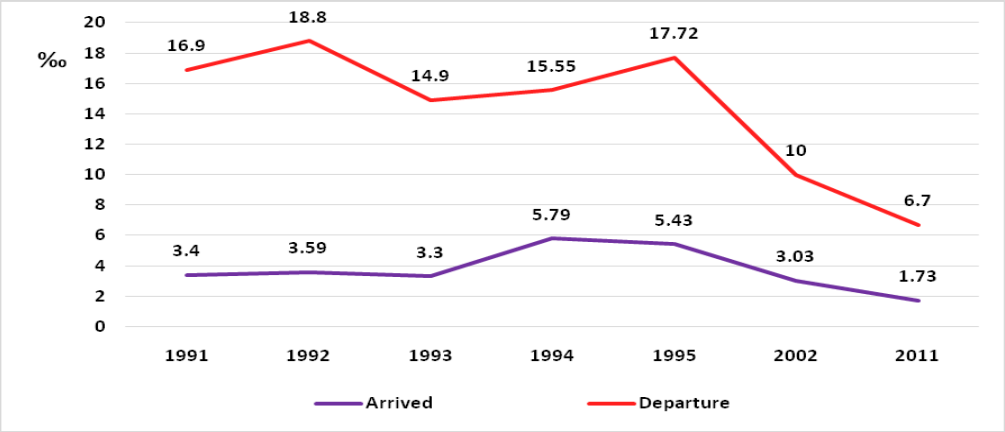

Figure 5: The population migration dynamics from the Ukrainian villages in Maramureş County between 1991-2011.

Table 6: The total increase of Ukrainian population in Maramures in 1991-1995.

Settlements	Year	natural		Migration		total	
		persons	‰	persons	‰	persons	‰
Bistra	1991	77	14.1	-109	-20	-32	-5.9
	1992	63	12.6	-166	-33.2	-103	-20.6
	1993	51	10.2	-69	-13.9	-18	-3.7
	1994	34	6.2	-51	-10.4	-17	-4.2
	2002	6	1.35	-58	-13.11	-52	-11.76
	2011	13	3.11	-16	-3.84	-3	0.73
Bocicoiu Mare	1991	11	2.3	-32	-6.6	-21	-4.3
	1992	32	7.1	-31	-6.9	1	0.2
	1993	-12	-2.7	-21	-4.6	-33	-7.1
	1994	-15	-3.3	-12	-2.7	-27	-6
	2002	- 4	- 0.9	**35**	**7.74**	31	6.84
	2011	-12	-3.14	-19	-4.97	-31	8.11
Poienile de sub Munte	1991	193	17.3	-211	-18.9	-18	-1.6
	1992	196	18.2	-132	-12.2	64	6
	1993	186	17.2	-187	-17.3	-1	-0.1
	1994	198	18.3	-190	-17.7	8	0.6
	2002	125	12.46	-75	-7.48	50	4.98
	2011	53	5.26	-55	-5.46	-2	-0.2
Remeţi	1991	17	5.0	-28	-8.1	-11	-3.1
	1992	25	7.04	-16	-4.7	9	2.34
	1993	4	1.02	-33	-9.8	-29	-8.78
	1994	11	3.3	23	6.8	33	10.1
	2002	4	1.3	-5	-1.64	-1	-0.64
	2011	3	0.99	-11	-3.62	-7	-2.63
Repedea	1991	111	20.4	-54	-9.9	43	10.5
	1992	94	18.9	-97	-19.6	-3	-0.7
	1993	92	18.5	-50	-10.1	42	8.4
	1994	78	15.7	-60	-12.1	18	3.6
	2002	34	7.14	-41	-8.61	-7	-1.47
	2011	47	9.97	-25	-5.31	22	4.66
Rona de Sus	1991	25	4.5	-71	-12.9	-46	-8.4
	1992	33	6.4	-69	-13.4	-36	-7
	1993	-7	-1.4	-53	-10.4	-60	-11.8
	1994	12	2.4	-56	-11.1	-44	-8.7
	2002	-11	-2.34	-42	-8.94	-53	-11.28
	2011	-16	-4.14	-23	-5.97	-39	10.11
Ruskova	1991	79	13.5	-58	-10	21	3.5
	1992	75	13.8	-73	-13.4	2	0.4
	1993	83	15.1	-39	-7.1	44	8
	1994	53	9.6	-30	-5.4	23	4.2
	2002	29	5.97	-67	-13.8	-38	-7.83
	2011	9	1.63	-26	-4.69	-17	-3.06
Total	1991	513	12.3	-564	-13.50	-51	-1.2
	1992	518	13.1	-584	-15.21	-66	- 2.11
	1993	397	10.1	-452	- 11.60	-55	-1.5
	1994	391	10.0	-382	-9.76	9	0.24
	2002	183	5.04	-253	-6.97	-70	-1.93
	2011	97	2.75	-175	-4.97	-78	2.22

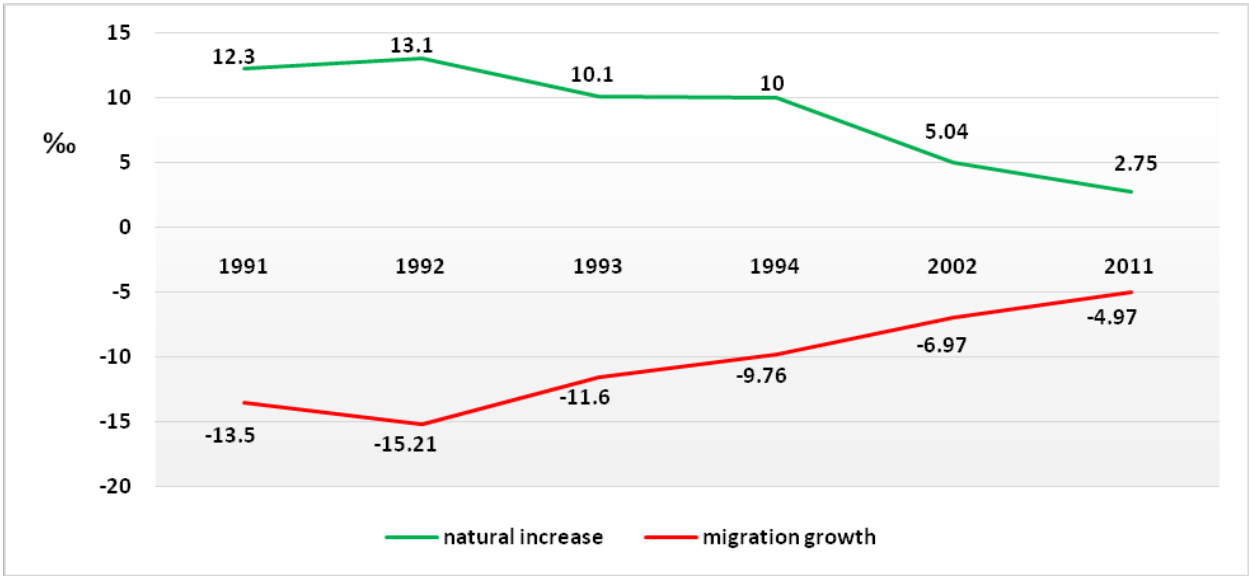

Figure 6: Total increase of Ukrainian population in the villages in Maramureş County between 1991-2011.

CONCLUSIONS

The data shows that the overall increase of Ukrainians in the period 1991-2011 had been negative. In the Ukrainian settlements in Maramureş there have been important differences observed in terms of total population growth during this period. In the villages of Bistra (Bystryi), Bocicoiu Mare (Velykyi Bychkiv), and Rona de Sus (Verkhnia Rivna), the migration gain exceeded the natural one. The overall population growth of the villages of Poienile de sub Munte (Poliana) and Remez (Remety), during that period, had gained both negative and positive values. Two settlements where the total population growth have had positive values up to 1995, are the villages Ruskova (Ruskova) and Repedea (Kryvyi).

In this case, the total population growth was directly related to the reduction in population size, age-sex structure, natural increase, the ethnic composition of the population, religious structures, and the socio-economic level of the population.

To revigorate the Ukrainian population from Maramureş County, there are real demographic politics due to the fact that in the near future, the tendencies, natural population increase, including the migratory one, will have negative values. In order to stimulate population growth through birth rates, not only of Ukrainian population but also of the entire Romanian population, especially in country that is member of European Union, considerable financial and social facilities are needed.

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(*) Recesamântul populatiei pe anul 1992. № 88 - Baia-Mare. - Directia judeteana de statistica Maramures; Recensământul populaţiei pe anul 2002//Direcţia judeteană de statistică Maramureş-BaiaMare)

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THE VEGETATION OF THE SLUMPING HILLS NEAR MOTIŞ VILLAGE (TRANSYLVANIA, ROMANIA)

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KEYWORDS: land slidings, Sarmatian age sediments, ecological gradients, xerothermic vegetation, mesophilous tall-herbaceous fringes.

ABSTRACT

The Southern Transylvanian Tableland is famous for its slumping hills with a mosaic of habitats, sheltering on relatively small area many different phytocoenoses with high species diversity. In a smaller area as on other similar slumping hills, near to the village Motiş can be found such hills with phytocoenoses distributed on the slopes along ecological gradients and as well with distinct differences between those of Northern and Southern orientation. Whereas on the slopes with Northern exposure meso-xerophilous and mesophilous communities can be found, in which dominate more European and Eurasian species of colline and montane levels, on the slopes of Southern orientation, xerothermic communities with characteristic steppe species and such of the warm Sub-Mediterranean zones develops. Highlighted are the communities of *Clematis recta*, in Northern exposure and *Chrysopogon gryllus* with *Carex humilis* on Southern exposed slopes.

REZUMAT: Vegetaţia glimeelor de lângă satul Motiş (judeţul Sibiu, Transilvania, România).

Podişul Transilvaniei de Sud este cunoscut pentru glimeele sale cu mozaicul lor de habitate, adăpostind pe suprafeţe relativ mici diferite fitocenoze cu o mare diversitate de specii. In arii mai puţin extinse faţă de alte arii similare, lângă satul Motiş se găsesc astfel de glimee cu fitocenoze distribuite pe pante de-a lungul unor gradienţi ecologici, existând diferenţe semnificative între cele cu expoziţie nordică şi sudică. Pe când, pe pante expuse spre nord se dezvoltă comunităţi xero-mezofile şi mezofile în care domină mai mult specii europene şi euroasiatice ale etajului colinar şi montan, pe pantele sudice se întâlnesc comunităţi xeroterme edificate de specii caracterstice de stepă şi de zone calde sub-mediteraneene. Scoase în evidenţă sunt comunităţile edificate de *Clematis recta* pe pante nordice şi de *Chrysopogon gryllus* cu *Carex humilis* pe pante sudice.

ZUSAMMENFASSUNG: Die Vegetation der Rutschungshügel bei Motiş/Mortesdorf (Kreis Sibiu, Transilvanien, Rumänien).

Das Hochland von Süd-Siebenbürgen ist bekannt für seine Rutschungshügel mit ihrem Mosaik an Lebensräumen, die auf relativ kleinen Flächen unterschiedliche Phytocoenosen mit einer hohen Artendiversität umfassen. Sie sind an den Hängen entlang von ökologischen Gradienten angeordnet und weisen deutliche Unterschiede zwischen Süd- und Nordlage auf. Während auf den nördlich ausgerichteten Hängen xero-mesophile und mesophile Gesellschaften vorkommen, in denen vorwiegend europäische und euroasiatische Arten der collinen und montanen Stufe vorkommen, finden sich auf den Südhängen xerotherme Gesellschaften, in denen charakteristische Arten der Steppe und warmer sub-mediterraner Gebiete anzutreffen sind. Hervorgehoben wird die Gesellschaft von *Clematis recta* in nördlicher Lage und die Gesellschaft von *Chrysopogon gryllus* mit *Carex humilis* auf der Südseite.

INTRODUCTION

Landslides are characteristic for some regions of Romanian national territory and occurr on larger scale in the Transylvanian Tableland. All these landslides being mentioned in more than 150 well-developed sliding zones (Morariu et al. 1964), indicated also on the geomorphological map of Romania (Badea et al., 1976).

Landslides occur in particular in the area of the Transylvanian Plain (Câmpia Transilvaniei) and as well in the Southern Transylvanian Tableland. According to Morariu et al. (1964) the occurrence of sliding zones with slumping hills, the so called "glimee" or "movile" or near Cluj-Napoca with the local name "Copârşaie", is strongly related to sediment deposits of the Sarmatian geological formations with remarkable intercalation of sands, brittle sandstones and conglomerates between the marl and limestone layers. Such formations can be found on larger area in the Southern Transylvanian Tableland on slopes of the Hârtibaciu river basin in its lower part (Caşolţ, Cornăţel) and its Upper part between the villages Noiştat and Movile (Grecu 1992) and as well on the border slopes of the Southern Transylvanian Tableland to the Olt Depression.

In the Târnava Mare river basin sliding area with slumping hills are coming across in the area of the village Păucea (near by the town of Mediaş and a smaller one at Motiş) (Sibiu county), on slopes near the village Apold (Sighişoara), at Saschiz in the place named "The ten small hills"/Zehnbüchel (Mureş county), and near Buneşti (Braşov county).

The slumping hills area between the villages Noiştat, Movile (named in old chronicles "centum collis"= hundred hills) (Sibiu county) and Seliştat (Braşov county) is the most famous area with slumping hills in the Southern Transylvanian Tableland (Niedermaier 1977, Schneider-Binder 1994, 1996, 2007).

The formation and age of the slumping hills was and is also today subject to many different opinions and discussions (Morariu et al. 1964). According to pollen analyses can be stated a phase of slides in the Boreal, respectively in the first part of the post-Glacial warm period. But also an older phase in the Pleistocene, pre-Boreal have been documented in the peat of "Dracăşviz" ("muddy meadow") near the locality of Şaeş (Pop 1960, Morariu et al. 1964).

In dependence of the extend of the area, the size of the slumping hills (conic, longish), their more or less steep slopes can be stated, commonalities, but also some differences between the slumping hills of the different above mentioned sliding zones. In general the most visible differences reflected through the phytocoenoses and their biodiversity are between Southern and Northern exposed steep slopes existing on the slumping hills. Such ecological researches concerning the differences between Southern and Northern exposed slopes have been realised first time on slumping hills near Cluj-Napoca (Bujoreanu 1933). On slumping hills of the Southern Transylvanian Tableland i.e. in the Hârtibaciu Tableland first researches about the distribution of vegetation in dependence of the slope orientation were realised in the area of Movile (Csürös and Kovács 1962, Niedermaier 1977, Schneider-Binder 1994, 1996) as well in the area of Apold and Saschiz (Schneider-Binder 1996, 2007).

On the Southern exposed slopes xerothermic plant communities edified by stepic species such as *Stipa pulcherrima, Stipa capillata, Salvia nutans, Festuca valesiaca, Carex humilis* and more others can be encountered (1994, 1996), whereas on the Northern exposed slopes mesophilous, montane species occur with edifying characteristic communities (Schneider-Binder 1984, 1994). The most characteristic ones on the Northern exposed slopes are the phytocoenoses of the

grassland association Seslerietum heuflerianae, interlocking with xero-mesophilous grasslands of the alliance Cirsio-Brachypodion or Mesobromion on the foot of the slopes or on those with orientation N-E, E or NW-W (Schneider-Binder 1994) and the phytocoenoses of the association Clematido recti-Laserpitietum latifolii Schneider-Binder 1984 of tall herbaceous plants (Schneider-Binder 1984).
There are also areas with slumping hills, in particular on the slopes of tributaries of the lower stretch of Târnava Mare river, where the xerophilous and xero-mesophilous plant communities are represented frequently by phytocoenoses of Golden Barb grass (*Chrysopogon gryllus*) and Earth-Sedge (*Carex humilis*), the association Chrysopogono-Caricetum humilis (Zolyomi 1950) 1958 phytocoenoses interlocking with those of Cirsio-Brachypodion alliance (Schneider-Binder 2012*),* the Dorycnio–Brachypodietum Cürös et Kovács 1962. Such type of phytocoenoses together with the tall herbaceous vegetation edified by *Clematis recta* on Northern oriented slopes has been encountered in the slumping hill area near the village Motiş, smaller as some of the above mentioned sliding zones, but with representative slumping hills. The objective of this paper is, to present the vegetation of these slumping hills, to compare it with that of the other known slumping hills and to find out their commonalities and distinguishing elements.

MATERIAL AND METHODS

During the vegetation periods of the 2009 and 2015 years field works were realised in the area of Motiş (Mortesdorf) village, Sibiu county. For finding out commonalities and differences between slumping hills from different area of the Southern Transylvanian Tableland, in particular the distribution of vegetation on their slopes with different orientation, additional field studies were realised in the area of Movile, Apold and Păucea in the years of 2009 and 2010. Phytocoenological samples were taken according to the method of Braun-Blanquet with the seven degree scale of abundance-dominance values (Braun-Blanquet 1964, Borza & Boşcaiu 1965). The size of sampling area has been 25qm (5m x 5m) with some exceptions. To follow the distribution of phytocoenoses along ecological gradients, also the side by side method of sampling have been used.

The samples has been included in a synthetic table according to different phytocoenological units and accompanied as well with data about phyto-geographical elements to show the different origin of the species and the interlocking elements of different biogeographical zones. For these elements the following abreviations are used:
Eur = Eu Eropean, Eur-Ct = European Continental, Eur-Submed.= European-Submediteranean, Eur-Med.= Euopean-Mediteranean, Ec = Central-European, Ec-SE Eur = Central-South-Eastern European, Submed -Ec = Sub-Mediteranean- Central European, Submed. = Sub-Mediteranean, Alp-Eur = Alpin-European, Eua = Eurasian, Eua-Ct = Eurasian-Continental, Eua-Submed = Eurasian-Sub-Mediteranean, Ct-Eua = Continental-Eurasian, Pont = Pontic, Pont-Med = Pontic-Mediteranean, Pont-Med-Ec = Pontic-Mediteranean- Central Europe, Pont-Pan = Pontic-Panonian, Pont-Pan-B = Pontic-Panonian-Balcanic, Balc = Balcanic, Carp-B-Pan = Carpathian-Balcanic-Panonian, Circ = Circumpolar.

The nomenclature of the species listed in the tables follows Ciocârlan (2009), Drăgulescu (2010) and Sârbu, Ştefan and Oprea (2013).

RESULTS AND DISCUSSION

The slumping hill area of the village Motiş in the upper part of the Viilor Valley (pârâul Valea Viilor) and upstream the community Valea Viilor (Wurmloch) (Fig. 1) is smaller as some of the above mentioned area, but representative for the interlocking of phyocoenoses edified by Golden Barb grass (*Chrysopogon gryllus*), ord. Danthonio-Chrysopogonetalia (Sanda, Öllerer and Burescu 2008), with those of the alliances Cirsio-Brachypodion (Dorycnio-Brachypodietum, Carici humilis Brachypodietum), Stipion lessingianae, Festucion valesiacae, all taking part of the order Festucetalia valesiacae. Therefore the area presents similarities with the slumping hill area of Păucea situated North-East of Motiş on the right side of the Târnava Mare river. In that area as well as on the slumping hills of Motiş are spread xerothermic grasslands edified by Golden Barb grass (*Chrysopogon gryllus*), a Sub-Mediterranean species, with the Northern border of its distribution in Transylvania in the Southern Transylvanian Tableland. Apart from the xero-mesophilous grasslands, on South-Eastern, Eastern, Western and South-Western exposed slopes, on the Northern exposed slopes of the Movile slumping hills develops small area with tall herbaceous communities edified by *Clematis recta* without *Laserpitium latifolium*, but the other edifying and characteristic species are present. Larger area of this community can be found at Păucea on the "Dealul cu bulbuci" (Täuber and Weber 1976, Schneider 2011 unpublished data) and on larger scale in the sliding zone area between the villages Noiştat and Movile (Schneider-Binder 1984). In the phytocoenoses of the association edified by *Carex humilis* and *Chrysopogon gryllus* are represented species of the alliances Stipion lessingianae such are *Vinca herbacea* and *Salvia nutans*, Festucion valesiacae, Cirsion-Brachypodion and the ordre Festucetalia valesiacae as well as characteristic species of the alliance Bromion, the order of Brometalia and the classe of Festuco-Brometea (Tab. 1). Characteristic for the slumping hills of Motiş is as well the high number of species of thermophilous fringe communities included in the classe Trifolio-Geranietea (with the ordre Origanietalia and the alliances Trifolion medii and Geranion sanguinei. These species are distributed not only in the phytocoenoses of tall herbaceous species as for example *Clematis recta* (Tab. 1, column 9 and 10), but also in the grasslands edified predominantly by *Chrysopogon gryllus* (Tab. Column 1-8).

Besides species taking part of the above mentioned phytocoenological categories, the phytocoenoses edified by *Clematis recta* (Fig. 2) include species of the Quercetalia pubescenti-petraea and the Fagetalia ordres. These species proves the intermediary position of the phytocoenoses edified by *Clematis recta* between open grassland communities to those of forests, constituting a relatively stable stage of tall herbaceous vegetation (Schneider-Binder 1984).

Table 1: as. Carici humilis-Chrysopopogontum grylli (sample 1 – 8) and Laserpitio latifolii-Clematidetum recti (sample 9-10). Species noted with + in one sample: **1**: Eua *Achillea millefolium*, Eua-Submed *Asparagus officinalis*, Pont/Pan/Balc *Cytisus austriacus*, Eua *Inula britannica*, Eur *Prunus spinosa*, Ec-SE-Eur *Trifolium alpestre*; **2**: Circ *Artemisia vulgaris*; Eua *Potentilla erecta*; **7**: Adv *Erigeron annuus*, Eur *Leontodon autumnalis*, Eua *Senecio jacobaea*; Cosm *Prunella vulgaris*; **9**: Eua-Submed. Cosm: *Campanula bononiensis*, *Phragmites australis*, Eur *Pimpinella major*, Eua *Plantago lanceolata*, Eur *Ranunculus polyanthemos* **10**: Eur *Anchusa officinalis*, Eua *Dactylis glomerata*.

	Number of sampling	1	2	3	4	5	6	7	8	9	10
	Slope orientation	SE	SE	E	SW	S	S	S	S	N	N
Flora element/	Slope inclination	45	40	35	35	25	40	30	35	40	45
distrib. area	Covering degree %	90	85	85	80	95	70	80	90	85	80
Sub-Med.	*Chrysopogon gryllus*	4	2	4	1	4	.	3	1	.	.
Eua-Ct	*Carex humilis*	.	3	1	1	+	+	.	3	.	.
Eua-Submed	*Botriochloa ischaemum*	+	2	.	.	2	3	2	3	.	.
	Stipion lessingianae										
Pont	*Vinca herbacea*	.	+	.	.	+	.	.	.	.	.
Pont.-Pan	*Salvia nutans*	.	.	+	.	.	.	.	.	.	.
	Festucion valesiacae										
Eua-Ct	*Astragalus austriacus*	.	.	.	.	.	.	+	+	.	.
Eua	*Linum austriacum*	.	+	.	.	.	.	+	.	.	.
Balc.	*Allium paniculatum ssp. fuscum*	+	.	.	.	.	+	.	.	.	.
Ec-SE-Eur	*Nonea pulla*	+	.	.	.	.	.	.	.	.	.
Pont-Pan	*Salvia austriaca*	+	.	.	.	+	.	.	.	.	.
Ec-Med	*Kengia serotina*	.	.	.	.	.	2	.	.	.	.
	Cirsio-Brachypodion										
Eur	*Helianthemum nummularium*	+	2	.	+	+	.	.	.	+	.
Eua-Ct	*Onobrychis arenaria*	+	.	.	.	.	.	+	+	.	.
Eua-Submed.	*Brachypodium pinnatum*	.	+	.	2	.	+	.	+	.	+
Eua	*Fragaria viridis*	+	.	+	+	.	.	.	2	.	.
Eur-Ct	*Seseli annuum*	.	.	.	.	.	.	+	+	+	+
Eur	*Linum catharticum*	.	.	.	.	.	.	.	+	+	.
	Festucetalia										
Eua-Submed	*Falcaria vulgaris*	+	+	.	.	.	.	.	.	.	.
Pont-Pan	*Thymus pannonicus*	.	+	.	.	2	2	.	.	.	.
P-Md-Ec	*Stachys recta*	+	.	1	.	+	+	.	.	.	.
Ct-Eua	*Veronica spicata*	+	.	+	+	.	.	.	.	.	.
Ec-SE-Eur	*Centaurea stoebe*	+	.	.	.	.	.	.	+	.	.
Eua-Ct	*Verbascum phoeniceum*	.	.	.	.	+	+	.	.	.	.
Ct-Eua	*Campanula sibirica*	.	.	.	.	.	+	+	+	.	.
Eur	*Potentilla cinerea*	.	.	.	.	.	.	+	.	.	.
Eua	*Ononbrychis viciifolia*	1	.	.	.	.	.	.	.	+	+
Eua-Ct	*Achillea setacea*	+	.	+	.	.	.	.	.	+	.
	Bromion-Brometalia										
Eua	*Gentiana cruciata*	.	+	.	.	.	.	.	.	+	.
Ct-Eua	*Ononis arvensis*	.	.	.	.	.	.	+	.	.	.
Submed-Ec	*Linum tenuifolium*	.	.	.	.	+	.	.	.	.	.
Eua	*Briza media*	.	.	.	.	.	.	.	+	+	.
	Festuco-Brometea										
Pont-med.	*Eryngium campestre*	+	.	+	+	+	.	+	+	.	.
Eua	*Filipendula vulgaris*	+	+	+	+	.	.	.	.	.	.
Eua	*Medicago falcata*	+	+	.	.	.	+	+	+	.	+
P-Med	*Astragalus onobrychis*	+	+	.	.	.	.	+	1	.	.
Eua	*Euphorbia cyparissias*	2	+	.	.	.	+	.	+	+	.
Eu-Submed	*Salvia pratensis*	+	+	.	+	+	.	.	.	.	.

P-Med	*Astragalus monspessulanus*	+	+	.	.	+	.	.	+	.	.
Eur-Med.	*Asperula cynanchica*	+	+	.	.	+	.	.	.	.	.
Eua-Ct	*Scabiosa ochroleuca*	.	.	+	.	.	.	+	+	.	.
Ct-Eur	*Pimpinella saxifraga*	+	.	.	.	.	.	.	+	.	.
Eur-Ct	*Cytisus hirsutus*	.	+	.	2	+	.	.	.	+	.
Eua	*Hypericum perforatum*	.	.	+	+	.	.	.	.	.	+
Ct-Eua	*Phleum phleoides*	.	.	.	.	.	.	+	+	.	.
Eua	*Galium verum*	.	.	+	+	.	.	.	+	.	.
Eua	*Campanula glomerata*	+	+	.	.	.	.	.	.	+	+
	Trifolion medii										
Eur	*Knautia arvensis*	+	.	.	.	.	.	.	.	+	.
Eua-Submed	*Brachypodium sylvaticum*	.	.	.	.	.	.	.	.	+	+
Eur	*Centaurea jacea*	+	.	.	.	.	.	+	.	.	.
	Geranion sanguineae										
Alp-Eur	*Bupleurum falcatum*	+	.	.	.	.	.	+	.	.	.
Eua-Ct	*Thalictrum minus*	+	.	+	+	.	+	.	.	.	.
Ec-Submed	*Dictamnus albus*	.	.	+	+	.	.	.	.	.	.
Ec-SE-Eur	*Dorycnium pentaphyllum ssp.herbaceum*	.	.	.	+	+	+	2	+	.	+
Ec - Submed.	*Teucrium chamaedrys*	+	+	.	.	+	+	+	.	.	.
Ec-SE-Eur	*Centaurea spinulosa*	+	.	.	+	+	.	.	.	+	.
Eua	*Silene vulgaris*	+	.	.	.	.	.	+	+	.	.
Ec	*Clematis recta*	.	.	.	.	.	.	.	.	4	4
Ec	*Anthericum ramosum*	+	.	+	+	.	.	.	.	.	.
	Origantietalia										
Circ	*Clinopodium vulgare*	+	.	.	+	.	.	.	.	.	.
Circ	*Solidago virgaurea*	.	.	.	.	.	.	.	.	+	+
	Trifolio-Geranietea										
Eur-Ct-Smed	*Coronilla varia*	+	.	.	.	+	.	+	.	.	.
Eur-Ct	*Peucedanum oreoselinum*	+	.	.	.	.	.	.	.	+	.
Eua	*Viola hirta*	.	.	.	+	+	+	.	.	.	.
	Molinion-Molinietalia										
Eua	*Stachys (Betonica) officinalis*	.	+	.	.	.	.	.	.	+	+
Eua-Ct	*Cirsium canum*	.	.	.	.	.	.	+	.	.	.
Eua	*Epipactis palustris*	.	.	.	.	.	.	+	.	.	.
Eua	*Centaurium pulchellum*	.	.	.	.	.	.	+	.	.	.
Circ.	*Parnassia palustris*	.	.	.	.	.	.	1	.	.	.
	Quercetalia pubescenti-petreae, Fagetalia, Querco-Fagetea, Prunion spinosae										
Submed	*Quercus pubescens*	+	+	.	.	.	.	.	.	.	.
Eur	*Hieracium umbellatum*	.	.	.	.	.	.	.	.	+	1
Carp-B-Pan	*Helleborus purpurascens*	.	.	.	.	.	.	.	.	2	1
Eua	*Betula pendula*	.	.	.	.	.	.	.	.	+	.
Eua	*Ulmus glabra*	.	.	.	.	.	.	.	.	+	.
Eua	*Genista tinctoria*	.	.	.	.	.	.	.	.	.	+
Ec	*Carpinus betulus*	.	.	.	.	.	.	.	.	+	.
Ec	*Allium scorodoprasum*	.	.	.	.	.	.	.	.	+	+
	Arrhenatheretalia, Molinio Arrhenateretea										
Pont-Pan-B	*Rhinanthus rumelicus*	.	.	.	.	.	.	.	+	.	.
Circ	*Elymus repens*	1	+	+	3	.	.	.	.	.	+
Eur	*Pimpinella major*	.	.	.	.	.	.	.	.	.+	.
Eur	*Euphrasia rostkoviana*	.	.	.	.	.	.	.	.	+	.
Eur	*Dianthus carthusianorum*	.	+	.	.	.	.	+	.	+	.
Eua	*Lotus corniculatus*	.	.	.	.	.	.	+	+	.	.
	Other acompaning species										
Ec-Med	*Salvia verticillata*	+	.	.	+	.	.	+	+	.	.
Ct-Eua	*Artemisia campestris*	+	.	.	.	.	+	.	.	.	.

Figure. 1: Aspect of the slumping hill “glimee”- area near Motiș (May 2015).

Figure 2: Late summer aspect of the tall herbaceous phytocoenoses edified by *Clematis recta* on the Northern exposed slope of one of the “glimee” hill area near Motiș village.

On some of the slumping hills, in particular on the Southern oriented steep slopes with high insolation and low covering degree, where incipient erosion processes can be observed, species such are *Botriochloa ischaemum* and *Kengia serotina* develops, attaining locally high abundance-dominance values. The last species has been observed with increasing values in the last years in the late summer aspect of dry grasslands in the Southern Transylvanian Tableland for example in the Buia Valley from Şeica Mare to Mihăileni (Fig. 3).

Fig. 3 - Slumping hills with incipient erosion and typical vegetation.

Another particular aspect of the slumping hills of Motiş, which can be shown also on other hills of the Southern Transylvanian tableland) is theexistence in the midst of xero-, xero-mesophilous and mesophilous vegetation of small patches of wet habitats edified by Common reed (*Phragmites australis*) or by other species indicating wetness such for example *Parnassia palustris, Cirsium canum, Epipactis palustris* and *Centaurium pulchellum* (Tab. 1, column 7). The occurrence of these wet islands are related to the geomorphological structure of the hills build by the sediment deposits of the Tertiary age with an alternation of sand, gravely marl and clay layers with different permeability. The water penetrates through the more permeable sandy layers, arriving above a marl or clay layer, being discharged on the surface in the case of Motiş as seepage water on the hill slopes (Schneider-Binder 2011).

CONCLUSIONS

Comparing the vegetation of the slumping hills near to the village of Motiș with other slumping hills of the Southern Transylvanian tableland, such are those of Movile, Apold, Saschiz and Păucea, we can observe similar patterns of species and communities distribution.

The existence and extend of each of the communities distributed on the slumping hills along ecological gradients in function of slope inclination and orientation as well as the degree of interlocking is related to the size and morphology of the respective slumping hills.

The clearest differences in vegetation are between Northern and Southern oriented slopes. Those with Northern orientation are characterized more through mesophilous and in some cases meso-xerophilous communities edified prevailing by species of European and Eurasian distribution of the hilly and montane levels. The Southern oriented slopes are characterized by prevailing xerothermic vegetation with steppe, i.e. Eurasian-Continental, Pontic, Pontic-Pannonian, Pontic-Mediterranean as well as by sub-Mediterranean and Mediterranean species. The other slopes are characterized by transition stages, sheltering xero-mesophilous and mesophilous grassland communities of the Cirsion-Brachypodion/ Festuco-Brometea and Molinio-Arrhenatheretea species.

The well-structured microrelief is responsible for the diversity of various microhabitats and the high number of species and various plant communities.

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AN EXAMINATION OF ROMANIA'S SAXICOLOUS HABITATS

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KEYWORDS: Romania, saxicolous habitats, characteristics, typology, floristic structure, field data sheet, chorology

ABSTRACT

This paper examines Romania's saxicolous habitats, in terms of structural types and bio-geographical sub-types, floristic and phyto-coenological characteristics, as well as the chorology of the Romanian Carpathians and adjacent areas. Six structural types of saxicolous habitats are highlighted (three being scree/detritus, two rocky slopes, one skeletal soils) and twelve bio-geographical sub-types (of which six being alpine, five continental, one steppe). The rock habitats in Romania are found for the most part in the alpine bio-region (the Carpathian range), some in the continental region (in gorges along rivers that reach the sub-mountainous, even the hill level) and most exceptionally in the steppe region in the Măcin Mts - old eroded mountains from the Hercinian chain of N Dobrudja; Canaraua Fetei, a zone of calcareous rocks in Southern Dobrudja). Those habitats are fragmented and small-sized; most are extremely hard to reach and enjoy a favourable state of preservation. In the description of samples being analysed, the field data sheet given below was employed.

REZUMAT: Consideraţii asupra habitatelor saxicole din România.

Lucrarea analizează habitatele saxicole din România pe tipuri structurale şi subtipuri biogeografice, particularităţile lor, caracteristicile floristice, fitocenologice şi corologia în Carpaţii româneşti şi la periferia acestora. Sunt evidenţiate şase tipuri structurale de habitate saxicole (trei de grohotişuri, două de fisuri de stânci/versanţi stâncoşi şi unul de soluri scheletice) şi 12 subtipuri biogeografice (şase alpine, cinci continentale şi unul stepic). Habitatele de stâncării din România sunt localizate preponderent în bioregiunea alpină (lanţul carpatic), câteva în cea continentală (în chei cu râuri care intră până în etajul submontan şi chiar colinar) şi excepţional în cea stepică în Munţii Măcin - munţi vechi erodaţi, parte a vechiului lanţ hercinic şi Canaraua Fetei, o zonă de stânci calcaroase din sudul Dobrogei). Sunt fragmentate, de mici dimensiuni şi, marea majoritate, sunt inaccesibile şi au o stare de conservare favorabilă. Pentru descrierea eşantioanelor cercetate s-a folosit fişa de teren inserată în lucrare.

ZUSAMMENFASSUNG: Betrachtungen über die Felshabitate in Rumänien.

Die Arbeit umfasst eine Analyse der Felshabitate Rumäniens gegliedert nach Strukturtypen und biogeographischen Untertypen, ihre Besonderheiten, die floristischen und phytocoenologischen Kennzeichen sowie ihr Vorkommen in den Karpaten Rumäniens und ihrer Randgebiete. Es werden sechs Strukturtypen von Felshabitaten (drei auf Geröll, zwei in Felsspalten und auf steilen Felsabhängen, sowie solche auf Skelettböden vorgestellt. Hinzu kommen 12 verschiedene biogeographische Subtypen, sechs alpine, fünf kontinentale und ein für die Steppen-Bioregion charakteristischer. Die Felsenhabitate sind vorwiegend in der alpinen Stufe der Karpaten verbreitet, einige kommen in der kontinentalen Region vor und zwar in Schluchten von Flüssen, die bis in die submontane Stufe oder das Hügelland vordringen und ausnahmsweise in der Steppen Bioregion im Măcin-Gebirge - ein abgetragenes Gebirge aus der hercynischen Kette - im Norden sowie ein Kalkfelsengebiet in der Canaraua Fetei im Süden der Dobrogea anzutreffen sind. Die Felshabitate sind fragmentarisch ausgebildet, von geringer Ausdehnung und meist unzugänglich, weshalb sie sich in einem guten Erhaltungszustand befinden. Für die Beschreibung der untersuchten Habitate im Gelände wurde ein Formblatt ausgearbeitet, das der Arbeit beiliegt.

INTRODUCTION

Saxicolous habitats share a number of features, of which we shall mention the most important. Rock habitats in Romania lie for the most part in the alpine bio-region (the Carpathian range), a few in the continental region (in gorges along rivers that reach the sub-mountaneous, even the hill level) and most exceptionally in the steppe region (Măcin Mts, N Dobrudja; Canaraua Fetei, S Dobrudja); such habitats consist of scree/detritus and rocky slopes. As a rule, they are rather difficult or impossible to reach, therefore one cannot study them closely; conversely, the human impact – deterioration, destruction – is diminished. In other words, those have been preserved unaltered for centuries (particularly in the case of high-altitude habitats). Most saxicolous habitats enjoy a favourable state of preservation. Another particular feature is their fragmentary nature: they frequently cover 1-10 square metres – such as a fissure, a ledge, a stretch of detritus. Also, they are poorly covered with plant species and are hard to find or identify as such.

There are six types of saxicolous habitats in Romania: one in the alpine bio-geographical region, four in the alpine and continental regions, and one in the alpine, continental and steppe regions (Tab. 1).

Table 1: Saxicolous habitats of Romania, with denominations, codes and bio-geographical regions.

No.	Cods of habitats	Names of habitats	Biogeographic regions
1.	8110	Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsidetalia)	ALP
2	8120	Calcareous and calcshist screes of the montane to alpine levels (Thlaspietea rotundifolii)	ALP, CON
3.	8160	* Medio-European calcareous scree of hill and montane levels	ALP, CON
4.	8210	Calcareous rocky slopes with chasmophytic vegetation (Potentilletalia caulescentis)	ALP, CON
5. .	8220	Silceous rocky slopes with chasmophytic vegetation	ALP, CON
6.	8230	Siliceous rock with pioneer vegetation of the Sedo-Scleranthion or of the Sedo-albi-Veronicion dillenii	ALP, CON, STE

MATERIAL AND METHODS

In order to identify the saxicolous habitats of Romania, the bibliography attached was employed, and trips to most mountain massifs in the Carpathians were made, especially in the years 2012-2015.

For each type of habitat, the plant associations and the typical species have been established, for the sake of easy identification in the field. In other words, the floristic and phyto-coenological composition of every habitat has been determined.

A field data sheet was created, in which information was noted concerning location, geo-morphology, geology, phyto-coenology, disturbing factors etc. (see field data sheet below).

Much of the information in this paper was obtained via author's work as an expert in the project "Monitoring of the state of preservation of Romanian species and habitats, Habitats Directive", funded by Programul Operaţional Sectorial Mediu (POS Mediu), Axa prioritară 4, SMIS-CSNR 17655.

FIELD DATA SHEET FOR THE HABITAT ……..

Code/Field data sheet no.		**Date: dd-mm-yyyy**										
Expert	**Surname**						**First name**					
Location	Bio-geographical area											
	Massif											
	Oronym/Toponym											
	Altitude (m)		Exposure				Slope (degrees)					
	Latitude (degrees, minutes, seconds)											
	Longitude (degrees, minutes, seconds)											
Landmarks	Distance (and height) of the occurrence from:											
	Road, path	River, stream	Lake	Forest, bush	Peak	Ridge						
	House	Cabin	Sheepfold	Bridge	Pole	Other						
Access	Means to reach the location											
	Departure point											
Type of field usage												
Field ownership												
Geo-morphology	**Macro-relief** (insert an X in the relevant box)	Gorge		Valley		Cirque						
		Ridge		Peak		Other						
	Micro-relief (insert an X in the relevant box)	Wall		Chimney		Path						
		Gully		Fissure		Other						
Geological substratum (insert an X in the relevant box)	Organic limestone		Crystalline limestone		Granite							
	Crystalline shale		Amphibolite		Gritstone							
	Calcareous detritus		Siliceous detritus		Other							

Area being analysed (underline the relevant figure)	1 m²	2 m²	3 m²	4 m²	5 m²	6 m²	7 m²	8 m²	9 m²	10 m²	20 m²	25 m²	Other
Coverage in vegetation of the area being analysed (underline the relevant percentage)	15%	20 %	25 %	30 %	35 %	40 %	45 %	50 %	55 %	60 %	65%	70 %	Other

	Coeno-taxonomic category (vegetal association)			
Floristic composition	Species	AD	Species	**AD**

Disturbing factors (underline the relevant code)	**A04** Grazing	**B02** Forestry	**C01** Quarry, Mine	**D01** Path, road	**D02** Power lines, wind plant	**F04** Fruit picking	**G01** Ski slopes	**G02** Camping, cabins and villas
	H04 Air pollution	**H05** Waste dumping	**I01** Allochtonous species	**J01** Fires	**K01** Erosion	**K04** Disease, parasites	**L04** Avalanches	Other

Intensity of impact (insert an X in the relevant box)	Insignificant			Moderate		Powerful		

Area being affected				
Time of occurrence				
State of preservation (underline the relevant term)	FV Favourable	U1 Inadequate	U2 Unfavourable	XX Unknown
Prognosis of evolution/trend, short-term/long-term (underline the relevant term)	0 Stable	+ Increasing	- Decreasing	x Unknown
Amplitude of changes, short-term/long-term	minimum %		maximum %	
Notes and suggestions for protection, reconstruction etc.				

Signature

RESULTS AND DISCUSSION

Using the specialised bibliography, a description was created for every type of saxicolous habitat, based on relevant floristic and phyto-coenological composition (see below).

8110 Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsidetalia)

Characteristic species:

Vascular cryptogams and phanerogams*: Androsace chamaejasme, Athyrium distentifolium*, *Festuca picta, Geum reptans, Luzula alpinopilosa, Minuartia sedoides, Oxyria digyna, Poa laxa, Ranunculus glacialis, Saxifraga bryoides, Saxifraga cymosa, Saxifraga carpathica, Saxifraga oppositifolia, Saxifraga moschata, Senecio carniolicus, Silene acaulis, Veronica baumgarteni* a.o.

Mosses: *Polytrichum alpinum, Polytrichum piliferum, Polytrichum sexangulare*, *Rhacomitrium lanuginosum*.

Lichens: *Cladonia* spp., *Lecidea* spp., *Rhizocarpon* spp., *Umbilicaria* spp., *Solorina crocea*, *Stereocaulon alpinum, Thamnolia vermicularis*.

Associations:

Festucetum pictae Krajina 1933 (syn.: Festuco pictae-Senecionetum carniolicae Lungu et Boşcaiu 1981), Poo contractae-Oxyrietum digynae Horvat et al. 1937 (syn. as. Oxyria digyna with Geum (Sieversia) reptans Puşcaru et al. 1956, as. Oxyria digyna with Poa nyárádyana (Simon n.n.) Csűrös 1957, Saxifragetum carpathicae-cymosae Coldea (1986) 1990, Saxifrago bryoidis-Silenetum acaulis Boşcaiu et al. 1977, Saxifrago carpathicae-Oxyrietum digynae Pawł. et al. 1928 (syn.: Oxyrietum digynae auct. rom. non. Br.-Bl. 1926), Sileno acaulis-Minuartietum sedoidis Puşcaru et al. 1956, Veronico baumgartenii-Saxifragetum bryoidis Boşcaiu et al. 1977.

8120 Calcareous and calcshist screes of the montane to alpine levels (Thlaspietea rotundifolii)

Characteristic species:

Vascular cryptogams and phanerogams*: Acinos alpinus (Calamintha baumgarteni), Arabis alpina, Cardaminopsis neglecta, Cerastium arvense* ssp. *calcicolum (C. arvense* ssp. *molle), Cerastium lerchenfeldianum, Cerastium transsilvanicum, Cystopteris alpina, Doronicum carpaticum, Doronicum columnae, Erytrichum nanum, Festuca violacea, Galium lucidum, Galium anisophyllum, Geranium macrorhizum, Linaria alpina, Papaver pyrenaicum* ssp. *corona sancti-stephani, Parietaria officinalis, Pritzelago alpina, Rumex scutatus, Saxifraga aizoides, Saxifraga moschata, Sedum fabaria, Teucrium montanum, Thymus comosus, Viola alpina* a.o.

Mosses: *Dicranum* sp., *Encalypta ciliata, Leskeela nervosa, Syntrichia montana*

Lichens: *Alectoria ochroleuca, Thamnolia vermicularis*

Associations:

Acino-Galietum anisophylli Beldie 1967 (syn. as. Calamintha baumgartenii with Galium anisophyllum Beldie 1967), Cardaminopsio neglectae-Papaveretum Coldea et Pânzaru 1986 (Papavero-Festucetum violaceae Beldie 1967), Cerastio calcicolae-Saxifragetum moschatae Coldea (1986) 1990, Cerastio lerchenfeldiani-Papaveretum Boşcaiu et al. 1977 (syn. Papavereto-Cystopteridetum Csűrös et al. 1956, Papavero-Linarietum alpinae Puşcaru et al. 1956, as. Papaver pyrenaicum with Viola alpina Puşcaru et al. 1981), Cerastio transsilvanici-Galietum lucidi Boşcaiu et al. 1996; Doronico columnae-Rumicetum scutati Boşcaiu 1977 (syn.: Rumicetum scutatii auct. rom.), Galio-Hirundinarietum Dihoru 1975 (syn. Vincetoxicetum officinalis Schwick 1944 p.p.), Parietarietum officinalis Csűrös 1958, Saxifragetum moschatae-aizoidis Boşcaiu 1971, Sedo fabariae-Geranietum macrorrhizi Boşcaiu et Täuber 1977, Thymo comosi-Galietum albi Sanda et Popescu 1999 (syn. Thymetum comosi Pop et Hodişan 1963, Galietum erecti Pop et Hodişan 1964, Teucrietum montani Csűrös 1958)

8160 * Medio-European calcareous scree of hill and montane levels

Characteristic species:

Vascular cryptogams and phanerogams*: Achnatherum calamagrostis, Acinos arvensis, Anthericum ramosum, Asplenium (Phyllitis) scolopendrium, Calamagrostis varia, Cardaminopsis arenosa, Carduus defloratus, Chaenorhinum minus, Cystopteris fragilis, Galeopsis angustifolia, Galeopsis ladanum, Geranium robertianum, Gymnocarpium robertianum, Melica ciliata, Rumex scutatus, Teucrium botrys, Vincetoxicum hirundinaria* a.o.

Mosses: *Abietinella abietina, Barbilophozia barbata, Campylium chrysophyllum, Ctenidium molluscum, Ditrichum flexicaule, Encalypta streptocarpa, Grimmia pulvinata, Homalothecium sericeum, Orthotrichum anomalum, Rhytidium rugosum, Schistidium apocarpum, Tortella tortuosa*.

Lichens: *Aspicilla (Lecanora) calcarea, Aspicilla (Lecanora) contorta, Caloplaca saxicola, Caloplaca variabilis, Candelariella aurella, Cladonia pocillum (Cladonia pyxidata var. pocillum), Cladonia rangiformis, Lecanora albescens, Peltigera praetexata, Peltigera rufescens, Verrucaria nigrescens*

Associations:

Achnatheretum calamagrostis Br.-Bl. 1918, Gymnocarpietum robertianae Kaiser 1926 (syn. Dryopteridetum robertianae (Kuhn 1937) Tüxen 1937, Thymo marginati-Phegopteridetum robertianae Csűrös et Csűrös Káptalan 1966)

8210 Calcareous rocky slopes with chasmophytic vegetation (Potentilletalia caulescentis)

Characteristic species:

Vascular cryptogams and phanerogams*: Achillea schurii, Alyssum montanum, Androsace lactea, Artemisia eriantha (Artemisia petrosa), Asplenium ruta-muraria, Asplenium trichomanes, Asplenium viride, Asplenium lepidum, splenium scolopendrium (Phyllitis scolopendrium), Biscutella laevigata, Campanula carpatica, Campanula crassipes, Campanula cochlearifolia, Ceterach officinarum, Cystopteris fragilis, Draba aizoides, Draba dorneri, Draba haynaldii, Draba kotschyi, Draba lasiocarpa, Draba stellata* subsp. *simonkaiana, Edraianthus kitaibelii, Erysimum crepidifolium, Festuca pallens, Gypsophila petraea, Hieracium bifidum, Hieracium glaucinum, Hieracium schmidtii, Kernera saxatilis, Poa rehmanii, Saxifraga cuneifolia, Saxifraga luteo-viridis, Saxifraga marginata* ssp. *rocheliana, Saxifraga moschata, Saxifraga mutata* ssp. *demissa, Sedum dasyphyllum, Sesleria filiifolia, Sesleria varia, Silene petraea, Silene zawadski, Thymus pucherrimus, Valeriana sambucifolia* a.o.

Mosses: *Anomodon viticulosus, Ctenidium molluscum, Distichum capillaceum, Encalypta streptocarpa, Grimma orbicularis, Grimma tergestina, Gymnostomum aeruginosum, Homalothecium lutescens, Homalothecium sericeum, Metzgeria conjugata, Neckera crispa, Porella (Madotheca) platyphylla, Scapania aspera, Seligeria calcarea, Tortella inclinata* and *Zygodon viridissimum*.

Lichens: *Aspicillia (Lecanora) calcarea, Aspicilia (Lecanora) contorta, Buellia epipolia, Caloplaca decipiens, Caloplaca saxicola (Caloplaca murorum), Caloplaca teicholyta, Collema auriforme (Collema auriculatum), Collema tenax, Dermatocarpon miniatum, Lecanora albescens, Lecanora campestris (Lecanora subfusca* var. *campestris), Lecanora dispersa, Leptogium lichenoides, Placynthium nigrum, Protoblastenia rupestris, Verrucaria nigriscens*.

Associations:

Achilleo schurii-Campanuletum cochleariifoliae Fink 1977, Artemisio petrosae-Gypsophiletum petraeae Puşcaru et al. 1956, Asplenietum trichomanis-rutae-murariae Kuhn 1937, Tüxen 1937 (syn. Tortulo-Asplenietum Tüxen 1937), Asplenio-Ceterachetum Vives 1964, Asplenio-Cystopteridetum fragilis Oberd. (1936) 1949, Asplenio quadrivalenti-Poëtum nemoralis Soó ex Gergely et al. 1966, Asplenio-Schivereckietum podolicae Mititelu et al. 1971, Asplenio-Silenetum petraeae Boşcaiu 1971, Campanuletum crassipedis Borza ex Schneider-Binder et al. 1970, Ctenidio-Polypodietum Jurko et Peciar 1963; Drabo lasiocarpae-Ceterachetum (Schneider-Binder 1969) Peia 1978, Saxifrago demissae-Gypsophiletum petraeae Boşcaiu et Täuber 1977, Saxifrago luteo-viridis-Silenetum zawadzkii Pawł. et Walas 1949, Saxifrago moschatae-Drabetum kotschyi Puşcaru et al. 1956, Saxifrago rochelianae-Gypsophiletum petraeae Boşcaiu et al. 1977, Sileno zawadzkii-Caricetum rupestris Täuber 1987, Thymo pulcherrimi-Poëtum rehmanii Coldea (1986) 1990.

8220 Siliceous rocky slopes with chasmophytic vegetation

Characteristic species:

Vascular cryptogams and phanerogams*: Asplenium adiantum-nigrum, Asplenium cuneifolium, Asplenium septentrionale, Asplenium trichomanes, Dianthus henteri, Jovibarba heuffelii (Sempervivum heuffelii), Polypodium vulgare, Potentilla haynaldiana, Rhodiola rosea (Sedum roseum), Saxifraga pedemontana* ssp. *cymosa, Sedum telephium, Senecio glaberrimus, Silene dinarica, Silene lerchenfeldiana, Symphyandra wanneri, Veronica bachofeni, Woodsia alpina, Woodsia ilvensis* a.o.

Mosses: *Amphidium mougeotii, Andreaea rupestris, Barbilophozia barbata, Barbilophozia lycopodioides, Bartramia pomiformis, Batramia ithyphylla, Bartramia halleriana, Bazzania trilobata, Diplophyllum albicans, Frullania tamarisci, Grimmia laevigata, Grimmia montana, Grimmia trichophylla, Hedwigia ciliata, Paraleucobryum longifolium, Rhacomitrium heterostichum, Rhacomitrium sudeticum, Schistostega pennata*.

Lichens: *Acarospora fuscata, Candelariella vitellina, Chrysothrix chlorina, Diploschistes scruposus, Lasallia pustulata, Lecanora polytropha, Lecidea (Lecanora) confluens, Lecidea fuscoatra, Lepraria incana, Parmelia conspersa, Parmelia saxatilis, Pertusaria corallina, Protoparmelia (Parmelia) badia, Rhizocarpon alpicolum, Rhizocarpon geographicum, Rhizocarpon obscuratum, Tephromela atra, Umbillicaria cylindrica, Umbillicaria deusta, Umbillicaria hirsuta, Umbilicaria polyphylla*.

Associations:

Asplenietum septentrionalis-adianti-nigri Oberd. 1938, Asplenietum septentrionalis Schwick 1944, Asplenio trichomanis-Poëtum nemoralis Boşcaiu 1971, Diantho henteri-Silenetum lerchenfeldianae Stancu 2000, Hypno-Polypodietum Jurko et Peciar 1963, Sempervivetum heuffelii Schneider-Binder 1969, Senecio glaberrimi-Silenetum lerchenfeldianae Boşcaiu et al. 1977, Silenetum dinaricae Schneider-Binder et Voik 1976, Sileno lerchenfeldianae-Potentilletum haynaldianae (Horvat et al. 1937) Simon 1958, Woodsio ilvensis-Asplenietum septentrionalis Tüxen 1937 (inclusiv subas. dianthetosum henteri (Schneider-Binder 1972) Drăgulescu 1988).

8230 Siliceous rock with pioneer vegetation of the Sedo-Scleranthion or of the Sedo-albi-Veronicion dillenii

Characteristic species:

Vascular cryptogams and phanerogams*: Aira caryophyllea, Allium montanum, Anthericum liliago, Arenaria serpyllifolia, Artemisia campestris, Cerastium brachypetalum, Cerastium glutinosum, Cerastium pumilum, Cerastium semidecandrum, Erophila verna (Draba verna), Festuca pallens, Festuca rupicola, Filago arvensis, Gagea bohemica, Gagea saxatilis, Galium pumilum, Hieracium pilosella, Holosteum umbellatum, Jovibarba heuffelii (Sempervivum heuffelii), Lactuca perennis, Myosotis ramosissima, Myosotis stricta, Petrorhagia prolifera, Potentilla argentea, Rumex acetosella, Saxifraga tridactylites, Scleranthus perennis, Scleranthus polycarpos, Sedum acre, Sedum album, Sedum annuum, Sedum rupestre, Sedum sexangulare, Sempervivum montanum, Silene nutans, Silene rupestris, Silene viscaria, Thymus pulegioides, Trifolium arvense, Trifolium striatum, Veronica dilenii, Veronica fruticans, Veronica verna, Vulpia myuros,* a.o.

Mosses: *Hythecium albicans, Ceratodon purpureus, Grimmia* ssp., *Hedwigia ciliata, Pleuridium subulatum, Polytrichum piliferum, Ptilidium ciliare, Rhytidium rugosum, Riccia ciliifera, Tortula muralis, Tortula ruraliformis (Tortula ruralis* subsp. *ruraliformis)*.

Lichens: *Cetraria aculeata (Cornicullaria tenuissima), Cladonia foliacea, Cladonia furcata, Cladonia gracilis, Cladonia pyxidata, Parmelia omphalodes, Parmelia saxatilis, Peltigera praetexata, Peltigera rufescens*.

Associations:

Polytricho piliferi-Scleranthetum perennis Moravec 1967, Sileno rupestris-Sedetum annuui Oberd. 1957, Vulpio-Airetum capillaris Paucă 1941.

Samples of saxicolous habitats have been identified in almost all mountain massifs in Romania (Tab. 2).

Table 2: The chorology of saxicolous habitats – considering bio-geographical and mountain massifs.

No.	Saxicolous habitats	Biogeographic regions	Chorology
1.	8110 Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsidetalia)	ALP	Maramureş Mountains (Farcău Mountain), Ţibleş Mountains (Arcer Peak, Ţibleş Peak), Mountains Rodnei (Anieşu Mare Peak, Galaţiu Peak, Pietrosu Mare Peak, Puzdra Peak, Rebra Peak), Suhard Mountain, Ciucaş Mountain, Bucegi Mountains (Bucşoiu Peak, Caraiman Peak, Coştila Peak, Omu Peak), Făgăraş Mountains (Arpăşel, Bâlea, Capra, Negoiu Peak), Cozia Mountain, Cindrel Mountains (Iezeru Mare, Iezeru Mic), Căpăţânei Mountains (Vânturariţa Peak, Vioreanu Peak), Parâng Mountains (Câlcescu, Coasta lui Rus, Gruiu Peak, Mândra Peak), Mehedinţi Mountains (Gaura Mohorului), Retezat Mountains (Bucura, Custura Peak, Peleaga Peak, Pietrele), Vâlcan Mountains (Oslea Mountain), Ţarcu-Godeanu-Cernei Mountains (Cleanţul Ilovei, Groapa Bistrei, Obârşia Hidegului, Ţarcu Peak), Apuseni Mountains (Cepelor Valley, Vlădeasa Peak).
2.	8120 Calcareous and calcshist screes of the montane to alpine levels (Thlaspietea rotundifolii)	ALP	Rarău-Giumalău Mountains (Rarău Peak), Rodna Mountains (Ineu Peak, Negoiescu Mare Peak, Pietrosu Peak), Bicaz Gorges, Siriu Mountains (Siriu Peak), Ciucaş mountains (Ciucaş Peak), Bucegi Mountains (Creasta Bucura, Omu Peak), Leaota Mountains (Cheii Gorges, Dâmboviţei Gorges), Piatra Craiului Mountains (Crăpăturii Valley, Marele Grohotiş, Piatra Craiului Mică), Piatra Mare, Mountain, Postăvaru Mountain, Făgăraş Mountains (Arpăşel, Doamnei Valley, Netedu Peak), Lotru Mountains (Căprăreţ Valley, Lotrioarei Valley, Târnovu Mare Mountain), Buila-Vânturariţa Mountains, Retezat Mountains (Piatra Iorgovanului, Piule), Ţarcu-Godeanu-Cernei Mountains (Ciuceava Mare, Gura Zlata, Ţarcu Peak), Apuseni Mountains (Boga Valley), Trascău Mountains (Bedeleu Mountain, Feneşului Valley, Întregalde Gorges), Gilău Mountains (Muntele Mare, Râmeţ Gorges, Scăriţa-Belioara), Bihor Mountains (Bulzeşti Gorges, Sighiştelului Valley,), Metaliferi Mountains (Crăciuneşti Gorges), Pădurea Craiului Mountains (Crişului Repede Defile, Iadului Valley).

Table 2 (continued): The chorology of saxicolous habitats – considering bio-geographical and mountain massifs.

3.	8120 Calcareous and calcshist screes of the montane to alpine levels (Thlaspietea rotundifolii)	CON	Tălmaciu-Podul Olt, Ţarcu-Godeanu-Cernei Mountains (Bedinei Gorge, Bela Reca Valley Cernei Valley at Bobot), Caraşului Gorges, Porţile de Fier, Turzii Gorges, Vadu Crişului.
4.	8160 * Medio-European calcareous scree of hill and montane levels	ALP	Leaota Mountains (Cheii Gorges, Dâmboviţei Gorges Ghimbavului Gorges), Cernei Mountains (Curmătura Paltina), Bihor Mountains (Vidra-Avram Iancu).
5.	8160 * Medio-European calcareous scree of hill and montane levels	CON	Cernei Valley (Bedinei Gorge, Prisăcinei Gorge).
6.	8210 Calcareous rocky slopes with chasmophytic vegetation (Potentilletalia caulescentis)	ALP	Rarău-Giumalău Mountains (Pietrele Doamnei), Ţibleş Mountains (Arsu Mountain), Rodnei Mountains (Corongiş Peak Piatra Rea, Pietrosu Peak), Ceahlău Peak, Suhard Mountain, Bicazului Gorges, Hăşmaşu Mare Mountain, Vrancei Mountains (Tişiţei Gorges), Bistriţei Aurii Valley, Trotuşului Valley, Ciucaş Mountains (Tigăile, Piroşca), Bucegi Mountains (Lespezi, Jepii Mici), Piatra Craiului Mountains (Piatra Craiului Mică, Şaua Crăpăturii), Piatra Mare Mountain, Postăvaru Mountain, Leaota Mountain, Iezer-Păpuşa Mountains (Cheii Gorges, Ghimbavului Gorges), Făgăraş Mountains (Arpăşel, Avrig Lake, Ciortea Peak, Jgheabul Văros, Podragului Valley at Turnuri), Lotrului Mountains (Târnovu Mare), Buila-Vânturariţa Mountains (Bistriţei Gorges), Retezat Mountains (Piatra Iorgovanului, Piule), Ţarcu, Godeanu-Cernei Mountains (Arjana Peak, Cleanţul Ilovei, Custura Gropii Bistrei, Obârşia Hidegului), Mehedinţi Mountains (Piatra Cloşanilor), Apuseni Mountains (Piatra Bulzului, Piatra Singuratică), Trascău Mountains (Galdei Valley, Piatra Ceţii).

Table 2 (continued): The chorology of saxicolous habitats – considering bio-geographical and mountain massifs.

7.	8210 Calcareous rocky slopes with chasmophytic vegetation (Potentilletalia caulescentis)	CON	Stânca Ştefăneşti, Cernei Mountains (Băile Herculane, Bedinei Gorge, Drăstănicului Gorge, Priscăcinei Gorge), Mehedinţi Mountains (Ţesnei Valley), Buila-Vânturariţa Mountains (Bistriţei Gorges), Aninei Mountains (Caraşului Gorges), Almăjului Mountains (Cazanele Dunării), Porţile de Fier, Apuseni Mountains (Aiudului Gorges, Avram Iancu, Baldovin in Bulzeşti Valley, Băcâia, Cibului Gorges, Crişului Repede Defile, Măzii Gorges, Turzii Gorges), Pădurea Craiului Mountains (Albioarei Gorges, Şuncuiuş in Mişid Valley).
8.	8220 Silceous rocky slopes with chasmophytic vegetation	ALP	Gutâi Mountains, Rodnei Mountains, Călimani Mountains (Hăitii Valley), Vrancei Mountains (Tişiţei Gorges), Nemira Mountains, Siriu Mountain (Colţii Balei), Piatra Craiului Mountains (Dâmbovicioarei Gorges, Prăpăstiile Zărneştilor), Iezer-Păpuşa Mountains (Ghimbavului Gorges, Peştera Urşilor), Leaota Mountains, Mountains Făgăraş (Suru Peak on Fruntea Moaşei, Şerbota Valley), Cozia Mountains (Cozia Peak), Parâng Mountains, Cindrel Mountains (Dealu Grosu, Fundu Râului, Râul Mare), Căpăţânii Mountains (Buila, Vânturariţa), Lotru Mountains (Călineşti Valley, Masa Verde, Lotrioara Valley, Căprăreţ Valley), Sebeşului Mountains (Oaşa at Stăvilar, Tărtărău, Tău), Retezat Mountains (Faţa Retezatului, Gemenele), Ţarcu-Godeanu Mountains (Custura Mătaniei, Piga Peak), Apuseni Mountains (Vlădeasa in Drăganului Valley), Gilău Mountains (Râmeţului Valley, Scăriţa - Belioara), Bihor Mountains (Ordâncuşei Gorges), Trascău Mountains (Feneşului Gorges), Codru-Moma Mountains, Metaliferi Mountains, Pădurea Craiului Mountains (Crişului Repede Defile, Iadului Valley).
9.	8220 Siliceous rocky slopes with chasmophytic vegetation	CON	Cozia Mountains (Călineşti Valley, Cozia Peak), Turnu Roşu Defile at Fântâna Împăratului), Orlat, Boiţa in Olt Defile, Eşelniţa, Mraconia, Porţile de Fier, Apuseni Mountains (Băcâia Gorges, Cibului Gorges, Crişului Repede Defile, Curături, Feneşului Gorges, Iadului Valley, Mada Gorges,Ordâncuşei Gorges, Râmeţului Valley, Vadu Crişului).

Table 2 (continued): The chorology of saxicolous habitats – considering bio-geographical and mountain massifs.

10.	8230 Siliceous rock with pioneer vegetation of the Sedo-Scleranthion or of the Sedo-albi-Veronicion dillenii	ALP	Maramureşului Mountains (Cisla Valley), Mehedinţi Mountains (Valley Ţesnei), Codru-Moma Mountains, Plopiş Mountains.
11	8230 Siliceous rock with pioneer vegetation of the Sedo-Scleranthion or of the Sedo-albi-Veronicion dillenii	CON	Băile Herculane, Cazanele Mari, Dunării Defile, Dubova , Eşelniţa Valley – Mraconiei Valley, Plavişeviţa, Sviniţa-Tricule, Mountains Locvei, Apuseni Mountains. (Turzii Gorge).
12.	8230 Siliceous rock with pioneer vegetation of the Sedo-Scleranthion or of the Sedo-albi-Veronicion dillenii	STE	Măcin Mountains. (Cheia, Greci).

CONCLUSIONS

In Romania, there are six structural types of saxicolous habitats: three being scree/detritus-based, two rock-fissure/rocky slopes, and one skeletal soils. If their bio-geographical distribution is taken into account, twelve sub-types result: six being alpine, five continental, and one steppe.

Between the associations included in each of the habitat types, many are of biogeographical importance, highlighting the particularities of the rocky vegetation of the Carpathian mountains in comparison with those of other European mountains.

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CONTRIBUTIONS TO THE KNOWLEDGE OF THE ANT FAUNA (HYMENOPTERA, FORMICIDAE) OF PARÂNG MOUNTAINS (ROMANIA)

Ionuţ TĂUŞAN [1]

KEYWORDS: ants, faunistics, *Lasius mixtus*, Romania.

ABSTRACT

The ant fauna of Romania is still understudied despite intensive myrmecological surveys which were carried out in the last decades. Data regarding the ant fauna from many regions are scarce or lacking. In particular, mountain areas are poorly studied. Herein, data concerning 16 ant species belonging to two subfamilies (Myrmicinae and Formicinae) are given. Most of the species are common for Romanian myrmecofauna. However *Lasius mixtus*, which has not been reported from Romania for almost 50 years, is now known from Parâng Mountains. Typical mountains species were identified in the present study: *Formica lemani*, *Manica rubida* and *Leptothorax acervorum*. Moreover, all species are first mentioned for the investigated area.

REZUMAT: Contribuții la cunoașterea mirmecofaunei (Hymenoptera: Formicidae) din Munții Parâng (România).

Mirmecofauna României este puțin studiată deși numeroase cercetări mirmecologice au fost întreprinse în ultimele decenii. Pentru multe regiuni ale țării se cunosc puține date sau acestea lipsesc. Un astfel de caz este reprezentat de zonele montane. În prezentul studiu sunt prezentate date despre 16 specii de furnici aparținând la două subfamilii (Myrmicinae și Formicinae). Majoritatea speciilor identificate sunt comune pentru fauna de furnici a României. Totuși, subliniem prezența speciei *Lasius mixtus* în Munții Parâng, care nu a mai fost semnalată în România de peste 50 de ani. Au fost colectate și specii tipice pentru zone montane precum *Formica lemani*, *Manica rubida* și *Leptothorax acervorum*. De asemenea, toate speciile identificate în acest studiu sunt noi pentru zona investigată.

ZUSAMMENFASSUNG: Beiträge zur Kenntnis der Ameisenfauna (Hymenoptera, Formicidae) des Parâng-Gebirges in den Südkarpaten (Rumänien).

Die Ameisenfauna Rumäniens ist wenig untersucht worden, obwohl in den letzten Jahrzehnten zahlreiche myrmekologische Untersuchungen durchgeführt wurden. Für viele Regionen des Landes gibt es wenige Angaben oder diese fehlen gänzlich. Ein derartiger Fall betrifft die montanen Gebiete. In vorliegender Arbeit werden Untersuchungen zu 16 Ameisenarten aus zwei Unterfamilien (Myrmicinae und Formicinae) vorgestellt. Die Mehrheit der festgestellten Arten sind für die Ameisenfauna Rumäniens häufig. Dennoch wird auf das Vorkommen der Art *Lasius mixtus* im Parâng-Gebirge hingewiesen, die seit mehr als 50 Jahren für Rumänien nicht mehr angegeben wurde. Es wurden auch für die montanen Gebiete typische Arten wie *Formica lemanni*, *Manica rubida* und *Leptothorax acervorum* bekanntgemacht. Auch die anderen im Gebiet festgestellten und in dieser Studie aufgelistete Arten sind neu für das Untersuchungsgebiet.

INTRODUCTION

Knowledge regarding qualitative-quantitative composition of the local fauna and the distribution of species among different habitat types can serve as basis for future complex studies treating the relationship between local and regional biodiversity patterns (Agosti et al., 2000).

In Romania, in the case of ant communities, there is a need for complete faunistic datasets on specific areas, as the data currently available is mostly scattered or even lacking.

Regular myrmecological studies in Romania were undertaken starting from the second half of the 20th century (Markó et al. 2006). However, the knowledge of the Romanian myrmecofauna is still deficient. The current checklist is most likely incomplete, due to many regions that are poorly or not investigated at all, such as: Moldavia, Banat and the mountain regions.

The intensive myrmecological surveys carried out in the last two decades improved the ant checklist to a total of 112 species (Markó, 2008; Ionescu-Hirsch et al., 2009, Czekes et al., 2012, Tăușan and Pintilioaie, 2016). And yet, this number was still considered low, since in other similar or neighbouring European countries there were significantly more species known (Czechowski et al., 2012).

Regarding the mountain ant fauna few data are available. Cîrdei et al. (1969) sampled ants from Oriental Carphatians. Later, Paraschivescu investigated different mountains such as: Retezat Mountains (1972), Semenic Mountains (1975), Bucegi Mountains (1976) and Apuseni Mountains (1982). More recent Moscaliuc collected ants from Rarău Mountains (2008) and Tăușan (2010) investigated Rodna Mountains.

In the frame of this study we investigated ants from different habitats, such as grasslands and forests from the Parâng Mountains, which has not been prior investigated.

The central part of the Southern Carpathians is represented by the Parâng-Cindrel Mountains, which stand out as one of the tallest and largest Romanian Carpathian ranges, being considered the most important hydrographic and orographic range in the area (Marinescu et al., 2013).

The Parâng Mountains are located between the Șureanu Mountains (North), Latoritei Mountains (North-East), Căpățânii Mountains (East), Vâlcan Mountains (West) and the Petroșani Depression in the North-West. The Parâng Mountains form the Eastern barrier of the Jiu Valley.

The Parâng Mountains consist mainly of crystalline rocks, covered with patches of sediments from the Paleozoic, Mesozoic (massive limestone, conglomerates) and Cenozoic eras, mixed with large areas of granite outcrops. On the Southern slope there are sedimentary rocks from the Mesozoic. The newest rocks are found on the southern frame of the mountains and in the North-West, where it is bordered by the Petroșani Depression. The nature of the rocks favoured the emergence of bulk, rounded ridges, separated by deep valleys (Ielenicz and Pătru, 2005).

The most characteristic features of this range are its massiveness and relatively conserved forest areas, providing a vast alpine area and subalpine meadow despite the related anthropogenic pressure (intensive population, tourism activities) (Marinescu et al. 2013). These mountains have one of Romania's largest forest ecosystems, and thus they shelter important Carpathian hotspots of biodiversity (Eberhardt et al., 2015).

MATERIAL AND METHODS

Several types of habitats were investigated such as forest edges (Figure 1) and subalpine meadows (Figure 2).

Ants were sampled by hand collecting from nests during June to September 2014 (Fig. 3).

Figure 1: Forest edge (near Rânca).

Figure 2: Alpine meadow (Parângul Mic).

The identification of ant species was carried out on the basis of several available identification keys (Seifert 2007, Czechowski et al., 2012). The specimens are preserved in 70% alcohol, in the ant collection of the Department of Environmental Protection and Physics (Lucian Blaga University of Sibiu).

The ants zoogeographical and ecological characterization is based on Czechowski et al. (2012) classification

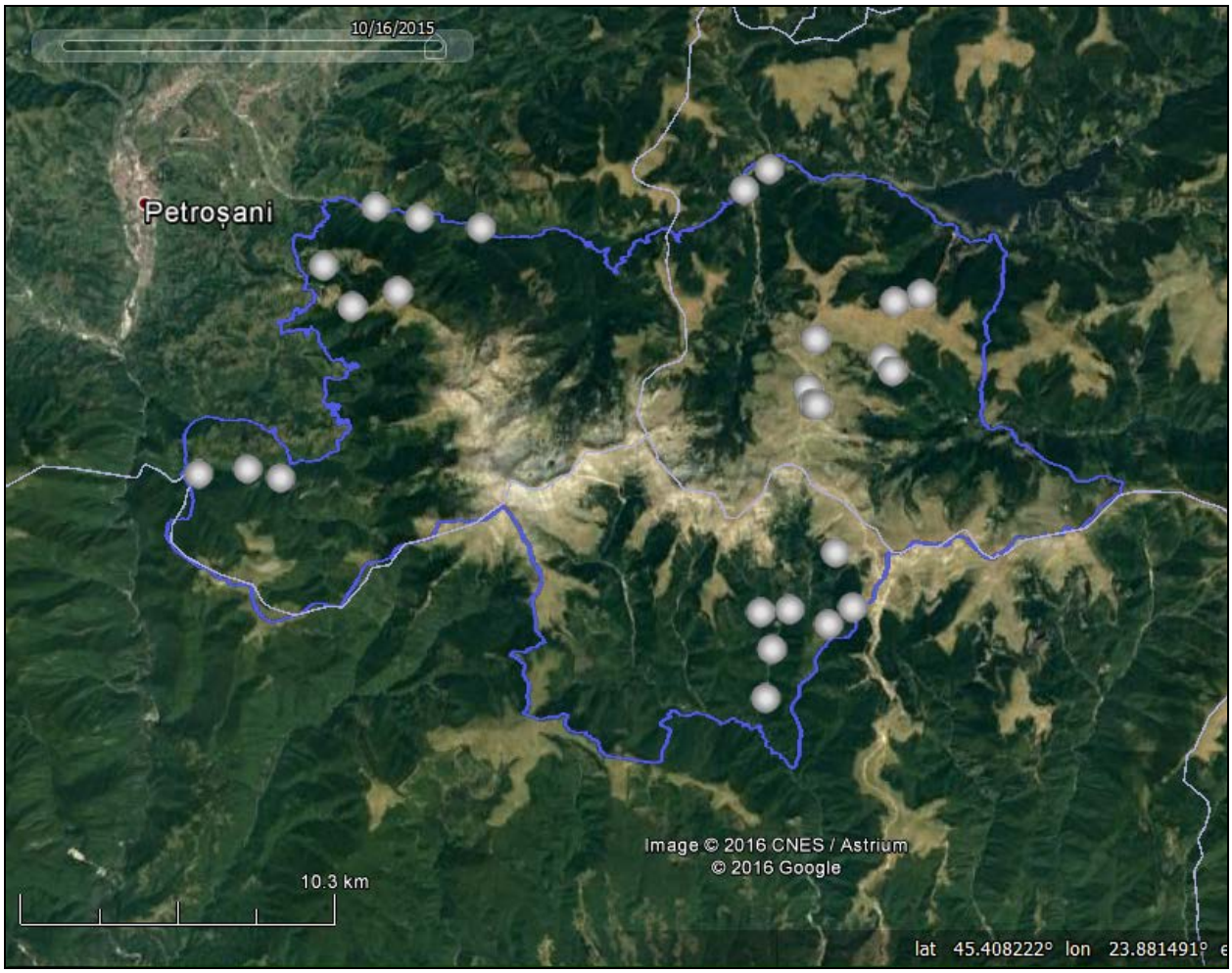

Figure 3: Map of sampling sites in Parâng Mountains (grey dots; blue border – SCI Parâng site) (modified after Google Earth map).

RESULTS

List of species

Altogether we identified 16 ant species belonging to two subfamilies: Formicinae (10 species) and Myrmicinae (6 species). Most of the species are common for the ant fauna of Romania. The species ecological character, habitat requirements are presented in the following.

Subfamily Myrmicinae

Myrmica rubra (Linnaeus, 1758) is a North-Palaeartic species known from almost the entire Europe and Palaearctic Asia. The eastern limit of the species range runs in East Siberia (the Transbaika region). *M. rubra* is a eurytopic species, ecologically the most tolerant of all European *Myrmica*. It is considered to be one of the most common ant species in the temperate zone of the Palaearctic. It occurs in very diverse habitats, especially in lowlands. The species is abundant in meadows with a high level of ground water (Czechowski et al., 2012; Czekes et al., 2012).

Myrmica ruginodis Nylander, 1846 is a polytopic mesohygrophilic species of forest where it replaces *M. rubra*. It avoids dry and sun-exposed places and unlike *M. rubra*, highly anthropogenic habitats. Present in mires; in mountains, it inhabits also open habitats above 1000 m a.s.l. (Czechowski et al., 2012; Czekes et al., 2012).

Myrmica scabrinodis Nylander, 1846 prefers humid habitats. It requires high insolation but is very tolerant of soil moisture. Prefers both open and forest habitats. Nests are usually in the ground, in tufts of grass or moss (Czechowski et al., 2012; Czekes et al., 2012).

Manica rubida (Latreille, 1802) is an oligotope of warm and moderately humid deciduous forests, nesting in the ground, under stones, in decaying wood (Czechowski et al., 2012). In Romania it occurs mainly in mountain regions, preferring forest edges.

Leptothorax acervorum (Fabricius 1993) is most abundant in dry and light coniferous, mainly pine forest with poor undergrowth. It occurs also in open habitats, ranging from moist mires to dry grasslands. In the mountain areas, it reaches the subalpine meadow and the alpine tundra zones. Nest consists mainly of decaying logs or stumps, in detached branches, under bark. (Czechowski et al., 2012). In Romania, it is common but not frequent, probably due to undersampling.

Tetramorium cf. *caespitum* is a species with wide distribution, it can be found in the whole Palaearctic. It prefers semixerophilous habitats mainly open, sun-exposed and dry places, sparsely covered with herbaceous vegetation; it is especially common in sandy soils in the plain region (Czechowski et al., 2012). In Romania it is probably the most common species.

Subfamily Formicinae

Lasius flavus (Fabricius, 1781) is a fairly thermophilic ubiquist species, preferring open and sunny habitats. It occurs in meadows and pastures where it nests with big soil mounds in high densities (Czechowski et al., 2012).

Lasius niger (Linnaeus, 1758) is a mesohygro and mesothermophilic species, occurring mainly in open habitats. Nests in the ground, often under stones (Czechowski et al., 2012).

Lasius platythorax Seifert, 1991 prefers, compared to *L. niger*, it prefers more humid habitats, especially forests. It usually builds nests in organic substrate, most frequently in dead wood, under bark, but also in grass tussocks with a humus root layer (Czechowski et al., 2012).

Lasius mixtus (Nylander, 1846) is a mesohygro- and mesothermophilic oligotope of humid habitats, both open (meadows, pastures) and wooded (light forests). Nest, with carton elements, in the soil, often under stones, occasionally with soil mounds (Czechowski et al., 2012).

Formica sanguinea Latreille, 1798 is quite thermophilic species of dry habitats both in woodlands and open areas. It prefers sunny places, especially clearings, forest edges and roadsides (Czechowski et al., 2012).

Formica cunicularia Latreille, 1798 is a quite thermophilic and xerophilic poltytope of rather open habitats. Nest with fairly large soil mounds, in the ground sometimes under stone (Czechowski et al., 2012).

Formica cinerea Mayr, 1853 is a quite xerophilic of dry open habitats and forests. It occurs in sunny sandy sites bare or overgrown with sparse herb vegetation, from coastal and inland dunes to open light pine forests (Czechowski et al., 2012).

Formica lemani Bondroit, 1917 is a boreo-mantane, quite oligothermic oligotope of mountain meadows, both moist and wet, also in forest glades, on mires and rarely in shaded humid forests (Czechowski et al., 2012).

Formica polyctena Förster, 1850 is a species included into wood ants (outside *F. rufa* group), although it is a quite thermophilic polytope and steppes, clearings or spares forests. Nests, with flat mounds made of coarse plant material, usually surrounded by a ring of tall herbage (Czechowski et al., 2012).

Camponotus ligniperda (Latreille, 1802) is a mesohygrophilic oligotope of deciduous forest; found also in mixed and coniferous forests, and even in open habitats sparsely overgrown with shrubs or single trees. It nests in dry stumps, in the ground under wood, under stones or in rock crevices, but always in connection with wood (Markó et al., 2009; Czechowski et al., 2012).

DISCUSSIONS

The species covered a wide spectrum ranging from open habitat species, such as *Myrmica scabrinodis*, to forests species (*Myrmica ruginodis*, *Lasius platythorax* and ubiquistic species, such as *Myrmica rubra*, *Lasius niger*, *Formica cinerea* and *Tetramorium* cf. *caespitum*. We also recorded typical mountain species: *Manica rubida*, *Formica lemani* and *Leptothorax acervorum*.

Regarding the species ecological classification half of them are polytopic, whereas 37% are oligotopic and 13% are eurytopoc (Figure 4).

The zoogeographical classification shows that Palaerctic elements (South and North) cover more 50% of the species. The Euro-Caucasian and Euro-Siberian are less represented (Figure 5).

A particular interesting record was *Lasius mixtus*, which has not been reported from Romania for almost 50 years.

Our results are in agreement with similar studies from different mountain regions of Romania. Paraschivescu (1972) identified 21 species from Retezat Mountains, and 19 species in Semenic Mountains (1975). Recently, Tăușan (2010) identified 16 species from Rodna Mountains, while Moscaliuc (2007) identified 20 species. Yet, a higher number of ant species were reported from Bucegi Mountains (36 species – Paraschivescu 1976) from Apuseni Mountains (29 species – Paraschivescu 1982). Cîrdei et al. (1969) recorded 31 species from Oriental Carpathians.

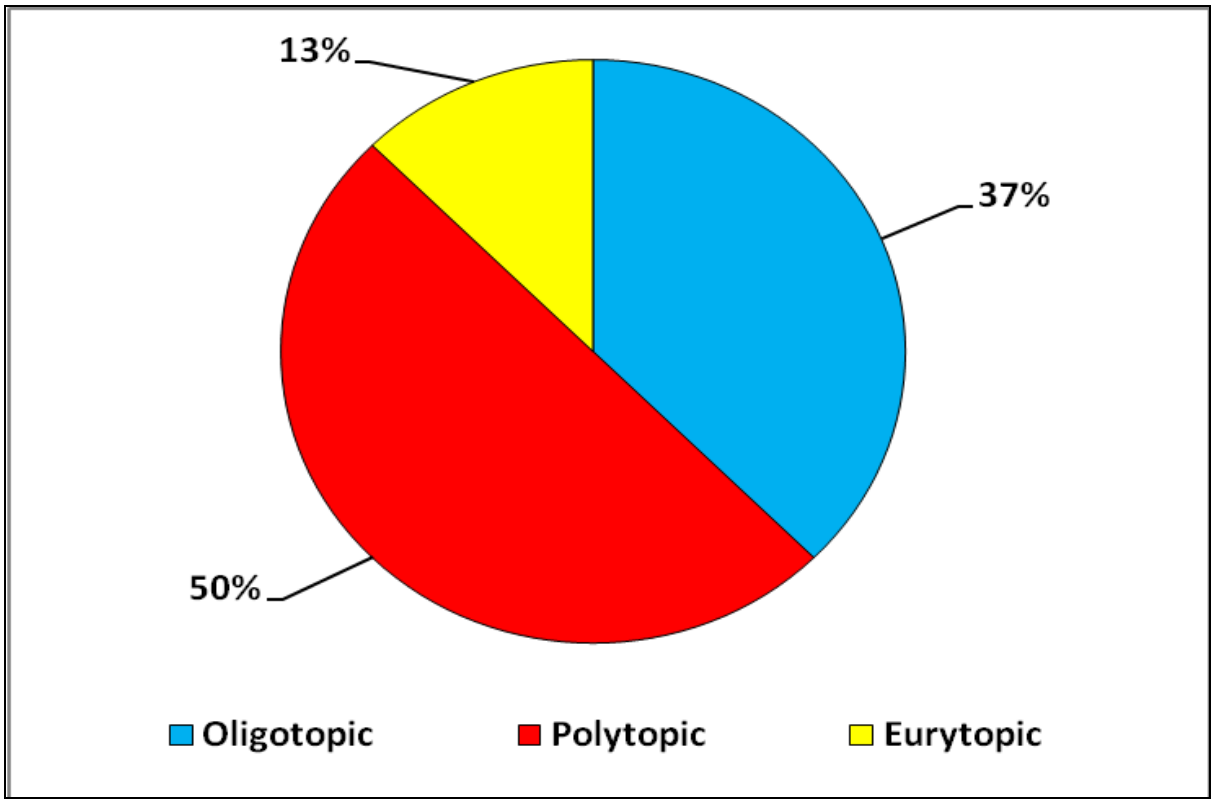

Figure 4: The ecological spectrum of the identified ant species of Parâng Mountains.

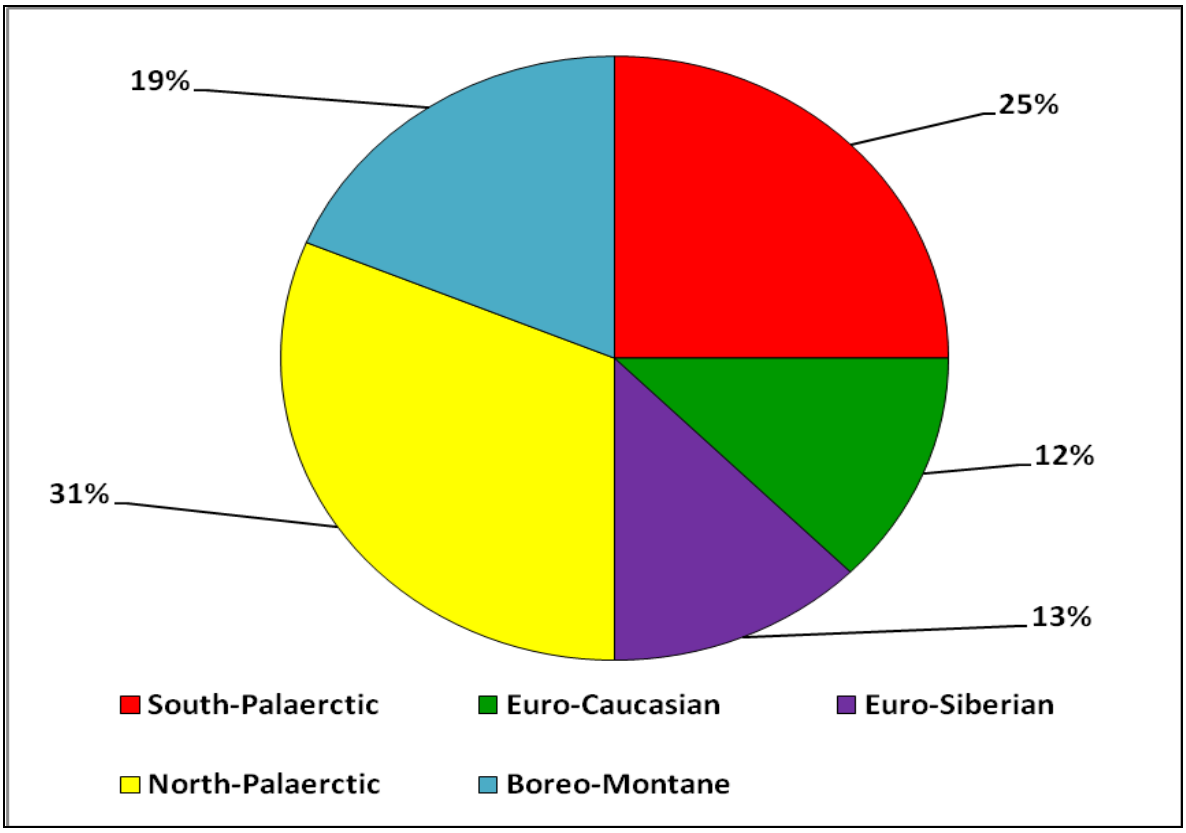

Figure 5: The zoogeographical spectrum of the identified ant species of Parâng Mountains.

CONCLUSIONS

Our preliminary results show that the ant fauna of Parâng Mountains is represented by a low number of species. However, all species are first mentioned for the investigated area, highlighting our contribution concerning the ant fauna data from mountain regions.

Further investigations are thus needed in order to improve our knowledge regarding the myrmecofauna of Parâng Mountains.

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COBITIS TAENIA LINNAEUS, 1758 SPECIES POPULATIONS MANAGEMENT SUPPORT SYSTEM IN NATURA 2000 SITE SIGHIŞOARA-TÂRNAVA MARE (ROSCI0227)

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KEYWORDS: Spined loach, Romania, aquatic habitats, human impact, management.

ABSTRACT

In this special investigation, the ADONIS:CE instrument was applied in the nature conservation domain to configure a distinguishing model of management for *Cobitis taenia* species. This management model includes this fish species' conservation interest identified necessities, in relation to habitats. Also, it includes the elements which reveal the appropriate conservation status and the significant management measures, together with the identified human pressures and threats on this species.

If the recommended management elements will not be implemented in the Sighişoara-Târnava Mare Natura 2000 site, the *Cobitis taenia* fish species' conservation status can deteriorate within the next few decades.

This type of approach based on a species and on a characteristic habitat, in the context of the human pressures and threats at the site level, can constitute the base of an efficient management of the conservation interest species populations.

REZUMAT: Sistem support pentru managementul populaţiilor speciei *Cobitis taenia* Linnaeus, 1758 în Situl Natura 2000 Sighişoara-Târnava Mare (ROSCI0227).

În această investigaţie, instrumentul ADONIS:CE a fost aplicat în domeniul conservarii naturii pentru a configura un model distinct de management pentru populaţiile speciei *Cobitis taenia*. Acest model de management include necesităţile acestei specii în ceea ce priveşte habitatele, de asemenea, include elementele care relevă statutul de conservare adecvat, presiunile şi ameninţările semnificative identificate şi măsurile de management.

Dacă elementele de management recomandate nu vor fi implementate în Situl Natura 2000 Sighişoara-Târnava Mare, statutul de conservare al speciei *Cobitis taenia* se poate deteriora în următoarele câteva decenii.

Acest tip de abordare bazată pe specie şi habitat caracteristic, în contextul presiunilor şi ameninţărilor umane la nivel de sit poate constitui baza unui management eficient al populaţiilor speciilor de interes conservativ.

RESUMEN: Sistema de soporte para decisions de manejo de las poblaciones de *Cobitis taenia* Linnaeus, 1758, en sitios Natura 2000 de Sighişoara-Târnava Mare (ROSCI0227).

En este estudio se aplicó el instrumento de modelación ADONIS:CE en el ámbito de la conservación, para configurar un modelo de manejo de la especie *Cobitis taenia*. Este modelo de manejo incluye información sobre las necesidades de conservación de la especie en relación al hábitat. También se incluyen elementos que revelan el estado de conservación, las medidas significativas de manejo y las presiones humanas que amenazan a la especie. Si no se aplican las medidas que se recomiendan en el sitio Natura 2000 de Sighişoara-Târnava Mare, entonces el estado de conservación del pez *Cobitis taenia* pudiera deteriorarse en las siguientes décadas. Dentro del contexto de las presiones humanas que afectan a la especie, los enfoques basados en la especie y en las características de su hábitat, pueden constituir la base de un manejo eficiente en la conservación de poblaciones de interés.

INTRODUCTION

To offer assurances that the endangered species of the European continent survive, the European Union component countries had a consensus in 1992 regarding the Habitats Directive, in compliance with the fact that for all these member states it is essential to reach the needed status for the protection of the species and habitats included in the Annex 2 of this Directive, with the aim of conserving and improving their ecological status (*, 1992).

On the Romanian territory, the Natura 2000 sites were recommended for protection, including the fish species conservation. They were proposed for their suitability in relation with the species conservation value. The designation of these European Natura 2000 net protected areas was accomplished and built on some of principal, clear-cut designed criteria: relatively low anthropogenic impact, good geographical locations, characteristic habitats and well preserved fish populations. There are some main elements in connection with which the Natura 2000 network can enhance the EU countries' nature conservation: a better education for the citizens, extention of the protected sites; capacity of the institutions being raised; and functional management schemes for valuable sites (Bănăduc, 2007, 2008, 2010, 2011; Bănăduc et al., 2012; Curtean-Bănăduc and Bănăduc, 2008; Papp and Toth, 2007).

Among the European conservative interest species we can find also *Cobitis taenia* Linnaeus, 1758. This fish species terra typical is on the territory of Sweden. It can be found in slow-flowing and in motionless aquatic habitats, with substrata layers dominated by sand or clay, not often on stony substrata. Commonly it can be found in the sandy-type riverbed sectors. It can, by some degree, use the intestinal respiration as an adaptation to the low content of oxygen in water. During the night, the species feed on algae, worms and insect larvae. The reproduction period lasts in general between April and June, when sticky roes are laid down (Bănărescu, 1964; Bănărescu and Bănăduc, 2007).

In Romania, the range of *Cobitis taenia* species comprises the following hydrographical basins: Tur, Crasna, Someș, Crișul Repede, Crișul Negru, Crișul Alb, Mureș, Târnava, Arieș, Bega, Caraș, Timiș, Cerna, Olt, Jiu, Hârtibaci, Gilort, Vedea, Olteț, Dâmboviţa, Argeș, Neajlov, Colentina, Călmăţui, Ialomiţa, Prut, Siret, Moldova, Bistriţa Moldovenească, Bârlad, Milcov, Buzău, etc. Its range was divided in smaller units in the last century due to the local and regional anthropogenic diversified impact, from one basin to another, and even from one protected area to another (Bănăduc, unpublished data).

The fish fauna structure, where *Cobitis taenia* species was found, in Sighișoara-Târnava Mare Natura 2000 site (ROSCI0227) has a concentration of a relatively low number of individuals as a consequence of the anthropogenic impact. The discontinuity on the distribution range of *Cobitis taenia* populations and their relatively low abundance prove the repercussions of the Târnava Mare River watershed (Bănăduc, 1999, 2000, 2005; Curtean-Bănăduc et al., 2007; Curtean-Bănăduc and Bănăduc, 2001, 2004a, b; Curtean et al., 1999).

In the contemporary overall shift in which the lotic systems become more and more precious natural capital components, the human activities effects will diminish the humans access to it (Curtean-Bănăduc and Bănăduc, 2012).

If this tendency will persist, no general management scheme will be enough in diverse natural protected areas; as a matter of fact, varied habitat elements must be considered and evaluated first. Next, the flexible management elements have to adapt and suggest the local habitats/species unique situation.

The modeling process components are more versatile in order to achieve a "large-scale vision" of systems and actions of various areas of expertise. These components are needed to discriminate the

process phases for optimum management. The modeling tools consist of software products which create models of business organizations, and carry out data about the models. There are three main functions: to confirm the present state, overview the results of potential changes, and recommend action plans to modify the condition in an advantageous way. Finally, there are diverse recommended options to create diagrams which contain components of specific management (Hall and Harmon, 2005).

MATERIAL AND METHODS

The Sighişoara-Târnava Mare Natura 2000 Site is located in Sibiu, Braşov, and Mureş counties in the Continental biogeographic region (24°49'16", 46°8'4", 85,815 ha, 315-829 m). The inclusion of this area was recommended for the conservation of four fish species, belonging to Habitats Directive (92/43/EEC) (Annex 2), (*Gobio kessleri* Natura 2000 code 2511 (*Romanogobio kesslerii*), *Barbus meridionalis* code 1138, *Sabanejewia aurata* code 1146, and *Gobio uranoscopus* code 1122). (*) Natura 2000 Standard data form http://natura2000.mmediu.ro/upl//formulare/ROSCI0227%20-%20F.pdf

The main aims of this research are: to expose the actual state of *Cobitis taenia* populations in ROSCI0227; to prove the human pressures and threats; and to obtain management elements for ameliorating the fish species conservation status relying on a specially designed model of management, which includes habitat needs of the fish species and habitat indicators as a management support system.

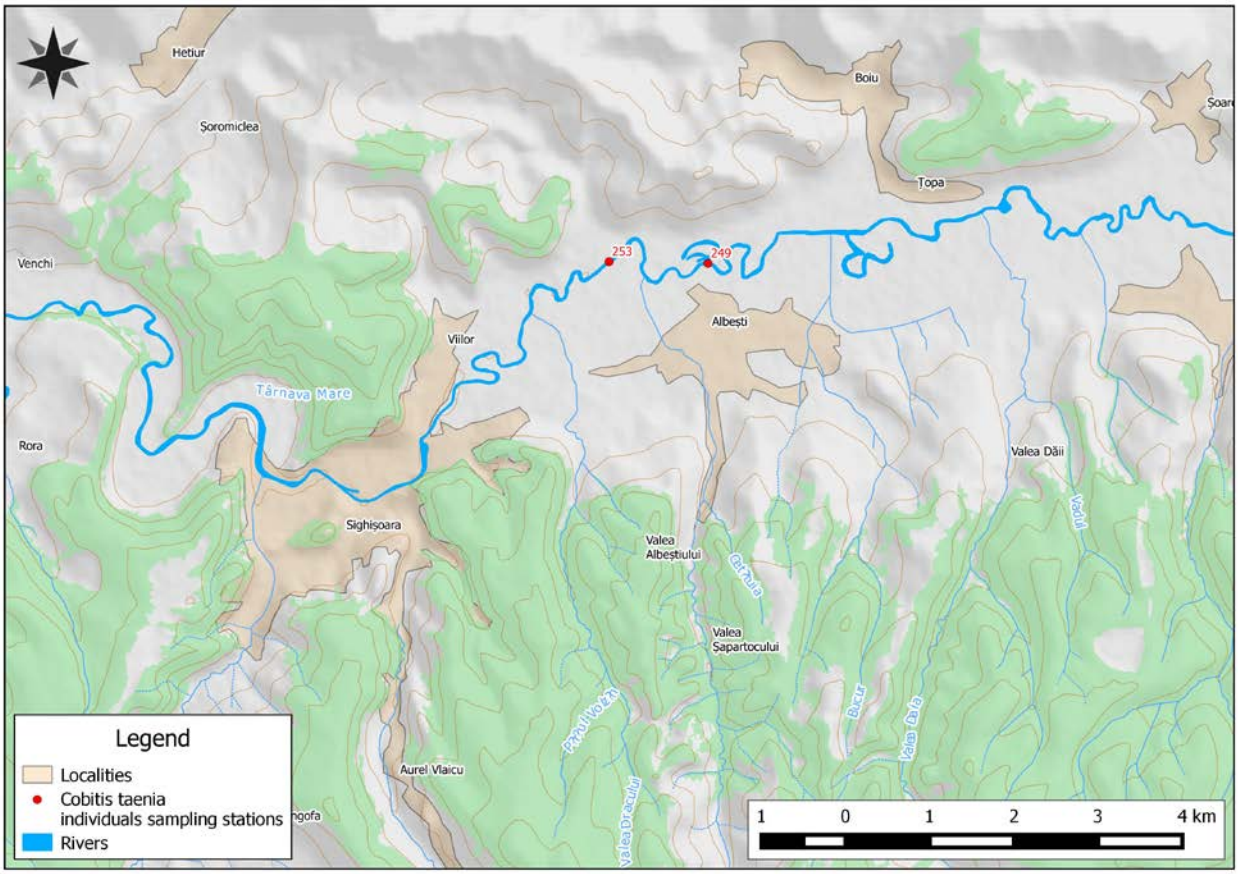

Figure 1: *Cobitis taenia* sampling stations: Târnava Mare River 253 and 249.

Another fish species of conservation importance that was identified in this site (Fig. 1) is *Cobitis taenia*. The fish specimens were collected (2012-2014) with fishing nets, followed by identification, andfreed in the habitats of origin on site. *Cobitis taenia* populations were monitored and their ecological status was evaluated in relation to the human activities, pressures, and threats identified in the studied habitats.

Cobitis taenia was evaluated in the research area and its ecological status was assessed in the presence of the inventoried main human impact threats and pressures, and on the fish population and the habitat's specificity.

The studied fish species population conservation status was assessed relying on the following main criteria: range area, well balanced distribution of the fish individuals on age classes, population sizes, and number (high/low) of fish in the local communities.

Cobitis taenia habitat necessities, pressures, and threats were evaluated relying on their presence/absence, and the dependence between them and the fish conservation status.

The recommendation of properly applied management for species' protection in the area of research and for highlighting the necessary process, an adjusted model of management was used. For that reason, ADONIS:CE was used, designed by Business Object Consulting. ADONIS: Community Edition, a free of charge tool offered by the BOC Group, which can be brought into practical operation as an entrance point to Business Process Management. This is a convenient path to be knowledgeable with ADONIS. ADONIS:CE is a stand-alone, rich version of ADONIS with some restraints, (if we compare it with the commercial edition). Business Process Model and Notation (BPMN) is a patterned modeling language which is helpful to make a picture of the specific processes. The processes can be modeled relying on uniform notation (**; Bănăduc et al., 2014).

RESULTS AND DISCUSSION

Cobitis taenia populations ecological state assessment

The *Cobitis taenia* conservation status in Târnava Mare River sampling sectors 253 and 249 (Fig. 1) can be accepted as low/very low in the context of: number of sampling stations, population size, unbalanced distribution of fish individuals on age classes, and a low weight of this fish species individuals in the local fish fauna structure. The habitats of the researched fish communities are in a medium/low conservation state, in respect of *Cobitis taenia* ecological necessities.

Human pressures and threats

In this research context, the next threats and pressures on *Cobitis taenia* fish species individuals were registered: water pollution, adjacent land erosion and accentuated sedimentation with mud of the riverbed as a result of wrong agricultural practice and deterioration of riparian vegetation, all of which adversely affect this species through the reduction of the quantity and quality of its trophic resources (benthic invertebrates) and cover the proper substrata for reproduction, harmful influence of numerous illegal waste deposits that produce leaching substances close to or even in the watercourses.

Specific requirements

Commonly, the adult fish require lotic sectors with approximately low speed water flow, with a sandy, muddy, clayish and rarely rocky riverbed. In the breeding season, this species require pebbles and/or aquatic vegetation to hold up their rows. This species is sensitive to pollution. (Bănărescu and Bănăduc, 2007)

Specific habitat indicators

Based on *Cobitis taenia* individuals presence/absence and relative abundance in the studied lotic sectors, some main habitat indicators are recommended: water surface weight with approximately low speed of flow (66%), substratum surface covered by sand weight (35%), muddy substratum weight (35%), pebbles substratum surface weight (20%), aquatic vegetation, and vegetal debris weight (10%).

Management measures

The lotic natural morphodynamic should be preserved and ecologically restored where it was disturbed. Conserving natural vegetation corridors (arboreal, shrubs, herbal) with a minimum width of 50 m on both banks is necessary for their function as sediment traps and their role in the trophic networks (Curtean-Bănăduc et al., 2014).

The storage of any category of waste in watercourses riverbeds and riverine wetlands should be forbidden.

A constant seasonal integrated monitoring system which should include the fish fauna should be supported.

Site adjusted management model

This recommended management model for *Cobitis taenia* wants to reveal its characteristics, and propose management elements to guarantee a good status.

The modeling tool used here is ADONIS: CE (Hall and Harmond, 2005). Based on the software modeling objects, we obtained an interface of this species which can easily be used, a comprehending of the process and management elements.

This on-site management model process relies on diverse activities, decisions, subprocesses, variables, and generators.

The principal objects used here to design the *Cobitis taenia* management model for ROSCI0227 with ADONIS:CE are presented (Hall and Harmon, 2005).

The management model of the species *Cobitis taenia* in Sighișoara-Târnava Mare sector consists of two processes (Fig. 2): first, called *Cobitis taenia Sighisoara* – is the basic process, containing all the necessary data for ecological requirements of the species (conditions which ensure favourable conservation status) and the second is actually a subprocess called in the main process (*Indicators for Cobitis taenia*) where it is checked if possible indicators comply or not for favourable conservation status and if it does not comply, it shows the management measures that can be taken to ensure favourable conservation status.

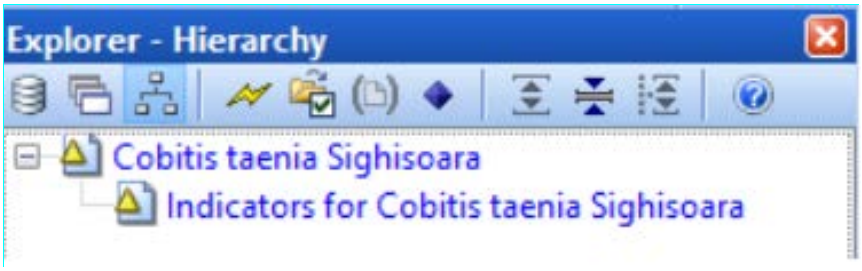

Figure 2: *Cobitis taenia* – model hierarchy.

The basic process *Cobitis taenia Sighisoara* (Fig. 3) consists of eleven activities, one subprocess and one decision. The first three activities provide data about the species name, popular names and critical requirements of the habitat. Habitat critical requirements are modeled further using parallelism and merging objects through activities which run in parallel and that, in fact, represent characteristics of habitat type, specific requirements for habitat (what species needs for reproduction, shelter, food), and using the subprocess *Indicators for Cobitis taenia*. After completing these activities follows a decision ("The conservation state is favourable?") that verifies whether or not the species is in favourable conservation status. If it goes on YES branch (variable = "conservation_state", probability = Yes, 90%), the process continues with another five activities – that reveals features of species sheet: other environmental requirements, reproduction period, distribution in the protected area, current pressures on species, threats – and the process ends. If it goes on NO branch (variable = "conservation_state", probability = No, 10%), then returns to activity Critical requirements of habitat, and the activities keep looping until the conservation state of species is favourable.

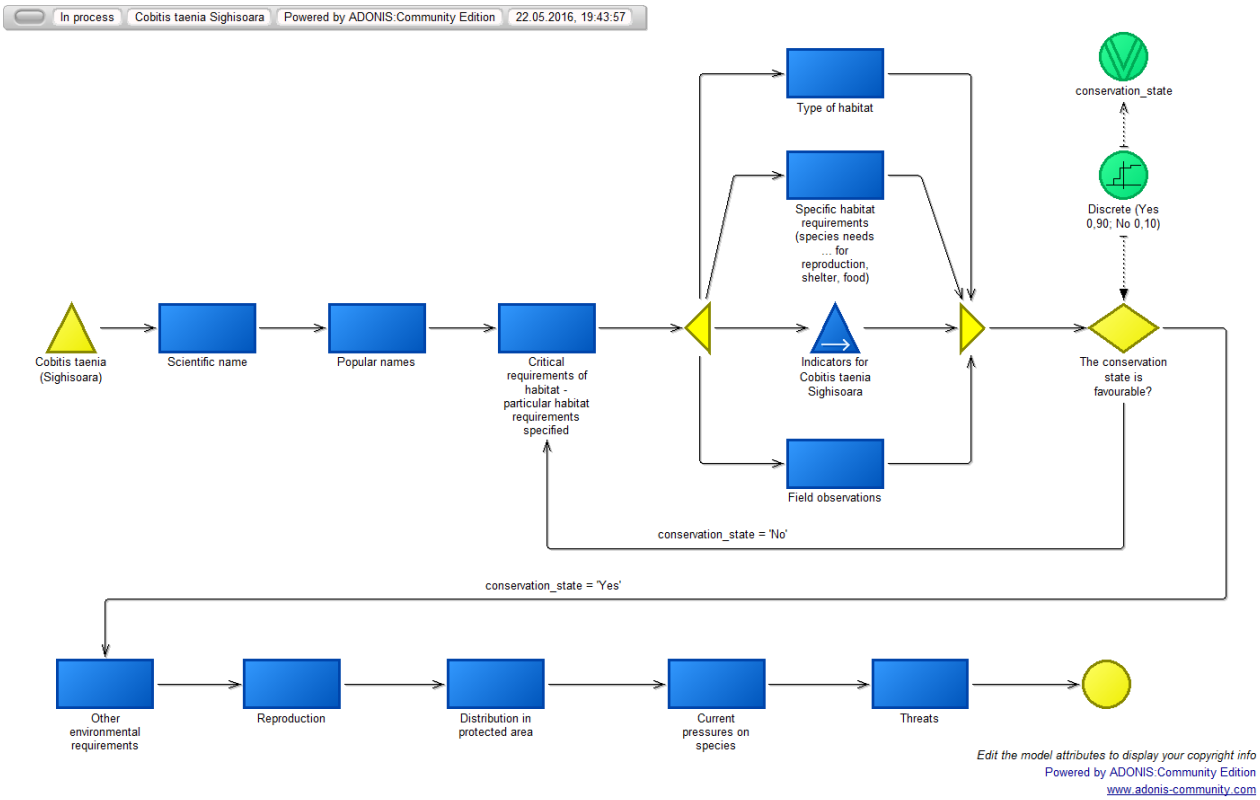

Figure 3: *Cobitis taenia* – basic process model.

The subprocess *Indicators for Cobitis taenia* (Fig. 4) begins with the activity *Actual state versus favourable conservation state* where there are stored actual values obtained from measurements made on the site and recommended values for five indicators of species: sandy substrate weight, silt substrates weight, gravel substrate weight, underwater vegetation and submerged vegetation debris weight, relatively slow surface water flow weight. Decisions are guided through each indicator separately. If they comply the percentage for favourable conservation state, then goes through every indicator on the "YES" branch until it reaches the final activity, namely, *Implementation of an integrated monitoring system for ichtyofauna performed by qualified/specialized personnel* and the process ends. For example, if you go on "YES" branch for the first indicator (variable = "sandy_substrate", probability 90%) and the "NO" branch for the second indicator (variable = "silt_substrate", probability 10%) then follows the management measures – modeled as activities – that should be taken to ensure favourable conservation state, namely: preserve the natural morphodynamics of riverbed, keep corridors of natural vegetation and prohibition abandonment of any kind of waste.

If the values for indicators do not comply with the values for favourable conservation state ("NO" branch), then it goes through different activities that describe management measures for these indicators.

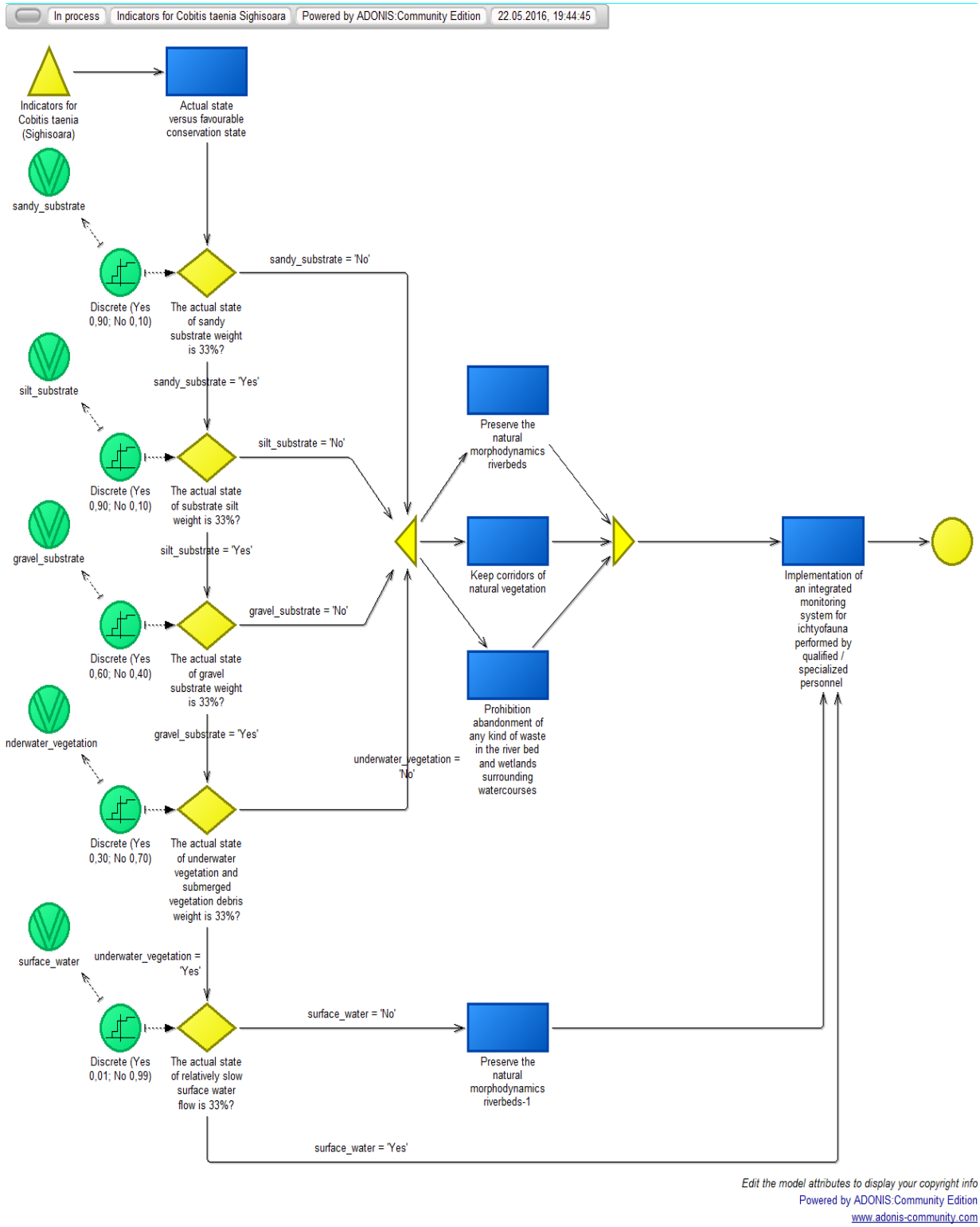

Figure 4: Subprocess "Indicators of *Cobitis taenia*".

For example, for the first four indicators, management measures are described in a series of three activities taking place simultaneously (using again, parallelism and merging objects). The last indicator is a necessary activity for management measure described by the *Natural Preserve riverbeds morphodynamics-1*, then reaching the last activity *Implementation of an integrated monitoring system for ichtyofauna performed by qualified/specialized personnel* and the process ends.

CONCLUSIONS

With the goal to facilitate a favourable conservation status in ROSCI0227 Natura 2000 site for the *Cobitis taenia,* the essential identified human threats to this fish species/habitats are: water pollution, riverine land erosion and over mudding of the riverbed.

Important for the studied fish species conservation are: lotic systems natural morphodynamics conservation or restoration, waste management, preservation of the riverine vegetation, poaching restriction, decreasing organic pollution, and the application of a continuous monitoring system for ichthyofauna.

In this research, a needed model for management decisions support, for *Cobitis taenia* fish species was realised.

The ADONIS:CE was used here in the nature conservation field of interest, recommending a management model for *Cobitis taenia* that circumscribes its main necessities in connection to the habitat, the indicators that reveal a good ecological status – the optimum management to elude and/or eradicate the pressures and threats which stress this species local populations.

If the recommended management does not control the study area, *Cobitis taenia* will have a poor conservation status.

This on-species, on habitats and on-site, management plan for *Cobitis taenia*, must be integrated in an overall ROSCI0227 management model for ichthyofauna too. For this goal, similar management schemes for other fish species of conservation interest should to be done.

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RESTORING THE FISH FAUNA CONNECTIVITY OF THE HÂRTIBACIU RIVER – RETIŞ DAM STUDY CASE (TRANSYLVANIA, ROMANIA)

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KEYWORDS: Hârtibaciu River, lateral connectivity, longitudinal connectivity, fish populations connectivity, dam, fish passage

ABSTRACT

The Hârtibaciu River local fish fauna includes a relatively high number of fish species, such as: *Squalius cephalus* (Linnaeus, 1758), *Alburnoides bipunctatus* (Bloch, 1782), *Alburnus alburnus* (Linnaeus, 1758), *Rhodeus amarus* (Bloch, 1782), *Gobio gobio* (Linnaeus, 1758), *Romanogobio kessleri* (Dybowski, 1862), *Barbus meridionalis* Risso, 1827, *Barbatula barbatula* (Linnaeus, 1758), *Misgurnus fossilis* (Linnaeus, 1758), *Cobitis taenia* Linnaeus, 1758, *Cobitis romanica* (Băcescu, 1943), and *Cobitis aurata* (De Filippi, 1863), which have a disrupted movement due to the hydrotechnical constructions (discharge sills, dams) located across the Hârtibaciu watercourse.

This study proposed a solution for improving the Hârtibaciu River continuum, in the proximity of the Retiș Dam in accordance with Water Framework Directive 2000/60/EC needs.

REZUMAT: Refacerea conectivității ihtiofaunei pe râul Hârtibaciu – studiu de caz pe sectorul barajului de la Retiș (Transilvania, România).

Fauna piscicolă locală a râului Hârtibaciu include un număr relativ mare de specii de pești precum urmează: *Squalius cephalus* (Linnaeus, 1758), *Alburnoides bipunctatus* (Bloch, 1782), *Alburnus alburnus* (Linnaeus, 1758), *Rhodeus amarus* (Bloch, 1782), *Gobio gobio* (Linnaeus, 1758), *Romanogobio kessleri* (Dybowski, 1862), *Barbus meridionalis* Risso, 1827, *Barbatula barbatula* (Linnaeus, 1758), *Misgurnus fossilis* (Linnaeus, 1758), *Cobitis taenia* Linnaeus, 1758, *Cobitis romanica* (Băcescu, 1943) şi *Cobitis aurata* (De Filippi, 1863). Deplasarea acestor specii este împiedicată de construcțiile hidrotehnice (praguri deversante, baraje) situate de-a curmezișul cursului Hârtibaciului. Studiul prezent propune o soluție de ameliorare a continuității râului Hârtibaciu in vecinătatea barajului de la Retiș, conform cerințelor Directivei Cadru Apă 2000/60/EC.

RÉSUMÉ: Restauration de la connectivité de l'ichtyofaune sur la rivière de Hârtibaciu – étude de cas sur le secteur du barrage de Retiș (Transilvanie, Roumanie).

La faune locale piscicole de la rivière de Hârtibaciu comprend un nombre relativement grand d'espèces de poissons tel qu'il suit: *Squalius cephalus* (Linnaeus, 1758), *Alburnoides bipunctatus* (Bloch, 1782), *Alburnus alburnus* (Linnaeus, 1758), *Rhodeus amarus* (Bloch, 1782), *Gobio gobio* (Linnaeus, 1758), *Romanogobio kessleri* (Dybowski, 1862), *Barbus meridionalis* Risso, 1827, *Barbatula barbatula* (Linnaeus, 1758), *Misgurnus fossilis* (Linnaeus, 1758), *Cobitis taenia* Linnaeus, 1758, *Cobitis romanica* (Băcescu, 1943) et *Cobitis aurata* (De Filippi, 1863), dont les déplacements sont bloqués à cause des constructions hydrotechniques (barrages, crête à débordement) situées sur la rivière de Hârtibaciu. L'étude propose une solution pour l'amélioration de la continuité de la rivière à proximité du barrage de Retiș, selon les requis de la Directive Cadre des Eaux 2000/60/EC.

INTRODUCTION

The major human impacts on water are pollution, deforestation, intensive agriculture, and last, but not least, river engineering and civil works which are carried out in or near water courses, restraining the river dynamic by destroying the local fish communities (Bănăduc, 1999, 2010; Bănăduc et al., 2013; Curtean-Bănăduc et al., 2014, 2015; Michalczyk, 1997; Petts et al., 1993; Radwan, 2006; Sender, 2007; Sandu et al., 2008; Gumpinger and Scheder, 2008; Kutzenberger, 2008; Gjyli and Mukli, 2009; Yildiz et al., 2010; Jeeva et al., 2011; Soolutayo, 2012; Bănăduc et al., 2013).

Different ecotechnic solutions can offer links between the longitudinal and lateral connectivity elements of watercourses, their need for implementation in different watershed sectors being very often a necessity. Besides the regulation in force regarding the ecological protection of water courses, some university courses should be organized to support scientifically the practical use of wetlands as generators of productive and equilibrated ecosystems and relaxing and healthy areas for people.

The subject of this paperwork represents a European theme of high importance and interest regarding the restoration of the water courses affected by the hydromorphological pressures created by the presence of transversal works which lead to the interruption of longitudinal connectivity of rivers, stopping the fish mobility options and modifying the flow regime (Kay and Vicu, 2013).

Intensive agricultural work, in most cases associated with the widespread use and misuse of fertilizers (pollution), alluvial forest destruction, expanding urban and rural ecological systems, industrial scale activities, hydrotechnical works etc., have diminished the natural aquatic ecological systems in qualitative and quantitative terms, and also to the loss and fragmentation of natural habitats and, therefore leading in damaging the biological and ecological diversity (Voicu et al., 2015).

The national legislative framework regarding the water policy (Water Law no. 107), reflecting the European Directives, mentions the obligation to ensure construction works in order to protect the fish migration and to maintain the ecological balance in the reservoirs.

The multiple functions (production, support, control, informational etc.) of the groundwater-dependent ecosystems – wetlands – (Kløve et al., 2011) have to meet, the resources and services they generate, have increased the number of international projects/actions targeting the existing wetland conservation and/or ecological restoration of wetlands in floodplains, currently confined by dykes, secondary grasslands, and so on during the last decade. It is now recognized not only that floodplains are one of the most productive and diverse ecosystems on Earth (Tockner and Standford, 2002), but they also contribute more than 25% of all terrestrial ecosystem services (Tockner et al., 2010).

Lateral connectivity is the link between the watercourse/river channel and floodplain, both parts of the same lotic system. Therefore, hydrology is an essential factor in determining the type and functional nature of floodplains (Ickes et al., 2005) which facilitates the exchange of carbon and nutrients between the river channel and floodplain (Thoms, 2003). Longitudinal connectivity represents the way in which organisms move the energy and material exchanges located throughout the water. Fragmentation of the longitudinal connectivity of watercourses caused by hydrotechnical constructions represents a major impact on sediment transport, hydrological regime, and biota migration.

The need for proper longitudinal connectivity of watercourses represents an essential condition for the Water Framework Directive approved by the European Community and, therefore, it should be applied to all streams containing lotic biota (Voicu and Merten, 2014).

RESULTS AND DISCUSSION

There are two temporary storage lakes on the Hârtibaciu River for flood protection, Beneşti and Retiş respectively. The temporary storage lake Retiş (3rd class importance) with a volume of 7200 cubic meters, located upstream from Brădeni, defends settlements and agricultural lands situated on the Hârtibaciu River, on Brădeni – Agnita water sector. Retiş Dam (Fig. 1 a, b, c, d and e) was built in 1988 nearby and is a temporary storage lake meant to protect the surrounding areas against flooding.

Figure 1a: Retiş Dam located on the Hârtibaciu River (google earth.com).

Figure 1b: Upstream of Retiş Dam.

Figure 1c: downstream.

Figure 1d: upstream.

Figure 1e: downstream.

Given that the average annual flow of the Hârtibaciu River is about 0,600 m/s, there is not enough water to sustain a performing wetland (about 7 hectares) by direct surface or underground water supply. Definitely, another solution must be found. The first solution involves fixing a sluiceway outside the dam, just in front of the discharger without sluiceway in order to block the Hârtibaciu River (Fig. 2). The flat wall sluiceway to be fixed is made of stainless steel and driven by an electric gear. The flat sluiceway must be calculated to withstand a water level of 2.5 meters. The current sluiceway must be recalculated or another flat wall electrically driven sluiceway must be fixed to the discharger, too.

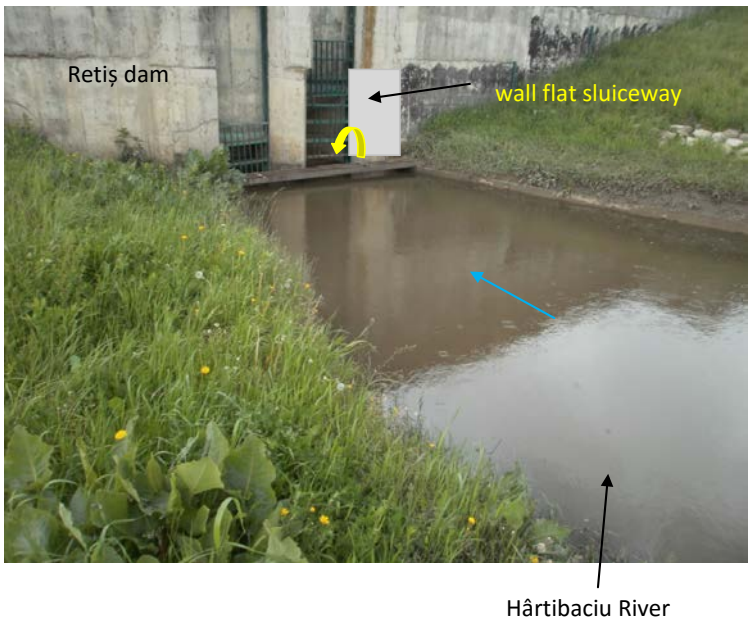

Figure 2: The need to fix a wall flat sluiceway.

After fixing the flat wall sluiceway, the water that normally flows through the current discharger will fill the two hectares of wetland created near and upstream of the dam. The same waterflow flowing through the current discharger must flow through a pipe or rectangular concrete canal after fixing the flat wall sluiceway/s (Fig. 3).

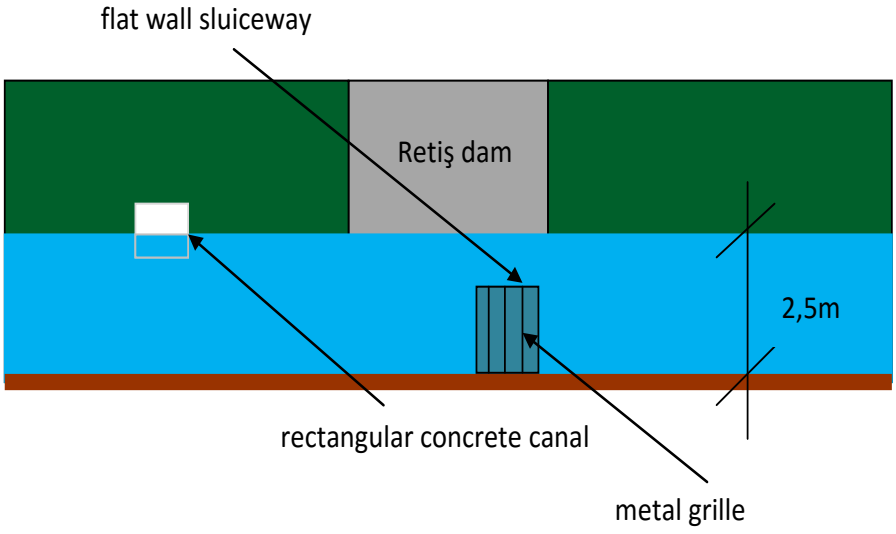

Figure 3: Positioning the rectangular concrete canal.

Area (habitat) that will support the newly created wetland biocoenosis must be dammed upstream by using a 2.5 m rectangular shaped earth dam (Fig. 4). So it will get through a part of the forest located upstream of the dam. The level of water in a performing wetland must be one meter and a half.

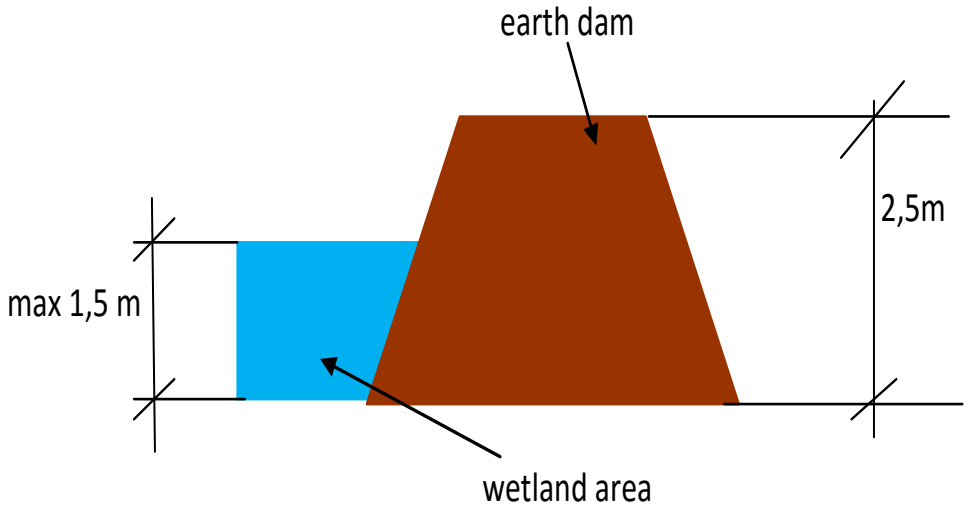

Figure 4: Earth dam separating the wetland area – indicative scheme.

In order to achieve a wetland in the area under research some particular stages need to be followed. Thus, the first stage aims at creating abiotic conditions supporting the development of a biotic component (communities of plants and aquatic animals). In this regard, within the study area the arrangement of the area upstream of Retiş Dam as well as its water supply system is recommended.

The second stage aims at populating with certain species of aquatic organisms (e.g. macrophytes, certain fish species). Ensuring the newly created ecological system functionality is achieved through complexity of the interrelationships that will be established between the two components (biotic and abiotic), that are the new wetland. Given the characteristic species for low-depth lentic aquatic ecosystems <1.5 m (relatively small ponds), when analyzed, before populating the wetland with different species the following features should be taken into account: the lack of profound floor; the pelagic area is entirely penetrated by solar radiation; the absence of a proper shore, the shoreline is shaped by immersed vegetation; thermal oscillations, both diurnal and seasonal are felt throughout the water depth. The aquatic vegetation has got a determinant role as it may act at different levels on the structure and distribution patterns of associated phytophyle fauna. Thus the existence of phytophyle invertebrate is strictly correlated with the existence of aquatic macrophytes.

In the study area, the wetland will be delineated naturally downstream by Retiş Dam, and also by the slopes and crest (Fig. 5), the right slopes (Fig. 6) and left slopes (Fig. 7a) next to the crest and upstream of the earth dam to be built (Fig. 7b). This wetland must be continuously supplied by the Hârtibaciu River. Upstream (ten meters away) of the earth dam to be built, the Hârtibaciu River will be fully captured in a concrete canal, but using some concrete sheet piles (Fig. 8).

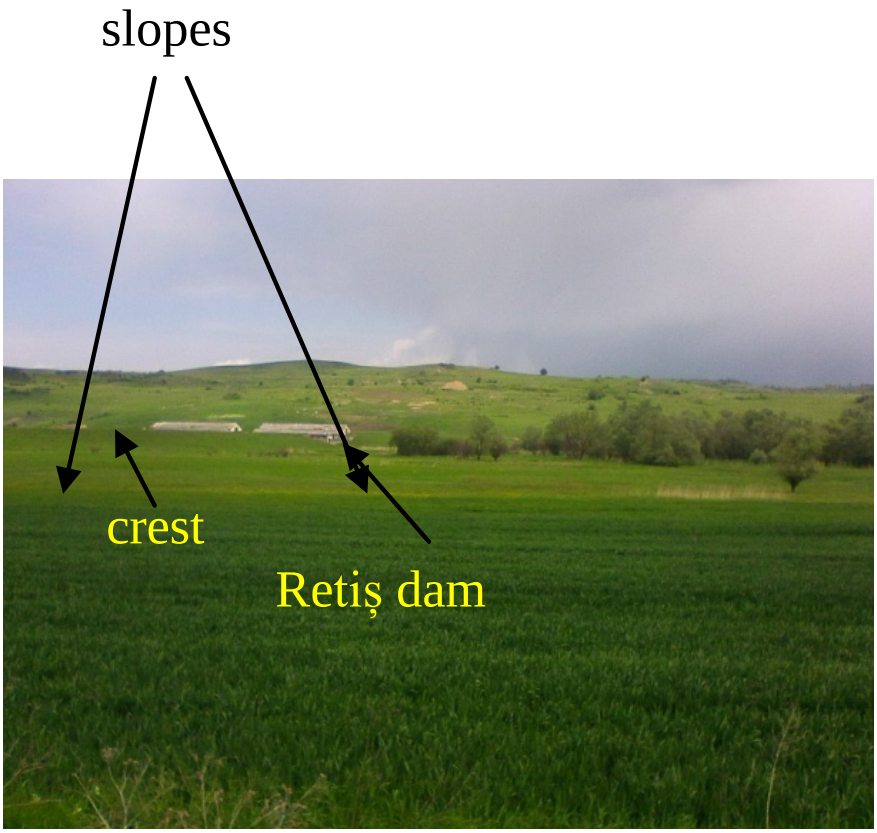

Figure 5: Slopes crest.

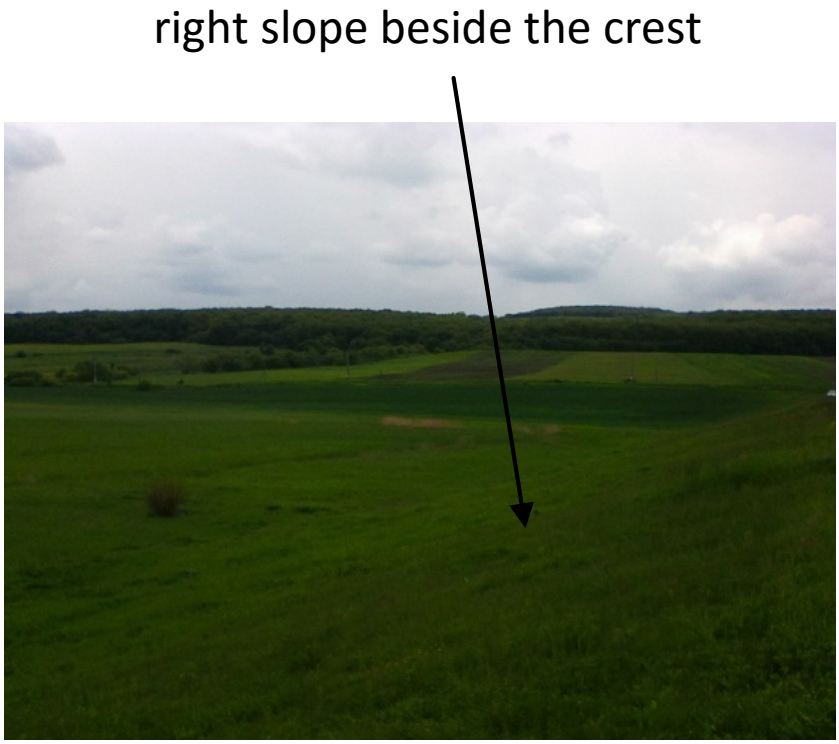

Figure 6: Right slope beside the crest.

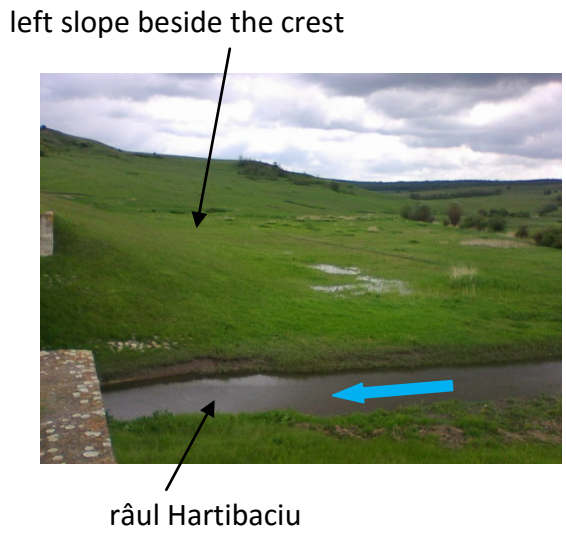

Figure 7a: Left slope beside the crest.

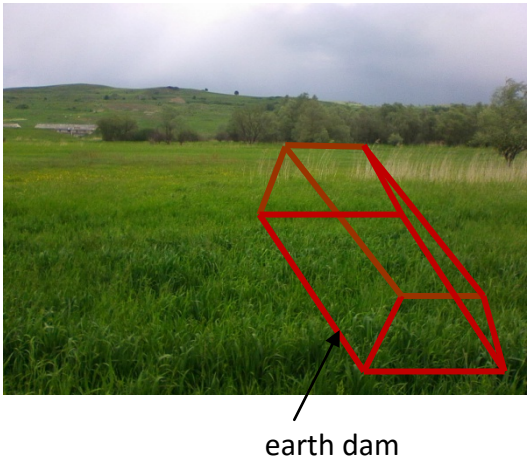

Figure 7b: Positioning dam to be built – scheme.

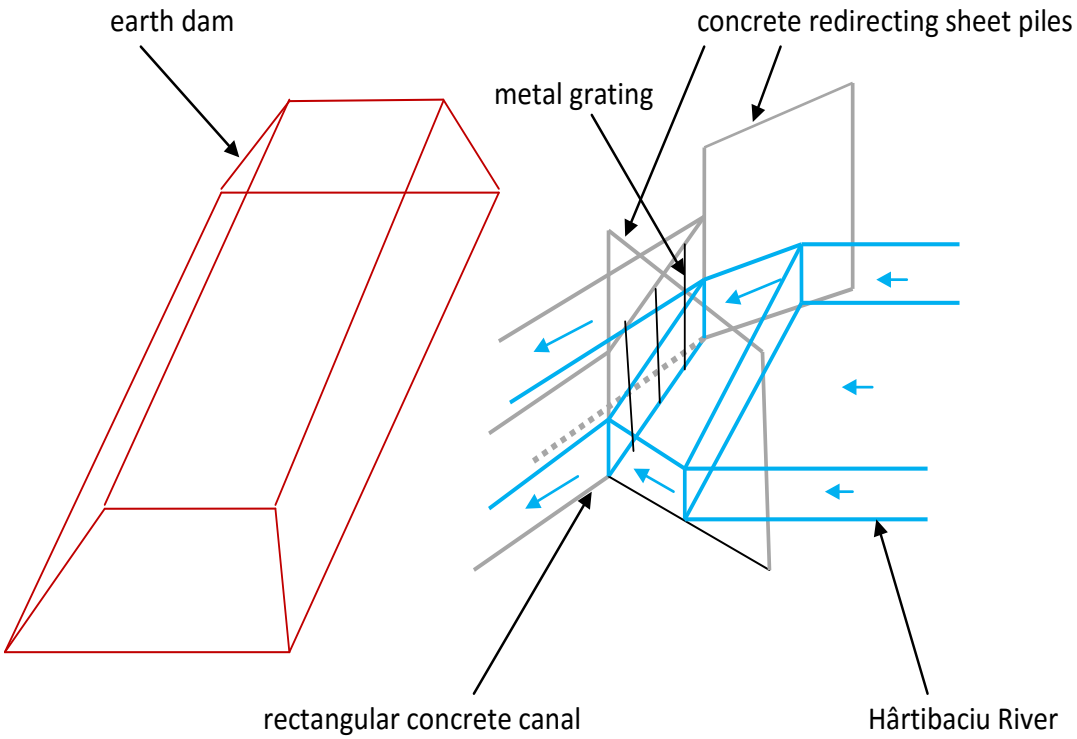

Figure 8: Positioning the rectangular concrete canal – indicative scheme.

The rectangular concrete canal descends into a rectangular (underground) basin that needs to be built next to the Hârtibaciu riverbed, right inside the newly created wetland. The basin is 6 m deep, 6 m wide, and 10 m long and there are durable plastic sheet piles fixed on all surfaces (Fig. 9). A manhole must be built near the basin in which to be a horizontal metal rod connected to a vertical sheet pile made of durable plastic (Fig. 10). They will be used for unsilting the basin.

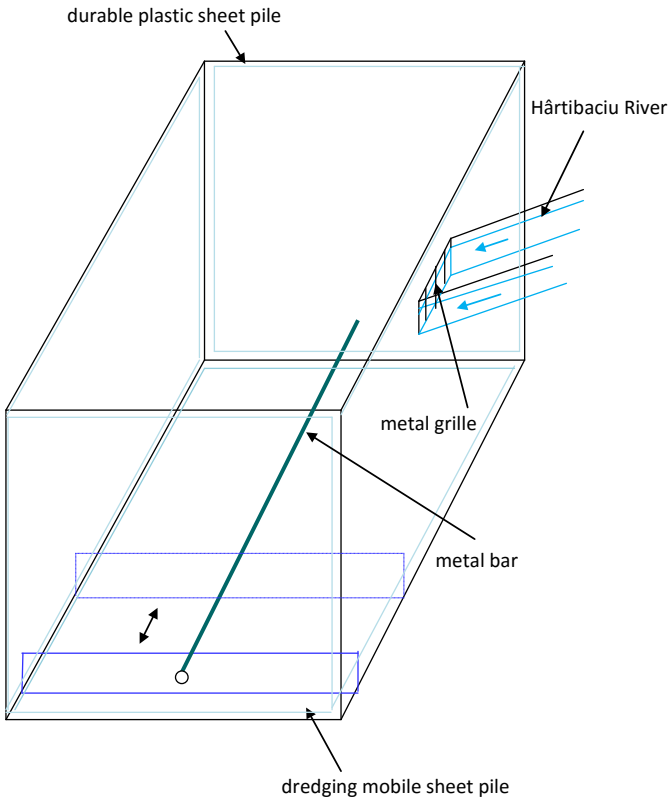

Figure 9: Positioning the rectangular basin and the dredging mobile sheet pile – scheme.

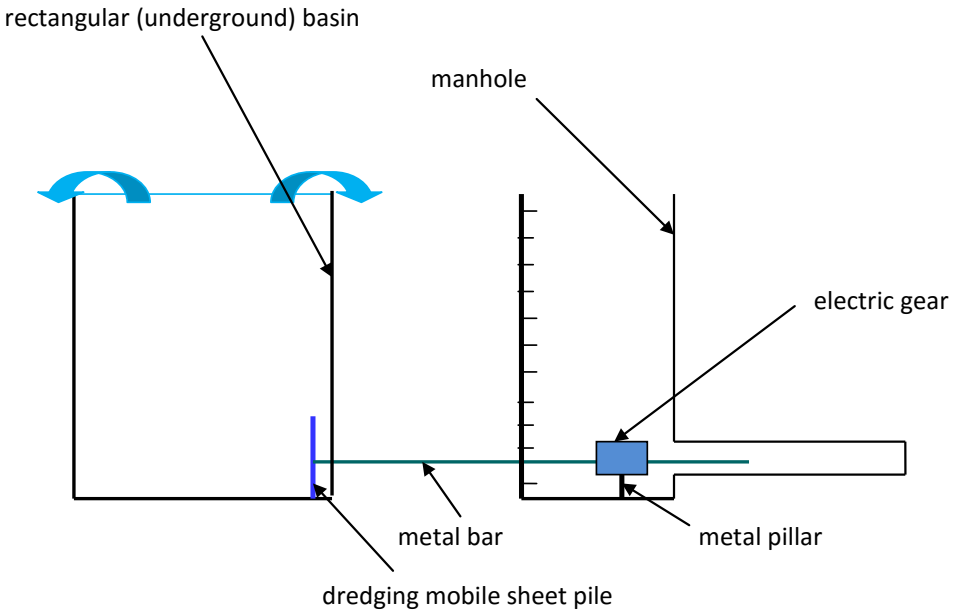

Figure 10: Positioning the manhole – indicative scheme.

Because there is a slope (40%) on the water supply canal of the rectangular basin, there is no risk of afflux, so that the wet area can be continuously supplied. The electric gear can be supplied from the national electricity network. The two stainless steel grilles located at the two ends (upstream, downstream) of the canal that feeds the rectangular basin block the floating elements avoiding blocking the channel. Thus, the created wetland is continuously supplied with water, which allows a proper development of the biocoenosis (Fig. 11).

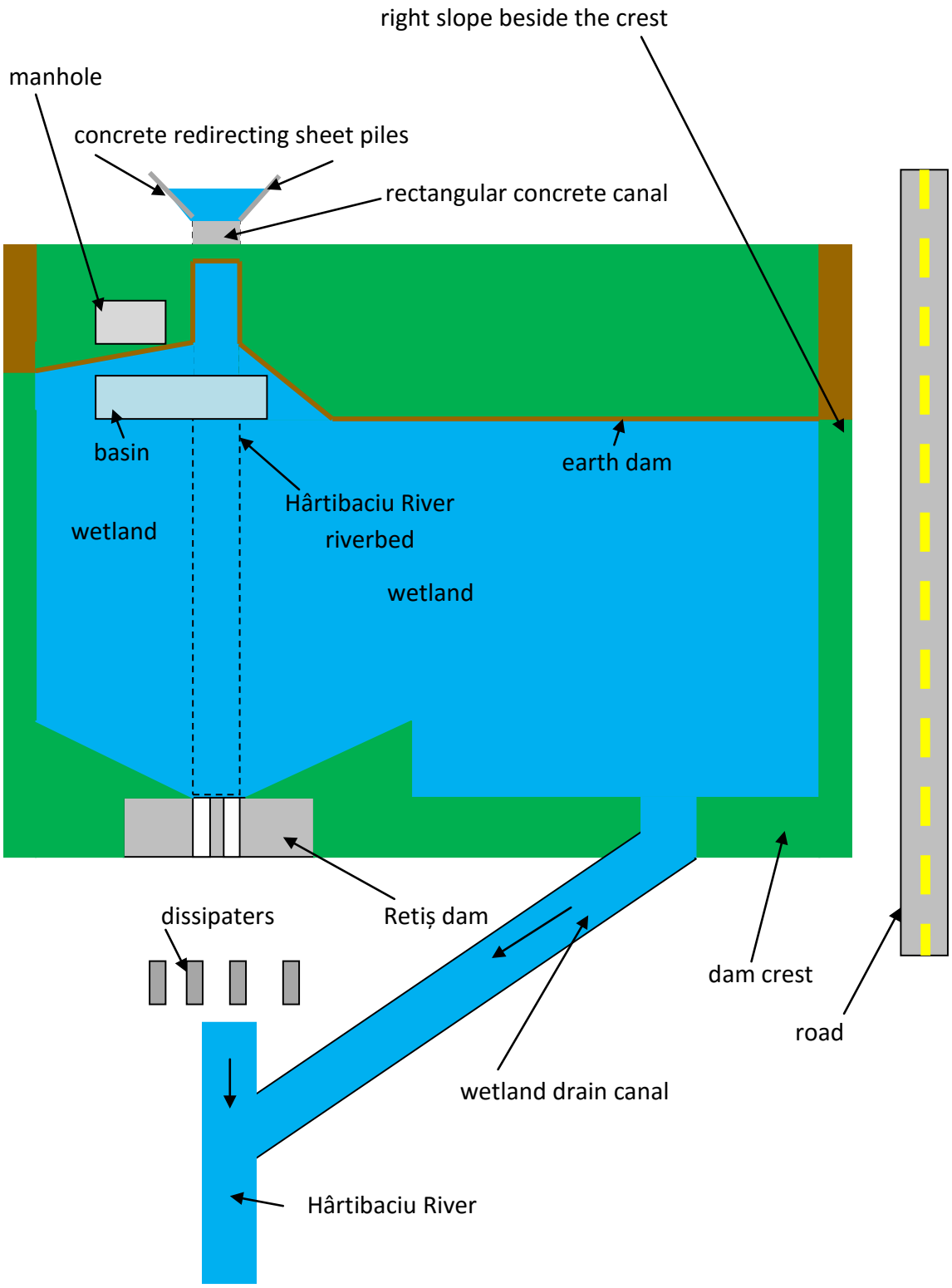

Figure 11: Positioning the rectangular concrete canal for water drainage – indicative scheme.

The only obstacle blocking the local fish species to reach the Hârtibaciu River sources is the Retiș Dam. The canal for wetland draining should be constructed in order to allow fish to climb up to the wet area, later to continue the road to sources via a canal that has direct connection with the Hârtibaciu River. Given that according to the construction (engineering calculation) the flow speed inside the concrete canal draining water from the wet area will be smaller than the flow speed of the the

Hârtibaciu River (0.4m / s), this provides a chance for fish migration. The canal will be arranged as a platform covered by river stones which help fish climb up the river (Figs. 12 and 13). Inside the right slope of the dam crest, the canal will be lit using LED waterproof lamps (Fig. 14).

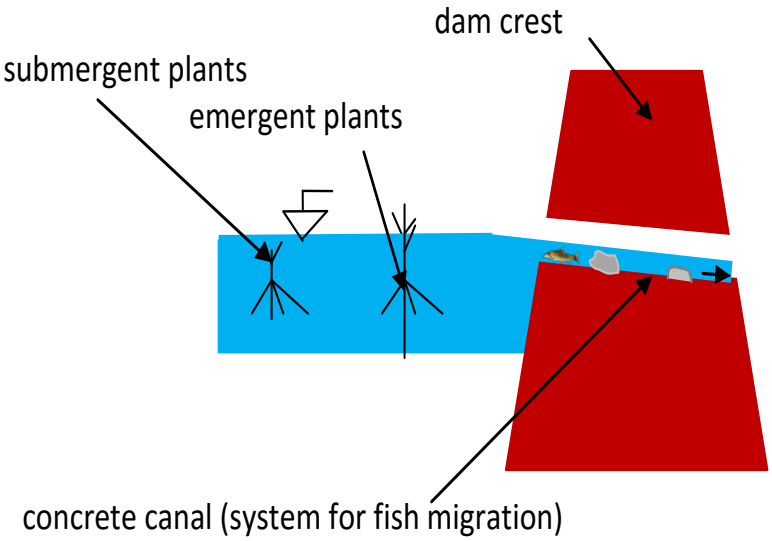

Figure 12: Positioning the concrete canal for fish migration on the slope crest – indicative scheme.

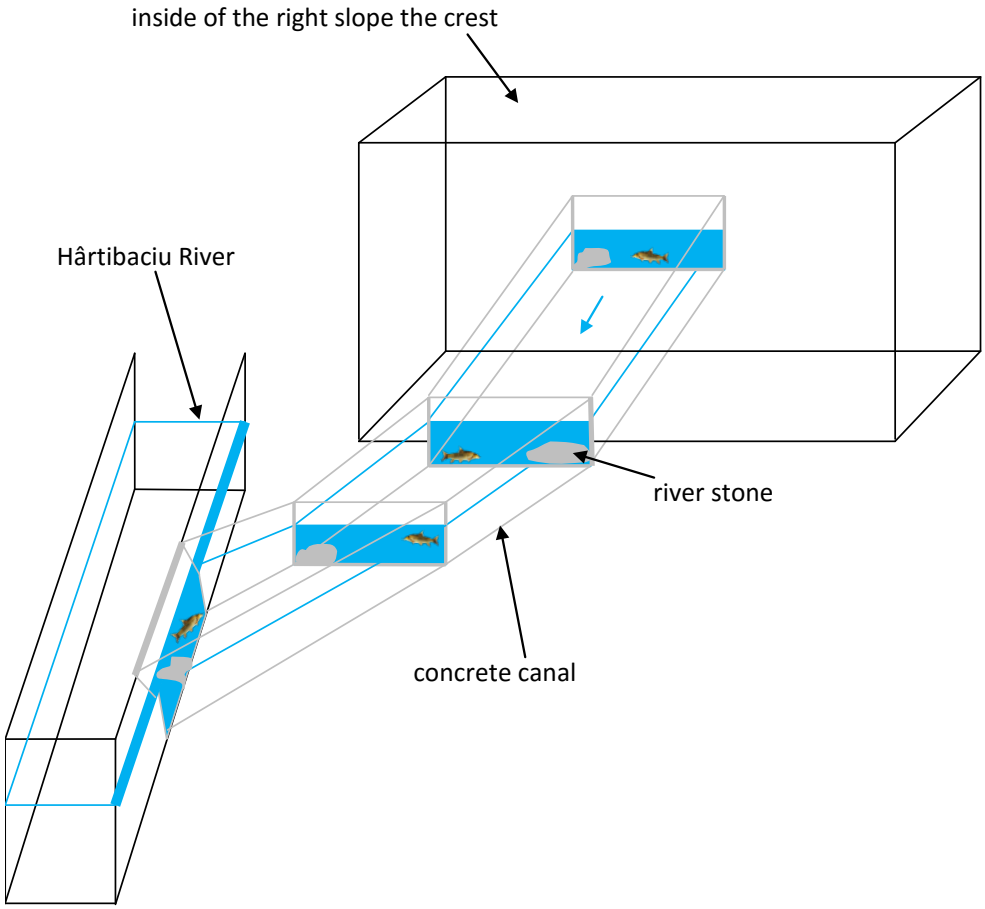

Figure 13: Fixing river stones inside the concrete canal – indicative scheme.

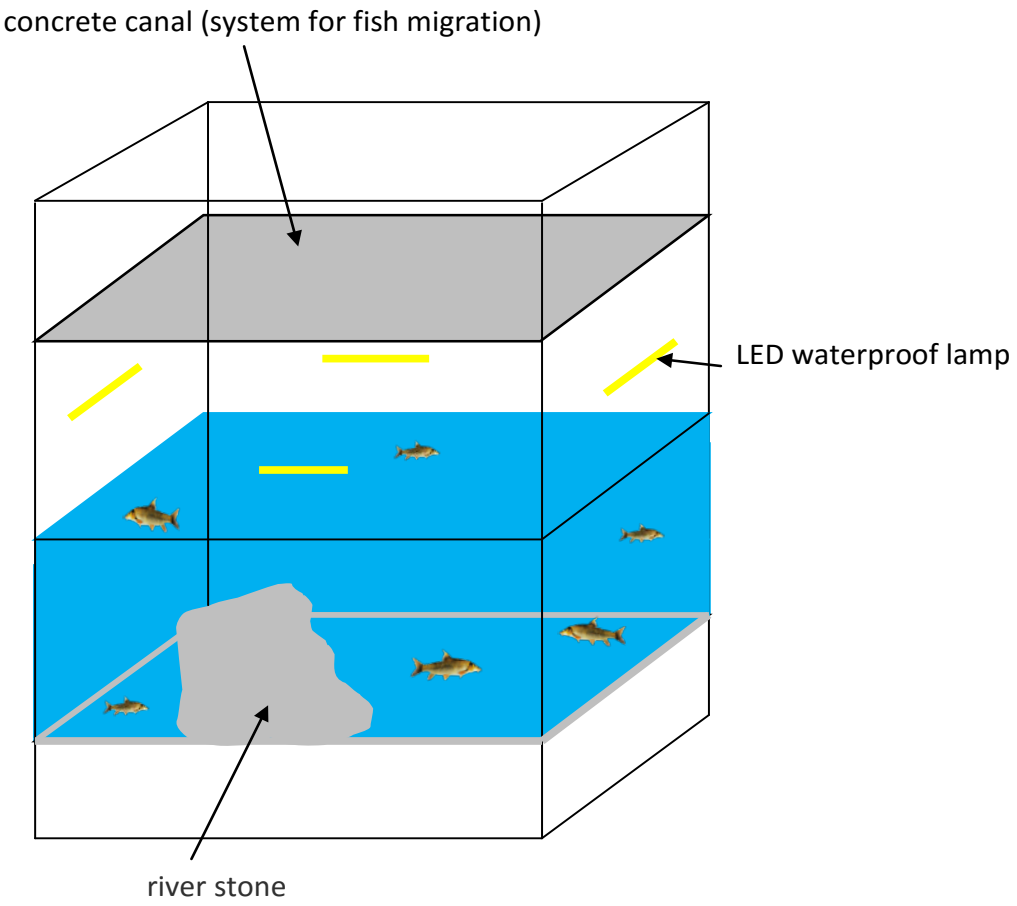

Figure 14: Positioning the LEDs inside the concrete canal for ichtyofauna migration.

CONCLUSIONS

This study proposed a specific technical solution for improving the Hârtibaciu River longitudinal continuum, in the proximity of the Retiș Dam area, in accordance with Water Framework Directive 2000/60/EC needs.

The upper Hârtibaciu River local lotic fish fauna which will benefit on this new hidrotechnical work include a relatively diverse fish species, as the following: *Squalius cephalus* (Linnaeus, 1758), *Gobio gobio* (Linnaeus, 1758), *Barbus meridionalis* Risso, 1827 and *Barbatula barbatula* (Linnaeus, 1758), which are blocked in the present by old hydrotechnical constructions located across the watercourse Hârtibaciu.

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THE CHANGES THAT OCCURRED BETWEEN 2010-2016 IN THE COMMUNITY INTEREST FISH SPECIES FROM PROTECTED AREA ROSCI0229 SIRIU (ROMANIA)

Luiza FLOREA [1]

KEYWORDS: ROSCI0229 Siriu, fish biodiversity, changes, fish conservation management.

ABSTRACT

The overarching goal of this study is to evaluate the changes of the protected aria ROSCI0229 SIRIU ihtiofauna and especially the changes of the community interest fish species from this protected aria. At the first fishing activity, in 2010 year, the Siriu ihtiofauna consisted in 10 fish species characteristic for the trout fishing zone. After six years, in 2016 year, at the second fishing activity which was made in the same 10 fishing stations, was captured the same 9 fish species. One of the previous species, *Rhabdofario mykiss* (rainbow trout), wasn't founded. Regarding the situation of the community interest fish species *Cottus gobio* and *Barbus petenyi*, their frequency of occurrence and numerically abundance are similar in the two analyzed periods.

REZUMAT: Schimbările care au avut loc în perioada 2010-2016 în comunităţile speciilor de pești de interes conservativ din aria naturală protejată ROSCI0229 Siriu.

Scopul acestui studiu este de a evalua schimbările care au avut loc în ihtiofauna ariei protejate ROSCI0229 Siriu și în special schimbările speciilor de pești de interes comunitar din această arie protejată. La prima activitate de pescuit, în anul 2010, ihtiofauna sit-ului Siriu a constat în 10 specii de pești caracteristice pentru zona piscicolă a păstrăvului. După șase ani, în anul 2016, la a doua activitate de pescuit care a avut loc în aceleași 10 stații de pescuit, s-au capturat aceleași 9 specii de pești. Una din speciile capturate anterior, *Rhabdofario mykiss* (păstrăv curcubeu), nu a mai fost găsită. În ceea ce privește situația scpeciilor de pești de interes comunitar *Barbus petenyi* și *Cottus gobio* frecvența de apariție a acestora și abundența numerică este asemanatoare în cele două perioade analizate.

ZUSAMMENFASSUNG: Die ziwschen 2010-21016 stattgefundenen Veränderungen in den Gesellschaften der Fische von gemeinschaftlichem Interesse im Schutzgebiet ROSCI0229 Siriu (Rumänien).

Das Ziel der vorliegender Untersuchung ist die Evaluierung der Veränderungen, die in der Fischfauna des Naturschutzgebietes ROSCI0229 SIRIU stattgefunden haben, vor allem die Veränderungen im Verhältnis der Fische von gemeinschaftlichem Interesse in diesem Gebiet. Während der ersten Befischung im Jahr 2010 bestand die Ichtiofauna aus 10 für die Forellenzone charakteristischen Arten. Nach sechs Jahren, also 2016, wurden bei der zweiten Erfassung an denselben 10 Probestellen 9 der kennzeichnenden Arten vorgefunden. Eine der Arten *Rhabdofario mykiss* (Regenbogenforelle), die in den ersten Fangproben dabei war, wurde nicht mehr festgestellt. Was die Fischarten von gemeinschaftlichem Interesse *Barbus petenyi* und *Cottus gobio* betrifft, ist die Frequenz ihres Vorkommens sowie ihre numerische Abundanz in den beiden analysierten Zeitspannen ähnlich..

INTRODUCTION

Romania, with theier highest biogeographic diversity, offers to the European natural heritage anaround of: 47% of the national territory covered by natural and semi natural ecosystems; 780 types of habitats; 3700 superior plant species; 33085 invertebrate species and 717 vertebrate species (Bănăduc, 2007; Bănăduc, 2010).

Romanian list of fish species (freshwater and brackish fish species) has suffered a series of modifications due on one hand of new knowledges of the systematics of European freshwater fishes and on the other hand of the occurrence and disappeared of fish species from natural waters of Romania. Fish species with different degrees of endangerment are included in lists of the various national and international documents (Law 13/1993-Berna Convention; Law 462/2001; OG 57/2007-Habitats and Birds Directive; Law 69/1994 -Convention CITES), the number of protected fish species varies from one document to another. The list of protected fish species in accordance with national regulations (Annex 3 of O.G. 57/2007, that provide the legal framework of the Nature 2000 Network) is composed by 27 fish species (Florea, 2011). The number of community interest fish species presented in one romanian SCI varies quite widely from one species to a maximum of 16 species per SCI. Of the 27 community interest fish species 4 fish species (*Cottus gobio, Barbus petenyi, Sabanejewia aurata, Cobittis taenia*) have a large spreading area, instade 9 fish species (*Romanichthys valsanicola, Eudontomyzon vladykovi, Rutilus pigus, Cobitis elongata, Leuciscus souffia, Eudontomyzon mariae, Alosa caspia, Hucho hucho, Umbra krameri*) have a small spreading area beeing very rare (Florea, 2011). In Romania, in 2007 years, there were, 273 SCIs, that representing 13.21% of the country surface. From all these 273 SCIs, only a total of 81 SCIs have fish species which must be protected.

To decrease or better stop the biodiversity loss, protected areas (PAs) are set to conserve habitats and species and constitute the most widespread instrument used in conservation planning (Margules and Pressey, 2000). Protected areas (PAs) are created for their inherent ecological value (Gaston et al., 2008) and olso for their potential to solve social and economic issues faced by local communities (Silva, 2009). After 2007 the romanian PAs increased from the 4.1% prior to 1989 to 19.29% of the national territory due to creation of 27 National and Natural Parks, and recently of 382 PAs as part of the pan-European Natura 2000 network (Ioja et al., 2010; Florea and Dorin, 2013).

MATERIAL AND METHODS

In the investigated protected area, ROSCI0229 SIRIU, included in the Nature 2000 Network, were named three community interest fish species: *Gobio uranoscopus frici* Vladykov, 1925 (Danubian longbarbel gudgeon), *Barbus petenyi* Heckel, 1852 (Danubian rheophilic barb) and *Cottus gobio* Linné, 1758 (bullhead). In the fishing activities during the spring and summer of 2010 year and the summer of 2016 year we founded two of them, *Barbus petenyi* and *Cottus gobio.*

In two different periods, spring and summer of 2010 year (Florea et. all, 2013) and the summer of 2016 year, we investigated the sames ten fishing stations on three river Buzau River, Siriu River and Crasna River. The fishing stations are representative of all types of streams from the hidrografic network of PAs ROSCI0229 Siriu.

The sampling of fish was made by electrofishing, a portable fishing device, type ELT62II, was used. Fishing was done on foot, zigzag from one bank to another over the entire stream, recording the length and the fished area. For each individual was made the most important somatic measurements.

RESULTS AND DISCUSSION

The ROSCI0229 SIRIU, part of Buzau River basin, is framed as part of ecoregion 10, Carpathian Mounts, and as part of alpine bioregion, with a total surface of 5.747 ha, having a minimum altitude of 546 m and maximum altitude of 1663 m (Fig. 1) (CJ Buzău, 2011)

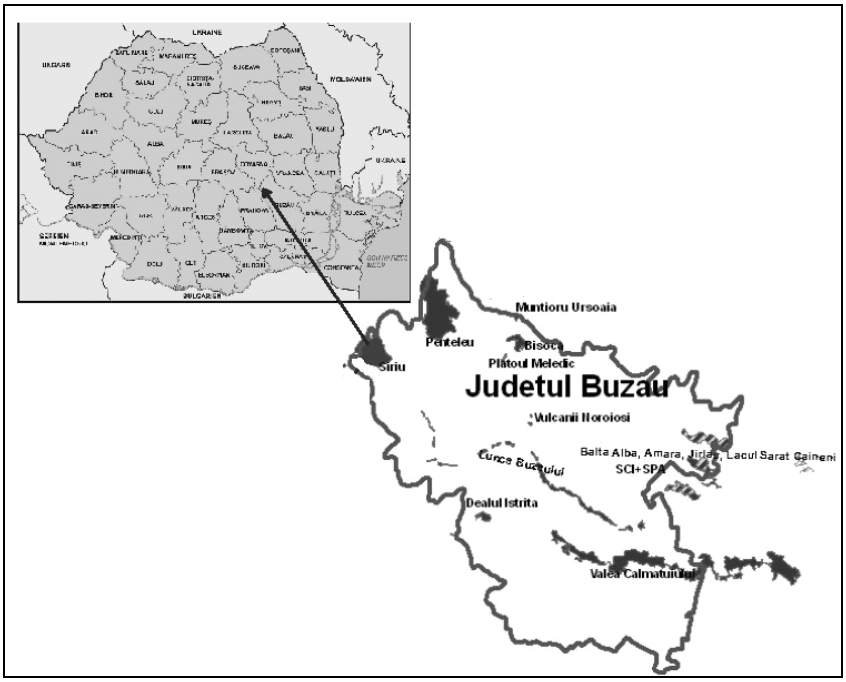

Figure 1: The localization of PAs ROSCI0229 Siriu.

Siriu Mountains consists in a central part of Mălâia Peak that has maximum altitude 1662 meters and in a cupola Bocârnea that has a altitude of 1657 m. Rocks are formed Siriu Mountains are predominantly represented by sandstone, clay and marl. . They form thick layers from a few centimeters up to 2-10 m, arranged in alternation. The presence of sandstones, marls, clays, sands, loess, salt and bands of gypsum determines occurrence in rivers waters of certain soluble salts and of mineral suspensions. In dry periods occur an increase in the water mineralization and in the rainy periods occur a strong erosion of soils, which which negatively affect waters quality.

Under the 1400 m altitude exist mountain forest whose climate is characterized by 3-5 months relatively cold and wet and 7-9 months temperate. The months of July to November are the richer in floods due to heavy rains from the end of spring and the beginning of late summer and melting of snows.

The valleys of Siriu Mountains have a radial deployment, are shallow in origin at 1400 m altitude and presents steep slopes when going down. Gradually, valleys become enlarged and acquires bigs depths. Hydrographic network of Siriu Mountains is tributary of Buzau River that collects water streams coming down from the highest peaks. Among largest we mention: Izvorul Negru and Bradu at east, Mreaja, Milea, Siriu Mare and Vâna Mălâei at south, Manea, Urlătoarea Mare and Urlătoarea Mică at north (Fig.2). The richest draining are found from late April to June (more than 50% of the annual average flow). The particularities of relief, as the high level of deforestation maximise the leakage thus, the floods constitute a important hydrological element (http://www.rezervatie-siriu.ro/).

The hydrography of Siriu Mountains is completed by Eagle Lake, also known as the Bottomless Lake, placed to the east of Mălâia Peak, at an altitude of 1420 m. The lake with an area of 1 ha and a maximum depth of 2 m is fed by rainfall and springs.

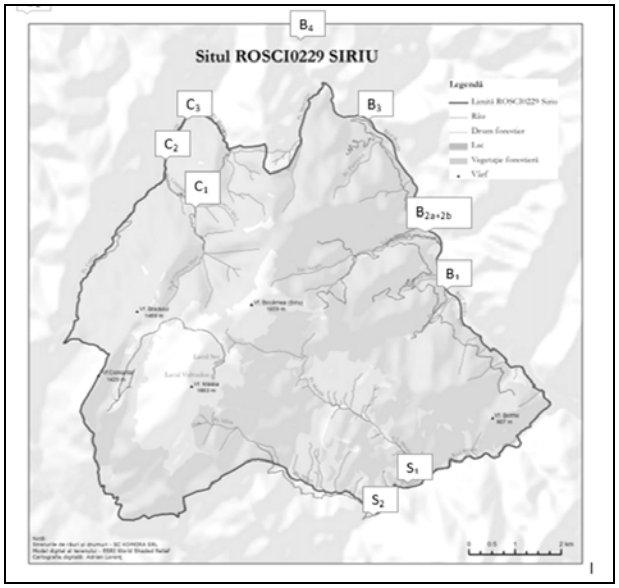

Figure 2: The hidrografic network of ROSCI0229 Siriu and the 10 fishing stations.

The investigated streams Buzau River, Siriu River and Crasna River are very different, the fishing stations chosen (Fig.2 and 3) surprise heterogeneity of environmental conditions: different slope, degree of shading, type of substrate, ranging width and depth (Tab.1), different degree of water velocities.

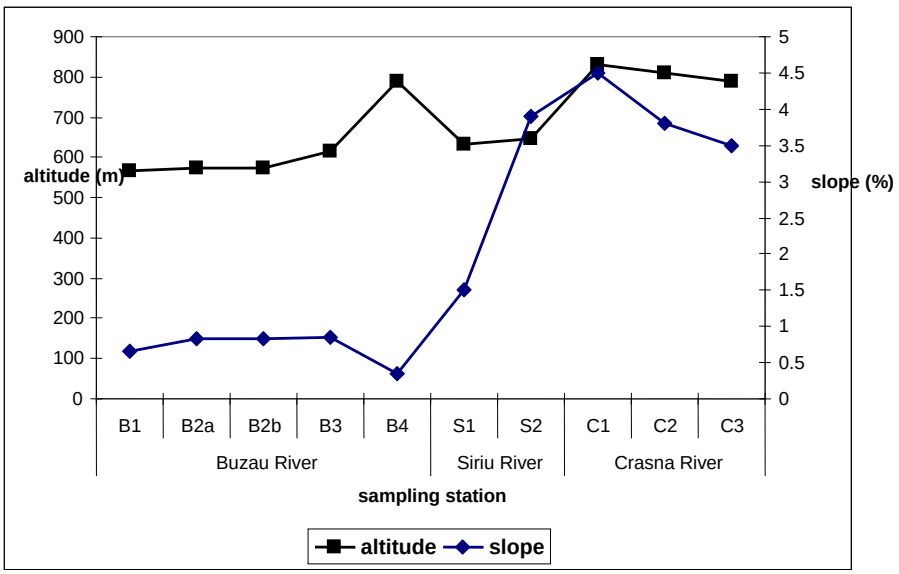

Figure 3 . The hydromorphological characters in fishing station of Buzau, Siriu and Crasna rivers

According with Standard sheet of ROSCI0229 SIRIU were named three community interest fish species that require protection measures: *Gobio uranoscopus* Vladykov, 1925 (Danubian longbarbel gudgeon), *Barbus petenyi* Heckel, 1852 (Danubian rheophilic barb) and *Cottus gobio* Linné, 1758 (bullhead). But, in the fishing activities during the spring and summer of 2010 year and summer of 2016 year we founded only two of them, *Barbus petenyi* and *Cottus gobio*. We have not found *Gobio uranoscopus* which in the near past was present in this region, especially in areas with waterfalls, ford and rapids where the water has a speed of 70-115 cm/s and the bottom is coverd by boulders.

At national level, the presence of this three community interest fish species inside of the 81's SCIs is quite diferent, two of them have a large spreading area with the following frequency:

- *Cottus gobio* is presented in 38 SCIs, with the frequency of 46.9% at national PAs level
- *Barbus peteny* is presented in 35 SCIs, with the frequency of 43.2% at national PAs level.

One of ROSCI0229 SIRIU named community interest fish species has a narow spreading area with the following frequency:

- *Gobio uranoscopus* is presented in 15 SCIs, with the frequency of 18.5% at national PAs level.

Barbus peteny is strictly sedentary fish, it is benthopelagic, prefers rivers and streams in mountainous and hilly areas, with stony riverbeds, clear and well oxygenated water and a fast-flowing current. Show preference especially for strong current and rocky bottom, in its downstream area the *Barbus petenyi* live together *Gobio uranoscopus.* It is also a species sensitive to pollution and can easily make hybrid species whit *B.barbus* and *B.haasi* (Banarescu, 1964).

Cottus gobio is a solitary bottom-dwelling fish, each individual defending a owen territory. Adults do not move between the different stretches of river, but larvae can be passively dispersed downstream after hatching and juveniles actively "explore" neighboring areas before choosing a territory (Chaumota et al., 2006). Show preference especially for cold, clear and fast-flowing shallow water of small stream to medium-sized rivers as well as on gravel or rocky shores of cold lakes (Banarescu, 1964). There are many studies of bullhead distribution thus allow our understanding of interactions between animals and their environment (Gosselin et al., 2010; Seeuws et al., 2005; Vlach et. al., 2005; Legalle et al., 2005; Chaumota et al., 2006; Charles et al., 2008).

In the past, research of Buzau River ichtyofauna revealed the existence of 22 species of fish (Banarascu, 1964), but the in upper Buzau River, upstream from Lake Siriu, was identified a total of 9 fish species (Tab. 1)

Table 1: Environmental and fishery characteristics of the stream of ROSCI0229 in the past.

River/ No.of fish species	Length (km) total / with fish	Medium width (m)	Biogenic capacity	Fish zone (km)			List of fish species
				Trout zone	Grayling zone	Nase zone	
Buzău/ seven fish species	60/60	5-20	V	50	10		*Salmo fario; Phoxinus phoxinus; Cottus gobio; Alburnoides bipunctatus; Barbus petenyi; Squalius cephalus; Thymallus thymallus;*
Siriu/ five fish species	15/15	5	VI	12		3	*Salmo fario; Cottus gobio; Chondrostoma nasus; Squalius cephalus; Barbus petenyi;*
Crasna/ three fish species	9/9	3	VI	9			*Salmo fario; Cottus gobio; Orthrias barbatulus*;

In the present the ichthyofauna of ROSCI0229 Siriu is composed of 10 species of fish caught in June and September 2010, and the same 9 species of fish caught in July 2016 (Tab.2). The missing species is *Rhabdofario mykiss* (rainbow trout), that wasen't founded. This species, native to America, was introduced in upper Buzău river and its tributaries before 1990, but restocking with rainbow trout proved to be totally ineffective. Instead, because the hydromorphological characteristics of the ROSCI0229 SIRIU site, especially of the Siriu stream, the repopulation with native trout fry (*Salmo fario)* before 1990 was successful.

Table 2. Fish species from ROSCI0229 Siriu in 2010 year and 2016 year

Scientific name	Common name	Number of individuals caucht in 2010 / (%)	Number of individuals caucht in 2016 / (%)
Barbus petenyi Heckel, 1852	Danubian rheophilic barb	49 / (25%)	32/ (27,5%)
Cottus gobio Linnaeus, 1758	bullhead	37 / (19%)	25/ (21,5%)
Squalius cephalus (Linnaeus, 1758)	chub	19 / (9,8%)	15/ (13%)
Alburnoides bipunctatus (Bloch, 1782)	sperlin	19 / (9,8%)	5/ (4,3%)
Alburnus alburnus (Linnaeus, 1758)	bleak	1 / (0,5%)	2/ (1,7%)
Chondrostoma nasus (Linnaeus, 1758)	nase	1/ (0,5%)	2/ (1,7%)
Salmo fario Linnaeus, 1758	river trout	48 / (24,8%)	28/ (24%)
Rhabdofario mykiss (Walbaum, 1792)	rainbow trout	1/ (0,5%)	0
Phoxinus phoxinus (Linnaeus, 1758)	minnow	11/ (5,7%)	4/ (3,4%)
Orthrias barbatulus (Linnaeus, 1758)	stone loach	7 / (4,4%)	3/ (2,5%)
Total		10 sp./193 ex.	9 sp./116 ex.

CONCLUSIONS

Barbus peteny and *Cottus gobio* is still common in suitable habitats from ROSCI0229 Siriu, but the decline of its population is suspected and expected to continue gradually due to on-going economic development.

The frequency and abundance of fish species from ROSCI0229 Siriu is similar in the two periods analyzed, in 2010 the higher number of individuals is due to a double catching effort.

Buzau River that collects all tributaries of ROSCI0229 Siriu hosts all species of fish presents in the site, but the most representative are the barb, the bullhead, the chub and the sperlin.

Siriu River, upstream of the confluence with the creek Milea, for a length of 30 km, has an area with good living conditions for trout and his accompanying species, bullhead. In the downstream area, for a length of 3 km there are good living conditions for chub and barbel.

Crasna river trout has as the main fish species the river trout that can be found accompanying by bullhead and stone loach.

Conservation of biodiversity in ROSCI0229 SIRIU will require, in fact, maintaining and promoting human activities. Thus, in this site may continue all activities if they are developed in a sustainable way and do not affect the species and habitats of community interest. There are no restrictions, but rather recommendations and support for: sustainable management of forest resources; use of best practices in agriculture; bio convert of land to obtain products; practicing eco-tourism; promoting traditional crafts and products.

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