THE CORMOPYTE FLORA OF CERNETU VILLAGE (TELEORMAN COUNTY, ROMANIA)

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KEYWORDS: Romania, cormoflora, list, biophorms, floristic elements, ecological categories.

ABSTRACT

The current paper is the outcome of research work covering half a century on the flora of Cernetu, a village in Teleorman County, lying about 40 m above sea level, and enjoying a temperate-continental climate. Until the present study, no research was performed research on the flora of this village. The authors have identified 581 cormophyte species on the site; these are analysed from biological, phyto-geographic, and ecological standpoints. The cormophyte flora of the territory in discussion consists for the most part of therophytes (41.24%), and hemi-cryptophytes (35.18%). The altitude coefficient (Kal) is 117.22, which is an indication of the low altitude, the high degree of anthropic alteration, and the advanced soil aridity. The high degree of anthropic alteration is evinced by the presence in the local flora of cosmopolitan species (9.53%) and of adventive species (6.41%).

REZUMAT: Flora de cormofite a satului Cernetu (județul Teleorman, România).

Lucrarea este rezultatul muncii de cercetare, timp de o jumătate de secol, a florei localității Cernetu din județul Teleorman aflată la cca. 40 m altitudine, într-un climat temperat-continental. Până în prezent flora localității nu a mai fost cercetată de altcineva. Autorii au identificat aici 581 de specii cormofite. Acestea sunt analizate sub aspect biologic, fitogeografic și ecologic. Cormoflora teritoriului cercetat este dominată de terofite (41,24%) și hemicriptofite (35,18%), coeficientul altitudinal (Kal) fiind de 117,22, ceea ce reflectă altitudinea joasă a teritoriului cercetat, gradul mare de antropizare și ariditatea accentuată. Gradul mare de antropizare este evidențiat și de participarea în flora locală a speciilor cosmopolite (9,53%) și adventive (6,41%).

ZUSAMMENFASSUNG: Die Cormophytenflora des Dorfes Cernetu (Kreis Teleorman, Rumänien).

Die Arbeit stellt das Ergebnis der Forschungsarbeit eines halben Jahrhunderts dar und betrifft die im Süden des Landes im Kreis Teleorman gelegene Ortschaft Cernetu. Sie liegt in einer Höhe von 40 m ü. M. und kennzeichnet sich durch ein gemäßigt kontinentales Klima. Bis heute wurde die Flora des Ortes und seiner Umgebung außer den Autoren dieses Beitrags von keinem Anderen erforscht. Dabei haben sie 581 Arten von Cormophyten aus biologischer, pflanzengeographischer, und ökologischer Sicht untersucht. Die Flora des erforschten Gebietes wird mit 41,24% von Therophyten und 35,18% Hemikryptophyten beherrscht. Der Höhenkoefizient (Kal) beträgt 117, 22 und widerspiegelt damit die niedrige Höhenlage des Gebietes, das hohe Ausmaß an menschlichem Einfluss und eine ausgeprägte Aridität. Die Stärke des menschlichen Einflusses zeigt sich auch durch den hohen Anteil an kosmopolitischen (9,53%) und adventiven (6,41%) Arten in der lokalen Flora.

INTRODUCTION

The village Cernetu (formerly known as Atârnaţi) lies on the right bank of the river Teleorman, in the Burnaz Plain (Câmpia Burnazului) and is an administrative division of the commune Mârzănesti, in Teleorman County in Romania. It is a typical village for low plains, its nucleus being in the Teleorman flood plain, 33-40 m above the sea level. The local coordinates (at the crossroads) are 43°54’32’’ N, 25°27’00’’ E. The Teleorman River is an left tributary of the Vedea, which is a tributary of the Danube, joining a few of kilometers downstream of Zimnicea town.

The plain-type relief of the site consists of geological formations from the Middle Pleistocene era, as shown by loess-like sediments (Map of Romanian Quaternary Period/Harta Cuaternarului din R.P.R., Comitetul Geologic, 1964).

Among the local soils, chernozems are the most common (chocolate and chestnut browns), medium-to-highly levigated. They evince a clayish texture, with extremely high porosity and permeability, and pH factors of 6.5-7.3. Along with chernozems, there are bown-reddish forest soils. Of the intra-zonal soils, frequent are salt-affected soils (particularly solonetzes), marshy grounds (of which some salinized), and flood-plain soils.

The temperate-continental climate shows high radiative and caloric values, high amplitudes of air temperatures, and relatively low precipitation amounts. The global annual solar radiation amounts to 125 calories per sq. cm. The average annual sunshine is in excess of 2,000 hours. The local air temperature averages 10.8°C (51.4F) (calculated over a 60-year period), while the local soil temperature averages 13°C (55.4F). The highest temperature was recorded in 1985: 40.7°C (105.2 F), while the lowest was the same year: -25.5°C (–13.9 F). The average annual precipitation amounts to 530 mm (calculated over a 52-year period). The year 1975 was cooler than usual (average temperature: 9.9°C/F; precipitation: 602.5 mm, while the year 1983 was warmer and drier (average temperature: 15.2°C/59.3F; precipitation: 460.2 mm). Evapotranspiration exceeds 700 mm per year, which typically results in an annual water deficit. Snowfall occurs on 25 days per year on average, while snow on the ground averages 55 days a year. The depth of the snow on the ground averages 20 cm. The vegetation period lasts for approximately 250 days a year. Winter winds blow from E, NE, and NW (particularly the Crivăț, an icy north wind), while in summertime winds usually blow from the S and SE (especially the Austru, a dry south wind, and sometimes also the Băltăreț, a warm marsh wind). Climate recordings are taken from the Alexandria weather station (altitude: 45 m), 10 km away from Cernetu.

MATERIAL AND METHODS

The flora and the vegetation of Cernetu was barely studied prior to our research. Flora României (Romania’s Flora) mentions only one species (*Carex divisa*) for Cernetu (in vol. XI), while I. Șerbănescu (1960) mentions *Camphorosma monspeliaca* (information subsequently quoted by Oprea, 2005, and Dihoru and Negrean, 2009).

Almost every year, from 1971 until 2015, went to the site and made notes on the plant species and phytocoenoses of different associations, collected plants and seeds. The plant seed catalog, from Botanical Garden, Bucharest, 1975, includes three species from Cernetu village (*Abutilon theophrasti*, *Centaurea iberica*, *Marrubium vulgare*), although the item Semina, of Drăgulescu Constantin collecta was omitted. Catalog de semințe, Grădina Botanică Cluj-Napoca, 1981/Plant Seed Catalog, Cluj Botanical Gardens, includes three others (*Portulaca oleracea, Potentilla supina,* and *Saponaria officinalis*). Thirty other species were recorded from Cernetu village in five ethnobotany studies (Drăgulescu 2003, 2007, 2009, 2010, 2014), among which are five fungi.

CD had learned about botanist Nicolae Roman, an inhabitants of Cernetu village who carried out research on the local flora and vegetation. I got in touch with him and suggested, over two decades ago, a collaboration for a monograph of the local flora and vegetation. I sent him my lists of species and associations, so that he could add his own. Twice we met at his place in Cernetu and discussed the monograph outline, or the specifics of some species we were not certain about. I completed my list with few of the species that he had found (such species are asterisked below). Unfortunately, he got ill and died in 2014. After his demise, his wife, botanist Ștefana Roman, handed me a field-work notebook in which Nicolae Roman had noted some surveys made in the salty meadows of Cernetu. She also allowed me to read through Nicolae Roman's herbarium in Cernetu, and sent me a list of plants collected from Cernetu, as preserved in the herbarium at their home in Bucharest. These are the reasons why Nicolae Roman features as a co-author of this paper.

Samples preserved, collected on site in Cernetu, can be found in the Herbarium of Bucharest University (BUC, collected by P. Enculescu) and, certainly, in the Herbarium N. Roman (HNR) and in the Herbarium C. Drăgulescu (HCD).

The present paper counts and analyses 581 cormophyte species, out of which 4 species are hybrid. The information used for species descriptions is cited from Sanda and collaborators (2003).

RESULTS AND DISCUSSION

The plants identified in the Cernetu site (Fig. 1) are analysed from several different perspectives: biological (bioform categories), phyto-geographic (floristic categories), and ecological (categories seen in relation to humidity preference, temperature or soil reaction), in order to point out the characteristics of the local cormoflora.

Figure 1: Teleorman River riparian softwood stands in the Cernetu Village area.

Analysis of bioforms

Upon an examination of the bioforms of the cormoflora in Cernetu village (Tab. 1), we notice the predominance of therophytes (41.24%), and of hemi-cryptophytes (35.18%), an indication of the low altitude of the area under investigation, of the high degree of anthropization, and of the advanced soil aridity.

Such characteristics are shown also by the altitude coefficient (Kal), given by the ratio of the therophytes and the hemi-cryptophytes existant in a given territory:

$$(Kal = \frac{T}{H} \times 100), \text{ in this case } \frac{41.24}{35.18} \times 100 = 117.22.$$

This value is indicative of an area below 100 m altitude and implicitly an area with obvious aridity and a strong anthropic influence.

Table 1: The structure of bio-forms in the cormoflora of Cernetu.

Bioform	Number of species	Percentage
MPh	15	**4.16**
MPh-mPh	9	
mPh	19	**4.33**
mPh-MPh	6	
nPh	7	**1.38**
nPh-L	1	
Ch	8	**2.77**
Ch-nPh	1	
Ch-H	7	
H	183	**35.18**
H-nPh	1	
H-Ch	6	
H-Hh	6	
H-G	7	
G	31	**7.62**
G-H	4	
G-Hh	9	
Hh	18	**3.12**
Hh-G	1	
Th	153	**41.24**
Th-TH-H	4	
Th-TH	34	
TH	35	
TH-H	12	
Total	**577**	**100**

Table 2: Categories of floristic elements in the cormoflora of Cernetu Village.

Floristic element	Number of species	Percentage
Cp	40	**6.93**
Eua	187	**46.10**
Eua (C)/Eua-C	49	
Eua (M)/Eua-M	13	
Eua (sM)/Eua-sM	17	
E	55	**12.13**
E (M)/E-M	7	
E (C)/ E-C	8	
Ec	13	**6.25**
Ec (M)/Ec-M	14	
Ec-sM	5	
Ec-B	1	
Ec-B-Cauc-Anat	1	
Ec-Cauc	1	
Ec-P	1	
P	4	**1.56**
P-Cauc	1	
P-B-Cauc	1	
P-B	3	
B	4	**0.87**
B-Cauc	1	
P-Pn	3	**2.60**
P-Pn-B	7	
Pn-B	4	
D-Pn	1	
P-M	15	**2.60**
M	18	**3.81**
sM	4	
Atl-M	7	**1.21**
Cosm	55	**9.53**
Adv	37	**6.41**
Total	**577**	**100**

Analysis of the floristic elements

The data in table 2 are the outcome of an analysis of geo-element categories of the local cormoflora was done.

Most species are part of the Euro-Asian (46.10%) element, including also the Eurasian-continental, Eurasian-Mediterranean and Eurasian-sub-Mediterranean group of elements, followed by the European element (12.13), a consequence of the geographical position of the investigated site. I find the weight of the circumpolar species (6.93% of the whole), due to hygrophilic and hydrophilic plants such as, for example: *Equisetum palustre, Myriophyllum spicatum, Berula erecta, Stachys palustris, Galium palustre, Potamogeton nodosus, Carex acuta, Juncus articulatus* and *Leersia oryzoides*.

Analysis of ecological types

Judged in view of their dependence on humidity factors, most species are xero-mesophytes (36.05%) and mesophytes (30.02%); by temperature, micro-mesothermophilous plants are dominant (61.53%), along with mesothermophilous species (21.83%); finally, by soil reaction, there is a predominance of slightly acido-neutrophilous plants (42.46%), also euryionic (34.84%) (Tab. 3).

Table 3: The ecological categories of the Cernetu cormoflora.

	Humidity		Temperature		Soil Reaction	
Value of ecological indices	Number of species	Percentage	Number of species	Value of ecological indices	Number of species	Percentage
0	24	**4.16**	84	**14.56**	201	**34.84**
1-1.5	41	**7.11**	-		-	
2-2.5	208	**36.05**	12	**2.08**	13	**2.25**
3-3.5	179	**30.02**	355	**61.53**	97	**16.81**
4-4.5	68	**11.78**	126	**21.83**	245	**42.46**
5	30	**5.20**	-		21	**3.64**
6	27	**4.68**	-		-	
Total	**577**	**100**	**577**	**100**	**577**	**100**

The list of identified species

The 581 plant species identified in and near Cernetu are ordered by family, in phylogenetic sequence. For each species, we have given the scientific name, the respective author(s) who identified its presence, its bioform, the floristic element, the ecological indices for humidity (H), temperature (T), and soil reaction (R), as well as the respective coenotaxons.

Equisetaceae

Equisetum arvense L.: G, Cosm; U3T3R0, Artemisietea, Chenopodietea, Secalietea;

Equisetum palustre L.: G, Cp; U5T2R0, Molinietalia;

Equisetum telmateia Ehrh. (*E. maximum* Lam.): G, Cp; U3.5T2R0, Alno-Padion, Filipendulo-Petasition;

Aspidiaceae

Dryopteris filix-mas (L.) Schott: H, Eua; U4T3R0, Querco-Fagetea;

Azollaceae

Azolla filiculoides Lam.: Hh, Adv; U6T4,5R0, Lemnion (HCD);

Aristolochiaceae

Aristolochia clematitis L.: G, M; U2.5T3.5R5, Arction lappae, Calystegion, Prunetalia;

Ceratophyllaceae

Ceratophyllum demersum L. ssp. ***demersum***: Hh, Cosm; U6T3R0, Potamion;

Ceratophyllum submersum L.: Hh, E; U6T3.5R0, Potamion (HCD);

Ranunculaceae

Adonis aestivalis L.: Th, Eua-C; U3T4R3, Secalietea; extinct;

Anemone nemorosa L. ssp. ***nemorosa:*** G, E; U3.5T3R0, Querco-Fagetea;

Anemone ranunculoides L.*: G, E; U3.5T3R4, Querco-Fagetea;

Clematis vitalba L.: nPh-L, Ec-M; U3T3R3, Prunetalia, Querco-Fagetea;

Consolida regalis S. F. Gray (*Delphinium consolida* L.) ssp. ***regalis:*** Th, Eua; U2T4R4, Caucalidion, Secalietea; cu f. ***ramosum*** Vis. (HCD)

Helleborus odorus Waldst. et Kit.: H, B; U2,5T3,5R4, Orno-Cotynetalia;

Nigella arvensis L.: TH, P-M; U2T4R4, Caucalidion, Secalietea;

Ranunculus acris L. ssp. ***acris***: H, Eua; U3.5T0R0, Molinio-Arrhenatheretea;

Ranunculus aquatilis L. (*Batrachium aquatile* (L.) Dum.): Hh, Cosm; U6T3R0, Potamion;

Ranunculus arvensis L.: Th, Eua-M; U3T3R0, Secalietea;

Ranunculus ficaria L. (*Ficaria verna* Hudson) ssp. ***bulbilifer*** Lambinon: H(G), Eua; U3.5T3R3, Querco-Fagetea;

Ranunculus illyricus L.*: H(G), P-M; U2,5T4R4, Festucion rupicolae;

Ranunculus repens L.: H, Eua; U4T0R0, Agropyro-Rumicion, Alno-Padion, Bidentetalia tripartiti, Calystegion, Molinio-Arrhenatheretea, Phragmitetea, Plantaginetea majoris;

Ranunculus sardous Cr.: Th-TH, Eua; U3T3R4, Agropyro-Rumicion, Agrostion stoloniferae, Nanocyperion flavescentis, Secalietea;

Ranunculus sceleratus L.: Th, Cp; U4.5T3R4, Bidention tripartiti;

Papaveraceae

Chelidonium majus L.: H, Eua; U3T3R4, Alliarion petiolatae, Arction lappae, Chenopodietea;

Corydalis cava (L.) Schweigg. et Koerte (*Corydalis bulbosa* auct.) ssp. **marschalliana** (Pallas) Charter*: G, Ec; U3T3R0, Querco-Fagetea;

Fumaria vaillantii Loisel: Th, Eua; U2.5T3.5R4.5, Caucalidion, Polygono-Chenopodion polyspermi, Secalietea;

Papaver dubium L. ssp. ***dubium***: Th, M; U2T3.5R3, Caucalidion, Festucion rupicolae;

Papaver rhoeas L. ssp. ***rhoeas***: Th, Cosm; U3T3.5R4, Secalietea;

Ulmaceae

Ulmus glabra Hudson (*U. montana* Stokes, *U. scabra* Miller): mPh-MPh, Eua; U4T3R3, Alno-Padion, Salicetalia purpureae (HCD);

Ulmus minor Miller (*U. foliacea* Gilib., *U. campestris* auct.): MPh, E; U3T3R4, Carpinion betuli, Querco-Fagetea (HCD);

Moraceae

Morus alba L.: MPh, Adv; U2T3.5R4, Salicetalia purpureae;

Cannabaceae

Cannabis sativa L. ssp. ***spontanea*** (Vavilov) Serebr. (*C. ruderalis* Janisevschi): Th, Eua (C), U2,5T3R4, Chenopodietea (HCD);

Humulus lupulus L.: H, Eua; U3.5T3R4, Alno-Padion, Prunetalia;

Urticaceae

Urtica dioica L.: H(G), Cosm; U3T3R4, Alno-Padion, Artemisietea, Salicion albae;

Urtica urens L.: Th, Cosm; U3T3R4, Chenopodietea;

Juglandaceae

Juglans regia L.: MPh, Ec-B-Cauc-Anat; U3T4R4, Fagetalia silvaticae;

Fagaceae

Quercus cerris L.: MPh-mPh, (s)M; U2T3.5R3, Quercetalia pubescentis (HCD,HNR);

Quercus frainetto Ten.: MPh, B; U2T4R3, Quercion frainetto;

Quercus pedunculiflora C. Koch: MPh, P-Anat; U2T4R4, Quercion pedunculiflorae (HCD);

Quercus pubescens Willd.: MPh, (s)M; U1.5T4R5, Quercetalia pubescentis cu f. ***pinnatifida*** (HCD);

Quercus robur L.: MPh, E; U3.5T3R0, Alno-Padion, Quercetea robori-petraeae (HCD);

Quercus virgiliana (Ten.) Ten: MPh, M; U2T4R4, Orno-Cotinion (HCD,HNR);

Betulaceae

Alnus glutinosa (L.) Gaerter: Mph-mPh, Eua; U5T3R3, Alnion glutinosae, Alno-Padion; extinct;

Corylaceae

Carpinus betulus L.: Mph-mPh, E; U3T3R3, Carpinion betuli (HCD);

Carpinus orientalis Miller*: MPh, B-Cauc; U3T4R4,5, Syringo-Carpinion orientalis;

Phytolaccaceae

Phytolacca americana L.: H, Adv; U3T0R0, Alliarion petiolatae, Carpinion betuli;

Portulacaceae

Portulaca oleracea L.: Th, Cosm; U3T0R0, Polygono-Chenopodietalia (Cat. Cluj 1981);

Caryophyllaceae

Agrostemma githago L.: Th, Cosm; U3T4R0, Secalietea;

Arenaria serpyllifolia L.: Th, Cp; U2T2.5R0, Festuco-Brometea;

Cerastium brachypetalum Desp.: Th, M; U3T3R0, Alysso-Sedion;

Cerastium dubium (Bast.) Guepin (*C. anomalum* Waldst. et Kit.): Th, P-M; U3T3R0, Agropyro-Rumicion, Puccinellio-Salicornietea;

Cerastium holosteoides Fries ssp. ***holosteoides*** (*C. caespitosum* Gilib., *C. triviale* Link., *C. fontanum* Baumg. ssp. *vulgare* (Hartm.) Graebner et Burdet): Ch-H, Cosm; U3T0R0, Molinio-Arrhenatheretea;

Cerastium pumilum Curt.*: Th, E (M); U2T3R0, Festuco-Brometea;

Cucubalus baccifer L.: H, Eua; U3.5T3R4, Calystegion, Senecion fluviatilis;

Dianthus armeria L. ssp. ***armeria****: Th-TH, E; U2T3R3, Quercetea pubescenti-petraeae, Quercetea robori-petraeae;

Dianthus carthusianorum L. ssp. ***carthusianorum***: H, E; U2T4R4.5, Festuco-Brometea;

Gypsophila muralis L.: Th, Eua-C; U2T3R4.5, Bidentetea tripartiti, Nanocyperetalia, Puccinellio-Salicornietea, Secalietea (HCD);

Herniaria glabra L.*: TH-H, Eua-M; U2.5T3.5R3, Festuco-Brometea, Polygonion avicularis;

Holosteum umbellatum L. ssp. ***umbellatum****: Th, Eua-M; U2T3.5R0, Festuco-Brometea, Secalietea;

Kohlrauschia prolifera (L.) Kunth (*Tunica prolifera* (L.) Scop., *Petrorhagia prolifera* (L.) P.W. Ball. et Heywood: Th, P-M; U1.5T4R3, Festuco-Brometea (HCD); cu f. ***uniflora*** Schur;

Sagina procumbens L.: H (Ch), Cp; U4T3R3, Arrhenatheretalia, Plantaginetea majoris, Secalietea;

Saponaria officinalis L.: H, Eua-M; U3T3R0, Calystegion, Chenopodietea, Senecion fluviatilis Cat. Cluj 1981);

Scleranthus annuus L. ssp. ***annuus***: Th, Eua; U2T3R2, Aperetalia;

Silene alba (Miller) E.H.L. Krause (*Melandrium album* (Miller) Garke): Th-TH, Eua; U3.5T2R3, Chenopodio-Scleranthetea, Onopordion acanthii, Origanetalia;

Silene otites (L.) Wib.: TH-H, E; U1.5T4R4.5, Festucetalia valesiacae, Festucion vaginatae;

Silene vulgaris (Moench) Garcke (*Behen vulgaris* Moench) ssp. ***vulgaris***: H, Eua; U3T3R4, Festuco-Brometea, Molinio-Arrhenatheretea, Quercetea robori-petraeae;

Spergularia marina (L.) Besser (*S. salina* (L.) J. et C. Presl.): Th-H, Cosm; U2T3R2, Cypero-Spergularion, Puccinellio-Salicornietea (HCD);

Spergularia rubra (L.) J. et C. Presl.: Th-H, Cp; U4T3R4, Aperetalia, Bidentetea tripartiti, Nanocyperion flavescentis, Plantaginetea majoris;

Stellaria graminea L.: H, Eua; U2.5T3R3, Arrhenatheretalia, Molinio-Arrhenatheretea;

Stellaria holostea L.: H, Eua; U3T3R0, Carpinion betuli, Querco-Fagetea;

Stellaria media (L.) Vill.: Th-TH, Cosm; U3T0R0, Chenopodietea;

Stellaria neglecta Weihe (*S. media* ssp. *neglecta* (Weihe) Gremli): Th-TH, Ec; U3.5T3R3, Querco-Fagetea;

Stellaria nemorum L.*: H, E; U3.5T3R3, Alno-Padion;

Amaranthaceae

Amaranthus albus L.: Th, Adv; U3T3R3, Chenopodietea (HCD);

Amaranthus blitum L. (*A. lividus* L., *A. ascendens* Loisel): Th, M; U3.5T4R4, Polygono-Chenopodion polyspermi;

Amaranthus crispus (Lesp. et Trev.) N. Terrac.: Th, Adv; U3T4R3, Chenopodietea, Sisymbrion officinalis;

Amaranthus cruentus L. (*A. paniculatus L.*): Th, Adv; U3T3R0, Chenopodietea;

Amaranthus deflexus L.: H, Adv; U2.5T4R4, Polygonion avicularis;

Amaranthus hybridus L. s. str. (*A. hypochondriacus* auct., *A. patulus* Bertol.): Th, Adv; U3T3R0, Chenopodietea, Secalietea;

Amaranthus retroflexus L.: Th, Adv; U3T3R0, Chenopodietea, Panico-Setarion;

Chenopodiaceae

Atriplex littoralis **L**.: Th, Eua; U0T0R0, Atriplicion littoralis (HCD);

Atriplex oblongifolia Waldst. et Kit.: Th, Eua-C; U2T3.5R4, Chenopodietea, Sisymbrion officinalis;

Atriplex patula L.: Th, Cp; U0T0R0, Chenopodietea, Polygono-Chenopodion polyspermi;

Atriplex prostrata Boucher (*A. hastata* auct.): Th, Cp; U3.5T0R0, Bidention tripartiti, Chenopodio-Scleranthetea, Chenopodion fluviatile, Puccinellietalia (HCD);

Atriplex sagittata Borkh. (*A. nitens* Schkuhr, *A. acuminata* Waldst. et Kit.): Th, Eua-C; U3T3R0, Chenopodietea, Chenopodion fluviatile, Senecion fluviatilis;

Atriplex tatarica L.: Th, Eua; U2T4R0, Chenopodietea, Sisymbrion officinalis;

Bassia prostrata (L.) G. Beck (*Kochia prostrata* (L.) Schrad.): Ch-nPh, Eua-C; U1.5T4R4.5, Puccinellietalia;

Bassia scoparia (L.) Voss (*Kochia scoparia* (L.) Schrader): Th, Eua; U3T3.5R0, Chenopodietea (HCD);

Camphorosma annua Pall. (*C. ovata* Waldst. et Kit.)*: Th, P; U2T4R5, Puccinellietalia;

Camphorosma monspeliaca L.: Ch, M; U2T4R5, Puccinellietalia (I. Şerbănescu, 1960, A. Oprea, 2005, Gh. Dihoru et G. Negrean, 2009, HCD,HNR,BUC, leg. Enculescu) (C. Drăgulescu, 2009, 2010, 2014);

Chenopodium album L. ssp. ***album*** (incl. ssp. ***spicatum*** (Koch) Nyar.): Th, Cosm; U3T3R0, Chenopodietea (HNR);

Chenopodium botrys L.: Th, Cosm; U3,5T4R0, Sisymbrion, Chenopodietea;

Chenopodium glaucum L.: Th, Eua; U3.5T4R0, Chenopodio-Scleranthetea, Chenopodion fluviatile, Puccinellietalia; cu f. ***angustatum*** Nyar. and f. ***microphyllum*** Prod. (HCD;

Chenopodium hybridum L.: Th, Cosm; U3T3R0, Chenopodietea, Chenopodio-Scleranthetea;

Chenopodium polyspermum L.: Th, Eua; U3T4R0, Polygono-Chenopodion polyspermi, Sisymbrion officinalis;

Chenopodium strictum Roth (*C. album* ssp. *striatum* (Krasan.) J. Murray): Th, Ec; U2,5T4R0, Chenopodio-Scleranthetea, Sisymbrion;

Chenopodium urbicum L.: Th, Eua-M; U3T0R3, Chenopodio-Scleranthetea, Cypero-Spergularion, Onopordion acanthii, Sisymbrietalia;

Polycnemum arvense L. ssp. ***arvense****: Th, Eua-C; U2T3R3, Festuco-Brometea, Secalietea (HNR);

Salsola kali L. şi ssp. ***ruthenica*** (Iljin) Soó: Th, Eua-C; U0T4R4, Eragrostetalia, Sisymbrion officinalis (HCD);

Suaeda maritima (L.) Dumort.: Th, Cosm; U4.5T3.5R5, Thero-Salicornion;

Polygonaceae

Polygonum amphibium L.: Hh, Cosm; U6T3R0, Agropyro-Rumicion, Agrostion stoloniferae, Phragmitetea, Polygono-Chenopodion polyspermi, Salicetea purpureae; cu f. ***terrestre*** Leyss;

Polygonum aviculare L.: Th, Cosm; U2.5T0R3, Polygonion avicularis (HNR); cu var. ***ascendens*** Mont.; var. ***neglectum*** (Bess.) Rchb.; var. ***procumbens*** (Gilib.) Hayne;

Polygonum convolvulus L. (*Bilderdykia convolvulus* (L.) Dumort., *Fagopyrum convolvulus* (L.) H. Gross.): Th, Eua; U2.5T3R3, Aperetalia, Chenopodio-Scleranthetea;

Polygonum hydropiper L.: Th, Cp; U4.5T3R4, Bidention tripartiti, Salicion albae;

Polygonum lapathifolium L. ssp. ***lapathifolium***: Th, Cosm; U4T0R3, Bidention tripartiti, Polygono-Chenopodion polyspermi, Sisymbrion officinalis;

Polygonum minus Hudson: Th, Cosm; U4.5T3R4, Bidention tripartiti;

Polygonum mite Schrank: Th, E; U5T3R4, Bidentetalia tripartiti; cu f. ***angustifolium*** (A. Br.) Beck (HCD);

Polygonum persicaria L.: Th, Eua; U4.5T3R0, Phragmitetea, Polygono-Chenopodietalia, Salicetalia purpureae;

Rumex acetosa L.: H, Cosm; U3T0R0, Molinio-Arrhenatheretea;

Rumex acetosella L. ssp. ***acetosella*** and ssp. ***tenuifolius*** (Wallr.) Hadac et Hasek (*Rumex tenuifolius* (Wallr.) A. Love): H, Cosm; U2T3R2, Festuco-Sedetalia;

Rumex conglomeratus Murray: H, Cp; U4T3R4, Agropyro-Rumicion, Bidention tripartiti (HCD);

Rumex crispus L.: H, Eua; U4T3R0, Agropyro-Rumicion, Arrhenatherion elatioris;

Rumex obtusifolius L. ssp. ***obtusifolius***: H, E; U4T0R3, Arction lappae, Artemisietea;

Rumex palustris Sm. (*R. limosus* Thuill.): Th-TH, Eua; U5T3R4, Bidentetea tripartiti, Phragmitetea (HCD);

Rumex patientia L. ssp. ***patientia***: H, Eua-C; U3T4R0, Arction lappae, Chenopodietea;

Rumex pulcher L.: Th-TH, Atl-M; U4T3R3, Sisymbrion (HCD);

Rumex sanguineus L.: H, E; U4T3R4, Alno-Padion;

Crassulaceae

Sedum maximum (L.) Hoffm.: H, E; U2T3R4, Festucetalia valesiacae, Querco-Fagetea;

Rosaceae

Agrimonia eupatoria L. ssp. ***eupatoria**:* H, Eua; U2.5T3R4, Festuco-Brometea;

Cerasus fruticosa (Pallas) Woronow (*Prunus fruticosa* Pallas)*: nPh, Eua-C; U1.5T3.5R4, Prunion fruticosae, Quercetalia pubescentis;

Crataegus laevigata (Poiret) DC. (*C. oxyacantha* auct. non L.)*: mPh, Ec; U3T3R3, Querco-Fagetea;

Crataegus monogyna Jacq. ssp. ***monogyna***: mPh, Eua; U2.5T3R3, Prunetalia, Querco-Fagetea; with f. ***dissecta*** (HCD);

Crataegus pentagyna Waldst. et Kit.: mPh, P-Pn-B; U3T3,5R3, Prunetalia (C. Drăgulescu, 2009, 2010, 2014);

Fragaria vesca L.: H, Eua; U3T2.5R0, Cynosurion cristati, Querco-Fagetea;

Fragaria viridis Weston (*F. collina* Ehrh.) ssp. ***viridis***: H, Eua; U2T4R3, Festucetalia valesiacae, Geranion sanguinei;

Geum urbanum L.: H, Eua; U3T3R4, Alno-Padion, Carpinion betuli, Prunetalia, Querco-Fagetea (C. Drăgulescu,2009, 2010, 2014);

Malus sylvestris (L.) Miller: mPh, E; U3.5T3R4, Alno-Padion, Carpinion betuli;

Potentilla anserina L.: H, Cosm; U4T3R4, Bidentetalia tripartiti, Molinietalia, Nanocyperetalia, Plantaginetalia majoris;

Potentilla arenaria Borkh. (P. cinerea auct. non Chaix) ssp. ***arenaria***: H, E (C); U2T3.5R4.5, Festucetalia valesiacae;

Potentilla argentea L. ssp . ***argentea***: H, Eua; U2T4R2, Festuco-Brometea, Onopordetalia, Quercetea pubescenti-petraeae;

Potentilla reptans L.: H, Eua; U3.5T0R4, Agropyro-Rumicion, Bidentetalia tripartiti, Molinio-Arrhenatheretea, Plantaginetea majoris;

Potentilla supina L.: TH-H, Eua-sM; U4T3R0, Bidention tripartiti, Nanocyperion flavescentis; (Cat. Cluj 1981,HNR);

Prunus cerasifera Ehrh.: mPh, P-B; U2T4R0, Querco-Fagetea (C. Drăgulescu, 2003, 2007, 2009, 2010, 2014);

Prunus mahaleb L. (*Cerasus mahaleb* (L.) Miller): mpH-MPh, M; U2T3R4,5, Quercetalia pubescenti-petraeae (HCD);

Prunus spinosa L. ssp. ***spinosa***: mPh, E; U2T3R3, Prunion spinosae;

Pyrus pyraster (L.) Burgsd.: mPh-MPh, E; U2T3R4, Quercetea robori-petraeae, Querco-Fagetea;

Rosa canina L.: nPh, E; U2T3R3, Prunion spinosae, Querco-Fagetea (HCD);

Rosa gallica L.: nPh, P-M, U2T4R4, Quercetalia pubescentis;

Rubus caesius L.: nPh, E; U4T3R4, Alno-Padion, Convolvuletalia, Salicetea purpureae, Secalietea;

Sorbus domestica L.*: mPh-MPh, M; U1,5T3,5R4, Quercetalia pubescenti-petraea;

Fabaceae

Astragalus glycyphyllos L.: H, Eua (sM); U3T3R4, Origanetalia, Querco-Fagetea;

Astragalus onobrychis L. ssp. ***onobrychis***: H, Eua-C; U1.5T3.5R4.5, Festucetalia valesiacae;

Coronilla varia L.: H, Ec-M; U2T3R4, Festuco-Brometea, Quercetea robori-petraeae;

Cytisus hirsutus L. ssp. ***leucotrichus*** (Schur) A. et D. Löve: nPh, Ec (M); U2T3,5R4, Quercetea pubescenti-petraeae, Festucetalia valesiacae;

Cytisus nigricans L. (*Lembotropis nigricans* (L.) Griseb.)*: nPh, Ec; U2.5T3.5R2, Quercetea pubescenti-petraeae;

Dorycnium pentaphyllum Scop. ssp. ***herbaceum*** (Vill.) Rouy (*Dorycnium herbaceum* Vill.): Ch(-H), Ec-M; U2T4.5R4, Festucion rupicolae, Geranion sanguinei;

Galega officinalis L.: H, P-M; U4.5T3R4, Bidention tripartiti, Calystegion, Molinietalia;

Genista tinctoria L. ssp. ***tinctoria***: Ch(-nPh), E; U2.5T3R2, Molinion coeruleae, Quercetea pubescenti-petraeae;

Lathyrus pratensis L.: H, Eua; U3.5T3R4, Molinio-Arrhenatheretea, Trifolion medii;

Lathyrus sylvestris L.: H, E-M; U2,5T3R4, Origanetalia;

Lathyrus tuberosus L.: H, Eua; U2T4R4, Caucalidion, Secalietea;

Lotus corniculatus L. ssp. ***corniculatus***: H, Eua; U2.5T0R0, Festucetalia valesiacae, Festucion vaginatae, Molinio-Arrhenatheretea, Plantaginetea majoris, Secalietea;

Lotus glaber Miller (*Lotus tenuis* Kit.): H, Eua; U3.5T3R4, Puccinellietalia (HCD);

Medicago falcata L.: H, Eua; U2T3R5, Festuco-Brometea, Secalietea;

Medicago lupulina L.: Th-TH, Eua; U2.5T3R4, Alysso-Sedion, Chenopodietea, Festuco-Brometea, Molinio-Arrhenatheretea, Plantaginetea majoris, Secalietea; with f. ***eriocarpa*** Rouy.;

Medicago minima (L.) L.: Th, sM; U1.5T4R4, Festucetalia valesiacae, Festuco-Brometea;

Medicago sativa L.: Ch-H, Eua (C); U2T3R5, Festuco-Brometea, Secalietea;

Melilotus albus Medik: Th-TH, Eua; U2.5T3R0, Artemisietea, Chenopodietea;

Melilotus officinalis Lam.: Th-TH, Eua; U2.5T3.5R0, Artemisietea, Chenopodietea, Secalietea;

Onobrychis viciifolia Scop.: H, Eua; U2T4R4.5, Festucetalia valesiacae, Mesobromion;

Ononis arvensis L. (*O. hircina* Jacq.) ssp. ***arvensis***: H, Eua-C; U3T4R0, Cirsio-Brachypodion, Molinio-Arrhenatheretea;***Ononis spinosa*** L. ssp. ***spinosa***: Ch-H, E; U0T3.5R0, Festuco-Brometea (HCD);

Robinia pseudacacia L.: MPh, Adv; U2.5T4R0, Robinion pseudacaciae (C. Drăgulescu, 2003, 2007, 2009, 2010, 2014);

Trifolium arvense L. ssp. ***arvense***: Th, Eua; U1.5T3R4, Arrhenatheretalia, Corynephoretalia, Festuco-Brometea, Secalietea;

Trifolium campestre Schreber: Th, E; U3T3R0, Arrhenatheretalia, Festuco-Brometea, Plantaginetea majoris, Secalietea;

Trifolium dubium Sm. Th, E; U3.5T2.5R0, Arrhenatheretalia, Arrhenatherion elatioris, Nanocyperion flavescentis;

Trifolium fragiferum L. ssp. ***fragiferum***: H, Eua; U3T3R4.5, Agropyro-Rumicion, Agrostion stoloniferae, Cynosurion cristati, Plantaginetea majoris (HCD, HNR);

Trifolium hybridum L. ssp. ***hybridum***: H, Atl-E; U3.5T3R4, Agropyro-Rumicion, Agrostion stoloniferae;

Trifolium pratense L. ssp. ***pratense***: H, Eua; U3T0R0, Molinio-Arrhenatheretea, Plantaginetea majoris, Secalietea;

Trifolium repens L. ssp. ***repens***: H, Eua; U3.5T0R0, Cynosurion cristati, Molinio-Arrhenatheretea, Plantaginetea majoris, Secalietea (C. Drăgulescu, 2007, 2009, 2010, 2014);

Vicia angustifolia Grugf. (*V. sativa* L. ssp. *nigra* (L.) Ehrh.) ssp. ***angustifolia***: Th, Eua; U0T3R0, Festuco-Brometea, Secalietea;

Vicia cracca L.: H, Eua; U3T0R3, Molinio-Arrhenatheretea;

Vicia hirsuta (L.) S.F. Gray: Th, Eua; U2.5T3.5R4, Aperetalia, Secalietea;

Vicia lathyroides L.: Th, Atl-M-Ec; U2T4R2,5, Festucetalia valesiacae;

Vicia pannonica Crantz ssp. ***striata*** (*V. striata* M. Bieb.) Nyman: Th, P-M; U3T3,5R4,5, Secalietea;

Vicia sepium L.: H, Eua; U3T3R3, Quercetea robori-petraeae, Querco-Fagetea, Trifolion medii;

Vicia tetrasperma (L.) Schreber: Th, Eua; U3.5T3R3, Aperetalia, Secalietea;

Haloragaceae

Myriophyllum spicatum L.: Hh, Cp; U6T0R4.5, Nymphaeion, Potamion;

Lythraceae

Lythrum hyssopifolia L.: Th, Cosm; U4T3R0, Nanocyperion flavescentis (HCD);

Lythrum salicaria L.: H, Cp; U4T3R0, Alnetea glutinosae, Filipendulo-Petasition, Molinietalia, Phragmitetea, Salicetea purpureae;

Lythrum virgatum L.: H, Eua-C; U4.5T3.5R4, Agrostion stoloniferae, Puccinellietalia;

Lythrum x scabrum Simk. (salicaria x virgatum) (HCD);

Peplis portula L. (*Lythrum portula* (L.) D.A. Webb.): Th, Atl-M; U4T3R0, Nanocyperion flavescentis;

Onagraceae

Epilobium hirsutum L.: H, Eua; U4T3R3, Phragmitetea;

Epilobium montanum L.: H, Eua; U3T0R3,5, Pino-Quercetalia (HNR);

Epilobium obscurum Schreber: H, E; U5T0R2, Glycerio-Sparganion (HCD);

Epilobium parviflorum Schreber: H, Eua; U5T3R4.5, Glycerio-Sparganion, Phragmitetea (HCD);

Oenothera biennis L.: TH, Adv; U2T4R0, Chenopodietea, Onopordion acanthii, Sisymbrion officinalis;

Cornaceae

Cornus mas L.: mPh, P-M; U2T3.5R4, Quercetea pubescenti-petraeae;

Cornus sanguinea L.: mPh, Ec; U3T3R4, Prunetalia, Querco-Fagetea;

Celastraceae

Evonymus europaeus L.: mPh, E; U3T3R3, Prunetalia, Querco-Fagetea;

Evonymus verrucosus Scop.: mPh, E; U2.5T3R4, Prunetalia, Quercetea pubescenti-petraeae, Querco-Fagetea;

Euphorbiaceae

Euphorbia cyparissias L.: H(G), Eua; U2T3R4, Festucetalia valesiacae, Festuco-Brometea, Onopordion acanthii, Robinion pseudacaciae;

Euphorbia helioscopia L.: Th, Eua; U3T3R0, Secalietea;

Euphorbia maculata L. (*Chamaesyce maculata* (L.) Small): Th, Adv; U2T3,5R4,5, Popygonion avicularis, Thero-Airion (HCD);

Euphorbia seguieriana Necker (*E. gerardiana* Jacq.)*: H, Eua-C; U1T3.5R4, Festucetalia valesiacae, Festuco-Brometea

Euphorbia serrulata Thuill. (*E. stricta* L.): Th, E (C); U4T3R4, Alno Padion, Calystegion, Senecion fluviatilis;

Rhamnaceae

Rhamnus cathartica L.: mPh, Eua; U2T3R4, Alno-Padion, Prunetalia, Querco-Fagetea;

Aceraceae

Acer campestre L. ssp. ***campestre***: Mph-mPh, E; U2.5T3R3, Querco-Fagetea (C. Drăgulescu, 2003, 2007, 2009, 2010, 2014); and ssp. ***marsicum*** (Guss) Hayek

Simaroubaceae

Ailanthus altissima (Miller) Swingle: MPh, Adv; U0T0R0, Ailanthetum altissimae;

Zygophyllaceae

Tribulus terrestris L.: Th, Ec-M; U0T4R4, Tribulo-Eragrostion, Trifolio-Geranietea (C. Drăgulescu, 2003, 2007, 2009, 2010, 2014);

Oxalidaceae

Oxalis corniculata L.: Th-H, Adv (M); U2,5T4R0, Chenopodietea;

Oxalis dillenii Jacq.: Th -H, Adv; U3T3,5R0, Chenopodietea (HCD);

Oxalis stricta L. (*O. fontana* Bunge, *O. europaea* Jordan): H, Adv; U3.5T0R0, Chenopodietea, Polygono-Chenopodion, Secalietea (HCD);

Geraniceae

Erodium cicutarium (L.) L'Herit: Th, Cosm; U2.5T0R0, Chenopodietea, Festuco-Brometea, Polygono-Chenopodietalia, Secalietea;

Geranium pratense L.: H, Eua; U3.5T3R5, Arrhenatheretalia, Arrhenatherion elatioris;

Geranium pusillum Burm.: Th, E; U2.5T3R0, Chenopodietea, Festuco-Brometea, Plantaginetea majoris, Secalietea;

Linaceae

Linum nervosum Waldst. et Kit.: H, Ec-Cauc; U1.5T4R4, Festucetalia valesiacae;

Araliaceae

Hedera helix L.: nPh, Atl-M; U3T3R3, Acerion;

Apiaceae

Anthriscus caucalis M. Bieb.: Th, P-M; U2T4R0, Arction, Alliarion;

Anthriscus sylvestris (L.) Hoffm.: TH-H, Eua; U3T3R4, Alno-Padion, Arrhenatheretalia, Salicetea purpureae;

Apium graveolens L. ssp. ***graveolens***: TH, Atl-M; U2T4R4,5, Glycerio-Sparganion (HCD);

Berula erecta (Hudson) Coville (*Sium erectum* Hudson): H-Hh, Cp; U6T3.5R0, Alno-Padion, Glycerio-Sparganion, Magnocaricion elatae;

Bifora radians Bieb.: Th, M; U3T4R0, Caucalidion, Consolido-Eragrostion;

Bupleurum affine Sadler: Th, P-Pn-B; U2T3.5R4, Festucion rupicolae;

Bupleurum falcatum L. ssp. ***falcatum***: H, E; U2T3.5R4, Festucetalia valesiacae, Geranion sanguinei;

Bupleurum tenuissimum L.: Th, Atl-M; U0T3.5R4.5, Puccinellietalia (HCD): f. ***longibracteatum*** (HCD);

Carum carvi L.: TH-H, Eua; U3.5T3R3, Agrostion stoloniferae, Arrhenatheretalia;

Conium maculatum L.: TH, Eua; U3T3R3, Arction lappae, Chenopodietea;

Daucus carota L. ssp. ***carota***: TH, Eua; U2.5T3R0, Arrhenatherion elatioris, Molinio-Arrhenatheretea;

Eryngium campestre L.: H, P-M; U1T4.5R4, Festucetalia valesiacae, Festuco-Brometea;

Eryngium planum L.: H, Eua; U2T3R4, Arrhenatherion elatioris;

Falcaria vulgaris Bernh. (*F. sioides* (Wib.) Aschers.): (Th)-TH-(H), Eua-sM; U2T4R4, Festucion rupicolae, Onopordetalia, Secalietea (C. Drăgulescu, 2003, 2007, 2009, 2010, 2014);

Pastinaca sativa L. ssp. ***pratensis*** (Pers.) Celak.: TH, Eua (sM); U3T4R4, Arrhenatherion elatioris, Molinio-Arrhenatheretea;

Peucedanum oreoselinum (L.) Moench.: H, E-C; U2.5T3R0, Danthonio-Brachypodion, Geranion sanguinei, Quercetea pubescenti-petraeae;

Pimpinella saxifraga L. ssp. ***saxifraga***: H, Eua-sM; U2.5T0R3, Festuco-Brometea;

Seseli annuum L.: TH-H, E (C); U2T3R3, Festuco-Brometea;

Tordylium maximum L.: Th-TH, Ec-M; U2T4R0, Festuco-Brometea, Origanetalia;

Torilis arvensis (Hudson) Link. ssp. ***arvensis***: Th, Ec; U2.5T3.5R4, Caucalidion, Onopordion acanthii (HCD);

Torilis japonica (Houtt.) DC. (*T. rubella* Moench.): Th, Eua; U3T3.5R4.5, Arction lappae, Querco-Fagetea;

Hypericaceae

Hypericum perforatum L.: H, Eua; U3T3R0, Festuco-Brometea, Origanetalia, Sedo-Scleranthetea;

Tiliaceae

Tilia cordata Miller: MPh, E; U3T3R3, Carpinion betuli;

Tilia tomentosa Moench.: MPh, B; U2,5T3,5R3, Quercion frainetto;

Malvaceae

Abutilon theophrasti Medik.: Th, Eua; U3T3R3, Chenopodietea; (Cat. sem. Buc. 1975, C. Drăgulescu, 2003, 2007, 2009, 2010, 2014);

Althaea officinalis L. ssp. ***officinalis***: H, Eua-C; U3T4R4, Bidention tripartiti;

Althaea pallida Waldst. et Kit. (*Alcea pallida* (Willd.) Waldst. et Kit.): H, P; U2T4R3, Festucetalia valesiacae;

Hibiscus trionum L.: Th, Eua; U2.5T4R4, Consolido-Eragrostion;

Lavatera thuringiaca L.: H, Eua-C; U2.5T3R0, Arction lappae, Onopordetalia;

Malva neglecta Wallr.: Th, Eua; U3T3R3, Chenopodietea, Sisymbrion officinalis;

Malva pusilla Sm.: Th, Eua; U3.5T3R3, Chenopodietea, Polygonion avicularis;

Malva sylvestris L. ssp. ***sylvestris***: Th-TH, Eua; U3T3R0, Onopordetalia, Sisymbrietalia;

Violaceae

Viola arvensis Murray: Th, Eua; U3T3R0, Secalietea, Aperetalia

Viola odorata L.: H, Atl-M; U2.5T3.5R4, Alliarion petiolatae, Prunetalia, Querco-Fagetea;

Brassicaceae

Alliaria petiolata (Bieb.) Cavara et Grande (*A. officinalis* Andrz.): Th-TH, Eua; U3T3R4, Alliarion petiolatae, Arction lappae, Querco-Fagetea;

Alyssum allysoides (L.) L.: Th-TH, Eua(C); U1T3R0, Alysso-Sedion, Festuco-Brometea;

Armoracia rusticana (Gaertn.) B. Mayer et Scherb. (*A. lapathifolia* Usten): H(G), Adv; U3T3.5R0, Arction lappae, Bidentetea tripartiti, Calystegion;

Berteroa incana (L.) D.C.: TH, Eua; U2T3.5R0, Festuco-Brometea, Sedo-Scleranthetea, Sisymbrietalia;

Brassica rapa L. ssp. ***sylvestris*** (L.) Janchen (ssp. *campestris* (L.) Clapham): Th, M; U3T3R4, Polygono-Chenopodion polyspermi, Secalietea;

Capsella bursa-pastoris (L.) Medik.: Th-TH, Cosm; U3T0R0, Chenopodietea, Chenopodio-Scleranthetea;

Cardaria draba (L.) Desv. (*Lepidium draba* L.): H, Eua; U2T4R4, Sisymbrion officinalis;

Descurainia sophia (L.) Webb (*Sisymbrium sophia* L.): Th-TH, Eua; U2.5T4R4, Onopordion acanthii, Sisymbrion officinalis;

Erophila verna (L.) Chevall (*Draba verna* L.) ssp. ***verna***: Th, Eua; U2.5T3.5R0, Festuco-Brometea;

Erysimum repandum Hojer: Th, Eua-C; U2.5T4R4.5, Chenopodio-Scleranthetea, Sisymbrion officinalis;

Lepidium campestre (L.) R. Br.: Th-TH, E; U2.5T3R0, Chenopodietea, Polygono-Chenopodion polyspermi;

Lepidium ruderale L.: Th-TH, Eua; U2T3.5R0, Polygonion avicularis, Sisymbrion officinalis; with f. ***pygmaea*** Todor;

Rorippa austriaca (Crantz) Besser: H, P; U4T3.5R4, Agropyro-Rumicion, Bidentetea tripartiti, Plantaginetea majoris, Senecion fluviatilis;

Rorippa pyrenaica (Lam.) Reichenb.: H, E; U2,5T3R3, Arrhenatheretalia;

Rorippa sylvestris (L.) Besser ssp. ***sylvestris***: H, Eua; U4T3R4, Agropyro-Rumicion (HCD);

Sinapis arvensis L.: Th, Eua; U3T3R3, Secalietea;

Sisymbrium officinale (L.) Scop.: Th-TH, Eua-M; U2.5T3R3, Chenopodietea, Sisymbrion officinalis;

Thlaspi arvense L.: Th-TH, Eua; U2T3R4, Polygono-Chenopodion polyspermi;

Thlaspi perfoliatum L.: Th, Eua; U2,5T3,5R4,5, Secalietea, Festuco-Brometea;

Resedaceae

Reseda lutea L.: TH-H, Eua; U2T3.5R4.5, Festucion rupicolae, Onopordion acanthii;

Salicaceae

Populus alba L.*: Mph-mPh, Eua; U3.5T3R3, Salicetalia purpureae;

Populus nigra L.: MPh, Eua; U4T3R4, Salicetalia purpureae;

Salix alba L. ssp. ***alba***: Mph-mPh, Eua; U5T3R4, Alno-Padion, Salicion albae (HCD);

Salix fragilis L.: mPh-MPh, Eua; U4.5T3R4, Alno-Padion, Salicion albae, Salicion triandrae;

Salix purpurea L. ssp. ***purpurea***: mPh, Eua; U5T3R4.5, Salicetalia purpureae;

Salix triandra L. emend. Ser. (*S. amygdalina* L.) ssp. ***triandra***: mPh, Eua; U5T3R0, Salicion triandrae;

Salix viminalis L.: mPh, Eua; U5T3R4,5, Salicetalia;

Cucurbitaceae

Bryonia alba L.: H, Eua-C; U3.5T3.5R0, Alliarion petiolatae, Calystegion;

Primulaceae

Anagallis arvensis L.: Th-TH, Cp; U3T3R4, Panico-Setarion, Polygono-Chenopodion polyspermi;

Anagallis foemina Miller: Th, Eua; U3T3.5R0, Secalietea;

Lysimachia nummularia L.: Ch, Eua; U4T3R0, Alnetea glutinosae, Alno-Padion, Bidentetea tripartiti, Molinietalia, Phragmitetea, Plantaginetea majoris, Querco-Fagetea, Salicion albae;

Lysimachia vulgaris L.: H(-Hh), Eua; U5T0R0, Alnetea glutinosae, Molinietalia, Phragmitetea, Salicetea purpureae;

Gentianaceae

Centaurium pulchellum (Swartz) Druce: Th-TH, Eua; U4T3.5R4, Isoeto-Nanojuncetea;

Apocynaceae

Vinca herbacea Waldst. et Kit.*: Ch, P-Pn; UTR, Festucion rupicolae;

Asclepiadaceae

Vincetoxicum hirundinaria Medikus ssp. ***hirundinaria*** (*Vincetoxicum officinale* Moench, *Cynanchum vincetoxicum* (L.) Pers.)*: H, Eua-C; U2T4R4, Festucetalia valesiacae, Geranion sanguinei, Quercetea pubescenti-petraeae;

Oleaceae

Fraxinus excelsior L.: MPh, E; U3T3R4, Acerion pseudoplatani, Alno-Padion (HCD);

Ligustrum vulgare L.: mPh, E-sM; U2.5T3R3, Berberidion, Carpinion betuli, Quercetalia pubescentis, Querco-Fagetea;

Solanaceae

Datura stramonium L.: Th, Adv (→Cosm); U3T4R4, Chenopodietea;

Hyoscyamus niger L.: TH, Eua; U3T3.5R4, Chenopodietea, Onopordion acanthii;

Lycium barbarum L.: mPh, Adv; U3T4R0, Arction lappae, Prunetalia;

Solanum dulcamara L.: Ch (nPh), Eua; U4.5T3R4, Alnetea glutinosae, Alno-Padion, Bidentetea tripartiti, Calystegion, Phragmition australis;

Solanum nigrum L. ssp. ***nigrum***: Th, Cosm; U3T4R0, Chenopodietea;

Convolvulaceae

Calystegia sepium (L.) R.Br.: G(H), Eua; U4,5T3R4, Calystegion, Salicion albae, Arction lappae;

Convolvulus arvensis L.: H(G), Cosm; U0T0R0, Arction lappae, Caucalidion, Chenopodio-Scleranthetea, Festuco-Brometea, Sisymbrion officinalis (C. Drăgulescu, 2009, 2010, 2014);

Convolvulus canthabricus L.: H, P-M; U1,5T3,5R4, Festucion rupicolae (HCD);

Cuscutaceae

Cuscuta campestris Yuncker (*C. pentagona* Engelm., *C. arvensis* auct., *C. gymnocarpa* Engelm.) ssp. ***campestris***: Th, Adv; U3T3R0, Chenopodietea (HCD);

Cuscuta epilinum Weihe: Th, Eua; U0T4R0, Lolio- Linion;

Cuscuta europaea L. ssp. ***europaea***: Th, Eua; U4T0R0, Arction lappae, Artemisietalia, Calystegion;

Cuscuta suaveolens Ser.: Th, Adv; U3T3,5R0, Stellarietea mediae;

Boraginaceae

Anchusa officinalis L. ssp. ***officinalis***: H (TH), E; U2T3.5R0, Festucion rupicolae, Onopordion acanthii;

Cynoglossum officinale L.: TH, Eua-C; U2T3R4, Festucion rupicolae, Onopordion acanthii;

Echium italicum L.: H, M; U2,5T4R3, Sysimbrietalia, Festucetalia;

Echium vulgare L.: TH, Eua; U2T3R4, Festuco-Brometea, Onopordion acanthii, Sedo-Scleranthetea;

Heliotropium europaeum L.: Th, sM; U2T4R0, Eragrostetalia, Secalietea;

Lappula squarrosa (Retz.) Dumort (*L. echinata* Gilib.): Th-TH, Eua; U2T3.5R4, Chenopodietea, Sisymbrietalia;

Lithospermum arvense L.: Th-TH, Eua; U0T0R4, Secalietea, Festucetalia valesiacae;

Myosotis stricta Link (*M. micrantha* auct.): Th, Eua(M); U1,5T3R0, Fectuco-Brometea;

Symphytum officinale L. ssp. ***officinale***: H, Eua; U4T3R0, Molinietalia, Phragmitetea;

Verbenaceae

Verbena officinalis L.: H, Cosm; U3T3R4, Agropyro-Rumicion, Arction lappae, Chenopodietea, Plantaginetalia majoris, Sisymbrietalia (HNR);

Lamiaceae

Acinos arvensis (Lam.) Dandy (*Calamintha acinos* (L.) Clairv.) ssp. ***arvensis***: Th-TH, E; U1.5T3.5R4, Festuco-Brometea, Sedo-Scleranthetea;

Ajuga genevensis L.: H, Eua; U2.5T3R4, Cynosurion cristati, Festuco-Brometea;

Ballota nigra L. ssp. ***nigra***: H, E; U2T3.5R4, Arction lappae, Chenopodietea; cu f. ***urticifolia*** Ortm. and f. ***leucantha*** Beck;

Calamintha vulgare L. (*C. clinopodium* Bentham, *Clinopodium vulgare* L.).: H, Eua; U2T3R3, Origanetalia, Querco-Fagetea;

Glechoma hederacea L.: H-Ch, Eua; U3T3R0, Agropyro-Rumicion, Alliarion petiolatae, Alno-Padion, Querco-Fagetea;

Glechoma hirsuta Waldst. et Kit.: H-Ch, P-M-Ec; U2.5T3R4, Querco-Fagetea;

Lamium album L.: H, Eua; U3T3R0, Alliarion petiolatae, Arction lappae;

Lamium amplexicaule L.: Th, Eua; U2.5T3.5R0, Chenopodio-Scleranthetea, Polygono-Chenopodietalia;

Lamium purpureum L.: Th, Eua; U3T0R4, Polygono-Chenopodietalia, Secalietea;

Leonurus cardiaca L. ssp. ***cardiaca***: H, Eua; U3T4R4.5, Arction lappae, Chenopodietea; with var. *glaber* (Gilib.) Abrom et Scholz;

Leonurus marrubiastrum L. (*Chaiturus marrubiastrum* (L.) Ehrh.): TH, Eua-C; U3T3R0, Chenopodietea, Onopordetalia, Sisymbrion officinalis;

Lycopus europaeus L.: H (Hh), Eua; U5T3R0, Bidentetea tripartiti, Phragmitetea, Salicetea purpureae;

Marrubium vulgare L.: H, Eua; U1.5T4R4, Onopordion acanthii; (Cat. Buc. 1975);

Mentha aquatica L.: H (Hh), E; U5T3R0, Alnetea glutinosae, Molinietalia, Phragmitetea, Salicion albae (HCD);

Mentha arvensis L. ssp. ***arvensis*** (ssp. *agrestis* (Sole) Briq.): H(G), Cp; U4T3R0, Calthion palustris, Molinietalia, Phragmitetea, Secalietea;

Mentha longifolia (L.) Hudson ssp. ***longifolia***: H(G), Eua; U4,5T3R0, Agropyro-Rumicion, Bidentetea tripartiti, Chenopodietea;

Mentha pulegium L.: H, Eua (sM); U4T3R5, Isoeto-Nanojuncetea, Nanocyperion flavescentis;

Mentha x dumetorum Schult. (*M. x hirta* Willd.) (longifolia x aquatica) (HCD);

Nepeta nuda L. (*N. pannonica* L.): H, Eua-C; U2T3R0, Aceri-Quercion, Festucion rupicolae, Quercetalia pubescentis;

Origanum vulgare L.: H, Eua-M; U2.5T3R3, Origanetalia, Prunetalia, Quercetea pubescenti-petraeae;

Prunella vulgaris L.: H, Cosm; U3T3R0, Bidentetea tripartiti, Plantaginetea majoris, Querco-Fagetea;

Salvia nemorosa L. ssp. ***nemorosa***: H, Ec; U2.5T4R3, Chenopodietea, Festuco-Brometea, Mesobromion, Onopordion acanthii (C. Drăgulescu, 2007, 2009, 2010, 2014);

Salvia pratensis L. ssp. ***pratensis****: H, E-sM; U2.5T3R4.5, Festuco-Brometea;

Salvia verticillata L.: H, Ec-M; U2T4R0, Chenopodietea, Festuco-Brometea, Onopordion acanthii, Plantaginetea majoris;

Stachys germanica L.: H, P-M; U2T4R4, Festuco-Brometea, Geranion sanguinei, Onopordion acanthii (C. Drăgulescu, 2003,2007,2009, 2010, 2014);

Stachys officinalis (L.) Trev. (*Betonica officinalis* L.): H, Eua; U3T3R0, Molinion coeruleae, Nardetalia, Origanetalia;

Stachys palustris L.: H, Cp; U4T3R4, Agrostion stoloniferae, Phragmitetea, Polygono-Chenopodion polyspermi;

Teucrium chamaedrys L.: Ch, Ec-sM; U2T3.5R4, Festuco-Brometea, Quercetea pubescenti-petraeae, Sedo-Scleranthetea;

Thymus pannonicus All. ssp. ***pannonicus*** (*Thymus kosteleckyanus* Opiz): Ch, P-Pn; U1.5T3.5R4, Festucetalia valesiacae;

Plantaginaceae

Plantago lanceolata L.: H, Eua; U0T0R0, Festuco-Brometea, Molinio-Arrhenatheretea;

Plantago major L. ssp. ***major***: H, Eua; U3T0R0, Plantaginetea majoris;

Plantago maritima L.: H, Eua; U4T0R5, Puccinellietalia; mai ales f. ***leptophylla*** Mert. et Koch (HCD);

Plantago media L.: H, Eua; U2.5T0R4, Festuco-Brometea, Molinio-Arrhenatheretea;

Plantago scabra Moench (*P. indica* L., *P. arenaria* Waldst. et Kit.) ssp. ***scabra***: Th, Eua-C; U2T4R0, Festucion vaginatae, Sisymbrietalia (HCD, HNR);

Scrophulariaceae

Linaria genistifolia (L.) Miller: H, Eua-C; U1T3.5R5, Festucetalia valesiacae, Festuco-Brometea, Quercetea pubescenti-petraeae;

Linaria vulgaris Miller: H, Eua; U2T3R4, Chenopodio-Scleranthetea, Epilobietea angustifolii, Onopordion acanthii, Secalietea;

Melampyrum barbatum Waldst. et Kit.; Th, D-Pn; U2,5T3,5R4, Stellarietea mediae, Festucetalia valesiacae;

Verbascum blattaria L.: TH, Eua-sM; U2.5T3.5R4, Onopordion acanthii (HCD);

Verbascum densiflorum Bertol. (*V. thapsiformae* Schrader): TH, E(M); U2,5T3,5R4,5, Onopordetalia;

Verbascum phlomoides L.: TH, E; U2.5T3.5R4, Chenopodietea, Onopordion acanthii, Secalietea;

Veronica anagallis-aquatica L.: H (Hh), Cp; U5T0R4, Bidentetea tripartiti, Glycerio-Sparganion, Phragmitetea;

Veronica arvensis L.: Th, Eua; U2.5T3R3, Arrhenatheretalia, Secalietea;

Veronica beccabunga L.: H (Hh), Eua; U5T3R4, Bidentetea tripartiti, Glycerio-Sparganion, Salicetalia purpureae (HNR); cu f. ***longiracemosa*** J. Kell. (HCD);

Veronica persica Poiret: Th, Adv; U3T0R4, Polygono-Chenopodietalia;

Veronica polita Fries: Th, Eua (M); U2,5T3,5R4,5, Secalietea;

Veronica scardica Griseb.: H (Hh), P-Pn-B; U5T0R0, Glycerio-Sparganion (HCD);

Orobanchaceae

Orobanche ramosa L.: Th, Ec-M; U3T4R0, Polygono-Chenopodion

Campanulaceae

Campanula glomerata L. ssp. ***glomerata***: H, Eua; U2.5T3R4, Arrhenatherion elatioris, Festuco-Brometea, Origanetalia, Quercetea robori-petraeae;

Campanula patula L.: TH, E; U3T2.5R3, Arrhenatheretalia;

Campanula rotundifolia L. ssp. ***rotundifolia***: H, Cp; U2T0R3, Festucetalia valesiacae,

Campanula sibirica L. ssp. ***sibirica***: TH, Eua-C; U2.5T4R4, Festucetalia valesiacae;

Rubiaceae

Asperula cynanchica L.: H, Ec-M; U2T3.5R4.5, Festucetalia valesiacae, Festuco-Brometea;

Cruciata glabra (L.) Ehrend. (*Galium vernum* Scop.) ssp. ***glabra***: H, Eua; U3T2R2, Alno-Padion, Artemisietea, Querco-Fagetea;

Cruciata laevipes Opiz (*Galium cruciata* (L.) Scop.): H, Eua; U2.5T3R3, Alno-Padion, Artemisietalia, Convolvuletalia, Salicion albae;

Galium aparine L.: Th, Cp; U3T3R3, Convolvuletalia;

Galium humifusum M.Bieb. (*Asperula humifusa* (M.Bieb.) Besser): H, P-B; U2T4R4,5, Festucetalia valesiacae (HCD);

Galium mollugo L.: H, Eua; U3T0R3, Arrhenatheretalia, Festuco-Brometea,

Galium palustre L. ssp. ***palustre***: H, Cp; U5T3R0, Magnocaricion elatae, Molinietalia;

Galium verum L.: H, Eua; U2.5T3.5R0, Festuco-Brometea, Origanetalia;

Sherardia arvensis L.: Th, Eua; U3T3R3, Secalietea;

Caprifoliaceae

Sambucus ebulus L.: H, Eua (sM); U3T3R4.5, Arction lappae, Artemisietea,

Sambucus nigra L.: mPh, E; U3T3R3, Alno-Padion, Prunetalia;

Viburnum lantana L.*: mPh, Ec-sM; U2.5T3R4.5, Berberidion, Querco-Fagetea;

Viburnum opulus L.: mPh, Cp; U4T3R4, Alnetea glutinosae, Alno-Padion;

Valerianaceae

Valeriana officinalis L.: H, Eua(sM); U4T3R4, Alnetea glutinosae, Alno-Padion, Magnocaricion elatae, Molinietalia;

Valerianella locusta (L.) Latterade (*V. olitoria* Poll.): Th, E; U3T3,5R4, Festucion vallesiacae, Caucalidion;

Dipsacaceae

Cephalaria transsilvanica (L.) Roemer et Schultes.: TH, P-M; U2T3.5R4, Festucion rupicolae, Sisymbrietalia (HCD);

Cephalaria uralensis (Murray) Roemer et Schultes: H, P-Pn; U1,5T4R4,5, Festucion rupicolae;

Dipsacus fullonum L. (*D. sylvestris* Hudson): TH, sM; U3.5T3.5R4, Agropyro-Rumicion, Artemisietea, Onopordetalia;

Dipsacus laciniatus L.: TH, Eua-C; U4T3.5R4, Agropyro-Rumicion, Artemisietea, Onopordetalia;

Knautia arvensis (L.) Coulter ssp. ***arvensis***: H, E; U2.5T3R0, Arrhenatheretalia, Festucion rupicolae;

Scabiosa ochroleuca L.: H, Eua-C; U2T4R4, Cirsio-Brachypodion, Festucetalia valesiacae;

Asteraceae

Achillea collina J. Becker: H, E-C; U2T3R3, Chenopodio-Scleranthetea, Festuco-Brometea;

Achillea millefolium L. ssp. ***millefolium***: H, Eua; U3T0R0, Agropyro-Rumicion, Artemisietea, Molinio-Arrhenatheretea, Polygonion avicularis;

Achillea pannonica Scheele*: H, E (C); U2T4R3,5, Festucetalia valesiacae;

Achillea setacea Waldst. et Kit.: H, Eua-C; U2T3R5, Festucetalia valesiacae, Sedo-Scleranthetea;

Anthemis arvensis L.: Th, E; U3T3R0, Chenopodio-Scleranthetea, Secalietea;

Arctium lappa L.: TH, Eua; U3T3R4.5, Arction lappae;

Arctium minus (J. Hill) Bernh.: TH, E; U3T3R4.5, Arction lappae (HCD);

Arctium tomentosum Miller: TH, Eua; U3T0R5, Onopordetalia;

Artemisia absinthium L.: H (Ch), Eua; U2T3.5R0, Arction lappae, Artemisietea, Festucion rupicolae, Onopordion acanthii (C. Drăgulescu, 2003,2007,2009, 2010, 2014);

Artemisia annua L.: Th, Eua-C; U3T3.5R4, Chenopodio-Scleranthetea, Sisymbrion officinalis;

Artemisia austriaca Jacq.: Ch-H, Eua-C; U2T4R4.5, Festucion rupicolae (HCD);

Artemisia campestris L. ssp. ***campestris***: Ch, Eua-C; U2T3.5R3, Festucetalia valesiacae, Festuco-Brometea;

Artemisia lerchiana Weber ex Stechm. (*Artemisia taurica* auct. rom. non Willd.): Ch(H), P; U1,5T4R4, Koelerio-Artemisietum lerchianae (HNR);

Artemisia pontica L.: H (Ch), Eua (C); U2,5T4R4,5, Festuco-Brometea (C. Drăgulescu, 2009, 2010, 2014, HCD, HNR);

Artemisia santonicum L. ssp. ***santonicum*** (*Artemisia monogyna* Waldst. et Kit.): Ch-H, Eua-C; U2.5T3R0, Puccinellio-Salicornietea;

Artemisia vulgaris L.: H, Cp; U3T3R4, Arction lappae, Artemisietea;

Aster linosyris (L.) Bernh.: H, Eua-C; U2T3R4, Festuco-Brometea;

Aster x salignus Willd. (lanceolatus x novi belgii);

Aster sedifolius L.: H, Eua(C); U4,T3R4, Festucion rupicolae, Puccinellietalia;

Aster tripolium L. ssp. ***tripolium***: H, Eua; U5T0R5, Puccinellietalia (HNR); ssp. ***pannonicus*** (Jacq.) Soo: H, P-Pn:

Bidens cernua L.: Th, Eua; U5T0R0, Bidention tripartiti (HNR);

Bidens frondosa L.: Th, Adv; U5T0R0, Bidentetea;

Bidens tripartita L.: Th, Eua; U4.5T3R0, Bidentetea tripartiti, Chenopodio-Scleranthetea, Nanocyperion flavescentis; f. ***quinquepartita*** (HCD);

Brachyachis ciliata (Ledeb.) Ledeb.: H, Adv; U2T3,5R4, Artemisietea vulgaris (HCD, HNR);

Carduus acanthoides L.: TH, E; U2T3R0, Onopordion acanthii;

Carduus crispus L. ssp. ***crispus***: TH, E; U4T3R0, Alno-Padion, Artemisietea, Salicion albae;

Carduus nutans L.: TH, Eua; U1.5T0R4.5, Festuco-Brometea, Onopordion acanthii (HCD);

Carlina vulgaris L. ssp. ***vulgaris***: TH, Eua; U2.5T3.5R0, Festuco-Brometea, Quercetalia pubescentis;

Carthamus lanatus L.: Th, P-M; U2.5T4R0, Festucion rupicolae, Sisymbrion officinalis (HCD);

Centaurea apiculata Ledeb. ssp. ***spinulosa*** (Rochel) Dostal (*C. scabiosa* L. ssp. *spinulosa* (Rochel) Hayek): H, E; U2T3,5R4,5, Danthonio-Brachypodion, Festucetalia valesiacae (C. Drăgulescu, 2009, 2010, 2014);

Centaurea biebersteinii DC. (*C. micranthos* S.G. Gmelin): TH-H, P-Pn-B; U2T3.5R4, Festucetalia valesiacae, Sisymbrion officinalis; with f. spinescens Borb. (HCD);

Centaurea calcitrapa L.: TH, Ec-M; U1.5T4R0, Onopordetalia, Polygonion avicularis, Sisymbrion officinalis;

Centaurea cyanus L.*: Th-TH, M→Cosm; U3T4R3, Aperetalia, Secalietea;

Centaurea iberica Trev.: TH, P-B; U1.5T4R0, Onopordetalia; (Cat. Buc. 1975)

Centaurea phrygia L. (C. austriaca Willd.): H, E; U3T2.5R3, Arrhenatheretalia;

Centaurea scabiosa L.: H, E; U2.5T0R4, Arrhenatheretalia, Festuco-Brometea, Geranion sanguinei;

Centaurea solstitialis L.: TH, M; U2T4R0, Onopordetalia, Sisymbrion officinalis;

Centaurea stenolepis A. Kerner: H, P-Pn-B; U2,5T3R2, Arrhenatherion, Trifolion medii;

Chondrilla juncea L.: TH-H, Eua-C; U1.5T3.5R4, Chenopodietea, Festucetalia valesiacae, Festuco-Brometea, Secalietea;

Cichorium intybus L. ssp. ***intybus***: H, Eua; U2.5T3.5R4.5, Agrostion stoloniferae, Arrhenatheretalia, Polygonion avicularis, Puccinellio-Salicornietea;

Cirsium arvense (L.) Scop.: G, Eua; U0T0R0, Artemisietea, Chenopodio-Scleranthetea, Onopordion acanthii;

Cirsium vulgare (Savi) Ten. (*C. lanceolatum* (L.) Scop. non Hill): TH, Eua; U3T3R0, Artemisietea, Onopordion acanthii;

Conyza canadensis (L.) Cronq. (*Erigeron canadensis* L.): Th-TH, Adv; U2.5T0R0, Chenopodietea, Festucion vaginatae, Sisymbrion officinalis;

Crepis biennis L.: TH, E; U3T3R4, Agrostion stoloniferae, Arrhenatheretalia, Sisymbrion officinalis;

Crepis foetida L. ssp. ***rhoaeadifolia*** (Bieb.) Celak.: Th, Eua; U2,5T3,5R3, Secalietea, Festuco-Brometea;

Crepis setosa Haller: Th, Ec-M; U2T3R3, Chenopodietea, Polygono-Chenopodietalia, Sisymbrion officinalis;

Crepis tectorum L.: Th, Eua; U2.5T0R0, Plantaginetea majoris, Polygono-Chenopodietalia, Secalietea, Sisymbrion officinalis;

Echinops sphaerocephalus L.: H, Eua-C; U2T4R4.5, Alliarion petiolatae, Onopordion acanthii;

Erigeron acris L. ssp. ***acris***: TH-H, Cp; U2.5T3R0, Festuco-Brometea, Mesobromion;

Erigeron annuus (L.) Pers. (*Stenactis annua* (L.) Less.) ssp. ***annuus***: Th-TH-H, Adv; U4T0R4, Alno-Padion, Arction lappae, Calystegion, Salicetea purpureae, Sisymbrion officinalis;

Eupatorium cannabinum L.: H, Eua; U4T3R0, Alnion glutinosae, Phragmitetea, Salicetalia purpureae;

Filago arvensis L.: Th, Eua-M; U2T3.5R0, Aphanion, Thero-Airion;

Filago vulgaris Lam. (*F. germanica* L. non Hudson): Th, Eua-M; U2T3R0, Aperetalia, Thero-Airion (HCD);

Galinsoga parviflora Cav.: Th, Adv→Cosm; U3.5T0R3, Polygono-Chenopodietalia;

Galinsoga quadriradiata Ruiz et Pavon (*G. hispida* Benth.): Th, Adv; U2,5T4R3, Stellarietea mediae, Bidentetea;

Helianthus tuberosus L.: G, Adv; U3.5T3R4, Calystegion;

Hypochoeris radicata L.: H, E; U3T3R2.5, Cynosurion cristati;

Inula britanica L.: TH, Eua; U3T3R0, Agropyro-Rumicion, Chenopodio-Scleranthetea, Molinietalia, Plantaginetea majoris, Puccinellio-Salicornietea;

Inula ensifolia L.: H, P-Pn-B; U1.5T3.5R4, Cirsio-Brachypodion, Festucetalia valesiacae;

Inula helenium L.: H, Adv; U4T3R3, Alno-Padion, Arction lappae, Senecion fluviatilis;

Lactuca saligna L.: Th-TH, Ec-M; U1.5T4R4, Chenopodio-Scleranthetea, Sisymbrietalia; ***Lactuca serriola*** Torner: TH, Eua; U1.5T3.5R0, Artemisietea, Chenopodietea, Sisymbrietalia;

Lapsana communis L. ssp. ***communis***: Th-TH-H, Eua; U2.5T3R3, Alliarion petiolatae, Arction lappae, Querco-Fagetea;

Leontodon autumnalis L. ssp. ***autumnalis***: H, Eua; U3T0R0, Cynosurion cristati, Molinio-Arrhenatheretea, Plantaginetalia majoris;

Leontodon hispidus L. ssp. ***hispidus***: H, Eua; U2.5T0R0, Mesobromion, Molinio-Arrhenatheretea;

Leucanthemum vulgare Lam. (*Chrysanthemum leucanthemum* L.) ssp. ***vulgare***: H, Eua; U3T0R0, Molinio-Arrhenatheretea;

Matricaria discoidea DC. (*M. matricarioides* (Less.) Porter p.p., *Chamomila suaveolens* (Pursh) Rydb.): Th, Adv; U3T0R0, Bidentetea tripartiti, Polygonion avicularis;

Matricaria perforata Merat (*M. inodora* L.) Th-TH, Eua; U0T3R3.5, Onopordion acanthii, Sisymbrion officinalis;

Matricaria recutita L. (*M. chamomilla* L. p.p., *Chamomila recutita* (L.) Rauschert): Th, Eua; U3T3.5R5, Aperetalia, Chenopodio-Scleranthetea, Plantaginetea majoris, Puccinellio-Salicornietea;

Onopordon acanthium L.: TH, Eua; U2.5T4R4, Onopordion acanthii (C. Drăgulescu, 2007, 2009, 2010, 2014);

Picris hieracioides L. ssp. ***hieracioides*****:** TH-H, Eua; U2T3R4, Arction lappae, Arrhenatheretalia, Festuco-Brometea, Sisymbrion officinalis;

Pulicaria dysenterica (L.) Bernh.: H, Ec; U4T3.5R0, Agropyro-Rumicion, Molinietalia (C. Drăgulescu, 2009, 2010, 2014);

Pulicaria vulgaris Gaertner: Th, Eua; U4T3R3, Agropyro-Rumicion, Bidention tripartiti, Isoeto-Nanojuncetea;

Scorzonera laciniata L. (*Podospermum laciniatum* (L.) DC.): TH-H, E(M); U2T0R4, Festuco-Brometea;

Senecio jacobea L. ssp. ***jacobea****:* H, Eua; U2.5T3R3, Arrhenatheretalia, Festucetalia valesiacae, Quercetea pubescenti-petraeae;

Senecio vernalis Waldst. et Kit.: Th, Eua-C; U2.5T4R0, Chenopodietea, Secalietea;

Senecio vulgaris L.: Th, Eua; U3T0R0, Chenopodietea;

Solidago canadensis L.: H, Adv; U3,5T3R3, Artemisietea, Calystrgion, Senecion fluviatilis;

Sonchus arvensis L. ssp. ***arvensis***: G, Eua; U3T3R4, Polygono-Chenopodion polyspermi;

Sonchus asper (L.) Hill.: Th, Eua; U3T0R0, Polygono-Chenopodion; cu var. ***inermis*** Bisch;

Tanacetum vulgare L. (*Chrysanthemum vulgare* (L.) Bernh.): H, Eua; U3T3R0, Arction lappae;

Taraxacum bessarabicum (Hornem.) Hand.-Mazz*.; H, Eua (C); U4T3R4, Puccinellietalia;

Taraxacum officinale Weber: H, Eua; U3T0R0, Arrhenatheretalia, Artemisietea, Plantaginetea majoris;

Tragopogon pratensis L. ssp. ***orientalis*** (L.) Celak. (*Tragopogon orientalis* L.): TH-H, E; U3T3R4, Agrostion stoloniferae, Arrhenatheretalia;

Tussilago farfara L.: G-H, Eua; U3.5T0R4.5, Filipendulo-Petasition, Tussilaginion;

Xanthium albidum (Wilder) H. Scholz ssp. ***riparium*** (Celak.) Wilder et Wagenitz: Th, Adv; U2,5T4R0, Onopordion;

Xanthium italicum Moretti (*Xanthium strumarium* L. ssp. ***italicum*** (Moretti) D. Löve): Th, E-M→Adv; U3.5T4R0, Bidentetea tripartiti, Chenopodion fluviatile, Sisymbrion officinalis;

Xanthium spinosum L.: Th, Adv→Cosm; U2.5T4R3, Chenopodietea, Onopordion acanthii;

Xanthium strumarium L.: Th, Eua; U3,5T3,5R4, Chenopodietea;

Xeranthemum annuum L.: Th, P-M; U2T4R3, Festucion rupicolae (HCD);

Xeranthemum cylindraceum Sibth. et Sm. (*X. foetidum* auct. non Moench): Th, P-M; U1.5T4R3, Festucion rupicolae;

Alismataceae

Alisma lanceolatum Wither: Hh, Eua; U6T0R4, Phragmitetea (HCD);

Alisma plantago-aquatica L.: Hh, Cp; U6T0R0, Phragmitetea;

Butomaceae

Butomus umbellatus L.: Hh, Eua; U6T3R0, Phragmitetea;

Juncaginaceae

Triglochin palustris L.: H, Cp; U5T0R0, Molinietalia, Puccinellio-Salicornietea (HCD);

Roman N. identified the *Triglochin bulbosa* L. ssp. *laxiflora* (Guss.) Rouy (*Triglochin laxiflora* Guss.) (HNR) in Cernetu, above Văcăreasca in the Mialache Valley's at the barrier lake. The plant has not been mention till then in Romania. Determination may be correct because the taxon is present in Eastern Europe (the former Yugoslavia, Albania, Greece). It grows also in Western Europe (Portugal, Spain, France, Italy) in Asia Minor, Africa. F. Schur (1866) calls it *Triglochin palustris* var. *gracillima pauciflora salina* synonymous with *Triglochin barrelieri* Loisel. (*Triglochin bulbosa* L. ssp. *barrelieri* (Loisel.) Rouy wide-spread in the Western and Southern Europe, North-West Africa and South-East Asia.

Potamogetonaceae

Potamogeton crispus L.: Hh, Cosm; U6T3.5R4, Potametalia;

Potamogeton natans L.: Hh, Cp; U6T2.5R4, Nymphaeion, Potamion;

Potamogeton nodosus Poiret (*P. fluitans* Roth): Hh, Cp; U6T3.5R4, Potametalia;

Potamogeton pusillus L.: Hh, Cosm; U6T3R4, Potamion (HCD);

Najadaceae

Najas marina L. (*Najas major* All.): Hh, Cosm; U6T4R4,5, Potamion pusilli (HCD);

Zannichelliaceae

Zannicheliia palustris L.: Hh, Cosm; U6T0R4, Potamion pussili (HCD);

Alliaceae

Allium rotundum L. (*Allium scorodoprasum* L. ssp. *rotundum* (L.) Stearn): G, Ec-sM; U2T4R4, Festucetalia valesiacae, Polygono-Chenopodion polyspermi, Secalietea;

Allium scorodoprasum L.: G, Ec; U2T3R4, Alno-Padion, Arction lappae, Quercetea robori-petraeae, Secalietea;

Liliaceae

Anthericum ramosum L.: H, Ec; U2.5T3.5R4, Festuco-Brometea (C. Drăgulescu, 2003,2007,2009,2010,2014);

Asparagus officinalis L.: G, Eua (sM); U1.5T4R3, Festuco-Brometea, Origanetalia, Quercetea pubescenti-petraeae;

(***Colchicum autumnale*** L.* it grows in Pilea forest, today Teleormanu, at 7 km north of Cernetu);

Gagea arvensis (Pers.) Dumort.: G, M; U2,5T4R0, Secalietea;

Ornithogalum umbellatum L.: G, M-Ec; U0T3,5R4, Festuco-Brometea;

Polygonatum odoratum (Miller) Druce: G, Eua(M); U2T3R4, Festuco-Bromete, Quercetea pubescenti-petraeae;

Scilla bifolia L. ssp. ***bifolia***: G, E; U3.5T3R4, Alno-Padion, Carpinion betuli, Querco-Fagetea;

Amaryllidaceae

Galanthus nivalis L.: G, Ec-sM; U3.5T3R4, Querco-Fagetea;

After N. Roman the species disappeared from Cernetu flora.

Iridaceae

Crocus flavus Weston (*C. moesiacus* Ker.-Gawl.): G, B; U3T4,5R3, Festuco-Brometea

Juncaceae

Juncus articulatus L. (*J. lampocarpus* Ehrh.): H, Cp; U5T2R0, Agropyro-Rumicion, Calthion palustris, Nanocyperion flavescentis; with f. *pallidiflorus* (Becker) I. Grinţ. (HCD);

Juncus compressus Jacq.: G, Eua; U4T3R4, Agropyro-Rumicion, Agrostion stoloniferae, Nanocyperion flavescentis, Plantaginetea majoris, Puccinellio-Salicornietea (HCD);

Juncus effusus L.: H, Cosm; U4.5T3R3, Alnetea glutinosae, Bidentetea tripartiti, Calthion palustris, Molinietalia, Plantaginetea majoris;

Juncus gerardi Loisel: G, Cp; U4.5T3R5, Agropyro-Rumicion, Juncion gerardii (HCD);

Juncus inflexus L.: H, Eua; U4T3.5R4, Agropyro-Rumicion;

Juncus tenuis Willd.: G, Adv; U3.5T3R4, Polygonion avicularis;

Cyperaceae

Bolboschoenus maritimus (L.) Palla (*Scirpus maritimus* L.) ssp. ***maritimus***: G (Hh), Cosm; U6T0R4.5, Bolboschoenion maritimi;

Carex acuta L. (*C. gracilis* Curtis) ssp. ***acuta***: G (Hh), Cp; U5T3R0, Alno-Padion, Calthion palustris, Caricion gracilis, Magnocaricion elatae (HCD);

Carex distans L.: H, Eua (sAtl-sM); U4T3R4, Agrostion stoloniferae;

Carex divisa Hudson: G, Eua; U4T3,5R5, Juncion gerardi, Molinietalia; (Flora XI, 720)

Carex hirta L.: G, Cp; U0T3R0, Agropyro-Rumicion, Magnocaricion elatae, Plantaginetea majoris;

Carex ovalis Good. (*C. leporina* auct. non L.): H, Cp; U4T2.5R3, Molinietalia;

Carex praecox Schreb.*: G-H, Eua; U2T3R3, Festuco-Brometea;

Carex tomentosa L.: G, Eua; U3T3R0, Molinio-Arrhenatheretea, Quercetea pubescenti-petraeae;

Carex vulpina L.: H, Eua; U4T3R4, Agropyro-Rumicion, Caricion gracilis, Magnocaricion elatae, Phragmition australis;

Cyperus pannonicus Jacq. (*Acorellus pannonicus* (Jacq.) Palla): Th-H, P-Pn-B; U4,5T3R5, Cypero-Spergularion (HNR);

Cyperus flavescens Jacq. (*Pycreus flavescens* (L.) Reichenb.): Th, Cosm; U4.5T0R4, Nanocyperion flavescentis (HCD);

Cyperus fuscus L.: Th, Eua; U6T3R4, Nanocyperion flavescentis (HNR);

Cyperus glaber L. (*Chlorocyperus glaber* (L.) Palla): Th, Eua (M); U5T3R4,5, Nanocyperion flavescentis (HCD);

Cyperus serotinus Rottb. (*Juncellus serotinus* (Rottb.) Clarke): G, Eua (M); U5,5T4,5R0, Nanocyperion flavescentis (HCD, HNR);

Eleocharis palustris (L.) Roemer et Schultes: G (Hh), Cosm; U5T0R4, Molinietalia, Nanocyperetalia, Phragmitetea, Puccinellietalia (HCD);

Fimbristylis bisumbellata (Forskal) Bubani (*F. dichotoma* auct. non Vahl.): Th, M; U3T4,5R4; Nanocyperion (HNR);

Schoenoplectus tabernaemontani (C.C. Gmelin) Palla (*Scirpus tabennaemontani* C.C. Gmelin): G (Hh), Eua; U5.5T3R4, Phragmitetea (HCD);

Scirpus lacustris L. (*Schoenoplectus lacustris* (L.) Palla): Hh-G, Cosm; U6T3R4, Phragmition;

Scirpus sylvaticus L.: G, Cp; U4.5T3R0, Alno-Padion, Calthion palustris, Molinietalia, Phragmitetea;

Poaceae

Agropyron cristatum (L.) Gaertner ssp. *cristatum*: H, Ec-P; U2T4R4,6, Agropyro-Kochion, Festucion valesiacae (HNR)

Agrostis capillaris L. (*A. tenuis* Sibth.) ssp. ***capillaris****:* H(G), Cp; U0T0R0, Festuco-Brometea, Molinio-Arrhenatheretea, Nanocyperetalia;

Agrostis stolonifera L. ssp. ***stolonifera***: H, Cp; U4T0R0, Agropyro-Rumicion, Agrostion stoloniferae, Alno-Padion, Magnocaricion elatae, Molinion coeruleae; with f. ***tenuis*** Heuff. (HCD);

Alopecurus aequalis Sobol: H, Cp; U5T3R5, Nanocyperion, Bidentetea;

Alopecurus pratensis L. ssp. ***pratensis****: H, Eua; U4T3R0, Agrostion stoloniferae, Calthion palustris, Filipendulo-Petasition, Molinio-Arrhenatheretea;

Anthoxanthum odoratum L.*: H, Eua; U0T0R0, Molinio-Arrhenatheretea;

Apera spica-venti (L.) Beauv. ssp. ***spica-venti***: Th, Eua; U3.5T0R2.5, Aperetalia;

Arrhenatherum elatius (L.) Beauv. ssp. ***elatius***: H, Eua; U3T3R4, Agrostion stoloniferae, Arrhenatherion elatioris;

Brachypodium pinnatum (L.) Beauv. ssp. ***pinnatum***: H, Eua (sM); U2T4R4, Brachypodio-Chrysopogonetalia, Festuco-Brometea, Quercetea pubescenti-petraeae;

Brachypodium sylvaticum (Hudson) Beauv.: H, Eua (sM); U3T3R4, Alno-Padion, Querco-Fagetea;

Briza media L: H, Eua; U0T3R0, Arrhenatheretalia, Molinietalia;

Bromus arvensis L. ssp. ***arvensis***: Th-TH, Eua-sM; U2.5T3R0, Chenopodietea, Onopordetalia;

Bromus commutatus Schrader: Th-TH, Eua (sM); U0T3R0, Agrostion stoloniferae, Arrhenatheretalia, Molinion coeruleae;

Bromus hordeaceus L. (*B. mollis* L.): Th-TH, Eua (sM); U0T3R0, Arrhenatherion elatioris, Festuco-Brometea, Sisymbrion officinalis;

Bromus inermis Leysser: H, Eua-C; U2.5T4R4, Arrhenatherion elatioris, Cirsio-Brachypodion, Festuco-Brometea, Quercetea pubescenti-petraeae, Sisymbrion officinalis;

Bromus squarrosus L.: Th, Eua; U1,5T4R4, Onopordion, Festucetalia valesiacae;

Bromus sterilis L.: Th, Eua (sM); U2T4R4, Arction lappae, Chenopodietea, Onopordion acanthii, Sisymbrion officinalis;

Bromus tectorum L.: Th, Eua-C; U1.5T3.5R0, Sisymbrion officinalis, Thero-Airion;

Calamagrostis epigeios (L.) Roth: G, Eua; U2T3R0, Molinietalia (C. Drăgulescu, 2009, 2010, 2014);

Chrysopogon gryllus (L.) Trin.*: H, Eua-sM; U1.5T4R4, Festucetalia valesiacae, Festucion vaginatae (to Ţigăneşti);

Crypsis aculeata (L.) Aiton: Th, Eua; U3,5T4R4, Cypero-Spergularion (HNR);

Crypsis schoenoides (L.) Lam. (Heleochloa schoenoides (L.) Host): Th, Eua; U0T4R4,5, Cypero-Spergularion (HCD);

Cynodon dactylon (L.) Pers.: G, Cosm; U2T3.5R0, Festuco-Brometea, Polygonion avicularis;

Cynosurus cristatus L.: H, E; U3T3R3, Arrhenatheretalia, Cynosurion cristati;

Dactylis glomerata L. ssp. ***glomerata***: H, Eua; U3T0R4, Fagion, Molinio-Arrhenatheretea;

Dichanthium ischaemum (L.) Roberty (*Andropogon ischaemum* L, Botriochloa ischaemum (L.) Keng.): H, Eua-M; U1.5T4.5R3, Festuco-Brometea;

Digitaria sanguinalis (L.) Scop. ssp. ***sanguinalis***: Th, Cosm; U1.5T0R4, Polygono-Chenopodietalia;

Echinochloa crus-galli (L.) Beauv.: Th, Cosm; U4T0R3, Bidention tripartiti, Chenopodietea;

Eleusine indica (L.) Gaertner: Th, Adv: U2T4R4,5, Polygonion avicularis (HCD);

Elymus hispidus (Opiz) Melderis (*Agropyron intermedium* (Host) Beauv.) ssp. ***hispidus***: G, Eua-C; U2T4R4, Festucetalia valesiacae;

Elymus repens (L.) Gould (*Agropyron repens* (L.) Beauv.): G, Cp; U0T0R0, Agropyro-Rumicion, Artemisietea, Molinio-Arrhenatheretea;

Eragrostis chilianensis (All.) Janken: Th, M; U2T4R4,5, Tribulo-Eragrostion, Stellarietea mediae (HCD);

Eragrostis minor Host (*E. poaeoides* Beauv.): Th, Ec-M; U3T4R0, Consolido-Eragrostion, Polygonion avicularis;

Festuca arundinacea Schreber: H, Ec; U4T3R4, Agropyro-Rumicion (HNR)

Festuca heterophylla Lam.: H, Ec-sM; U2.5T3R3, Carpinion betuli;

Festuca pratensis Hudson ssp. ***pratensis***: H, Eua; U3.5T0R0, Agrostion stoloniferae, Molinio-Arrhenatheretea;

Festuca pseudovina Hackel: H, Eua-C; U2T4R4, Festucetalia valesiacae, Festucion pseudovinae, Puccinellio-Salicornietea;

Festuca rupicola Heuffel ssp. ***rupicola****: H, Eua-C; U1.5T4R4, Festucion rupicolae, Seslerio-Festucion pallentis;

Festuca valesiaca Schleicher: H, Eua-C; U1.5T4R4, Festucetalia valesiacae, Quercetea pubescenti-petraeae;

Glyceria nemoralis (Uechtr.) Uechtr. et Koernicke: H, Ec; U5T3R3, Glycerio-Sparganion (HCD);

Glyceria notata Chevall. (*G. plicata* (Fries) Fries): H (Hh), Cp; U6T3R4.5, Glycerio-Sparganion;

Holcus lanatus L.: H, Cosm; U3.5T3R0, Molinio-Arrhenatheretea;

Hordeum geniculatum All.* (*H. hystrix* Roth, *H. maritimum* ssp. ***gussonianum*** (Parl.) Aschers. et Graebn.: Th, Eua (C); U2T4R4,5, Puccinellion limosae;

Hordeum marinum Hudson: Th, Atl-M; U2T4R3, Puccinellion limosae (HCD):

Hordeum murinum L. ssp. ***murinum***: Th, Eua; U2.5T4R0, Chenopodietea, Plantaginetea majoris, Polygonion avicularis, Sisymbrion officinalis;

Koeleria macrantha (Ledeb.) Schultes (*K. cristata* (L.) Pers. p.p., K. gracilis Pers.) ssp. ***macrantha****: H, Eua; U2T4R5, Festuco-Brometea;

Leersia oryzoides (L.) Swartz: G (Hh), Cp; U6T3R0, Bidentetea tripartiti, Glycerio-Sparganion (HCD);

Lolium perenne L.: H, Cosm; U2.5T4R4.5, Cynosurion cristati, Plantaginetalia majoris;

Phleum phleoides (L.) Karsten: H, Eua-C; U2T3R4, Festuco-Brometea;

Phleum pratense L.: H, Eua; U3.5T0R0, Cynosurion cristati, Molinio-Arrhenatheretea;

Phragmites australis (Cav.) Steudel ssp. ***australis***: G (Hh), Cosm; U6T0R4, Phragmition australis;

Poa angustifolia L.: H, Eua; U2T3R0, Festuco-Brometea;

Poa annua L.: Th-H, Cosm; U3.5T0R0, Polygonion avicularis;

Poa bulbosa L. (inclusiv var. vivipara Koeler): G-H, Eua; U1,5T3,5R4, Festucetalia valesiacae;

Poa compressa L.: H, E; U1,5T3R0, Sedo-Scleranthetea, Festuco-Brometea, Secalietea, Chenopodietea:

Poa pratensis L.: H, Cp→Cosm; U3T0R0, Molinietalia, Molinion coeruleae;

Puccinellia distans (L.) Parl. ssp. ***distans***: H, Eua; U3.5T0R5, Agrostion stoloniferae, Puccinellietalia;

Sclerochloa dura (L.) Beauv.: Th, M; U2.5T3R3, Polygonion avicularis (C. Drăgulescu, 2010, 2014);

Setaria pumila (Poiret) Schultes (*S. glauca* auct. non L., *S. lutescens* (Weigel) F.T. Hubbard): Th, Cosm; U2.5T4R0, Eragrostetalia, Polygono-Chenopodietalia;

Setaria verticillata (L.) Beauv.: Th, Ec-M; U2T4R0, Polygono-Chenopodietalia, Secalietea (C. Drăgulescu, 2003, 2007, 2009, 2010, 2014);

Setaria viridis (L.) Beauv.: Th, Cosm; U2T3.5R0, Polygono-Chenopodietalia;

Sorghum halepense (L.) Pers.: H, Adv; U3T4R0, Secalietea, Chenopodietea;

Stipa capillata L.: H, Eua(C); U1T4R4, Festucetalia valesiacae;

Tragus racemosus (L.) All.: Th, M; U0T0R4, Tribulo-Eragrostion;

Vulpia myuros (L.) C.C. Gmelin: Th-TH, Eua (Cosm); U1T3.5R2, Thero-Airion;

Sparganiaceae

Sparganium erectum L. (*S. ramosum* Hudson) ssp. ***erectum***: G (Hh), Eua; U5.5T3.5R0, Glycerio-Sparganion, Phragmition australis; ssp. ***neglectum*** (Beeby) K. Richter (S. neglectum Beeby);

Typhaceae

Typha angustifolia L.: G (Hh), Cp; U6T4R0, Phragmition australis;

Typha latifolia L.: G (Hh), Cosm; U6T3.5R0, Phragmition australis;

Lemnaceae

Lemna minor L.: Hh, Cosm; U6T3R0, Lemnion minoris;

Lemna trisulca L.: Hh, Cosm; U6T3R4, Lemnion minoris (HCD);

Spirodela polyrhiza L.: Hh, Cosm; U6T3,5R0, Lemnion minoris;

Plant species identified in a sub-spontaneous state in the area of interest: *Anethum graveolens* L., *Atriplex hortensis* L., *Brassica napus* L., *Cannabis sativa* L., *Commelina communis* L., *Coreopsis tinctoria* Nutt., *Cosmos bipinnatus* Cav., *Cucumis melo* L., *Cucurbita pepo* L., *Cydonia oblonga* Mill., *Datura inoxia* Mill., *Elaeagnus angustifolia* L., *Gleditsia triacanthos* L., *Helianthus annuus* L., *Hemerocallis fulva* L., *Lycopersicon esculentum* Mill., *Parthenocysus inserta* (A. Kerner) Fritsch, *Pharbitis purpurea* (L.) Voigt., *Polygonum orientale* L., *Ricinus communis* L., *Rudbeckia laciniata* L. f. *pleno, Satureja hortensis* L., *Vitis labrusca* L., *Vitis vinifera* L.

CONCLUSIONS

The authors identified 581 cormophyte species in the local flora of Cernetu Village. Their analysis indicates an arid climate, with high temperature variations, characteristic of low plains, and a high degree of anthropic alteration. Of the rare and endangered species extant in situ, the following species are worth mentioning: *Alisma lanceolatum, Apium graveolens, Artemisia lerchiana, Azolla filiculoides, Butomus umbellatus, Camphorosma monspeliaca, Convolvulus canthabricus, Crataegus pentagyna, Crocus flavus, Cyperus serotinus, Fimbristylis bisumbellata, Najas marina, Ononis spinosa, Quercus frainetto, Quercus pedunculiflora, Quercus virgiliana, Veronica scardica.*

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THE ASSOCIATION SPIREETUM ULMIFOLIAE ZÓLYOMI 1939 IN THE ORĂŞTIE RIVER BASIN (SOUTHERN CARPATHIANS, ROMANIA)

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KEYWORDS: *Spireea chamaedryfolia*, floristic elements, life forms, ecological indices, Orăştie, Southern Carpathians.

ABSTRACT

The authors study the phytocoenoses of the Spireetum ulmifoliae Zólyomi 1939 association as they occur in the Orăștie River Basin (Southern Carpathians). These vegetal communities are part of the habitat 40A0 in European typology, designated as Peripheral Pannonic shrubberies, whereas in the national typology they are included in habitat R3116, also known as Southern Carpathians shrub communities of *Spireea chamaedryfolia* (Doniţă et al., 2006).

These shrubby formations comprise a natural habitat of great importance calling for the establishment of special areas of conservation.

The phytocoenoses of the association are analysed in terms of physiognomy and floristic composition, life forms spectrum, floristic elements, and of the ecological preferences of species with regard to temperature, humidity and the chemical reaction of soils.

REZUMAT: Asociația Spireetum ulmifoliae Zólyomi 1939 din bazinul râului Orăştie (Carpaţii Meridionali/România).

Autorii prezintă un studiu al fitocenozelor asociaţiei Spireetum ulmifoliae Zólyomi 1939 identificate în bazinul râului Orăștie (Carpaţii Meridionali). Aceste grupări vegetale se înscriu în tipul de habitat de interes comunitar 40A0, tufărișuri subcontinentale peri-panonice, iar pe plan naţional în tipul de habitat R3116, tufărișuri sud-est carpatice de cununiță (*Spireea chamaedryfolia*) (Doniţă et al., 2006).

Tufărișurile sud-est carpatice de cununiță reprezintă un habitat natural care necesită ocrotire prin desemnarea de arii speciale de conservare.

Fitocenozele asociaţiei sunt analizate sub aspectul fizionomiei şi compoziţiei floristice, al bioformelor, elementelor floristice şi preferinţelor ecologice ale speciilor identificate, faţă de temperatură, umiditate și reacția chimică a solului.

RÉSUMÉ: L'association Spireetum ulmifoliae Zólyomi 1939 dans le bassin de la rivière Orăştie (Carpates Méridionales/Roumanie).

Les auteurs présentent une étude des phytocénoses de l'association Spireetum ulmifoliae Zólyomi 1939 identifiées dans le bassin de la rivière Orăştie (Carpates Méridionales). Ces groupes végétaux s'inscrivent dans le type d'habitat d'intérêt communautaire 40A0, des buissons sous-continentaux péri-pannoniques et sur plan national, dans le type d'habitat R3116, des buissons sud-est carpatiques (*Spireea chamaedryfolia*) (Doniţă et al., 2006).

Les buissons sud-est carpatiques (*Spireea chamaedryfolia*) forment un habitat naturel qui nécessite la protection par la désignation de surfaces spéciales de conservation.

Les phytocénoses de l'association sont analysées sous l'aspect de la physionomie et de la composition floristique, des bioformes, des éléments floristiques et des préférences écologiques des espèces identifiées, par rapport à la température, l'humidité et la réaction chimique du sol.

INTRODUCTION

The hydrographic basin of the Orăştie River lies in the central-western part of Romania (Fig. 1). It is located between the hydrographic basins of the rivers Strei (to the South and West) and Cugir (to the East), while to the North the Orăştie River discharges into the Mureş River (Trufaş, 1986).

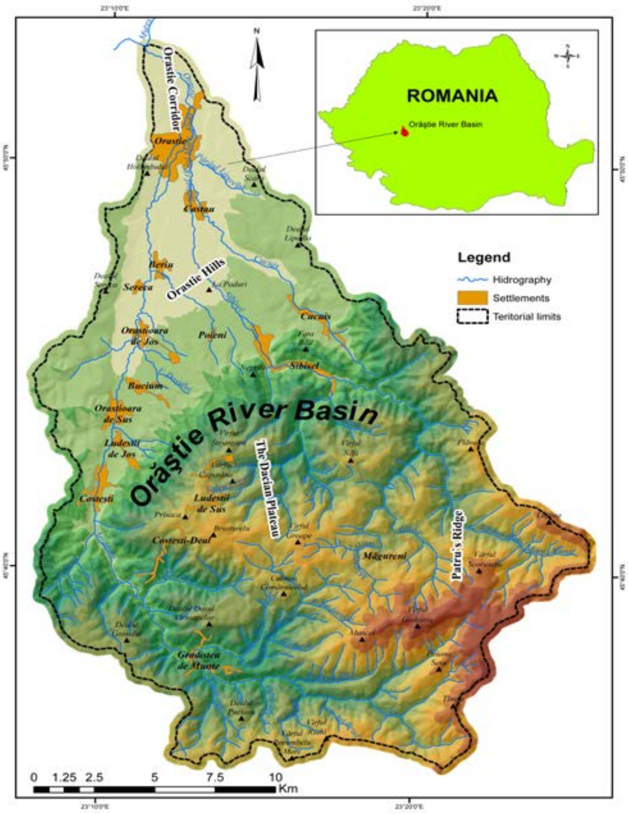

Figure 1: Position of Orăştie River Basin in Romania.

The Şureanu Mountains consist mainly of meso-metamorphic and epi-metamorphic crystalline schists, surrounded peripherically by some areas of sedimentary rocks (sandstones, conglomerates, limestones, etc.). We must add that within the studied territory just a portion of these mountains is included, namely the west-north-western part, commonly known as the Orăştie or Sarmizegetusa Mountains. The altitudinal range wherein the phytocoenoses of **Spireetum ulmifoliae** Zólyomi 1939 were identified is anywhere between 670 m and 960 m.

The territory under analysis is part of the temperate climatic zone, its maritime-influenced climatic sector, its lower mountainous division, the Southern Carpathians subdivision, the complex topoclimate of the Orăştie lowlands and Parâng highlands (Trufaş, 1986).

The average thermal differences between the outskirts of the mountains and their summits reach circa 10 degrees Celsius. Towards their north-western limits, due to the warm air incursions from the Banato-Crişana plains, the yearly average temperatures range from 9 to 10°C. In winter, the multiannual average temperatures vary between -2°C and -7°C, in spring they rise by $6\text{-}12^{\circ}$C, in summer they reach 8°C on the mountain tops and over 19 degrees on the outskirts, while in autumn the average temperatures decrease by $5.5\text{-}7^{\circ}$C as compared to those in the summer months (Trufaş, 1986).

The rainfall amounts in multiannual average to circa 550-600 mm in the outskirts and increases to over 1000 mm in the high altitude central parts. In the whole of Transylvania the rainfall quantum is 500-700 mm/year (Pătru et al., 2006).

MATERIAL AND METHODS

The vegetation studies in the hydrographic basin of the Orăştie River (central-western Romania) were conducted throughout 2009 and 2014, targeting all types of sites indicative of the association **Spireetum ulmifoliae** Zólyomi 1939. The vegetation research deployed the phytocoenologic survey methods drawn up by Braun-Blanquet (1964) adjusted according to the particularities of the region under scrutiny. The sampling technique and the annotations (quantitative appraisals) were observed strictly in accordance with the instructions of the authors Borza and Boşcaiu (1965). The associations were identified using the characteristic species, without overlooking the differential and dominant species.

The phytocoenological worksheets contain information regarding the stational habitat conditions in which the phytocoenoses evolve: rock, soil, altitude, exposition, slope, vegetation coverage. At the same time when we took down the taxa that define each relevé, we also gave a quantitative appraisal of the participation of each and every species with respect of abundance and dominance, in accordance with the method proposed by Braun-Blanquet and Pavillard (1928), and we pencilled in the overall vegetation coverage using the methods designed by Tüxen (1955) and Ellenberg (1974).

The phytocoenologic table of the association was structured according to the methodology designed by Braun-Blanquet (1964) and improved by Ellenberg (1974).

The methodology we used for positioning the association into the superior coeno-taxonomic units, namely suballiance, alliance, order, and class, took into consideration the traditional ecological-floristic systems developed by Sanda et al. (2008).

The phytocoenologic synoptic table for this association (Tab. 1) consists of information pertaining to the floristic and coenologic composition of the plant population rendering the phytocoenosis, the life form, the floristic (phytogeographic) element, the ecological indices of humidity (U), temperature (T), soil reaction (R), the ordinal numbers of the relevées, the absolute altitude in metres (a.s.l.), and the sampled surface (m^2). The last column of the synoptic table holds the constancy of species (K), whose classes are marked by Roman digits from I to V. The values of the synthetic phytocoenologic indices, namely the constancy (K) was computed using the methods proposed by the scientists Braun-Blanquet and Pavillard (1928), and Cristea et al. (2004).

The determination of taxa followed the criteria established by Ciocârlan (2009).

The nomenclature of taxa was done according to Ciocârlan (2009), and the vegetal association was analysed using the main ecological indices of the component species, life forms and floristic elements, the data being shown graphically in spectra and diagrams (Sanda et al., 2005).

RESULTS AND DISCUSSION

In Romania, this association was studied by Csürös-Káptalan (1962) in the gorge Cheile Turului near to the town of Turda (Cluj County), by Dihoru (1975) from the Siriu Mountains, by Hodişan (1979) from the massive of Măgura Rodnei (Bistriţa-Năsăud County), by Drăgulescu (1995) from the valley of the Sadu River (Sibiu County) and Niculescu (2006) from the upper basin of the Luncavăţ River (Vâlcea County). In the area we worked, this association was observed in the Sibişelului Valley, the Șureanu Mountains.

The phytocoenoses of the association **Spireetum ulmifoliae** Zólyomi 1939 are growing on rocky slopes, of westerly and north-westerly exposition, with inclination of 50^o-80^o, at altitudes of 670-960 m a.s.l. (Tab. 1).

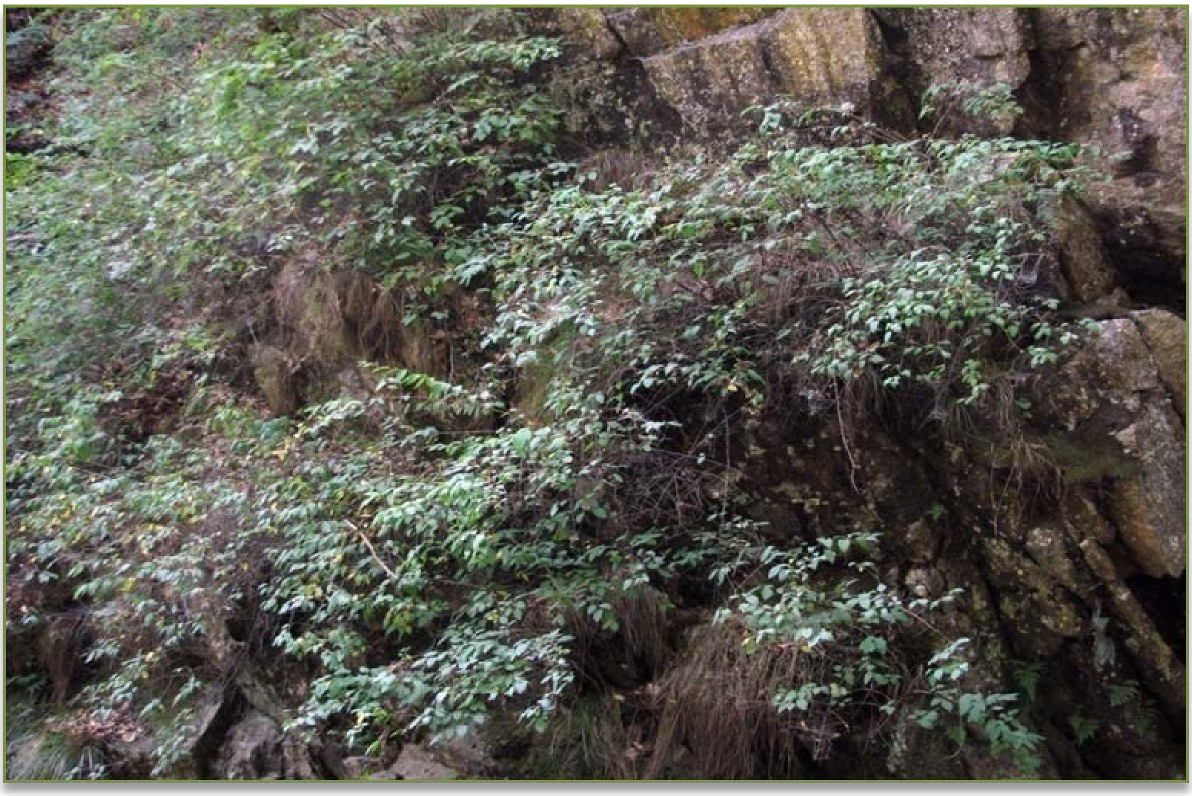

Figure 2: **Spireetum ulmifoliae** Zólyomi 1939, Șureanu Mountains – Sibișelului River (15.07.2012).

The floristic elements comprise 23 species of cormophytes and 3 species of bryophytes, adding up to a general cover of 60-85% (Tab. 1). *Spiraea chamaedryfolia*, the characteristic and dominant species of the association, with a general cover of 52.50% ADm is accompanied by the characteristic species of the alliance **Spireion chamaedryfoliae**, order **Sambucetalia racemosae** and class **Epilobietea angustifolii**, among which the following species are worth mentioning: *Calamagrostis arundinacea*, *Rubus idaeus, Fragaria vesca, Sambucus racemosa, Senecio sylvaticus*. In the phytocoenoses of the association occur plants that are transgressive from the chasmophile phytocoenoses belonging to the class **Asplenietea trichomanis** (*Poa nemoralis, Polypodium vulgare, Asplenium trichomanes* ssp. *trichomanes*, *Cystopteris fragilis*, *Sedum maximum*) as well as species from the forest phytocoenoses belonging to the class **Querco-Fagetea** (*Athyrium filix-femina, Campanula persicifolia*, *Galium schultesii*, *Prenanthes purpurea*).

The life form spectrum (Fig. 3) outlines the prevalence of hemicryptophytes (56.52%) followed by phanerophytes (26.07%), geophytes (8.69%) and terophytes (8.69%).

The spectrum of floristic elements (Fig. 4) reveals that the Circumpolar species (21.73%), those Eurasian (21.73%) and European (21.73%) share the same percentage, being followed by the Central-European species (13.04%) with the same percentage as the Cosmopolitan ones (13.04%).

The diagram of ecological indices (Fig. 5) shows that according to humidity the mesophile species prevail (65.21%), followed by the xero-mesophile species (26.07%), whereas thermally speaking, the micro-mesothermal species hold the highest percentage (56.51%), followed by the microthermal (26.08%) and eurithermal species (17.39%). The chemical reaction of soils outlines the euri-ionic (43.47%) and acid-neutrophile species (34.78%) and lastly those mildly acid-neutrophile (17.38%).

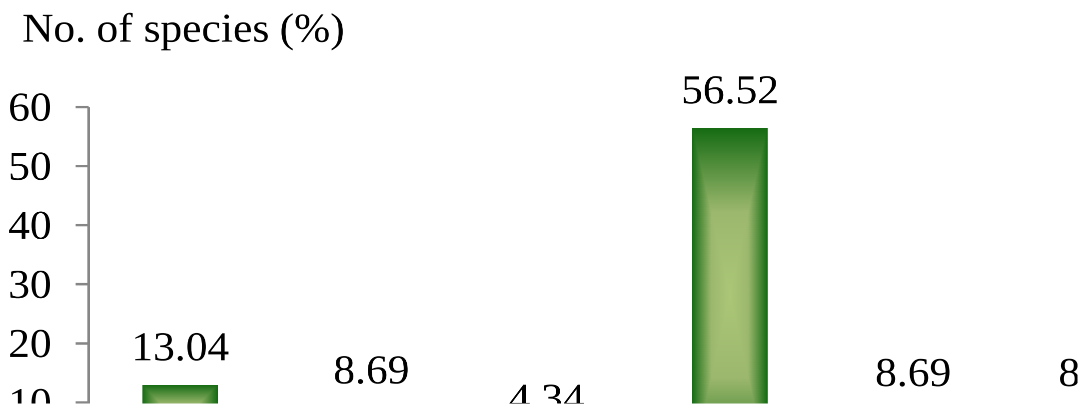

Figure 3: Life forms spectrum of the **Spireetum ulmifoliae** Zólyomi 1939 association, where: MPh – Megaphanerophytes; mPh – Mezophanerophytes; nPh – Nanophanerophytes; H – Hemicryptophytes; G – Geophytes; Th – Annual terophytes.

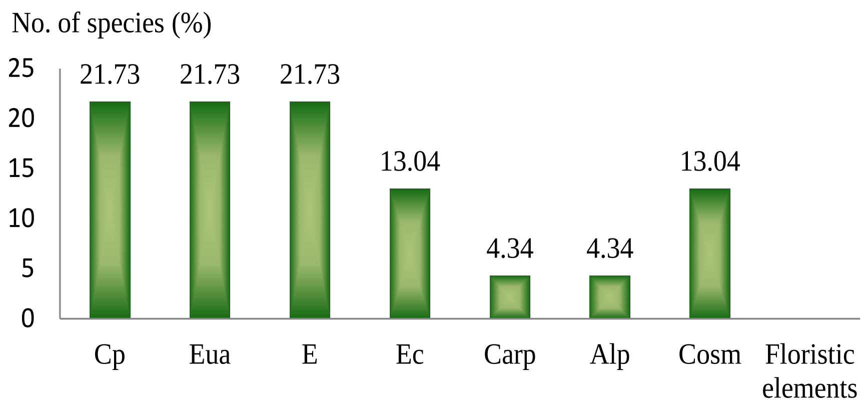

Figure 4: Spectrum of floristic elements of the **Spireetum ulmifoliae** Zólyomi 1939 association, where: Cp – Circumpolar; Eua – Eurasian; E – European; Ec – Central European; Carp – Carpathian; Alp – Alpine; Cosm – Cosmopolitan.

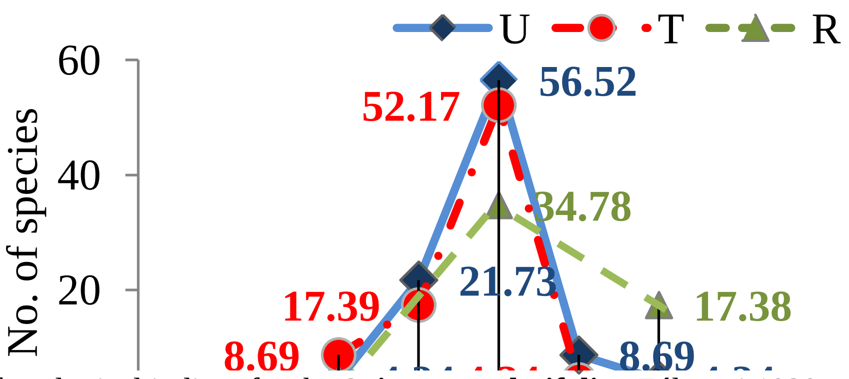

Figure 5: Diagram of ecological indices for the **Spireetum ulmifoliae** Zólyomi 1939 association, where: U – humidity, T – temperature, R – the chemical reaction of soils.

If we have to compare the shrub communities of **Spireetum ulmifoliae** analysed by Drăgulescu (1995) in the Sadului Valley (Southern Carpathians) with those investigated in the Orăștie Valley (Southern Carpathians), we shall notice many similarities and few differences.

In the diagram of ecological indices, the humidity line shows that the xero-mesophile species are prevalent in the Sadului Valley (60%), whereas in the Orăștie Valley the mesophile ones prevail (65.21%). Thermally speaking, both river basins are dominated by micro-mesothermal species (56.51% − Orăștie Valley; 56% − Sadului Valley). The chemical reaction of soils allows for the growing of acid-neutrophile species (34.78% − Orăștie Valley; 40% − Sadului Valley).

Poorly sunlit slopes and higher soil moisture in the Orăștie Valley determines the extant differences among the saxicole phytocoenoses of S**pireetum ulmifoliae** Zólyomi 1939 in the two analysed areas of the Southern Carpathians.

The life form spectrum highlights the hemicryptophytes at the top of the diagram (56.52% − Orăștie Valley; 72% − Sadului Valley), whereas the floristic elements spectrum outlines the Circumpolar species, at the same percentage (21.73%) as the Eurasian and European species in the Orăștie Valley, while in the Sadului Valley the Eurasian species (45%) are followed by the European (28%).

CONCLUSIONS

The behaviour of cormophytes regarding the three ecological factors (humidity, temperature and the chemical reaction of soils) shows that the phytocoenoses of the association **Spireetum ulmifoliae** Zólyomi 1939 in the Orăștie River Basin are dominated by mesophile, micro-mesothermal and acid-neutrophile species. A significant percentage of species are euri-ionical. The life form spectrum is dominated by hemicryptophytes, followed by phanerophytes, while the spectrum of floristic elements emphasizes the Circumpolar, Eurasian and European species.

At a national level, the shrub communities of *Spireea chamaedryfolia* belong to the habitat type R3116 (Doniţă et al., 2006). The conservation status of this type of habitat in Romania is "inadequate with unknown evolution trend" (Mihăilescu et al., 2015).

Table 1: Association **Spireetum ulmifoliae** Zólyomi 1939 in Orăştie River Basin.

L. f.	Fl. e.	U	T	R	No. relevées	1	2	3	4	5	K
					Altitude (m.)	670	750	890	940	960	
					Exposition	V	V	V	NV	NV	
					Slope (º)	80	70	60	55	50	
					Coverage (%)	70	70	60	80	85	
					Surface (m^2)	15	20	30	25	20	
1	2	3	4	5	6	7	8	9	10	11	12
					Car. ass.						
mPh-nPh	Eua	3	2.5	0	*Spiraea chamaedryfolia*	4	4	3	4	3	V
					Spireion chamaedryfoliae et Sambucetalia racemosae						
H	Eua(C)	2.5	3	2	*Calamagrostis arundinacea*	+	.	1	+	2	III
MPh-mP	E(M)	3	3	3	*Sambucus nigra*	.	+	.	+		II

Table 1 (continued): Association **Spireetum ulmifoliae** Zólyomi 1939 in Orăştie Basin.

					Epilobietea angustifolii						
nPh	Cp	3	3	3	*Rubus idaeus*	.	+	1	.	+	III
H	Eua	3	2.5	0	*Fragaria vesca*	.	.	+	+	.	II
mPh	Cp	3	2	3	*Sambucus racemosa*	.	.	+	.	+	II
Th	E	3	3	3	*Senecio sylvaticus*	+	.	+	.	.	II
H	Cp	2.5	3	3	*Solidago virgaurea*	+	.	.	+	.	II
Th	Eua	3	2	0	*Galeopsis speciosa*	.	+	.	.	.	I
					Asplenietea trichomanis						
H	Cp	3	3	0	*Poa nemoralis*	+	.	1	+	+	IV
G	Cp	3.5	3	4	*Polypodium vulgare*	+	+	+	.	+	IV
H	Cosm	3	0	4	*Asplenium trichomanes* ssp. *trichomanes*	+	.	.	+	.	II
H	Cosm	3.5	0	0	*Cystopteris fragilis*	.	.	.	+	+	II
H	E	2	3	0	*Sedum maximum*	.	+	+	.	.	II
H	Ec(Mont)	3	0	4.5	*Valeriana tripteris*	+	.	.	.	.	I
H	Carp-B-Anat	2.5	4	3	*Veronica bachofenii*	.	+	.	.	.	I
					Querco-Fagetea						
H	Cosm	4	2,5	0	*Athyrium filix-femina*	.	.	.	+	+	II
H	Eua	3	3	0	*Campanula persicifolia*	.	.	+	.	+	II
G	Ec	2.5	3	3	*Galium schultesii*	.	+	+	.	.	II
H	Ec(Mont)	3	2.5	0	*Prenanthes purpurea*	.	.	.	+	+	II
MPh -mPh	E	3	3	3	*Carpinus betulus*	+	.	.	.	.	I
Th-TH	Cosm	3.5	3	3	*Geranium robertianum*	.	.	.	+	.	I
					Variae syntaxa						
H	Alp-Carp-B	2.5	3	4	*Achillea distans*	+	+	.	.	.	II
MPh	E	0	0	0	*Picea abies*	.	.	.	+	+	II
-	-	-	-	-	*Dicranum scoparium*	.	.	+	+	.	II
-	-	-	-	-	*Polytrichum strictum*	.	.	.	1	1	II
-	-	-	-	-	*Rhytidiadelphus triquetrus*	.	.	.	1	3	II

Place and date of sampling: 1-3 Sibişelului Valley − Şureanu Mountains (15.07.2012);
4-5 Sibişelului Valley − Şureanu Mountains (15.09.2013).
where: L. f. − life forms: mPh – Mezophanerophytes; nPh − Nanophanerophytes;
H − Hemycriptofites; G − Geophytes; Th − Annual terophytes; TH – Biennial terophytes.
Fl.e. − floristic elements: Cp − Circumpolar; Eua − Eurasian; Eua(C) − Eurasian (Central);
E − European; E(M) − European (Mediterraneean); Ec − Central European;
Ec(Mont) − Central European (Mountain); Carp-B-Anat − Carpathian-Balkan-Anatolian;
Alp-Carp-B – Alpino-Carpathian-Balkan; Cosm – Cosmopolitan; K − constancy.
Ecological indices: U – humidity; T – temperature; R − the chemical reaction of soils.

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DEVELOPMENT OF *TAXUS BACCATA* L. POPULATION UNDER TREE CANOPY IN THE TUDORA RESERVATION

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KEYWORDS: English yew, vitality, population regeneration, local climatic conditions.

ABSTRACT

Population development of the species *Taxus baccata* L. in the Tudora Reservation, was investigated in this study. Floristic composition of plant community including this species as well as other important factors crucial for yew development, as tree canopies were analysed. Natural regeneration of yew from the stand was also analysed. All yew individuals (including saplings) were measured and graphically represented by projecting their canopies in permanent sample plots. Indicator species identified in the floristic composition suggested the communities belong within the *Geranio robertianae – Fagetum taxetosum baccatae* sub-association and Dacian beech forests habitat type (91V0). A number of yew saplings from under various canopy types were compared and it was concluded that yew seeds germinate under the canopy of many tree species at Tudora, especially under *Fagus sylvatica* and mature trees of *Taxus*.

REZUMAT: Dezvoltarea populaţiei de *Taxus baccata* sub coronamentul arborilor din Rezervaţia Tudora.

În această lucrare s-a investigat dezvoltarea populaţiei spontane de *Taxus baccata* în rezervația de la Tudora. A fost analizată compoziţia floristică a comunităţilor de plante în care se dezvoltă specia şi o serie de factori importanţi pentru dezvoltarea tisei, cum ar fi coronamentul arborilor.S-a urmărit şi regenerarea naturală a tisei din arboret. Toţi indivizii de tisă (inclusiv puieţii) au fost măsuraţi şi reprezentaţi grafic prin proiecţia coroanelor în suprafeţele de probă permanente investigate. Speciile indicatoare identificate în compoziţia floristică au sugerat încadrarea acestei comunităţi cu tisă în subasociaţia *Geranio robertianae – Fagetum taxetosum baccatae* şi tipul de habitat – păduri dacice de fag (91V0). A fost comparat numărul de puieţi de tisă de sub coronamentul arborilor. S-a concluzionat că seminţele de *Taxus baccata* germinează îndeosebi sub *Fagus sylvatica* şi arbori mamă de *Taxus*.

RÉSUMÉ: Le développement de la population de *Taxus baccata* sous le couvert des arbres dans la Réserve Tudora.

Dans cet article, on a étudié le développement spontané de la population de *Taxus baccata* dans la Réserve Tudora. La composition floristique des communautés végétales dans laquelle se développe l'espèce et un certain nombre de facteurs importants pour le développement de l'if tels que la canopée des arbres ont été analysés. La régénération naturelle et le peuplement de l'if ont été observé. Tous les individus (y compris les jeunes arbres) ont été mesuré et représenté par la projection de leur canopées sur des surfaces d'échantillonnage permanentes. Les espèces indicatrices identifiées dans la composition floristique indiquent une appartenance à la sous-association *Geranio robertianae – Fagetum taxetosum baccatae* et au type d'habitat des Hêtraies daciennes (91V0). De nombreux jeunes ifs se trouvant sous la canopée ont été comparés et on a pu en conclure que les graines d'ifs sont capables de germer sous la canopée de nombreuses espèces d'arbres, à Tudora, plus particulièrement sous *Fagus sylvatica* et sous les arbres matures tels que *Taxus*.

INTRODUCTION

English yew (*Taxus baccata* L.) is an endangered and rare tree species in many European countries (Thomas and Polwart, 2003). It is a tertiary relict tree, widespread in Europe, Western Asia and North Africa (Pârvu, 2005). In Romania it is considered to be a vulnerable and rare species (Oltean et al., 1994). In terms of ecological preferences, *Taxus baccata* generally occurs in areas with an oceanic-mountain climate and develops well under sheltered and shaded conditions (forests), with relative high atmospheric humidity. The species is also sensitive to drought (Șofletea and Curtu, 2007). It is sporadically distributed in pure beech forests and also in mixed coniferous and beech forests (Sârbu et al., 2013).

The most favourable stations for yew development are those from mountainous areas (rarely in hilly regions), more frequently in beech and mixed forests, often on rocky terrain, in less accessible sites (Romanian Flora vol. I). In an optimum oceanic climate, *Taxus baccata* is a gregarious species, comprising ancient pure stands, as was observed in Denmark (1388 individuals/ha, including 513 mature yew individuals over 30 mm in diameter) (Svenning and Magard, 1999). In northern Britain and continental Europe *Taxus baccata* also occurs as an isolated tree, well developed on a great variety of soils. In the North-western part of Wales it is the most frequent graveyard tree (33%).

Natural regeneration of yew is possible when enough female and male individuals exist, as is considered to be the case in Tudora forest (Pârvu, 2005). When yew reaches almost 20 years old, it can produce seeds; this phenomenon occurs earlier in solitary individuals from open spaces and later in individuals from dense and massive forests in the East of Europe (Șofletea and Curtu, 2007; Vidakovic, 1991). Yew regeneration takes place under a canopy of different trees and shrubs, being hardly noticeable in the vegetation period. Young yew plants are often injured by pests and herbivores (Thomas and Polwart, 2003). In some natural reservations in Poland, yew seedlings disappear after 2-3 years due to some factors with complementary influence as: falling water level in soils or dryness in the atmosphere (Iszkuło and Boratyński, 2004; Garcia et al., 2000).

The aims of this study are to characterize the protection status, local conditions and structure of the yew population and the composition of the vegetation with *Taxus baccata* in the Tudora Forest natural reservation. This reservation is located in the continental biogeographical region (Habitats Directive, 1992), the main vegetation type being represented by old Moldavian beech forests identified by *Fagus sylvatica, Fagus orientalis* and *Fagus taurica* (Horeanu et al., 1972; Mohan et al., 1993; Chifu et al., 2006; Mohan and Ardelean, 2006). The presence of a population of *Taxus baccata* in this forest was the main reason why it was declared a natural reservation (in 1975).

Previous researches on *Taxus baccata* in the Tudora forest demonstrated the spontaneous origin of yew in this area (Horeanu, 1981; Horeanu, 1984; Haralamb and Caliniuc, 1938; Horeanu and Popa, 1972; Cioltan and Cioltan, 1989; Huzdup, 1973; Oprea, 2005; Sârbu et al., 2007). According to some recent studies, the yew population in Tudora is declining (Brânzan, 2013), possibly because in 1890 the former private owner (Cantacuzino Pașcanu) cut all the forest, including the old yew individuals. Although the individuals of the species regenerated, their number decreased. In these conditions, the actual age of the yews is around 120 years (Cioltan and Cioltan, 1989).

MATERIAL AND METHODS

The study has been carried out in the Tudora Reservation (Fig. 1). The study area was located at 6 km East of Tudora village (47°30’-47°32’ N, respectively 26°40’-26°42’ E, Fig. 1). The reservation is situated in the central region of the Siret Ridge, which is a part of the Moldavian Plateau. The relief varies, with deep valleys and steep slopes, presenting a general WSW-NNE aspect (Badea et al., 2010). It is specific to a monocline plateau with accentuated cuestas (Posea et al., 1982), with an altitudinal range from 314 to 513 m. Geologically, the area belongs to the Moldavian Platform, with superior Sarmatian deposits, represented by the Buglovian (successions of clays and marls with sand intercalations) and Volhinian (shallow deposits of sands, sandstones, oolithic limestone with loamy intercalations) sublevels (Badea et al., 2010).

Figure 1: Tudora Yew Reservation.

Natural profiles carved by the streams are rich in fossils (gastropods and Sarmatian lamellibranchiate – Figs. 2 and 3). Permeable and impermeable sedimentary rocks, phreatic waters, springs, relief fragmentation density, high altitudinal differences (199 m) and a torrential rainfall regime favoured the geomorphological processes of the terrain, and, also, the erosion and landslides, the area presenting a high potential for degradation (Bucur, 1954).

Watercourses transport large quantities of eroded material and uprooted secular beeches and numerous yew exemplars with sliding (due to landslides). The high degree of forestation (the biggest from Suceava Plateau) and some harder rocks are the only limiting factors for the development of erosion processes (Badea et al., 2010). The climate is specific to hilly and plateau areas, with annual average temperatures of 8-9˚C and annual average rainfalls ranging from 600 to 700 mm (Posea et al., 1982). The predominant soil type is represented by luvosols (white luvisols), formed under deciduous forests and a cooler and wetter climate (Ungureanu and Nimigeanu, 1986). On accentuated slopes the erodisols are the dominant soil type.

Figure 2: Deposits with Sarmatian lamellibranchiate fossils.

Figure 3: Deposits with Sarmatian lamellibranchiate fossils.

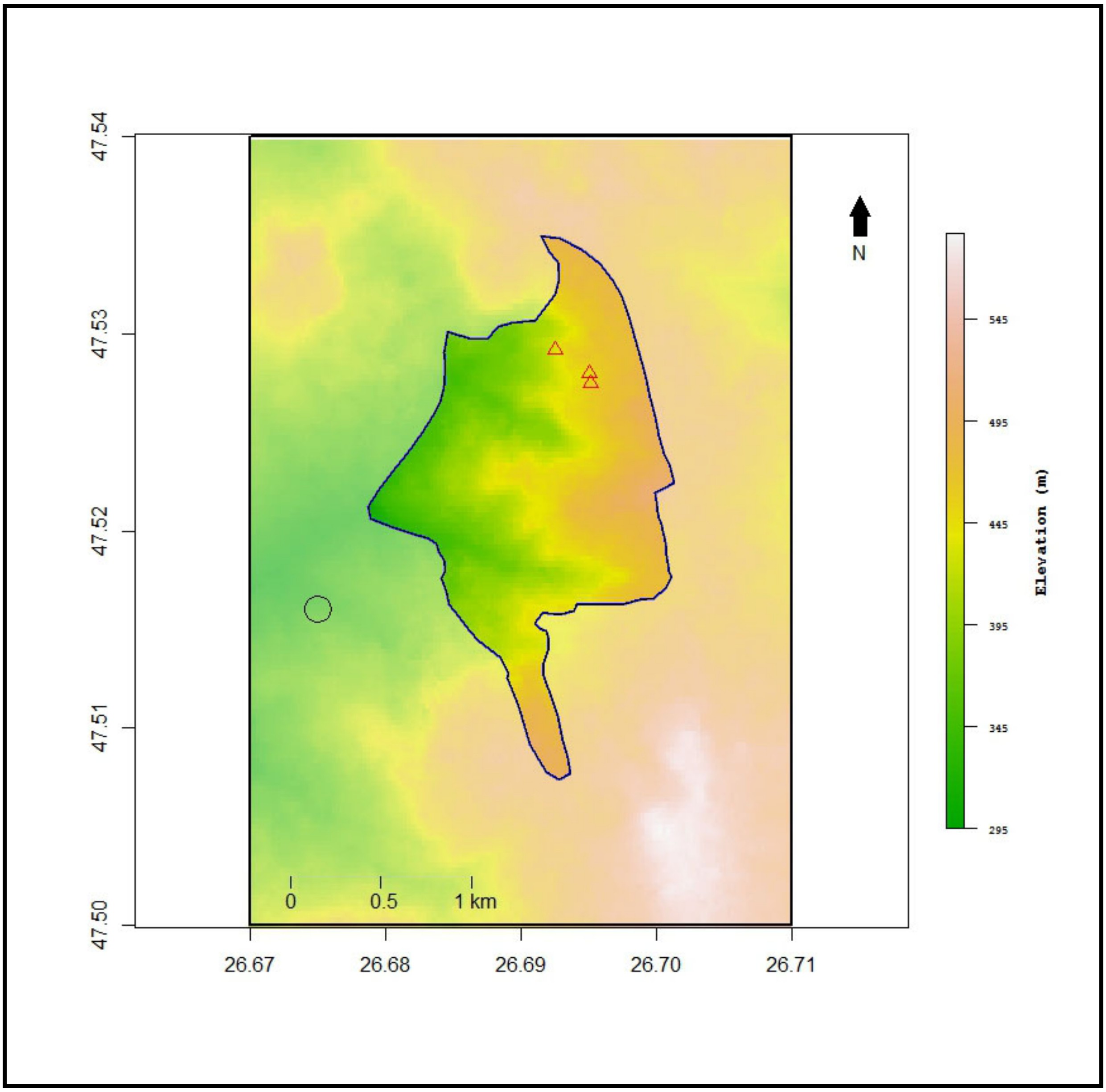

Figure 4: Elevation map of Tudora Yew Reservation (black circle = Tudora Village, red triangle = observation plot). Made in R and QGIS.

In Tudora Forest, *Taxus baccata* is represented by individuals with different age and various sizes, of spontaneous origin (Tufescu, 1937). The study has been carried out in 3 permanent plots, in two consecutive years. The sample plots have been divided in 15x15m squares. The position of individual yews, their diameter and height were recorded. For the graphical representation of every tree canopy from the sample plots, was used the Corel software. Floristic composition of sample plots was investigated by phytosociological relevés.

RESULTS AND DISCUSSION

Floristic and phytosociological composition of plots. Tudora Forrest has a well developed tree layer. Generally, it includes tall trees species as those within the genus *Fagus,* which are dominant. In between the tree layer are representatives of other genera: *Cerasus*, *Acer*, *Fraxinus*, *Tilia*, *Ulmus* and *Betula*. In certain parts of the forest the shrub layer is well developed and is represented by *Coryllus avellana*, *Cornus sanguinea*, *Cornus mas*, *Viburnum opulus* and *Crataegus monogyna*.

In the three plots studied, the tree layer represented 65-85% cover and was dominated by *Fagus sylvatica*, along with *Taxus baccata* which was co-dominant, with a cover of approximately 25%. In some plots, *Carpinus betulus* also showed an important cover. Sporadically, in the tree layer, *Acer campestre* was also present. Only in one plot the shrubs layer was well developed, with 40% cover and a composition including juvenile trees of *Fagus sylvatica*, *Acer platanoides*, *Sorbus torminalis* or other shrubs such as *Cornus mas* or *Crataegus monogyna*. The herb layer was relatively species-poor, among the component species being *Cephalanthera rubra*, *Euphorbia amygdaloides*, *Poa nemoralis*, *Viola reichenbachiana*, *Carex pilosa*, etc. The presence of *Cypripedium calceolus*, a protected orchid species, was also notable. Most of the species in the floristic composition were Eurasian and European hemicryptophytes and phanerophytes.

From a phytosociological perspective there was highlighted the presence of some characteristic species for the Epipactido – Fagenion (*Cephalanthera rubra*) sub-alliance, Symphyto cordati – Fagion alliance (*Acer pseudoplatanus*) and Fagetalia sylvaticae order (*Salvia glutinosa*, *Euphorbia amygdaloides, Fagus sylvatica, Pulmonaria officinalis, Daphne mezereum* etc.) and Querco – Fagetea (*Viola reichenbachiana*, *Staphyllea pinnata, Mycelis muralis, Hepatica nobilis, Dentaria bulbifera, Poa nemoralis* etc.) vegetation class (Tab. 3). All these species suggested a community belonging to the Geranio robertianae – Fagetum *taxetosum baccatae* Horeanu 1981 em. Chifu et al. 2006 sub-association (Chifu et al., 2014). The habitat type (according to Habitats Directive 92/43/EEC) was 91V0 Dacian Beech forests (*Symphyto-Fagion*).

Spatial structure of yew stands. In the investigated sample plots two main tree layers, often with superimposed projections of canopies, have been identified. Individuals of ***Taxus baccata*** were identified in the lower layer. However, the yew is a typical species for lower tree layer and it is generally considered as a species with reduced requirements of light. Lighting conditions in the beech forest are in general unfavourable for other tree species, including the yew. Despite this factor, seedlings of yew can survive under the thick canopies, while other species of trees are removed and cannot survive because of poor conditions of light. However, even the yew display reduction in height in forests where canopy is very dense. The upper layer was composed of taller tree species compared to the yew. The results of this study also showed the possibility of yew seed germination under mature yew individuals. However, a great number of seedlings have been identified under canopies of broad-leaved plants due to the fact that birds prefer tall trees with orthotropic crown and the thick canopy effect on yew seed dispersion and germination (Gierrtych, 2000).

Table 1: Number of tree individuals in investigated sample plots in Tudora Reservation.

No. crt.	Tree species	Number of individuals	Diameter at 1.3 m (cm)	Height (m)	Canopy diameter (m)
1.	*Fagus sylvatica*	58	30.87 ± 21.89	15.14 ± 9.07	3.52 ± 2.42
2.	*Acer pseudoplatanus*	4	25.38 ± 22.51	16.25 ± 7.8	3.42 ± 1.63
3.	*Tilia cordata*	2	41.0 ± 10.32	23.0 ± 1.41	4.72 ± 0.29
4.	*Cerasus avium*	3	23.15 ± 0.64	19.77 ± 4.2	4.66 ± 0.79
5.	*Fraxinus excelsior*	1	29.7 ± 0.0	22.0 ± 0.0	4.99 ± 0.0
6.	*Ulmus glabra*	2	20.0 ± 3.96	16.5 ± 0.71	3.21 ± 0.1

Yew individuals have been classified as seedlings (H ≤ 50 cm) and saplings (H > 50 cm) in their spatial distribution on the ground. Frequently, structural indicators in forestry research are used as a measure of biodiversity. Structural diversity is an important indicator to understand the distribution of trees, individual growing conditions and competitive relations in a sample area of the forest (Pommerening, 2002). Mature yews have morphological answers for the needles dimension of (needle length, width, thickness, specific leaf area) in conditions of different lighting, depending on the coverage of forest. It can be said that there is a double response of the yew according to the light (efficient photosynthetic reactions in different lighting conditions and the size of the needles is determined especially by the plant size) (Devaney et al., 2014).

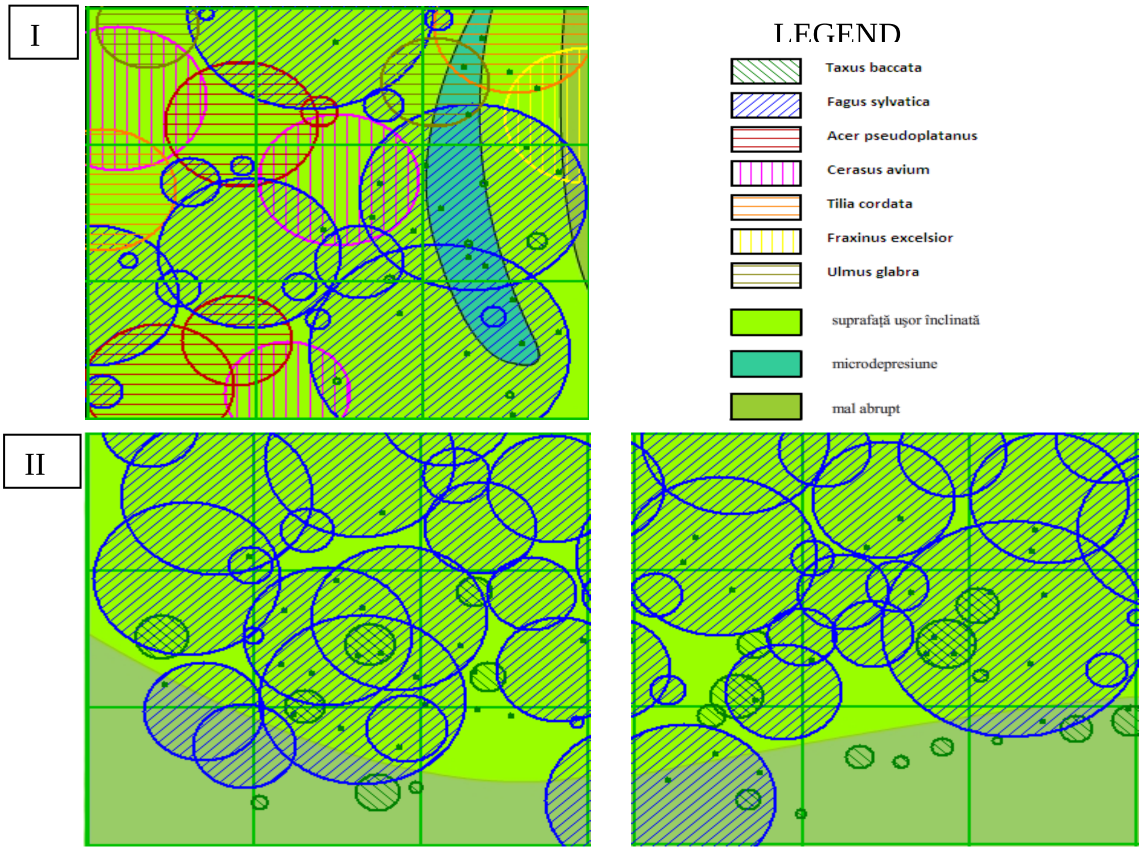

Figure 5: Distribution of *Taxus baccata* individuals under the canopy of broad-leaved trees in the Tudora Reserve – plot 1, 2 and 3 with tree-like yews different heights.

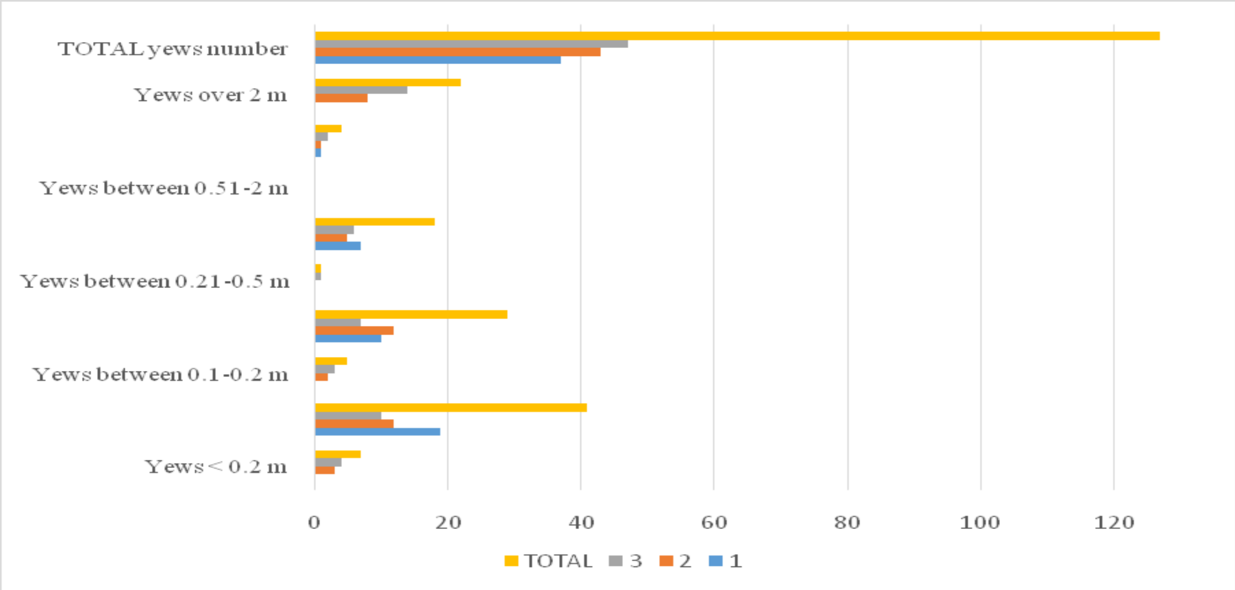

Figure 6: Distribution of *Taxus bacata* individuals under the canopy of broadleaved trees in the Tudora – plots 1, 2 and 3 with tree-like yews different heights.

Table 2: Number of yew individuals registered inside of Tudora Yew Reservation area deppending on height classes and position.

Plot surfaces	Yews < 0.1 m		Yews between 0.1-0.2 m		Yews between 0.21-0.5 m		Yews between 0.51-2 m		Yews over 2 m	Number of yews total
	Near the trunk (*Taxus*)	Under deciduous tree canopy	Near the trunk (*Taxus*)	Under deciduous tree canopy	Near the trunk (*Taxus*)	Under deciduous tree canopy	Near the trunk (*Taxus*)	Under deciduous tree canopy		
I	0	19	0	10	0	7	0	1	0	37
II	3	12	2	12	0	5	0	1	8	43
III	4	10	3	7	1	6	0	2	14	47
Total	7	41	5	29	1	18	0	4	22	127

For the current study, a stratified sampling (based on plant height) of those 127 de individuals of *Taxus baccata* was realized, across five demographic size classes: small seedlings (yews under 0.1 m); seedlings (0.10-0.20 m); young saplings (0.21-0.50 m); saplings (0.51-2 m); and juveniles (2-6 m) (Tab. 2). Seed germination was high at most 80%.

The highest frequency was registered for yews under 10 cm height, found under the canopies of *Fagus sylvatica* and another broadleaved species, in which the surviving rate during first 3-4 years is higher. Also a great number of yews between 0.1-0.2 m, (22.83%) has been identified under the canopy of broadleaved trees and inventoried. The yews form the lower layer. In the lower layer are the saplings of the canopy trees.

Young saplings (0.21-0.50 m) represented 14.96% of the total inventoried individuals of *Taxus baccata*. Generally, the larger individuals have been identified in II and III sample plots.

Field observations showed that yews with heights in 0.5-2 m range were the fewest (3.14% of the total number). Their location was probably due to the hardly accessible area for timber exploitation. Also, individuals over 2 m in height were identified in the area situated above the canyon, probably originating from the mature individuals of *Taxus baccata* which were cut by Cantacuzino Pascanu in 1890.

Figure 7: Adult *Taxus baccata* individual on the cliff edge.

The study showed us that older seedlings of yew were concentrated under the female yew canopies and the youngest were under the canopies of beech (Figs. 7, 8 and 9). The yew individuals appeared in the sample plots dominated by *Fagus sylvatica* where they form a secondary shrub layer, and dominate in setting of the sample surface, accompanied by *Fagus sylvatica* and *Acer campestre*. *Taxus baccata* appears in sample areas characterized by two layers of vegetation; the dominant tree layer which is constituted by beech trees and second layer which consists of a mixture between yew and beech, accompanied by other woody species components.

Taxus baccata has a significant presence in the lower tree layer also due to the fact that the species has a slow growth rate, and lower height compared to other species at the maturity stage.

Phenological observations revealed that *Taxus baccata* produces seeds in August – October period, the red aril surrounding the seed being able to attract frugivores birds. That can explain why the greater densities of saplings had been observed under canopy of beech, similar to the reports from the Cantabrian mountains (Garcia et al., 2000). The spread of seeds for ***Taxus baccata*** is achieved through fieldfare (Turdidae), wood nuthatch *Sitta europea* (Sittidae), Bohemian waxwing *Bombycilla garrulus* (Bombycillidae) and the small mammals as *Apodemus sylvaticus* species that consume large amounts of seeds that are rich in lipids (Thomas and Polwart, 2003; García et al., 2005a).

Figures 8, 9: Stages of development for *Taxus baccata* individuals in Tudora forest.

Management measures

As a limiting factor influencing the natural regeneration of yew in the Tudora forest, based on the field observations, sheep grazing inside the reservation area can be mentioned. Although the sheep avoid *Taxus baccata* individuals, they produce damage by trampling.

Inability of natural regeneration coul also be associated with habitat degradation (cutting of mature trees) due to human activity (Lyubenova and Nedelchev, 2001) or natural erosion of the terrain.

In order to enhance the status of *Taxus baccata* population in Tudora forest the management measures must also take into account the seed dispersal birds. Their diversity could be maintained only if the forest trees diversity is ensured. Sheep grazing in the forest should be completely eliminated.

Table 3: Phytosociological relevés with *Taxus baccata* in Tudora Reservation (*Geranio robertianae – Fagetum* (Burduja et al. 1974) Chifu and Ştefan 1994 em. Chifu and Zamfirescu 2001 *taxetosum baccatae* Horeanu 1981 em. Chifu, Mânzu and Zamfirescu 2006.

Geoelement	Bioform	No. of relevé	1	2	3
		Area (m^2)	1000	1000	1000
		Altitude (m.a.s.l.)	420	460	458
		Aspect	NV	VNV	V
		Slope (º)	15	12	10
		Tree layer cover (%)	85	65	80
		Shrubs layer cover (%)	15	35	15
		Herbs layer cover (%)	5	10	15
		Tree height (m)	25	25	25
		Tree diameter (cm)	10-65	10-65	10-60
Dif. subass.					
Atl.-medit.-centr.-eur.	Ph.	Taxus baccata	2	2	+
Atl.-medit.-centr.-eur.	Ph.	Taxus baccata juv.	1	2	+
Circ.	Ch.	Orthilia secunda	-	+	-
Epipactido-Fagenion					
Eur.	G.	Cephalantera rubra	+	+	+
Eur.	G.	Cephalantera longifolia	-	-	+
Fagion et Fagetalia sylvaticae					
Circ.	H.	Hepatica nobilis	-	-	+
Euras.	H.	Salvia glutinosa	+	+	+
Eur.	H.	Pulmonaria officinalis	+	+	+
Eur. centr.	Ph.	Acer pseudoplatanus juv.	+	-	+
Euras.	G.	Lathyrus vernus	-	+	-
Euras.	H.	Asarum europaeum	-	-	+
Centr.eur., subatl.,submedit.	Ch.	Euphorbia amygdaloides	+	-	+
Euras.	Ph.	Daphne mezereum	+	-	-
Euras.	H.	Sanicula europea	+	-	+
Euras.	G.	Galium odoratum	-	-	+

Table 3 (continued): Phytosociological relevés with *Taxus baccata* in Tudora Reservation (*Geranio robertianae – Fagetum* (Burduja et al. 1974) Chifu and Ştefan 1994 em. Chifu and Zamfirescu 2001 *taxetosum baccatae* Horeanu 1981 em. Chifu, Mânzu and Zamfirescu 2006.

Geoelement	Bioform	No. of relevé	1	2	3
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		Herbs layer cover (%)	5	10	15
		Tree height (m)	25	25	25
		Tree diameter (cm)	10-65	10-65	10-60
		Querco-Fagetea			
Eur.	Ph.	Fraxinus excelsior juv.	+	-	-
Eur.	Ph.	Acer platanoides juv.	+	+	+
Eur.	Ph.	Quercus petraea juv.	+	-	-
Eur.	Ph.	Acer campestre	-	-	1
Eur.	Ph.	Acer campestre juv.	+	-	+
Eur.	Ph.	Tilia cordata juv.	-	-	+
Centr.eur.	Ph.	Carpinus betulus	1	-	1
Atl.-medit.	Ph.	Hedera helix	+	-	+
Circ.	H.	Poa nemoralis	+	+	+
Euras.	G.	Neotia nidus-avis	-	+	-
Euras.	H.	Viola reichenbachiana	+	+	+
Eur.	H.	Mycelis muralis	-	+	-
Eur. centr.	Ph.	Staphylea pinnata	-	-	+
Cosm.	H.	Athyrium filix-femina	-	-	+
Centr.eur.	G.	Carex pilosa	-	-	1
Centr.eur.	G.	Dentaria bulbifera	-	-	+
Eur.	Ph.	Ulmus minor	+	-	-
Pont.-medit.	Ph.	Cornus mas	+	+	-
Centr.eur.	Ph.	Sorbus torminalis	+	+	-
Centr.eur.	Ph.	Sorbus torminalis juv.	-	-	+
		Variae syntaxa			
Euras.	Ph.	Crataegus monogyna	+	+	+
Euras.	Ch.	Veronica officinalis	+	+	-
Eur. centr.	G.	Lathyrus niger	-	+	-
Carp.-balc.	H.	Hieracium murorum	-	+	-
Euras.	G.	Cypripedium calceolus	-	+	-
Euras.	Ht.	Arctium lappa	-	+	-
Centr. eur.-atl.-medit.	H.	Atropa belladona	-	+	-
Cosm.	H.	Urtica dioica	-	-	+
Euras.	G.	Lilium martagon	-	-	+
Euras.	H.	Stachys sylvatica	-	-	+

CONCLUSIONS

- ✓ The natural regeneration of *Taxus baccata* population in the Tudora Reservation is numerous and successful (although it covers a relatively small area).
- ✓ The spatial extent of ***Taxus baccata*** population is mainly due to ornithological dispersal of seeds.
- ✓ Yew regeneration was successful under canopy of tall trees of the genera *Fagus*, *Cerasus*, *Acer* and *Ulmus.*
- ✓ The health of yew individuals from Tudora Reservation is heavily dependent on a good conservation of the entire forest.
- ✓ A judicious management of the reservation could ensure the increase of *Taxus baccata* population. Management measures should also take into account the birds communities which help to disperse yew seeds.

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NATURA 2000 COLEOPTERA FROM ROSCI0326: DISTRIBUTION, CONSERVATION STATUS AND FUTURE MANAGEMENT PROPOSALS

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KEYWORDS: *Lucanus cervus, Cerambyx cerdo, Morimus funereus,* distribution, conservation status, ROSCI0326, Muscelele Argeșului, Romania.

ABSTRACT

The present study aims to investigate the distribution and conservation status of three Coleoptera species included in the Annex II of the Habitat Directive that are present in ROSCI0326 Muscelele Argeșului. Among the three species, *Lucanus (Lucanus) cervus* (Linnaeus 1758) has the best representation with consistent populations in all the three forest patches belonging to the site. *Morimus asper funereus* Mulsant 1862 is also well represented at site level, although its populations are not as consistent and uniformly spread as the previous species. *Cerambyx cerdo* Linnaeus 1758 was identified in the filed investigations, but the small number of individuals sampled does not allow the estimation of the population present at site level or its conservation status. The results of the investigations indicate a proper management of the site and the presence of low intensity threats on the Coleoptera species of communitarian interest.

REZUMAT: Coleoptere Natura 2000 din ROSCI0326: distribuție, stare de conservare și propuneri de management.

Prezentul studiu investighează distribuția și starea de conservare a trei specii de Coleoptere, incluse în Anexa II a Directivei Habitate, prezente în situl ROSCI0326 Muscelele Argeșului. Dintre cele trei specii, *Lucanus (Lucanus) cervus* (Linnaeus 1758) este cel mai bine reprezentată, cu populații consistente în toate cele trei corpuri de pădure aparținând sitului. *Morimus asper funereus* Mulsant 1862 este, de asemenea, bine reprezentat la nivelul sitului, chiar dacă populațiile nu sunt la fel de consistente și de uniform răspândite ca cele ale speciei anterioare. *Cerambyx cerdo* Linnaeus 1758 a fost identificat în cadrul investigațiilor de teren, dar numărul mic de indivizi observați nu permite o estimare a populației prezente la nivelul sitului sau a stării de conservare a speciei. Rezultatele investigațiilor indică un management adecvat al sitului și prezența unor amenințări de intensitate scăzută asupra speciilor de coleoptere de interes comunitar.

ZUSAMMENFASSUNG: Für das Natura 2000 Netzwerk bemerkenswerte Käfer aus dem Gebiet ROSCI0326: Verbreitung, Erhaltungszustand und Managementvorschläge.

Vorliegende Untersuchung befasst sich mit Verbreitung und Erhaltungszustand von drei Coleopteren-Arten, die im Anhang II der Flora-Fauna-Habitatrichtlinie der Europäischen Union gelistet sind und im Schutzgebiet ROSCI0326 Argeş-Berge /Muscelele Argeşului vorkommen. Von den drei Arten ist der Hirschkäfer *Lucanus (Lucanus) cervus* (Linnaeus 1758) am besten, mit umfassenden Populationen in allen drei untersuchten Wäldern des Natura 2000 Gebietes vertreten. Ebenso ist auch der Trauerbock (*Morimus asper funereus* Mulsant 1862) innerhalb des Gebietes gut vertreten, obwohl die Populationen weniger umfangreich und einheitlich in der Fläche verbreitet sind als jene des Hirschkäfers. Der Heldbock (*Cerambyx cerdo* Linnaeus 1758) wurde während der Untersuchungen auch festgestellt, die geringe Individuenzahl erlaubte es jedoch nicht, eine Schätzung der im Natura 2000-Gebiet vorhandenen Populationsgröße oder des Erhaltungszustandes zu unternehmen. Die durchgeführten Untersuchungen weisen auf ein adäquates Management des Schutzgebietes sowie auf eine geringe Bedrohung für die Käferarten von gemeinschaftlichem Interesse hin.

INTRODUCTION

ROSCI0326 Muscelele Argeşului situated in the south of Romania, comprises of three separate forest areas situated at approximately 24.887289° Eastern latitude and 45.135025° Northern longitude (Fig. 1).

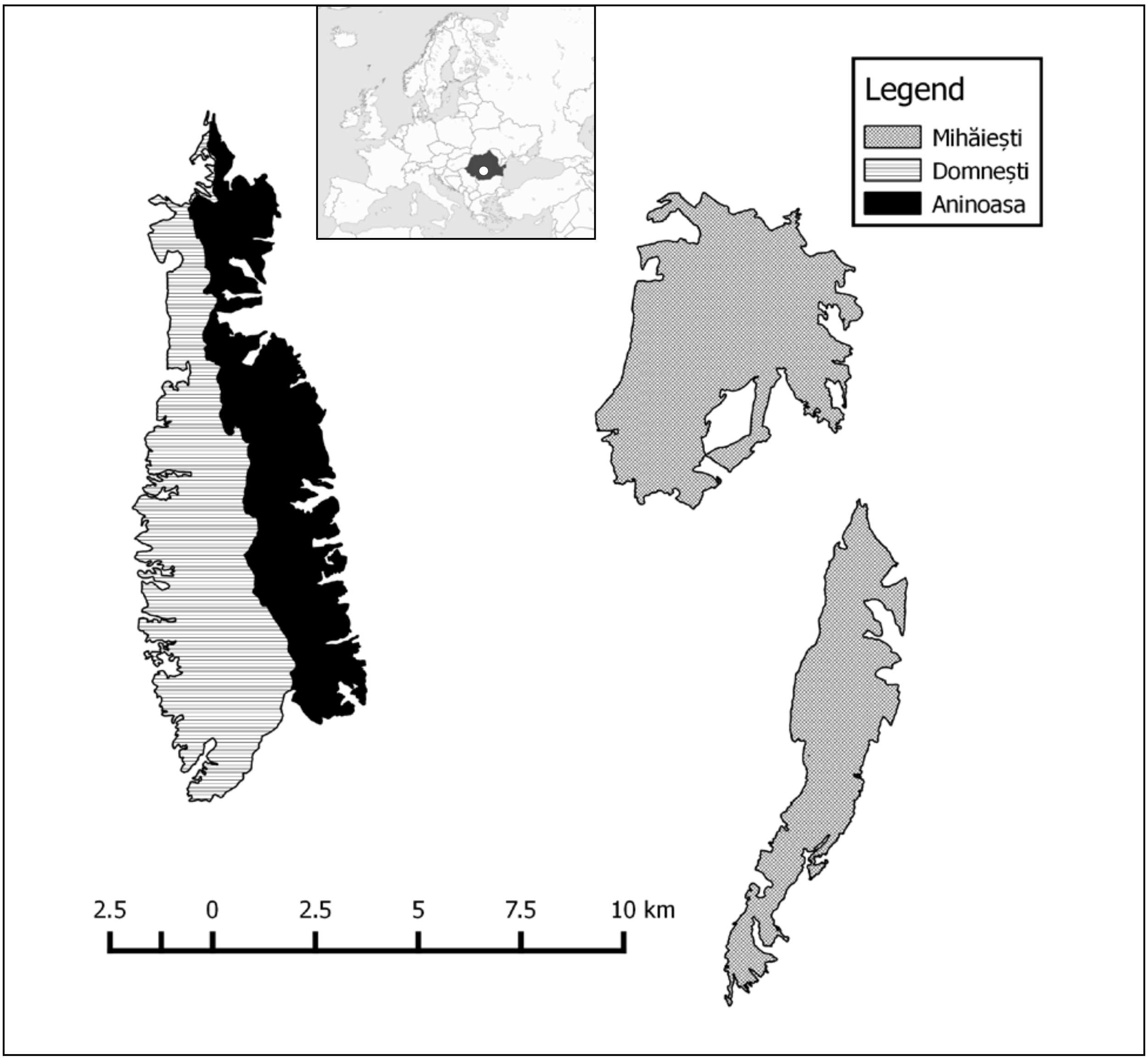

Figure 1: Position of the sampling sites for Coleoptera species inside ROSCI0326 Muscelele Argeşului; small map: location of the sampling area – white circle – in Romania and Europe.

The predominantly oak and beech forest areas are situated in the eastern part of the Getic Plateau, inside the Aninoasa, Domneşti and Mihăeşti forest districts, covering 10014.7 ha. Alongside the forest habitats, the site is important through the presence of three protected species belonging to the Coleoptera: *Lucanus (Lucanus) cervus* (Linnaeus 1758) (the stag beetle), *Morimus asper funereus* Mulsant 1862 (the undertaker beetle) and *Cerambyx cerdo* Linnaeus 1758 (the great capricorn beetle) (Tatole et al., 2009).

MATERIAL AND METHODS

The investigated species were, as presented above, *L. cervus*, *M. a. funereus* and *C. cerdo*, according to the Standard Data Form of the protected area. Observations focused on the presence of the adults and of chitinous remains (elytra, hardened body parts) and on the specific flight orifices, in the case of *C. cerdo*.

Daylight visual longitudinal transects were covered in order to identify the distribution and abundance of the three Coleoptera species, in May-August of 2015, the interval of maximum activity of the species (Ruicănescu, 2008 a, b, c; Vrezec et al., 2012). In the case of *Cerambyx cerdo*, dawn visual transects were also covered (Vrezec et al., 2012), in the same period of time as daylight transects.

Twenty-six 500 m transects were chosen inside and at the edge of the forests (Fig. 2), mainly in the areas covered by the habitats 9170 Galio – Carpinetum oak and hornbeam forests, 91Y0 Dacian oak and hornbeam forests, 9110 Luzulo – Fagetum beach forests, and 9130 Asperulo-Fagetum beach forests.

The position of the transects was recorded with a Garmin Montana 650t GPS, in order to avoid repetition. Our investigation targeted mainly large trees, both alive and degraded, stubs and fallen trunks, as the most favourable woody material to host individuals from the investigated species (Vrezec et al., 2008, 2012; Albert et al., 2012; Campanaro and Bardiani, 2012).

Species' identification was conducted using the key provided by Gîdei and Popescu (2011), while the taxonomy is presented according to Fauna Europaea (Alonso-Zarazaga, 2013; Ausidio, 2013).

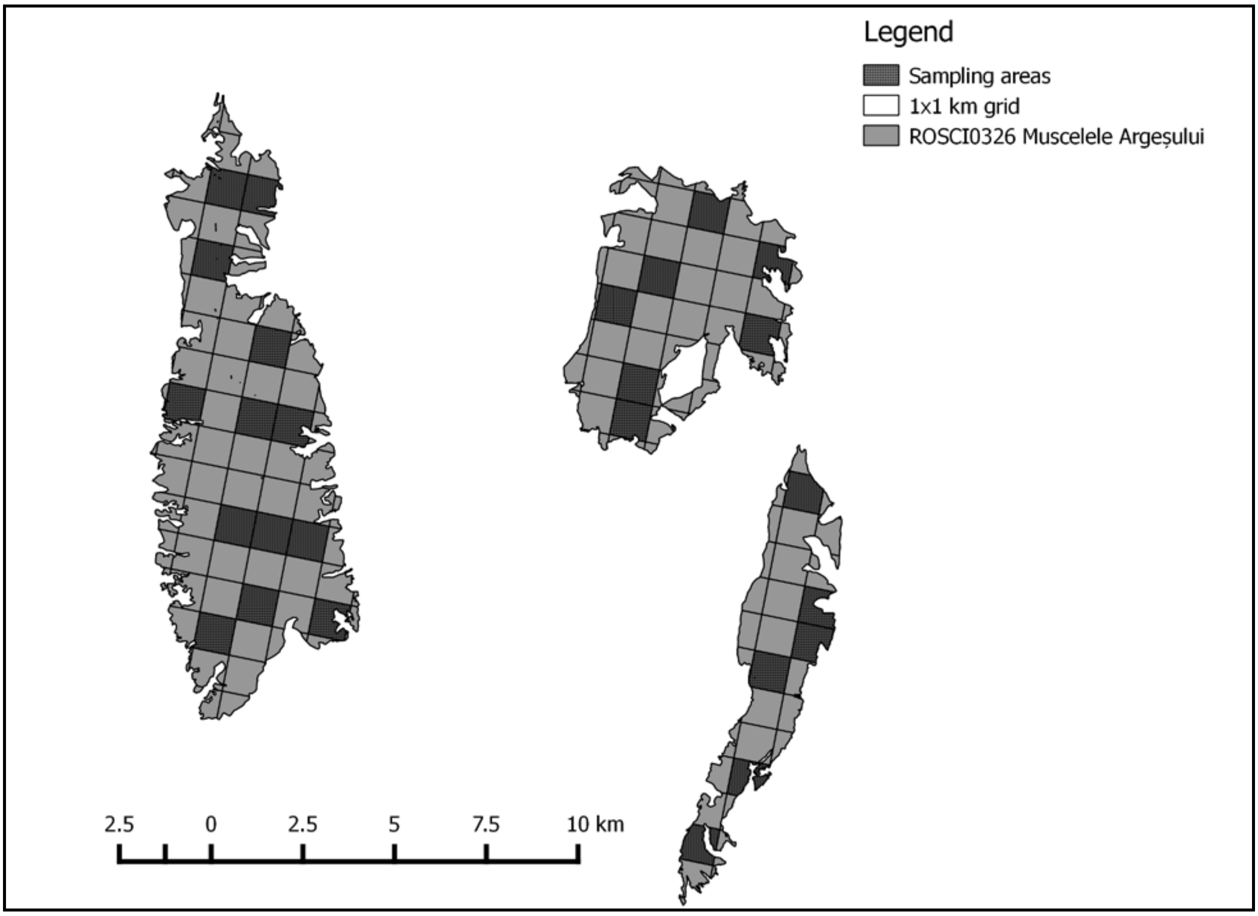

Figure 2: Position of the sampling sites for Coleoptera species inside ROSCI0326 Muscelele Argeșului.

RESULTS AND DISCUSSION

Of the three investigated species, *L. cervus* has the best representation in the area with 234 individuals sampled, as live individuals or exoscheletal remains. The extrapolation proved that the population at site level is around 100.308-101.316 adults (with a 3% confidence level) in the maximum activity period.

The activity period for the species starts at the beginning of May and lasts until the second half of July, with no consistent differences between males and females.

The species is widespread inside the protected area, being absent only in the southern extremity of the Aninoasa-Domnești area and in the northernmost part of the northern Mihăiești area, most likely because of the forest composition, dominated by beech and hornbeam (Fig. 3).

The species seems to thrive in the areas with strong domination of oak trees with diameters of 35-40 cm, where densities of up to 25 individuals/ha were recorded, higher than in the areas with century-old oaks, considered as the most favourable habitat for the species (Harvey and Gange, 2006; Harvey et al., 2011). Forest edges, also mentioned as favourable habitats (Rink and Sinsch, 2007), recorded similar densities as the deep forest areas, most likely due to the rarefied character of most of the forests in the area, with sufficient light reaching the forest floor.

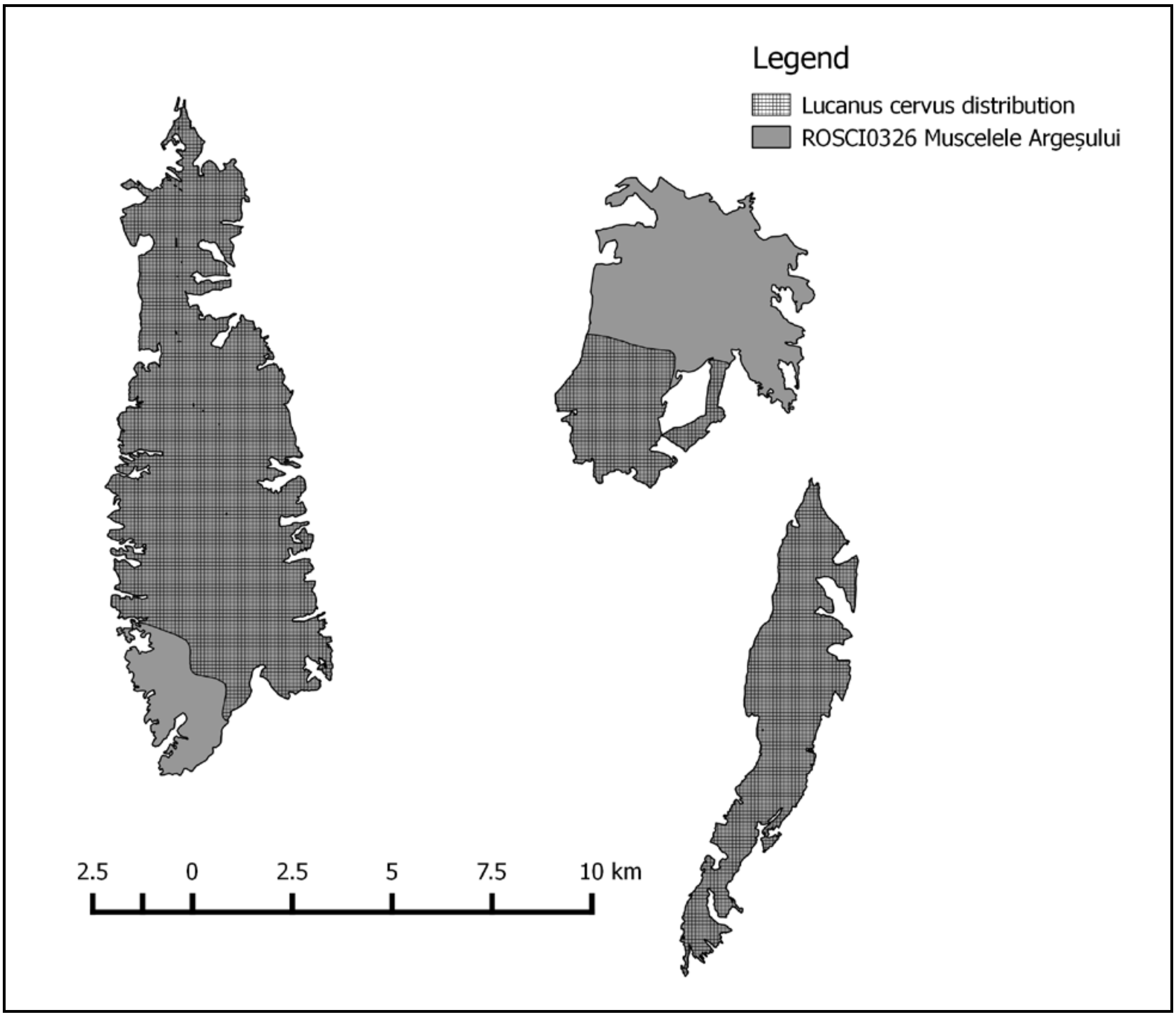

Figure 3: *Lucanus cervus* distribution inside ROSCI0326 Muscelele Argeșului.

M. funereus is also well represented in the area, with 97 live individuals sampled throughout the investigations. The extrapolation proved that the population at site level is around 39.436-39.832 adults (with a 3% confidence level) in the maximum activity period.

The activity period for the species is similar with the one of *L. cervus*, starting at the beginning of May and lasting until the second half of July, also with no consistent differences in activity between males and females.

The species is also widespread inside the protected area, lacking in the northernmost part of the northern Mihăiești area, and in the central parts of the Domnești-Aninoasa area and the southern Mihăiești area (Fig. 4). The most probable cause for the absence of the species is also the forest composition, with younger trees and the dominance of beech, hornbeam or locust tree.

The most suitable habitats for *M. funereus* are older oak dominated forests, with trees exceeding 60 years in age, with stubs and hollows, where densities of around 10 individuals/ha were recorded. Such habitats are also the ones given as the most favourable in the scientific literature (Dojnov et al., 2012).

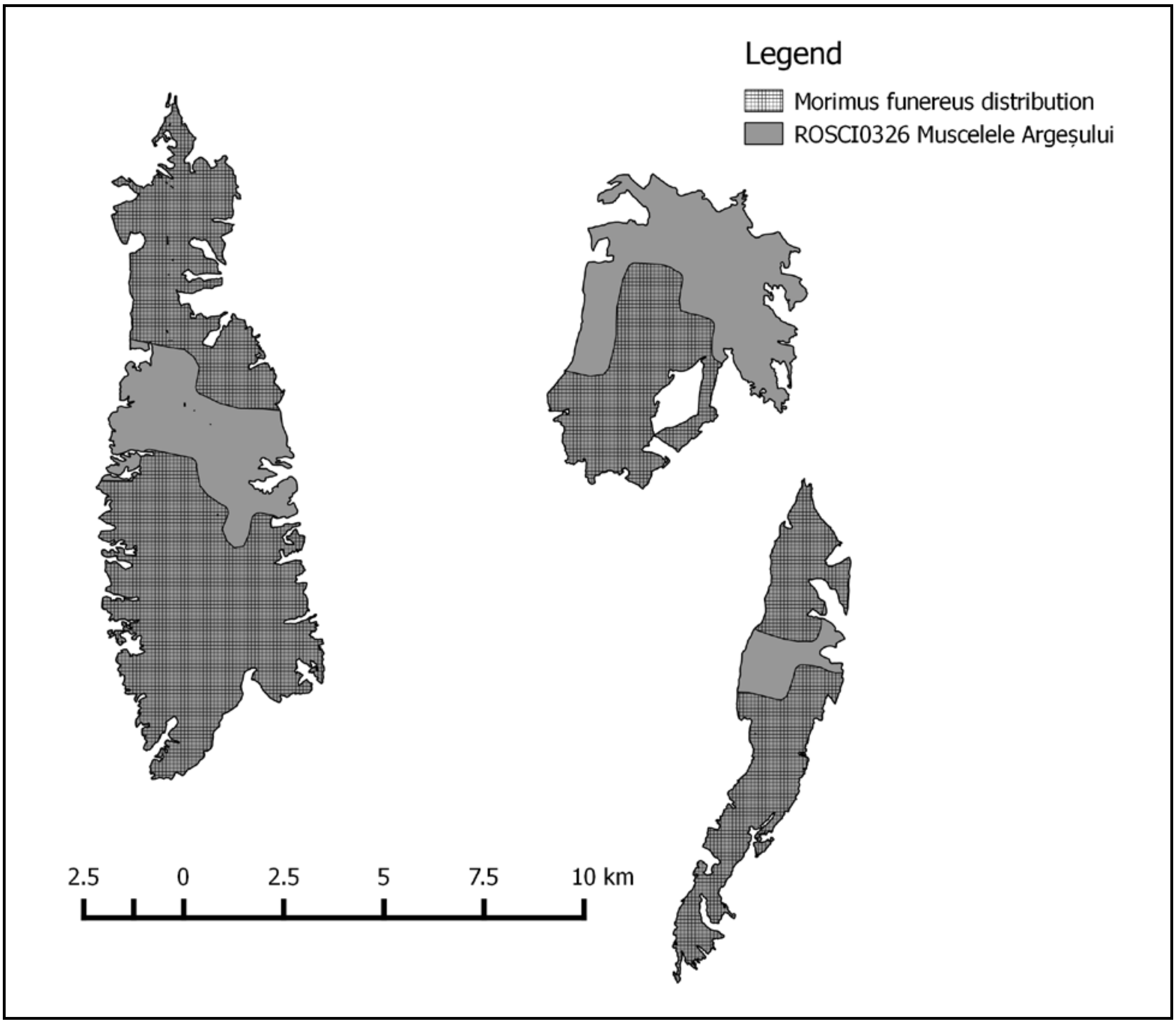

Figure 4: *Morimus funereus* distribution inside ROSCI0326 Muscelele Argeșului.

C. cerdo is the most cryptic of the three species investigated, with only eight individuals recorded throughout field surveys, three individuals collected from stubs and branches and five observed during dawn transects.

Although it can be stated that the species is present at the site level, it is difficult to estimate the size of the population (most likely fewer than 1000 live individuals) or its conservation status.

All the individuals were observed in areas with century-old oak trees present, the habitat considered as the most suitable (Vrezec et al., 2012), therefore such habitats are most likely the one preferred by the species in the investigated area.

All *C. cerdo* individuals were observed in the Mihăiești forested areas, the species being most likely absent in the Domnești-Aninoasa area.

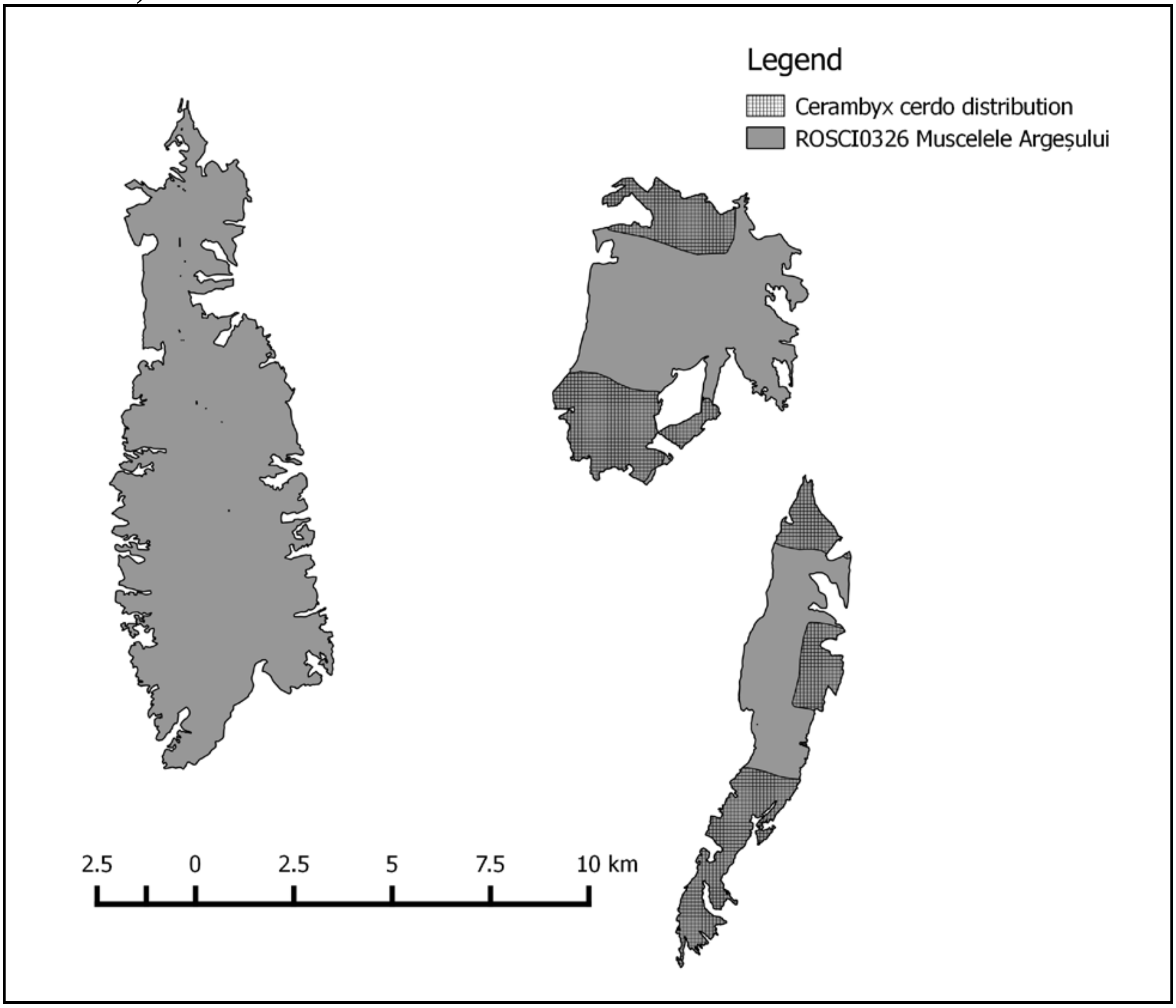

Figure 5: *Cerambyx cerdo* distribution inside ROSCI0326 Muscelele Argeșului.

All three species are facing the same threats inside ROSCI0326 Muscelele Argeșului, namely forest exploitations without replantation, removing of logs, dead trees and stubs, and the collection of individuals by amateur entomologists. All the threats have a low or very low intensity at the site level, therefore the populations of the three species are most likely to grow or at least maintain at present numbers in the future.

In present, forest management inside the protected area is mainly properly conducted, although most of the forests are privately owned, therefore the well-being of the three Coleoptera species is not threatened. As management proposals, three types of activities are in hand:

- Restrictions regarding the removal of dead wood from the forests (fallen trunks, branches, logs and stubs);
- Cutting of the trees at a 1-1.2 m from the soil, allowing the formation of dead trunks.
- Regulating the three species allowed to be replaced from the forests, with locust tree and hornbeam as the main candidates to be exploited.

CONCLUSIONS

All the three species of Coleoptera mentioned in Standard Data Form of ROSCI0326 Muscelele Argeșului were identified during the field survey, with two of them (*L. cervus* and *M. funereus*) having consistent and widespread populations. The situation of the third species (*C. cerdo*) is still unknown and requires further investigations.

The investigations proved that at the present day forest management is mainly favourable for the three species and their populations are most likely to grow or at least maintain at current numbers in the following years, if the present management conditions are preserved.

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SABANEJEWIA AURATA (DE FILIPPI, 1863) SPECIES IN MARAMUREŞ MOUNTAINS NATURE PARK (ROMANIAN CARPATHIANS) ECOLOGICAL STATUS AND MANAGEMENT

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KEYWORDS: Golden spined loach, habitats, human impact, pressures, threats, assessment, management.

ABSTRACT

Sabanejewia aurata is a fish of conservation concern, and has experienced a rapid deterioration in population/habitat condition.

The typical habitat of *Sabanejewia aurata*, in Maramureş Mountains Nature Park varies a lot in quality, with 55% of the sampling stations in good conservation status, 30% in average status and 15% in a reduced condition.

This paper presents some of the key human pressures and threats that caused this concern, with a particular focus on pollution from organic and mining sources. It considers how these can be mitigated to improve this species populations and distribution.

REZUMAT: Specia *Sabanejewia aurata* (De Filippi, 1863) în Parcul Natural Munții Maramureșului (Carpații Românești), stare ecologică și management.

Sabanejewia aurata este o specie de interes conservativ, care a cunoscut o deteriorare rapidă a populaţiilor, datorită degradării condiţiilor de habitat.

Habitatul tipic pentru *Sabanejewia aurata*, în Parcul Natural Munţii Maramureşului, variază mult ca şi calitate, 55% dintre sectoarele de râu analizate sunt în stare bună de conservare, 30% în stare medie şi 15% în stare precară.

Lucrarea prezintă unele presiuni şi ameninţări antropice cheie care provoacă îngrijorare, cu o focalizare particulară pe surse de poluare miniere şi menajere. Se prezintă măsuri de management pentru îmbunătăţirea stării populaţiilor şi distribuţiei acestei specii.

RESUMEN: Estado ecológico y gestión de la especie *Sabanejewia aurata* (De Filippi, 1863) en el Parque Natural Montañas de Maramureş (Cárpatos Rumanos).

Sabanejewia aurata es un pez de interés y también preocupación por su conservación, y ha experimentado una rápida deterioración en las condiciones de hábitat y de su población.

El hábitat típico del *Sabanejewia aurata*, en el Parque Natural Montañas de Maramureş varía grandemente en calidad, con un 55% de estaciones de muestreo con un estado de buena conservación, 30% con un estado de conservación medio, y un 15% con una condición reducida de conservación.

Este artículo presenta algunas claves en relación a la presión humana y amenazas que causaron esta preocupación, con un enfoque particular sobre la polución causada por fuentes orgánicas y minería.

El artículo también considera como esas alteraciones pueden ser mitigadas para la mejorar la distribución de esta especie.

STUDY AREA

The flowing water ecosystems of the Maramureș Mountains Nature Park, Romania, lie mostly within in the Vișeu River Basin, with a small section lying in the Bistița Aurie Basin (Fig. 1), in the northern part of Romania. The Vișeu Basin is flanked by the Maramureș Mountains to the North East, by the Rodna Mountains in the South, and by the Maramureș hills to the West and South-West. The lower altitude point of the area is at the junction of Vișeu River and Tisa River, 303 m above the sea level, and the highest point is the Pietrosul Rodnei Peak at 2,303m in the Rodna Mountains. Due to its tectonic, geological and geographical variation (karst, exokarst, glaciar relief forms, etc.) the studied area is very diverse in terms of landscapes, biotopes, biocoenosis, amongst other ichtyocoenosis factors. (Curtean-Bănăduc et al., 2008; Bănăduc et al., 2011)

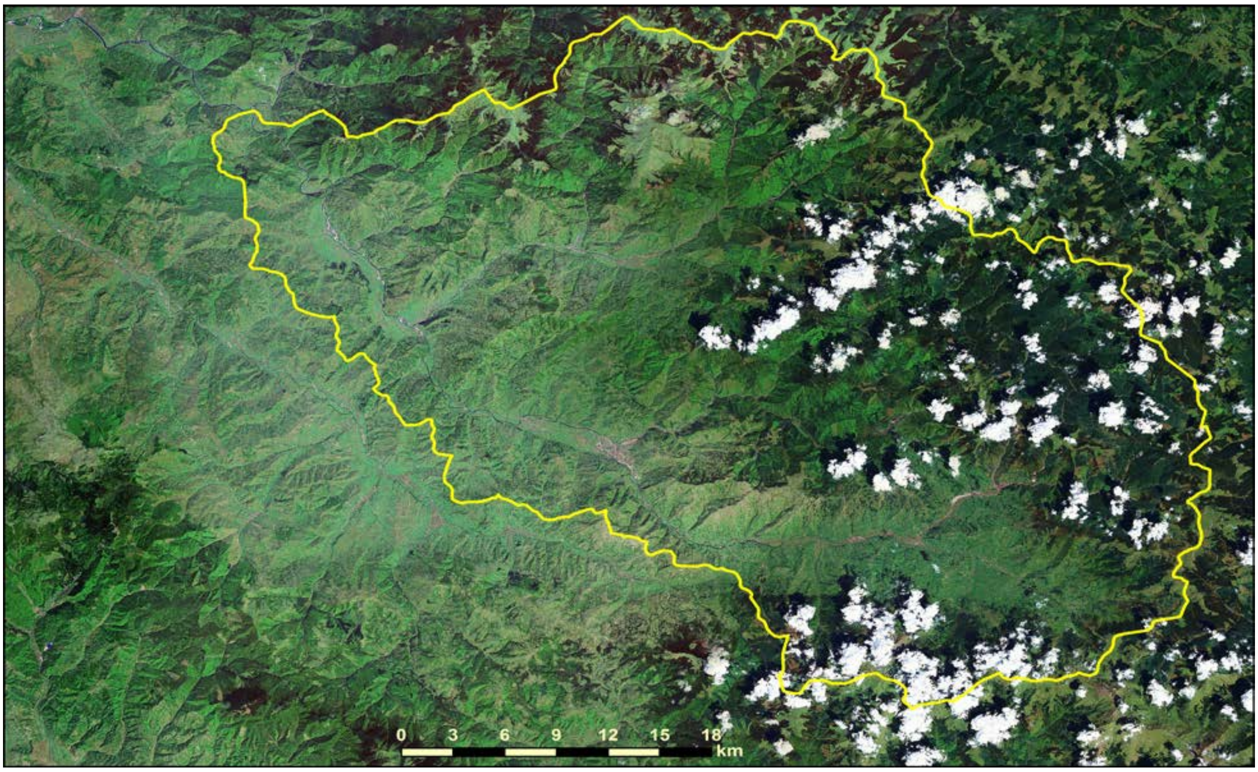

Figure 1: Vișeu River Basin.

The Vişeu River is a second degree tributary of the Danube River, running in the Tisa River in the northern part of Romania. This river has a length of 80 km and a multiannual average discharge at its convergence with the Tisa River of 30.7 m^3/s. The source is located in the Prislop Pass (1,416 m) and it run into the Tisa River near the village of Valea Vișeului. The total basin area is around 1,606 km^2. In its highest reaches, from its springs in the Moisei locality, the Vișeu River has a slope of 20-50 m/km and is locally named Vișeuț or Borșa. From Moisei, the Vișeu River enters the Maramureș Depression where the valley is broader, with occasional confined gorge-like areas namely: Rădeasa Gorge between Moisei and Vișeu de Sus, Oblaz Gorge between Vișeu de Jos and Leordina, and Vișeu Gorge between Bistra and Valea Vișeului. The hydrography of Vișeu River is a typical example of Eastern-Carpathian-Moldavian type in its higher division and of Eastern-Carpathian-Transylvanian types in its lower division. Its flow is considerable in the spring (39.4% of the annual flow) subsequently declining during the summer (27% of the annual flow) likewise during the autumn (18.6% of the annual flow) and with the minimum flow during winter (15% of the annual flow). (Curtean-Bănăduc et al., 2008; Bănăduc et al., 2011)

Due to the fact that the Vișeu Basin is located for the most part in mountain zones (67%) induces a significant density of the hydrographic system (0.7-1 km/km^2) and to one of the biggest specific flows in the Romanian Carpathians, due to precipitation levels of more than 1100 mm/year. In the higher sector, the streams originating in the glacial-type Rodna Mountains have an elevated flow (approximative 5 m^3/s). The most significant tributaries of Vişeu originating in the Rodna area are: Fântânilor Valley (7 km length), Negoiasa Valley (6 km), Repedea Valley (10 km), Pietroasa Valley (7 km), Vremeșu Valley, Hotarului Stream, Dragoş's Valley (11 km) and Izvorul Negru (7 km). From the Maramureș Mountains the north-east tributaries are the followings: Hășmașul Mic, Cercănel (11 km), Țâșla (20 km), Vaser (52 km in length, catchment area 422 km^2, with an average flow of 9 m^3/s contributing 27% to the total flow of Vișeu), Novăț (16 km, 88 km^2 tributary of the Vaser), Ruscova (39 km in length and 435 km^2 basin area, normal discharge of 11.3 m^3/s), Socolău (13 km in length and 72 km^2 basin area, tributary of the Ruscova), Repedea (19 km in length and 87 km^2 basin area, tributary of the Ruscova), Bardi (11 km in length and 32 km^2 basin area, tributary of the Ruscova), Covașnița (11 km in length and 34 km^2 basin area, tributary of the Ruscova), Frumușeaua (14 km in length) and Bistra (nine km in length). From the Maramureș Hills spring the south-west tributaries, which are small and with no significant water flow: Drăguiasa, Cocicoi, Spinului, Plăiuț, Neagră and Luhei. (Curtean-Bănăduc et al., 2008; Bănăduc et al., 2011)

In the Vişeu River basin, water characteristics are influenced in a natural way by mineral springs (150 in Maramureş Mountains, six in Rodnei Mountains and five in Maramureş hills) with a diverse mineral content (including ferrous, bicarbonate, sulphureous and also saline minerals). (Curtean-Bănăduc et al., 2008)

In the Rodnei and Maramureş mountains, the streams and rivers continuum is occasionally disrupted by considerable waterfalls and rapids, the most significant of which are: Cimpoioasa Valley, Cailor, Repedea Valley and Izvorul Verde, all from the Rodnei Mountains, and Tomnatic, Criva and Bardău from the Maramureş Mountains. The region also includes stagnant waters. Glacial lakes from Rodnei Mountains are placed at an altitude of over 1,900-1,950 m and appeared near some deposits: Gropi Lake, Iezer Lake, Buhăiescu Lake, Negoiescu Lake, Rebra Lake and Cimpoieş Lake. As wetlands there are both eutrophic and oligotrophic marshes: Tăul Obcioarei, Strungi Marsh, Tăul Ihoasa, Jneapănul Hânchii, Tăul Băiţii, Pietrosul Barcăului Marsh, Preluca Meşghii, Tăul cu Muşchi, Vârtopul Mare Marsh and Bedreasca. The lakes from Maramureş Mountains are Bârsănescu, Lutoasa, Budescul Mare, Măgurii and Vinderel. On the Vişeu River passage near Petrova town, there are some ponds. (Curtean-Bănăduc et al., 2008; Bănăduc et al., 2011)

The heterogeneity of aquatic and semi-aquatic habitats and their correlated endangered, rare and endemic species from Vişeu Basin area is high and valuable from a conservation complexity perspective. The fish species are not excluded from this point of view in the studied area, as noted by diverse ichthyologists, over more than a century of studies in the area of interest (Antonescu, 1934; Vasiliu, 1959; Bănărescu, 1964; Staicu et al., 1998; Curtean-Bănăduc et al., 2008). Half of the fish species present in the area are of conservation value.

MATERIAL AND METHODS

This specific study on *Sabanejewia aurata* maps the populations of this species in the Munţii Maramureşului Nature Park, and evaluates its conservation status. The study was carried out between January – July 2015, with samples taken from 370 sampling sectors (Fig. 2, Tab. 2).

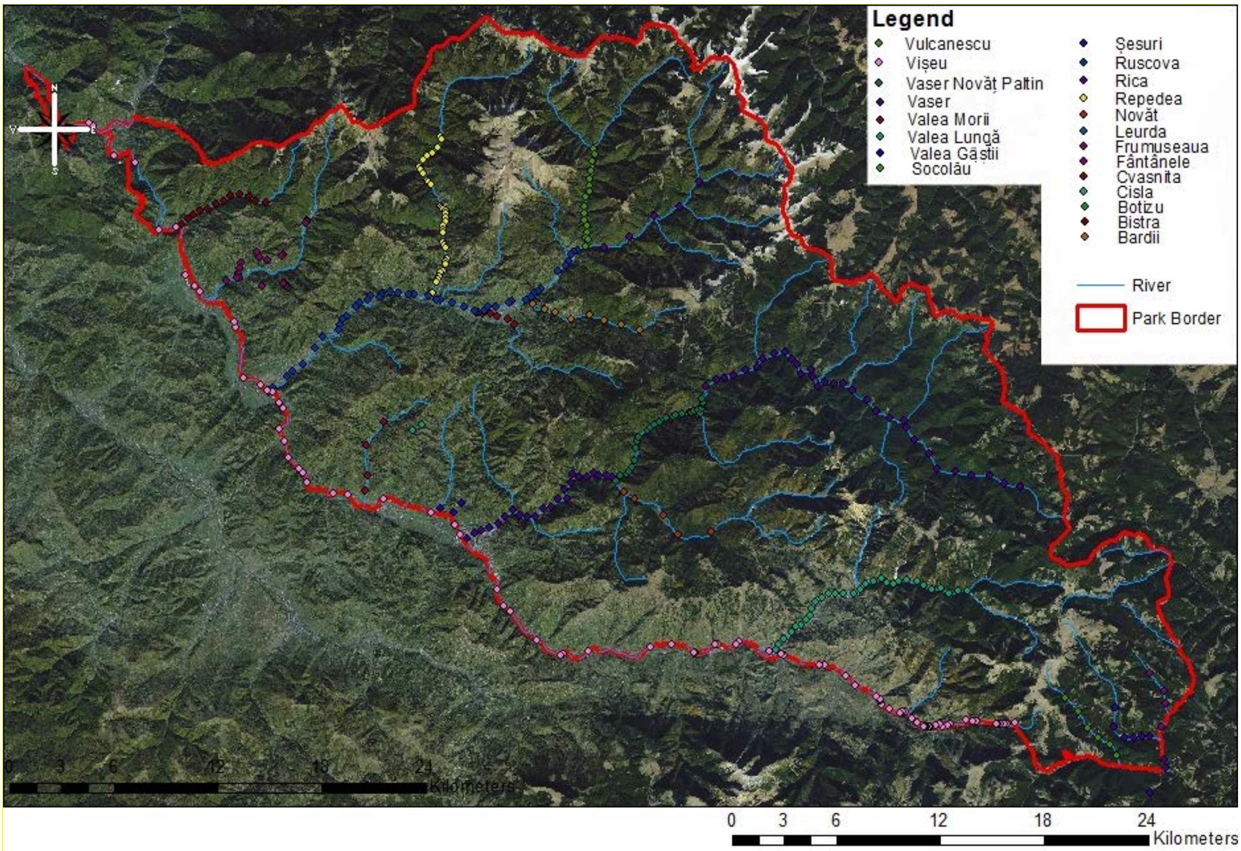

Figure 2: The 370 sampling stations location.

To evaluate the distribution and condition of *Sabanejewia aurata* populations, repeated quantitative samples of fish were taken from about 3 km below the spring location of each watercourse in the studied area, in sectors containing habitats likely to be inhabited by *Sabanejewia aurata*. This distribution of the sampling sectors ensures the representativeness of the collected data and allows the evaluation of the effects on the studied populations of factors likely to have a negative impact on populations, including modifications to the biotope characteristics, poachery, pollution sources, hydrotechnical works, substratum exploitation, etc.

The quantitative samplings of the fish were performed using an electronarcosis capture method applied for a specified amount of time according to the size of each sampling section (two hours on Vişeu River, one hour on Ruscova River, 30 minutes on the other rivers of the studied zone), on 100 m lengthwise sectors per sampling station. Following the application of the electronarcosis method, captured individuals fish were identified and counted and then released back into their own natural habitat.

The captured fish were then grouped into the following classes: (C) – common species, (R) – rare species, or (V) – very rare, following the guidelines for Natura 2000 data collection, which assume that a count of individuals can indicate the size/density of a population.

The criteria used to evaluate the status of the studied population are: balanced distribution of individuals by age classes, population size, distribution areal size and the percentage of individuals of the species of interest in the fish communities.

In the context of the guidelines for Natura 2000 standard data form filling the criteria "The conservation degree of specific habitats" include subcriteria: i) the degree of conservation of the habitats features which are important for the species; ii) possibilities for recovery.

The first criterion listed requires a global evaluation of the features of the habitat regarding the needs of the species of interest. “The best expertise available” is used to rank this criteria: I. elements in excellent condition, II. well preserved elements, III. elements in average degraded condition.

In the situations in which the subclass I is granted ”I: elements in excellent condition” or ”II: well preserved elements”, the criteria B (b) it should be classified entirely as ”A: excellent conservation” or ”B: good conservation”, disregarding of the other sub- criterion classification.

In the situation of this sub-criterion ii) which is taken into account only if the items are partially degraded, an assessment of the viability of the studied population is needed. The achieved ranking system is: I. easy recovery; II. restoration possible with average effort; III. restoration difficult or impossible.

The fusion practiced for ranking relly on two sub-criteria: Excellent conservation = elements in excellent condition, regardless of classification of recovery possibility; B good conservation = well preserved elements, regardless of classification of recovery possibility; = elements in average or partially degraded condition and easy to restore; C average or reduced conservation = all other combinations.

In each sampled section the following factors were assessed: condition, pressures and threats on habitats and populations of interest fish species.

The monitoring sections for fish population conservation status of the *Sabanejewia aurata* species in the study area were settled not only in the river sections in which these species populations are stable, presenting a good or very good conservation status, good characteristic habitats, but also in the river sections located at the edge of the studied site for the studied species, sectors under anthropogenic pressure that can imperil the populations status – the Representativity Criteria.

The economical criterion was also considered for establishing stations for monitoring, in this manner a mean number was agreed to supply the needed data for the management factors in order to be able to sustain a favourable status for the interest species population.

Sabanejewia aurata characteristics

Sabanejewia aurata (De Filipi, 1863), Code Natura 2000: 1146, Actinopterygii – Cypriniformes – Cobitidae – Cobitinae (Fig. 4), was identified as present in the researched area in the last century, (Bănărescu, 1969, Telcean and Bănărescu, 2002, Bănăduc et al., 2013, Homei, 1963).

The body is of variable height, moderately laterally compressed, 5-20 dorsal spots, 5-17 lateral spots, the septum along the side muscles is not visible through the tegument transparency, or is slightly visible, but it never appears as a dark longitudinal stripe and the spots never merge with this septum. At the caudal base fin is a vertical dorsal spot and a ventral spot, both small. On the back of the head are small, closely distributed spots. There is an adipose dorsal ridge, and occasionally a ventral one. The species can reach 10 cm in length, but the dimensions are very variable (Bănăduc 2007a, b, 2008a, b, 2011; Bănăduc et al., 2012; Bănărescu 1964, 1969; Bănărescu and Bănăduc 2007).

It is a freshwater and demersal fish species, present mostly in the upper and in the middle parts of the streams and rivers. The existence of the sand in the river and stream beds is a major habitat condition, as these fish typically bury/hide themselves in the sand. The food consist mainly of small size macroinvertebrates. Bănărescu (1964, 1969), Bănărescu and Bănăduc (2007)

The studied fish species is protected under the Bern Convention Annex III and Habitats Directive Annex 2.

Sabanejewia aurata has no economic value.

RESULTS

The river and stream sectors where the fish species *Sabanejewia aurata* was found (Fig. 3) during the research are shown in the table 2 (Fig. 4). For each lotic section the catch index values are presented (individuals number per time and effort unit).

Figure 4: *Sabanejewia aurata* Regan, 1911 specific habitat at the Vișeu and Tisa rivers confluence – N - 47°54.754’, E - 24°08.762’, alt. 331 m.

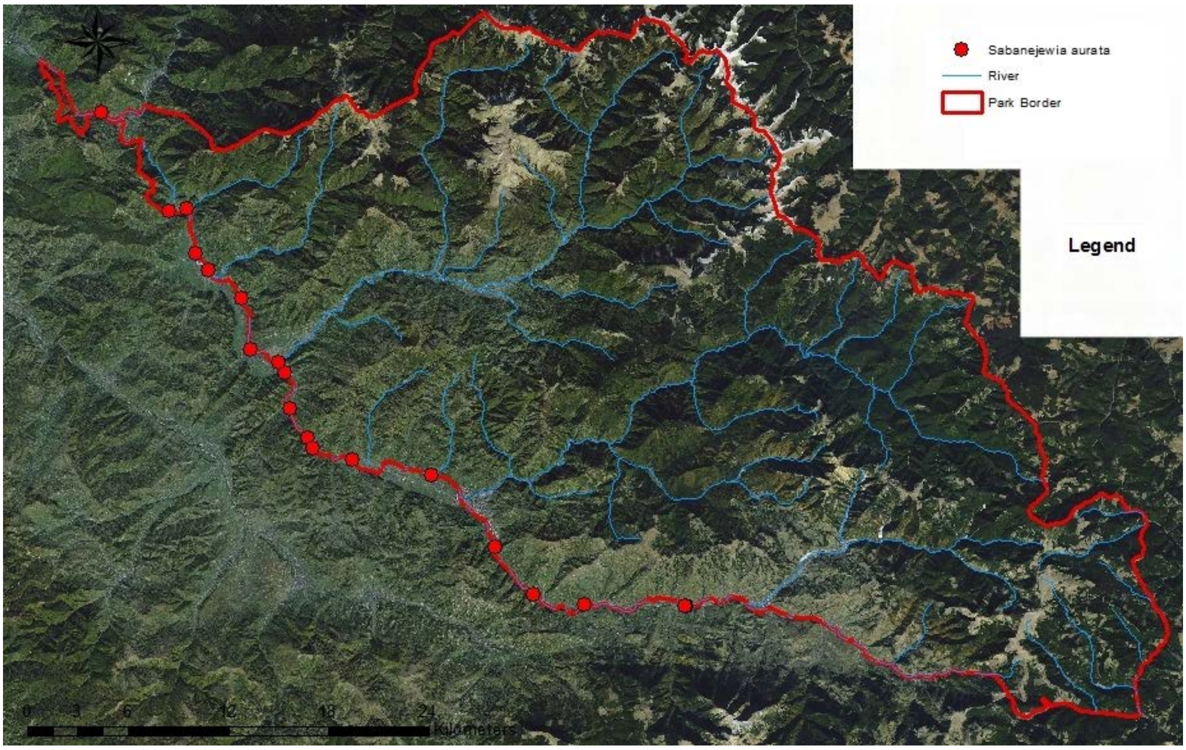

Figure 4: *Sabanejewia aurata* Regan, 1911 distribution/sampling stations location.

Table 2: *Sabanejewia aurata* sampling points in Maramureș Mountains Nature Park area.

No. crt.	River	Station code	Lat. (N')	Long. (E')	Catch index no. ind./ 50 m x 30 min	Characteristic habitat state
1.	Vișeu	55	47 43 54,9	24 20 05,0	1	reduced
2.	Vișeu	58	47 44 34,2	24 17 59,6	1	reduced
3.	Vișeu	40	47 39 16,2	24 36 06,6	2	reduced
4.	Vișeu	41	47 39 16,8	24 36 01,8	4	good/**average**
5.	Vișeu	44	47 39 17,7	24 31 12,8	2	good/**average**
6.	Vișeu	47	47 39 36,9	24 28 49,0	1	good/**average**
7.	Vișeu	50	47 41 07,9	24 26 57,3	1	good/**average**
8.	Vișeu	53	47 43 24,6	24 23 54,0	1	good/**average**
9.	Vișeu	57	47 44 15,8	24 18 11,9	4	**good**/average
10.	Vișeu	58	47 45 31,2	24 17 07,2	12	**good**/average
11.	Vișeu	61	47 46 40,4	24 16 51,8	17	**good**/average
12.	Vișeu	64	47 46 59,5	24 16 33,1	7	**good**/average
13.	Vișeu	65	47 47 23,4	24 15 11,7	19	**good**/average
14.	Vișeu	68	47 49 03,8	24 14 45,1	22	**good**/average
15.	Vișeu	70	47 49 56,9	24 13 09,2	27	**good**/average
16.	Vișeu	71	47 50 27,5	24 12 29,1	38	**good**/average
17.	Vișeu	73	47 51 53,9	24 12 03,1	39	**good**/average
18.	Vișeu	74	47 51 48,3	24 11 12,4	23	**good**/average
19.	Vișeu	75	47 54 57,6	24 07 56,3	11	**good**/average
20.	Vișeu	79	47 43 54,9	24 20 05,0	7	good/**average**

Sabanejewia aurata is present in the research area with long-lasting populations in the middle and lower sectors of theVișeu River.

The habitat area available to the species is big enough and of good enough average quality to ensure long-term species durability.

However, as the following section discusses, the human activities in the study area, both separately and in combination, present an extra pressure that influences the medium- and long-term viability of the species.

DISCUSSION

Based on the above data collection, coupled with knowledge of the habitat requirements of *S. aurata*, some key anthropomorphic risk factors were identified, notably organic pollution and pollution caused by mining activities.

Organic pollution: the study area has a deep-rooted problem with sewage and wastewater treatment as well as the influences of local farms and illegal waste deposits (Fig. 5). In much of the Vişeu River area (Fig. 6), organic pollution causes a constant stress for *S. aurata*. Solutions to this issue require comprehensive sewage systems to be built in the Vişeu River basin and the sewerage water of the localities along the side of the main water courses must be managed.

Figure 6: Lotic sectors negatively influenced by organic pollution/illegal waste deposits and saw dust; N - 47°39.471’, E - 024°37.795’.

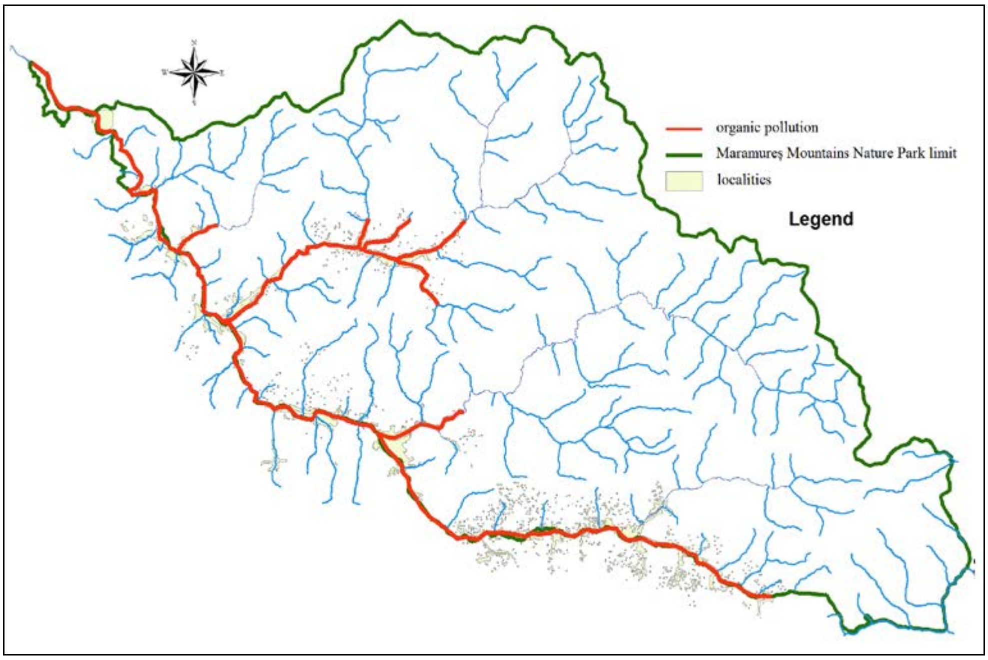

Figure 7: Lotic sectors negatively influenced by organic pollution.

Pollution caused by mining activities. The remnant pollution resulting from activities of heavy metal mining (Fig. 8) in the Țâșla River basin are influencing both the Țâșla Strem aquatic habitats and also the ecosystems of the upstream Vișeu River. The impact of rain and snow-melt washing through mine galleries, surface mining areas and greened refuse heaps and into the river system is rated as considerable on the Țâșla River and important on the upstream Vișeu River.

This contamination can be avoided by insulating or filling the old mine galleries such that water cannot penetrate, and by insulating (not greening) the refuse heaps from the streams in the basin of the Țâșla River.

Figure 8: Dissafected industry facilities and mining sterile dumps near the Țâșla River.

As a result of these identified pollution sources on the aquatic habitat and fish species, the assessment of *Sabanejewia aurata* indicates that it is only “average” in status.

The following management actions should be implemented in the researched area: management of water use; protecting water from pollutants such as toxins and heavy metals as these are accumulative and have adverse effects on aquatic biota (Staicu et al, 1998; Viman et al., 2010; Amundsen et al., 2011); establishment of buffer zones for aquatic systems; integrated management of sewage and waste water and surface water pollution; creation of integrated water resource management for the Vișeu Basin; creation of ecological networks; support for high quality scientific inventories and studies of integrated watershed management.

CONCLUSIONS

The fish species *Sabanejewia aurata* is a characteristic indicator of habitat ecologic status in Maramureş Mountains Nature Park area, which varies in quality between reduced, average and good due to many factors. The general decrease in habitat quality in the studied park is the result of human-generated organic pollution and mining pollution.

Sabanejewia aurata is a moderately distributed species in the researched area of Vișeu River.

55% of the studied lotic sectors of the Vişeu River where *Sabanejewia aurata* was found are in good conservation status. 30% of the studied lotic sectors are of average conservation status, and could be improved with medium-term restoration measures. 15% of the studied lotic sectors are in poor condition where long term restoration is difficult.

With the implementation of ecological rehabilitation of the upper Vișeu River, there is potential for significant improvements in water quality and a related increase in the status and distribution area of *Sabanejewia aurata*. However, if no action is taken, the effects of pollution in the area are likely to continue to negatively affect habitat quality and species populations.

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ROMANOGOBIO KESSLERII (DYBOWSKI, 1862) FISH SPECIES POPULATIONS MANAGEMENT DECISIONS SUPPORT SYSTEM IN ROSCI0227 – SIGHIȘOARA-TÂRNAVA MARE (ROMANIA)

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KEYWORDS: Kessler's gudgeon, habitats, pressures, threats, management, Natura 2000 site, Transylvania, Romania.

ABSTRACT

Based on the ADONIS:CE, a model of *Romanogobio kesslerii* fish species that includes all the needs for habitat: the element that satisfy a favorable conservation status – the sufficient measures, and the pressures – and threats on species was created.

The main threats to *Romanogobio kesslerii* (Dybowski, 1862) populations in ROSCI0227 are: the microhabitat silt sedimentation; diffuse pollution; river-lining field erosion; water regime change; invasive fish species; poaching; longitudinal fragmentation; organic pollution; river regularisation; and riverbed substrata overexploitation.

The authors designed a management specific scheme for *Romanogobio kesslerii* populations in ROSCI0227.

REZUMAT: Sistem support pentru luarea deciziilor de management a populațiilor speciei *Romanogobio kesslerii* (Dybowsky, 1862) in ROSCI0227 – Sighișoara-Târnava Mare (România).

Utilizând ADONIS:CE a fost creat un model pentru specia *Romanogobio kesslerii*, care include toate necesitățile pentru habitat, elementele care satisfac statutul de conservare favorabilă – măsurile de suficiență, presiunile și amenințările asupra speciei.

Principalele presiuni și amenințări asupra populațiilor de *Romanogobio kesslerii* (Dybowski, 1862) în ROSCI0227 sunt: colmatarea microhabitatelor cu sedimente; poluarea difuză; eroziunea bazinală; modificarea regimului hidrologic; speciile invazive de pești; braconajul; fragmentarea longitudinală; poluarea organică; regularizarea râului; supraexploatarea substratului râului.

Autorii au creat o schemă de management specific pentru populațiile de *Romanogobio kesslerii* în ROSCI0227.

RESUMEN: Sistema de soporte para decisiones de manejo de las poblaciones del pez *Romanogobio kesslerii* (Dybowski, 1862) en ROSCI0227 – Sighișoara-Târnava Mare.

Se generó un modelo para el pez *Romanogobio kesslerii* basado en el modelo ADONIS:CE, el cual incluye como datos de entrada las necesidades fundamentales de hábitat, aquellos elementos que satisfacen un estado favorable para la conservación (medidas de manejo), así como también las presiones y amenazas que enfrenta la especie. Las principales amenazas para las poblaciones de *Romanogobio kesslerii* (Dybowski, 1862) en ROSCI0227 son la sedimentación de limos, contaminación difusa, erosión del revestimiento de los ríos, cambios en los regímenes de agua, especies invasoras, pesca ilegal, fragmentación longitudinal del paisaje, contaminación orgánica, regularización fluvial y sobreexplotación del sustrato fluvial. En este trabajo, los autores proponen un diseño específico de manejo para las poblaciones de *Romanogobio kesslerii* en ROSCI0227.

INTRODUCTION

The European Union associate nations are obliged to guard from harm the Habitats Directive (Annex 2) species, and they should not allow the deterioration of conservation status produced by human activities (*, 1992).

The Natura 2000 sites of Romania, containing those designed for the conservation of some fish species, were proposed for their ecological status conservation. The approval of site suggestions were based on the following criteria: well conserved, permanent and vigorous fish populations; characteristic natural habitats; good geographical position; and low human activities impact. There are a few ways the Natura 2000 European network can improve the EU countries' nature quality: the expanding of the natural areas; the building of institutional capacity; application of proper and updated management plans for the natural areas; and raising awareness (Bănăduc, 2007a, 2010, 2011; Bănăduc et al., 2012; Curtean-Bănăduc and Bănăduc, 2008).

Romanogobio kesslerii (Dybowski, 1862) represents one of the fish species of conservation interest. These species are living in the middle sector of the relatively big lotic system. They choose a speed of the water of 45-70/90 cm/s, sandy riverbed and relatively shallow water. These specimens frequently form schools and have a breeding cycle in June. They spawn in shallow river water over sand or gravel substrata. The no-longer live vegetation debris looks to be a beneficial factor for the breeding sectors selection. The roes are laid down on the riverbed and are attached to the substrate. The edible material consist mainly of small psamofilic organisms and diatoms. Adults, as well as juveniles, are active during the day. (Bănărescu, 1964; Bănărescu and Bănăduc, 2007)

In the Romanian territory, the spreading area of this species is much more fragmented than it was half a century ago (Bănărescu, 1964). Human effects being the main cause - effects which are different from one lotic sector to another, including some protected areas (Battes et al., 2005, 2009; Bănăduc, 2005, 2007a, b, 2008; Bănăduc and Curtean-Bănăduc, 2013; Bănăduc et al., 2013; Bănărescu, 1964; Bănărescu and Bănăduc, 2007; Oţel, 2007; Simalcsik et al., 2004; Telcean and Bănărescu, 2002; Telcean and Cupşa, 2009a, b; Meşter et al., 2003; Ureche, 2008).

The present structure of the fish associations, which contain *Romanogobio kesslerii* in ROSCI0227 (Natura 2000 site Sighişoara-Târnava Mare), reveals less than optimum individuals as an effect of anthropogenic impact. The spreading ranges of the fish communities and their relative abundance variation in this Natura 2000 studied site reveal the relative effect of lotic habitat quality status in 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).

Human activities have a great impact on the worldwide tendency for rivers to become a priceless treasure (Curtean-Bănăduc and Bănăduc, 2012).

If this tendency persists, no general/superficial "cook book type" management elements are going to be sufficiently helpful in all protected areas, due to the fact that various habitat attributes should be assessed. As a consequence, specific management elements should be adapted and suggested for the local habitats' specific characteristics and conditions.

Recently, the modeling methods of processes are used more to acquire the so called "big picture" of specific systems and/or actions of whatsoever sphere. These methods are used to facilitate the interpretation process stages for adapted/updated management. The instruments of modeling are fundamentally products of software, products used to make and/or assess models for business organizations, and to expose information about models. There are three basic functions that are addressed: detail of an actual situation, assessing the effects of potential modifications, and documenting strategies to change the actual situation in a divergent direction. As a last outcome, they can make diverse charts which present the necessary management issues (Hall and Harmon, 2005).

The intentions of this study are to highlight the state of the *Romanogobio kesslerii* population in the ROSCI0227 Natura 2000 site, to reveal the actual human impact pressures and threats, to suggest management elements for the conservation and rise of this species conservation status based on a management model developed on specific needs of this species and its specific habitat indicators, and as a special designed support system for management decisions.

MATERIAL AND METHODS

The ROSCI0227 (24°49’16”, 46°8’4”, 85,815 ha, between 315 and 829 m altitude) is located in Braşov, Sibiu and Mureş administrative units (county/județ), in the Continental biogeographic region. The inclusion of this area was proposed for the protection of a number of four fish species, belonging to the Annex 2 of the Habitats Directive (92/43/EEC), (*Gobio kessleri* Natura 2000 code 2511 (*Romanogobio kesslerii*), *Barbus meridionalis* code 1138, *Sabanejewia aurata* code 1146, and *Gobio uranoscpus* code 1122). (*)

The lotic systems sectors of the researched area where *Gobio kessleri* were identified are shown in figure 1.

The fish specimens were sampled in 2012-2014 with active fishing nets, followed by on - site identification, and then at once released, in their natural habitats.

Romanogobio kesslerii populations were monitored in the research period and their ecological status was assessed in connection to the human activities, pressures, and threats found in the species’ habitats.

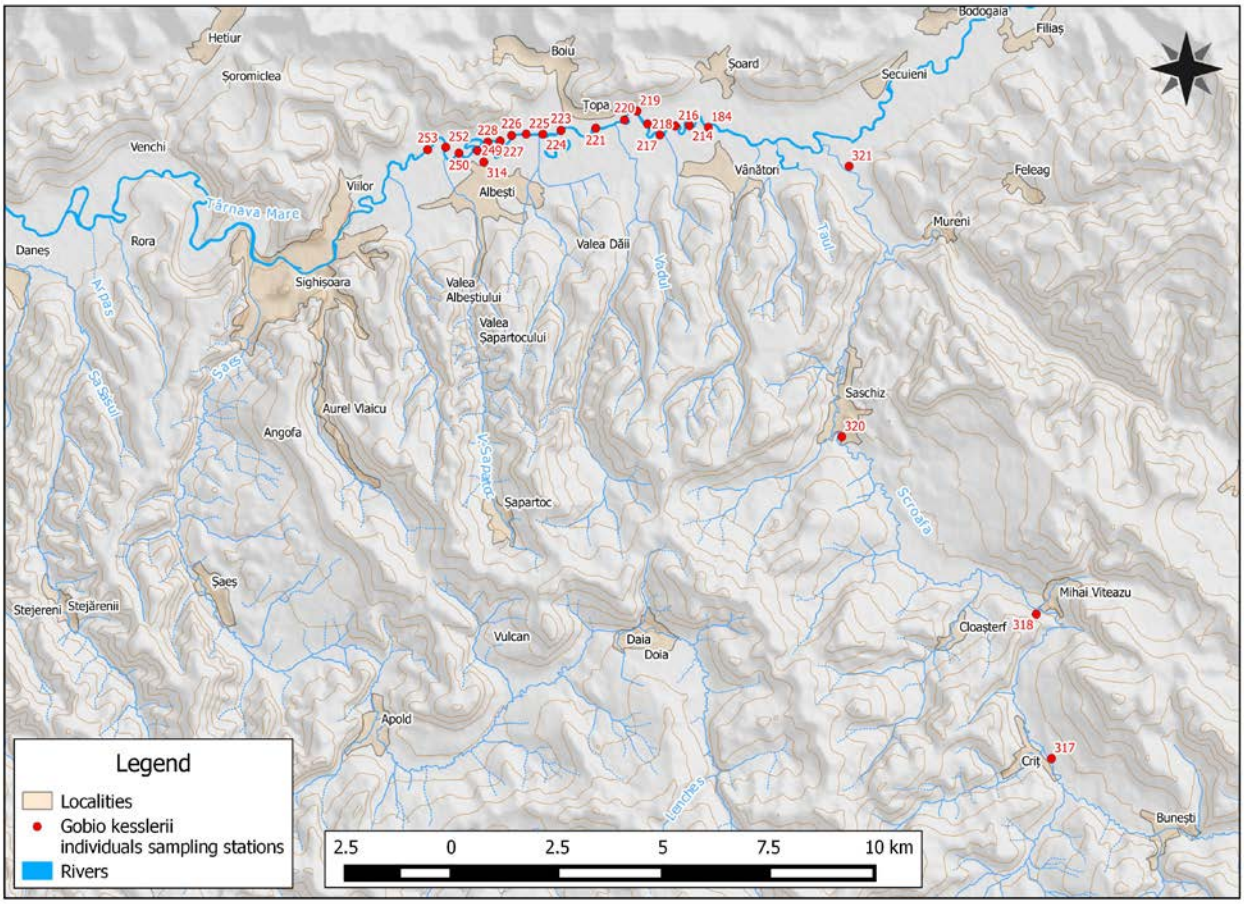

Figure 1: *Gobio kesslerii* individuals sampling stations: Scroafa River 321, 320, 318, 317, Şapartoc Stream 314 and Târnava Mare River 253, 252, 250, 249, 228, 227, 226, 225, 224, 223, 221, 220, 219, 218, 217, 216, 215, 214, 184 (GIS support Mr. Pătrulescu A.).

RESULTS AND DISCUSSION

Assessment of *Romanogobio kesslerii* species populations' state

Romanogobio kesslerii populations ecological state in the **Scroafa Stream** in the lotic sectors 321, 320, 318, and 317 (Fig. 1) was considered to be low in relation to balanced distribution of the individuals on age classes, population size, and a low percentage of this fish species' individuals in the fish communities. The studied habitats- where the individuals of the species were sampled- are in a low ecological state.

The ecological state of *Romanogobio kesslerii* populations in the **Șapartoc Stream** 314 (Fig. 1) was considered to be low in relation to balanced distribution of the individuals on age classes, population size, and a low percentage of this fish species' individuals in the fish communities. The studied habitats- where the individuals of the species were sampled- are in an average/low ecological state.

Romanogobio kesslerii individuals sampled in **Târnava Mare River** in 253, 252, 250, 249, 228, 227, 226, 225, 224, 223, 221, 220, 219, 218, 217, 216, 215, 214 and 184 sectors (Fig. 1) vary among very good (in the sectors 253 and 250), good (in 252, 249 and 220), and low (in 228, 227, 226, 225, 224, 223, 222, 221, 219, 218, 217, 216, 214, and 184) in relation to balanced distribution of the individuals in age classes, population size, and a low percentage of this fish species' individuals in the fish communities. The studied habitats- where the individuals of the species were sampled- are in a good, average and low ecological state inducing the fish communities condition.

Human pressures and threats

During the study in the Scroafa, Șapartoc and Hârtibaciu lotic systems, relatively numerous pressures and threats on the studied fish species of conservation interest populations were identified:

- microhabitat silt sedimentation ratio much higher than the natural one due to human-induced erosion in numerous areas of the Târnava Mare catchment area as a result of irrational agricultural practices, erroneously performed riverbed modifying works, river-adjacent humanized or semi-natural areas surface lessivage by abundant rainfalls, and a situation facilitated by the general context of reduction of the riparian vegetation;
- permanently diffuse pollution sources with significant synergic effects;
- problems induced by the river-lining field erosion and accentuated silt sedimentation in the riverbed, as a result of inadequate agricultural practices as riparian vegetation deterioration, is having a negative impact on this species from the perspective of the quantitative and qualitative reduction of its food sources;
- the modified regime of the water course liquid and solid discharges;
- favoring the occurrence of invasive fish species (*Pseudorasbora parva*, *Gobio gobio*, etc.) and/or more tolerant to changes in the *Gobio kessleri*'s natural habitat, and competing with the latter conservational interest species;
- poaching;
- the longitudinal connectivity of the Târnava Mare River, including for *Gobio kessleri*, also suffers due to severe man-made impact in certain sectors (e.g. Copşa Mică, Mediaş, etc.), consequently the quality of all the species populations in the river being impacted;
- as long as the habitats offering good conditions for this species are contracting due to various man-made impacts, each of the sectors still offering auspicious conditions to the species are becoming vital for the survival of the species, not only in the here-discussed basin;
- pollution, especially organic;
- there are numerous illegal waste deposits producing lixiviates in the very proximity of the water courses;
- river regularization and riverbed substrata overexploitation, without calling for alternative solutions of water basin management is the most frequent and an increasing threat, with a major negative impact related to the changes of the favourable habitats of the species.

Specific requirements

Romanogobio kesslerii individuals are present in the middle sector of relatively big rivers. The mature individuals need lotic areas with shallow water, with a mostly sandy substrata and a speed flow of water of 45-70/90 cm/s. Frequently numerous, such fish can be found aggregated in schools. The breeding takes place in June, when the mature individuals choose faster flowing water sectors with gravel, sand and plant debris on the river substrata. Before becoming adults, these fish need relatively slow water flowing sectors, low depth, and sandy riverbed. The edible material is mostly represented by small psamofilic organisms and diatoms (Bănărescu and Bănăduc, 2007).

Specific habitat indicators

In relation with the *Romanogobio kesslerii* presence and relative abundance in the research sectors, some habitat indicators are suggested: zones in the minor riverbed with water depth of under 0.5 m (66%); percentage of sandy substrate (66%); percentage of pebbles substrate (33%); vegetal debris weight on the substrate/channel (15%); weight of fast flow-water surface (66%); and weight of slow flow-water surface (33%).

Management measures

Building lentic areas is not recommended if any human interventions/ hydrotechnical work which modifies the liquid flow in such a way that the water has more or less than 40-65 cm/sec., or even more or less than 4-90 cm/sec., or leads to a decrease in the number of individuals of this species until extinction. It is recommended to prohibit construction/ hydrotechnics that have an effect of modifying the speed regime of the water in these rivers. For example, construction of bridges, culverts, etc. must be carried out at multiannual maximum flow level, in order to maintain the water flow regime.

A complex system of stairs for fish that minimize the negative effect of lotic discontinuities created by series of dams and existing lakes must be constructed.

The overexploitation of mobile aggregates from the riverbed to the bed rock, respectively the removal of sand substrate should not be allowed, since the sand subtrate is an important characteristic of the species habitat needed for preservation. It is necessary to prohibit the exploitation of aggregates in areas with slow and average flow, shallow and sandy bottom and in areas with less than 3 km between exploitations such as Cibin, Olt, Hârtibaciu and Târnava Mare rivers. In Scroafa and Şapartoc rivers the aggregates exploitation from the riverbed is not recommended.

During the reproduction period (June), the banning of fishing and aggregates exploitation in riverbeds is recommended.

In all river sectors of interest the criminal phenomenon linked to poaching is very intense and almost permanent, for this reason it requires a better control.

The preservation of natural vegetation corridors (arboreal, shrub and herbaceous) with a minimum width of 100 m on both banks of the river is recommended.

It is necessary to prohibit the abandonment of any kind of waste in the riverbed and the wetlands surrounding watercourses.

Seasonal integrated monitoring is recommended; this should include the monitoring elements of water charging with organic substances.

Site adjusted management model

The processes for this site management model were made using modeling library objects ADONIS: CE (for more details – Hall and Harmon, 2005 – Version 1.1, November, 2005 http://mhc-net.com/whitepapers_presentations/2005

Process Trends (040 306) .pdf), and relies on the use of activities, decisions and variables accompanied by generators. Activities (blue rectangle) are used to describe the characteristics of the species *Gobio kessleri*. Decisions (yellow diamonds) occur when we want to check if certain indicators measured in the field are in conditions for favorable conservation. For decisions, variables and generators are assigned that determine the probability that fulfils these indicators. Subprocesses (blue triangles) are used to facilitate comprehension models (works exactly as a process and can be called within models).

As it is showed in the model hierarchy (Fig. 2), the main process is "Gobio kessleri" and has two subprocesses: "Gobio kessleri indicators" and "Specific requirements". "Gobio kessleri indicators" has also three subprocesses that describe the management measures that should be taken into account to assure a favorable conservation state.

For an easier understanding, as well as the references between processes, the figure below (Fig. 3a, b) shows the subprocess called in the basic model.

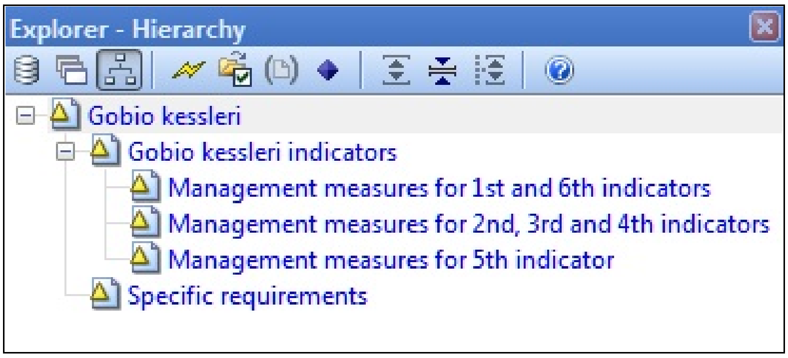

Figure 2: Gobio kessleri – model hierarchy.

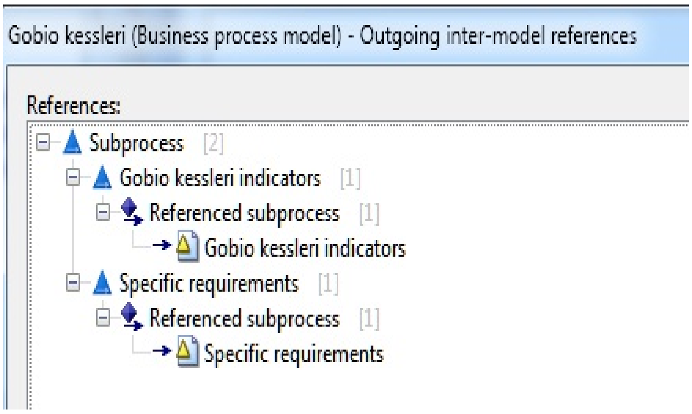

Figure 3a: Outgoing inter-model references (in main process "Gobio kessleri" and in subprocess "Gobio kessleri indicators").

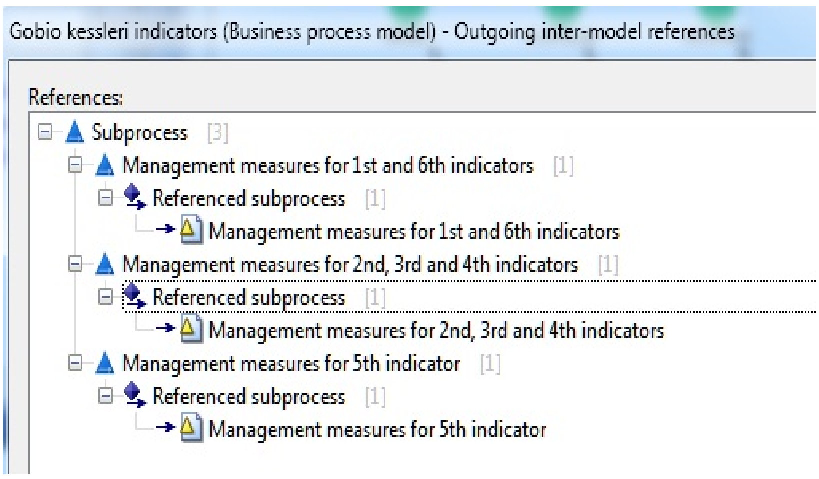

Figure 3b: Outgoing inter-model references (in main process "Gobio kessleri" and in subprocess "Gobio kessleri indicators").

The main process is "Gobio kessleri" (Fig. 4) and was modeled using two subprocesses (Figs. 5 and 6): one decision that checks if the conservation state is favorable or not, and finishes with an activity which implements an integrated monitoring system.

After going through the activities of the subprocess "Specific Requirements", it proceeds by checking the indicators in the subprocess "Gobio kessleri indicators". If the conservation status is favorable, then scroll to the last activity and the process is concluded. If the conservation status is not favorable, then it goes again through the two subprocesses and it takes the management measures until it ensures favourable conservation status. This process finishes with last activity, "Implemention of an integrated monitoring system".

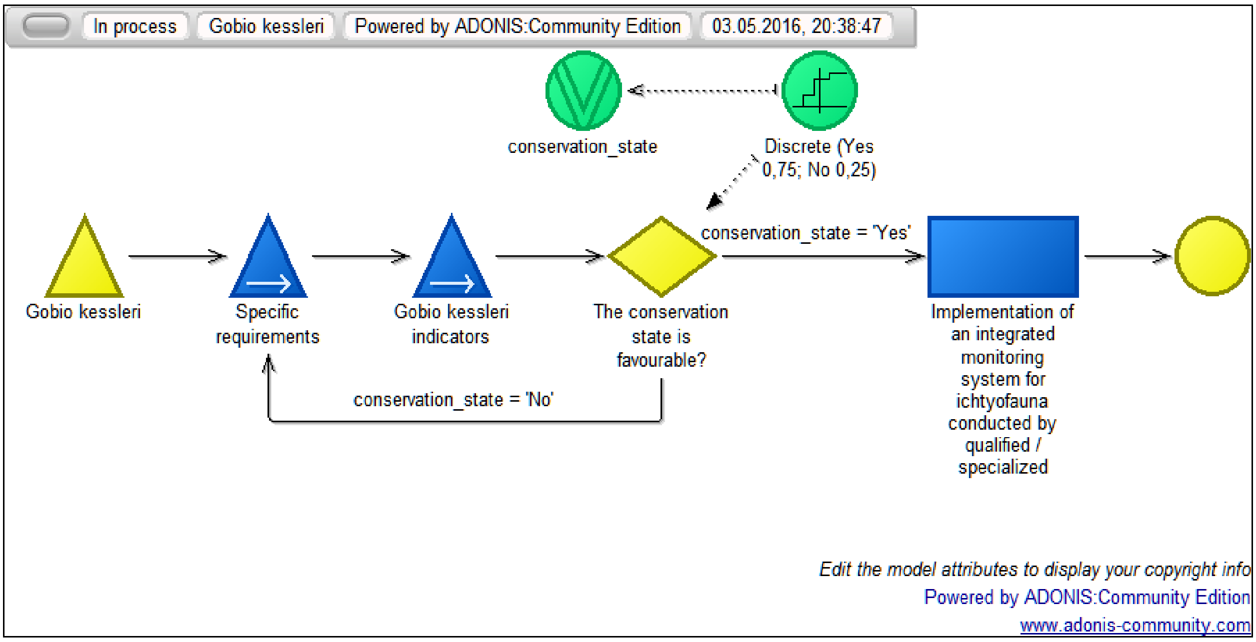

Figure 4: Gobio kessleri – basic process model.

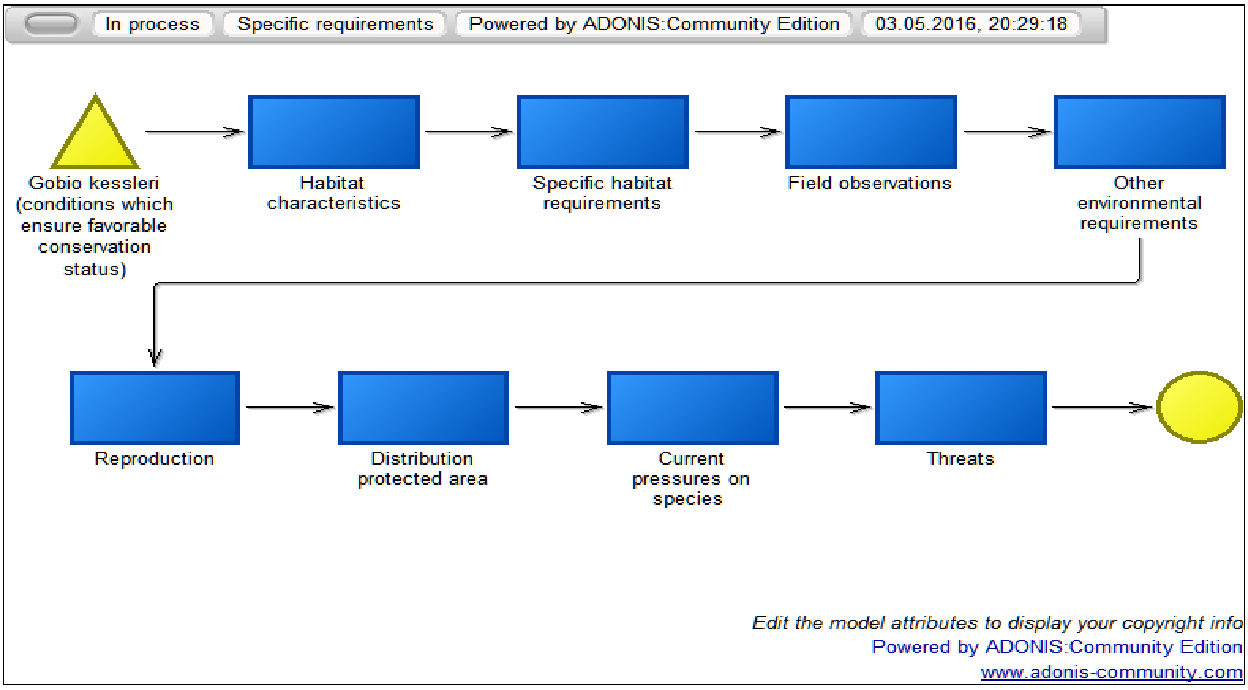

Figure 5: Subprocess "Specific requirements" – characteristic of *Gobio kessleri* species.

The subprocess "Specific requirements" is modeled using only activities and presents the characteristic of *Gobio kessleri* species: type of habitat, specific requirements of habitat, observations made in the field, other environmental demands, the reproduction period, distribution in the protected area, pressures on the species and the threats found in Sighișoara – Târnava Mare area.

It then follows the subprocess "Gobio kessleri indicators" that checks if every possible indicator (areas in riverbed with water depth less than 0.5 m, sandy substrate weight, gravel substrate weight, plant debris on the substrate weight/ channel, fast flowing water surface weigh, slow flowing surface water weight) fulfill or is not a favorable for conservation status. If they fulfill favorable conservation status, it then gets to the last activity, namely the one that shows the danger of poaching, and the process is closed. If the conservation status is not favorable, depending on each indicator – separately, they are called the subprocesses with management measures to be taken for the welfare of the species. (e.g.: "The actual state for the sandy substrate weight is 66%?", if it goes on the "Yes" branch ("sandy_substrate = 'Yes'", probability = 99%) then it goes to the next decision; if it goes on the "No" branch ("sandy_substrate = 'No'", probability = 1%), then it follows the subprocess Management measures for 2nd, 3rd and 4th indicators). After the management measures were taken, it then follows the last activity and the process ends.

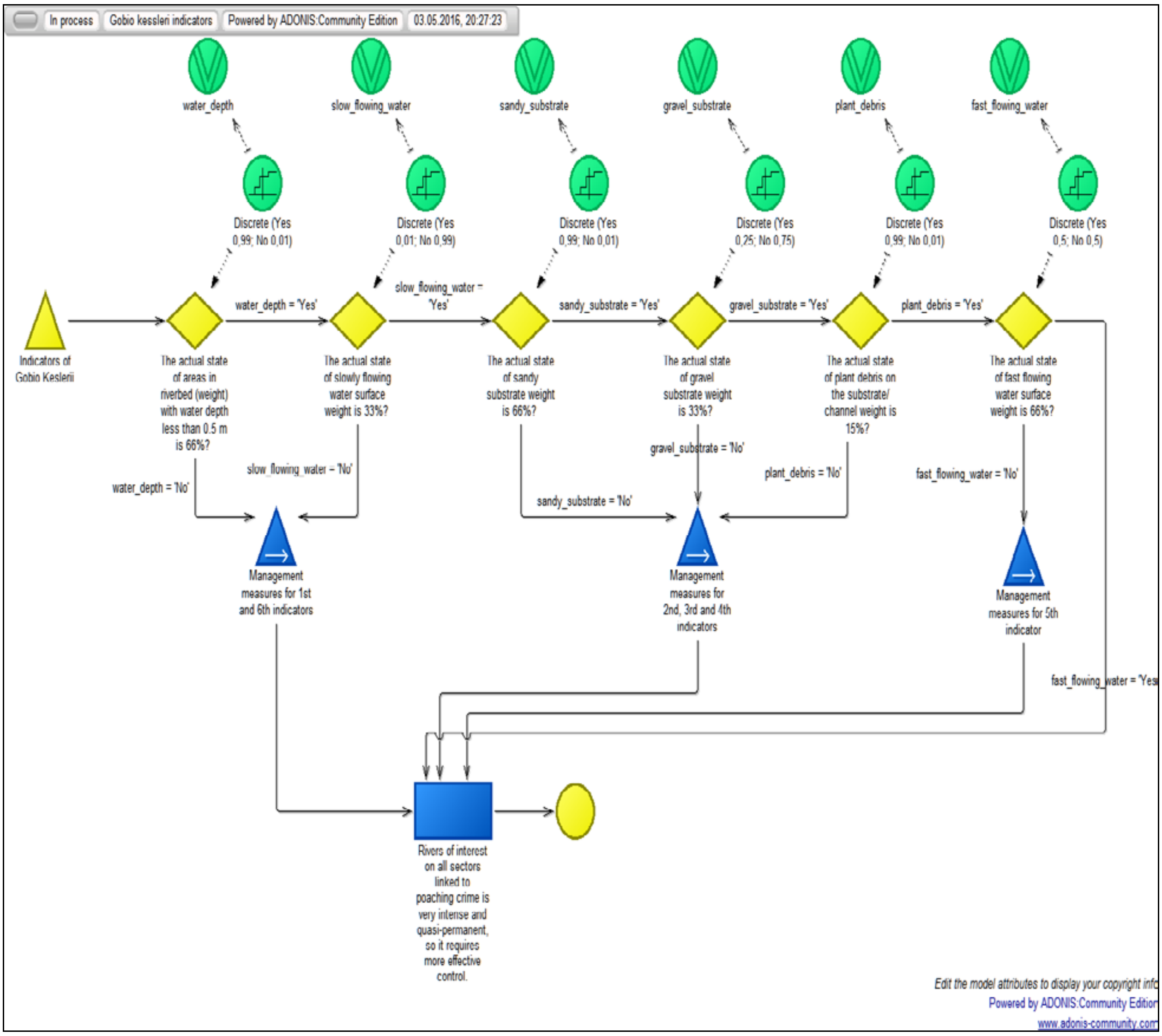

Figure 6: Subprocess "Indicators of Gobio kessleri".

Subprocesses "Management measures for 1st and 6th indicators" (Fig. 7), "Management measures for 2nd, 3rd and 4th indicators" (Fig. 8), and "Management measures for 5th indicator" (Fig. 9) are a chain of activities with management measures to be taken for each indicator separately. Indicators 1 though 6 are taken with the same measures of control (e.g.: keeping natural morphodinamics of riverbed, exploiting mobile aggregates in riverbed, fishing is banned during reproduction period, and prohibit the abandonment of waste). Second, third and fourth indicators have the same management measures and were carried out in one subprocess "Management measures for 2nd, 3rd, and 4th indicators". For 5th indicator, management measures are modeled in the subprocess "Management measures for 5th indicator".

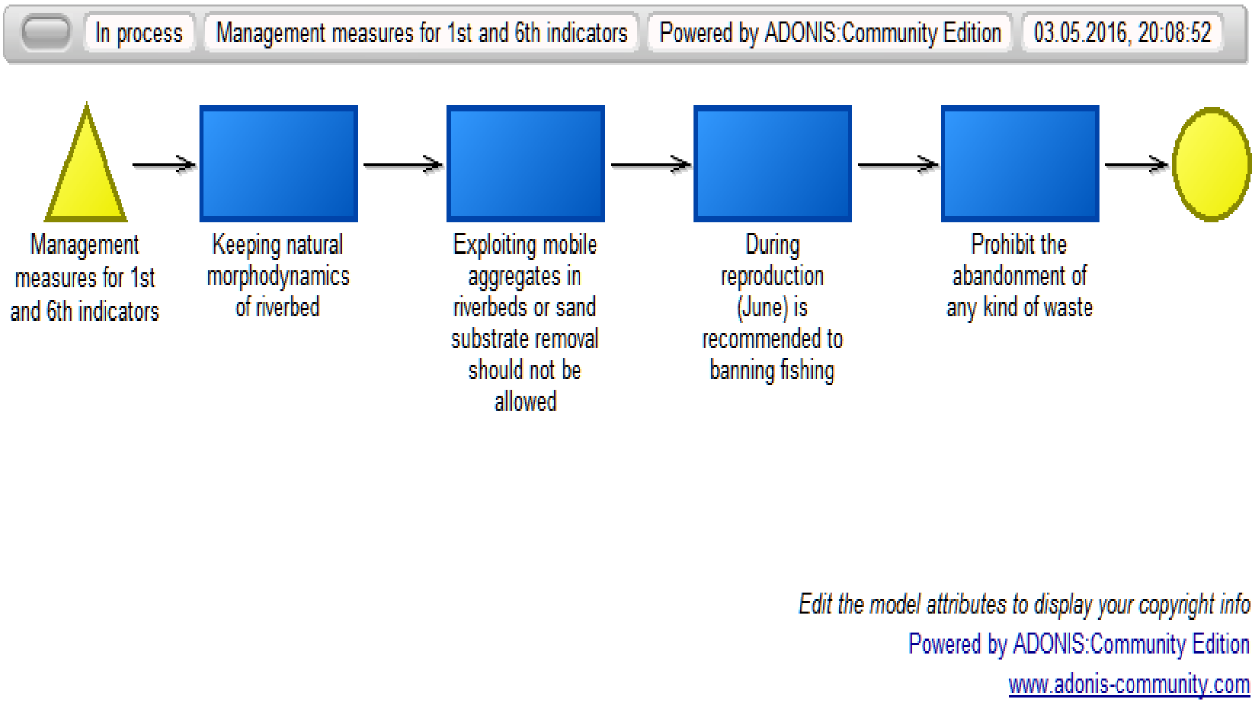

Figure 7: Subprocess "Management measures for 1st and 6th indicators".

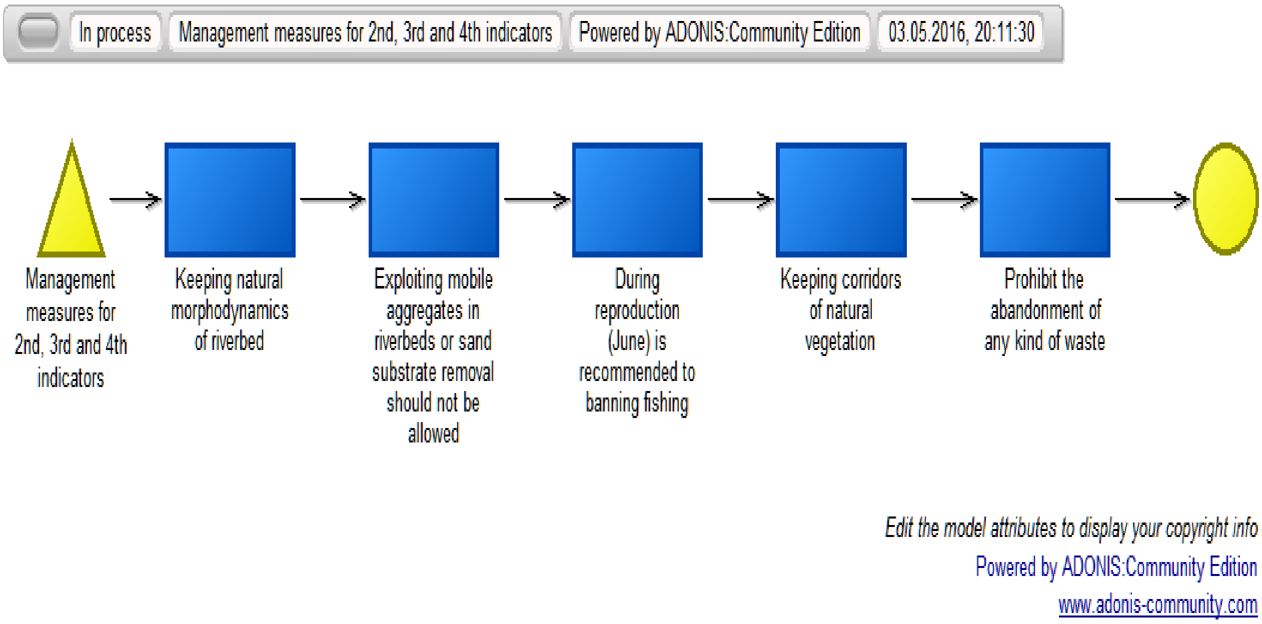

Figure 8: Subprocess "Management measures for 2nd, 3rd and 4th indicators".

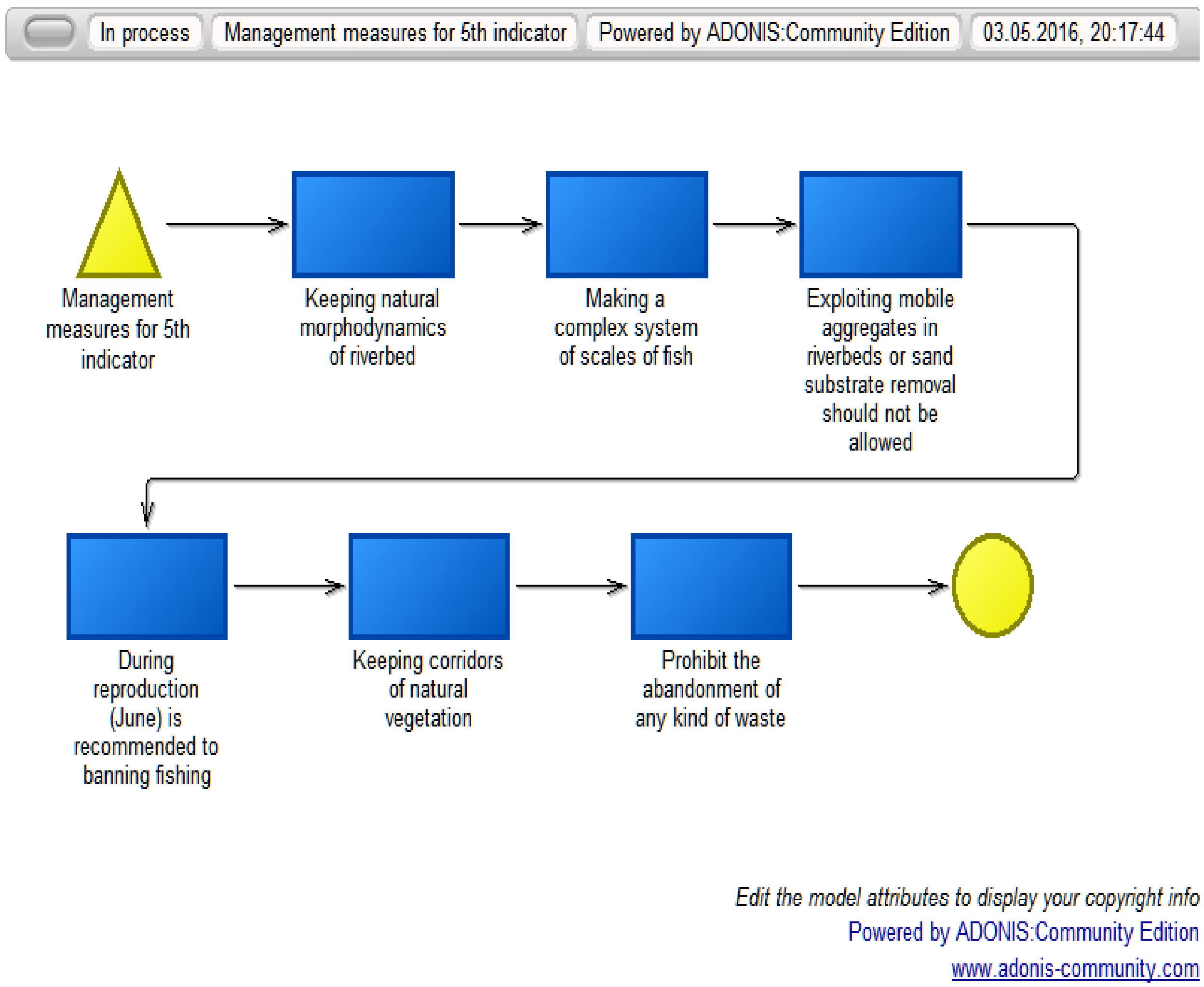

Figure 9: Subprocess "Management measures for 5th indicators".

CONCLUSIONS

The present identified main pressures and threats on the *Romanogobio kesslerii* populations in the Natura 2000 site ROSCI0227 – Sighişoara-Târnava Mare are: microhabitat silt sedimentation; diffuse pollution; river-lining field erosion; water regime change; invasive fish species; poaching; longitudinal fragmentation; habitat bad conditions; organic pollution; river regularization; and riverbed substrata overexploitation.

The authors designed a management specific scheme for *Romanogobio kesslerii* fish species in ROSCI0227. The ADONIS:CE instrument is used here in biology/ecology domain, to design a model of *Romanogobio kesslerii* fish species that includes the requirements for habitat, the indicators that assure a favorable conservation status, the optimum measures, and the existing pressures and threats.

For the time to come, this type of management should be designed based on systems for other fish species of conservative interest of ROSCI0227 protected area.

Annual integrated monitoring is necessary in the studied area, including specialised fish monitoring.

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EXTRACTION OF AGREGATES FROM ALLUVIAL PLAINS. CASE STUDY: BUZĂU RIVER (ROMANIA)

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KEYWORDS: Natura 2000 site, alluvial plain, hydromorphic changes.

ABSTRACT

The aggregate (gravel and sand) extraction industry is a key economic activity for entire societies, civil engineering, and real estates, which are heavily dependent on it. Aggregates may be considered conditionally renewable resources, being replenished by rivers at certain rates. The exploitation of such mineral resources – although strictly regulated – may induce long-term changes in lotic and riverine ecosystems, with insidious effects on human well-being. This paper presents some findings of studies undertaken by the Ecological University of Bucharest in Natura 2000 site ROSCI0103 "Lunca Buzăului" and also the experience as custodians regarding the legal and regulatory framework of aggregate extraction. It presents the actual state of aggregate extraction activity from Buzău alluvial plains, with some of its environmental returns and hazards, and with new trends and potential directions of this activity towards sustainable solutions.

REZUMAT: Exploatarea agregatelor minerale în luncile râurilor. Studiu de caz: râul Buzău (România).

Exploatarea agregatelor minerale (pietriş şi nisip) este o activitatea foarte importantă pentru întreaga societate, de aceasta depinzând industria construcțiilor şi a dezvoltării infrastructurii. Mineralele pot fi considerate resurse regenerabile în mod condiționat, fiind depuse de râuri la anumite rate. Exploatarea acestor resurse minerale nonenergetice – deşi puternic reglementată la ora actuală – poate induce modificări ale ecosistemelor lotice şi a celor adiacente pe termen lung, cu efecte greu de prevăzut pentru calitatea vieții umane. Acest articol prezintă rezultate ale studiilor derulate de Universitatea Ecologică din Bucureşti în situl Natura 2000 ROSCI0103 Lunca Buzăului şi experiența privind cadrul legislativ şi de reglementare a activității de exploatare a agregatelor minerale din postura de custode al acestei arii naturale protejate. Articolul prezintă situația actuală a exploatării agregatelor minerale la nivelul râului Buzău, cu beneficiile şi riscurile de mediu asociate, precum şi tendințe noi şi posibilități de orientare a acestei activități spre opțiuni durabile.

ZUSAMMENFASSUNG: Auswirkungen des Kies- und Sandabbaus in den Flussauen. Fallstudie Buzău-Fluss (Rumänien).

Der Kies- und Sandabbau ist eine wichtige Tätigkeit für die gesamte Gesellschaft, da von ihr die Bauindustrie und die Entwicklung der Infrastruktur abhängig ist. Die Mineralaggregate Kies- und Sand können bedingt als erneuerbare Ressourcen angesehen werden, da sie von den Flüssen bei bestimmten Ereignissen angelandet werden. Der Abbau dieser nicht-energetischen mineralen Ressourcen kann – obwohl er gegenwärtig streng geregelt ist – langfristig Veränderungen der lotischen und der angrenzenden Ökosysteme verursachen, deren Folgen für die Lebensqualität der Menschen schwer vorhersehbar sind. In vorliegender Arbeit werden die Ergebnisse der Untersuchungen vorgestellt, die von der Ökologischen Universität Bukarest im Natura 2000 Gebiet ROSCI0103 Lunca Buzăului/Buzău-Aue durchgeführt wurden. Auch werden die mit den rechtlichen Rahmenbedingungen und Regelungen der Abbautätigkeit gemachten Erfahrungen aus der Sicht eines Kustoden dieses Schutzgebietes mitgeteilt. Die Arbeit belegt den Ist-Zustand des Kies- und Sandabbaus am Beispiel des Buzău Flusses mit allen damit verbundenen Vorteilen und Umweltrisiken sowie die neuen Tendenzen und Orientierungsmöglichkeiten dieser Tätigkeit hin zu nachhaltigen Optionen.

INTRODUCTION

Rivers are complex and dynamic geomorphic systems whose major function is the transportation of water and sediments (Langer, 2003). These systems are in a dynamic equilibrium mostly governed by highly interdependent hydraulic variables. Any change of one variable induces a response in one or more of the others (Langer, 2003).

Although mineral aggregates represent the second most exploited raw material (after water) globally, there is no available global homogenous direct data regarding this type of mining activity (UNEP, 2014). Indirect assessment from data of cement industry, civil engineering, land expansion and ecological restoration projects, leads to a minimum figure of 40 billion cubic meters of sand and gravel exploited annually, which is double the annual estimated global sedimentation rate (acc. to Milliman and Syvitki, 1992, in UNEP, 2014). In ecological terms, the exceeding sedimentation rate by exploitation means the carrying capacity of the lotic and riverine ecosystems will exceed as well. This over-exploitation led to degradation of the structure and functions of riverine and lotic ecosystems, like the rise of turbidity and its impacts on biodiversity (Kondolf, 1997; UNEP, 2014), instability of the upstream channel, upstream and downstream erosion, deepening of the channel, deposition of fine sediment downstream (siltation), lowering of the water-table, with effects on riverine vegetation, and the reduction of oxbow formation/replenishment (Kondolf, 1997; Ward et al., 2001; UNEP, 2014).

The aggregate industry gained momentum in the last 20 years, tripling the estimated quantity of exploited aggregates from 1994 to 2012 (acc. to USGS), especially due to the economic growth of Asia (UNEP, 2014). Special policies for this field were not developed because the environmental impacts caused by in-stream mining are very insidious and hard to quantify and monitor. For instance, at the international level, any convention to regulate the extraction, trade and use of aggregates extracted from inland waters does not exist (UNEP, 2014). The governance is not coherent in this field and there are several regulation levels between national legislation and several international conventions; there are also no globally accepted standards to regulate this mining activity (Velegrakis et al., 2010 and Radzevicius et al., 2010, in UNEP, 2014).

MATERIAL AND METHODS

We surveyed the Buzău River from 2011 to 2015 between Siriu (Buzău County) and Vișani locality (Brăila County) for riparian habitats and aquatic species (macroinvertebrates, fishes, amphibians, tortoises) and the anthropogenic impact caused by in-stream and riparian aggregate mining. We also reviewed 68 Aproppriate Assessment Studies for mining projects developed inside the Natura 2000 site from 2011 to 2015 and visited project sites located between the Vipereşti and Cilibia localities. For changes in river morphometry, we selected two in-stream mining sites (at Bordușani and Dâmbroca localities,) mining projects ordered by Buzău-Ialomița Water Branch (regional water management body) for river regulation and flood control. At those two sites, recent (May 2015) and older (October 2011, November 2011, May 2014, July 2014) satellite imagery was used available through Google Earth Service (Digital Globe, CNES/ Astrium, 2016). We used the measurement tool from Google Earth software, which has an error of aprox. 0.112%, if placed correctly. We also acknowledged a placement error of aprox. 0.5 m. The resolution of imagery varies at the two study sites between 15 and 30 cm. We also did an extensive legislation screening and ran several meetings with local stakeholders throughout the legal custody period (March 2011 – March 2016.) Some of the fieldwork and meetings were facilitated through a structural EU funded project, which aimed to elaborate the management plan.

RESULTS AND DISCUSSION

Economic activities of production and civil engineering depend heavily on the extractive industry for raw materials (CE, 2011). The quantities of exploited mineral aggregates at the EU level were estimated at 1 billion tons, the related economic field registered a rate of turn-over of around 20 billion euros and an offering of 238.000 places of employment (UEPG, 2016) (Fig. 1).

Although, at the EU level, the trend of aggregate extraction is decreasing; in the period 2008-2014 the national aggregate extraction industry recorded an upward trend, the extracted volumes nearly tripled between 2008 and 2012 (UEPG, 2012).

An alarming fact from the sustainability point of view of this domain of raw material market is that in spite of the European trend, the amount of aggregates obtained from recycled building materials or from the crushing processes of open mining pits was negligible at a national level.

The rate of aggregates obtained through the crushing of rocks, manufacturing, or from recycling building materials fluctuated at the EU level through 2008-2014, reaching in 2014 46% aggregates from crushing, 8% from recycling, 2% from production, 4% from sea dredging and 40% from in-stream and terrace mining. The upward of aggregates obtained through crushing and recycling leads to a lower threat on riverine and riparian ecosystems.

This is not valid for Romania, where the figures for crushed, recycled or produced aggregates are negligible. For 2014, Romania was relying on 98% of its aggregate extraction on in-stream and terrace mining (see Fig. 2; UEPG, 2016).

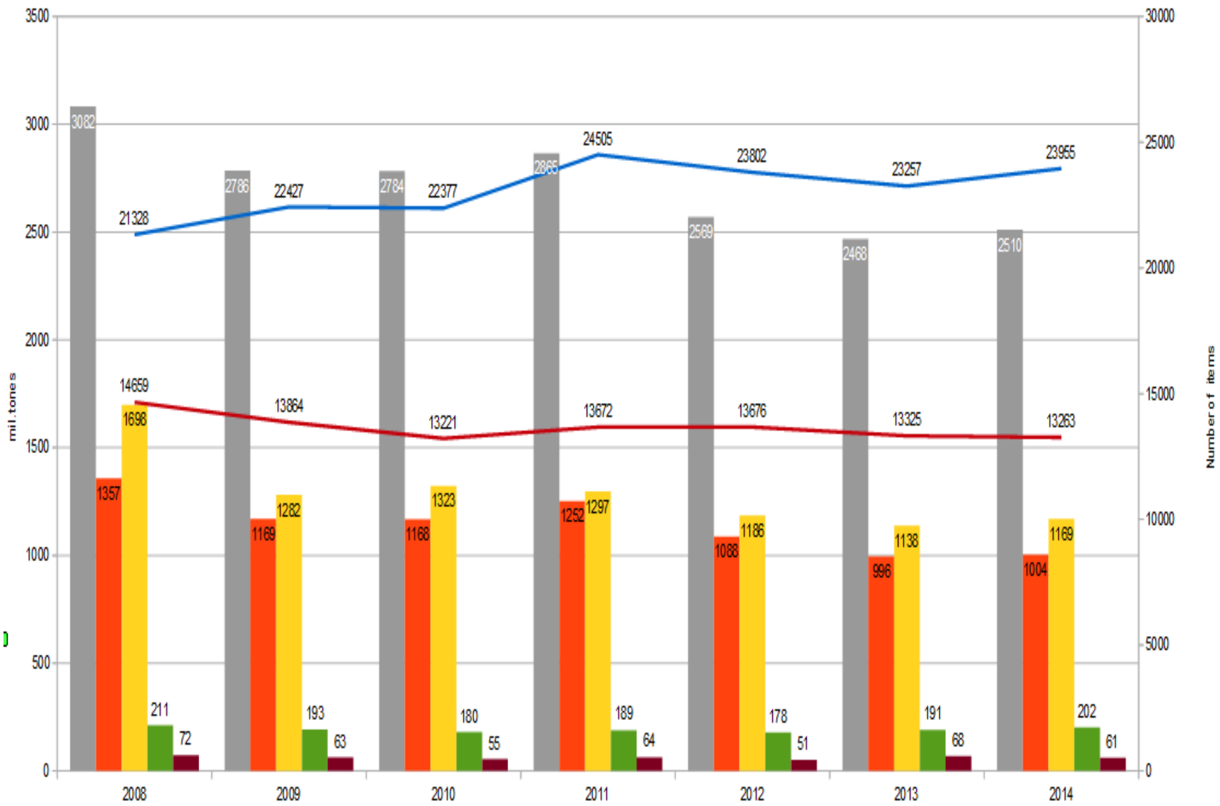

Figure 1: The EU 27 Aggregate Industry (total production in grey), split into aggregate extraction (sand and gravel from rivers and terraces; in red), rock crushing (in yellow), aggregate recycling (in green) and aggregate manufacturing (in brown.) The right vertical axis scales the figures of extraction sites (blue line) and of extraction companies (red line) across EU 27.

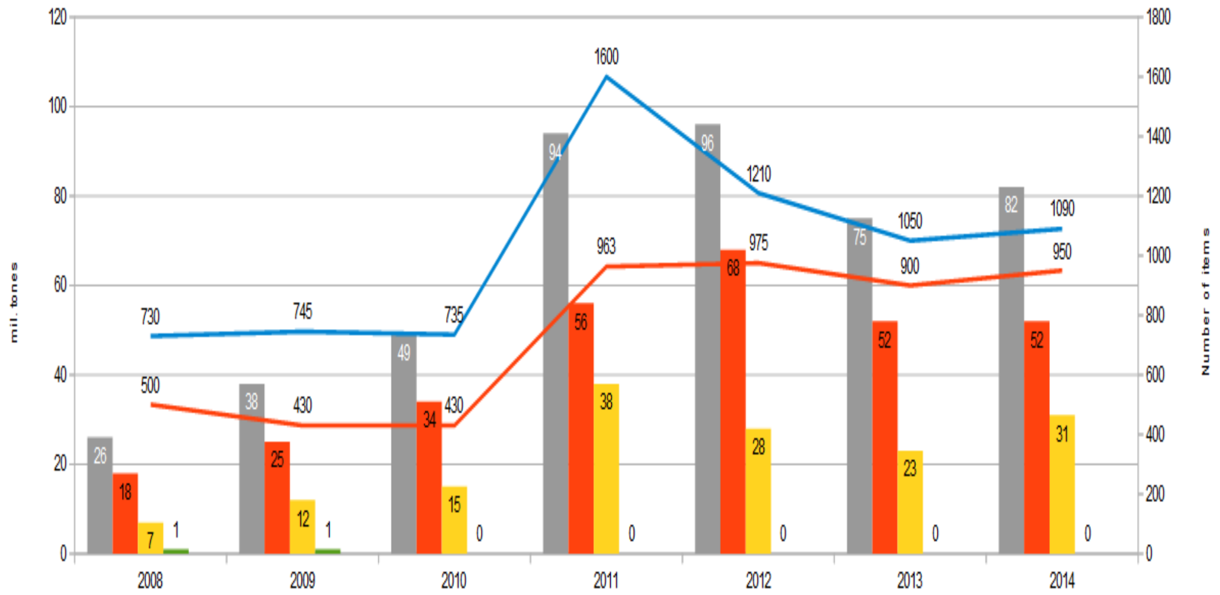

Figure 2: The Romanian Aggregate Industry (total production in grey), split into aggregate extraction (sand and gravel from rivers and terraces; in red), rock crushing (in yellow), aggregate recycling (in green) and aggregate manufacturing (in brown – 0 in this case.) The right vertical axis scales the figures of extraction sites (blue line) and of extraction companies (red line) in Romania.

At the Natura 2000 site ROSCI0103 Lunca Buzăului, the in-stream and terrace mining of aggregates is located between the city Pătârlagele and the Cilibia locality, being documented since the communist era. Until the Revolution (1989) there were 8 gravel plants documented. According to the county's annual statistic, in 2013, 24 aggregate mining companies were recorded, from a total of 8,890 economic unities, adding up a turn-over of 127 mil. lei (0.87% of the county's turn-over) and having a figure of 951 employees. The civil engineering branch, which depends directly on aggregate mining, recorded in 2013 a turn-over of 783 mil. lei's (5.4% of the county's turn-over), ran through 730 companies, with a total of 5,976 employees (10% of the county's active labour force) (INS, 2013). If we keep in mind that aggregates are used almost at any type of civil engineering (road-building, pipe-lining, erosion and flood control works, land-slide control works, parking, other types of buildings), we will grasp a clearer image on the importance of the aggregate industry – on a county level, national level, and on a European level.

One out of the four major threats on the *Buzău* river, identified in the *Buzău-Ialomița* Watershed Management Plan, is the hydromorphic alterations (ANAR, 2009). These alterations are effects of changes undergone by this river in the last 40 years generated by aggregate exploitation and hydrotechnical works (dams and crossovers). Thus, the braiding indices decreased, it appeared that a loop arrest phenomena and the length of the river decreased (EUB, 2014). There were also lateral erosions and channel instability recorded, affecting even civil engineering structures, like the Mărăcineni bridge, which was destroyed in 2005 by high waters.

Natura 2000 site ROSCI0103 Lunca Buzăului was designated in 2007 through Ministerial Order no. 1964 for riverine and riparian species and habitats. This Natura 2000 site of community interest is a classic case where the two Directives (Habitats Directive 92/43/EEC and Water Framework Directive 2000/60/EC) synergistically apply, for the protection and enhancement of aquatic and dependent ecosystems are a common objective of both European directives. Such water bodies are noted in a special register for protected areas, according to article 6 from the Water Framework Directive. Those protected areas receive the status of "water dependent protected areas" – a case where both of the Directives apply (EC, 2011). The Water Framework Directive 2000/60/EC is transposed in Romanian legislation in the Law no. 310/2004, which modifies the Water Law 107/1996, and the Nature Directives (Birds and Habitats) are both transposed in Urgent Government Ordinance 57/2007, adopted by the Parliament with addenda and changes in the Law of Natural Protected Areas no. 49/2011. Article 34 from Law 310/2004, with the subsequent legal acts, together with the Mines Law no. 85/2003 and Government Decision 1208/2003 (standard specifications) govern the river in-stream and terrace aggregate extraction in Romania. The Law of Natural Protected Areas no. 49/2011, Government Decision no. 445/2009 for EIA and the Ministerial Order 19/2010 regarding the Appropriate Assessment standard specifications which regulate the activity of assessment of impact on the environment and Natura 2000 sites. The regulation process of river in-stream aggregate mining in Natura 2000 sites is presented in figure 3.

The responsible bodies for the regulation process of aggregate extraction activities from in-stream and river terrace are represented by the National Agency for Mineral Resources, Regional Water Branch and Local Environmental Protection Agency (LEPA). The Natura 2000 site is included in the regulation schema (the administrator/custodian,) in the sense that LEPA asks for and takes into account the custodians advice/notice (Law no. 49/2011 and M. O. 1052/2014). Thus, the custodians notice is not a regulatory act (permit or advice), but the Environmental Accept emitted by LEPA is based on the custodians notice.

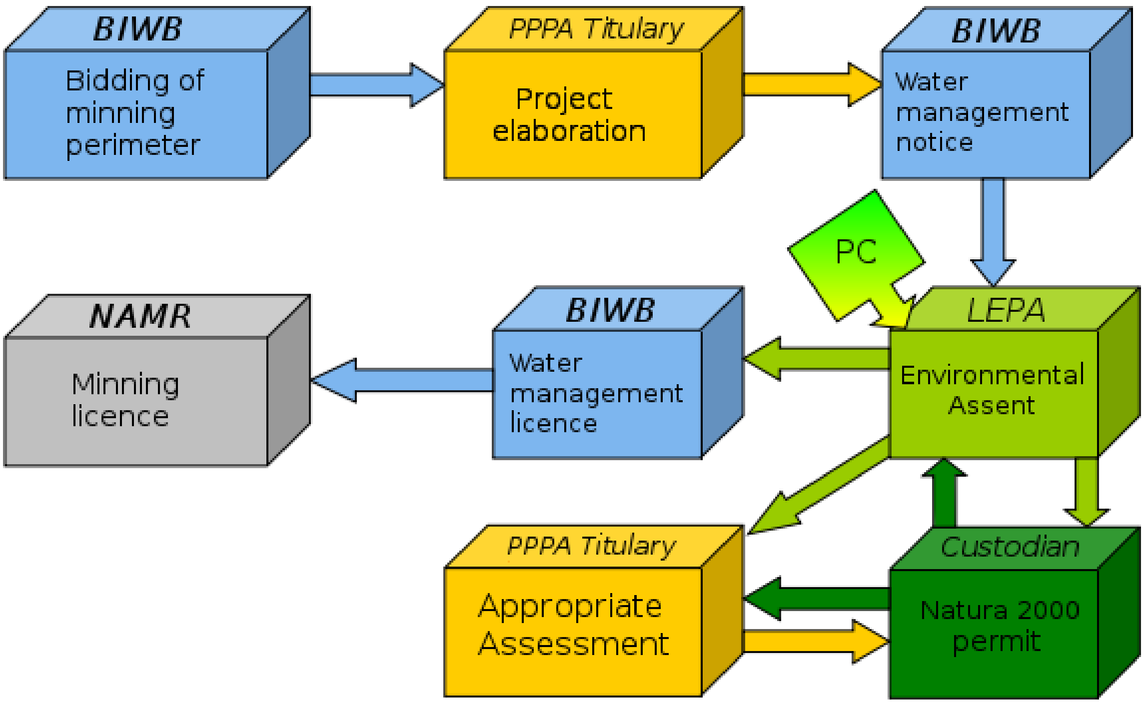

Figure 3: The regulatory process of in-stream aggregate mining activities in a Natura 2000 site (*NAMR* = National Agency for Mineral Resources, *BIWB* = Buzău-Ialomița Water Branch, *LEPA* = Local Environmental Protection Agency, *PPPA Titulary* = project/plan/programme/activity titulary, *PC* = public consultation).

The mining features in the minor bed and terraces of the Buzău River

The strategy documents the norms and permits issued by public authorities that regulate the extraction of the mineral aggregates from the ROSCI0103 Lunca Buzăului which are: the Ialomiţa River Basin Management Plan, the Flood Prevention, Management and Mitigation Plan, the Flood Risk Management Plan and the Management Plan of the Natura 2000 Site ROSCI0103 Lunca Buzăului.

The norms issued by the Buzău-Ialomița Water Branch set forth the terms for the exploitation of the mineral aggregates in the Natura 2000 Site ROSCI0103 *Lunca Buzăului*, in order to preserve the natural hydrology regime that includes: the observation levels of the thalweg both upstream and downstream from the exploitation site, keeping safety pillars and artificial slopes to the river banks, a careful use of the digging equipment, applying a specific exploitation methodology, namely in longitudinal stripes, from upstream to downstream of the digging site, by successive retraction from the longitudinal line of the river bed to the shores, while keeping transversal chocking sills to foster deposits of the suspended matter and the limitation of regressive erosion, deposit the excavated material for a limited period of time outside the border of the exploitation site (this helps removal of the excess water), topographic monitoring of the configuration of the minor bed (requested after significant hydrological events, such as floods) and topographic measurement after works completion, keeping the natural thalweg from before the works as a pre-condition to regulate the desilting and retraining of the river bed.

LEPA's regulatory acts stipulate for a number of in-stream and terrace mining conditions, derived from the environmental legal framework, as well as from custodian's permit. These terms were elaborated by field studies carried out by the Ecological University of Bucharest that is the custodian of the Natura 2000 Site ROSCI0103 *Lunca Buzăului*. The obligation to complete the works and to deposit financial guarantees for rehabilitation of the environment are set forth in the general norms and in specific exploitation permits, in order to ensure the integrity of the Natura 2000 site and the environmental protection.

The main term of the exploitation permit is banning the exploitation of the mineral aggregates from the minor river bed from the 1st of April to the 1st of July, as this interval is used by fish for reproduction.

In spite of all these terms being observed, pressures from extraction of the mineral aggregates were encountered at the level of lotic ecosystem in the Natura 2000 Site ROSCI0103 Lunca Buzăului (ANAR, 2009; ***, 2012; Stoica, 2013; UEB, 2014). The river sector from downstream Berca to the river mouth of Siret is included in the exceptions from Art., 4.4. of the Water Framework Directive, by prolongation of the term to reach the good ecological status for the period 2022-2027 (ANAR, ABA *Buzău-Ialomița*, INHGA, 2015).

During the first planning cycle (ANAR, 2009) four types of pressures were identified, among them is the hydromorphic alteration. These pressures jeopardised the efforts to reach the objective of good ecological status for the year 2015, as provided by the Water Framework Directive. During the second planning cycle (ANAR, 2015), the exploitation of aggregates is listed in the subchapter "Other types of anthropic pressures", without evaluation of the impact to the ecological status.

The field studies in ROSCI0103 *Lunca Buzăului* documented both positive and negative impacts of the extraction activity to the lotic and riparian ecosystems in the area and detailed the threats to the conservation objectives.

This article reviews both identified direct threats from the mineral aggregates exploitation and risks estimated from structural modifications observed during field trips or reported by authorities in-charge of natural resources administration. The article also reviews positive trends that can lead the mining in the area to a more sustainable practice.

Functional and structural modifications and their effects

1. Decreasing the structural diversity of the lotic ecosystem

The leveling of the flowing bed and the vertical cut of the banks lead to the decreasing of the stability of the lotic ecosystem (O'Conner, 1991; Douglas and Lake, 1994; Elmqvist et al., 2003; Tews et al., 2004; Scott, 2007). The negative effects to the lotic ecosystem include:

1. Loss of fish reproduction sites;
2. Loss of refugees of the aquatic fauna from floods and predators (Palmer et al., 1996);
3. Dramatic decrease of available food for fishes, by decreasing of the detritus (O'Connor, 1991);
4. Decreasing of the aquatic vegetation, mainly algae (Dudley et al., 1986);
5. Decreasing of the habitat complexity, mainly of the fractal dimension of the substrate, which in turn can lead to a decrease in the number of invertebrate taxa and population density (Taniguchi and Tokeshi, 2004);
6. Modification of the filtration capacity, following the impact on the riparian vegetation (Ashraf et al., 2011);
7. Modification in the sedimentation rate, by removal of the structural diversity elements such as logs (Franklin, 1992);
8. Modification of the capacity to dissipate the kinetic energy and concentration of the kinetic energy, leading to negative impacts downstream.

2. Lowering the level of the thalweg and of the piezometric level

The structure of the Buzău River sector within the boundaries of the Natura 2000 site ROSCI0103 is modified compared to its natural status by 2 major hydrotechnical works: Siriu Dam and Berca-Cândești Dam. These two dams alter the solid flow and consequently cause hungry water phenomena (Langer, 2003): retention of the solid flows by the hydrotechnical works while allowing liquid flows to pass the works, mostly during high waters which mobilize the sediments from downstream of the works and the lower level of the thalweg, eventually leading to bank erosion.

Lowering the level of the thalweg causes the lowering thalweg levels of the tributaries and bank to undercut. Three transversal abrupt discharges, located between the villages Berca and Vadu Pașii, Berca-Cândești Dam, along with the rigorous topographic monitoring of the natural levels of the thalweg, ensure a defense line to the regressive erosion and to the risk of lowering the thalweg levels.

However, at the berm abrupt discharge downstream the road and railway bridge from Vadu Paşii there is a difference of 1-2 meters to the natural levels. The abrupt discharge was built in 2003 to protect the bridge. The concrete abrupt discharge was damaged by the erosion caused by waters flowing directly into it. The rehabilitation works started in 2012 to strengthen and clean the river bed (remove the clogs) in order to protect the concrete abrupt.

In the River sector between Moșești and Vișani villages, the poplar trees from riverside coppice (managed by the Ianca Forest Unit) withered because of the lowering thalweg level that continued to cause the lowering of the water table. These poplar (and willow) coppices are a valuable plant association, namely a Natura 2000 habitat and is one of the assets for which the area was declared a Natura 2000 site. The association survival critically depends on the high level of the water table.

Both downstream and upstream of the river segment located between Vadu-Pașii and Săgeata villages (segment which exhibits the highest accumulation of agreggates exploitation yards in the minor river bed) the thalweg level was lowered as a consequence of aggregate mining. Most likely the aggregates exploitation as well as the impact of the two dams caused the loss of balance between the erosion rate and the sedimentation rate which further caused the lowering of the thalweg level (and the lowering of the water table.)

Although there is data about Buzău River solid flow, and hydraulic models were constructed, including support capacity studies (for Vadu Pașii village sector - Stoica, 2013), we did not find a study on the carrying capacity of the entire length of the Buzău River between the boundaries of the Natura 2000 site affected by the in-stream mining activities. Such a study is needed to find out the equilibrium point between the sedimentation rate and the aggregates exploitation rate. Nonetheless, the Buzău – Ialomița Basin Management Plan includes the objective of establishing this equilibrium point (ANAR, 2009).

3. Changes in river hydraulic regime

Modifications of the hydraulic regime are mainly due to changes in the river profile. Thus, a large channel profile appears through sand and gravel bar skimming and leveling of the riverbed; this kind of riverbed leveling leads to the lack of valley floor clears delineation and channels instability (Kondolf, 1994; USGS, 2003). Another kind of impact could be that of lowering the elevation of bar surface by sand and gravel extraction, which may reduce the threshold water discharge at which sediment transport occurs (OWRRI, 1995, cited in USGS, 2003). Bar skimming also leads to reduced oxbow surface and function, with a certain decrease in wetland biodiversity and its services.

On the other hand, shrinking of the river cross profile, and thus, the nonobservance of the natural plain river cross section, leads to downstream kinetic energy build-up and bank erosion, as well as channel instability. The loss of lotic ecosystems structural diversity also has considerable negative impacts on aquatic and riparian species and habitats.

In the respect of approvement for new terrace mining projects, there is no thorough carrying capacity assessment regarding availability of underground water for fish-ponds resulting from mining activities. Thus, there are some concerns that opening more and more water surfaces through excavating under the water-table will expose Buzău alluvial cone ROIL5 underground water reserve to intense evaporation phenomena, given the temperate-continental climate with steppic character. Cumulated with channel incision, this exposure of water surfaces would lower the water-table, thus affecting local communities and riparian vegetation.

In ROSCI0103 Lunca Buzăului site there are 2 cases of major changes of river cross profile, inside 2 mining leases with mining licenses and water management licenses: one along Dâmbroca village and the other along Bordușani village. Both in-stream mining operations were designed to cutoff some meanders and to stop right bank undercutting. Both in-stream mining operations reduced the active channel cross profile to 10-20% of its natural width, leaving behind a completely artificial profile: vertical banks of up to 2 m height, flat river bed with leveled depths, very narrow cross profile, unnatural for flat open country rivers. The mining operations along the Dâmbroca locality managed to rechannel the Buzău River at high discharges, but generated bank erosion of the new channel and a downstream in-depth right bank erosion of nearly 60 meters, putting an aggregate station at risk (Fig. 4). The mining operation along the Bordușani locality did not manage to rechannel the Buzău River at high discharges, the river recatching its former natural channel, with a downstream in-depth right bank erosion of nearly 50 m between 2011 and 2015 (Fig. 5).

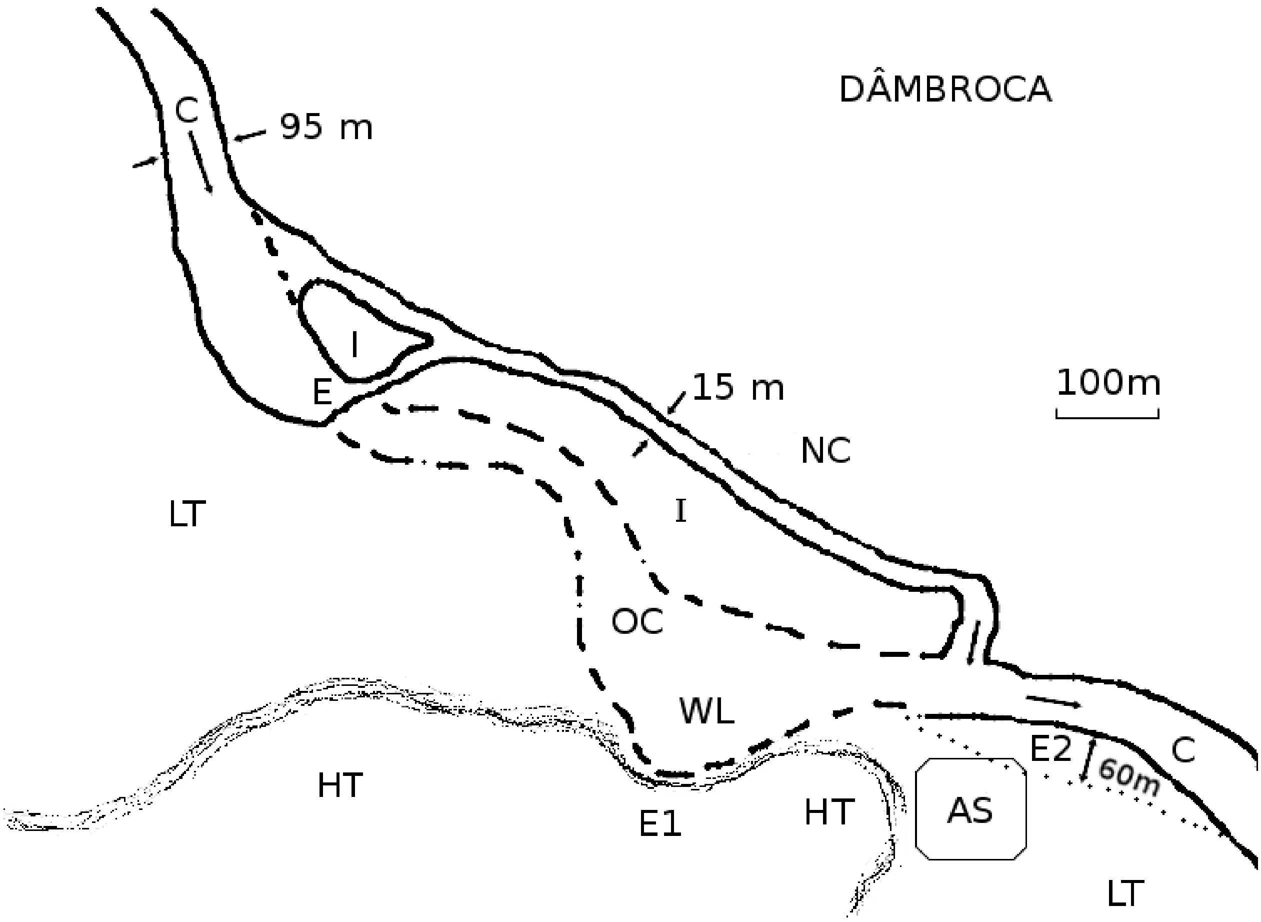

Figure 4: In-stream aggregate mining on the Buzău River, along Dâmbroca locality: AS = aggregate station, C = Buzău River channel, E = embankment, E1 = right bank erosion upstream of AS, E2 = right bank erosion downstream AS, I = islet, HT = high terrace, LT = low terrace, NC = new channel, OC = old channel, WL = wetland.

Changes in flow regime occur because of changes in the flowing section (following the drastic straightening of the river bed), leveling of the flowing bed and formation of vertical banks which result in bank undercutting, enlargement of the flowing section and augmentation of the solid flow (Kondolf, 1997). These effects are encountered in the Lunca Buzăului Natura 2000 site, in the Berca-Săgeata River sector and are marked in the case of the regularization works carried out off the villages *Dâmbroca* and *Bordușani*. The effects of changes to the hydraulic regime of the lotic ecosystem are the following:

- Overcharge of the downstream lotic ecosystem by sediments, mostly fine silt type;
- Decreasing in water quality, following an increase in turbidity and decrease in light penetration depth, increase in temperature and driving the organic and toxic suspension back to the water flow (Langer, 2003);
- Augmentation of erosion of the flowing bed, in case the extraction rate exceeds the sedimentation rate (Kondolf, 1997);
- Regressive erosion, in case of accidental decrease below the natural level of the thalweg;
- Choking of some downstream areas, because of sediment charge, sediments resulted from regressive erosion and bank undercutting;
- Increase in mobility of gravel beds in the upper layer is discontinued as a result of mining activity (Parker and Klingeman, 1982, in Kondolf, 1997);

Modification of the hydraulic capacity to control the upstream flow (leading to erosion in the low depth areas) (Pauley et al., 1989, in Kondolf, 1997), that impacts the fish reproduction areas.

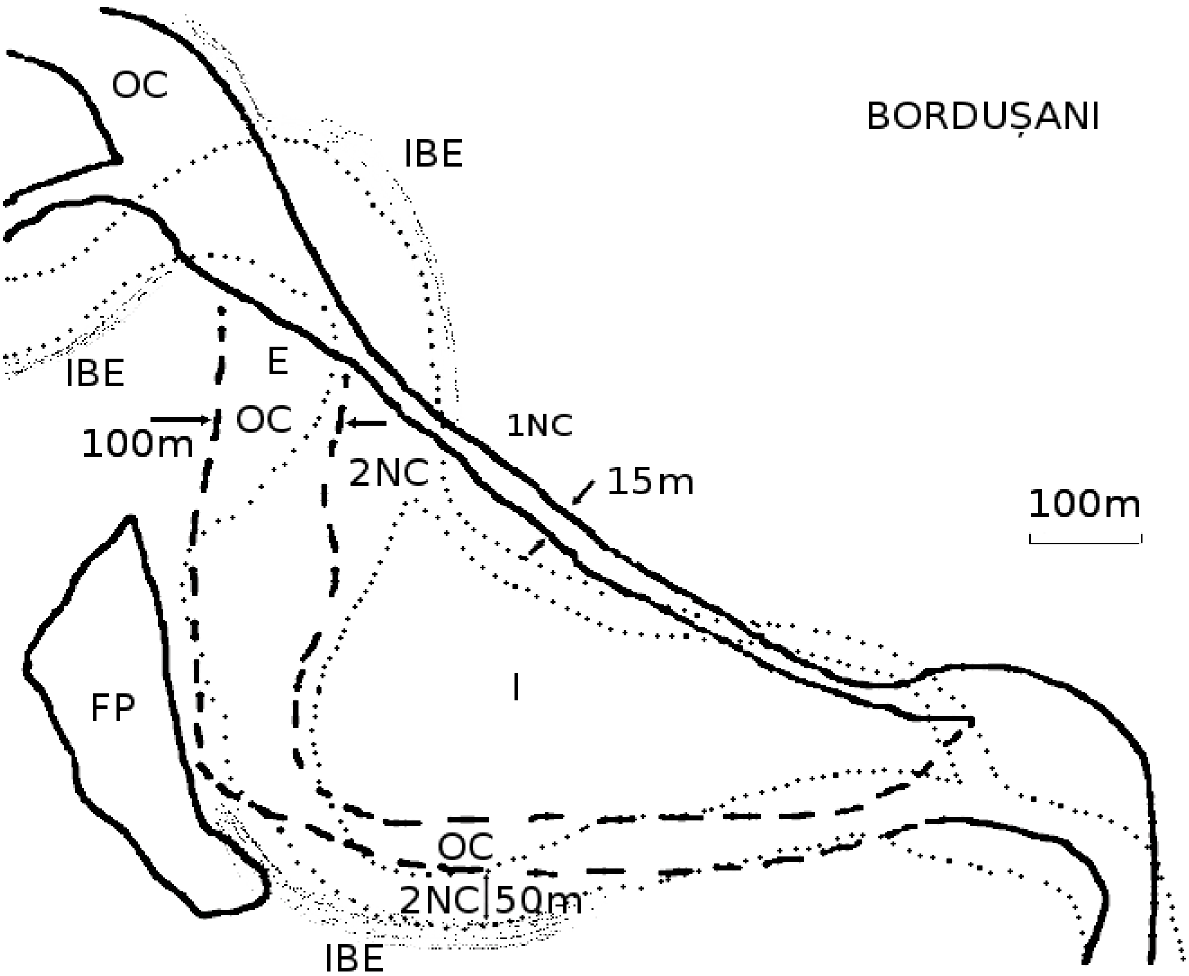

Figure 5: In-stream aggregate mining on Buzău River, along Bordușani locality:
E = embankment, FP = fish pond in an old terrace mining pit, IBE = intense bank erosion, NC = new river channel, OC = old river channel.

The field studies revealed the following impacts to the environment from the changes in the hydraulic regime of the riparian ecosystems:

- Bank undercutting;
- Limited water supply of secondary or dead branches, further impacting the biodiversity and wetland services.
- As a result of lateral erosion:
    - Disappearance of areas covered by *Tamarix ramosissima*, that may evolve towards protected Habitat 92D0: Southern riparian galleries and thickets (Nerio-. Tamaricetea and Securinegion tinctoriae);
    - Disappearance of the areas covered by wooden vegetation, leading to a decrease in shadow degree, vanishing of the cover areas for the fauna and increasing of the water temperature;

Increase in bank height and blocking energy exchanges (disturbance of the food chains: hampering of migration between lotic and riparian ecosystems of some invertebrate, amphibian, reptile species, preventing waders to feed themselves).

4. Changes to the characteristics of the solid flow

The in-stream mining of mineral aggregates from the Buzău River modifies the grading of the substrate by deposition of fine alluvium (Rundquist, 1980, in USGS, 2003), in the mining area itself and upstream.

Changes to the grading causes the following effects:

- Hampering the water flow through the gravel substrate obstacles which blocks the development of the roe and makes the elimination of the excretion impossible (USGS, 2003);
- Destruction of the reproduction habitats, mainly for *Gobio uranoscopus* and *Gobio kessleri*;
- Hampering the fixation of the roe to the substrate in the case of *Gobio kessleri*;
- Decreasing the population size and the biodiversity of the macroinvertebrates, which leads to reduction of the food resource for the fish species;
- Inhibition of the fish larvae, alevins and adults behavior, including the migration behavior and even blocking the reproduction process; (USGS, 2003).

Extraction of aggregates from the river bed also modifies the temporal dynamics of solid flow, in such a way that the modified hydraulic regime increases the total suspended matter and the overall turbidity, mostly in the low waters period of time, in obvious opposition to the natural flow regime when the turbidity is high at high waters.

The reproduction period for the conservative interest fish species (April to July) partially overlaps with the period of high solid flows and high turbidity (March to May).

During the period July to November the roe and the alevins need lower water turbidity and higher values of dissolved oxygen to survive and to allow the alevin's food – namely aquatic invertebrates – to grow. During this critical period, mining aggregates in the minor river bed may cause the following:

- The decrease in reproduction success for the conservative interest fish species caused by the death of the embryos following the level of dissolved oxygen or by washing away the roe and its transport downstream, following the impossibility to anchor to the substrate;
- The increase of juvenile's mortality, following the decrease of available food and choking or removal of the shelter areas;
- Gill's irritation for some invertebrates species and for all fish species (***, 2012).

Other Risks of mineral aggregates mining in the River bed and River terraces

The risks from aggregate mining, which are threats to the integrity of the Natura 2000 ROSCI0103 Lunca Buzăului, were assessed from the nature of the activities, but in absence of concrete documented cases.

The first risk is that mining activities may exceed the natural sedimentation rate, in absence of a study of the Natura 2000 site carrying capacity. To evaluate the carrying capacity, it is necessary to take into account the synergy of the mining with other activities' impact (such as hydrotechnical engineering, water abstraction, changes to natural flooding regime, the anthropic flow control in the 2 upstream dams: *Siriu* and *Cândești*).

A second risk comes from the completed excavations that resulted in fish pools, located in the lower meadow (Kondolf, 1994). In the ROSCI0103 Lunca Buzăului site there are at least two such excavation locations placed at least 40 m distance from the current river channel. Such pools could arrest the river channel at high discharges, further generating upstream or retrograde erosion.

A third risk comes from the illegal in-stream mining activities, either by exceeding the allowed border of the exploitation area and/or by exceeding the allowed extracted volume of mineral aggregations. These levels are set forth in the Permits issued by the 3 Authorities: the authority for mineral resources, the authority for water management and the authority for environmental protection. There are written or verbal testimonials about such illegal mining activities, but the custodian could not document any illegal exploitation.

Another (relatively) minor risk that may be easy to handle is the pollution risk from mineral oils or fuels from the exploitation equipment.

From the Natura 2000 site management perspective, there is a risk of weak institutional cooperation, resulting in a weak control of the environmental crimes, including illegal mining for mineral aggregates. The complex and costly permitting procedure, in connection with a weak presence of the agents in the field may encourage such illegalities. These mentioned aspects are common in many other Member States of the European Union, as problems in the implementation of the Water Framework Directive (del Tanago et al., 2011).

Positive aspects and trends in the mineral aggregates mining from the minor bed and terraces of the Buzau River.

Commonly the mining impacts on environment are assumed negative but nowadays an increasing number of companies implement compensatory measures for the biodiversity to balance the residual impact, which cannot be diminished locally and to invest in ecological rehabilitation of the mining areas. Such actions may lead to an added value to the biodiversity potential (Harrison et al., 2010). Ecological University of Bucharest specialists field studies revealed the enlargement of the wetland area and of the *Emys orbicularis* habitat, following the increasing number of fish pools constructed in old mining pits in the Buzău River terrace (UEB, 2014). In these wetlands dwell invertebrates, reptiles, birds and mammals.

A positive trend at the level of strategic planning is the adoption of the re-naturation measures for the river, known as “more room for rivers,” as a blueprint of natural services rehabilitation, out of which erosion control of the lotic and riparian ecosystems plays a central role, (ANAR, 2012).

Another positive aspect is the presence of the activity type, “Reduction of the impact of hydromorphic pressures at the level of water bodies, with the aim of biodiversity protection (passages of ichtyofauna over transversal dams, wetland restoration, river bed and meadow rehabilitation ” (MFE, 2015).

Additionally, the Buzău-Ialomița Water Branch is very open to cooperation with stakeholders, an attitude that is also specified in the River Basin Management Plan 2016-2021. The same cooperation aim is set in the Natura 2000 ROSCI Lunca Buzăului Management Plan, in the form of the action 3.2.3. – “Identification of partnership opportunities, identification of financing opportunities and elaboration of an ecological rehabilitation of the Buzău River in the sector Berca –Săgeata” – in order to reconnect the river segments relevant for habitats integrity.

Although some Western European Countries completely banned the mining in the minor beds of the rivers (Kondolf, 1997), in our opinion the mining can be allowed in the river beds in Romania, under the terms of elaboration of detailed studies to find out the carrying capacity of the lotic ecosystem and to attenuate the environmental impact. In our opinion, the evaluation of the mining projects case by case, could be used as a good practice in the European Union environmental impact assessment (according to EIA Directive – 2014/52/EU, art.3) and can ensure a greater flexibility to legal control over mining activities. Such an approach also allows matching economic development needs to the conservation needs, which is a basic aim of the Natura 2000 network.

A set of good practices from the United Kingdom confirms that the aggregate mining can be safely carried out by observing the biodiversity conservation needs and can even lead to improvements in the quality of lotic and riparian ecosystems, in the historically degraded areas. The studies of environmental, social and economic benefits prove opportunities for economic growth while preserving the quality of the ecosystem services, mostly in the situation of a smart development of the ecological rehabilitation.

Among these studies one may count the Evaluation of net benefits of the ecological rehabilitating of the Ripon City Quarry (Worhkshire, England) mining area (Olsen and Shanon, 2010).

Another good practice example is the ecological reconstruction of the Congost River (Spain) included in the Natura 2000 site ES5110025 Riu Congost, near Granollers village (EC, 2010).

The mineral aggregates exploitation by Hanson Aggregates leads to the formation of the Middleton Lakes, administrated by the Royal Society for Birs Protection (RSPB, 2009). The same type of activity leads to the formation of the Panshanger Park, administrated by Tarmac Company (part of CRH Group). The Panshanger Park is a wetland complex along the Mimram River, passing through a puzzle of arable land, pastures and forest, well-endowed to serve as a recreational and bird – watching area.

CONCLUSIONS

The observations and measurements undertaken at Dâmbroca, Bordușani and Vadu Pașii (Buzău County) confirmed a negative impact of in-stream aggregate mining, especially lateral erosion and channel widening. Diminishing of bank vegetation areas were documented, including salt cedar habitats (*Tamarix ramosissima*) as well as the depletion of fish trophic resource.

Past in-stream mining activities had an impact on the evolution capacity of ecosystem complexes from the studied area, but this involution could be improved through best practices adapted from similar European experiences.

Aggregate extraction from rivers and terraces may be developed with significant benefits for biodiversity – in the wider context of habitat fragmentation and diminishing – only with the conditions of maintaining the lotic ecosystems carrying capacity, of natural river hydraulics and with an intelligent watershed temporal and spatial planning of mining activities. The framing of mining within the natural river hydraulics depend strictly on the functional cooperation between environmental protection and resource management authorities on the one hand and of mining companies on the other.

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TRANSYLVANIAN REVIEW OF SYSTEMATICAL AND ECOLOGICAL RESEARCH 16 (2014) SPECIAL ISSUE – THE IRON GATES NATURE PARK

– REVIEW –

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Angela Curtean-Bănăduc and Doru Bănăduc, Transylvanian Review of Systematical and Ecological Research, 16 - special issue (2014), "Lucian Blaga" University of Sibiu, Faculty of Sciences, Department of Ecology and Environment Protection. The Iron Gates Nature Park, 218 pages, Ed. Universităţii "Lucian Blaga" din Sibiu, ISSN 1841-7051.

Volume 16, a special issue of the Transylvanian Review of Systematical and Ecological Research (TRSER) was recently issued by "Lucian Blaga" University of Sibiu/Romania. The publication is based on scientific papers representing different fields of investigation and studies relating to the Iron Gates Nature Park. Papers include geological studies, morphometric analyses of the river basin, microclimatic features as well as micro- and macro-habitat analyses. The importance of the conservation of autochthonous species as well as possible negative impacts of non-native on native species is also considered in papers in this volume. Significant social and economic changes, the return to private ownership regime and establishment of the protected area which happened in this region at the end of XX and start of XXIst centuries have had an impact on landscape typology and fragmentation. Altogether, papers in this volume give valuable contribution for the determination of the ecological status of the Iron Gates Natural Park with an overview of changes induced by human impact in this sector of the Danube.

The first paper presented by author Mihai Emilian POPA is dedicated to "*Lepidophloios acerosus* Lindley and Hutton 1831 in the carboniferous cucuiova formation, Iron Gates Natural Park (Banat, Romania)". The lycopsid *Lepidophloios acerosus* Lindley and Hutton 1831 is reported for the first time in Romania and these fossils represent significant geological heritage values of the Iron Gates Nature Parks. From a paleoecological point of view, *Lepidophloios acerosus* is a coal generator, occurring in wet habitats such as the edges of coal producing mires. The carboniferous deposits of the Sirinia Basin (Svința-Svinecea Mare sedimentary zone) were known since the XX century. The author and his collaborators show evidence of covered outcrops in the Sirinia Basin using GPS gear and GIS methods, as well as the emergence of new, although smaller outcrops, such as those along Dragosela Valley.

The study presented by the author Erika SCHNEIDER-BINDER refers to "Phytogeographical importance of the mountains along the Danube mountain gap valley and surrounding area", and relates to the high biodiversity of the studied area which is represented by many xero-thermophilous species, phytocoenoses and habitats of Southern origin. The variety of phyto-geographical regionalisation highlights the uniqueness of the area, being a meeting point of species with their Northern, Southern, Western or Eastern limits in the Danube Gorge. The South-Western Carpathians between Serbia and Romania represent the most thermophilous corner of the Carpathians. Specific geology of this region creates unique site conditions that contribute to the large variety of macro- and micro-habitats in the region of the Danube gorge. The author also highlights the relevance of the habitats occurring in the Danube cross valley and surrounding area (including the characteristic phyto- and zoo-coenoses) for the Natura 2000 network.

The paper of Cristian TETELEA, "Morphometric analysis to extrapolate the geoecological potential of the rivers in the Iron Gates Natural Park (Banat, Romania)", is based on morphometric analysis of watersheds from the Iron Gates Natural Park. The author emphasizes the importance of morphometric analysis because morphometric parameters of a river basin are influenced by a series of biotic and abiotic factors. These parameters are a very good alternative for understanding the underlying geoecological factors at watershed scale when there is a scarcity of other data relating to soil, lithology, geomorphology and vegetation. Also, using morphometric analysis of the river network and watersheds can be of great support in the determination of river ecosystem health. The results of this paper can be useful for the conservation of aquatic and riparian habitats as well as for the ecological restoration of certain river segments and water bodies.

Results of researchers concerning the "Microclimate observation at Hermann's tortoise (*Testudo hermanni boettgeri*) habitat in the Iron Gates Natural Park. Case study: lower Eselnita watershed (Banat, Romania)" are presented and discussed by Cristiana-Maria CIOCANEA, Athanasios-Alexandru GAVRILIDIS and Vasile BAGRINOVSCHI. This paper highlights the necessity for monitoring both the evolution of microclimatic features in the lower Eselentia watershed, and species behaviour, in order to determine if global climate change endangers the conservation management of the tortoise. The Iron Gates Natural Park represents suitable habitat for the existence and development of *Testudo hermanni boettgeri* due to its Mediterranean climatic influences and vegetation structure. Hermann's tortoise represents a flagship species for the Iron Gates Natural Park and it is strictly protected due to the decreased number of individuals caused by illegal trade and habitat loss. Monitoring and recording of the temperature and humidity parameters in lower Eselentia watershed revealed higher multiannual mean temperatures in this area than in other areas in the Iron Gates Natural Park. The authors conclude that the lower Eselentia watershed represents a stable region regarding climatic parameters and an excellent habitat for populations of *Testudo hermanni boettgeri*. They also suggest a monitoring period of at least 50 years in order to elaborate in depth conclusions on the oscillations of climatic parameters in the lower Eselentia watershed.

The paper "The current state of phyto-coenological research in the "Iron Gates" Danube Gorge (Banat, Romania)" is presented by Constantin DRAGULESCU. The author of this study presents a concise history of phyto-coenological research conducted previously in the Danube Gorge based on 55 important papers authored by 54 specialists in the period from 1931 to 2006. The author reports that the vegetation and flora of the Iron Gates Gorges were both well studied for more than half of a century before the construction of the Iron Gates, and after the formation of the new anthropogenic lake, especially after the establishment of the Iron Gates Natural Park.

In the paper concerning the **"***Orchidaceae* L. family in the Iron Gates Park (Romania)" the author Stretco MILANOVIC explains the problem relating to the insufficient information which is available about orchid flora in the Iron Gates Nature Park. The main problem is represented by the lack of the data regarding the detailed geographical distribution and the actual conservation status of species and populations. In the Danube Gorge 29 species of orchids are found in accordance with literature data. The study performed by author in the Iron Gates Nature Park in the 15 year period from 1996 to 2011 recorded the presence of 23 orchid species. The author also recorded the presence of 2 new species in the Danube Gorge area: *Epipactis purpurata* Sm. and *Listera ovata* (L.). At the end author highlights the fact that the current protection measures to conserve orchid species in the Iron Gates Natural Park cannot be considered sufficient.

Results of research concerning the "Particularities of the aquatic vegetation from Iron Gates Natura 2000 site (Banat, Romania)" are presented and discussed by Irina GOIA and Adrian OPREA. The results of investigations on aquatic vegetation along Romanian bank of the Danube River in the area of Iron Gates are presented by authors. In this protected area the authors identified some newly described phytocoenotaxons. In order to assess the conservation status of the plant communities, phytosociologic tables were accompanied with coenotaxonomic, phytogeogaphical, ecological and social strategy analysis. The authors have newly identified eleven plant association and sub-associations in the investigated area, which could be a consequence of vegetation succession after the construction of dam.

Irina GOIA, Cristina-Maria CIOCANEA and Athanasios-Alexandru GAVRILIDIS presented interesting work which relates to "Geographic origins of invasive alien species in Iron Gate Natural Park (Banat, Romania)". They present an inventory and distribution of invasive alien species and their direct impact on conservation status of habitats, and also their indirect economic and sociological impact on human communities. They especially emphasized the most aggressive alien species. The authors identified 43 invasive alien species in the Iron Gates Natural Park and made impact assessments. The most vulnerable areas are the wetlands. At the end authors make recommendations for the establishment of concrete actions for monitoring invasive alien species.

The main objective of the "Land snail fauna of Portile de Fier (Iron Gates) Nature Park (Banat, Romania)" presented by the author Voichita GHEOCA, is to analyse terrestrial mollusc fauna of the Iron Gates Nature Park. The author identified 45 species of terrestrial gastropods on 17 sampling locations. Four of these 45 species were recorded for the first time in the area. The results of the analyses presented by author confirm that the current legal and illegal exploitation of limestone threatens the molluscan communities associated with this type of habitat. One of the main purposes of this paper is to contribute to the assessment of biodiversity in the Iron Gates Nature Park, for a future management plan. At the end author points out that the limited mobility of gastropods and the continuous landscape change makes the colonization of habitats in Iron Gates Nature Park difficult.

In their case study "Preliminary data on the ecological requirements of the invasive spiny-cheek crayfish in the Lower Danube" the authors Malina PIRVU and Angheluta VADINEANU present preliminary data on the ecological preferences of the invasive species *Orconectes limosus* as well as on its control. Monitoring was performed of relevant tributaries in the invaded Danube sector in order to assess the species ability to colonize small river systems. Analyses showed a preference of species for deep and warm rivers, low water velocity and also high concentration of calcium. The authors report for the first time data relating to the contact between the indigenous crayfish species, *Astacus astacus* and *Astacus torrentum*, and non-indigenous crayfish species *Orconectes limosus*. *Orconectes limosus* can present a future threat for the indigenous crayfish species, and a risk of coming into contact with the protected species.

Analysis of the longitudinal dynamics of the benthic macroinvertebrate communities of the left Danube tributaries is presented in the paper "Benthic macroinvertebrate communities in the northern tributaries of the Iron gates Gorge (Danube River)" by Angela CURTEAN-BANADUC. The Sirinia, Liubicova, Berzasca and Mraconia Rivers have their sources in the Almaj mountains and are classified into western Carpathian type with short length, large slope and relatively high flow rates. The results, based on 95 quantitative benthic macroinvertebrate samples collected at 19 locations, show that the Sirinia, Liubcova and Berzasca Rivers have a relatively big structural variability, while the communities of the Marconia River have a smaller structural variability, which emphasises the good ecological status of the analysed rivers, except the Berzasca River sector downstream of the town Berzasca which is under man-made modifications.

Doru BĂNĂDUC and Angela CURTEAN-BĂNĂDUC present very interesting results which reveal some aspects of the ichthyofauna of the Berzasca, Sirinia, Liubcova and Mraconia Rivers. The dynamic environmental conditions in the last few decades, induced partly by the Iron Gate I Lake area, were correlated with some qualitative and quantitative changes over a period of time in fish fauna. The fact was revealed that all the studied rivers play a significant role as reproduction and shelter habitats for lotic fish species of small-medium size, within the near Danube Iron Gate I Lake

The authors Doru BANADUC, Angela BANADUC, Mirjana LENHARDT, and Gabor GUTI present in their paper "Portile de Fier/Iron Gate area (Danube) fish fauna" the impact of major hydrotechnical works, pollution, overexploitation and poaching on the ichthyofaunal structure in the "Iron Gates" area of the Danube River. The study includes data from 65 fish species and their status in the XIX – XXIst centuries. This Danube sector is well known as very rich in fish and as a consequence is very important for fisheries. The authors emphasize that due to anthropogenic impact in the "Iron Gates" sector, drastic changes have been induced in the structure of fish communities. Changes were represented by the decrease of populations of autochthonous, economically and culturally important anadromous fish species (sturgeons and shads) and the increase in the catch of allochthonous fish species. Improvement of conservation status needs involvement of national and international authorities, and better monitoring and management of fish communities, including habitat management.

The aim of the paper "Analysing landscape fragmentation and classifying threats to habitats of community interest in the Iron Gates Natural Park" written by Mihaita-Iulian NICULAE, Mihai Razvan NIȚĂ and Gabriel VANĂU is to evaluate the ecological impact of landscape fragmentation, identifying and classifying threats affecting habitats of community interest in the Iron Gates Natural Park. The authors quantified landscape fragmentation for the period 1990 – 2006 using landscape metrics, and evaluated its effects on habitats of community interest, and identified and classified the main categories of threats to and priorities for the areas where they generate environmental conflicts in relation to habitats of community importance. The results of the analyses show that the Iron Gates Natural Park represents an area in which landscapes have suffered reduced modifications after its establishment as a protected area in 2000. Also, recent changes in the structure of the landscapes have not yet induced significant changes in spatial relations established in time between landscape elements.

Finally the last paper included in the volume presented by Mihăiţă-Iulian NICULAE, Mihai Razvan NIȚĂ, Gabriel VANĂU, Cristina CIOCANEA and Athanasios GAVRILIDIS concerns the "Spatial and temporal dynamic of rural and urban landscapes identified in the Iron Gates Natural Park". This paper presents landscape typologies in the Iron Gates Natural Park and evaluates their dynamics in the period 1990 – 2006. The dynamics of the landscape are assessed based on changes of land use and land covers within the Corine Land Cover databases. Changes were recorded in only 4.4% of the study area, with the highest ratio of change in forest landscapes, and significant decreases were recorded in shrub and rare vegetation landscapes as well as mixed agricultural landscape. One of the main objectives of this paper is also to evaluate the spatial and temporal dynamic of landscape typologies in the study area in the period of significant social and economic change, return to a private ownership regime and establishment of the protected area. At the end authors suggest that the typologies of landscapes identified in the Iron Gates Natural Park can serve as a support for future studies and public administration. A model for the dynamic of landscapes represented in this study can be improved by adding data of a better spatial resolution or integrating the views of residents as an important element in landscape evaluation.

This volume of Transylvanian Review of Systematical and Ecological Research (TRSER) is presented on 218 pages which include the 14 papers mentioned above, with maps, photos, diagrams, graphics and tables.

The papers presented in the Special issue Volume 16 represent a unique collection of data relating to the Iron Gates National Park area. The authors of the above papers emphasize the specific geology of this region which contributes to the large variety of micro- and macro-habitats in the studied area. This area is also known for its high biodiversity and representativity of fossils, flora and fauna which are the geological, natural and cultural heritage of this Danube River sector. The authors confirm new records of particular plant and animal species, and plant associations, as well as significant changes in macroinvertebrate and fish communities. Analyses of the morphometric parameters of the river basin and evaluation of microclimatic features give more information about the specific characteristics of this region. Some papers in this volume indicate the negative impact of allochthonous invasive species, especially on autochthonous endangered species. Landscape typology and fragmentation represent studies which offer a good basis for future monitoring and management plans.

The editors of this volume have succeeded in the preparation of a valuable product relating to Iron Gates Natural Park. We congratulate them for the excellent organization, coordination and editorial activities which have resulted in a complex and valuable volume devoted to unique area of Iron Gates Natural Park.

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"A GÂNDI DESPRE APĂ ... DIN APĂ", UN CURS PRACTIC DE "SFIDARE A GRAVITAŢIEI"/ THINKING OF WATER ... FROM THE WATER", A PRACTICAL COURSE OF "DEFYING GRAVITY"

– REVIEW –

Anca-Narcisa NEAGU [1]

"Thinking of water**…from the water"** is unique in Romanian limnology, freshwater science, but also in recent Romanian biological literature, which is quite poor in „confessions" and too shy in defining new world views that will inspire future generations of students and researchers. The book is indeed a confessional document, centered on an idea that I found recently reading a book by Richard Dawkins, "the most famous biologist of our times", entitled "A boundless curiosity: how I became a scientist": "Ethologists tend to focus on the role of species behaviour in the natural environment".

Reading the book by Professor Ionel Miron, I realized that his entire scientific journey has been built following a single thread: "*thinking of water…from the water"* and I understood the essence of the well-chosen title, centered on the absolute necessity of direct observation of life in the water, starting with the largest lake in the country, Bicaz Lake, but extending to other lakes and even the sea and ocean or rivers that pulse under the Sahara desert.

Life in water is brought before our eyes painted through the experience of a HUMAN-researcher lifetime, whose passion and perseverance has metamorphosed the way we see the universe. Celebrating 80 years of life, the author gives us his personal example of achievements in the harsh environment of scientific research, with all the ingredients of success, the whole book developing Saint-Exupéry's idea that "there is only direction, ascension and fight for something" and while paraphrasing the same writer, I realized that only the hard-won way has allowed him to reach this celebration day. For me and for all who know him, but also for those who will read this book, the name **Miron** remains strongly associated with symbols that will never be separated: **batiscape LS 1**, which is unique in the country; the ship **„Emil Racoviţă"; „steaua de pe lac**" in which are domesticated trout; and **The Potoci** Biological Station, where a whole series of students from Romania and other parts of the world have learned from him how to "think of water...from the water". So, I learned that the laboratory experiment could never replace, explain or elucidate the laws governing the complexity of the processes taking place in nature. The microcosm created by man in flasks, in a closed laboratory, is always too far from the enormity of the macrocosm that houses the colossal representations of nature! The young researcher Ionel Miron also probably understood this when he began the journey of science and this book shows that nothing can replace the value of direct observation of living organisms, whose behaviour in nature can never be similar to those exiled in laboratory. And, so… "it is enough to learn to love the sea to begin to build ships..."!

I thought to write about this book as "a practical course of defying gravity". The metaphor of "defying gravity" belongs to Caroline Myss, but I dare to use it this time more in its own sense than the figurative one, because I know that the Professor has always been in love with the feeling of weightlessness, so I think that this impetus and tendency of the defying of his own weight by diving in water represents the moment of his ascension both in land and especially in water. And when you really want to defy gravity you undertake and invest everything to learn how to do this. In this case, defying gravity was achieved by inventing and experimenting research in a submerged laboratory named a bathyscape, and also by learning the skills needed to get into this laboratory, with the help of the autonomic diver and also with the help of a scientific boat, named „Emil Racoviţă”. I also saw that Dawkins remembers how “my life has changed” next to his mentor, Niko Tinbergen, the well-known Nobel laureate ethologist, just as our author, early in his confessions, links the defining of his personality with the Academician Peter Jitariu, assimilated as “spiritual father”, and helped by his wisdom and understanding, defying gravity and entering the aquatic universe have become concrete, thus becoming not only a direction but also the assurance of a future that guided the rest of his life.

This book can be considered a page of history of the “Alexandru Ioan Cuza” University of Iaşi, and also of Romanian biological research in general, because of the power of his statements. Numerous photos and documents that the author has initiated, maintained and published in this book demonstrate good and bad, the beautiful and the ugly, major ups and downs that any devoted researcher passes in tireless search for funds for financing, in building worthy teams, lasting friendships, in discovery of new research methods and resources, in efficiency of the entire research procedure, in conquering international visibility, in penetration of educational administrative systems that are always suffocated by bureaucracy, in continuous verification of new hypotheses, in binding research work with family life, in a long series of sacrifices for the practical application of research results, in an insane curiosity that never sleeps, in a desire for boundless success, in a thirst to share all the results of research, in a passion and mission to build new destinies.

And all of these should be imagined in an entirely different dimension: that of aquatic universe, governed by its own harsh laws, ruthless, that only a “*human-fish*” can understand, as Commander Cousteau called the aquanauts. Morphed into “human-fish” by his passion, Professor Miron, reveals all the graces mentioned by Caroline Myss, that are required by any aspirant on the path of scientific research: strength of character, curiosity, wisdom, knowledge, understanding, honour and guidance. The practical course of “defying gravity” teaches us what steps you need to make on land so that you can dive into water, so that you can prize out even the slightest information; what love for a unique profession means; perseverance, passion, curiosity overcoming fear by facing a world where life always swings between the mirage of “defying gravity” and the attraction of “the inebriation of the deep”.

REVIEWER:

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