ANALYSIS OF THE CHILIA LEVEE NATURAL ENVIRONMENT BASED ON THE HISTORICAL AND ARCHAEOLOGICAL DATA CORRELATED WITH REMOTE SENSING TECHNIQUES

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KEYWORDS: Romania, Danube Delta, Chilia Veche, Chilia Levee, natural grasslands, non-irrigated arable land, barrow tombs (tumuli), settlement.

ABSTRACT

The historical and archaeological studies are made, in general, based on punctual observations performed in the frame of archaeological sites. By switching from a strictly historical vision to the multidisciplinary one obtained from the remote sensing techniques, a new vision about archaeological information is provided to specialists.

Within this paper we study elements related to the mapping of the main vegetation types, those based on free GIS data. In the case of Chilia area (Chilia Plain) the area was used as a strategic point and for commercial roads. Evidence of this is provided by the type (tumular tombs and fortified settlement) and the distribution of archeological sites, in relation to the natural environment.

REZUMAT: Analiza cadrului natural al grindului Chilia, pe baza datelor istorice şi arheologice, corelate cu tehnici de teledetecție.

Studiile istorice și arheologice sunt, în general, realizate pe baza observațiilor punctuale efectuate în cadrul siturilor arheologice. Astfel, o nouă viziune cu privire la informațiile arheologice poate fi furnizată specialiștilor prin trecerea de la o viziune strict istorică la una multidisciplinară, obținută pe baza tehnicilor de teledetecție.

În cadrul acestei lucrări, au fost abordate elemente legate de cartografierea principalelor tipuri de vegetație pe baza unor date GIS gratuite. În cadrul zonei Chilia (Câmpului Chilia), zona a fost folosită ca punct strategic și pentru drumuri comerciale. Toate aceste aspecte sunt dovedite de tipul (morminte tumulare și aşezări fortificate) și de distribuția siturilor arheologice, în raport cu cadrul natural.

RÉSUMÉ: Analyse de l'environnement de la levée du Chilia basée sur les données historiques et archéologiques en corrélation avec des techniques de télédétection.

Les études historiques et archéologiques sont généralement faites sur la base d'observations spécifiques faites dans le cadre de sites archéologiques. En passant d'une vision purement historique à une vision pluridisciplinaire obtenue grâce à des techniques de télédétection, les spécialistes peuvent avoir une nouvelle vision sur les informations archéologiques.

Dans cet article, ont été discutés les éléments liés à la cartographie des principaux types de végétation sur la base de données SIG libres. Dans le cadre de la levée du Chilia area (Plaine du Chilia), la zone a été utilisée comme point stratégique ainsi que pour les routes commerciales, ce qui a été démontré par le genre (tombes tumulaires et village fortifié) et la distribution, en relation avec l'environnement naturel des sites archéologiques.

INTRODUCTION

The aim of this study was to analyse the spatial distribution of human settlements and in particular the ways in which people occupied space and used the natural environment. Usually, the connection between the spatial location and social organization of human settlements and environmental resources is very tight.

The spatial distribution of archaeological sites was established based on the archaeological digging works and GIS/SGI data. The influences of environmental factors upon the studied human communities provide the required background for the manifestation of the internal community factors. This allows an assessment of the environmental factors characteristics at the level of a particular historical period, based on the knowledge of human settlements characteristics, areas occupied by them, and the people's habits.

RESULTS AND DISCUSSION

In this paper we used digital data (data that is not available commercially) from different sources, as follows:

ASTER GDEM Ver2 was produced by METI and NASA in cooperation with the Japan-US ASTER Science Team (www.gdem.aster.ersdac.or.jp);

Slope in degree and Hillshade of the ground in Dobrogea − processed grid according to ASTER GDEM Ver2;

Relief Map Units (shapefiles format) provided by geo-spatial.org (earth.unibuc.ro);

Landsat Enhanced Thematic Mapper Plus (ETM+) − seven spectral bands (0.45-12.50 micrometers);

Attribute maps (scale 1:1,000,000) derived from the European Soil Database v2 (Google Earth files format) made by European Soil Data Centre (ESDAC) and provided through European Soil Portal (eusoils.jrc.ec.europa.eu);

CORINE Land Cover maps (shapefiles format) accomplished by European Environment Agency at scale 1:100,000 in 2006 (www.eea.europa.eu);

Tree species maps for European forests (http://www.efi.int/) according with "Statistical mapping of tree species over Europe";

Photovoltaic Geographical Information System (PVGIS) ArcGRID map (http://re.jrc.ec.europa.eu);

The RAN archaeological sites distribution map (according to Institute for Cultural Memory).

The archaeological sites distribution maps according to vector layers.

Through the field research the points that mark off the perimeter of the archaeological sites were recorded with the GPS devices. The field research data obtained from the GPS devices has been imported into the application like GNSS Solutions and EasyGPS (http://www.easygps.com), exported to geographic coordinate system WGS84 ellipsoid and transformed into Stereo system 70 with TransDat application (http://www.rompos.ro/?page=transdat).

The next step was to convert TransDat text or GPX data type in SHP (ESRI Shapefile or simply shapefile) format. After converting into shapefile format the GPX data type were reprojected from WGS84 to Stereo 70. Bringing data into shapefile format was made in Quantum GIS (QGIS) application (free distributed under GNU license). Vector data were finally stored in three types of shapefile corresponding to the three types of vector geometry data, such as: point vectors type shapefile, polyline vectors type shapefile and polygon vectors type shapefile.

Then, depending on the shapefile types, the archaeological data were classified into three main categories as follows: 1. point shapefile vector type which define points of archaeological interest; 2. polyline shapefile vector type which generally define access ways (major and secondary roads, contour lines etc.); 3. polygon shapefile vector type shapefile which define the perimeters of archaeological interest.

The next step was to trace the protection zones based on the option of generating buffer area. Plotting protection zones was achieved by selecting a buffer zone radius set as follows: 50 meters for points and/or sites of archaeological interest, which are not included in the List of Historical Monuments; 500 meters for points and/or sites of archaeological interest which are included in the List of Historical Monuments.

Within the Chilia Levee, the ground level decreases gradually from north to south (Figs. 2 and 4). The highest elevation is found in the north-west grid (7.1 m above sea level) and the lowest in the south-east (about 2 m). However, the evolution of level land from east to west, according to ASTER GDEM Ver2, shows an interesting aspect. A section from east to west through the middle of the levee highlighted field level rise from 1 m, in the deltaic plain, to 4 m at a point located at a distance about 2 km from the eastern edge of the Chilia Levee. In the western part, the elevation of the ground level decreases from 4 m to about 1 m, in the deltaic plain, at a distance about 1 km from the western edge of the levee.

In this paper it was very important to know these things because the barrow necropolis occupies the east side of the Chilia Levee and the settlements west side (Fig. 1).

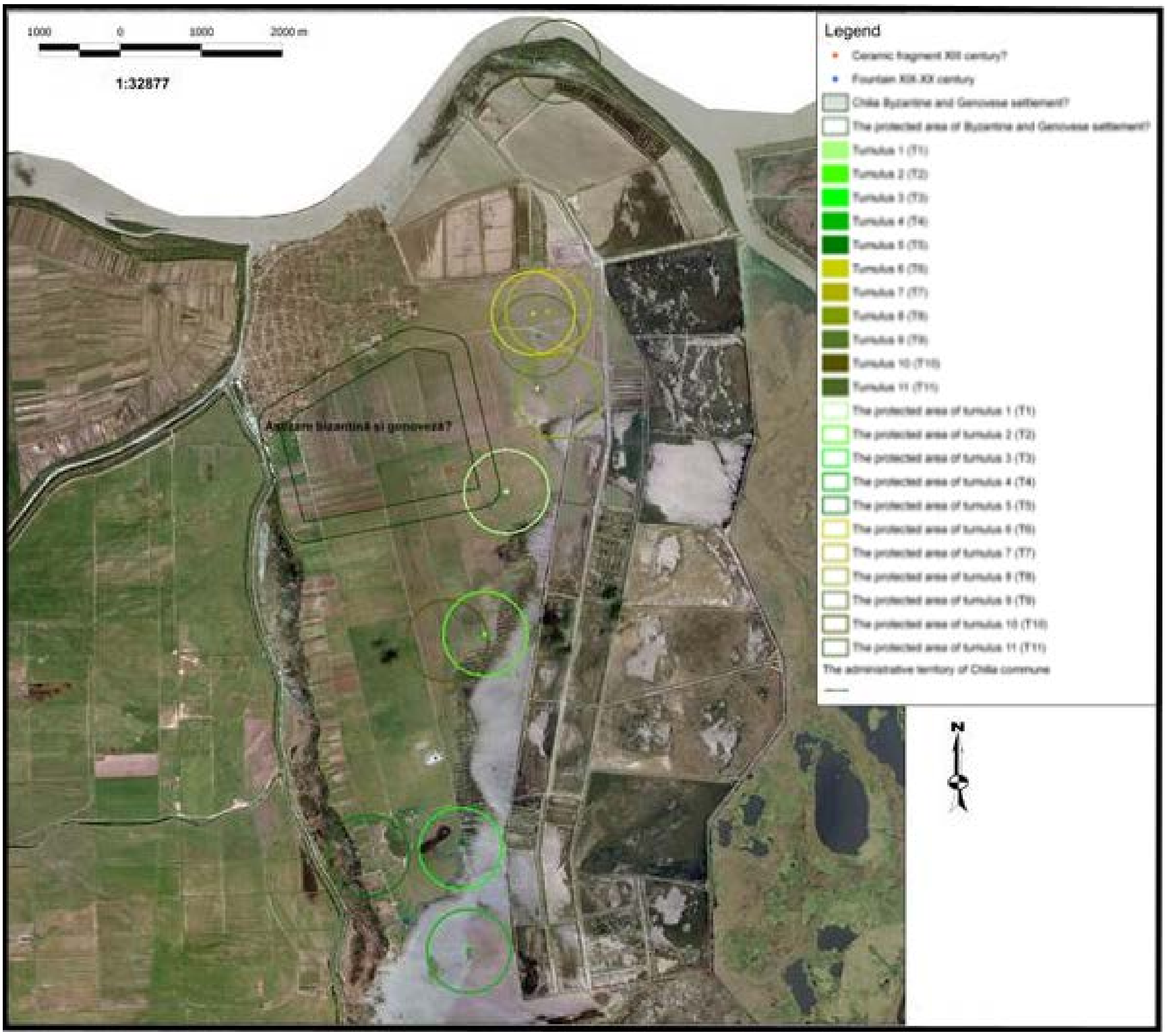

Figure 1: The archaeological sites distribution map depending on the Chilia levee digital orthophotograph (2005).

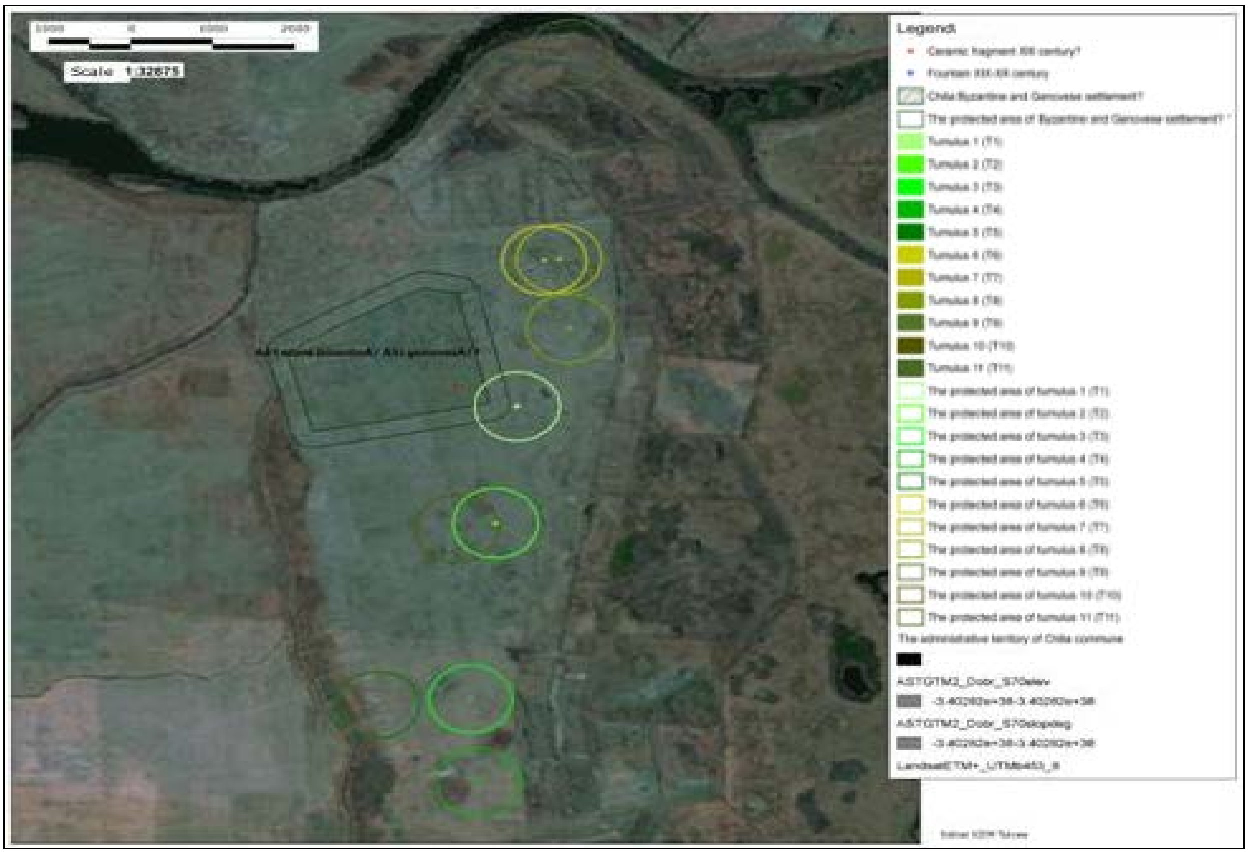

Figure 2: The archaeological sites distribution map depending on the Landsat ETM+ (spectral bands 3, 4 and 5) and ASTER GDEM Ver2, ARC/INFO ASCII GRID slope aspect.

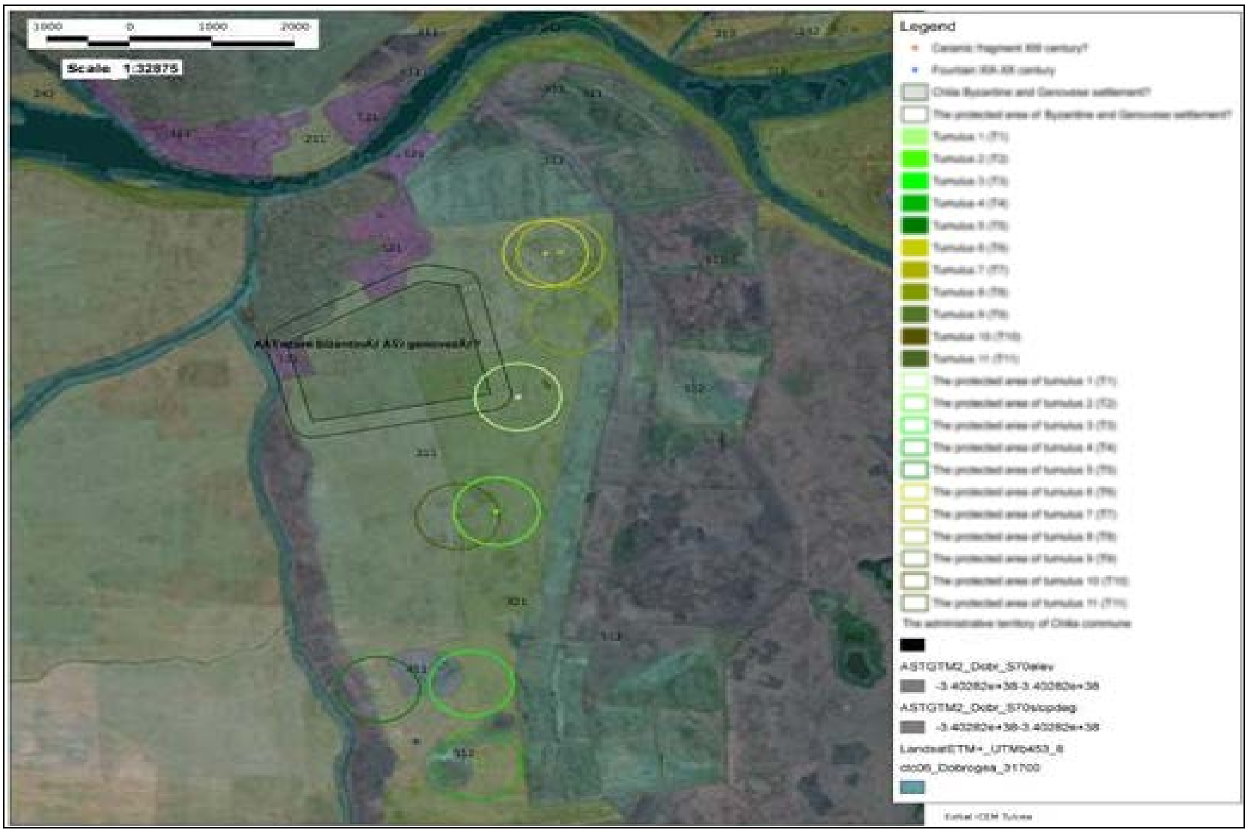

Figure 3: The archaeological sites distribution map depending on the CORINE Land Cover classes and Landsat ETM+ (spectral bands 3, 4 and 5), as well as ASTER GDEM Ver2, ARC/INFO ASCII GRID slope aspect.

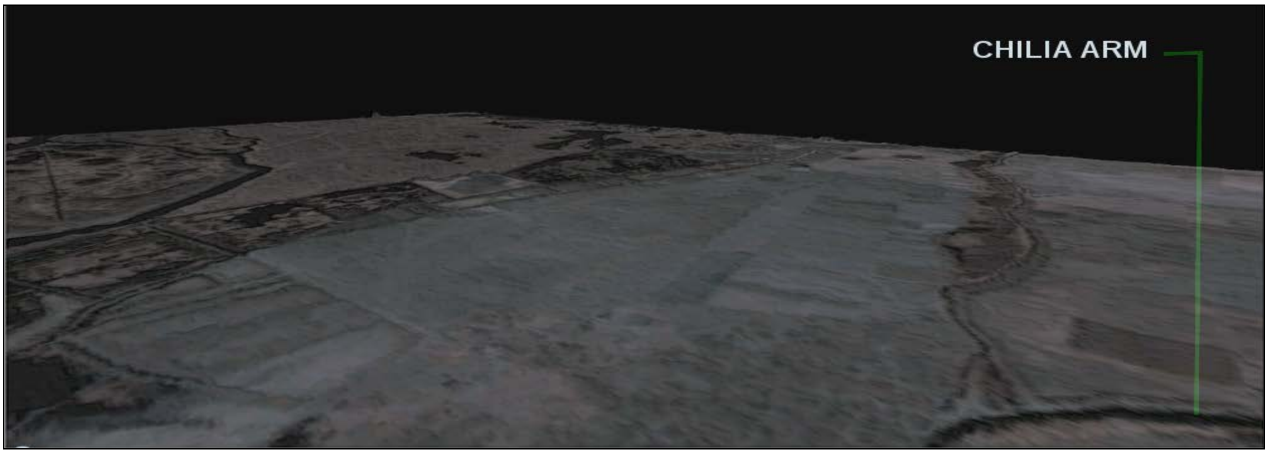

Figure 4: 3D view of Chilia levee from Danube River (Chilia Branch).

The Chilia meadow is mostly used as farmland (CORINE Land Cover code 211). This is also favored by its height which is above the flood boundary, as well as the soil cover (Gâştescu and Ştiucă, 2008).

Within this levee (Fig. 3 and Tab. 1), the following species of plants can be identified: at the edge beam, on surfaces that are frequently flooded (CORINE Land Cover codes 411 and 512), we encounter *Agrostis stolonifera* and *Trifolium fragiferum* to which is added the halophyte species as *Juncus gerardi*, *Suaeda maritima*, *Puccinellia distans* and the willow forests (*Salix alba*) established on the less solified river deposits; on the little taller areas which are rarely flooded (CORINE Land Cover code 311) the poplar riverside coppices (*Populus canescens* and *Populus alba*) can be encountered; on the raised areas away from normal floods *Aeluropus litoralis* appears (CORINE Land Cover code 321).

Inside the area, on the depressionary surfaces, *Salicornia herbacea* occurs on grasslands which is mixed in the more humid places (CORINE Land Cover codes 411 and 512) with *Suaeda maritima* and on the driest places (CORINE Land Cover code 321) with *Aeluropus litoralis* (on areas with Gleyi-Mollic Solonchaks soils). (Gâştescu and Ştiucă, 2008)

Within Chilia Veche Commune, the earliest material evidence of human presence belongs to the Bronze Age.

Despite numerous archaeological investigations from Dobrogea, Bronze Age has remained one of the least known historical periods in this territory. Within all chronological schemes devised by specialists, after cultures known as Cernavodă I, III and II (in chronological order), which are dated to the end of the Eneolithic and the late Bronze period a big gap can be noticed. Basically, until the late Bronze period from which some discoveries are assigned to the culture Coslogeni, no artifacts have been discovered so far.

The northern part of the territory between the Danube and Black Sea, during the period that comprises Early and Middle Bronze Age (3500-1500 BC), has been inhabited by nomadic people originally from the northern part of Black Sea. Based on their material vestiges and spiritual creation these were included in the Katakombnaja and Jamnaja cultures.

The fishery planning works during the years 1984-1985 have imposed the rescue excavations at the point called by locals Ciorticut of certain archaeological vestiges. Ciorticut point is located about six km south-west of Chilia Veche Village. Excavations, coordinated by Vasiliu (1995), aimed to save the archaeological vestiges of two barrow graves threatened by destruction. In the two mounds more funeral horizons can be seen. Thus if the funeral tombs from the base had a rectangular shape grave dug into the sterile soil technique that can be attributed to early Bronze Age, the secondary tombs that have an oval pit are specific for Sarmatians (VI and VII centuries AD). (Vasiliu, 1995)

These belonged to a first series of mounds located in the west south-west of the levee, grouped by two or by three and placed at a distance of 3.5-4 km in the east-west direction from Chilia Veche to the point Ciorticut (that alignment is currently destroyed by the fisheries planning works). (Vasiliu, 1995)

The barrow graves were related to the existence of local human communities in this part of the Chilia Field. In that period of time the Chilia Levee was an extension of Bugeac Plain in the form of a peninsula. Of course, the vegetation was typical for Ponto-Sarmatian steppe (with characteristic associations of *Stipa capillata*, *Festuca valesiaca* and *Bothriochloa ischaemum*).

With the formation of the Sulina branch and afterwards Chilia the delta progresses over them and forces the human communities to move in a first phase of south-west to south-east and then with the evolution of Sulina Delta, these start to rise to the north. The second stage begins with the formation of Chilia Delta when the Genoese and later Byzantine period (XIII Century AD) the human communities move toward the west north-west and in the end to the north north-west (now). This fact is shown by the second row of tumuli that are leaving from the levee south-west part and with the development of Sulina Delta the alignment moves to the south-east, and then up to the north (Figs. 1, 2 and 3; Tab. 1). The latest tumulus presence in the north north-east of the levee and the moving of human communities towards south-east show a forming of the shore grids from the south-west to south south-east and afterwards starting from north north-west to west and north north-east. This occurs after the separation from the mainland of the peninsula Chilia. According to these data it can be assumed that the formation of willow and poplar meadows followed the same pattern.

After the Chilia Levee forming and before organized human intervention it was obviously bounded by fluvial forests of willows with a characteristic fairly rich floristic spectrum. Among the tree species we mentioned species of willow (*Salix alba*, *Salix fragilis*, *Salix pentandra*, *Salix purpurea*, *Salix aurita*, and *Salix rubra*), white poplar (*Populus alba*), in association with the red sea buckthorn (*Tamarix gallica*), and blackberry bushes (*Rubus caesius*). Herbaceous layer is represented by: *Equisetum palustre*, *Poetrivialis* sp., *Hydropiper polygonum*, *Stellaria aquatica*, *Raphanus raphanistrum*, *Rorippa palustris*, *Potentilla reptans*, *Symphytum officinale*, and *Solanum dulcamara*. This herbaceous layer became grazing pastures used for cattle and sheep every time after flood waters retreatment in the area of interest. In areas exposed to the floods for a longer time period clumps of small willows have developed (*Salix cinerea*). Of course, in the central area a part of the original Ponto-Sarmatian steppe is maintained in a degraded form by the grazing.

Currently due to lower economic activity, the return to the traditional activities of local residents and tourism promotion in the area, a recovery of the natural environment to its original conditions has been taking place.

Chilia Field is located in the fluvial (riverine) delta between Chilia and Sulina branch and covers an area of 5,428 ha (Gâştescu and Ştiucă, 2008).

During the Late Pleistocene the Chilia Plain was an extension of the Bugeac Plain, because in that period the deltaic territory has emerged. From that period, the loess deposits have been preserved on the base of the nowadays soil cover. (Gâştescu and Ştiucă, 2008)

Table 1: Correlation of the environmental factors and CORINE Land Cover classes with the different archaeological sites types (Corine).

Lithology	Soil (SRTS – 2003)	CORINE Land Cover (Codes)	CORINE Land Cover (Label three)	Archaeological sites types
Late Pleistocene loess deposits and Holocene deposits of siltite	Calcareous-Alluvial Gley Soils (Gk)	121	Industrial or commercial units	–
Late Pleistocene loess deposits	Vermic Chesnut Soils (Kv)	121	Industrial or commercial units	Byzantine and Genovese settlement
Late Pleistocene loess deposits	Calcareous-Marshy Alluvial Gley Soils (Ga), Vermic Chesnut Soils (Kv)	121	Industrial or commercial units	Byzantine and Genovese settlement
Late Pleistocene loess deposits	Vermic Chesnut Soils (Kv), Gleyed Chesnut Soils (Kg), Gleyed Chernozems (Cg), Calcareous-Marshy Alluvial Gley Soils (Ga)	211	Non-irrigated arable land	Byzantine and Genovese settlement and some tumuli
Late Pleistocene loess deposits	Calcareous-Alluvial Gley Soils (Gk)	311	Broad-leaved forest	One tumulus at the edge of area
Late Pleistocene loess deposits and Holocene deposits of siltite	Gleyed Chesnut Soils (Kg), Gleyed Chernozems (Cg), Calcareous-Alluvial Gley Soils (Gk), Calcareous-Gleyed-Mollic Alluvial Soils (A), Gleyi-Mollic Solonchaks (Sm)	321	Natural grasslands	More tumuli row along that area and Byzantine and Genovese settlement
Late Pleistocene loess deposits	Calcareous-Alluvial Gley Soils (Gk)	411	Inland marshes	–
Late Pleistocene loess deposits	Gleyi-Mollic Solonchaks (Sm)	411	Inland marshes	–
Late Pleistocene loess deposits and Holocene deposits of siltite	Calcareous-Marshy Alluvial Gley Soils (Ga), Calcareous-Gleyed Alluvial Soils (Ag), Calcareous-Alluvial Gley Soils (Gk), Calcareous-Mollic Alluvial Gley Soils (Gm), Calcareous-Gleyed-Mollic Alluvial Soils (A), Gleyi-Mollic Solonchaks (Sm)	411	Inland marshes	–
Late Pleistocene loess deposits and Holocene deposits of siltite	Gleyi-Mollic Solonchaks (Sm), Calcareous-Alluvial Gley Soils (Gk)	512	Water bodies	–
Late Pleistocene loess deposits	Gleyi-Mollic Solonchaks (Sm)	512	Water bodies	–
Late Pleistocene loess deposits	Gleyi-Mollic Solonchaks (Sm)	512	Water bodies	–
Late Pleistocene loess deposits and Holocene deposits of siltite	Gleyed Chesnut Soils (Kg), Gleyed Chernozems (Cg), Gleyi-Mollic Solonchaks (Sm)	512	Water bodies	–
Late Pleistocene loess deposits	Gleyi-Mollic Solonchaks (Sm)	512	Water bodies	–

CONCLUSIONS

Based on the data obtained by correlating information regarding the spatial distribution of archaeological sites with those of the natural environment evolution of the Chilia Levee, the five stages were determined: 1. peninsula covered by the typical vegetation for Ponto-Sarmatian steppe (with characteristic associations of *Stipa capillata*, *Festuca valesiaca*, and *Bothriochloa ischaemum*); 2. separation from the mainland of the peninsula Chilia with the forming of the shore grids; 3. Chilia Levee forming was, at the beginning, bounded by fluvial forests of willows with a fairly rich floristic spectrum; 4. the economic period was characterized by activities with a negative impact on the natural environment (Ponto-Sarmatian steppe is maintained in a degraded form by the grazing) and archaeological remains; 5. currently the natural environment benefit by the recovery conditions, due to lower economic activity and the return to the traditional activities of local residents, as well as a tourism promotion in the area.

Of course, this study represents a first step in the development of interdisciplinary studies related to the evolution of the Chilia Levee, in particular and the Danube Delta in general.

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THE IMPACT INDUCED BY ANTHROPOGENIC ACTIVITIES ON SLOPE EROSION IN GUŞTERIŢA HILL (TRANSYLVANIA, ROMANIA)

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KEYWORDS: erosion, land use, clay quarry exploitation, motocross track.

ABSTRACT

In the last decades, anthropogenic impact on slopes and on geomorphological processes has increased greatly through changing of land cover, intensive exploitation of resources, surface fragmentation and inadequate use of lands. This paper presents the results of field observations on the relationship between land use and pluvial denudation processes such as surface erosion, rill erosion, ravening and torrentiality in a small area near Sibiu locality (Romania). The study reveals that the most intensive processes and representative landforms are found on local roads, animal paths, and motocross-enduro tracks on pastures and on clay quarry outcrops. The most frequent and widespread processes are sheet erosion and rill erosion. Anthropogenic pressure leads to an acceleration of these processes, and to partial or total degrading of lands. The paper draws attention to the possibility of triggering major imbalances of slopes in this way.

REZUMAT: Impactul indus de activităţile antropice asupra eroziunii versanţilor în Dealul Guşteriţa (Transilvania, România).

În ultimele decenii, impactul antropic asupra versanţilor și asupra proceselor geomorfologice este din ce în ce mai mare prin schimbarea tipului de acoperire a terenurilor, prin exploatarea intensivă a resurselor, prin fragmentarea suprafeţelor și utilizarea necorespunzătoare a terenurilor. Lucrarea prezintă rezultatele observațiilor de teren asupra legăturilor dintre utilizarea terenurilor și procesele de pluviodenudare cum ar fi: eroziunea în suprafață, şiroirea, ravenarea și torențialitatea într-un areal restrâns din apropierea orașului Sibiu (România). Studiul relevă că procesele cele mai intense și formele de relief reprezentative se găsesc pe drumurile locale, poteci de animale, piste de motocross-enduro, pe pășuni și pe aflorimentele din carierele de exploatare a argilelor. Cele mai răspândite procese sunt eroziunea areolară şi şiroirea. Presiunea antropică duce la accelerarea proceselor și la degradarea parțială sau totală a terenurilor. Lucrarea atrage atenția asupra posibilității de declanşare în acest fel a unor dezechilibre majore de versant.

ZUSAMMENFASSUNG: Die Induzierte Auswirkungen durch anthropogene Aktivitäten auf dem Hanglage Erosion im Guşteriţa (Transilvanien, Rumänien).

In den letzten Jahrzehnten die anthropogener Auswirkungen auf den Hängen und auf geomorphologische Prozesse wird zunehmend durch: Veränderung der Bodenbedeckung, intensive exploatation von Ressourcen, Oberflächen Fragmentierung und unzureichende Nutzung der Ländereien. Der Beitrag stellt die Ergebnisse der Feldbeobachtungen auf der Beziehung zwischen der Landnutzung und pluvial Denudation Prozesse vor, sowie: Oberflächenerosion, Bächlein-Erosion, reißender Erosion in einem kleinen Bereich in der Nähe der Sibiu/Hermannstadt, (Rumänien). Die Studie zeigt, dass die meisten intensive Prozesse und Vertreter Landschaftsformen sind örtlichen Straßen, Tierpfade, Motocross Enduro-Tracks auf Weideland und auf die Tongrube Aufschlüsse gefunden. Die häufigsten und weit verbreitete Prozess sind die Flächenerosion und Rillenerosion. Der anthropogene Druck führt zu beschleunigenden dieser Prozesse und zur teilweisen oder vollständigen Verschlechterung der Länder. Der Studium macht die Aufmerksam uber die Herstellungsmöglichkeit diese Weise größeren Ungleichgewichte Pisten darauf.

INTRODUCTION

Slope erosion is a geomorphic process exercised by rain water through a series of complex mechanism like: the impact of raindrops, runoff, ravening and torrentiality. The action of rainfall occurs with different intensity depending on local conditions: the nature and the characteristics of the rocks (cohesion, compaction, friability), slope, vegetation coverage degree, soil cohesion (Costea, 2011).

The plucking out of soil aggregates or rocks, and removal from superior horizons from slope deposits is very aggressive if the slope has suffered from previous anthropogenic impact by land use, surface division, by modification of morphometric and morphographic characteristics of slope; and through compaction and soil sealing etc. (Foley et al., 2005).

The pluvial aggressivity on slopes increases with anthropogenic impact by land use. If the land use is chaotic and ignores soil characteristics, geological substratum and slope morphometry, total land degradation and formation of “badlands” will result (Howard and Kerby, 1983).

In Romania, degraded and unproductive surfaces totaled in 2013 an area of 500.94 thousand ha. In Sibiu County these lands occupied an area of 9.1 thousand ha, that means 1.6% of land fund. To these lands are added agricultural lands which are affected by erosion in a high proportion. INSSE statistics mention for Sibiu County that the arrangement works to combat soil erosion on a surface of 79.42 thousand ha, representing 26.07% from the total agricultural land at county level. Of these, 38.66 thousand ha are arable, 35.96 thousand are meadows, and 3.28 thousand are orchards. At municipal level the situation is almost the same; the degraded and unproductive lands represent 183 ha, that means 1.5% from land fund. These surfaces are the result of the interaction between natural factors and anthropogenic pressure, through an inefficient and inappropriate use of land characteristics.

Gușterița Hill is situated in the northeastern part of Sibiu, being identified by it’s high altitude compared to the general level of the city. The studied area is part of Sibiu locality, the neighbourhood of Gușterița being spread on the base of the hill and on its south-western slope.

Gușterița Hill belongs to the Hârtibaciu Plateau, being a structural type interfluve (cuesta) situated at its southwestern extremity, bordering the Sibiu Depression. The geological substratum is made of Panonian deposits (clay, marl, sands) arranged in a monoclinic structure. Panonian sedimentary formations in the Gușterița Hill are made of two lithological complexes in which alternating layers of different rocks and thickness can be identified. (Ciupagea et al., 1970; Lubenescu, 1972; Popescu et al., 1995)

Due to the quarrying of clays, both lithological complexes are visible on slopes with a west-southwestern exposure. The basal complex is made of marls and clays: marls are whitish grey or blue in colour, ferruginous sandy marls alternating with clay layers of whiteish yellow colour. Lubenescu (1981) identified in this complex a pelitic facies in which massive grey-yellow clays with a high content of sand on the upper side dominate; he called them Gușterița strata. The upper complex is composed of layers of small polygenic gravels, with crystalline schists and calcareous sandstone formations, which alternate with white, grey and yellow layered coarse sand, in which can be identified insertions of yellow clays, grey marls and coarse concretions, the Vingard strata (Lubenescu, 1981).

The layers from both complexes are very friable, easy to shape by hydric erosion, especially due to the presence of sand and gravel rocks with weak cohesiveness that favors erosion. This process is favored also by the presence of clays and marls, which have a higher cohesiveness, although in high humidity they become impermeable, and in dry conditions they form hard soil crusts. In both cases storm rain water infiltration is clogged and runoff is favored.

Regarding the altitude, Guşteriţa area is developed on an elevation of 200-400 m. The highest altitude is reached on the major interfluve which is orientated from north to south in Dealul La Tablă/ La Tablă Hill (641 m). The main ridge aligns the erosion outliers which exceed 600 m, and large saddles situated at the origin of the Fărmândoala Valley tributaries, the Pe Remeți and Daia valleys. From this ridge, secondary interfluves detach on the north-northwest – south-southeast: Capul Dealului, Dealul Cocoșului/ Cocoșului Hill (621 m), Pe Coastă (605 m), Dealul Pădurii/ Pădurii Hill (598 m), Dealul Galben/Galben Hill, as a result of the accentuated fragmentation exercised by the hydrographical network.

On this altitudinal development, three hipsometrical levels can be identified.

– The level under 425 m, which corresponds to the Cibin River's meadow and to the slide glacis from the base of the Gușterița Hill. This continues on the Fărmândoala Valley until its confluence with the Nepindoala Valley.

– The level between 425-525 m, which corresponds to cuesta type slopes and the structural slopes from Fărmândoala basin (to the west), Remeți (central) and Daia (to the east), which occupies the largest surface and is affected by massive landslides and by rill and gully erosion.

– The level over 525 m corresponds to the main and secondary ridges in which the superior erosion surface (600-650 m) is identified, of Dacian – inferior Romanian age, and also the inferior erosion surface (Hîrtibaciu surface, with altitudes of 525-550 m) of superior Romanian – inferior Pleistocen age (Grecu, 1992; Sandu, 1998). On this altitudinal level, in the source area of small basins, regressive erosion is recorded on ravines and gullyes.

Predominant are structural landforms with asymmetrical slopes: cuesta fronts which correspond to the layer's heads from the monoclinal structure and the structural surfaces which correspond to the stratification plans. The monoclinal structure indirectly influences the processes of hydric erosion through slope asymmetry with different inclinations and exposures. Gușterița Hill is a secondary interfluve orientated on the northwest-southwest directions, between the Fărmândoala and Pe Remeți valleys, with the maximum altitude reached on the Pădurii Hill (598.4 m). The western and south-western slopes are straight, shorter, with high relief energy (150 m) and with steep slopes (30-35-50°), and in the clay quarry area the slopes can reach 70-90°.

In these morphometric and favourable exposure conditions (western, south-wetstern) the insolation is high, and the rill erosion processes are limited. However, they are present on the succession of outcrops from the clay quarries, and in depositing areas of materials resulted from exploitation and in quarry dumps. The north-eastern slopes correspond to the structural surfaces – they are longer, the inclination is less steep (8-10-15^{o}), the relief energy is low (50-75 m) and the humidity is higher. In these conditions surface erosion, rill erosion, ravening and torrentiality dominate.

Hydric erosion, through pluvial denudation processes, is favoured by the relief fragmentation density. The torrential fragmentation prevails, which is realised by an elementary network of the 1st, 2nd and 3rd order (Horton-Strahler ranking) which indicates a high susceptibility to erosion (Sandu, 1998; Costea, 2011). The relief density fragmentation values are between 0.7 km/km^2 and 3.17 km/km^2, with maximum values reached in areas of torrential convergence (Fig. 1).

The slope's drainage is conducted through rills, ravines and gullies to these areas of torrential convergence, where a deepening of 4-5 m of the torrent's channel, resulted from linear erosion, can be distinguished. On one hand, this strong erosion is due to the high erodibility of the soils and the friability of the rocks. On the other hand, the large surfaces of the torrential reception basins and the land used predominantly as grasslands, favour the accumulation of large volumes of water from the slopes.

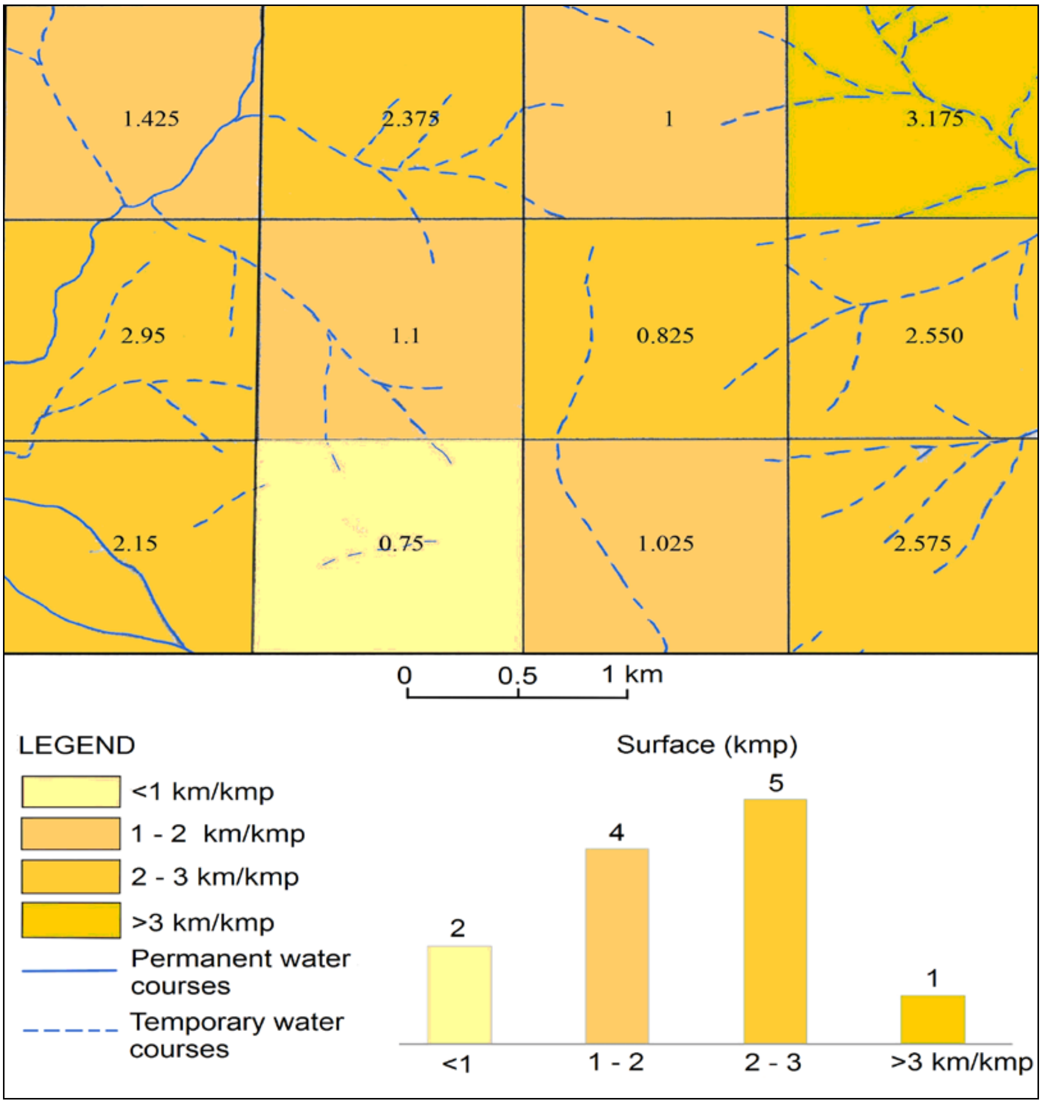

Figure 1: Fragmentation density map.

METHODS

The evaluation of anthropogenic pressure influence in accelerating slope erosion processes is based on evaluation of morphometric conditions which favor hydric erosion, land use, as well as direct observations in the field on typology, frequency and intensity of hydric erosion on different categories of land use. For this purpose the map of drainage density and land use were made. Also, for the interpretation of erosion processes direct measurements and observations were executed on road network, motocross tracks, pastures and also on different erosion landforms. The maps were drawn based on a topographic map with a scale of 1:25,000 from the 1982 edition and based on orthophotoplans from different years (2005 and 2010), supplemented by field observations made in the autumn of 2014.

RESULTS AND DISCUSSION

Human pressure in Gușterița Hill is manifested by: agricultural activities (culture of plants, fruit growing and grazing), industrial activities (clay operation for bricks and tiles) and sport (motocross and enduro). The analyzed area in terms of land use occupies an area of 584.6 ha, of which 34.20% is occupied by forests, 29.44% are pastures, pastures with shrubs and meadows, 19.40% are arable lands, 3.01% of the surface is covered by orchards, 8.28% by buildings, 3.50% is with local roads, cart roads, paths and motocross tracks and 2.18% is used as clay pit (Figs. 2 and 3).

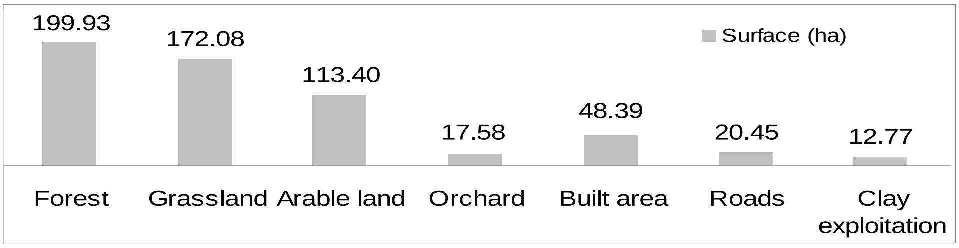

Figure 2: Land use diagram in Guşteriţa Hill.

All anthropogenic pressure from the area of Guşteriţa Hill interfere with geological and geomorphological conditions, and determine the intensification of pluvial denudation processes. As we saw, the geological and geomorphological fund is by its nature favourable to erosion processes and anthropogenic actions that through aggressive activities can lead to slopes imbalance and total degradation through erosion or even to the older mass movement reactivation.

Hydric erosion processes are diversified by slope, type and rank of surface coverage, and by land use. These do not act individually; they are associated with each other and with gravitational process and form morphogenetic complex processes (Costea, 2011). One of these processes is dominant and the others are subsidiary. Because of land use diversity in this restricted area, and because of a different pressure made on lands, the erosion processes were manifested and occurred with more or less intensity, generating elementary or advanced erosion forms in different stages of development.

Erosion on roads and carts paths

Whereas the study area is a part of the administrative area of Sibiu, and recently changes took place in the land fund structure as a result of Law 18/1991 (the land restitution on private property), Guşteriţa Hill came to the attention of land-owners. They built permanent or seasonal residences which led, together with agricultural activities and sport, to an accentuated fragmentation by local roads, paths and motocross tracks (Figs. 3 and 4).

Guşteriţa Hill is a very attractive destination because it provides recreation conditions through the beauty of the landscape, by the view over Sibiu locality, and by the sedative and comfortable climate conditions for human beings. These issues have led to increased accessibility in this area, and a network of cobbled roads of local importance, which follow level curves, but also appear as a disorganized, chaotic, roads network that cut the versants in all directions, especially along the slope.

On these roads were installed hydric erosion processes, diversified by slope. Where the slope is small the surface erosion process dominates, and where the slope is greater the runoff processes dominate, from the simple small runoff ditches (which measure five to 15 cm in depth) to deep channels with slope breakages and very active processes of regressive erosion (20-50 cm in depth). Some of the roads have become real gully drainage channels.

This is the case of the extension of Bisericii Street on an old access road to the grassland and the arable lands, which cuts the cuesta front on its length. The traffic has determined the deepening of this carriage road. Whereas the road was cut on the length of the slope and lateral ditches weren’t built to collect the water, the drainage has concentrated on the axis of the road, or on its sides, on the carriage or vehicles tracks (Fig. 5). In the conditions of a steep slope (15-30-35°) and of the sandy-clayey soil, it has been washed and degraded, becoming today impracticable.

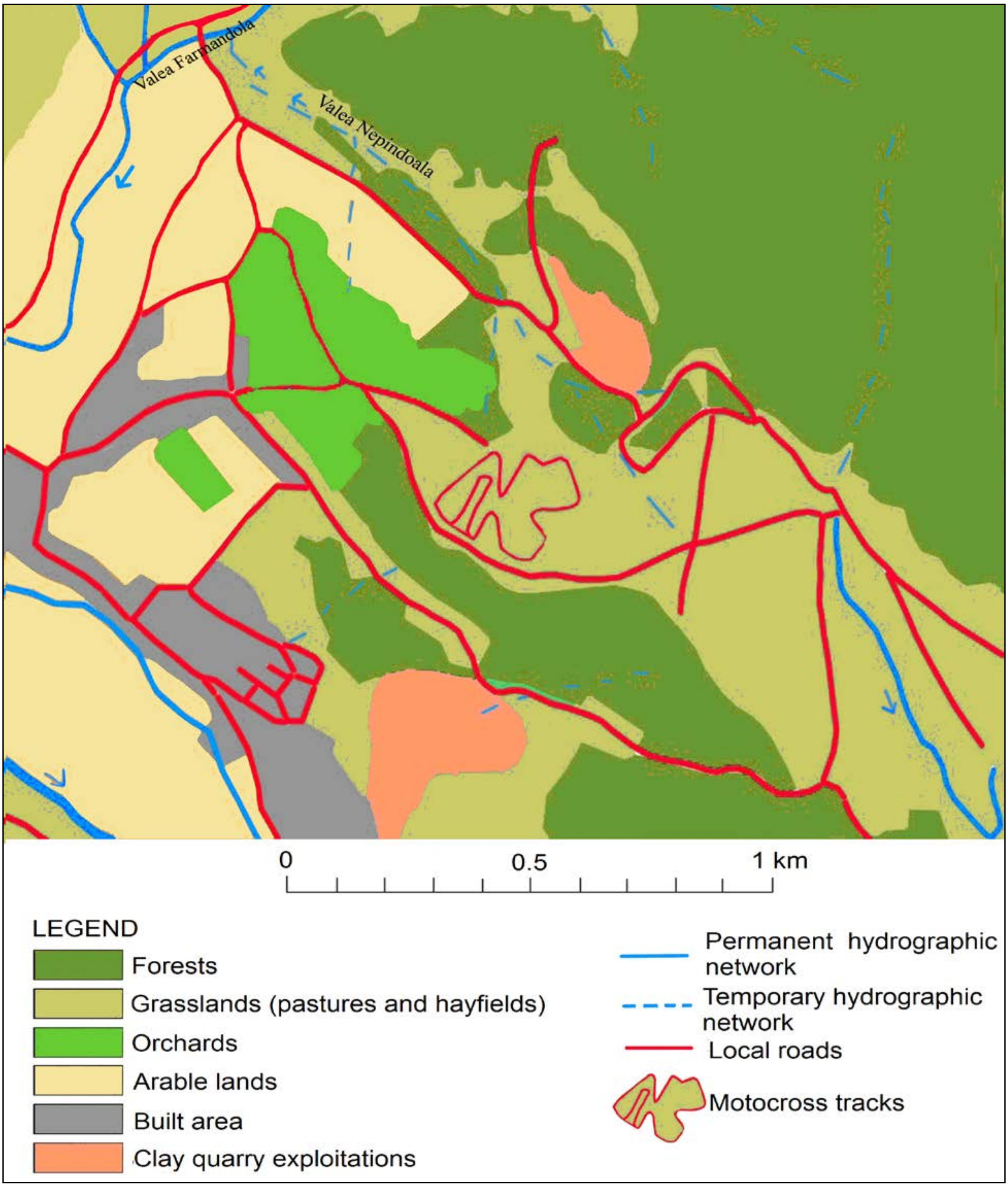

Figure 3: Land use in Guşteriţa Hill area.

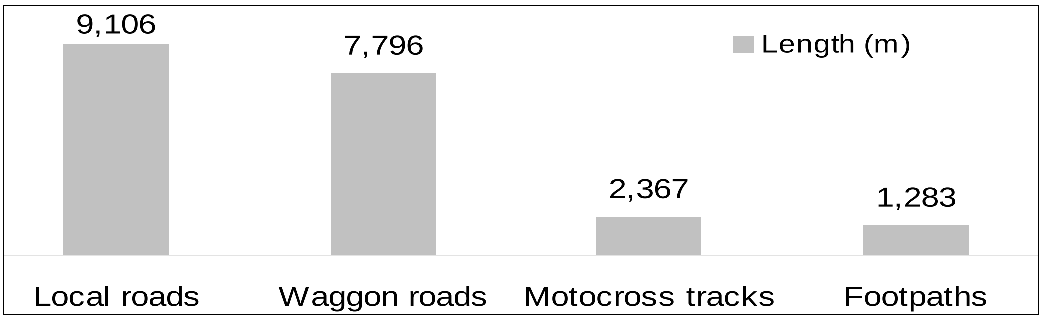

Figure 4: Length of roads diagram according their importance.

Figure 5: Deepening and upstream extension of the runoff channels through the processes of suffusion and regressive erosion and the evolution into more advanced form.

The sands being permeable have favoured the processes of suffusion which have accelerated the underground erosion of the friable horizons and the deepening of the channels (Fig. 6). The concentration of the water on the same channel leads to the deepening of the runoff forms down to the bedrock; the compacting and the deposits sealing of the road surfaces as a result of the successive passing has favoured this specific process.

Figure 6: Association between suffosion and rill erosion with steps of 40-50 cm forming.

Erosion on the motocross tracks

The Guşteriţa Hill has drawn the attention of lovers of the extreme sports, motocross and enduro, due to the possibility of the development of some tracks with different levels of difficulty. The motocross and enduro tracks have a total length of 2,367 m and they are located on the structural surface (closed circuit one and a linear track two – Fig. 7) where the slopes vary from 10-15^o to 35-40^o; also on the steep slope in the old clay quarry (Fig. 7), where the slopes reach 60-70^o. This activity has led to the total destruction of the vegetation on the tracks and a lack of soil protection. This, associated with the soil sealing and the compacting of the slope deposits, with the pressure of repeated runs with motorcycles and additionally the results from the rain which fell in significant quantities (650 mm/year with a torrential character during spring and summer), have lead to rill and inter-rill erosion of tracks and to slopes fast degrading. The measurements of the tracks indicate a width of 2-10 m on the primary track and 0.5-1.5 m on the linear tracks; and different lengths of 1,597.8 m for the closed circuit (1), 194.82 m the linear track (2), and 141.86 m the linear track (3), with two uphill loops of different lengths (146 m and 186 m) (Fig. 7).

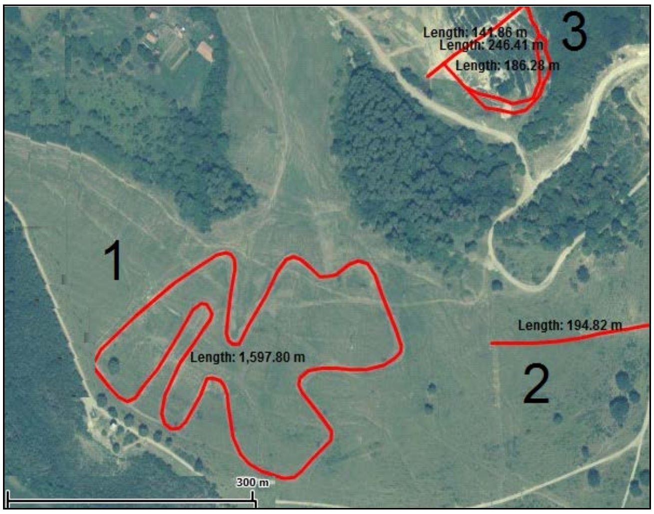

Figure 7: The position of the motocross tracks on Gușterița Hill.

Through jumping, the clayey soil gets more compacted, taking the form of the object which has fallen on to it, such as in the case of motocross ditches shaped in the form of wheels (Robescu and Elekes, 2008). On these ditches the rain water flows and deepens them, and creates more evolved forms of runoffs, like gullies.

The shape of the runoff ditches is different in the curvature areas of the track, where the slope is reduced and where the process of surface erosion dominates and the flow begins to concentrate. Through the uphill ramification (regressive erosion), multiplication and convergence (braiding) the channels attract in their area the flow from the closest surfaces (inter-rill) (Fig. 8).

Figure 8: Inter-rill and rill erosion with reduced deepening of runoff channel.

The channels are of small dimensions (length of a couple of centimeters up to dozens of centimeters or even a few meters, and depths of a few centimeters).

As the slope grows, the forms become more evolved, they have a linear development on the length of the slope, and their longitudinal and transversal profile changes frequently as a result of the concentration of the hydric flux through the attraction of the flows from other channels, and through the attraction of hydric flux from the inter-rill erosion (Fig. 9).


Figure 9: Advanced rill erosion with deep rills.

The runoff channels are present on the entire length of the track; their transverse profile is deepened in into a V-shape, the longitudinal profile presents different steps and depths from 10-15 cm to 40 cm in the points where the flow focuses. These forms are in a continuous dynamic from one passing of a motorcycle to the next, and from one rain to the next. The edge of the ditches break when the motorcycles pass, and when it rains the water that is concentrated on the ditch loaded with solid materials produce a sharp deepening through linear and swirling erosion.

Erosion on animal paths and as a result of grazing

Because Gușterița Hill is a rural settlement on the margins of the city of Sibiu, grazing is an agricultural activity that has been practiced here since historical times, and is today still very frequent. Although as a result of urban expansion it has been integrated as a neighborhood in the administrative limits of the city, Gușterița still has a rural character, both through its aspect and occupations. A part of the population deals with livestock and the cultivation of plants on small areas.

The anthropogenic pressure on grasslands is not very high, yet forms of erosion can be found on animal paths which cross the slopes and lead to the degradation of the vegetation. Releasing the animals to graze on wet pastures after rain fall is not a good practice because the soil rich in clay is kneaded by the hooves of the animals, and once it is dry it becomes compacted and forms crusts. The compactation and crustification affects water circulation and increases the slopes vulnerability to erosion.


Figure 10: Sheet erosion at ravines crossing.

Also the animals exert a mechanical pressure on the vegetation layer, and they rip and interrupt the grass on the animal paths or in the grazing locations, therefore leading to the destruction of soil protection, and thus favoring surface erosion, rill erosion and ravening on the animal paths (Figs. 10 and 11).

The biggest pressure is exerted by sheep which with their sharp hooves interrupt the grassy cover and through the total ripping of the grass during grazing determine the degradation of the pasture. On the heavily grazed pastures or on the animal paths, alteration crusts and places where the water gathers form. Also the pollution with nitrites and nitrates, alongside the compactation and erosion, lead to the decrease in quality of the vegetation and even to its disappearance.

Figure 11: Erosion in surface on the slope due to animal crossings to the pastures.

Erosion through ravines and torrentiality on mixed use of lands

Ravines (Fig. 12) and torrents are the result of the repeating processes of runoff and their evolution in time through the concentration of a large volume of water. Ravines are frequent on structural surface type slopes with northern and north-eastern exposition which evolved from rill ditches. They are found at the source area of the Nepindoala Valley, they have complex shapes, are active, simple or ramificated, with big lenghts (65-200 m), and have a V- or U-shaped transverse profile, deepened in the bedrock (0.5-1.5 m). The longitudinal profile presents numerous layers which indicate the phases of their evolution. The peaks of the ravines are in a constant retreat during each rain fall due to an accelerated regresive erosion on the animal paths or trails. Because the superficial deposits are rich in sands, the ravening process is associated with suffusion.

Figure 12: Linear ravine in the source area of Nepindoala Valley.

Torentiality represents the most complex erosion phenomena in Guşteriţa studied area. The Nepindoala Valley is a torrential organism which has a reception basin of about 1 km^2. The supply of the torrent is realised through rills and ravines, and through washing in slope surface. The runoff is focused on two points of torential convergence in which dislevelments have formed, measuring 3-5 m beside the surface of the slope. The torrent's channel is heavily deepened and has an asymmetric profile due to the geological structure (Fig. 13).

The erosion was very strong and forestation with pine (reforestation) has occurred in the torrential convergence area and the torrent channel. This measure was not sufficient because the supply basin is used as a pasture and in the recent years, for sport activities such as enduro. The variability of precipitation and the torrential nature, combined with the particularities of the geological substratum and with the inefficient management of lands from the supply basin, have led to the maintaining of the phenomena, even to their acceleration, whereas forests which should have had a role in protection, are degrading through hydraulic undermining processes caused by the flow on the torrential thalweg (Fig. 13).

Slope erosion on the outcrops of clay quarries

Clay exploitation in Guşteriţa Hill is tied to the history of the Sibiu locality and to its spatial evolution, the clay being used as a construction material.

The area that has been subjected to clay exploitation totals almost 40 ha, in two areas: the big quarry, active, at the basis of the Pădurii Hill in the eastern-southeastern extremity of the neighborhood of Guşteriţa; and a small quarry, now closed, on the right slope of the Nepindoala Valley.

The big quarry has a semicircular form and an opening of almost 400 m on the steep slope of Hârtibaciu Plateau. It develops an altitude of over 50 m and has ten levels. The total surface that is being exploited is 33.5 ha (Fig. 14). The openings which are subject to pluvial denudation varies from one year to another depending on industrial needs. In 2005 the exploited area was 10.4 ha, and in 2007 it was 10.7 ha.

On the opening of the quarry and on the dumps (materials or sterile), splash erosion, sheet erosion and rill erosion have occurred. Pluvio-denudation is favored by the friability of the materials from the slopes, from the high content of sands, and by the drying of the outcrops due to insolation. This is a secondary process in addition to the gravitational and anthropogenic ones. On each level sandy deluvio-proluvial deposits can be found, which come from the gravitational processes, and through surface washing of the material from the quarry. Vertical washing of the layers and suffusion have taken over the openings from the slopes forming suffusion funnels.

Figure 13: Nepindoala's torrent channel.

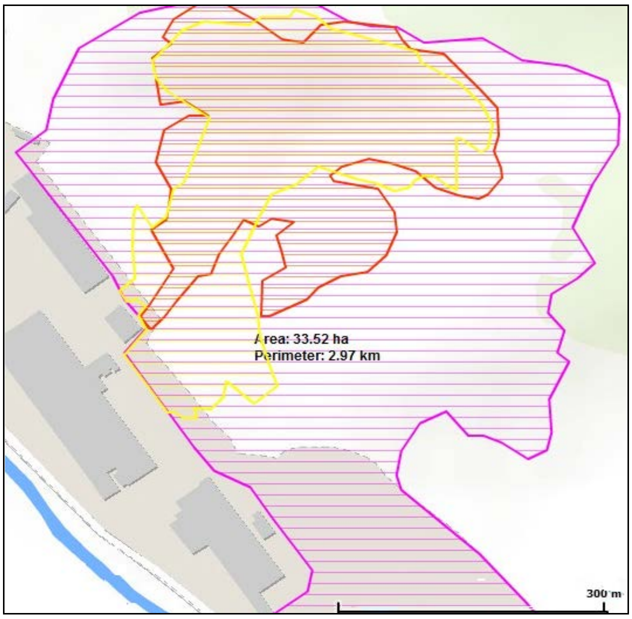

Figure 14: Dynamic of the area affected by erosion in Tondach exploitation quarry (purple line – limit of the surface under the incidence of exploitation; red line – 2005; yellow line – 2010).

Figure 15: The restriction of the area affected by surface erosion in the little quarry.

Such combination of processes can also be found in the old exploitation quarry. The quarry has a quasi-linear form, following the development of the cuesta type slope, and cuts the slope on eight levels of exploitation. In the openings of the exploitation terraces, outcrop more cemented layers with fine sands and coarse, stratified, weakly cemented which favor the pluvial denudation (Fig. 15). After the quarry was closed, stabilization of the processes has been tried by planting acacia (*Robina pseudoacacia*) and sea buckthorn (*Hippophaë rhamnoides*), which has lead in time to the reduction of the surfaces exposed to pluvial denudation from 4.57 ha in 2005 (red line) to 2.07 ha in 2010 (yellow line). Recently, this slope has been cut on its incline by the motocross track which favors the acceleration of the surface washing, runoffs and ravines processes. The purple line represents the surface limit which is under the incidence of the exploitation.

CONCLUSIONS

The slopes from the Gușterița area are exposed to the actions of active pluvial denudation (splash and sheet erosion, rill erosion, ravening and torrentiality). Their intensity was accelerated following the anthropogenic actions and by the modifications of the slopes characteristics through the cutting of roads, the creation of motocross tracks, the exploitation of pastures and the exploitation of materials from the slopes.

Following these activities, surfaces that have been uncovered of vegetation were identified, and surfaces with a high degree of compacting and waterproofing, with high vulnerability to the processes of erosion have also been identified. Following this study we recommend taking some measures against erosion, appropriate to each use of land or activity, and increasing land productivity so as to increase the protection role of vegetation, to maintain the vegetal layer continuity and slope stability.

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BIOCHEMICAL ACTIVITY VIA CATALASE OF HEAVY METALS-CONTAMINATED SOIL IN THE CITY OF SIBIU (TRANSYLVANIA, ROMANIA)

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KEYWORDS: catalase, heavy metals, pollution.

ABSTRACT

Since natural and anthropogenic heavy metal contamination of soils can be evaluated by using enzymatic activities as biosensors, the present paper focuses on catalase activity related with Pb, Cd, Zn, and Cu concentrations measured in five locations in Sibiu, at two different depths of soil sampling. Catalase activity was variable, on average 0.64 ± 0.86 mg H_2O_2/g soil, with a registered peak of 3.06 mg H_2O_2/g soil in the industrial zone. Significant correlations ($p < 0.05$) were found between catalase activity and concentration of Zn, Cd, Pb, and Cu to a soil depth of 0-5 cm, meaning that soil bioactivity via catalase is stimulated by moderately polluted areas and inhibited by high levels of contamination with heavy metals. This aspect may be of practical interest when considering historical anthropogenic contamination and environmental risk management.

REZUMAT: Activitatea biochimică, via catalază, a solului contaminat cu metale grele în oraşul Sibiu (Transilvania, România).

Deoarece contaminarea naturală şi antropică a solurilor cu metale grele poate fi evaluată prin utilizarea activităţilor enzimatice ca biosenzori, lucrarea de faţă se axează asupra activităţii catalazei în relaţie cu concentraţiile de Pb, Cd, Zn şi Cu, măsurate în cinci puncte din Sibiu, la două adâncimi diferite de prelevare a probelor de sol. Activitatea catalazei a fost variabilă, în medie 0,64 ± 0,86 mg H_2O_2/g sol, cu un maxim înregistrat de 3,06 mg H_2O_2/g sol în zona industrială. Au fost găsite corelaţii semnificative ($p < 0,05$) între activitatea catalazei şi concentraţia de Zn, Cd, Pb şi Cu la o adâncime de 0-5 cm în sol, ceea ce înseamnă că bioactivitatea solului prin catalază este stimulată de zonele moderat poluate cu metale grele şi inhibată de nivelurile ridicate ale contaminării cu aceste metale. Acest aspect ar putea fi de interes practic atunci, când intră în discuţie contaminarea antropică istorică şi gestionarea riscurilor de mediu.

ZUSAMMENFASSUNG: Die biochemische Aktivität über Katalase des durch Schwermetalle kontaminierten Bodens in Sibiu/Hermannstadt (Transilvanien, Rumänien).

Da man natürliche und anthropogene Schwermetallkontamination von Böden mittels Verwendung enzymatischer Prozesse als Biosensoren bewerten kann, konzentriert sich die vorliegende Arbeit auf die mit Pb, Cd, Zn und Cu Konzentrationen verbundene Katalase-Tätigkeit, die an fünf Standorten in jeweils zwei unterschiedlichen Bodentiefen in Sibiu/Hermannstadt gemessen wurde. Die Katalaseaktivität wechselte im Durchschnitt zwischen 0,64 ± 0,86 mg H_2O_2/g Boden und hatte einen Spitzenwert von 3,06 mg H_2O_2/g Boden im Industriegebiet. Signifikante Korrelationen ($p < 0,05$) wurden zwischen der Katalase Aktivität und Konzentrationen von Zn, Cd, Pb und Cu in einer Bodentiefe von 0-5 cm festgestellt. Daraus ergibt sich, dass die Bioaktivität des Bodens über Katalase in mäßig belasteten Bereichen angeregt wird und bei hohen Ausmaßen an Belastung mit Schwermetallen gehemmt wird. Dieser Aspekt könnte von praktischem Interesse sein, wenn man die historische anthropogene Belastung und das Umweltrisikomanagement in Betracht zieht.

INTRODUCTION

Soil contamination is a chemical state that is deviated from the natural composition, but has no adverse effect on organisms, while pollution occurs when an element or natural substance is present in high concentrations as a result of human activity and has a clear negative impact on biological processes (Kabata-Pendias and Sadurski, 2004).

The metals are some of the most stable toxic pollutants, which cannot be removed by biodegradation, but only passed into biologically inactive sediments. Heavy metals like lead are involved in long-term damages on humans' health, e.g. decreased mental performances, especially when lead exposure is related to cognitive and behavioral development in school-age children rather than during earlier childhood (Hornung et al., 2009). For example, aluminum, antimony, arsenic, barium, beryllium, cadmium, lead, mercury, silver, strontium, and thallium are metals without known beneficial effects in humans (Goyer, 2004). Moreover, lead, cadmium, mercury, arsenic are generally considered the most toxic to humans and animals, due to their bioaccumulation and carcinogenic actions (Morais et al., 2012). Health damage caused by toxic metals may vary, ranging from irritation to teratogenic and mutagenic effect (Mudgal et al., 2010a). Important disturbances of biochemical processes were also reported in plants and animals by absorption of these elements from soils, sediments, and water (Mudgal et al., 2010b). Due to the discharge of untreated urban and industrial waste water soil pollution is a major threat to ecological integrity (Mahmood and Malik, 2014). In this respect, exposure measurements and the use of indicators, as well as setting acceptable levels or criteria related to chemicals, are essential for the protection of high risk populations and subgroups which are most vulnerable, i.e. children.

The soil enzymes act as a biological catalyst to facilitate some reactions and metabolic processes in the biogeochemical cycles of nutrients, playing the role of biosensors to natural or anthropogenic disturbances in the ecosystem (Cadwell, 2005; Pan and Yu, 2011; Shun and Tong, 2001). Catalase activity in soils is considered an indicator of aerobic microbial activity and has been related to soil fertility (Trasar-Cepeda et al., 1999).

Since catalase is a metaloenzyme, bioactivity is reduced by heavy metals which may mask catalytically active groups, having denaturing effects on the conformation of proteins, competing with the natural ions involved in the formation of enzyme-substrate complexes, or by affecting the enzyme synthesis (Liu, 2008).

Given that bioindicators are the most sensitive to the changes in the environment, which could prove long-term effects of pollution, this study focused on elucidating the relationship between soil catalase activity and heavy metal contamination, in particular lead (Pb), cadmium (Cd), zinc (Zn), and copper (Cu).

MATERIAL AND METHODS

Collection and preparation of soil samples:

Soil samples (N = 10) collected from five locations in the city of Sibiu (Tab. 1, Fig. 1) were subjected to microwave acid digestion according to EPA method 3051 (Milestone Start D program) and mineralization with Berghoff system, at 175°C and 30 Bar.

Chemical analysis of the elements Pb, Cd, Zn, and Cu:

The concentration of the metals of diluted solution were determined by flame atomic absorption spectrometry (Graphite Furnace Atomizer GFA-EX7) according to SR ISO 11047, and expressed as mg/kg dry mass (DM).

Table 1: Details of soil samples.

Location of soil samples	Depth of sampling (cm)	Code
Poplaca Forest	0-5	P1
	6-30	P2
Sibiu Meteo Station	0-5	M1
	6-30	M2
Oţelarilor Street (industrial zone)	0-5	O1
	6-30	O2
Unirii Square (central zone)	0-5	U1
	6-30	U2
Luncii Street	0-5	L1
	6-30	L2

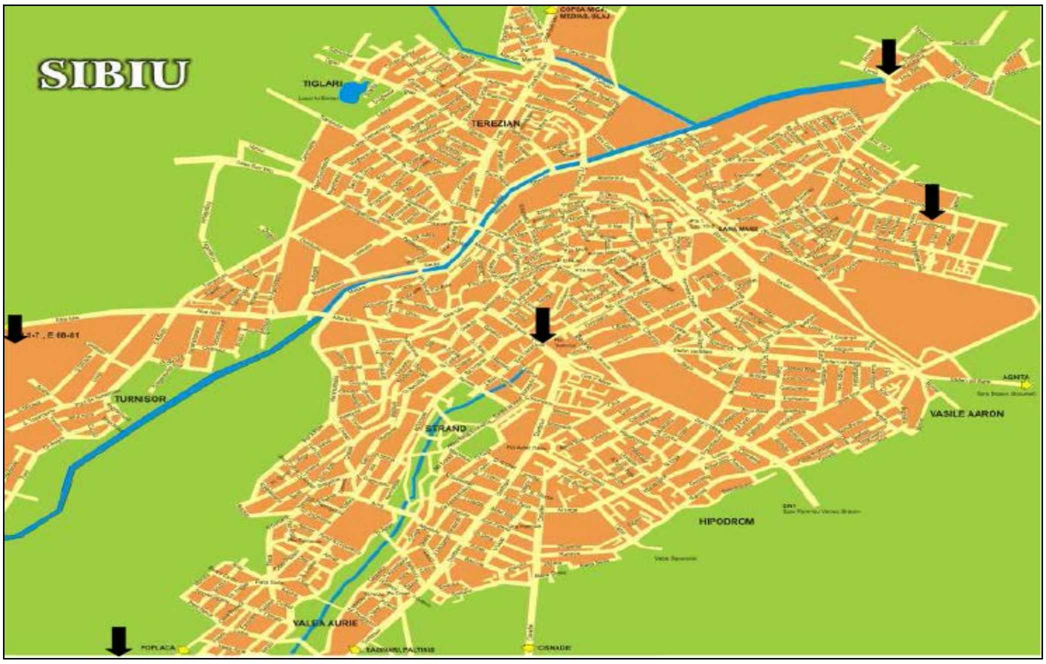

Figure 1: Location of sampling points (black arrows).

Digestion, mineralization, and determination of heavy metals Pb, Cd, Zn, and Cu were performed by the chemical laboratory of Sibiu Regional Environmental Protection Agency.

Soil catalase activity analysis:

The titration method based on the decomposition of the substrate (hydrogen peroxide H_2O_2) by catalase was applied.

Catalase activity is expressed as the difference between total catalytic activity and non-enzymatic catalytic activity mg H_2O_2/g soil (1 ml 0.05 N $KMnO_4$ corresponds to 0.85 mg H_2O_2). Overall catalytic activity is the difference between the consumption of $KMnO_4$ in the blank with substrate and active samples (soil and substrate).

RESULTS AND DISCUSSION

The concentration of heavy metals, as well as catalase activity of the analyzed soil samples, is shown in table 2. In O2 sampling point, the concentration of the four heavy metals exceeds the threshold of alert, the same in O1 (for Pb, Zn, and Cu), respectively, in U2 for Pb. Regarding the depth of soil sampling (0-5 cm, and 6-30 cm, respectively), no significant differences were found by Kruskal-Wallis test between the values of heavy metals.

Table 2: Heavy metals content and catalase activity of soil samples.

Sample	Concentration of heavy metals (mg/kg DM)				Catalase activity (mg H_2O_2/g soil)
	Pb	Cd	Zn	Cu	
P1	17.49	0.78	86.67	14.19	0.48
P2	7.60	0.78	55.26	12.34	0.38
M1	36.94	0.85	67.11	16.73	0.28
M2	42.25	0.78	42.72	14.80	0.13
O1	568.50	2.29	309.94	147.12	3.06
O2	930.14	4.56	1,036.70	287.14	0.26
U1	45.40	0.84	75.05	75.05	0.26
U2	73.94	1.30	95.81	36.17	0.56
L1	45.38	1.12	139.25	36.17	0.74
L2	37.94	1.25	127.47	33.26	0.29

Catalase activity was variable, on average 0.64 ± 0.86 mg H_2O_2/g soil, as shown in figure 2. In the industrial zone (sample O1), the soil bioactivity was four times higher (1.66 mg H_2O_2/g of soil) than the average of the other samples (0.39 mg H_2O_2/g of soil).

Regarding the depth of soil sampling, catalase activity was comparable in samples collected from non-industrial areas.

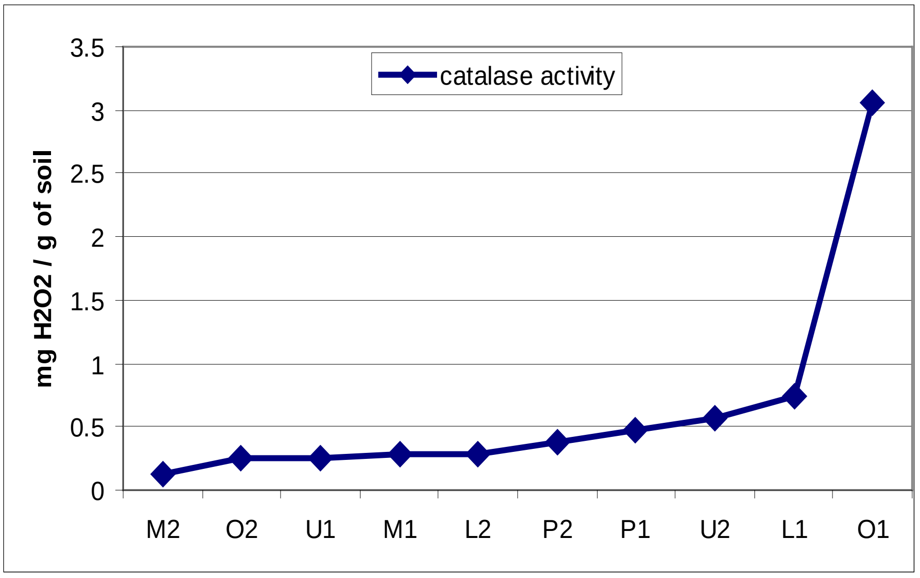

Figure 2: The soil bioactivity via catalase in all analyzed samples.

The enzyme behaved differently in the industrial polluted area, stimulated by the significant presence of heavy metals in the sample O1, but inhibited by the increasing concentration of these pollutants in the sample O2. By applying probability matrices alpha, we obtained significant correlations ($p < 0.05$) between catalase activity and concentration of Zn, Cd, Pb, and Cu to a depth of 0-5 cm of soil (P1, M1, O1, U1, and L1). The difference (as a percentage) is illustrated in figure 3.

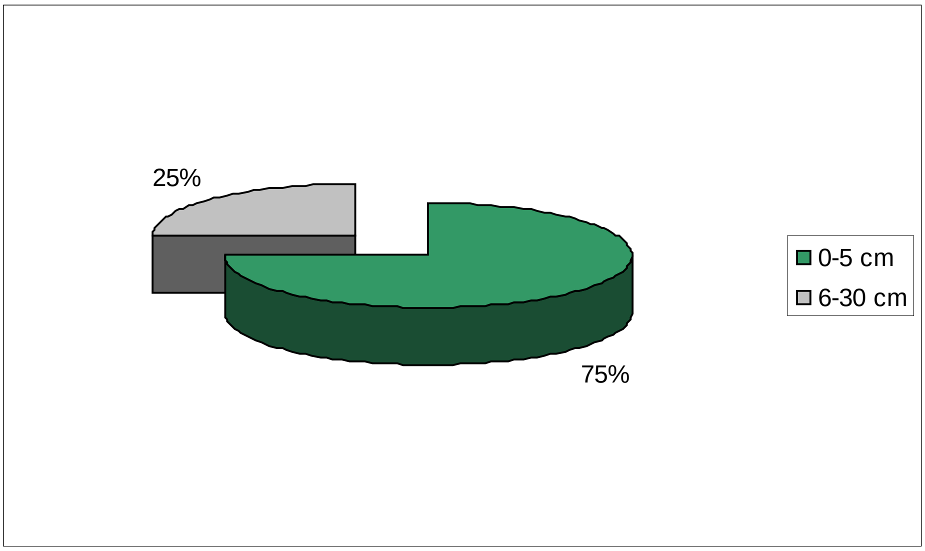

Figure 3: Share of catalase activity, by the depth of soil sampling.

Our results are in agreement with the scientific literature, which shows that the total and available contents of soil Cu, Cd, Pb, and Zn had significant negative correlation with the activity of soil catalase, especially at high concentrations of heavy metals (Xiaoguang et al., 2011; Karaca et al., 2010; Wang et al., 2009), while in slightly and moderately polluted soils the bioactivity was higher than in non-industrial areas (Tang et al., 2014; Guo et al., 2012). The inhibiting effect of Cd, Zn, and Cu seems to be more pronounced than Pb's effect on enzymatic activity (Masto et al., 2011; Liu et al., 2008; Yang et al., 2006).

CONCLUSIONS

Evaluation of natural and anthropogenic soil contamination with heavy metals (Pb, Cd, Zn, and Cu) was investigated by using the enzyme catalase as an important biomarker. The investigation refered to five locations in Sibiu locality, soil sampling being done at two different depths. Catalase activity was variable, in average of 0.64 ± 0.86 mg H_2O_2/g soil, with a peak of 3.06 mg H_2O_2/g soil in the industrial zone. Significant correlations ($p < 0.05$) were found between catalase activity and concentration of Zn, Cd, Pb, and Cu to a soil depth of 0-5 cm.

In conclusion, catalase sensitivity to heavy metals in the soil may be used in environmental risk management programs for urban industrial areas.

ACKNOWLEDGEMENTS

We acknowledge the Environmental Protection Agency of Sibiu, Romania, who provided soil samples of determined heavy metals concentration.

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PLANT ECOLOGY AS REFLECTED IN ROMANIAN PHYTONOMY

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KEYWORDS: Romania, ethnobotany, phytonyms, plant ecology.

ABSTRACT

Out of a total of 21,000 Romanian folk plant names, the authors have selected 2,400 that include terms denoting the living habitats of the respective species. 146 words have been identified that depict ecotopes – land and water, wild and anthropic, forest, agricultural, horticultural, pratal, saxicolous/ rupicolous, arenaceous, halophilous, growing cultivated fields, ruderal. Over 430 phytonyms indicate living habitats where such plants live as parasite and saprophyte species, fungi and cormophytes, also mosses and lichens. Some also specify the host species. Mention is made of the situation when popular names refer to ecotopes indirectly, by including the names of animals (e.g. "frog", "fish", "cuckoo", "wolf", "snake", "bear", "lizard", "mouse", etc.) sharing the environments with the respective plant species. Few phytonyms are single words, as the great majority are compounds formed as follows: two nouns (the former in the Nominative, and the latter in the Accusative; or one in the Nominative followed by another in the Genitive, working as an attribute), or a noun in the Nominative and an adjective working as an attribute.

REZUMAT: Ecologia plantelor reflectată în fitonimia românească.

Autorii au selectat din cele 21.000 de fitonime, populare româneşti, un număr de 2.400, care evidenţiază prin unul sau mai mulţi termeni componenţi mediile de viaţă ale speciilor numite. Au fost identificate 146 de cuvinte-nume de ecotopuri terestre şi acvatice, naturale şi antropice, forestiere, agricole, horticole, praticole, saxicole, arenicole, halofile, segetale, ruderale. Peste 430 fitonime evidenţiază mediile de trai ale speciilor parazite şi saprofite, ciuperci şi cormofite, dar şi ale unor muşchi şi licheni. Unele dintre acestea precizează şi specia gazdă care este parazitată. Este semnalată procedura populară de a reda ecotopurile speciilor indirect, prin evidenţierea unor specii de animale (broască, peşte, cuc, lup, şarpe, urs, şopârlă, şoarece, etc.) care trăiesc în aceleaşi medii cu plantele respective. O mică parte dintre fitonime sunt simple, marea majoritate fiind compuse, fie dintr-un substantiv în nominativ şi un altul în acuzativ, fie prin compunerea a două substantive, primul la nominativ, al doilea cu valoare de atribut genitival ori dintr-un substantiv în nominativ şi un adjectiv cu funcţie de atribut.

ZUSAMMENFASSUNG: Die Ökologie der Pflanzen im Spiegel der rumänischen Namengebung.

Die Verfasser haben von 21.000 volkstümlichen Pflanzennamen 2.400 ausgewählt, die durch einen oder mehrere der sie zusammensetzenden Teilbegriffe die Lebensräume der Arten kennzeichnen. Es wurden 146 Namenwörter terrestrischer und aquatischer, natürlicher und menschlich bedingter, forstlicher, landwirtschaftlicher, Garten-, Wiesen-, Felsen-, Sand- und Salzstandort sowie Acker- und Ruderalstandort bezogener Ökotope identifiziert. Über 430 Pflanzennamen beziehen sich auf den Lebensraum von Parasiten und Saprophyten, auf Pilze und höhere Pflanzen, aber auch auf Moose und Flechten. Einer dieser Namen weist auf die Wirtspflanze des Parasiten hin. Die volkstümliche Herangehensweise, die Ökotope der Arten indirekt durch das Hervorheben von Tierarten (Frosch, Fisch, Kuckuck, Wolf, Schlange, Bär, Eidechse, Maus, u.a.), die im selben Lebensraum vorkommen wiederzugeben, wird hervorgehoben und dargelegt. Ein geringer Teil der Pflanzennamen ist einfach, die Mehrheit ist zusammengesetzt und besteht entweder aus einem Hauptwort im Nominativ und einem anderen im Akkusativ, oder aus einer Zusammensetzung zweier Substantive, von denen das erste im Nominativ und das zweite in der Eigenschaft eines Genetiv Atributs vorkommt, oder aus einem Substantiv im Nominativ und einem Adjektiv in der Funktion eines Atributs.

INTRODUCTION

Out of the 21,000 Romanian folk plant names, 2,400 (or 11.5%) refer to the ecotope of the said species. These are alphabetized below, along with the respective scientific denominations.

From an ecological standpoint, the Romanian phytonyms naming the plants' environment include 146 terms denoting both natural habitats (ca. 1,900, e.g. "wild", "mountain", "cliff", "rock", "forest", "woods", "steppe with dry valleys", "old forest", "fenced-in district (of a forest)", "sand", "pond", "marsh", etc.) and anthropic habitats almost 500 in all, e.g. "cornfield", "cereal field", "stubblefield", "sown field", "(cultivated) field", "garden", "yard", "fence", "house", "room", "cellar", "wall", "land", "ba(u)lk", "apiary", etc.

Species from both land ecosystems (almost 2,000 phytonyms) and water ecosystems (410 phytonyms) are mentioned. Of the former category, the most frequent items occur in relation to field, cultivated-field, field-weed, and ruderal habitats 435 items; examples: "field", "upturned field", "(cultivated) field", "path between two upturned fields", "land", "balk", "cornfield", "(cereal) field", "stubblefield", "sown field", "garden", "kerb", "(house) yard", "fence", "house", "room", "wall", "shed", "roof", "window", "(window) pane", "(flower) pot", "(flower) bowl", "enamelled clay jar", "(boiling) pot", "crock", "hearth", "fire", "path", "road", "way", "trodden patch", "ditch", "waste"; then mountain and saxicolous 288 items, e.g. "mount(ain)", "crag"/"cliff", "rock"/"stone", "gravel", "lime(stone)", "pointed end of a rock", forest 280 items, e.g. "forest", "(old) forest", "grove", "riverside coppice", "grove of young thorny trees or shrubs", "riverside coppice", "fenced-in district (of a forest)", "pine woods", "fir woods", "spruce fir woods"; grassland (160 items, e.g. "pasture", "hay field", "grass", "clearing", "fallow land", "common", "meadow", "swamp", "(village) common", "hay field", "sheep fold", "plain", "river bank", "valley"/"dale"/"glen", "river meadow", "hill", "hillock", "hill side/slope"); halophilous (25 items, e.g. "salty pasture-land"/"saltings", "salt", "salt marsh") and arenaceous (23 items, e.g. "sand"). There are also 260 wild-habitat terms.

Other phytonyms, more than 430, indicate the living habitats of parasite and saprophyte species, fungi and cormophytes, as well as mosses and lichens e.g. "wood", "stump", "(tree) chump", "log", "tree", "fruit tree", "trunk", "tree hollow", "fir branch", "branch". Some phytonyms specify the host of the parasite e.g. "wheat", "apple (tree)", "corn", "chestnut (tree)", "(grape)vine", "rye", "birch", "nut (tree)", "plum (tree)", "osier", "willow", "elder tree", "oak (tree)", "larch tree", "beech (tree)", "cherry (tree)", "elm (tree)", "black/dark mullein", "hemp", "clover", "shepherd's thyme", "barberry", "alfalfa", "wormwood", "sage", "tobacco", "cucumber", "onion", "orache", "nettle", "sunflower", "potatoes", "vetch", etc.

Among the phytonyms that denote water habitats for the plants under discussion, some indicate hydrophilous or water-pollinated species 240 items, e.g. "water", "lake", "puddle", "(mud-bottomed) lake", "pond", "sea", "spring", "brook", "stream", "river"; while others indicate hygrophylous species 50 items, e.g. "swamp", "marsh", "fen", "peat".

A means of specifying the ecotopes for certain plant species is to name them indirectly, by mentioning animal species that share habitats with the respective plants. Hence, there are 120 plants thus connected with frogs and fish – therefore aquatic species; and more than 90 connected with animals such as "cuckoo", "wolf", "snake", "bear", "lizard", "mouse", etc. – therefore terrestrial species (all in all, over 500 items, of which a majority indicate other aspects, such as organ morphology, quality – in particular in terms of toxicity or edibility, flowering phenology, etc.).

The around 2,400 Romanian plant names whose semantics can help in identifying the living habitats of the respective species fall into at least five categories from a linguistic standpoint.

Few phytonyms (103) concentrate the plant ecology in just one word: arinariţă (i.e. nisipariţă) < arina, sand(y); bahniţă (i.e. mlăştiniţă, plantă de mlaştină) < bahnă, “fen”; bălănică (i.e. possibly plantă de bâlc/baltă) < possibly, bâlc, “puddle”; băltăţele < baltă, also “puddle”; bisacăn/brisacă/prisacăn (i.e. plantă de prisacă) < prisacă, “apiary”; brâncăuş (i.e. creson de izvor) < German Brunnenkresse; buhăşei (i.e. ciuperci de buhaş, desiş) buhaş, “thicket”; câmpeniţă < câmp, “field”; cioturaşi (i.e. ciuperci de cioturi) < ciot, “stump”; ciripă (i.e. floare de cirip, ghiveci) < cirip “flower pot”; dumbravnic(ă) (i.e. plantă de dumbravă, pădure de stejar) < dumbravă, “grove”; făgeţea < făget, “beech woods”; fântânic < fântână, “well”; gărdurariţă < gard, “fence”; holdiţă < holdă, “cornfield”; lăculeasă < lac, “lake”; luncişori < luncă, “river meadow”; mălurea (i.e. creşte pe mal) < mal, “bank”; mărăcinar < mărăcine, “bramble”; mirgău (i.e. possibly plantă de mărghilă, mărgău) < mărghilă, “puddle”; miriştea (i.e. plantă de mirişte) < mirişte, “stubblefield”; mlăcele (i.e. plantă de mlacă, mlaştină) < mlacă, “marsh”; mlăştiniţă < mlaştină, “marsh”; mestecănei (i.e. ciupercă pe mesteceni) < mesteacăn, “birch (tree)”; nadă, natiş, natiţă (i.e. plante de apă) < rad. nad- “water plants”; nisipariţă, nisipăriţă, nisipuş < nisip, “sand”; nucari < nuc, “(wal)nut tree”; pădureţ, păduriţă, pădureancă < pădure, “forest”; petreancă < piatră, “stone”; plopan < plop, “poplar”; plutiţă < plută, “cork tree”; prundar < prund, “gravel (ground)”; răchită, răcoţean, rocoină (i.e. plante de locuri umede) < răchită, “osier”; râureancă < râu, “river”; runcan < runc, “(artificial) clearing in a forest”; sălcar < salcie, “willow”; sărăcică (i.e. plantă de sărătură) < sărătură, “salting”; steiţă (i.e. floare de stei, stâncă) < stei, “sharp rock”; stejărar < stejar, “oak tree”; zidăriţă < zid, “wall”, etc.

Majority of phytonyms (a total of about 2,300) indicate plant ecology in two or more words.

Most phytonyms (1,430) include two nouns, one in the Nominative and the other in the Accusative (with a preposition in between them), which specify plant habitats: ai de munte, i.e. “mountain garlic/bulb”; bojorei de iarbă, i.e. “grass peony”; brustur de baltă, i.e. “pond burr”; burete de luncă, i.e. “river-meadow mushroom”; cânepă de apă, i.e. “water hemp”; crin de grădină, i.e. “garden lily”; cucută de apă, i.e. “water hemlock”; curechi de mare, i.e. “sea cabbage”; drăgaică de stâncă, i.e. “Our Lady’s bedstraw from-the-rocks”; floare de fân, i.e. “hay flower”; garoafe de poiană, i.e. “glade carnation”; hrib de nisip, i.e. “sand boletus”; iarbă de ţărm, i.e. “seashore grass”; iederă de pădure, i.e. “forest ivy”; jaleş de mirişte, i.e. “stubblefield sage”; leuştean de bahnă, i.e. “fen lovage”; macriş de râuri, i.e. “river sorrel”; stejar de piatră, i.e. “stone oak”; tămâiţă de drum, i.e. “road Ambrosia”; urfen de zăvoi, i.e. “riverside-coppice Myricaria”; viorele de ogoare, i.e. “(cultivated) field violet”, etc.

Other phytonyms (470 items) are compounded via a noun in the Nominative and an adjective functioning as an attribute which points out the quality and, indirectly, the living habitat, e.g. “crab/wild apple”, “wild vetch”, etc.

Some of them (380 items) have been formed by juxtaposing two nouns – one in the Nominative and the other functioning as a possessive attribute, e.g.: ardeiul broaştii i.e. “frog’s pepper”; barba bradului i.e. “fir-tree’s beard”; buretele nucului i.e. “(wal)nut tree’s mushroom”; căldăruşa stâncii i.e. “rock’s little pail”; cimbrişorul câmpului i.e. “field’s wild thyme”; floarea bălţii i.e. “pond’s flower”; gheba cioturilor i.e. “stumps’ (honey) agaric”; iarba codrului i.e. “old woods’ grass”; luminiţa muntelui i.e. “mountain’s twinkle”; mana viţei de vie i.e. “vine’s blight”; năvădeala peştilor i.e. “fishes weaving”; otrăţelul bălţilor i.e. “ponds bladder wort”; putregaiul porumbului i.e. “corn’s rot”; râia trifoiului i.e. “clover’s scabies”; sălăţica zidului i.e. “wall’s little salad”; torţelul trifoiului i.e. “clover’s dodder”; umbrarul muntelui i.e. “mountain’s arbour”; verzeala zidurilor i.e. “walls’ greenness”; zgaiba stâncii i.e. “rock’s pustule”, etc.

Phytonyms formed through extended composition are very rare, e.g. bureţi de cei de pe goron i.e. "mushrooms of the oak"; buruiană de sub alun i.e. "weed from under the hazelnut tree"; cosâţă care se face în semănături i.e. "(hair) plait that grows in sown fields"; iarbă sfărâmătoare de pietri i.e. "grass that crushes stones"; scai ghimpos încolăcitor pă lemn i.e. "thorny thistle coiling on wood", etc.

RESULTS

List of phytonyms

Acriş sălbatic (*Ribes grossularia* syn. *Ribes uva-crispa*), afin de mlacă, afin de tău (*Vaccinium uliginosum*), afin de munte, afine de pădure (*Vaccinium myrtillus*), afin sălbatic (*Daphne mezereum*), agriş de mare (*Ephedra distachya*), agriş sălbatic (*Ribes grossularia* syn. *Ribes uva-crispa*), ai de câmp (*Allium scorodoprasum, Galanthus nivalis*), ai de grădină (*Allium sativum*), ai de munte (*Allium ochroleucum, Allium victorialis*), ai de pădure (*Allium ascalonicum, Allium schoenoprasum, Allium ursinum, Asphodeline lutea, Chelidonium majus, Lilium martagon*), ai sălbatic (*Allium ascalonicum, Allium ochroleucum, Allium oleraceum, Allium panicullatum, Allium ursinum*), aişor de câmp, aişor de pădure (*Lilium martagon*), aiul şarpelui (*Allium rotundum, Allium scorodoprasum, Allium victorialis*), aiuţi de munte (*Allium ursinum*), albăstrele de munte (*Centaurea triumfettii*) albăstriţă de grâu (*Centaurea cyanus*), alior de baltă (*Euphorbia palustris*), alior de câmp (*Euphornia cyparissias*), alior de pădure (*Euphorbia amygdaloides*), alior de semănături (*Euphorbia exigua*), alun de casă, alun de grădină (*Corylus maxima*), alun sălbatic (*Corlylus colurna*), anasonul bradului (*Anisomyces*), angelică de pădure (*Angelica sylvestris*), angelică sălbatică (*Angelica archangelica, Angelica sylvestris*), angelină sălbatică (*Angelica sylvestris*), anghinare de grădină (*Cynara cardunculus*), anin(e) de munte (*Alnus viridis*), apiu de apă, apiu de părău (*Apium graveolens*), arbore de mangrove (*Rhizophora mangle*), ardei sălbatic (*Galinsoga parviflora*), ardeiul broaştii, ardeiul broştii (*Polygonum hydropiper, Polygonum persicaria*), arginţică de grădină (*Silybum marianum*), arginţică de pădure (*Chrysosplenium alternifolium*), arin de baltă (*Euphorbia palustris*), arin de munte (*Alnus viridis*), arinariţă (*Arenaria serpyllifolia*), arior de baltă (*Euphorbia palustris*), armirai sălbatic (*Carduus hamulosus*), arsânic de grădină (*Lychnis calcedonica*), arşinic de căţun (*Rhodiola rosea*), arţar de cameră (*Abutilon hybridum*), arţar de codru (*Acer pseudoplatanus*), asmăţui de grădină (*Anthriscus cerefolium*), asmăţui de munte (*Anthriscus nitida*), asmăţui de pădure (*Anthriscus nemorosa*), asmăţui de câmp (*Torilis arvensis*), asmăţui sălbatic (*Anthriscus trichospermus* syn. *Anthriscus cerefolium* ssp. *trichospermus, Chaerophyllum cicutaria* syn. *Chaerophyllum hirsutum, Torilis japonica*), aţa apei (*Cladophora* ssp., *Philonotis fontana, Potamogeton pusillus, Spirogyra* ssp., *Zannichellia palustris*), aţă de mare (*Ruppia maritima*), azalee de grădină (*Godetia amoena* syn. *Clarkia amoena*).

Baba secării (*Secale cornutum*), bahniţă (*Scheuchzeria palustris*), balbisă de baltă (*Stachys palustris*), banii broaştelor (*Lemna minor*), barba bradului, barba copacilor (*Usnea* ssp.), barba ursului de bahne (*Equisetum palustre*), bârbolnic/bârbornic de baltă (*Veronica becabunga*), bălănică (*Puccinellia distans*), bălbisă de pădure (*Stachys silvatica*), băloşel de pinet (*Gomphidius viscidus*), băltăţele (*Ranunculus acris*), băluşca câmpului (*Camarophyllus pratensis*), băluşca molidului (*Gomphidius glutinosus*), bărbănoc de câmp (*Vinca minor*), bărbănoc de grădină (*Vinca herbacea*), bărbuşoară de munte (*Arabis turrita*), bărbuşoară de stâncă (*Erysimum saxosum* syn. *Erysimum comatum*), bărsacăn (*Senecio nemorensis* syn. *Senecio germanicus*), băsacăn, beseacăn, bisacăn, bisăcă, bâ(r)sacăn, brisacă, basacă (*Epilobium angustifolium*), bâsâiocul câmpului (*Galinsoga quadriradiata* syn. *Galinsoga* *ciliata*), bican de pădure (*Galega officinalis*), bichină sălbatică (*Lotus corniculatus*), bob de mare (*Phytolacca americana*), bob de ţarină (*Lathyrus silvester*, *Vicia* ssp.), bob sălbatic (*Lathyrus* ssp.), bobul broaştei (*Menyanthes trifoliata*), boghiţă (*Iris pseudacorus, Roripa silvestris*), bojor de munte, bojorei de munte (*Rhododendron kotschyi* syn. *Rhododendron myrtifolium*), bojorei de iarbă (*Orchis morio*), bolonică (*Sium latifolium*), bolundă în holdă (*Lolium temulentum*), bombă de câmp (*Hibiscus trionum*), bonzăraş de holdă (*Centaurea cyanus*), borceag de câmp (*Vicia cracca*), boroştean sălbatic (*Daphne mezereum*), bortocină de grădină (*Onobrychis viciaefolia*), bortocină sălbatică (*Astragalus onobrychis*, *Onobrychis viciifolia*), bosioc de câmp (*Calamintha acinos* syn. *Acinos arvensis*), bostan de apă (*Echinocystis lobata*), botcană de câmp (*Hieracium aurantiacum*), brad de cameră (*Araucaria* ssp.), brad de munte (*Pinus sylvestris*), brad sălbatec (*Pinus pinaster*), bradul broaştei (*Equisetum palustre*), brăduleţ de pădure (*Equisetum sylvaticum*), brăduţ de câmp (*Equisetum arvense*), brăduţul bălţii (*Equisetum palustre*), brâncăuş (*Cardamine pratensis*) from German, Burnkresse, brânduşă de munte (*Crocus banaticus*, *Crocus heuffelianus*), brânduşă de nisip (*Merendera sobolifera*), brânza broaştei (*Batrachium trichophyllus*), brădiş înecat (*Ceratophyllum* ssp., *Myriophyllum* ssp.), brădişor de apă (*Fontinalis antipyretica*), brăduleţ de pădure (*Equisetum sylvaticum*), brăduţ de apă (*Hippuris vulgaris*), brăduţ de casă (*Asparagus sprengeri*), brăduţ de câmp (*Equisetum arvense*), brăduţ de munte, brăduţ de pârleală (*Bruckenthalia spiculifolia*), brăduţul bălţii (*Equisetum palustre*), breben sălbatic (*Lythrum salicaria*), brebenei de munte (*Corydalis cava*), brei de câmp (*Mercurialis annua*), brei de pădure (*Mercurialis annua*), brisacă (*Epilobium angustifolium*), broasca apei (*Potamogeton* ssp.), broscan (*Nuphar luteum*), broscariţă, broscăriţă (*Ludwigia palustris, Triglochin palustre, Potamogeton natans*), broscăriţa noduroasă (*Polygonum lapathifolium*), broschiţă (*Ranunculus sardous*), bruncuţă de apă (*Nasturtium officinale*), brustur de baltă (*Petasites hybridus*), brustur de luncă (*Arctium nemorosus*), brustur de pădure (*Telekia speciosa*), brustur de păraie (*Tussilago farfara*), brustur de râu (*Petasites hybridus, Tussilago farfara*), brusture de munte (*Arctium tomentosum*), buchet de câmp (*Dianthus carthusianorum*), buciniş de apă, buciniş de baltă (*Cicuta virosa*), buciumul broaştei (*Oenanthe aquatica*), bucuria casei (*Begonia sanguinea, Impatiens balsamina*), buegia broaştei (*Polygonum hydropiper*), bujor de câmp (*Orchis morio*, *Paeonia tenuifolia*), bujor de grădină (*Paeonia officinalis*), bujor de munte (*Paeonia peregrina, Rhododendron kotschyi* syn. *Rhododendron myrtifolium*), bujor de pădure (*Daphne mezereum, Orchis maculata, Paeonia peregrina*), bujor sălbatic (*Anthyllis vulneraria, Orchis morio*), bujorei de munte (*Rhododendron kotschyi* syn. *Rhododendron myrtifolium*), bujorei de pădure (*Epipactis atrorubens*), bujorul bălţii (*Lythrum salicaria, Orchis laxiflora* ssp. *elegans*), bujorul bălţii bătut (*Orchis incarnata*), bujorul broaştei (*Trifolium hybridum*), bujorul câmpului (*Orchis morio*), buhăieşi (*Lactarius deliciosus*), bulbuc(e)i de munte (*Trollius europaeus*), bulbucei de pădure (*Chrysosplenium alternifolium*), bulbuci de baltă (*Caltha palustris* ssp. *laeta*), buledea gârlei (unidentified), bulgăraşi de var (*Asperula capitata*), bulgări de stâncă (*Cnidium silaifolium*), bumbac de câmp (*Eriophorum* ssp.), bumbac de munte (*Trollius europaeus*), bumbac de munte (*Trollius europaeus*), bungeac, bungiac (*Mnium undulatum* syn. *Plagiomnium undulatum*, *Sphagnum* ssp.) bugeac, bugiac (*Funaria hygrometrica*), bugeag (*Polytrichum commune*), bunget, bunjet (*Lycopodium clavatum*), bunghişor(i) de munte (*Erigeron alpinus*), bureatică de lemn (*Lobaria pulmonaria*), bureciori de cetină (*Marasmius perforans*), burecior(i) de pădure (*Agrocybe praecox*), burecior(i) de rânsă (*Ciboria amentacea*), bureciorul ramurilor (*Marasmius ramealis*), burete alb de pajişte (*Agaricus campester*), burete de brad (*Cantharellus cibarius*), burete de buhaş (*Lactarius deliciosus*), burete de casă (*Merulius lacrymans* syn. *Serpula lacrymans*), burete de câmp (*Agaricus arvensis, Agaricus campestris*), burete de copaci (*Fomes fomentarius, Pleurotus ostreatus*), burete de goron (*Daedalea quercina*), burete de gunoi (*Coprinus comatus*), burete de lemn (*Lenzites betulina, Lobaria pulmonaria*), burete de luncă (*Agaricus campester*), burete de mărăcine (*Calocybe gambosa*), burete de mesteacăn (*Boletus scaber, Cortinarius cinnamomeus, Trametes versicolor* syn. *Coriolus versicolor*), burete de muşchi (*Clitopilus prunulus*), burete de nuc (*Polyporus squamosus*), burete de pivniţă (*Merulius lacrymans* syn. *Serpula lacrymans*), burete de plop (*Boletus aurantiacum, Boletus duriusculus*), burete de prun (*Calocybe gambosa, Fomes fomentarius, Marasmius oreades, Rhodophyllum clypeatum, Rhodophyllum soundersii*), burete de răchită (*Trametes suaveolens*), burete de salcă (*Trametes suaveolens*), burete de scorbură (*Volvariella bombycina*), burete de soc (*Auricularia auricula-judae*), burete de spin (*Russula alutacea, Russula grisea, Russula lepida*), burete de stejar (*Boletus aereus, Boletus purpureus, Boletus satanas, Daedalea quercina, Fistulina hepatica, Ganoderma lucidum*), burete de zadă (*Fomitopsis officinalis*), burete măstăcănesc (*Lactarius torminosus*), burete negru de fag (*Pleurotus ostreatus*), burete roşu de stejar (*Boletus purpureus, Fistulina hepatica*), buretele fagului (*Pleurotus ostreatus*), buretele nucului (*Polyporus squamosus*), bureţi albi de pădure, bureţi de acăţ (*Calocybe gambosa*), bureţi de arine (*Armillariella mellea*), bureţi de baligă (*Agaricus campester*), bureţi de bărc (*Boletus scaber*), bureţi de brad (*Scutiger ovinus*), bureţi de buturugă (*Hypholoma capnoides*), bureţi de cătină (inderminated), bureţi de cioată (*Armillaria mellea*), bureţi de cei de pe goron (*Daedalea quercina*), bureţi de cireş (*Pycnoporus cinnabarinus*), bureţi de copaci (*Coriolus versicolor*), bureţi de fag (*Dryodon erinaceus* syn. *Hericium erinaceus, Lenzites betulina, Pleurotus ostreatus, Polyporus squamosus*), bureţi de gunoi (*Coprinus atramentarius*), bureţi de gunoişte (*Agaricus campestris*), bureţi de iarbă (*Marasmius alliaceus, Marasmius scorodonius*), bureţi de lemn (*Coriolus versicolor, Hypholoma fasciculare, Lenzites betulina, Pleurotus ostreatus*), bureţi de livadă (*Lactarius deliciosus*), bureţi de mesteacăn (*Dermocybe cinnamomea, Placodes betulinus* syn. *Piptoporus betulinus*), bureţi de molid (*Boletus pinicola*), bureţi de munte (*Scutiger ovinus*), bureţi de padină (*Agaricus campester*), bureţi de pajişte (*Agaricus campester, Marasmius alliaceus, Marasmius oreades, Marasmius scorodonius*), bureţi de pădure (*Lactarius piperatus*), bureţi de păşune (*Marasmius oreades, Scutiger ovinus*), bureţi de perje (*Calocybe gambosa*), bureţi de plop (*Boletus aurantiacus, Ptychoverpa bohemica*), bureţi de pom (*Armillariella mellea*), bureţi de porumbari (*Calocybe gambosa*), bureţi de salcâm (*Calocybe gambosa*), bureţi de salcie (*Trametes suaveolens*), bureţi de spin(i) (*Lactarius deliciosus, Lactarius piperatus, Rhodophyllus clypeatus, Russula lepida, Tricholoma georgii* syn. *Calocybe gambosa*), bureţi de tei (indeterminate), bureţi de tropini (*Armillariella mellea*), bureţi de ulm (*Lyophyllum ulmarium*), bureţi de zăvoi (*Ptychoverpa bohemica*), bureţi măstăcăneşti (*Piptoporus betulinus*), bureţi mestecăneşti (*Boletus scaber*), bureţi pruneşti (*Marasmius oreades, Rhodophyllum clypeatum, Rhodophyllum soundersii*), bureţi goroneşti (*Lactarius piperatus*), bureţi de goron (*Daedalea quercina*), burghine de pădure (*Viburnum opulus*), buricul apei (*Hydrocotile vulgaris*), buruiană de pe rozor (*Hypericum perforatum*), buruiană de sub alun (*Ajuga reptans*), buruiană de sub fag (indeterminate), busuioc de baltă (*Scutellaria hastifolia, Stachys palustris*), busuioc de casă (*Ocimum basilicum*), busuioc de câmp (*Galinsoga parviflora, Galinsoga ciliata, Mentha pulegium, Prunella vulgaris*), busuioc de cucuruz (*Galinsoga parviflora*), busuioc de mirişte

(*Stachys annua*), busuioc de munte *(Dracocephalum moldavicum, Melissa officinalis*), busuioc de pădure (*Origanum vulgare*), busuioc sălbatic (*Chenopodium polyspermum, Galinsoga parviflora, Galinsoga ciliata, Orobanche ramosa, Melissa officinalis, Prunella laciniata, Prunella vulgaris, Salvia austriaca*), busuiocul broaştei (*Betonica officinalis* syn. *Stachys officinalis, Teucrium scordium, Veronica beccabunga*), busuiocul broaştelor (*Scutellatia hastifolia*), busuiocul câmpului (*Anagallis arvensis, Melissa officinalis, Galinsoga quadriradiata* syn. *Galinsoga ciliata*).

Cais sălbatic (*Amygdalus nana* syn. *Prunus tenella*), calapăr de munte (*Hypochoeris uniflora*), cală de grădină (*Hosta plantaginea*), calce de baltă (*Caltha palustris* incl. ssp. *laeta*), calendarul codrului (*Arum maculatum*), cânepă sălbatică (*Clematis vitalba*), cânepa broaştei, cânepă de apă (*Conferva rivularis*), captalan de râu (*Cirsium rivulare*), cardamă de izvoare (*Nasturtium officinale*), carpen de pietriş (*Carpinus orientalis*), carul câmpului (*Carum carvi*), carul pădurilor (*Arnica montana*), castan sălbatic (*Aesculus hyppocastanum, Ailanthus altissima*), castane de apă, castane de baltă, castane de lac (*Trapa natans*), castravete de mare (*Zygophyllum fabago*), castravete sălbatic (*Ecbalium elaterium*), castraveţi sălbatici (*Echinocystis lobata, Sicyos angulata*), căldăruşa stâncii (*Aquilegia transsilvanica*), călţunaşi de câmp (*Viola tricolor*), cămaşa broaştei (*Hydrodictyon reticulatum*), cămaşa fagului (*Orthotrichum* sp.), căpşun de câmp, căpşun de deal, căpşun de pădure (*Fragaria viridis*), căpşună sălbatică (*Fragaria vesca*), căpşuni de grădină (*Fragaria ananassa, Fragaria moschata*), cătină de curte (*Lycium barbarum*), cătină de grădină, cătină de garduri (*Lycium halimifolium* syn. *Lycium barbarum*), cătină de râu(ri) (*Berberis vulgaris, Hippophaë rhamnoides, Myricaria germanica*, cătrănică sălbatică *Artemisia maritima* syn. *Artemisia santonica*), cătuşnică (de cea) sălbatică (*Marrubium peregrinum, Marrubium vulgare*), căţeii bălţii (*Pedicularis sceptrum-carolinum*), câmpeniţă (*Camarophyllus pratensis*), cânepa codrului, cânepă de apă, cânepă de vale, cânepă sălbatică (*Eupatorium cannabinum*), ceapa ciorii de câmpie (*Allium ammophilum*), ceapă de câmp (*Allium fistulosum*), ceapă de grădină (*Allium cepa*), ceapă de mare, ceapă de mare ceorească (*Urginea maritima* syn. *Drimia maritima*), ceapă de munte (*Allium victorialis*), ceapă sălbatică (*Allium* ssp., *Anthericum ramosum, Galanthus nivalis, Ornithogallum umbellatum*), ceraşa evreului de pădure (*Physalis alkekengi*), cercelucă de grădină (*Dicentra spectabilis*), cerenţel de munte (*Geum reptans*), cereş sălbatec (*Cerasus fruticosus*), cereş sălbatic (*Cerasus avium* var. *sylvestris*), cerinţel de munte (*Geum reptans*), certică de grădină (*Lepidium sativum*), baraboi sălbatic (*Chaerophyllum hirsutum*), chenarul bălţii (*Limosella aquatica, Littorella uniflora*), cheptenele broaştei (*Lycopus exaltatus*), chica bradului (*Usnea* ssp.), chica muntelui (*Alectoria ochroleuca*), chim de câmp, chim sălbatic, chimen de câmp, chimin de câmp, chimin sălbatic, chimion de câmp, chimion sălbatic (*Carum carvi*), chimen de apă (*Oenanthe aquatica*), chimen de câmpuri (*Nigella arvensis*), chimen de munte (*Ligusticum mutellina*), chimin de câmp (*Carum carvi*), chimin de grădină (*Pimpinella anisum*), chimin dulce de grădină (*Pimpinella anisum*), chimin porcesc de câmp (*Peucedanum oreoselinum*), chimin sălbatic, (*Carum carvi*), chiminu(l) ursului de munte (*Ligusticum mutellina*), chimion de apă, chimion de baltă (*Oenanthe aquatica*), chimion de câmp (*Carum carvi*), chimion de câmpuri (*Nigella arvensis*), chimion de grădină (*Pimpinella anisum*), chimion de grădină dulce (*Foeniculum vulgare*), chimion sălbatic (*Carum carvi*), chinarul luncii (*Luzula luzuloides*), chiparos de baltă (*Taxodium distichum*), chipăruşul broaştei (*Polygonum hydropiper*), chir de apă, chir de baltă (*Beckmannia erucaeformis*), chitic de pădure (*Humulus lupulus*), cicoare de câmp (*Cichorium intybus*), cicoare de grădină (*Cichorium endivia*), cicoare de munte (*Mulgedium alpinum* syn. *Cicerbita alpina*), cimbrişor de câmp (*Thymus* *pannonicus*), cimbrişor de munte (*Thymus alpestris*, *Thymus balcanus*), cimbrişor de muşuroi, cimbrişor de rozor (*Thymus pulegioides*), cimbrişor sălbatic (*Thymus* ssp. *spontane*), cimbrişorul câmpului (*Thymus glabrescens*), cimbru de câmp (*Calamintha acinos, Thymus glabrescens, Thymus pulegioides, Thymus* ssp. *spontane*), cimbru de deal al broaştei (*Anagallis coerulea* syn. *Anagallis foemina*), cimbru de grădină (*Hyssopus officinalis, Satureja hortensis, Thymus vulgaris*), *cimbru de munte* (*Calamintha alpina, Thymus balcanus, Thymus pulcherrimus, Thymus pulegioides*), cimbru mare de munte (*Calamintha alpina*), cimbru sălbatic (*Saturaja kitaibelii, Thymus balcanus, Thymus comosus, Thymus glabrescens, Thymus pulcherrimus*), cimbrul câmpului (*Thymus pulegioides*), cimburel de baltă al broaştei (*Anagallis coerulea* syn. *Anagallis foemina*), cimburel sălbatic (*Leonurus marubiastrum*), cimburelul broaştei (*Mentha pulegium*), cinstea câmpului (*Astrantia major*), cinsteţ de munte (*Stachys alpina*), ciocârţi de gorun (indeterminate), ciolobot de stâncă (*Centaurea reichenbachoides*), ciotfă, cioturaşi (*Pholiota mutabilis*), ciuperca de cioată (*Armillariella tabescens*), cireaşa codrului (*Atropa belladonna, Physalis alkekengi*), cireş de pădure (*Cerasus avium* var. *sylvestris, Ligustrum vulgare*), cireş de stepă (*Cerasus fruticosa* syn. *Prunus fruticosa*), cireş pădureţ, (*Cerasus avium* var. *sylvestris*), cireş sălbatic or cireş de pădure, cireşe pădureţe (*Cerasus avium* syn. *Prunus avium, Cerasus vulgaris* syn. *Prunus cerasus*), ciripă (*Pelargonium zonale*), ciucalău de câmp (*Hieracium aurantiacum*), ciucioi de zăvoi (*Agaricus campester, Ptychoverpa bohemica*), ciuciulete de plop (*Ptycoverpa bohemica*), ciuciuleţi de butuc, ciuciuleţi de fag (*Pleurotus ostreatus*), ciuciuleţi de luncă (*Agaricus campester*), ciuciuleţi de pădure (*Cantharelus cibarius, Pleurotus ostreatus*), ciuciuleţi de prun, ciuciuleţi de spine (*Calocybe gambosa*), ciucuşoară de stânci (*Alyssum saxatile*), ciulin de baltă (*Trapa natans*), ciuma apei, ciuma apelor (*Elodea canadensis, Elodea nuttallii*), ciuma pădurii (*Knautia arvensis*), ciupărcă de pădure (*Agaricus silvaticus*), ciupearcă de brad (*Scutiger ovinus*), ciupearcă de chimniţă (*Merulius lacrymans*, syn. *Serpula lacrymans*), ciuperca bradului (*Gloeophyllum abietinum*), ciuperca broaştei (*Amanita phalloides*), ciuperca de cioată (*Armillariella tabescens*), ciupercă albă de bălegar (*Agaricus campestris*), ciupercă albă de pădure (*Agaricus sylvicola*), ciupercă de bălegar (*Agaricus arvensis, Agaricus campester*), ciupercă de brad (*Boletus bovinus*, *Scutiger ovinus*), ciupercă de branişte (*Agaricus arvensis*), ciupercă de brădet (*Boletus luteus*), ciupercă de cale (*Agaricus bisporus*), ciupercă de casă (*Merulius lacrymans* syn. *Serpula lacrymans*), ciupercă de castan (*Lentinus elodes*), ciupercă de chimniţă (*Merulius lacrymans* syn. *Serpula lacrymans*), ciupercă de câmp (*Agaricus arvensis, Agaricus campester, Agaricus macrosporus, Agaricus xanthodermus*), ciupercă de fâneaţă (*Agaricus pratensis*), ciupercă de gunoi (*Agaricus campester, Coprinus atramentarius*), ciupercă de iarbă (*Agaricus campester*), ciupercă de imaş (*Agaricus campester*), ciupercă de mirişte (*Leucoagaricus* ssp.), ciupercă de molid (*Lactarius deliciosus*), ciupercă de padină (*Agaricus arvensis*), ciupercă de pivniţă (*Merulius lacrymans* syn. *Serpula lacrymans*), ciupercă de ogor (*Agaricus campester, Agaricus pratensis*), ciupercă de pădure (*Agaricus arvensis, Agaricus silvaticus, Agaricus silvicola*), ciupercă de păscălău, ciupercă de păşune (*Agaricus campester, Agaricus pratensis*), ciupercă de pe coastă (*Boletus scaber*), *ciupercă de pivniţă* (*Serpula lacrymans*), ciupercă de putregai (*Armillariella mellea*), ciupercă de tulpină (*Pluteus cervinus*), ciuperci albe de pădure (*Clitopilus prunulus*), ciuperci albe de rât (*Agaricus campester*), ciuperci de arine (*Armillariella mellea*), ciuperci de brad (*Scutiger ovinus*), ciuperci de cărpiniş (*Boletus scaber*), ciuperci de fag (*Boletus edulis*), ciuperci de goron (*Lactarius piperatus*), ciuperci de gunoişte (*Agaricus campestris*), ciuperci de hotar (*Agaricus arvensis*, *Agaricus campester*), ciuperci de lan (*Agrocybe dura*), ciuperci de luncă (*Agaricus campestris*), ciuperci de măr (*Rhodophyllum clypeatum*), ciuperci de mărăcine (*Calocybe gambosa*), ciuperci de mesteacăn (*Boletus aurantiacus, Boletus scaber, Boletus testaceo-scabrus, Lactarius torminosus*), ciuperci de pajişte (*Agaricus campester, Marasmius oreades*), ciuperci de paloşte (*Agaricus campester*), ciuperci de pădure (*Agaricus silvicola, Russula cyanoxantha*), ciuperci de păşune (*Agaricus campester*), ciuperci de plop (*Tricholoma populinum*), ciuperci de prun (*Marasmius oreades, Rhodophyllum clypeatum, Rhodophyllum soundersii*), ciuperci de rât (*Agaricus campester*), ciuperci de stejar (*Boletus aereus, Boletus purpureus*), ciuperci de târlă (*Agaricus campester*), ciuperci de tufă (*Boletus scaber*), ciuperci pădurene (*Russula* ssp.), ciuperci roşii de brad (*Tricholomopsis rutilans*), ciupercuţe de pajişte (*Agaricus campester*), ciurlan de câmp (*Xanthium strumarium*), clocoţei de baltă (*Thalictrum lucidum*), clocoţei de roghină (*Leucojum vernum*), clocoţei sălbatici (*Digitalis grandiflora*), clocoţel de pădure (*Galanthus nivalis*), clopoţăl de câmp (*Campanula patula, Campanula rotundifolia*), clopoţăl de grădină (*Aquilegia vulgaris*), clopoţăl de pădure (*Campanula rapunculoides*), clopoţei de câmp (*Campanula persicifolia*), clopoţei de coastă (*Campanula sibirica*), clopoţei de munte (*Campanula alpina, Campanula rapunculoides, Campanula serrata*), clopoţei de stâncă (*Symphyandra wanneri*), clopoţei pitici de stânci (*Campanula cochleariifolia*), clopoţel de câmp (*Consolida regalis*), clopoţel de pădure (*Streptopus amplexifolius*), clopoţel de grădină (*Campanula medium*), clopoţele de pădure (*Campanula persicifolia*), cloşca pădurii (*Polypilus frondosus*), coacăz de munte (*Ribes alpinum, Ribes petreum, Vaccinium vitis-idaea*), coacăză de munte (*Bruckenthalia spiculifolia, Ribes alpinum*), coacăză sălbatică (*Ribes grossularia* syn. *Ribes uva-crispa*), coada apei (*Hydrurus foetidus*), coada calului de baltă (*Equisetum palustre*), coada calului de câmp (*Equisetum arvense*), coada calului de pădure (*Equisetum sylvaticum*), coada calului de râturi (*Equisetum pratense*), coada vulpii de munte (*Alopecurus laguriformis*), cocârţi de gorun (indeterminate), cocoşei de câmp (*Adonis aestivalis, Adonis vernalis, Dianthus carthusianorum, Narcissus poëticus*), cocoşei de grădină (*Centaurium umbellatum* syn. *Centaurium erythraea, Dianthus barbatus*), cocoşei de pădure (*Viscaria vulgaris*), cocoşei de piatră (*Silene lerchenfeldiana*), cocoşei sălbatici (*Lathyrus tuberosus*), cocoşel de casă (*Dianthus barbatus*), cocoşel de iarbă (*Dianthus carthusianorum*), cocoşel de luncă (*Lychnis flos-cuculi*), cocoşel de păşune (*Colchicum autumnale*), cocoşi de munte (*Rhododendrom kotschyi*), codâie de baltă (*Equisetum palustre*), codrul cucului (*Lathraea squamaria*), copită de brad (*Anisomyces odoratus, Phellinus hartigii*), copită de copaci (*Phellinus ignarius*), copită de pin (*Phyllinus pini*), copită de plop (*Phellinus tremulae*), copită de prun (*Phellinus ignarius, Phellinus pomaceus*), copită de stejar (*Phellinus robustus*), coprine de câmp (*Narcissus stellaris*), coprine sălbatice (*Narcissus stellaris*), corleagănul broaştii (*Rumex conglomeratus*), cornişor de munte (*Lycopodium selago* syn. *Huperzia selago*), cornul secării (*Claviceps purpurea*), cornuţ de munte (*Cerastium arvense*), cornuţ de piatră (*Cladonia cornuta*), cornuţul ierbii (*Cerastium holosteoides*), corobatică de câmp (*Centaurea jacea*), coroniţa fânului (*Coronilla varia*), cosâţă care se face în semănături (*Vicia cracca*), cozărei de alun (*Boletus scaber*), cozărei de brad (*Boletus granulatus, Boletus luteus*), crastavan de munte (*Angelica sylvestris*), crăiasa pădurii (*Amanita caesarea*), crăpuşnic de baltă (*Cirsium palustre*), credei de munte (*Luzula sudetica*), cresonul izvoarelor (*Nasturtium officinale*), cretică de grădină (*Lepidium sativum*), creţăruş sălbatec (*Tanacetum vulgare*), crin broştesc (*Butomus umbellatus, Hemerocallis flava* syn. *H. lilio-asphodelus*), crin de apă (*Acorus calamus, Gladiolus imbricatus, Hosta plantaginea, Hottonia palustris, Iris pseudacorus*), crin de baltă (*Iris pseudacorus*), crin de glastră (*Amaryllis* *vittata*), crin de grădină (*Iris germanica, Lilium candidum, Philadelphus coronarius*), crin de mare (*Hosta sieboldiana*, *Nymphaea alba*), crin de munte (*Larix decidua*), crin de pădure (*Lilium martagon, Lonicera caprifolium*), crin de sacsân (*Hosta plantaginea*), crin de stânci (*Lloydia serotina*), crin sălbatic (*Hemerocallis lilio-asphodelus, Iris pseudacorus, Lilium martagon*), crin galbăn de apă (*Iris pseudocorus*), crinişor de stâncă (*Lloydia serotina*), crinul broaştei (*Hemerocallis fulva, Iris pseudacorus*), croţobei sălbatici (*Prunus spinosa*), cruciuliţă de munte (*Senecio carpaticus*), crumpene sălbatice (*Helianthus tuberosus*), cucoşi de perj (plums with *Taphrina pruni*), cucurbătă sălbatică (*Bryonia alba*), cucurbătă de tină (*Citrullus vulgaris*), cucurbetă sălbatică (*Bryonia alba*), cucuruz de munte (*Petasites albus*), cucuruz de pădure (*Lathraea squamaria*), cucuruz sălbatic (*Convallaria majalis*), cucuruzul pădurii (*Lathraea squamaria, Polygonatum latifolium, Polygonatum odoratum*), cucută de apă (*Cicuta virosa*), cucută de baltă (*Cicuta virosa, Oenanthe aquatica*), cucută de pădure (*Galium schultesii*), cucută sălbatică (*Selinum carvifolia*), cucuţică de baltă (*Oenanthe aquatica*), cuib de munte (*Carduus candicans*), cuişoară de grădină (*Dianthus caryophyllus, Dianthus superbus*), cuişoare de câmp (*Dianthus carthusianorum*), cuişoare sălbatice (*Holosteum umbellatum*), cuişori de câmp (*Dianthus carthusianorum*), cuişoară de munte (*Allysum repens*), cujmărea de munte (*Valeriana tripteris*), cumin de grădină (*Foeniculum vulgare*), cumin de mare (*Crithmum maritimum*), cumin sălbatic (*Peucedanum palustre, Seseli* ssp.), cupa cucului de pădure (*Campanula persicifolia*), cupa vacii de pădure (*Calystegia silvatica*), cupe de câmp (*Campanula patula*), curechi de câmp (*Brassica napus, Brassica rapa*), curechi(u) de mare (*Crambe maritima*), curechi de munte (*Ligularia glauca, Ligularia sibirica*), curechi de stâncă (*Sedum roseum, Sempervivum tectorum*), curechi sălbatic (*Brassica rapa*), curechiul stâncii (*Sempervivum tectorum*), curpăn de pădure (*Clematis vitalba*), curpen de grădină (*Clematis jacqmanni*), curpen de munte (*Clematis alpina, Lonicera xylosteum*), curpen de pădure (*Clematis recta, Clematis vitalba*), curpen sălbatic (*Vitis sylvestris*), curpină de pădure (*Convallaria majalis*).

Dafin sălbatic (*Daphne mezereum, Eleagnus angustifolia, Viburnum tinus*), dedeţei de pădure (*Anemone sylvestris*), dediţei de pădure (*Anemone sylvestris, Pulsatilla vulgaris,* syn. *Pulsatilla montana*), dediţei sălbatici (*Anemone nemorosa, Anemone sylvestris*), degeţel de câmp (*Digitalis lanata*), degeţel de pădure (*Digitalis grandiflora*), degeţel de zăpadă (*Soldanella pusilla*), diană sălbatică (*Mentha pulegium*), doctorul căşii (*Aloe* ssp.), dovleac de apă (*Nuphar luteum*), drăgaică de baltă (*Galium palustre*), drăgaică de stâncă (*Galium kitaibelianum*), dulceaţa apei, dulcele apei (*Glyceria aquatica*), dumblamnic, dumbrahnic, dumbrainic, dumbrajnic (*Melittis melissophyllum*), dumbravnic (*Asperula odorata* syn. *Galium odoratum, Eupatorium cannabinum, Melittis melissophyllum, Tanacetum balsamita*), dumbravnic şerpesc (*Salvia glutinosa*), dumbravnică (*Agrimonia eupatoria, Melittis melissophyllum*), dumbravnicul calului (*Salvia glutinosa*), dunbăţ de pădure (*Teucrium chamaedrys*).

Faptnic de câmp (*Stachys recta*), faptnică de câmp, (*Stachys germanica*), fasole sălbatică (*Convolvulus arvensis, Symphytum cordatum*), fasolea broaştei (*Menyanthes trifoliata*), făgeţea (*Mycelis muralis*), fălcariţă de câmp (indeterminate), făsui sălbatic (*Physalis alkekengi*), fân de livadă, fân de livezi, fânul livezii (*Poa pratensis*), fântânic (*Fontinalis antipyretica*), fâsoi sălbatic (*Convolvulus arvensis*), feregă de făget (*Dryopteris phegopteris*), feregă de piatră (*Cystopteris fragilis*), feregă sălbatică (*Asplenium trichomanes*), ferică de câmp (*Pteridium aquilinum*), ferigă de baltă (*Thelypteris palustris*), ferigă de brădet (*Polystichum lonchitis*), ferigă de casă (*Nephrolepis exaltata*), ferigă de câmp (*Pteridium aquilinum*), ferigă de munte (*Athyrium filix-femina*), ferigă de oală (*Nephrolepis exaltata*), ferigă de pădure

(*Dryopteris filix-mas*), ferigă de piatră (*Cystopteris* ssp.), ferigă de zăvoi (*Matteuccia struthiopteris*), feriguţă de piatră, feriguţă de stâncă (*Polypodium vulgare*), ficăţei de pădure, ficăţei de stejar (*Fistulina hepatica*), fierea câmpului (*Cuscuta campestris*), fierea bradului (*Leucopaxillum amarus*), fierea muntelui (*Cetraria islandica*), fierea trifoiului (*Cuscuta trifolii*), filimină de câmp (*Ajuga chamaepytis*), finhienul bălţii (*Oenanthe aquatica*), firezul codrului (*Polystichum lonchitis*), firul potecului (*Eragrostis minor*), firuţă de baltă (*Glyceria fluitans*), firuţă de livezi (*Poa pratensis*), firuţă de munte (*Poa media*), firuţă de piatră (*Poa badensis*), flămânzică de stâncă (*Draba lasiocarpa*), floare broştească (*Ranunculus acris*, *Ranunculus repens*), floare de apă (*Begonia semperflorens*, *Caltha palustris*, *Impatiens noli-tangere*, *Impatiens sultani* syn. *Impatiens walleriana*, *Lythrum salicaria*, *Potentilla anserina*), floare de baltă (*Caltha palustris*, *Ranunculus auricomus*), floare de bărc (*Epilobium angustifolium*), floare de câmp galbenă (*Tragopogon dubium*), floare de colţi (*Leontopodium alpinum*), floare de fân (*Hypericum perforatum*), floare de glastră (*Pelargonium zonale*), floare de grâu (*Centaurea cyanus*), floare de nisip (*Portulaca grandiflora*), floare de pe guruiet (*Cruciata levipes*), floare de pe părău (*Melica uniflora*, *Convallaria majalis*), floare de pe potec (*Lupinus polyphyllus*), floare de perină broştească (*Anthemis macrantha*), floare de piatră (*Leontopodium alpinum*), floare de stâncă (*Leontopodium alpinum, Sedum spurium*), floare de tău (*Nymphaea lotus* var. *thermalis*), floare de gavanos (*Pelargonium zonale*), floare din şanţ (*Sieglingia decumbens*), floare domnească (*Dianthus carthusianorum*), floare roşie de sacsâie (*Pelargonium zonale*), floare soare de grădină (*Helianthus tuberosus*), floarea bălţii (*Lythrum salicaria*), floarea broaştei, floarea broaştii, floarea broaştelor (*Caltha laeta, Ranunculus acris, Taraxacum officinale*), floarea câmpului (*Lotus tenuis*), floarea codrului (*Atropa belladona*), floarea cucului (*Anemone nemorosa*, *Atropa belladonna*, *Convallaria majalis, Cypropedium calceolus*, *Geranium phaeum*, *Lathyrus vernus*, etc.), floarea grâului (*Centaurea cyanus*, *Consolida regalis*), floarea holdei (*Adonis aestivalis, Consolida regalis*), floarea lanului (*Consolida regalis*), floarea miriştei (*Stachys annua, Stachys recta*), floarea muşchiului (*Saxifraga bryoides*) floarea paiului (*Centaurea cyanus*), floarea pădurii (*Atropa belladonna, Asperula odorata* syn. *Galium odoratum*), floarea potecului (*Lupinus* ssp.), floarea pratului (*Filago arvensis*), floarea sării (*Armeria maritima*), floarea soarelui de câmp (*Helianthus tuberosus, Tragopogon orientalis*, *Tragopogon pratensis*), floarea soarelui de grădină (*Helianthus tuberosus, Rudbeckia laciniata*), floarea soarelui sălbatică (*Helianthus decapetalus*), floarea stâncii (*Leontopodium alpinum*), floarea varului (*Gypsophila petraea*), flori boiereşti de câmp (*Dianthus superbus*), flori de bordură (*Gypsophila repens*), flori de cirip (*Pelargonium zonale*), flori de deal (*Galanthus nivalis*), flori de fereastră (*Pelargonium zonale*), flori de fân (*Rhinanthus glaber, Rhinanthus minor*), flori de hârb (*Pelargonium zonale*), flori de mălăişte (*Equisetum arvense*), flori de nisip (*Portulaca grandiflora*) flori de oală (*Pelargonium zonale*), flori de pe lac (*Ranunculus* sp.), flori de secară (*Claviceps purpurea*), flori de zid (*Sedum spurium*), flori din grâu (*Centaurea cyanus*), flori din holdă (*Consolida regalis*), flori sălbatice (*Viola canina*), floricică de pe lac (*Ranunculus repens*), foaia făgetului (*Mycelis muralis*), foaia pădurii (*Astragalus glycyphyllos*), foalele pădurii (*Polypilus giganteus*), foarfeca bălţii, foarfecele bălţii (*Stratiotes aloides*), focăriţă de munte (*Hieracium aurantiacum*), fragă de pădure (*Fragaria vesca, Fragaria viridis*), fragi de câmp (*Fragaria moschata, Fragaria vesca, Fragaria viridis*), fragi de pajişte (*Fragaria viridis*), fragi de pădure, (*Fragaria vesca*), frasin de luncă (*Fraxinus angustifolia*), frasin de munte (*Fraxinus ornus*), frasin de piatră (*Fraxinus ornus*), frunza bălţii (*Ranunculus repens*), frunze de sub tufă (*Ajuga reptans*), fulgi de izvor (*Silene pusilla* syn. *Heliosperma quadrifidum*) fusui sălbatec (*Lathyrus tuberosus, Physalis alkekengi*), fusul apei (*Acorus calamus*).

Garoafă de apă (*Butomus umbellatus*), garoafă de ghiveci (*Dianthus caryophyllus*), garoafă de grădină (*Dianthus barbatus, Dianthus caryophyllus, Dianthus chinensis*), garoafe de câmp (*Dianthus carthusianorum*), garoafe de munte (*Dianthus superbus*), garoafe de pădure (*Dianthus armeria*), garoafe de piatră (*Dianthus barbatus*), garoafe de poiană (*Dianthus carthusianorum*), garoafe sălbatice (*Dianthus carthusianorum, Dianthus superbus*), garofiţa bălţii (*Lychnis flos-cuculi*), garofiţa mării (*Limonium vulgare*), garofiţă albă de stânci (*Dianthus spiculifolius*), garofiţă de câmp (*Dianthus carthusianorum*), garofiţă de grădiniţă (*Lychnis calcedonica*), garofiţă de iarbă (*Dianthus carthusianorum*), garofiţă albă de stânci (*Dianthus spiculifolius*), garofiţă de câmp (*Dianthus carthusianorum*), garofiţă de mare (*Statice* ssp.), garofiţă de munte (*Dianthus tenuifolius*), garofiţă de nisip (*Dianthus arenarius*), garofiţă de stepă (*Dianthus leptopetalus*), garofiţe de grădină (*Dianthus barbatus, Tagetes patula*), garofiţe de munte (*Dianthus compactus, Dianthus superbus*), gâscariţă de munte (*Arabis alpina*), gâstane galbene de baltă (*Iris pseudocorus*), găinuşa pădurii (*Pleurotus ostreatus*), găinuşă de munte (*Polypilus frondosus*), gălbenele de laz (*Senecio ovatus*), gălbenele de munte (*Doronicum carpaticum, Ranunculus carpaticus, Ranunculus polyanthemos, Ranunculus sceleratus*), gălbenele de pădure (*Lysimachia nummularia, Lysimachia punctata, Ranunculus nemorosus*), gălbenuşa inului (*Camelina sativa*), gălbenuşe de pădure (*Potentilla crhysantha*), gălbenuşi de mlaştină (*Crepis paludosa*), gălbenuşul ierbii (*Leontodon hispidus*), gălbenuşul inului (*Camelina microcarpa, Camelina sativa*), gălbinele de munte (*Doronicum carpaticum, Ranunculus sceleratus*), gălbiori de stejărete (*Cantharellus cibarius* var. *pallidus*), gărdurariţă (*Nitraria schoberi*), gheabă de brad (*Lepiota clypeolaria*), gheabă de pădure (*Collybia longipes* syn. *Xerula longipes*), gheba cioturilor (*Pholiota mutabilis*), ghebă de păşune (*Macrolepiota excoriaria*), ghebe de brad (*Lepiota clypeolaria*), ghebe de arin (*Flammula alnicola*), ghebe de luncă (*Marasmius oreades*), ghebe de pădure (*Flammulina velutipes*), ghebe de rădăcină (*Armillariella mellea*), ghebe de stejar (*Collybia fusipes, Fomes fomentarius*), gheorghine sălbatice (*Rudbeckia laciniata*), gherghine de grădină (*Dahlia cultorum*), gheorghine sălbatice (*Rudbeckia laciniata*), ghiltan de baltă (*Iris pseudacorus*), ghimbere de munte (*Gentiana lutea, Gentiana punctata*), ghimpe pădureţ (*Ruscus aculeatus*), ghiocei de baltă (*Leucojum aestivum*), ghiocei de grădină (*Narcissus* ssp., *Primula acaulis* syn. *P. vulgaris*), ghiocei de munte (*Narcissus poëticus, Pulsatilla alba*), ghiocei de pădure (*Anemone nemorosa, Anemone ranunculoides*), ghiorghine sălbatice (*Rudbeckia laciniata*), ghizdei de mlaştină (*Lotus uliginosus*), ghizdei de sărătură (*Lotus tenuis*), gimbere de munte (*Gentiana punctata*), giugiuma broaştei (*Mentha aquatica*), giugiumă broştească (*Mentha aquatica*), giugiumă de grădină (*Mentha piperita*), giugiumă de munte (*Calamintha silvatica*), giugiumă de pădure (*Mentha longifolia*), gliviţe de ulm (*Lyophyllum ulmarium*), glogojanul broaştei (*Rumex palustris*), glojdanii broaştei (*Rumex conglomeratus*), goliciunea fetei pădurii (*Aruncus vulgaris*), grâu de baltă (*Beckmannia erucaeformis*), grâu sălbatic (*Agropyron cristatum, Brachypodium pinnatum, Brachypodium sylvaticum*), grâul pădurii (*Melampyrum bihariense*), grâuşor de câmp (*Gagea lutea*), gruieţ (*Thymus pulegioides*), gulă de baltă (*Petasites hybridus*), gulioara câmpului (*Ranunculus bulbosus*), gunoişte (*Agaricus campestris*), gura leului de câmp (*Linaria vulgaris*), gura leului sălbatică (*Lathyrus tuberosus, Linaria vulgaris*).

Hamei sălbatic (*Cardamine bulbifera, Humulus lupulus*), hirean de grădină (*Lepidium sativum*), hiruşor de pădure (*Poa nemoralis*), holbură sălbatică (*Polygonum dumetorum* syn. *Fallopia dumetorum*), holdiţă (*Centaurea cyanus*), horşti de munte

(*Luzula silvatica*), horşti de pădure (*Luzula luzuloides*, *Luzula silvatica*), hrean de apă (*Cardamine amara*), hrean de sărătură (*Lepidium crassifolium, L. latifolium*), hrean sălbatic (*Lepidium crassifolium, L. latifolium, Rorippa sylvestris*), hreanul pădurii (*Cortinarius varius*), hrenoasă de mare (*Cakile maritima*), hrib de bălegar (*Agaricus campester*), hrib de brad (*Boletus pinicola*), hrib de fag (*Boletus edulis*), hrib de mesteacăn (*Boletus aurantiacus, Boletus scaber*, *Boletus testaceo-scabrus*), hrib de muşchi (*Boletus chrysenteron*), hrib de nisip (*Boletus aereus, Boletus variegatus*), hrib de plop (*Boletus aurantiacum*), hrib de stejar (*Boletus purpureus*), hrib de tufă (*Boletus scaber*), hrib de zădiş (*Boletus elegans*), hribă de brad *Boletus pinicola*), hribă de carpen (*Boletus griseus*), hribă de plop (*Boletus aurantiacum*), hribă de stejar (*Boletus aereus*).

Iarba bălţii (*Alopecurus pratensis*, *Deschampsia caespitosa*), iarba broaştei (*Juncus bufonius*, *Mentha aquatica*, *Thalictrum* sp., *Triglochin palustre*), iarba broaştelor (*Hydrocharis morsus-ranae*), iarba câmpului (*Agrostis stolonifera*), iarba cucului de pădure (*Cardamine impatiens*), iarba drumului (*Eragrostis minor*), iarba drumurilor (*Chenopodium murale*, *Chenopodium urbicum*), iarba fânului (*Agrostis stolonifera*, *Agrostis tenuis*, *Anthoxanthum odoratum*), iarba izvoarelor (*Polygonum hydropiper*), iarba mării (*Zostera marina*), iarba mlaştinei (*Juncus* ssp.), iarba nisipului (*Corynephorus canescens*), iarba pădurii (*Atropa belladonna*), iarba păretelui (*Parietaria officinalis*), iarba potecului (*Lolium perenne*), iarba şarpelui (*Dryopteris filix-mas*, *Orchis maculata*), iarba stâncilor (*Agrostis rupestris*), iarbă albă de slatină (*Puccinellia distans*), iarbă broştească (*Ajuga laxmanni*), iarbă de apă (*Eriophorum latifolium*, *Gnaphalium uliginosum*), iarbă de bahnă (*Beckmannia erufiformis*), iarbă de baltă (*Conferva* ssp., *Spyrogyra* ssp., *Tribonema* ssp., *Epipactis palustris*), iarbă de bătătură (*Lolium perenne*), iarbă de bou sălbatică (*Anchusa ochroleuca*, *Anchusa officinalis*), iarbă de cale (*Lolium perenne*, *Plantago major, Plantago media, Poa annua*), iarbă de grădină (*Portulaca oleracea*), iarbă de mare (*Zostera marina*), iarbă de margină (*Rubia tinctorum*), iarbă de munte (*Festuca ovina*), iarbă de piatră (*Melilotus officinalis*), iarbă de roghină, iarbă de rovină (*Eriophorum* ssp.), iarbă de sare (*Puccinellia distans*), iarbă de sărătură (*Puccinellia distans, Suaeda maritima*), iarbă de slatină (*Puccinellia convoluta* var. *pseudobulbosa*), iarbă de smidă (*Cerastium vulgatum* syn. *Cerastium holosteoides*), iarbă de strat (*Armeria alpina*), iarbă de ţărm (*Ammophila arenaria*), iarbă de ţelină (*Lolium perenne*), iarbă dulce de baltă (*Glyceria aquatica* syn. *G. maxima*, *Glyceria fluitans, Poa annua*), iarbă dulce de munte (*Taraxacum officinale, Polypodium vulgare*), iarbă dulce de pădure (*Polypodium vulgare*), iarbă grasă de ghiol (*Salicornia herbacea*), iarbă grasă de grădină (*Plantago major, Polygonum aviculare, Portulaca grandiflora, Portulaca oleracea*), iarbă roşie broştească (*Polygonum amphibium*), iarbă sălbatică (*Calamagrostis epigeios*), iarbă sfărâmătoare de pietri (*Parietaria officinalis, Saxifraga* ssp.), iarbă stricătoare de peatră (*Saxifraga* ssp.), iasca bradului (*Phellinus robustus*), iască de castan (*Hymenochaete rubiginosa*), iasca de cioată a foioaselor (*Coriolus versicolor*), iasca de cioată a răşinoaselor (*Fomitopsis pinicola*), iasca de cioată a stejarilor (*Daedalea quercina*), iasca fagului (*Fomes fomentarius*, *Fomitopsis annosa*), iasca galbenă a foioaselor (*Laetiporus sulphureus*), iasca mesteacănului (*Piptoporus betulinus*), iasca stejarului (*Phellinus robustus*), iasca viţei de vie (*Stereum hirsutum*), iască de brad (*Hymenochaete abietina*), iască de cer (*Daedalea quercina*), iască de cioată (*Coriolus versicolor, Daedalea quercina, Phellinus ignarius*), iască de ciot (*Phellinus ignarius*), iască de frasin (*Phellinus alveolaris*), iască de mesteacăn (*Piptoporus betulinus*), iască de pe copaci (*Phellinus ignarius*), iască de rădăcini (*Fomitopsis annosa*), iască de salcie (*Trametes suaveolens*), iască de stejar (*Daedalea quercina*), iască de zadă

(*Fomitopsis officinalis*), iasmin de grădină (*Philadelphus coronarius*), iasomie sălbatică (*Jasminum fruticans*), iazma munţilor (*Calamintha nepeta*), iederă de grădină (*Vinca minor*), iederă de munte (*Rhododendron kotschyi*), iederă de pădure (*Hedera helix*), ierboi de bahnă (*Beckmannia erucaeformis*), iliac de munte (*Alnus viridis*), in de baltă (*Eriophorum angustifolium*), in de câmp (*Linum* ssp.), in de munte (*Linum extraaxilare*), in sălbatec (*Linum nervosum*), in sălbatic (*Linaria genistifolia, Linaria vulgaris*), inima bălţii (*Nymphoides peltata*), inima broaştei (*Parnassia palustris*), inuţ de apă (*Samolus valerandi*), inuţ de câmp (*Linum catharticum*), isma broaştei (*Mentha aquatica, Mentha longifolia*), isma broaştii (*Mentha aquatica, Mentha arvensis, Mentha longifolia*), ismă de grădină (*Mentha crispa, Mentha piperita*), ismă de pădure (*Calamintha silvatica*), ismuşoară de câmp (*Calamintha acinos*), izma apei, izma bălţilor (*Mentha aquatica*), izma broaştei (*Mentha aquatica, Mentha arvensis, Mentha longifolia, Mentha pulegium*), izma broaştei păroasă (*Mentha arvensis*), izma pădurilor (*Calamintha intermedia*), izmă broştească (*Mentha aquatica, Mentha longifolia*), izmă de apă (*Mentha aquatica, Mentha longifolia*), izmă de câmp (*Mentha longifolia*), izmă de cea sălbatică (*Mentha aquatica*), izmă de deal (*Calamintha vulgare*), izmă de grădină (*Melissa officinalis, Mentha crispa, Mentha piperita*), izmă de munte (*Calamintha intermedia*), izmă sălbatică (*Calamintha clinopodium, Calamintha intermedia, Melissa officinalis, Mentha longifolia, Nepeta pannonica, Prunella vulgaris*), izmuşoară de deal (*Calamintha subisodonta*).

Închegăţică de prund (*Potentilla reptans*), încurcătoarea peştilor (*Ceratophyllum demersum*).

Jale de munte (*Hypericum perforatum*), jale de câmp (*Salvia glutinosa, Salvia pratensis, Stachys annua, Stachys recta*), jale de grădină (*Salvia officinalis*), jale sălbatică (*Ambrosia elatior, Salvia nemorosa*), jalea câmpului (*Salvia pratensis*), jaleş de baltă (*Stachys palustris*), jaleş de câmp (*Salvia glutinosa, Salvia verticillata, Stachys annua, Stachys recta*), jaleş de grădină (*Salvia officinalis*), jaleş de mirişte (*Stachys annua*), jaleş de mlaştină (*Stachys palustris*), jaleş de pădure (*Salvia pratensis*), jaleş sălbatic (*Salvia glutinosa, Salvia pratensis, Salvia verticillata, Stachys recta*), jalie de câmp (*Salvia nemorosa*), jebghiu de munte (*Lobaria pulmonaria*), jepi de munte (*Pinus mugo*), jie sălbatică (*Parthenocissus quinquefolia*), jiţă sălbatică (*Parthenocissus quinquefolia*), joaie de grădină (*Salvia officinalis*).

Lalea de grădină (*Tulipa gesneriana*), lalea de pădure (*Tulipa biebersteiniana*), lalele de grădină (*Tulipa* ssp.), laleţică de piatră (*Llloydia serotina*), laptele cânelui de câmp (*Euphorbia helioscopia*), laptele cânelui de pădure (*Euphorbia amygdaloides*), laptele cânelui de păşune (*Euphorbia cyparissias*), laptele cucului de pădure (*Euphorbia amygdaloides*), laptele stâncii, laptele stâncilor (*Androsace* ssp.), laur de grădină (*Lupinus polyphyllus*), laur de munte (*Umbellularia californica*), lăculeasă (unidentified plant), lămâi de deşert (*Eremocitrus glauca*), lămâi sălbatic (*Citrus trifoliata*), lămpiţa muntelui (*Silene dioica*), lăptucă de mare (*Ulva lactuca*), lăptucă de pădure (*Sonchus oleraceus*), lăptucă sălbatică (*Lactuca serriola*), lăptucul pădurii (*Hieracium sabaudum*), lâna broaştei (*Conferva* ssp., *Spirogyra* ssp., *Tribonema* ssp.), lână de apă (*Conferva* ssp., *Spirogyra* ssp., *Tribonema* ssp.), lânărica stâncii (*Leontopodium alpinum*), lână de baltă (*Agrostis stolonifera*), lemn câinesc de baltă (*Frangula alnus*), lemn de apă (*Impatiens balsamina, Myricaria germanica*), leuştean broştesc (*Ranunculus acris*), leuştean de bahnă, leuştean sălbatic (*Peucedanum latifolium*), leuşteanul broaştei (*Ranunculus sceleratus, Trollius europaeus*), leuşteanul muntelui (*Agrimonia eupatoria*), levenţică de grădină (*Lavandula angustifolia*), lichen de piatră (*Cetraria islandica*), lichen de prun, lichen de stejar (*Evernia prunastri*), lichenul prunilor (*Evernia prunastri*), liliac de câmp (*Aster tripolium*), liliac de grădină (*Hesperis matronalis*), liliac de mare (*Hosta *plantaginea*), liliac de munte (*Alnus viridis, Daphne mezereum*), liliac de pădure (*Daphne mezereum*), liliac sălbatic (*Aster tripolium, Daphne mezereum, Syringa vulgaris*), liliacul broaştei (*Menyanthes trifoliata*), lilie sălbatică (*Iris* sp.), lilion sălbatic (*Majanthemum bifolium*), lilion sălbatic (*Majanthemum bifolium*), limba apei (*Potamogeton* ssp.), limba bălţii (*Alisma plantago-aquatica, Potamogeton natans, Potamogeton nodosus, Ranunculus lingua*), limba bălţilor (*Alisma plantago-aquatica, Plantago lanceolata*), limba broaştei (*Alisma plantago-aquatica, Arum maculatum, Hydrocharis morsus-ranae, Plantago altissima, Plantago lanceolata*), limbariţa bălţilor (*Alisma lanceolatum*), limbă de bou sălbatecă (*Anchusa officinalis*), limbă de piatră (*Pinguicula vulgaris*), limbrici de iarbă, limbrici de munte (*Thamnolia vermicularis*), linariţă de munte (*Linaria alpina*), lingura bălţii (*Alisma plantago-aquatica, Potamogeton natans*), lingura broaştei (*Alisma plantago-aquatica*), lingurea de baltă (*Cochlearia officinalis*), linguriţa broaştei (*Ludwigia palustris*), linte broştească (*Lemna* ssp., *Spyrodella polyrrhiza*), linte de apă (*Callitriche verna*), linte de baltă (*Lemna* ssp., *Spyrodella polyrrhiza*), linte de praturi (*Lathyrus pratensis*), linte de rât (*Lathyrus tuberosus*), linte sălbatică (*Lathyrus aphaca, Lathyrus sylvestris, Lathyrus vernus, Lemna* ssp., *Vicia pannonica, Vicia sativa*), lintea bălţilor (*Lemna* ssp., *Spyrodella polyrrhiza*), lintea broaştei (*Alisma plantago-aquatica, Lemna* ssp., *Spyrodella polyrrhiza*), lintea broaştelor (*Lemna* ssp., *Spyrodella polyrrhiza*), lintea gardurilor (*Vicia hirsuta*), lintea pratului (*Lathyrus* ssp., *Vicia* ssp.), lintică sălbatică (*Lathyrus vernus*), lintiţă de apă (*Lemna* ssp., *Spyrodella polyrrhiza*), lipideul broaştelor (*Conferva* ssp., *Spyrogyra* ssp., *Trebonema* ssp.), lipitoare de piatră (*Preissia quadrata*), lobeniţă de ţară (*Cucurbita maxima*), lobodă albă de grădină (*Atriplex hortensis*), lobodă de drum (*Chenopodium urbicum*), lobodă de drumuri (*Chenopodium nitens*), loboditţă de munte (*Pulmonaria rubra*), lobodă de pădure (*Lapsana communis*), lobodă sălbatică (*Atriplex tatarica, Chenopodium album*), luben sălbatec (*Luffa cylindrica*), lubeniţă de ţară (*Cucurbita maxima*), luceafăr de baltă (*Lythrum salicaria*), lucernă de mare (*Medicago marina*), lucernă de stepă (*Medicago hispida, Medicago rigidula*), lucernă sălbatică (*Trifolium campestre, Trifolium dubium*), lugaciu (*Dipsacus sylvestris*) (bg., scr., rus. lug "pasture"), lujerul broaştei (*Rumex conglomeratus, Rumex crispus*), luminiţa apei (*Utricularia vulgaris*), luminiţa muntelui (*Silene dioica*), luminiţă de munte (*Melandrium rubrum* syn. *Silene dioica*), luncişori (*Marasmius oreades*), lupoaia captalanului (*Orobanche flava* syn. *O. petasites*), lupoaia cânepii (*Orobanche ramosa*), lupoaia cimbrişorului (*Orobanche alba* syn. O. *epithymum*), lupoaia dracilei (*Orobanche lucorum*), lupoaia dumbăţului (*Orobanche teucrium*), lupoaia lucernei (*Orobanche lutea* syn. *O. medicaginis*), lupoaia pelinului (de câmp) (*Orobanche artemisiae-campestris*), lupoaia salviei (*Orobanche salviae*), lupoaia sânzienelor (*Orobanche caryophyllacea* syn. *O. galii*), lupoaia scailor (*Orobanche reticulata*), lupoaia trifoiului (*Orobanche minor*), lupoaia tutunului (*Orobanche ramosa*), luţernă sălbatică (*Medicago falcata, Medicago lupulina*).

Mac de apă (*Hydrocleis nymphoides*), mac de câmp (*Papaver dubium, Papaver rhoeas*), mac de grădină (*Papaver orientale, Papaver rhoeas, Papaver somniferum*), mac de munte, mac galben de munte (*Papaver pyrenaicum* ssp. *corona sancti stephani*), mac roşu de grădină (*Papaver bracteatum*), mac sălbatic (*Chelidonium majus, Glaucium corniculatum, Papaver rhoeas*), macicina broaştei (*Mentha longifolia*), măcriş de câmp, macriş de iarbă (*Rumex acetosella*), macriş de grădină (*Rumex acetosa, Rumex acetosella, Rumex patientia*), macriş de munte (*Rumex acetosa*), macriş de pădure (*Oxalis acetosella*), macriş de râuri (*Berberis vulgaris*), macriş sălbatic (*Rumex acetosella, Rumex crispus*), macrişul broaştei, macrişul broaştii (*Rumex conglomeratus*), macrişul caprei de pădure (*Oxalis acetosella*), macul câmpului

(*Papaver rhoeas*), mai de apă (*Nuphar luteum*), malin sălbatic (*Daphne mezereum, Ligustrum vulgare, Orchis sambucina*), mama pădurei/pădurii (*Asperula arvensis, Asperula odorata* syn. *Galium odoratum, Geranium robertianum, Plantago major, Pteridium aquilinum*), mama secării (*Claviceps purpurea*), mana apei (*Glyceria aquatica, Glyceria nemoralis*), mana apei subţire (*Glyceria notata*), mană de apă (*Drosera intermedia, Glyceria aquatica, Glyceria notata* syn. *Glyceria plicata*), mana castraveţilor (*Pseudoperenospora cubensis*), mana cepei (*Perenospora destructor*), mana florii soarelui (*Plasmopara helianthi*), mana lobodei (*Perenospora farinosa*), mana secării (*Claviceps purpurea*), mana viţei de vie (*Plasmopara viticola*), marariu de casă (*Foeniculum vulgare*), marariul muntelui (*Anthriscus trichosperma*), margaretă de câmp (*Chrysanthemum leucanthemum*), margarete de grădină (*Chrysanthemum parthenium* syn. *Tanacetum parthenium*), măslin sălbatec, măslinaş sălbatec (*Olea europea* ssp. *sylvestris*), măslin sălbatic (*Eleagnus angustifolia*), mazăre de câmp (*Pisum arvense*), *mazăre de fân* (*Vicia pannonica*), mazăre de grădină (*Phaseolus vulgaris, Pisum sativum*), mazăre de pădure (*Astragalus glycyphyllos*), mazăre sălbatică (*Coronilla varia, Lathyrus latifolius, Lathyrus vernus, Pisum arvense, Pisum elatius*), mazere de câmp (*Pisum arvense, Pisum sativum*), mazere de grădină (*Pisum sativum*), măceş de munte (*Rosa pendulina*), măcriş de câmp (*Berberis vulgaris*), măcriş de grădină (*Lepidium sativum, Rumex acetosa*), măcriş de iarbă (*Rumex acetosella*), măcriş de mare (*Nasturtium officinale*), măcriş de munte (*Oxyria digyna*), măcriş de (pe) mirişte (*Rumex acetosella*), măcriş de râuri (*Berberis vulgaris*), măcrişul broaştei (*Rumex crispus*), măcrişul cucului (*Oxalis acetosella*), măgerean de grădină (*Majorana hortensis*), măgeran sălbatic (*Origanum vulgare*), mălai de munte (*Luzula silvatica*), mălaiul pădurii (*Luzula luzuloides*), mălăoaia stâncilor (*Helianthamum rupifragum*), mălin sălbatic (*Daphne mezereum*), mălura bălţii (*Myriophyllum spicatum, Myriophyllum verticillatum*), mălura grâului (*Tilletia tritici*), mămăliga bradului (*Trichia favoginea*), mănărei de mlaştini (*Lathyrus palustris*), mănerei de pădure (*Lathyrus latifolius*), măr de grădină (*Malus domestica*), măr pădureţ (*Malus sylvestris*), mărar de grădină (*Anethum graveolens*), marariu de casă (*Foeniculum vulgare*), mărar sălbatic (*Peucedanum rochelianum*), mărarul apei, mărarul bălţilor (*Oenanthe aquatica*), mărarul muntelui, marariul muntelui (*Chaerophyllum bulbosum, Anthriscus trichosperma*), mărarul stâncilor (*Prangos carinata*), mărar de apă (*Potamogeton pectinatus*), mărarul broaştei (*Matricaria inodora*), mărăcinari (*Calocybe gambosa*) (mushrooms under brambles), mărăcine de câmp (*Eryngium campestre*), mărăcine de drum (*Eryngium planum*), mărgăritărel de pădure (*Convallaria majalis*), mărul lupului (*Crataegus monogyna, Daphne mezereum, Evonymus europaeus*, etc.), măruncă de câmp (*Tanacetum vulgare*), mătase de apă (*Spirogyra* ssp.), mătasea broaştei (*Converva vulgaris, Mougeotia* ssp., *Spirogyra* ssp., *Tribonema bombycina*), mătasea broaştelor (*Peplis portula*), mătasea lucernei (*Cuscuta trifolii*), mătasea trifoiului (*Cuscuta epithymum, Cuscuta trifolii*), mătasea urzicii (*Cuscuta europaea*), mătăcina broaştei (*Mentha aquatica, Mentha longifolia*), mătăcina broaştii (*Mentha aquatica*), mătăcină de casă (*Mentha piperita*), mătăcină sălbatică (*Mentha longifolia*), mătrăguna bălţii (*Ceratophyllum* ssp., *Myriophyllum* ssp.), mătrăguna gunoiului (*Datura stramonium*), mătrăgună de ape (*Ranunculus sceleratus*), mătreaţa apelor (*Callitriche cophocarpa*), mătreaţa bradului, mătreaţa brazilor, mătreaţă de arbori (*Usnea* ssp.), mătreaţă de apă (*Conferva vulgaris*), mătreaţă de pe pârâu, mătreaţă de (pe) topliţă (*Callitriche* or *Lemna*), mătură de curte, mătură de grădină (*Kochia scoparia*), mături de nisipuri (*Centaurea arenaria*), mături sălbatice (*Xeranthemum* ssp.), măzăriche de câmp (*Vicia sativa*), măzăriche de grădină (*Lathyrus odoratus*), măzăriche de hat (*Vicia dumetorum*), măzăriche de holdă

(*Lathyrus tuberosus, Vicia* sp.), măzăriche de pădure (*Vicia sylvatica*), măzăriche sălbatică (*Lathyrus tuberosus, Vicia craca*), măzăriche sălbatică de iarbă (*Astragalus glycyphyllos*), măzărichea cucului (*Lathyrus niger, Lathyrus vernus*), măzăroi sălbatic (*Vicia sepium*), mânătărci de plop (*Boletus aurantiacus*), mângâierea apelor (*Euphrasia rostkoviana, Euphrasia stricta*), mei de pădure (*Milium effusum*), mei pădureţ (*Milium effusum*), mei sălbatic (*Panicum miliaceum*), melin de pădure (*Daphne cneorum*), menta broaştei (*Mentha longifolia*), mentă broştească (*Mentha longifolia*), mentă de câmp (*Mentha longifolia*), mentă de grădină (*Mentha spicata*), mentă de pădure (*Mentha longifolia*), mentă sălbatică (*Melissa officinalis*), merişoare sălbatice (*Andromeda polifolia*), merişor de munte (*Ribes alpinum, Vaccinium vitis-idaea*), merişor de stâncă (*Amelanchier ovalis*), micsandre sălbatice (*Erysimum repandum, Erysimum wittmanni, Sisymbrium officinale*), micsă sălbatică (*Scilla bifolia*), micşunea de baltă, micşuneaua apei, micşuneaua bălţii (*Butomus umbellatus*), micşunea de munte (*Viola alpina*), micşunele de fereastră (*Matthiola incana*), micşunele de grădină (*Cheiranthus cheiri*), micşunele de munte (*Viola declinata*), micşunele sălbatice (*Eryssimum transsilvanicum*), mierea pădurii (*Pulmonaria officinalis*), mierea stâncii (*Eritrichium nanum*), miericică de câmp (*Anchusa officinalis*), milătărci de luncă (*Agaricus campester*), milătărci de mesteacăn (*Boletus aurantiacus*), miliţea de nisipuri (*Silene pontica*), minta bălţilor, minta broaştei, minta broaştelor (*Mentha aquatica*), mintă broştească (*Mentha aquatica*), mintă de apă (*Mentha aquatica*), mintă de câmp, mintă de câmpuri (*Mentha longifolia*), mintă de grădină (*Mentha longifolia, Mentha piperita*), mintă de munte (*Calamintha intermedia, Mentha longifolia*), mintă de pădure (*Mentha longifolia*), mintă sălbatică (*Calamintha intermedia, Mentha longifolia, Mentha spicata*), mireasma muntelui (*Rhododendron kotschyi*), mirgău (*Scutellaria galericulata*), miriştea (*Stachys annua*), mitărci de codru (*Boletus edulis*), mitărci de mesteacăn (*Boletus scaber*), mitărci de pajişte (*Agaricus campester*), mlăcele (*Lysimachia thyrsiflora*), mlăştiniţă (*Epipactis* ssp., *Luzula pilosa*), mlăştiniţă purpurie (*Epipactis atropurpurea* syn. *Epipactis atrorubens*), mohor de munte (*Phleum alpinum*), mohor sălbatic (*Beckmannia erucaeformis*), molotru sălbatec (*Seseli* ssp.), molura bălţii (*Myriophyllum spicatum, Myriophyllum verticullatum*), molură de munte (*Libanotis montana*), morcoi sălbatec (*Daucus carota*), morcov de câmp (*Daucus carota*), morcov de deal (*Eryngium campestre*), morcov de mare (*Astrodaucus littoralis*), morcov sălbatic (*Daucus carota, Peucedanum latifolium*), moţul balegii (*Coprinus* ssp.), moţul bălţii (*Potamogeton natans*), muma pădurii (*Aruncus vulgaris, Asperula odorata* syn. *Galium odoratum, Lathraea squamaria, Plantago major, Pteridium aquilinum*), muma secării (sclerotia of the fungal parasite *Claviceps purpurea*), mur de mirişte (*Rubus caesius*), mur de pădure (*Rubus caesius, Rubus idaeus*), mur de zăvoi (*Rubus caesius*), mur negru, mur pădureţ sălbatic (*Rubus plicatus*), mură de câmp, mură de mirişte (*Rubus caesius*), mură de ogoare (*Rubus caesius*), mure de pădure (*Fragaria vesca, Rubus hirtus*), mura pădurii (*Actaea spicata*), murea pădurii, mura pădurilor, murea pădurilor (*Lathraea squamaria*), mustaţa brazilor (*Usnea* ssp.), muşcată de apă (*Tradescantia* sp.), muşcată de câmp (*Geranium macrorrhizum*), muşcată de oală (*Pelargonium bellum, Pelargonium odoratum, Pelargonium radula*), muşcăţel de stâncă (*Saxifraga moschata*), muşcată de munte (*Scabiosa lucida*), muşcatul dracului de câmp (*Knautia arvensis*), muşcatul dracului de pădure (*Knautia dipsacifolia*), muşcătura broaştei (*Hydrocharis morsus-ranae*), muşcăţel de stâncă (*Saxifraga moschata*), muşchi de (a)coperiş (*Bryum argenteum, Bryum caespiticeum, Grimmia pulvinata*), muşchi de arin (unidentified), muşchi de baltă (*Marchantia polymorpha*), muşchi de bătătură (*Bryum argenteum*), muşchi de casă (*Tortula muralis*), muşchi de cioată (*Dicranum scoparium*), muşchi de copac(i) (*Leucodon sciuroides, Lobaria pulmonaria*), muşchi de curte (*Bryum argenteum*), muşchi de fag (*Lobaria pulmonaria*), muşchi de fântână (*Marchantia polymorpha*), muşchi de foc (*Funaria hygrometrica*), muşchi de ghivece (*Physcomitrium piriforme*), muşchi de izvoare (*Philonotis fontana*), muşchi de lemn (*Lobaria pulmonaria*), muşchi de mlacă (*Sphagnum* sp.), muşchi de mlaştină (*Drepanocladus* sp., *Marchantia polymorpha*), muşchi de munte (*Cetraria islandica*), muşchi de pădure (*Dicranum scoparium, Polytrichum commune*), muşchi de pe colţuri (*Cladonia rangiferina*), muşchi de pe copaci (*Lobaria pulmonaria*), muşchi de piatră (*Cetraria islandica, Chondrus crispus, Lobaria pulmonaria, Lycopodium clavatum, Pogonatum urnigerum, Rhacomitrium sudeticum*), muşchi de piatră amară (*Cetraria islandica*), muşchi de piatră dulce (*Chondrus crispus*), muşchi de pisc (*Polytrichum alpinum*), muşchi de putregai (*Dicranum scoparium*), muşchi de sat (*Tortula ruralis*), muşchi de salcie (*Fontinalis antipyretica*), muşchi de stejar (*Evernia prunastri*), muşchi de turbă (*Sphagnum* ssp.), muşchi de vatră (*Ceratodon purpureus, Funaria hygrometrica*), muşchi de zid (*Tortula muralis*), muşchi înecat (*Fontinalis antipyretica*), muşchiul fagului (*Lobaria pulmonaria, Stereum hirsutum*), muşchiul izvoarelor (*Cratoneurum commutatum*), muşchiul pomilor (*Thuidium erectum*), muşchiul stejarului (*Lobaria pulmonaria*), muşchiul stâncii (*Cetraria islandica*), muşeţel de câmp (*Matricaria chamomilla, Mentha pulegium*), muşeţel sălbatic (*Adonis aestivalis*), muştar alb sălbatic (*Brassica elongata, Erucastrum gallicum*), muştar de câmp (*Sinapis arvensis*), muştar de grădină (*Sinapis alba*), muştar de ziduri (*Diplotaxis muralis*), muştar sălbatic (*Brassica elongata, Brassica juncea, Brassica nigra, Sinapis arvensis*), muştarul stâncilor (*Hesperis matronalis*).

Nadă de roghină (*Phragmites australis*), nalbă de casă (*Malva neglecta*), nalbă de câmp (*Althaea officinalis, Malva sylvestris*), nalbă de fereastră, nalbă de geam (*Pelargonium zonale*), nalbă de grădină (*Althaea rosea*), nalbă de pădure (*Althaea officinalis*), nalbă sălbatică (*Lavatera thuringiaca, Malva neglecta, Malva pusilla, Malva sylvestris*), nap galben de câmp (*Daucus carota*), napi de grădină (*Helianthus tuberosus*), napi de mirişte (*Brassica napus, Brassica rapa*), napi de pădure (*Tamus communis*), napi porceşti de pădure (*Tamus communis*), napi sălbatici (*Brassica napus, Brassica rapa*), napii porcului de pădure (*Tamus communis*), napul şopârlei (*Smyrnium perfoliatum*), năpuşori de câmp (*Brassica napus*), năpuşor de munte (*Pedicularis oederi*), narcise sălbatice (*Narcissus angustifolius*), narciză de grădină (*Narcissus poëticus*), natiş (*Riccia fluitans*), natiţă (*Potamogeton natans, Potamogeton nodosus*) (rad. i.-e. *(s)na-t- "to flow"), nădai, nădaia, nădaie, nădar (*Symphytum officinale*) (rad. *nad- "wet"), nădăţică (*Equisetum* ssp.), nălbuţă de lac (*Alchemilla vulgaris*), năpuşori de câmp (*Brassica napus*), năpuşor de munte (*Campanula serrata, Pedicularis oederi*), năsipariţă (*Arenaria serpyllifolia*), năvădeala peştilor (*Potamogeton pusillus*), neghina pădurii (*Lychnis coronaria*), neghină de grădină (*Lychnis coronaria*), neghină de câmp, neghină de grâu, neghină de holde (*Agrostemma githago*), neghină de pădure (*Lychnis coronaria*), nemţişor de munte (*Delphinium elatum*), nemţişor de stâncă (*Delphinium fissum*), nemţişori de câmp (*Consolida regalis*), nemţişori de grădină (*Consolida ajacis*), nemţoaică de câmp (unidentified), netoată, natote, noatotă (*Lycopodium* ssp.), netotă (*Juniperus sabina, Lycopodium annotinum, Lycopodium clavatum*), cimbru netot (*Thymus comosus*), nătoată (*Chelidonium majus*) (rad. i.-e. *snat-, snət- "to flow"), neuitata bălţii (*Myosotis scorpioides*), neuitata pădurii (*Myosotis sylvatica*), niintă de câmp (*Mentha arvensis*), ninta broaştei (*Mentha longifolia, Polygonum lapathifolium*), nintă broştească (*Mentha aquatica, Mentha longifolia, Mentha piperita*), nintă de câmpie (*Mentha longifolia*), nisipariţă (*Mollugo cerviana*), nisipăriţă (*Argusia sibirica*), nisipuş

(*Ceratodon purpureus*), nitărci de lemn (*Pleurotus ostreatus*), nitărci de pajişte (*Agaricus campester*), noatătă, noatotă (*Lycopodium selago* syn. *Huperzia selago*), noiţa câmpului (unidentified), norele de grădină (*Mirabilis jalapa*), noroc la casă (*Begonia rex, Coleus blumei, Impatiens sultani*), norocul casei (*Impatiens sultani*), norocelul apei (*Marsilea quadrifolia*), noroiţă (*Elatine alsinastrum*), notătoare (*Potamogeton natans, Trapa natans*), nucar(i) (*Polyporus squamosus*) (mushroom on walnut), nu mă uita de grădină (*Callistephus chinensis*), nu mă uita de munte (*Myosotis alpestris*), nuc sălbatic (*Ailanthus altissima*).

Oasele peştilor (*Myriophyllum spicatum*), obsigă de pădure (*Brachypodium sylvaticum*), ochii broaştei (*Primula farinosa, Myosotis scorpioides*), ochiul boului de câmp (*Erigeron acris*), ochiul boului de casă (*Callistephus chinensis*), ochiul boului de grădină (*Chrysanthemum maximum*), ochiul boului de munte (*Aster alpinus*), ochiul boului de pădure (*Chrysanthemum rotundifolium*), ochiul boului de pe luncă (*Chrysanthemum leucanthemum*), ochiul boului sălbatic (*Bellis perennis*), ochiul broaştei (*Myosotis scorpioides, Ranunculus acris, Ranunculus repens, Veronica triphyllos*), odolean de munte (*Valeriana montana*), odolean de stâncă (*Valeriana tripteris*), oiţe sălbatice (*Anemone sylvestris*), opaiţul pădurii (*Silene heuffelii*), orbalţ de p'ângă apă (*Filipendula ulmaria*), orez pădureţ (*Oryzopsis virescens*), orez sălbatic (*Leersia oryzoides, Zizania aquatica*), orezul broaştei (*Leersia oryzoides*), orz de pădure (*Elymus europaeus*), orz sălbatic (*Hordeum murinum*), orzoaică de baltă (*Vallisneria spiralis*), otrăţel de apă, otrăţel de baltă (*Utricularia minor, Utricularia vulgaris*), otrăţelul bălţilor (*Utricularia vulgaris*), ouă de copaci, ouă de lemn (*Volvariella bombycina*), oul inului (*Camelina* ssp.), ovăs sălbatic (*Avena fatua, Avena sterilis, Bromus mollis, Bromus sterilis*), ovăsc sălbatic (*Arrhenatherium elatius*), ovăscior de luncă (*Arrhenatherum elatius*), ovăscior de munte (*Avenastrum versicolor*), ovăz păsăresc, ovăz sălbatic (*Avena fatua*), ovăzul nisipurilor (*Avena strigosa*), ovăz sălbatic (*Avena fatua*).

Palagină de baltă (*Caltha laeta*), palmier de munte (*Chamaedorea* sp.), paltin de câmp (*Acer platanoides*), paltin de munte (*Acer pseudoplatanus*), pana apei (*Salvinia natans*), pana broaştei (*Myriophyllum* sp.), pana cucului (*Anemone nemorosa, Primula veris, Pulmonaria rubra*), pana făgetului (*Dryopteris phegopteris* syn. *Phegopteris connectilis*), pana peştelui (*Salvinia natans*), panseaua câmpului (*Viola arvensis*), pansele sălbatice, panseluţă sălbatică (*Viola tricolor*), panseluţe de câmp (*Viola arvensis, Viola tricolor*), panseluţe de munte (*Viola declinata*), papură de baltă (*Typha angustifolia, Typha latifolia*), papură de câmp (*Iris halophila*), papură de şes (*Iris halophila*), paza casei (*Sempervivum tectorum*), păduchi de câmp, păduchii câmpului (*Bidens cernua, Bidens tripartita*), pădureancă (*Asperula odorata*), pădurei (*Cantharellus cibarius*), pădurene (*Russula* ssp.), pădureţ (*Malus sylvestris*), păduroaică (*Lathraea squamaria*), păduriţă (*Moehringia trinervia*), păduroniu, păduroi (*Melampyrum arvense, Melampyrum bihariense*), păiş de baltă (*Agrostis canina*), păiş de luncă (*Festuca pratensis*), păiş subţire de pădure (*Festuca heterophylla*), păiuş de câmpie (*Festuca valesiaca*), păiuş de munte (*Festuca drymeia*), păiuş de nisipuri (*Festuca vaginata*), păiuş de sărătură (*Puccinellia distans*), păiuş de stânci (*Festuca saxatilis, Festuca versicolor*), păiuşul bălţilor (*Deschampsia caespitosa*), pălăria cucului (*Geranium phaeum*), pălăria pădurii (*Amanita pantherina*), păpădie de mlaştini (*Taraxacum palustre*), păpădie de munte (*Leontodon croceus*), păpădie de sărătură (*Taraxacum bessarabicus*), păr de câmp, păr de pădure (*Pyrus pyraster*), păr de stâncă (*Amelanchier ovalis*), păr pădureţ, păr sălbatic (*Pyrus pyraster*), părăluţă de munte (*Pyrola uniflora* syn. *Moneses uniflora*), părul bradului (*Usnea* sp.), părul cucului (*Pyrola* sp.), părul Mumii Pădurii (*Polytrichum commune*), părul Vâlvii Pădurii (*Polytrichum commune*), păstaia şarpelui (*Arabis turitta*), păstaie de câmp (*Lupinus polyphyllus*, *Phaseolus vulgaris*), păsăţelul dealului (*Lepidium ruderale*), păstârnac sălbatic (*Pastinaca sativa* ssp. *pratensis*), păstârnac sălbatic (*Malabaila graveolens*), păstrăv(i) de fag, păstrăv(i) de nuc (*Pleurotus ostreatus, Polyporus squamosus*), păstrăv de pădure (*Lactarius deliciosus*), păstrăv(i) de salcie (*Pluteus salicinus*), păstrăv de stejar (*Fistulina hepatica*), păstrăv roşu de stejar, păstrăvi roşii de stejar (*Fistulina hepatica*), păstrăvul cerului, păstrăvul fagului (*Pleurotus ostreatus*), păstrăvul scailor (*Pleurotus eryngii*), păsula şarpelui (*Cynanchum vincetoxicum*), păsulă sălbatică (*Phaseolus multiflorus*), pătarea trifoiului (*Pseudopeziza trifolii*), pătlagina apei, pătlagina bălţii, pătlagina bălţilor (*Alisma plantago-aquatica*), pătlagină de drumuri (*Plantago major*), pătlagină de munte (*Plantago atrata*, *Plantago gentianoides*), plătagina bălţilor (*Plantago lanceolata*), plătăgina bălţilor (*Alisma plantago-aquatica*), platagină de apă (*Alisma plantago-aquatica*), pătrânjei de câmp (*Peucedanum oreoselinum*), pătrânjel sălbatic (*Caucalis lappula, Peucedanum oreoselinum*, *Pimpinella major*, *Pimpinella saxifraga*), pătrinjel de câmp (*Pimpinella saxifraga*), pătrunjel de câmp (*Pimpinella saxifraga*), pătrunjel de munte (*Selinum carvifolia, Peucedanum oreoselinum*), pătrunjelul broaştelor (*Oenanthe aquatica*), pătrinjel de câmp (*Pimpinella saxifraga*), pătrânjei de câmp (*Peucedanum oreoselinum*), pătrânjel sălbatic (*Caucalis lappula, Peucedanum oreoselinum, Pimpinella major, Pimpinella saxifraga*), pătura broaştelor (*Spirogyra* ssp.), pâhă de sărătură (*Puccinellia distans*), pâinea apei (*Colocasia esculenta*), pânza broaştei (*Spirogyra* ssp.), pelin alb de munte (*Artemisia petrosa*), pelin de câmp (*Artemisia campestris*, *Artemisia vulgaris*), pelin de drumuri (*Artemisia campestris*), pelin de grădină (*Artemisia absinthium*), pelin de mare (*Artemisia santonica*), pelin de sărătură (*Artemisia maritima* syn. *Artemisia santonica*), pelin de stânci (*Artemisia lobelii, Artemisia petrosa*), peliniţă de sărătură (*Artemisia salina* syn. *Artemisia santonica*), pene de se fac prin fân (*Dianthus carthusianorum*), peniţa bungeacului (*Sphagnum* ssp.), pesmă de munte (*Centaurea pinnatifida*), peste pădure, peste de pădure (*Humulus lupulus*), peştişori de fag (*Pleurotus ostreatus*), petreancă (*Heliosperma quadrifidum*), petrigei sălbatici (*Pimpinella saxifraga*), petringei sălbatici (*Pimpinella saxifraga*), petringele de câmp (*Peucedanum oreoselinum, Pimpinella saxifraga*), petrinjei de casă (*Petroselinum hortense*), petrinjei de câmp (*Pimpinella major, Pimpinella saxifraga*), petrinjei sălbatici (*Daucus carota*, *Pimpinella saxifraga*), petrinjel de munte (*Selinum carvifolia*), petrinjel sălbatic (*Pimpinella saxifraga*), petrinjelul broaştelor (*Oenanthe aquatica*), petrişei de câmp (*Pimpinella saxifraga*), petrungel sălbatic (*Pimpinella saxifraga*), petrunjel sălbatic (*Aethusa cynapium*, *Pimpinella saxifraga*), piciorul cocoşului de munte (*Ranunculus montanus*), piersic sălbatic (*Amygdalus nana* syn. *Prunus tenella*), pin de munte (*Pinus cembra, Pinus sylvestris*), pin de piatră (*Pinus mugo, Pinus pinea*), pin maritim (*Pinus maritima*), pin silvestru (*Pinus sylvestris*), pintenaş de câmp (*Consolida regalis*), pintenaşi de grădină (*Consolida ajacis*), pintenul secării (*Claviceps purpurea*), pintrijel de câmp (*Peucedanum oreoselinum*), piparcă sălbatică (*Polygonum hydropiper*), piper de apă, piper de baltă, piper de bălţi, piper de vale (*Polygonum hydropiper*), piper de răzor (*Bunias orientalis*), piperiu de apă (*Polygonum hydropiper*), piperniţă (*Asarum europaeum, Satureja hortensis*), piperniţă de grădină (*Satureja hortensis*), piperul apelor (*Elatine alsinastrum, E. hexandra, E. hydropiper, E. triandra*), piperul bălţii, piperul broaştei (*Polygonum hydropiper*), piperul pădurii (*Asarum europaeum, Daphne mezereum*), piperul pădurii (*Asarum europaeum*), piperiu de apă (*Polygonum hydropiper*), piperniţă de grădină (*Satureja hortensis*), piperul apelor (*Elatine* ssp.), piperul bălţii, piperul broaştei (*Polygonum hydropiper*), pipirig de mare (*Juncus maritimus*), pipirig de munte (*Equisetum hyemale, Juncus alpinus*), pipirig de pădure (*Juncus acutiflorus*), pir de apă (*Paspalum paspalodes*), pir de baltă (*Juncus tenuis*), pir de mare (*Agropyron junceum*), pir de ţelină (*Cynodon dactylon*), pir pădureţ (*Agropyron caninum*), pita pădurii (*Lactarius deliciosus, Lactarius piperatus*), pitarcă de mesteacăn (*Boletus scaber*), pitoi de plop (*Ptychoverpa bohemica*), pitarcă de mesteacăn (*Boletus scaber*), pitoi de plop (*Ptychoverpa bohemica*), platagină de apă (*Alisma plantago-aquatica*), plămâna de apă (*Nymphoides peltata*), plătagina bălţilor (*Plantago lanceolata*), plătăgina bălţilor (*Alisma plantago-aquatica*), plătangină de apă (*Alisma plantago-aquatica*), pleava bălţii (*Lemna minor*), plop de apă (*Populus alba, Populus nigra*), plop de munte, plop de pădure (*Populus tremula*), plop de vale (*Populus canadensis*), plopişor, plopencuţă, plopancă, plopeşti (*Boletus aurantiacus*), plop(e)an, plopencuţele, plopencii, plopenchii (*Russula* sp.) (mushroom that grows under poplars), pluta broaştelor (*Nuphar lutea*), plutitoare dulce (*Glycyrrhiza echinata*), plutiţă (*Salvinia natans*), plutniţă (*Cicuta virosa, Nymphaea alba*), poamă de pădure (*Vitis sylvestris*), poamă sălbatică (*Bryonia alba, Parthenocissus quinquefolia, Vitis labrusca, Vitis sylvestris*), poame de runc (*Rubus idaeus*), podbal de apă, podbal de baltă (*Alisma plantago-aquatica*), podbal de munte (*Arnica montana*), podbal mare (*Petasites hybridus*), polbeal de munte (*Homogyne alpina*), podoaba balegii (*Coprinus atramentarius*), podoaba ferestrelor (*Fuchsia hybrida*), pojarniţă de munte (*Hypericum alpigenum*), pojarul sfeclei (*Cercospora beticola*), polbeal de munte (*Homogyne alpina*), polonidă de baltă (*Cirsium canum*), polonidă de baltă (*Cirsium canum*), pomiţă de grădină (*Fragaria ananassa*), pomiţă de pădure (*Fragaria vesca*), popdeal de munte (*Homogyne alpina*), poroinic de mlaştină (*Orchis cordiger*), porumbul cucului (*Arum maculatum, Lathraea squamaria*), porumbul şarpelui (*Arum maculatum*), potcă de pădure (*Viola* sp.), pragul casei (*Portulaca grandiflora*), prâsad de câmp (*Cirsium vulgare, Onopordon acanthium*), priboi sălbatic (*Geranium pusillum*), pribolnic de baltă (*Veronica beccabunga*), prisacăn (*Chamaenerion angustifolium* syn. *Epilobium angustifolium*), prun sălbatic (*Padus racemosa* syn. *Prunus padus*), prundar (*Myricaria germanica*), pufuliţă de baltă (*Epilobium hirsutum*), pufuliţă de mlaştină (*Epilobium palustre*), pufuliţă de munte (*Epilobium alpinum, Epilobium montanum*), pufuliţă de pietrişuri (*Epilobium fleischeri*), punguliţă de stânci (*Aethionema saxatilis*), pupele de pădure (*Physalis alkekengi*), pur de baltă (*Allium angulosum*), pur de grădină (*Allium ascalonicum*), pureci de câmp (*Bidens cernua, Bidens tripartita*), pureci de cucuruz (*Bidens tripartita*), putregaiul porumbului (*Gibberella zeae*), putregaiul rădăcinilor (*Armillariella mellea, Phallus impudicus*), putregaiul roşu (al lemnului) (*Phellinus pini*), putrezitorul lemnelor (*Merulius lacrymans*).

Racoină (*Stellaria media*), racovină (*Stellaria graminea, Stellaria media*), racoviţă, racuină (*Stellaria media*) (*rac/*rec- "wet"), rapiţă de câmp (*Brassica napus, Brassica rapa, Sinapis arvensis*), rapiţă de grădină (*Sinapis alba*), rapiţă sălbatică (*Brassica napus, Brassica nigra, Brassica rapa, Raphanus raphanistrum, Rapistrum perenne, Rorippa islandica, Sinapis arvensis*), răchită de luncă (*Salix alba*), răchită de pădure (*Salix caprea*), răchită de roghină (*Salix alba*), răchiţică de câmp (*Aster tripolium* ssp. *pannonicus*), răcogină, răcoina găinilor (*Stellaria media*), răcoină (*Anagallis arvensis, Anagallis foemina, Stellaria alsine, Stellaria aquatica, Stellaria media*), răcoină albastră (*Anagallis coerulea*), răciină, răciună (*Stellaria graminea, Stellaria media*), răcohină, răconină (*Stellaria graminea, Stellaria media*), răcorină (*Stellaria media*) (*rac/*rec- "wet"), răculeţ, răcuşor (*Polygonum bistorta, Polygonum viviparum, Filipendula ulmaria*), răcovină (*Stellaria media*), răcoţeanul bălţii (*Stellaria palustris*), răchita (*Salix* ssp.), răchitanul (*Lythrum salicaria*), răchiţica (*Polygonum lapathifolium, Polygonum persicaria*), răchiţelele (*Vaccinium oxycoccus*), rădiche de grădină, rădiţă sălbatică (*Armoracia* *rusticana*), răscoage de bărc (*Epilobium angustifolium*), răsură de câmp (*Rosa gallica*), râia broaştei (*Cladophora* ssp.), râia crumpenelor, râia neagră a cartofului (*Synchytrium endobioticum*), râia trifoiului (*Cuscuta epithymum*, *Cuscuta trifolii*), râia urzicii (*Cuscuta europaea*), râie broştească (*Cladophora* ssp., *Conferva* ssp., *Ranunculus repens*, *Spyrogyra* ssp., *Tribonema* ssp.), râie de apă (*Cladophora* ssp., *Conferva* ssp., *Spyrogyra* ssp., *Tribonema* ssp.), râjnică de pădure (*Cardamine impatiens*), râsa pădurii (*Geranium robertianum*), râşcov de brad (*Lactarius deliciosus*), râşcov de fag (*Lactarius deliciosus*), râşcov de mesteacăn (*Lactarius torminosus*), râureancă (*Myricaria germanica*), regina bălţii (*Iris pseudacorus*), rezâchie sălbatică, rezichie sălbatică, rezăchie sălbatică (*Ribes grossularia* syn. *Ribes uva-crispa*), ridiche de grădină (*Raphanus sativus*), ridiche sălbatică (*Raphanus raphanistrum*, *Sinapis arvensis*), righiche sălbatică (*Raphanus raphanistrum*), rocobină (*Stellaria media*), rocogină (*Stellaria media*), rocoină (*Stellaria alsine*, *Stellaria media*, *Stellaria graminea*, *Anagallis arvensis*, *Anagallis foemina*), rocoină de ochi (*Stellaria holostea*), rocoină mare (*Stellaria neglecta*), rocoină roşie (*Anagallis arvensis*), rocotină (*Stellaria graminea*, *Stellaria media*), rocoţea (*Stellaria graminea*), rocoţel (*Holosteum umbellatum*, *Stellaria graminea*, *Stellaria holostea*, *Stellaria media*), rocovină (*Stellaria graminea*), rocoviţă (*Stellaria media*) (*rac/*rec- "wet"), rodul casei (indeterminate), rodul secarei, rodul secării (*Claviceps purpurea*), rogoz de ariniş (*Carex remota*), rogoz de baltă (*Carex acuta*, *Carex riparia*, *Carex* ssp.), rogoz de câmp (*Carex caryophyllea*), rogoz de coastă, rogoz de deal (*Carex humilis*), rogoz de mlaştină (*Carex pauciflora*), rogoz de munte (*Carex montana*), rogoz de pădure (*Carex montana*, *Carex pairaei*, *Carex sylvatica*), rogoz de păşune (*Carex tomentosa*), rogoz de pe tău (*Typha angustifolia*, *Typha latifolia*), rogoz de sărătură (*Bolboschoenus maritimus*), rogoz mare de pădure (*Carex pairae*), rogoz mic de pădure (*Carex digitata*), romaniţă de câmp (*Anthemis arvensis*), romaniţă de munte (*Achillea schurii*, *Anthemis carpatica*), romăniţă de câmp (*Anthemis arvensis*), romăniţă de grădină (*Chrysanthemum parthenium* syn. *Tanacetum parthenium*), romăniţă sălbatică (*Anthemis cotula*), romoniţă de câmp (*Anthemis arvensis*), romoniţă de grădină (*Chrysanthemum parthenium* syn. *Tanacetum parthenium*, *Chrysanthemum segetum*, *Matricaria chamomilla*), romoniţă de câmp (*Anthemis arvensis*), romoniţă de grădină (*Chrysanthemum segetum*, *Matricaria chamomilla*, *Tanacetum parthenium*), roşcobă de mare (*Cassia fistula*), roşcov sălbatic (*Gleditschia triacanthos*), roşcov de munte (*Lactarius deliciosus*), roşii de oală (*Lycopersicon esculentum* var. *cerasiforme*), roşioară sălbatică (*Lathraea squamaria*), rotunjoară de părău (*Chrysosplenium alternifolium*), roua muşchiului (*Drosera rotundifolia*), roză de deal (*Gratiola officinalis*), rozetă sălbatică (*Reseda lutea*), rozmarin de baltă (*Ledum palustre*), rozmarin de munte (*Gnaphalium silvaticum*), rozmarinul câmpului (*Ajuga chamaepytis*), rug de câmp (*Rosa gallica*), rug de luncă (*Rubus caesius*), rug de munte (*Rubus idaeus*), rug de pădure (*Rubus caesius*), rug sălbatic (*Rosa canina*), rugă sălbatică (*Rosa canina*), rugi de rug de grădină (*Rosa centifolia*), rugina bradului (*Chrysomyxa abietis*), rugina grâului, rugina secării (*Puccinia graminis*), rugina perelor (*Gymnosporangium sabinae*), rugină de baltă (*Senecio paludosus*), rugină de stâncă (*Juncus trifidus*), ruja munţilor (*Rhododendron kotschyi*), rujă de câmp (*Helianthus annuus*), rujă de deal (*Lavathera thuringiaca*), rujă de munte (*Hieracium aurantiacum*), rujina grâului (*Puccinia graminis*), rujnici de munte (*Aster alpinus*), rumenele de munte (*Silene armeria*), rumpepiatră (*Saxifraga* ssp.), runcan (*Rubus idaeus*), ruscea de poiană (*Colchicum autumnale*), rută de grădină, rută de muri (*Ruta graveolens*), rută de livezi (*Thalictrum minus* var. *majus*), rută sălbatică (*Ajuga chamaepytis*), rutişor de munte (*Thalictrum alpinum*).

Sacâz, sacâzel (*Pelargonium peltatum*), salata broaştei (*Caltha palustris* ssp. *laeta, Ranunculus lateriflorus, Tussilago farfara, Veronica beccabunga*), salata cucului (*Ficaria verna* syn. *Ranunculus ficaria*), salata lupului de baltă (*Crepis paludosa*), salata mării (*Ulva lactuca*), salata muntelui (*Solidago virgaurea*), salata stâncii (*Hieracium bifidum*), salată de apă (*Pistia stratiotes*), salată de câmp (*Ficaria verna* syn. *Ranunculus ficaria*), salată de grădină (*Lactuca sativa*), salată de mare (*Ulva lactuca*), salată de pădure (*Erechtites hieracifolia, Ficaria verna* syn. *Ranunculus ficaria, Smyrnium perfoliatum*), salată sălbatică (*Ficaria verna* syn. *Ranunculus ficaria, Lactuca serriola*), salatele broaştei (*Ranunculus repens*), salbie de câmpuri (*Salvia pratensis*), salcă de pârâu (*Salix starkeana*), salcie broştească (*Salix cinerea*), salcie de munte (*Salix caprea*), salcie de nisipuri (*Salix rosmarinifolia*), salcie de pârâu (*Salix starkeana*), salcie sălbatică (*Salix cinerea*), salvie de casă, salvie de grădină (*Salvia officinalis*), salvie de câmp (*Salvia pratensis*), salvie sălbatică (*Salvia pratensis*), sanfiu de câmp (*Dianthus carthusianorum*), sansiu turcesc de câmp (*Saponaria officinalis*), sasău de apă (*Nymphaea alba*), saschiu de câmp (*Vinca herbacea*), săgeata apei, săgeata apelor (*Sagittaria sagittifolia*), sălata broaştii (*Caltha palustris* ssp. *laeta*), sălată de pădure, sălată nemţească, sălăţica zidului (*Chondrilla juncea*), sălbată, sălbatic (*Lolium temulentum*), sălbăţă (*Lolium perenne*), sălbăticiune (*Vitis sylvestris*), sălbăţie (*Lolium perenne, Lolium temulentum*), sălcar (*Trametes suaveolens*) (mushroom on willows), sănfirei de câmp (*Centaurium umbellatum* syn. *Centaurium erythraea*), săpun de mal, săpunar sălbatic (*Saponaria officinalis*), săpunul luncii (*Saponaria officinalis*), sărătură (*Puccinellia distans*), sărătură roşie (*Salicornia herbacea*), sărătură tufoasă (*Suaeda maritima*), sărăturică (*Goniolimon tataricum*), sărături (*Limonium gmelini*), săricică (*Salsola kali, Salsola soda*), sărigea (*Salicornia herbacea, Salsola kali*), sărpun de pe coastă (*Thymus comosus*), sâmziene de pădure (*Asperula odorata*), sânjuane de pădure (*Asperula odorata* syn. *Galium odoratum*), sânziană de pădure (*Galium sylvaticum*), sânziene de baltă (*Galium palustre*), sânziene de grădină (*Solidago canadensis*), sânziene de munte (*Asperula capitata, Galium anisophilum*), sânziene de pădure (*Asperula odorata* syn. *Galium odoratum, Galium schultesii*), sânziene de stânci (*Asperula capitata*), sânziene sălbatice (*Galium sylvaticum*), sânzuiene de pădure (*Asperula odorata* syn. *Galium odoratum*), sârma apei (*Vallisneria spiralis*), sburătoare de apă (*Epilobium hirsutum, Lythrum salicaria*), sburătoare de baltă (*Lythrum salicaria*), sburătoare de pădure (*Chamaenerion angustifolium* syn. *Epilobium angustifolium*), scai de ape (*Cirsium rivulare*), scai de câmp (*Eryngium campestre*), scai de râu (*Cirsium rivulare*), scai ghimpos încolăcitor pă lemn (*Smilax aspera*), scai pădureţ (*Dipsacus fullonum*), scaiul dracului de munte (*Carlina acaulis*), scânteioare de luncă (*Gypsophila muralis*), scânteiuţă de munte (*Antennaria dioica, Potentilla ternata*), scânteiuţe de munte (*Aster alpinus*), scânteuţă de mal (*Aster lanceolatus, Aster salignus*), scânteuţă de sărătură (*Spergularia maritima*), scânteuţe sălbatice (*Dianthus carthusianorum, Primula veris*), scânteioare de pădure (*Gagea lutea*), scaunul popii de grădină (*Dianthus caryophyllus*), scăunelul broaştei (*Lychnis flos-cuculi*), scăunişe sălbatice (*Dianthus carthusianorum*), scăiuşet de casă (*Cichorium intybus*), scăiuşi de luncă (*Cirsium oleraceum*), scăriţa muntelui (*Blechnum spicant*), scăunelul broaştei (*Lychnis flos-cuculi*), scăunişe sălbatice (*Dianthus carthusianorum*), sclipeţi de munte (*Potentilla ternata*), scoriş de munte (*Polygonum bistorta*), scoruş de munte (*Sorbus aucuparia*), scoruş de pădure (*Sorbus torminalis*), scoruş sălbatic (*Sorbus aucuparia*), scradă de pădure (*Carex sylvatica*), scrintitoare de baltă (*Potentilla anserina*), scrumbia pădurii (*Russula xerampelina*), scunchie sălbatică (*Prunus padus*), secară de nisipuri (*Secale silvestris*), secară sălbatică (*Secale silvestris*), secărea de grădină (*Foeniculum vulgare, Pimpinella anisum*), secărică de câmp (*Bromus secalinus* or *Carum carvi*), secărică de brădet (*Sarcodon infundibulus*), selină sălbatică (*Oenanthe aquatica*), sfeclă sălbatică (*Beta trigyna*), sferegă de dos (*Dryopteris filix-mas*), sferegă de faţă (*Pteridium aquilinum*), siminic de câmp (*Antennaria dioica*), siminic sălbatic (*Gnaphalium sylvaticum*), sipică de munte (*Scabiosa lucida*), sipică de râpe (*Cephalaria laevigata*), sisinei de munte (*Pulsatilla alba*), slăbănog de câmp (*Mercurialis annua*), slobonog de câmp (*Mercurialis annua*), slobonov de câmp (*Mercurialis annua, Mercurialis perennis*), soc de câmp (*Cardaria draba*), soc de munte (*Sambucus racemosa*), sorb de pădure, sorb sălbatic (*Sorbus torminalis*), spanac sălbatic (*Chenopodium album*), spanacul stânelor (*Chenopodium bonus-henricus*), sparangă de brădet (*Monotropa hypopytis*), sparanghel de glastră (*Asparagus sprengeri*), sparanghel sălbatic (*Asparagus tenuifolius*), sparcetă de munte (*Onobrychis montana*), sparcetă de nisip (*Onobrychis arenaria*), spata pădurii (*Dryopteris filix-mas*), spată de codru (*Laserpitium latifolium*), spânţ de deal (*Adonis vernalis*), spânz de munte (*Helleborus purpurascens*), spetează sălbatică (*Iris pseudacorus*), spicul şarpelui (*Lycopodium clavatum*), spinarea luoului (*Arhyrium filix-femina*), spin de (pe) holde (*Cirsium arvense*), spini de gard (*Lycium barbarum*), spini răi din holdă (*Cirsium arvense*), sporul casei (*Impatiens sultani* syn. *Impatiens walleriana*), spumar de pădure (*Cardamine impatiens*), stânjenei de baltă (*Iris pseudacorus*), stânjenel de munte (*Gentiana kochiana, Iris ruthenica*), stânjenel mic de munte (*Iris ruthenica*), stânjenel sălbatic (*Iris halophila*), stânjeni de baltă (*Iris pseudacorus*), stânjeni de grădină (*Iris germanica*), stânjeni de pădure (*Iris variegata*), stânjinel de baltă (*Iris pseudacorus*), stânjinel de grădină (*Iris germanica*), stea de baltă (*Trapa natans*), steaua baltei, steaua bălţii (*Callitriche verna*), steaua muntelui (*Astrantia major*), steaua stâncii (*Lloydia serotina*), steaua bălţii (*Callitriche verna*), steaua stâncii, steiţă (*Lloydia serotina*), stejar american de mlaştină (*Quercus palustris*), stejar de baltă (*Quercus palustris*), stejar de luncă (*Quercus robur*), stejar de piatră (*Quercus ilex*), stejărar (*Daedalea quercina*) (mushroom on oaks), stejie de baltă (*Rumex aquaticus*), stejie de grădină (*Rumex patientia*), steliţa ierbii (*Stellaria graminea*), steliţa izvoarelor (*Saxifraga stellaris*), steliţa rorii (*Parnassia palustris*) (roră means marsh), steluţă sălbatică (*Aster amellus*), steluţe de dumbravă (*Stellaria nemorum*), steluţe de munte (*Leontopodium alpinum*), steluţă sălbatică (*Aster amellus*), steluţe de munte (*Leontopodium alpinum*), sterie de bălţi (*Callitriche verna*), ștevie de baltă (*Rumex limosus*), știn de (pe) holde (*Cirsium arvense*), strai de broască (*Spirogyra* ssp.), straiul apei (*Spirogyra* ssp.), straiul broaştei (*Converva rivularia, Spirogyra* ssp.), stratul broaştei (*Spirogyra* ssp.), străjacul broaştei (*Eriophorum latifolium*), strugurele mării (*Ephedra distachia*), struguri de mare (*Phytolacca americana*), struguri sălbatici (*Vitis sylvestris*), strugurii broaştei (*Potamogeton nodosus*), strugurii ciorii (*Actaea spicata*), struna apei (*Fontinalis antipyretica*), struţa apei (*Veronica anagallis-aquatica*), stuh de baltă (*Phragmites communis* syn. *Phragmites australis*), stuh de câmp (*Calamagrostis epigeios*), stuh sălbatic (*Calamagrostis varia*), stuh de baltă (*Phragmites communis* syn. *Phragmites australis*), stuh de câmp (*Calamagrostis epigeios*), stuh sălbatic (*Calamagrostis varia*), sugelul pădurii (*Salvia glutinosa*), sulfină de nisipuri (*Melilotus arenarius*), sulfină de sărătură (*Melilotus altissimus*), sunătoare de câmp (*Crepis capillaris*), sunătoarea fânului (*Rhinanthus glaber, Rhinanthus minor, Rhinanthus rumelicus*) has been named also sunătoare de munte (*Antennaria dioica*), susai de câmp (*Sonchus arvensis*), susai de munte (*Cicerbita alpina, Mycelis muralis*), susai de pădure (*Mycelis muralis, Prenanthes purpurea*), susai pădureţ (*Mycelis muralis*), susai sălbatic (*Mycelis muralis*).

Şalată de vâlcele (*Caltha palustris* ssp. *laeta*), şale de câmp (*Salvia pratensis*), şampinion de pădure (*Agaricus sylvaticus*), şampinionul oilor (*Agaricus arvensis*), şampi(in)on (*Agaricus arvensis, Agaricus campester, Agaricus xanthodermus*), şălată de câmp (*Ranunculus ficaria*), şălată de grădină (*Lactuca sativa*), şălată de pădure (*Ficaria verna* syn. *Ranunculus ficaria*), şălătucă sălbatică (*Ranunculus ficaria*), şelată sălbatică (*Ranunculus ficaria*), şiştăvirea inului (*Colletotrichum lini*), şneapân de munte (*Juniperus communis*), şofran de grădină (*Carthamus tinctorius, Crocus sativus*), şofran sălbatic (*Anthericum ramosum, Carthamus tinctorius, Cnicus benedictus*), şopârliţă de apă (*Veronica anagallis-aquatica*), şopârliţă de câmp (*Veronica arvensis*), şopârliţă de munte (*Veronica alpina, Veronica montana*), şovar de munte (*Poa trivialis*), ştevia stânelor (*Rumex alpinus*), ştevie de baltă (*Rumex aquaticus, Rumex limosus* syn. *Rumex palustris*), ştevie de grădină (*Rumex patientia*), ştevie de munte, ştevie de pădure (*Astrantia major*), ştir de grădină (*Amaranthus paniculatus*), ştir de ogoare (*Amaranthus hybridus* ssp. *hypochondriacus*), ştir roşu de grădină (*Amaranthus paniculatus*), ştir sălbatic (*Amaranthus retroflexus*), şuvar de munte (*Poa trivialis*), şuvar sălbatic (*Hemerocallis fulva*), şuvăr de munte (*Poa trivialis*), tabac sălbatic (*Doronicum austriacum*).

Tabacul câmpului (*Arnica montana*), tăbac de baltă (*Rumex hydrolapathum*), tăbacă sălbatică (*Pulmonaria filarskyana*), tăbacul broaştelor (*Rumex hydrolapathum*), tăbac de baltă (*Rumex hydrolapathum*), tăbacă sălbatică (*Pulmonaria rubra*), tăbacul broaştelor (*Rumex hydrolapathum*), tăciune de cucuruz (*Ustilago zeae*), tăciune de secară (*Claviceps purpurea*), tăciunele grâului (*Ustilago tritici*), tăciunele porumbului (*Ustilago zeae*), tăieţeii broaştei (*Potamogeton pusillus, Ruppia rostellata*), tămâioară sălbatică (*Viola tricolor*), tămâiţă de câmp (*Ajuga chamaepytis, Aster tripolium*), tămâiţă de drum (*Ambrosia elatior* syn. *A. artemisifolia*), tămâiţă de grădină (*Chenopodium ambrosioides, Chenopodium botrys*), tătăişi de câmp (*Chrysanthemum leucanthemum*), tătăişi de grădină (*Callistephus chinensis*), tătăişi de pădure (*Chrysanthemum corymbosum, Chrysanthemum rotundifolium*), tătăişi sălbatice (*Pulicaria dysenterica*), tătănească de munte, tătânească de pădure, tătânească de fag (*Symphytum cordatum*), tei de cameră (*Sparmannia africana*), tei de deal, tei de pădure (*Tilia cordata*), tei pădureţ (*Tilia cordata*), tei roşu pădureţ (*Tilia cordata*), tenghere (*Prunus armeniaca* syn. *Armeniaca vulgaris*), tengheri (*Zea mays*), tinghirel (*Prunus armeniaca*) (cf. magh. tengeri, marin, de mare), tetea pădurii (*Senecio sylvaticus*), tidvă de apă (*Nympahea alba*), tigvă de tină (*Citrullus vulgaris*), tigvă de apă (*Nuphar luteum*), tilişcă de munte (*Circaea alpina*), timoftică de munte (*Phleum alpinum* ssp. *commutatum*), titvă de apă (*Nymphaea alba*), toporaşi de câmp (*Consolida regalis*), toporaşi de grădină (*Aquilegia vulgaris*), toporaşi de munte (*Viola declinata*), toporaşi de pădure (*Erythronium dens-canis, Viola odorata*), torţelul cimbrişorului (*Cuscuta epithymum*), torţelul inului (*Cuscuta epilinum*), torţelul măzărichii (*Cuscuta trifolii* ssp. *viciae*), torţelul plopului (*Cuscuta lupuliformis*), torţelul sălciilor (*Cuscuta lupuliformis*), torţelul trifoiului (*Cuscuta trifolii*), torţelul urzicii (*Cuscuta europaea*), trâmbiţa bradului (*Clitocybe infundibuliformis*), trâmbiţa muşchiului (*Cladonia fimbriata, Cladonia pyxidata*), trandafir de baltă (*Mentha pulegium*), trandafir de câmp (*Rosa agrestis, Rosa canina, Rosa gallica*), trandafir de grădină (*Rosa centifolia*), trandafir de munte (*Rhododendron kotschyi* syn. *Rhododendrom myrtifolium, Rosa pendulina*), trandafir de pădure (*Rosa multiflora, Rosa pendulina*), trandafir sălbatic (*Lychnis coronaria, Rosa canina*), trandafiraş de munte (*Rhododendron kotschyi* syn. *Rhododendrom myrtifolium*), trandafirul broaştei (*Lycopus exaltatus, Mentha longifolia*), trandafirul broaştelor (*Mentha pulegium*), trandahir sălbatec (*Rosa gallica*), trăsnitoarea apei (*Najas major, Najas minor*), trestie de baltă (*Phragmites communis* syn. *Phragmites australis*), trestie de câmp (*Calamagrostis epigeios*), trestie de mare (*Arundo donax, Calamus rotang*), trestioară de pădure (*Calamagrostis arundinacea*), trifoi de baltă, trifoi de lac (*Menyanthes trifoliata*), trifoi de luncă alb (*Trifolium repens*), trifoi de luncă roşu (*Trifolium pratense*), trifoi sălbatic (*Dorycnium herbaceum, Lotus corniculatus, Medicago falcata, Ononis arvensis, Trifolium pratense*), trifoiaş de baltă (*Menyanthes trifoliata*), trifoiaş sălbatic (*Medicago falcata*), trifoişte de baltă (*Menyanthes trifoliata*), trompeta apei (*Cryptocoryne* sp.), troscot de apă, troscot de baltă (*Polygonum amphibium*), troscot de cereale (*Polygonum convolvulus*), troscot de câmp (*Polycnemum arvense*), troscot de munte (*Polygonum alpinum*), troscot de nisipuri (*Polygonum arenarium*), troscotul broaştei (*Montia fontana*), troscotul broaştelor (*Polygonum amphibium*), turturea de munte (*Carlina acaulis*), tutun de pădure (*Pulmonaria officinalis*).

Ţâtron sălbatic (*Hedera helix*, *Ruscus hypoglossum*), ţâţa oii de câmp (*Campanula trachelium*), ţelăr sălbatic (*Peucedanum oreoselinum*), ţelina broaştei (*Ranunculus repens*), ţelină de grădină (*Apium graveolens*), ţelină de izvor (*Ranunculus repens*), ţelină de lac(u) (*Apium* sp., *Peucedanum palustre*), ţelină sălbatică (*Oenanthe aquatica*), ţipruş de câmp (*Ajuga chamaepytis*), ţipruş de grădină (*Santolina chamaecyparissus*), ţipruş sălbatic (*Thuja* sp.).

Ulcicele sălbatice (*Convallaria majalis*, *Polygonatum odoratum*), ulm de câmp (*Ulmus carpinifolia*), ulm de munte (*Ulmus scabra*), umbrarul muntelui (*Alchemilla vulgaris*), umbreluţa muşchiului (*Mycena galopus*), umbreluţă de apă, umbreluţă de baltă (*Hydrocotyle vulgaris*), untişor de baltă (*Caltha laeta*, *Ranunculus sceleratus*), ura muntelui (*Gymnadenia conopsea*), urechea nucului (*Polyporus squamosus*), urechea ulmului (*Polyporus squamosus*), urechiuşe de stâncă (*Sempervivum tectorum*), urechiuşi de lemn (*Lentinellus cochleatus*), urfen de zăvoi (*Myricaria germanica*), ursoaică de câmp (*Gentianella amarella* syn. *G. germanica*), ursoică de grădină (unidentified), urzica bălţii (*Lycopus europaeus*), urzica broaştei (*Lycopus europaeus*), urzică de baltă (*Lycopus europaeus*), urzică de casă (*Coleus blumei*), urzică de câmp (*Lamium maculatum*), urzică de fereastră (*Coleus blumei*), urzică de grădină (*Coleus blumei*), urzică de pădure (*Urtica dioica*), urzică de şură (*Urtica urens*), urzică moartă pădureaţă (*Galeopsis tetrahit*), urzică pădureaţă (*Galeopsis tetrahit*), ustunoi de mare (*Urginea maritima* syn. *Drimia maritima*), ustunoi sălbatic (*Allium flavum*, *Allium oleraceum*, *Allium scorodoprasum*), usturoi de câmp (*Allium oleraceum*), usturoi de munte (*Alium montanum, Allium ochroleucum*), usturoi de pădure (*Allium scorodoprasum, Allium ursinum*), usturoi sălbatic (*Allium rotundum, Allium vineale, Gagea lutea*).

Vâlva pădurii (*Lathraea squamaria*), vanilie de câmp (*Heliotropium europaeum, Heliotropium suaveolens*), vanilie de grădină (*Heliotropium peruvianum*), vanilie sălbatică (*Heliotropium europaeum*), varza mării (*Crambe maritima*), varză de apă (*Pistia stratiotes*), varză de grădină (*Brassica oleracea* var. *capitata*), varză de mare (*Crambe maritima*), varză de stâncă (*Sedum roseum, Sempervivum tectorum*), vâzdoage de luncă (*Lychnis flos-cuculi*), vâzdoance de câmp (*Dianthus compactus*), văcălie de brad (*Fomitopsis pinicola*), văcălie de fag (*Fomes fomentarius, Ganoderma applanatum*), văcălie de mesteacăn (*Placodes betulinus* syn. *Piptoporus betulinus*), văcălie de salcie (*Trametes suaveolens*), văsc de brad, văsc de păr (*Viscum album*), văsc de pădure (*Loranthus europaeus*), vâsc alb de stejar, vâsc de brad (*Viscum laxum* ssp. *abietis*), vâsc de conifere (*Viscum laxum*), vâsc de foioase (*Viscum album*), vâsc de pin (*Viscum laxum*), vâsc de stejar, vâscul stejarului (*Loranthus europaeus*), vâsc de apă, vâsc de baltă (*Callitriche verna*, *Myriophyllum spicatum*, *Myriophyllum verticillatum*), verbină de câmp (V*erbena officinalis*), verbenă de nisip, verbină de nisip (*Abronia umbellata*), verbină sălbatică (*Verbena officinalis*), verbincă sălbatică (*Isatis tinctoria*), verdeaţa zidurilor, verzeala zidurilor (*Pleurococcus vulgaris*), vervine de grădină (*Verbena hybrida*), verzişoară de munte (*Sempervivum montanum*), veselia casei (*Begonia sanguinea*), veştejirea inului (*Fusarium lini*), vie pădureană (*Clematis vitalba*), vie păsărească (*Clematis vitalba, Vitis sylvestris*), vie sălbatică (*Humulus lupulus, Parthenocissus quinquefolia, Vitis labrusca, Vitis sylvestris, Vitis vinifera*), vin sălbatic (*Parthenocissus quinquefolia*), vineriţă de arătură (*Ajuga chamaepytis*), vineţele de stâncă (*Centaurea calvescens, Centaurea kotschyana*), vineţică de câmp (*Centaurea cyanus*), violete de casă/cameră (*Saintpaulia ionantha*), viorea de munte (*Viola declinata*), viorea de pădure (*Viola sylvestris* syn. *Viola reichenbachiana*), viorea sălbatică (*Viola canina*), viorele de casă (*Viola odorata*), viorele de fereşti (*Matthiola incana*), viorele de grădină (*Viola mirabilis*, *Viola odorata*), viorele de munte (*Cardamine glanduligera*), viorele de oală (*Saintpaulia ionantha*), viorele de ogoare (*Viola arvensis*), viorele de pădure (*Pulmonaria* sp., *Viola sylvestris* syn. *V. reichenbachiana*), viorică de pădure (*Viola mirabilis*), virnie sălbatică (*Vitis sylvestris*), vişin sălbatic (*Cerasus fruticosa* syn. *Prunus fruticosa*), vişina cucului (*Atropa belladonna*), vişină de munte (*Pulsatilla alba*), vişinel de stepă, vişinel sălbatic (*Cerasus fruticosa* syn. *Prunus fruticosa*), viţă de luncă (*Solanum dulcamara*), viţă de munte (*Vitis rupestris*), viţă de pădure (*Vitis sylvestris*), viţă de vie sălbatică (*Vitis labrusca, Vitis sylvestris*), viţă sălbatică (*Humulus lupulus, Parthenocissus quinquefolia, Parthenocissus tricuspidata, Vitis labrusca*, *Vitis sylvestris*, *Vitis vinifera*, *Vitis vulpina*), viţă sălbatică americană (*Parthenocissus quinquefolia*), viţişoara câmpului (*Veronica persica*), viţişoară (*Clematis vitalba, Clematis viticella*), volbură de gard(uri) (*Calystegia sepium*), volbură de nisip (*Convolvulus persicus*), volbură de stepă (*Convolvulus canthabricus*), volbură sălbatică (*Calystegia sylvatica*), volovatic de munte (*Carduus glaucus* syn. *Carduus defloratus* ssp. *glaucus*), vulturică de pădure (*Hieracium lachenalii*), vulturică de stânci (*Hieracium pojorîtense*, *Hieracium villosum*).

Zambilă de apă (*Eichhornia crassipes*), zambilă de câmp (*Scilla bifolia, Viola odorata*), zambilă sălbatică (*Hyacinthella leucophaea*), zaschiu sălbatic (*Dianthus barbatus*), zâna pădurii (*Asperula odorata*), zâna poienii (*Galium verum*), zbârciog de munte (*Morchella elata*), zbârciog de pin (*Gyromitra esculenta*), zburătoare de mlaştină (*Epilobium palustre*), zburătoare de zăvoi (*Epilobium parviflorum*), zgaiba stâncii (*Verrucaria* sp.), zidăriţă (*Barbula* sp., *Parietaria officinalis*), zmochin sălbatec (*Ficus carica*).

CONCLUSIONS

This work ads to the previous ones highlighting the significance of the vernacular names of plants.

These names often synthetize characteristics of the vegetal species in a similar manner with the scientific names.

The species enumerated in the following lines are expressions of plant ecotops such as perceived and expressed by the Romanian people.

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FLORA AND VEGETATION OF ALPINE WETLANDS OF THE CARPATHIAN BIOSPHERE RESERVE (UKRAINE)

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KEYWORDS: wetland, plants distribution, biotopes, protected massifs.

ABSTRACT

The article includes the results of alpine wetlands research at the Carpathian Biosphere Reserve to add candidates to the Ramsar List. Proposed to be included are three alpine wetlands reserve located within the Chornohora, Svydovets and Maramorosh ranges, namely: “Ozirna-Brebenyeskul”, “Marmarosky Mountain” and “Svidovetsky Mountain”. The main emphasis is given to flora and vegetation of the lakes and sedge-sphagnum slope bogs. Vegetation communities are described and rare and endemic flora species provided. Posted for wetland habitat reserve for habitat concept EUNIS. Their general characteristic and location within the Carpathians are given. It is noted that these wetlands play an important biogeocenotic role accumulating for a long time a significant amount of moisture during rains and snowmelt. Wetlands are centres of rich biological diversity with significant rare species and plant communities.

REZUMAT: Flora şi vegetaţia zonelor umede alpine din Rezervaţia Biosferei a Carpaţilor (Ucraina).

Articolul include rezultatele cercetărilor asupra zonelor umede din Rezervaţia Biosferei a Carpaţilor din Ucraina, candidate pentru lista Ramsar. Sunt propuse trei zone umede alpine localizate în regiunile Chornohora, Svydovets şi Maramureş şi anume „Ozirna-Brebenyeskul”, „Munţii Maramureşului” şi „Muntele Svidovetsky”. Atenţia cea mai mare este acordată florei şi vegetaţiei lacurilor şi a mlaştinilor de pantă cu rogozuri şi muşchi de turbă. Sunt descrise comunităţile de plante şi scoase în evidenţă specii de plante rare şi endemice. Ele sunt calificate ca şi rezervaţii de habitate de zone umede după conceptul habitatelor EUNIS. Sunt prezentate, de asemenea, caracteristicile lor generale în cadrul Carpaţilor. Se subliniază că aceste zone umede joacă un important rol biogeocenotic, acumulând pentru un timp îndelungat o cantitate semnificativă de apă rezultată din ploi şi topirea zăpezilor. De asemenea, aceste zone umede sunt centrele unei bogate biodiversităţi cu importante specii şi comunităţi de plante rare.

ZUSAMMENFASSUNG: Flora und Vegetation der alpinen Feuchtgebiete im Biosphärenreservat Karpaten (Ukraine).

Die Arbeit umfasst die Forschungs-ergebnisse betreffend die Feuchtgebiete des Biosphärenreservats Ukrainische Karpaten, die auch Anwärter für die Ramsarliste darstellen. Dafür sind drei alpine Feuchtgebiete vorgeschlagen, die in den Gebieten Chornohora, Svydovets und Maramureşch und “Ozirna-Brebenyeskul”, “Maramureşcher Gebirge” und “Svidovetsky Gebirge” liegen. Die größte Aufmerksamkeit wird der Flora und Vegetation der Seen und Hangmoore mit Seggen und Torfmoosen gewidmet. Die Pflanzengesellschaften werden beschrieben und dabei seltene und endemische Pflanzen hervorgehoben. Die Gebiete werden als Reservat von Feuchtge-bietslebensräumen nach dem Habitatkonzept von EUNIS qualifiziert. Dabei werden auch ihre allgemeinen Kennzeichen innerhalb der Karpaten angeführt. Es wird unterstrichen, dass diese Feuchtgebiete eine wichtige biogeocoenotische Rolle spielen, da sie für lange Zeit eine beachtliche Wassermenge aus Regenfällen und Schneeschmelze speichern. Auch sind diese Feuchtgebiete Zentren einer reichen Biodiversität mit seltenen Arten und Pflanzengesellschaften.

INTRODUCTION

The Carpathian Biosphere Reserve (CBR) has an area of 58,035 ha and is composed of nine isolated massifs that are located on different elevations from the Transcarpathian lowland to the alpine zones of the Ukrainian Carpathians within altitudes 180-2,061 m a.s.l. alpine belt of CBR, is a special natural treasure where wetland complexes are widely distributed.

During 2009-2012 we worked on the inclusion of some alpine wetland complexes of CBR to the Ramsar List of internationally important wetlands (Fig. 1).

Generally it is proposed to include three wetlands of the Chornohora, Svydovets and Marmamureş Mountain ranges to the List, namely: "Ozirnyi-Brebenescul Wetland", "Highland Maramureş Wetland" and the "Svydovets Highland Wetland" (Pokynchereda et al., 2010, 2013). The main emphasis is given to flora and vegetation researches of the wetlands along with identification of rare plant species.

MATERIAL AND METHODS

The expeditions researched all territory of the alpine belt of the Carpathian CBR – the Chornohora, Maramureș and Svydovets protected massifs were fully investigated. Flora species census was conducted according to a special scientific programme for protected areas of Ukraine – Chronicles of Nature (Andrienko, 2002).

Phytocoenotic characteristics of the communities is made based on geobotanical descriptions of sites. Processing of descriptions and selection of vegetation units are made considering the dominant principles of classification. The names of all the plants listed on "Determinants of plants of the Ukrainian Carpathians (Determinant plants Ukrainian Carpathians, 1977)", the name given by the plant association's Prodromus of vegetation in Ukraine.

RESULTS AND DISCUSSION

The wetland "Ozirnyi-Brebeneskul" is located on the territory of the Chornohora Mountain range of CBR at the altitudes 956-2,061 m a.s.l.; catchment area – 1,656.91 hectares. It covers the slopes of the Hoverla, Bretskul, Turkul, Pozhyzhevska, and Brebeneskul mountains, where the sources of rivers Hoverla, Brebeneskul, Ozirnyi, and White Tisza are located. Here there are four major glacial lakes: Upper Ozirnyi, Lower Ozirnyi, Bretskul and the cirque lake Brebeneskul.

The Svidovets alpine wetland lies in the territory of the Svydovets mountain range of CBR in the altitudes 1,000-1,881 m a.s.l.; catchment area – 1,614 ha. It is located on the slopes of the Big Blyznytsi and Small Blyznytsi, Stig, Lesser Menchul Mountains, where the rivers Svydovets, Trufanets, Hropyanets, Trostianets, and Kisva have their origin. In these lands there are glacial lakes: Maiden's Tears (Divochi Slyozy) and Drahobratske. Nearby are several smaller Sedge-Sphagnum lakes and wetlands within the Urda, Steryshora, Flantus, Heryshaska, Dohyaska, Troyaska, and Stara valleys.

The Maramureş alpine wetland is in the Maramureş Mountains range of CBR at the altitudes of 900-1,937 m a.s.l.; catchment area – 2,128 ha. It occupies the slopes of Pop Ivan Maramureş, Berlybashka, Petros Marmarosky, Bendryaska, Holovachyn, and Scherban mountains, where the rivers Large Rossosh, Small Rossosh, Yavirnykovyi, White Stream, Kvasniy, Radomir, and Pop Ivan have take their origin. On these lands there are three lakes: Bukovets, Pop Ivan and Hropshora (Tab. 1). Nearby there are several smaller lakes and overgrown wetlands (Sedge-Sphagnum) in the valleys of the mountain streams Yavirnyk, Lysyche, Berlebashka, Lechyn, and Kvasniy (Tab. 1).

Figure 1: Location of CBR wetlands in the Carpathians.

Other lakes need more research. In the Maramureş massif of CBR there are the following lakes: Berlybaske (length about 25 m and width about nine m) in the upper forest belt under the Berlybashka Mountain (Latundor), two lakes Costelka in the sub-alpine belt about 12 m wide and about nine m long under the Chirnyi Grun Mountain on the Kostan-Gropa alpine meadow, Galgazha Lake on the Galgazha meadow about 10 m long and about eight m wide. The given sites contain basins with hollows where Sedge-Sphagnum bogs have formed on Pop Ivan, Shcheban, Berlubashka, and Chornyi Grun mountains.

Wetland communities belong to the grass-sedge hygrophilous vegetation subtype – *Prata graminoso-caricosa hydrophila* (K. Malinowski, 1980). The flora of the alpine wetland ("Ozirnyi-Brebeneskul", "Alpine Svydovets wetland", and "Alpine Maramureş wetland") are represented by wetland and riparian plant communities within the upper forest, subalpine and alpine zones in part. Wetland groups formed mainly the following types: *Carex echinata, C. rostrata, C. pauciflora, C. cinerea, Eriophorum vaginatum, Empetrum nigrum, Sphagnum riparium, S. fallax, S. cuspidatum, S. fuscum, S. magellanicum, Polytrichum alpinum* and others. Wetland habitats have a significant number of rare species included in the Green Data Book of Ukraine (Didukh, 2009): *Swertia alpestris, S. perennis, S. punctata, Pinguicula alpina*, etc.; as well as rare endemic and relict species: *Carduus kerneri, Phyteuma vagneri, Ranunculus kladnii* and *Anemone narcissiflora*. There are three species included in the European Red List: *Pulmonaria filarszkyana, Primula poloniensis* and *Heracleum carpaticum*. In humid shore areas grow some orchid species: *Dactylorhiza cordigera, D. fuchsii* and others. Many more alpine lakes are located within the upper forest belt of undergrowth crooked-form *Picea abies, Pinus mugo, Juniperus sibirica,* and *Duschekia viridis*. Only here have been registered phytocoenoses rare for Ukraine: *Pinetum (mugi) sphagnosum* and *Sphagneta depressipiceetosa*. In addition, among the shore vegetation have been found the rare shrub noda *Rhododendreta myrtifolium, Loiseleurieta procumbentis*, cited in Green Data Book of Ukraine (Didukh, 2009).

Table 1: Characteristics of the largest CBR alpine lakes.

No.	Name	Altitude m a.s.l.	Water surface, ha	Depth, m	Length, m	Width, m	GPS coordinates
Chornohora Massif							
1.	Brebeneskul	1,801	0.60	2.8-3	152-47	47-25-32	N48°06,103' E024°33,707'
2.	Upper Ozirnyi	1,625	0.20	0.5	120	15-22	N48°07,550' E024°31,196'
3.	Lower Ozirnyi	1,513	0.25	3.2	50	20-30-25	N48°08,030' E024°30,956'
4.	Bretskul	1,731	0.16	1.7	60	20-15-40	N48°09,114' E024°30,031'
Svydovets Massif							
5.	Maiden's Tears (1)	1,597	0.20	1.7	65.4	18-32	N48°13,712' E024°14,111'
6.	Maiden's Tears (2)	1,597	0.10	1.2	30	12-19	N48°13,712' E024°14,111'
7.	Drahobratske	1,382	0.12	1.8	35	18-25-20	N48°14,453' E024°14,445'
Maramureș Massif							
8.	Bukovets	1,245	0.20	1.8	71	22-15-6	N47°56,724' E024°17,269'
9.	Pop Ivan	1,701	0.05	0.5	12	8-10	N47°55,970' E024°19,427'
10.	Gropshora	1,380	0.01	0.5	10	5-12	N47°57,354' E024°19,634'

Within wetlands of the alpine zone are described the associations Caricetum (rostratae) purum, Caricetum (rostratae) sphagnosum, Eriophoretum (latifolii) sphagnosum, and Empetretum (nigri) sphagnosum. The paniculate sedge *grouping (Cariceta paniculatae)* is listed in the Green Data Book of Ukraine (Didukh, 2009). Grass-sedge communities are relicts of glacial and interglacial periods, so they are the habitat for a number of rare alpine and arctic-alpine plant species and therefore require comprehensive protection. Here dominate hygrophilous species: *Carex rostrata*, *C. paniculata*, *Eriophorum latifolium*, *E. vaginatum*, and some species of mosses or lichens, particularly the genera *Sphagnum*, *Polytrichum* and others.

Around lakes, in the shore area of wetlands, arboreal and shrub communities have been described: Piceetum (abietis) sphagnosum, Pinetum (mugi) eriophoroso (vaginatae) -sphagnosum, Pinetum (mugi) polytrichosum, Pinetum (mugi) vaccinioso (myrtilli) -polytrichosum, Juniperetum (sibiricae) vaccinioso (myrtilli) -hylocomiosum, Rhododendretum (myrtifolii) sphagnosum. Dominant are *Picea abies*, *Pinus mugo*, *Juniperus sibirica*, and *Duschekia viridis*. Furthermore, among the observed species are: *Rhododendron myrtifolium* Schott and Kotschy, *Loiseleuria procumbens* (L.) Desv. Only here are found phytocoenoses that are very rare in Ukraine, listed in the Green Book of Ukraine (Didukh, 2009): Pineto (mugi) -sphagneta – mountain pine sphagnum, which is typical of mountain wetlands in Western Europe and Sphagneta depressipiceetosa – dwarf spruce – sphagnum.

According to the EUNIS classification of habitats, within these wetlands the following habitats occur: (*Sphagnum magellanicum*) hummocks, (*Eriophorum vaginatum*) quaking bogs, (*Eriophorum-Sphagnum magellanicum*) lawns, (*Carex rostrata*) quaking mires, (*Carex rostrata*) alkaline fens, (*Eriophorum vaginatum*) quaking bogs, beds of large sedge (*Carex*) ssp.

CONCLUSIONS

Highland (alpine) wetlands of CBR play an important role in biogeocoenotic terms, accumulating over a long time a significant amount of moisture during rains and snowmelt. They are centers of rich biological diversity with significant rare species and plant communities. Due to the remoteness of powerful sources of anthropogenic pollution, wetlands of CBR serve as a reference system for the study of the flow of various natural processes without direct human impact. These wetlands are promising for inclusion in the Ramsar convention and meet its criteria: lands located in the Ukrainian Carpathians in foothill areas of the highest mountains in the upper forest belt, subalpine and alpine zones, where streams originate and from a large river network with the density of 2.9 km/km^2, which play an important role in feeding the Tisza River (a tributary of the Danube). 5% of the wetlands are boggy. These are mainly mountain oligotrophic bogs formed during the ice age.

The studied location is the residence of a number of rare plant species and formations.

The site supports a number of populations of species that are important for the biodiversity of the Carpathian biogeographical region. Constant monitoring or at least periodic research of coenotic links of the various components of the biota and hydrochemical parameters of water, creating the possibility of indicating hydrobiocenoses and mountain ecosystems as a whole against the background of the analysis of air pollution and global climate change.

It is worth mentioning that alpine wetlands are located within all the CBR zones – zone of absolute protection, buffer zone and anthropogenic landscapes – mostly in the areas of land use, without exclusion from management, which means for these areas implementation of certain human activities. First of all tourism and grazing under certain circumstances may present a significant threat to these unique natural complexes. Inclusion of the alpine wetlands of CBR to the Ramsar list will not only increase their protected status, but also will introduce here an effective management that will definitely help preserve them for future generations.

An integrated management for all the Carpathian wetlands should obviously include the Ukrainean Carpathian wetland areas (Galvánek et al., 2014), including CBR wetlands.

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THE PONTO-SARMATIC STEPPE HABITAT TYPE 62C0* ON SOUTHERN EXPOSED HILLS OF THE TRANSYLVANIAN TABLELAND (ROMANIA)

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KEYWORDS: Pontic species, steppic habitats, xerothermic vegetation.

ABSTRACT

The priority habitat type 62C0* Ponto-Sarmatic steppes is present in the South-Eastern part of Romania in the Steppic Region, but it is also present on the steep Southern exposed hill slopes of the Transylvanian Tableland. The main distribution area of the habitat type in the tableland is located in the “Câmpia Transilvaniei” region, but it is present as well on the Southern exposed hill slopes of the Mureş and Târnava valleys, reaching near the Southern border of the Transylvanian Tableland. The distribution area corresponds closely with that of the Feathergrass *Stipa lessingiana*, a Pontic flora element which has its most Southern locality in Transylvania near the locality of Şeica Mare (Sibiu County). Although the habitat type is mentioned from the Transylvanian Tableland, it was not included in the declared steppic sites of the area. This is why a revision of the steppic sites and their xerothermic habitat types are needed.

REZUMAT: Tipul de habitat 62C0* Stepe ponto-sarmatice pe pante sudice ale Podişului Transilvaniei (România).

Tipul de habitat prioritar 62C0* este reprezentat în regiunea stepică din sud-estul ţării, dar se găseşte pe suprafeţe mai mici şi pe pante sudice puternic înclinate în Podişul Transilvaniei. Arealul principal al tipului de habitat îl constituie „Câmpia Transilvaniei”, dar este prezent şi pe pante sudice puternic înclinate din Valea Mureşului şi a Târnavelor, ajungând până aproape de limita sudică a Podişului Transilvaniei. Aria de răspândire corespunde în mare parte cu cea a speciei de colilie *Stipa lessingiana*, un element floristic pontic cu punctul cel mai sudic din Transilvania în apropiere de comuna Şeica Mare (Judeţul Sibiu). Cu toate că tipul de habitat este menţionat ca existent în Transilvania nu este citat în siturile stepice de interes comunitar din Podişul Transilvaniei. Datorită acestui fapt o revizuire a siturilor stepice de interes comunitar din Transilvania şi a tipurilor acestora de habitate xeroterme stepice constituie o necesitate.

ZUSAMMENFASSUNG: Der Lebensraumtyp 62C0* Pontisch-Sarmatische Steppe an Süd exponierten Hängen des Siebenbürgischen Hochlandes (Rumänien).

Der prioritäre Lebensraumtyp 62C0* ist vorwiegend in der Steppen-Region im Südosten Rumäniens verbreitet, kommt aber auch an südlich exponierten Steilhängen im Hochland von Siebenbürgen vor. Die Hauptverbreitung des Habitattyps liegt hier in der “Siebenbürgischen Heide”/“Câmpia Transilvaniei”, er kommt jedoch auch auf den Südhängen des Mieresch/Mureş und der Kokeltäler/Târnava Mare vor und reicht bis fast an die Südgrenze des Siebenbürgischen Hochlandes. Sein Verbreitungsareal deckt sich beinahe mit dem des Lessing Federgrases *Stipa lessingiana*, ein pontisches Florenerelement, das in Siebenbürgen seinen südlichsten Verbreitungspunkt nahe der Gemeinde Marktschelken/Şeica Mare Kreis Hermannstadt/Sibiu hat. Obwohl der Lebensraumtyp für Siebenbürgen angegeben ist, wird er in den für das Hochland angeführten Natura 2000 Gebieten mit Steppenvegetation nicht vermerkt. Daher erweist sich eine Revision der Natura 2000 Gebiete mit Steppenvegetation als erforderlich.

INTRODUCTION

The steppic, xerophilous and xero-mesophilous grasslands of the Transylvanian Tableland are known for their rich species, being remarkable from the point of view of a high number of rare pontic, and Eurasian-Continental species of the Eastern Continental steppes and meadow steppes. Due to the establishment of the European Natura 2000 network of sites of community importance, the steppic and in general the xerothermic habitats became an interest of the European Community.

Although the habitat type 62C0* Pontic-Sarmatic steppe habitats is already mentioned in the Interpretation Manual EUR 27 (2007), as existing in the Transylvania area, it is lacking as a habitat type in the listed Natura 2000 steppic sites of the hilly area of the Transylvanian Tableland included in the Annexe no. 4 of the Ordinance of the Romanian Government no. 776/5.05.2007 referring to the declaration of the sites of community importance as an integrated part of the European ecological Natura 2000 network. Mentions of the habitat type in a Natura 2000 site of the Transylvanian Tableland were published later from the Natura 2000 site Sighişoara-Târnava Mare (Oroian, 2009; Oroian et al., 2014).

Phytocoenoses of the habitat type 62C0* edified by *Stipa pulcherrima* and other species of pontic origin are arriving through the Western part of the tableland and the hills along the Mureş River corridor to the area of Târnava Mare and further along the hills of the Visa Valley to the Southern border of the Transylvanian Tableland (Csürös, 1963; Borza and Boșcaiu, 1965; Schneider-Binder, 1975, 1977). To understand the existence of steppic vegetation on a hilly area, it is important to know some details about the Transylvanian Tableland and the site conditions for the occurrence of steppic vegetation.

The Transylvanian Tableland/ “Podișul Transilvaniei” is a hilly area formed from Tertiary deposits in a tectonic depression and has a manifold structured relief. That is why in dependence of slope exposition, inclination and the strongly related insolation results in a small area of a mosaic of various habitat conditions that are closely linked to the substrate composed of marl, sandstone and clay layers and the arised soil conditions.

The Northern part of the tableland, between the Someş rivers i.e. the Someşul Mare in the North and Someşul Mic in the Northern, North-Western and Western part, the Arieş River in South-Western part the Mureş River in the Southern part and the Eastern Transylvanian Depression and pre-mountains area, is named “Câmpia Transilvaniei”/“The Transylvanian Plain” area, although it is a hilly area. From South of the Mureş River to the Olt River, extends the Southern Transylvanian Tableland.

In the Central and Western part of the “Câmpia Transilvaniei” the hills are smaller as in the Eastern part near to the mountains and as well as in the Southern Transylvanian Tableland, (the Târnava Tableland). The mean temperature in the area called “Câmpia” is of 9°C, which is 2-3°C higher than the Eastern and Northern part, where the mean temperature is 6-7°C. The precipitations are between 500 to 600 mm.

The name of a “Plaine” in the first view is in contradiction with the hilly area, but seeing its dominant vegetation which is similar to a steppe with open grasslands, it seems this name was given to the area by the people knowing its steppe characteristics with a particular type of dry grasslands vegetation. The bare hills of the “Câmpia Transilvaniei” as a characteristic landscape element were studied by botanists and highlighted by travelers through the tableland and came from the long time interest of botanists as it demonstrated plant collection proofs from the end of the 18th Century in the collections at the Museum of Natural History of Sibiu/Hermannstadt. In particular the landscape of the slumping hills with the name “Copârşaie” and the “hay meadows near Cluj-Napoca” (“Klausenburger Heuwiesen”) were known from the end of 18th Century and became, through the research of the 19th Century and the beginning of the 20th Century, a classic site for steppic vegetation in Transylvania area (Borza, 1930; Csürös, 1978).

In the middle of the 19th Century the English traveler and journalist Charles Boner visited Transylvania (Boner, 1868) and described the area of "Câmpia Transilvaniei" as "... a stretch of the country, characterised through its nude, bare and waste appearance, which presents a high contrast to the other regions". This part of the country name means "land with open grasslands".

The occurrence of this habitat type is concentrated in the area of the Northern/ North-Western part of the Transylvanian Tableland, the so called "Câmpia Transilvaniei" and the dry parts of the Southern Transylvanian Tableland – the "Podişul Târnavelor". The distribution of communities included in this habitat type follows the approximate distribution limit of the Feathergrass species *Stipa lessingiana*, respectively the alliance Stipion lessingianae (Niedermaier, 1970, 1983; Schneider-Binder, 1977, 2013), which coincides with the delineation of the sylvo-steppe level as it is given by Csürös (1963). According to Paşchovschi and Doniţă (1967) the area is a sylvo-steppe conditioned by geomorphology and soil structure, the limits being in the Southern part less outspread as the sylvo-steppe level according to Csürös (1963). In all cases the habitat type 62C0* covers a small area on the front of Southern exposed hills, these being closely interlocked with the habitat types 6210 and 6240.

MATERIAL AND METHODS

The Southern part of the distribution area of the habitat type 62C0* Ponto-Sarmatic steppes has been studied by phytocoenological sampling according to the method of Braun-Blanquet (1964) of the vegetation along ecological gradients from the top to the foot of chosen hills near to the localities of Micăsasa, in the Târnava Valley, Axente Sever/Frauendorf, and Agârbiciu/Arbegen. The steepest components, which are a part of the Southern exposed slopes, were given special attention as they shelter the most characteristic steppe species of the Ponto-Sarmatic habitat type 62C0*. Samples from earlier studies (Schneider-Binder, 1975, 1977) are compared with newer samples from the area (2009), in particular with those from Şeica Mare, the most Southern locality of occurrence in Transylvania for the species *Stipa lessingiana*. The samples are also compared with those of other area of the Transylvanian Tableland (Schneider-Binder, 1977). Furthermore analysed are the different plant communities included in the habitat type 62C0* Ponto-Sarmatic steppes from the point of view of their characteristic species and abundance-dominance values. The succession of different phytocoenoses from the top of the hill to the open upper stretch of the slope is shown in a synthetic table using frequency values.

RESULTS AND DISCUSSION

On the studied Southern exposed slopes of the Transylvanian Tableland area, including those of slopes of the Târnava Mare Valley and Visa Valley, the communities are disposed from the top to the foot of the hills along ecological gradients and includes a large range of species from xerophilous, xero-mesophilous, to mesophilous and meso-hygrophilous species. The same structure and disposition of the phytocoenoses along ecological gradients has been stated in the area of "Câmpia Transilvaniei" including the "Copârşaie" and "Hay meadows" near Cluj-Napoca.

Thermophilous oak forests with *Quercus pubescens*, including sometimes also Flower Ash (*Fraxinus ornus*) on the upper edge of the slopes (in the Southern Transylvanian Tableland) are followed by xero-termophilopus scrub communities edified by Small almond bush (*Amygdalus *nana*) (habitat type 40A0* Subcontinental peri-Pannonic scrub) (Schneider-Binder, in printing) and locally also by Dwarf sherry (*Cerasus fruticosa*). They are succeeded by a tall herbaceous fringe mostly edified by the continental and quite rare Felty Goldilock Aster (*Aster oleifolius* = *A. villosus*), *Peucedanum tauricum*, *Silene bupleuroides* and other Eastern steppe elements (Tab. 1). Frequently the tall herbaceous fringes are edified also by *Peucedanum cervaria*, *Peucedanum oreoselinum*, *Dictamnus albus* and other thermophilous species of the Origanietalia order and the Geranion sanguinei alliance. But as the most characteristic fringe community in relation with the Pontic-Sarmatic steppe habitat appears in the Southern Transylvanian Tableland, as we observed, that is edified by *Aster oleifolius* (= *villosus*) and *Peucedanum tauricum*. (Tab. 1, column 2, Fig. 1). On the steep slopes, due to inclination and insolation of the substrate, high temperatures are developed, and the tall herbaceous fringe of Goldilocks Aster is strongly interlocked with the open Feathergrass steppe areas.

Figure 1: Edaphic conditioned steppe habitat
on a Southern exposed hillside
in the Buia-Valley near to Şeica-Mare.

Table 1: Synthetic table of plant communities of the upper part of a Southern exposed hill side near Şeica Mare: Small Almond scrub – Amygdaletum nanae (1), fringe of *Aster oleifoliuss*, Feathergrass steppe association *Stipetum pulcherrimae* and ass. of *Agropyron cristatum*.

	Number of columns	1	2	3	4
	Number of samples	1	5	5	5
	Frequency		F	F	
Associations (framed) and Stipion lessingianae					
	Amygdalus nana	**4**	II	–	–
	Aster oleifolius (= villosus)	+	**V**	II	V
	Peucedanum tauricum	+	IV	I	II
	Stipa pulcherrima	.	IV	**V**	III
	Stipa lessingiana	.	–	II	–
	Salvia nutans	.	II	V	III
	Onosma pseudoarenaria	.	III	V	II
	Hypericum elegans	.	II	IV	I
	Salvia transsilvanica	.	I	IV	–
	Vinca herbacea	+	III	III	–
	Cephalaria uralensis	.	III	III	I
	Brassica elongata	.	I	II	III
	Allium denudatum	–	II	I	–
	Scorzonera hispanica	.	I	**–**	III
	Serratula radiata	.	–	I	–
Differential species Stipetum pulcherrimae					
	Carex humilis	+	III	V	IV
	Leontodon asper	.	–	V	–
	Astragalus monspessulanus	.	I	V	–
	Teucrium montanum	.	I	IV	–
	Astragalus austriacus	.	II	V	I
Agropyro-Kochion					
	Agropyron cristatum	–	I	–	**V**
Cirsio-Brachypodion					
	Brachypodium pinnatum	1		II	
	Thesium linophyllon	.	I	I	I
	Dorycnium herbaceum	.	II	V	–
	Fragaria viridis	+	I	II	II
Festucion vallesiacae-Festucetalia					
	Festuca valesiaca	.	III	IV	II
	Verbascum phoeniceum	.	III	IV	III
	Centaurea micranthos	.	IV	V	IV
	Campanula sibirica	.	III	III	–
	Stipa capillata	.	III	I	I
	Salvia austriaca	.	I	II	I
	Adonis vernalis	+	IV	I	I
	Euphorbia seguieriana	+	III	V	I
	Thymus pannonicus	.	II	IV	–
	Iris pumila	.	IV	II	II

Table 1 (continued): Synthetic table of plant communities.

	Stachys recta	.	I	IV	II
	Allium flavum	.	IV	II	I
	Cytisus austriacus	.	IV	III	–
	Inula ensifolia	.		II	–
	Jurinea mollis	.	IV	IV	II
	Kengia (= Diplachne) serotina	+	IV	IV	–
	Onobrychis arenaria	.	I	IV	–
	Achillea setacea	.	III	II	II
	Scorzonera austriaca	.	I	.	II
	Aster amellus	.	II	–	I
	Pulsatilla montana	.	I		
Festuco-Brometea					
	Teucrium chamaedrys	+	V	IV	V
	Eryngium campestre	+	IV	V	II
	Euphorbia cyparissias	+	IV	III	IV
	Falcaria sioides	+	IV	II	III
	Astragalus onobrychis	.	I	III	III
	Koeleria macrantha	.	II	IV	II
	Aster linosyris	.	III	I	I
	Potentilla arenaria	.	III	V	
	Botriochloa ischaemum	.	III	IV	
	Medicago falcata	+	III	II	
	Poa angustifolia	.	III	IV	
	Bupleurum falcatum	.	I	IV	
	Artemisia campestris	.	II	IV	
	Tragopogon dubius	+	II	IV	
	Asperula cynanchica	.	II	II	
	Phleum phleoides	.	I	II	
	Veronica spicata	.	II	I	
	Salvia pratensis	.	II	I	
	Melica ciliata	.	I	II	
	Linaria genistifolia	.	–	IV	
	Chondrilla juncea	.	–	II	
	Hypericum perforatum	.	I	–	
	Muscari comosum	.	I		
	Senecio jacobaea	.		I	
Trifolio-Geranietea, Origanietalia					
	Clinopodium vulgare	+	I	I	
	Viola hirta	.	I	III	IV
	Coronilla varia	.	II	I	
	Dictamnus albus	.		II	
	Cytisus nigricans	.		I	
	Origanum vulgare	.		I	
	Agrimonia eupatoria	.	.	II	

Table 1 (continued): Synthetic table of plant communities.

Other species					
	Elymus hispidus	.	V	I	II
	Asparagus officinalis	.	I	I	II
	Echinops ritro ssp. *ruthenicus*	.	III	–	I
	Acinos arvensis	.	I	II	
	Isatis tinctoria	.	I	.	I
	Robinia pseudoacacia	.	I	II	
	Rhamnus tinctoria	.	I	.	
	Ligustrum vulgare	1	III	II	
	Prunus spinosa	1	I	I	
	Pyrus pyraster	.	–	II	
	Fraxinus ornus	+	III	–	
	Viburnum lantana	+	II	–	
	Crataegus monogyna	+	I	–	
	Rosa spinosissima	+	I	–	

These steepest front parts of the slopes are covered with typical feather grass steppes edified prevalent by *Stipa lessingiana* and/or *S. pulcherrima*, *Salvia nutans, Cephalaria uralensis, Hypericum elegans, Astragalus dasyanthus, Vinca herbacea, Crambe tataria, Jurinea mollis Salvia transsilvanica,* and *J. simonkaiana, Peucedanum tauricum, Ajuga laxmanni, Centaurea trinervia* (this last only in the “Câmpia Transilvaniei”), and others. On many areas in Southern Transylvania *Stipa lessingiana* is replaced by *Stipa pulcherrima* (Schneider-Binder, 1977, 2013). A similar vegetation structure and species composition is described from the Eastern European Pontic steppes, for example from the Derkulian steppe in the Donez Basin with the edifying species of Feathergrasses (*Stipa lessingiana* and *Stipa rubentiformis*) and *Salvia nutans* (Lawrenko in Walter, 1974).

On the hills of the “Copârşaie” – slumping hill areas near Cluj-Napoca were measured on Southern exposed slopes already in the first third of the 20th century close to the soil surface temperatures of 52°C (Bujoreanu, 1933). In the same time on the Northern exposed slopes, the temperature has been only 27°C on the soil. Even the high temperature values on Southern exposed slopes explain – according to Borza and Boşcaiu (1965) – the survival of steppic vegetation in the midst of a forest area. Temperature measures were realized as well on Southern exposed slopes of the Southern Transylvanian Tableland in the area of Şerbuţa Valley between Şura-Mare and Slimnic localities. During the month of May, 50°C has been registered on the upper part of the slope profile (Schneider, 1990).

Such types of ecological gradients with a characteristic succession of vegetation along the upper part of the hills have been observed in the Târnava Mare Valley near to Micăsasa, the Visa Valley near the villages Axente Sever/Frauendorf and Agârbiciu/Arbegen on the top of the hills above the former vignards, near Şeica Mare/Marktschelken and the most Southern locality at Slimnic/Stolzenburg (Schneider-Binder, 1977, 2009).

Wider spread as the habitat type 62C0* of Ponto-Sarmatic steppes are xero-thermophilous and xero-mesophilous grasslands of Festucion vallesiacae and Cirsio-Brachypodion alliances, covering a large area in the Transylvanian Tableland. They are localized in the middle and lower part of the slopes, where in comparison with the front part, the insolation and related temperature is less extreme. They are localized on Southern, South-Western and South-Eastern, but also sometime on Western and Eastern exposed slopes.

As mentioned before between Northern and Southern exposed slopes are major differences of temperature and related to this fact also differences in the composition of vegetation. This can be observed in the "Câmpia" and as well in the Southern Transylvanian Tableland. But a good example for the differences between Southern and Northern exposition are the small slumping hills that are between Noiştat and Movile, Păucea, Motiş (Sibiu County), Apold, Saschiz (Mureş County), Buneşti (Braşov County), Alecuş (Alba County). On a very small area, dry grasslands can be observed and edified by *Stipa pulcherima* and *Stipa capillata* with species such as *Jurinea mollis*, *Salvia nutans*, *Brassica elongate*, and on the Northern part tall herbaceous phytocoenoses can be found and edified by *Laserpitium latifolium* and *Clematis recta*, taking part of the association Clematido recti-Laserpitietum latifolii (Schneider-Binder, 1984). At Apold, this can be seen on the top of the hills in a similar way as the "Copârşaie" hills near Cluj-Napoca phytocoenoses of *Artemisia pontica* (Schneider-Binder, 1996, 2007).

The habitat 62C0* is represented by plant communities of the alliances Stipion lessingianae, Artemisio-Kochion, Festucion valesiacae and Pimpinello-Thymion zygoidi (EUR 27, 2007; EUR 28, 2013; Gafta and Montford, 2008). The last Pimpinello-Thymion zygoidi is lacking in Transylvania, but is well represented in Dobrogea. Included in the habitat type 62C0* are the following associations: Carici humilis-Stipetum joannis Pop and Hodişan 1985, Stipetum lessingianae Soó (1927 n.n.) 1947, Stipetum pulcherrimae Soó 1942, Stipetum stenophyllae Soó 1944, Danthonio-Stipetum stenophyllae Ghişa 1941, Chrysopogono-Caricetum humilis Zolyomi (1950) 1958, Artemisio austriacae-Poëtum bulbosae Pop 1970, Artemisietum ponticae (Borza n.n.) Păun (1966, 1974), Cynodonto-Poëtum angustifoliae (Rapaics 1926) Soó 1957, Salvio nutantis-Paeonietum tenuifoliae Mititelu 1990, Agropyro-Kochietum prostratae Zólyomi (1957) 1958, Agropyretum pectiniformis (Prodan 1939) Dihoru 1970, Elytrigietum hispidi (Dihoru, 1970) Popescu and Sanda 1988 (Oroian, 2009; Doniţă et al., 2005; Gafta and Montford, 2008).

Strongly related to these communities are the bush formations of the habitat type 40A0 Peripannonic shrubs with Small almond (*Amygdalus nana*) and European dwarf cherry (*Cerasus fruticosa*) and as well xerothermic tall herbaceous vegetation edified by *Aster villosus* (Fig. 2) and *Peucedanum tauricum*.

Although the habitat type Ponto-Sarmatic steppe exists according to older and newer researches in some of the declared Natura 2000 sites with steppic vegetation of the Transylvanian Tableland, it is not listed as existing in the different declared sites of community interest. In general it exists only in a few sites with steppic, respectively with xerothermic habitat types. These are the area of "Coasta Lunii" near Câmpia Turzii, the Hay-meadows and "Copârşaie" landscape near Cluj-Napoca, the meadows of "Dealul Corhan-Săbed", the area of "Suatu-Ghiriş", in which the endemic species occurs *Astragalus péterfii* Jáv., the slope "Râpa Lechinţa" on the Northern border of the "Câmpia" area, the steppic islets near Slimnic and the slumping hills of Păucea.

All in all there are mentioned mostly the habitat-types 6240 and 6210, although the steppic habitats of the Hay-meadows-Copârşaie near Cluj-Napoca represents a classic site for small patches of natural steppic vegetation (Borza, 1930). As well for the Natura 2000 site, "Steppic islets near Slimnic" are known as the steppic associations with pontic species (Schneider-Binder, 1977), but this is not mentioned in the site description. The study of the vegetation of the Natura 2000 site "Sighişoara-Târnava Mare" mentions the habitat type 62C0* including characteristic associations (Oroian, 2009; Oroian et al., 2014). But the interlocking of the habitat type with the habitat types 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festucetalia-

Brometalia) and 6240* Sub-pannonic steppic grasslands makes a delineation sometimes difficult.

This is why more detailed studies are needed to be taken into account, that the Ponto-Sarmatic habitat type is limited to the most dry parts of the Southern exposed hill slopes, the corresponding site conditions of this edaphic, and microclimatic conditioned steppe is only on the steepest front parts of the upper part of the slope.

Figure 2: The Felty Goldilack Aster (*Aster oleifolius* = *A. villosus*) is characteristic for the tall herbaceous fringe situated between the Small almond scrub and the open steppic grassland with feathergrass. Summer aspect between Axente Sever and Agârbiciu hillsides of the Visa Valley. (Foto Schneider Eckbert).

CONCLUSIONS

Studying the Southern exposed hillsides of the Transylvanian Tableland, there many interferences of different xero-thermic plant communities occurring due to the special geo-morphological and soil conditions. This makes it difficult to delineate the habitat types in dry site conditions. But a differentiation is given through studies along slope profiles, taking into account that the Ponto-Sarmatic steppe habitat is located on the steepest upper front parts of the slopes. In these parts the site conditions for its occurrence are given by the combination of the geo-morphological structure, the substrate (marl and sandstone), the exposition and high inclination, which altogether assure on these slopes a microclimate with the highest warming as basic conditions for the existence and conservation of the steppe habitats in the Transylvanian Tableland.

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TOTAL PHENOLICS CONTENT OF ROMANIAN PROPOLIS AND BEE POLLEN

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KEYWORDS: total phenolics, propolis, bee pollen.

ABSTRACT

Total phenolics content of bee products was shown to be directly dependent to antioxidant activity, thus subjecting many scientific papers. Due to biodiversity, a great variability of results were observed between regions, countries, and continents. The aim of our study was to assess the total phenolics content of propolis and bee pollen from certain Romanian areas in order to provide a geo-referencing tool for further epidemiological evaluation.

Measurements were carried out using the Folin-Ciocalteu assay and revealed the following results: 971 ± 79.6 mg GAE/100 g propolis, 493.4 ± 88.7 mg GAE/100 g bee pollen respectively. Between phenolics content of raw and dry pollen there was a difference in favor of raw pollen samples, but without statistical significance. The highest values of total phenolics (> 1,000 mg GAE/100 g) were found in propolis originating from Sebeş, Jibert, Şoarş, and Ticuşu, which are areas with low anthropogenic activity.

REZUMAT: Conţinutul în fenoli totali al propolisului şi polenului de albine românesc.

Conţinutul în fenoli totali al produselor apicole s-a dovedit a fi în directă dependenţă cu activitatea lor antioxidantă, fiind subiectul multor lucrări ştiinţifice. Datorită biodiversităţii, a fost observată o mare variabilitate a rezultatelor între regiuni, ţări şi continente. Scopul studiului nostru a fost de a evalua conţinutul în fenoli totali al propolisului şi al polenului de albine din anumite zone din România, cu scopul de a oferi un instrument de georeferinţă pentru viitoare evaluări epidemiologice.

Măsurătorile au fost efectuate utilizând metoda Folin-Ciocalteu şi au relevat următoarele rezultate: 971 ± 79,6 mg GAE/100 g propolis, respectiv 493,4 ± 88,7 mg GAE/100 g polen de albine. Între conţinutul fenolic al polenului crud şi uscat a existat o diferenţă în favoarea probelor de polen crud, dar fără semnificaţie statistică. Cele mai mari valori ale fenolilor totali (> 1.000 mg GAE/100 g) s-au înregistrat la propolisul din Sebeş, Jibert, Şoarş şi Ticuşu, zone cu activitate antropică scăzută.

ZUSAMMENFASSUNG: Der Gehalt an Gesamtphenolen des Propolis und Blütenpollens von Bienen in Rumänien.

Infolge von Untersuchungen wird deutlich, dass der Gehalt an Gesamtphenolen in Bienenprodukten in direkter Beziehung zu ihrer antioxydativen Tätigkeit steht und den Gegenstand vieler wissenschaftlicher Untersuchungen bildet. Dank der Biodiversität, wurde eine hohe Variabilität der Ergebnisse zwischen Regionen, Ländern und Kontinenten festgestellt. Ziel dieser Studie war es, den Gesamtphenolgehalt von Propolis und Blütenpollen aus bestimmten Gebieten Rumäniens zu bewerten, um für künftige epidemiologische Auswertungen ein Instrument der Georeferenzierung anzubieten.

Die Messungen wurden mit Hilfe des Folin-Ciocalteu-Verfahrens durchgeführt und brachten folgende Ergebnisse: 971 ± 79.6 mg GAE/100 g Propolis, beziehungsweise 493,4 ± 88,7 mg GAE/100 g Blütenpollen. Zwischen dem Phenolgehalt von Roh- und Trocken-Pollen ergab sich ein Unterschied zugunsten der Rohpollenproben, jedoch ohne statistische Signifikanz. Die höchsten Werte an Gesamtphenolen (> 1.000 mg GAE/100 g) wurde in den Propolis-Proben von Sebeş, Jibert, Şoarş und Ticuşu, in Gebieten mit geringer anthropogener Tätigkeit festgestellt.

INTRODUCTION

The chemical profile of "poplar" propolis, typical for the temperate zone, can be characterized by the following parameters: total flavone and flavonol content, total flavanone and dihydroflavonol content, and total phenolics content (Bankova, 2005) which are also one of the most critical ingredients related to antioxidant activity in bee pollen, depending on its botanical and geographical origin (Aličić et al., 2014). Many scientific and research papers have subjected the composition and antioxidant capacity of these bee products over the past decade in order to develop potent medicines with anti-oxidant, anti-inflammatory, antimicrobial, healing, or local anesthetic properties. In this respect, our National Medicines Agency has approved the propolis tincture (30%) and suppositories with propolis (Miprosept) as over-the-counter medicines. According to Sahin et al. (2010), phenolic derivatives from honey, propolis and bee pollen might serve to identify lead compounds, targeting the physiologically relevant metalloenzyme carbonic anhydrase.

Due to the biodiversity variability, correlation between the floral origin of honeys and the physical and biochemical properties, respectively, was observed (Cimpoiu et al., 2012; Dobre et al., 2010). Similarly, the composition of propolis varies significantly according to the species of bee, geographic origin, and also to the month of collection (Frankland et al., 2009), as well as to the solvent used in extraction process – higher content of active substances was obtained when ethanol was used (Ramanauskienė et al., 2013). Therefore, polyphenolic profile (phenolic acids and flavonoids) of honey could be used as a complementary method for authenticity determination together with pollen analysis and other physico-chemical analysis (Mărghitaş et al., 2010).

The goal of this specific study was to assess the total phenolics content of propolis and bee pollen from certain Romanian areas (southern/southeastern Transylvania) as a geo-referencing tool for further databases.

MATERIAL AND METHODS

Samples and chemical reagents

The raw propolis samples (n = 10) were collected from ten localities of Brașov County, while the bee pollen samples (n = 9) were collected from five localities of Sibiu County, as shown in tables 1 and 2, and figures 1a and 1b. Two types of heterofloral bee pollen were used, respectively raw and dry pollen (drying was carried out at a constant temperature of 45°C, to reduce the moisture content to 8%).

Chemical reagents of analytical grade without further purification were used.

Table 1: Characterization of propolis samples.

No. of sample	Sample origin	Mass (g)	Solvent volume (ml)
1	Sâmbăta de Sus	2.05	20
2	Hurez	2.03	20
3	Cincu	2.02	20
4	Sebeş	2.03	20
5	Viştea	2.01	20
6	Jibert	2.00	20
7	Părău	2.05	20
8	Şoarş	2.03	20
9	Victoria	2.05	20
10	Ticuşu	2.02	20

Table 2: Characterization of bee pollen samples.

No. of sample	Sample origin	Type of pollen	Mass (g)	Solvent volume (ml)
1	Cisnădie	Dry	2.32	20
2	Sălişte	Dry	2.25	20
3	Glâmboaca	Dry	2.00	20
4	Cisnădie	Dry	2.10	20
5	Nucet	Dry	2.18	20
6	Cisnădie	Raw	2.02	20
7	Sălişte	Raw	2.05	20
8	Dobârca	Raw	2.06	20
9	Cisnădie	Raw	2.15	20

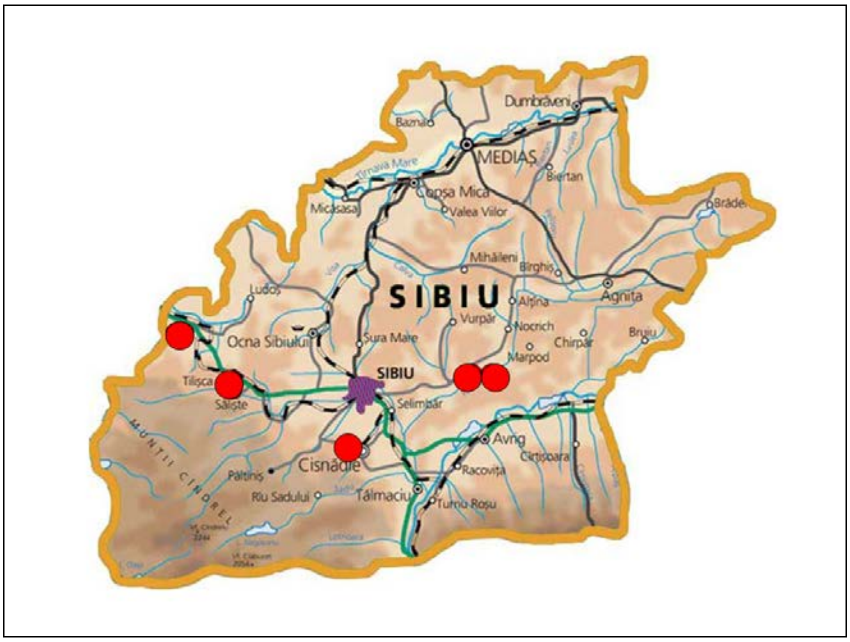

Figure 1a: Geographic origin (Sibiu County) of propolis and pollen samples.

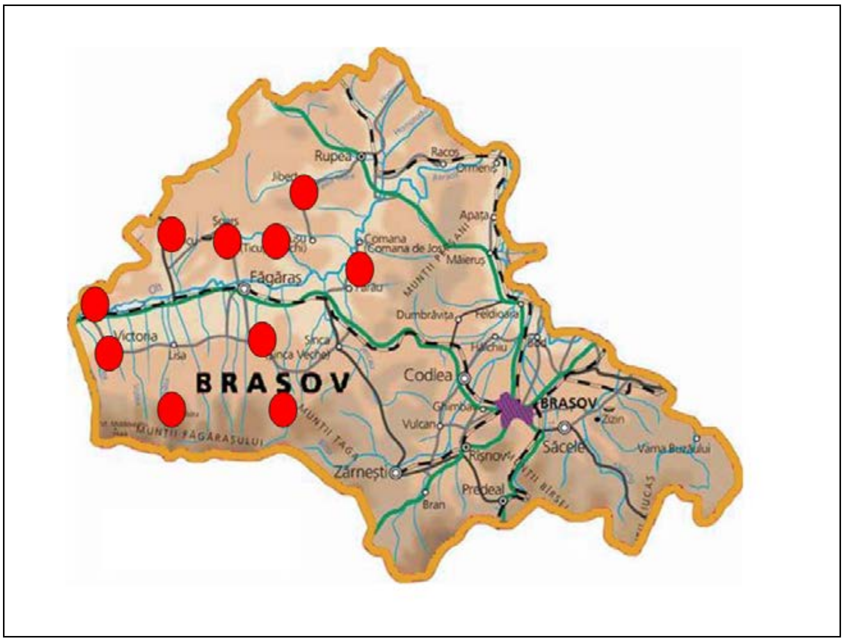

Figure 1b: Geographic origin (Braşov County) of propolis and pollen samples.

Extraction and assay of total phenolics

In this study phenolics were extracted from propolis and pollen samples with 95% (V/V) methanol, 90 minutes at room temperature.

The total phenolics content in each extract was determined according to the Folin-Ciocalteu method (Singleton and Rossi, 1965) using SPECORD 200 PLUS spectro-photometer (Analytik Jena, Germany). Gallic acid was used as standard for the calibration curve.

Total phenolics were expressed in milligram of gallic acid equivalents per 100 g dry mass (mg GAE/100 g DM).

Statistical processing was performed using Mann-Whitney Test to compare total phenolics content in raw and dry pollen samples, at a probability of 0.886.

RESULTS AND DISCUSSION

The total phenolics content of propolis and bee pollen samples from certain Romanian areas has been evaluated in the present study. The applied analytical techniques are based on the Folin-Ciocalteu assay. The Folin-Ciocalteu method represents an in vitro rapid and low-cost assay used for quantitative spectro-photometric analysis of (poly)phenols. The colorimetric reaction between such compounds and the redox reagent of Folin-Ciocalteu (mixture of phosphomolybdate and phosphotungstate) generates a blue chromophore in alkaline solution, which absorbs at 745 nm. The content of total phenolics of the extracts was evaluated by using gallic acid as a standard material, and expressed as mg of gallic acid equivalents mg GAE/100 g product dry mass.

The highest values of total phenolics (> 1,000 mg GAE/100 g) were found in propolis originating from Sebeş, Jibert, Şoarş, and Ticuşu, which are areas with low anthropogenic activity (Fig. 2). The mean value of total phenolics measured in pollen samples (493.4 ± 88.7 mg GAE/100 g) was significantly lower compared to propolis content (971 ± 79.6 mg GAE/100 g), as illustrated in figure 3. Raw pollen was slight more abundant in total phenolics than dry pollen, but the difference is not statistically significant (Fig. 4).

The range of total phenolics content found in propolis is reported to be within 31-299 mg GAE/g of ethanolic extract (Cottica et al., 2011), but the bulk of results are difficult to compare, since worldwide authors used various solvents, various extraction conditions, and samples from different places which have different concentrations of polyphenols (Silva et al., 2012). It has been reported a great variability between European and Brasilian propolis, respectively Italian and Russian propolis have similar polyphenolic composition, while Brasilian propolis shows lower polyphenolic and antioxidant characteristics (Fabris et al., 2013). By polarographic approach, Serbian propolis ranges from 5.31 ± 0.05% g to 1.45 ± 0.02% g of total phenolics content (Potkonjak et al., 2012).

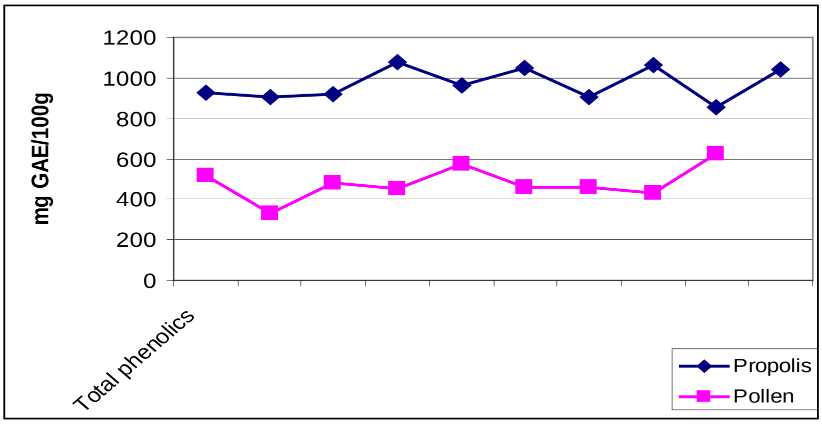

Figure 2: Total phenolics distribution (mg GAE/100 g) of the analyzed samples.

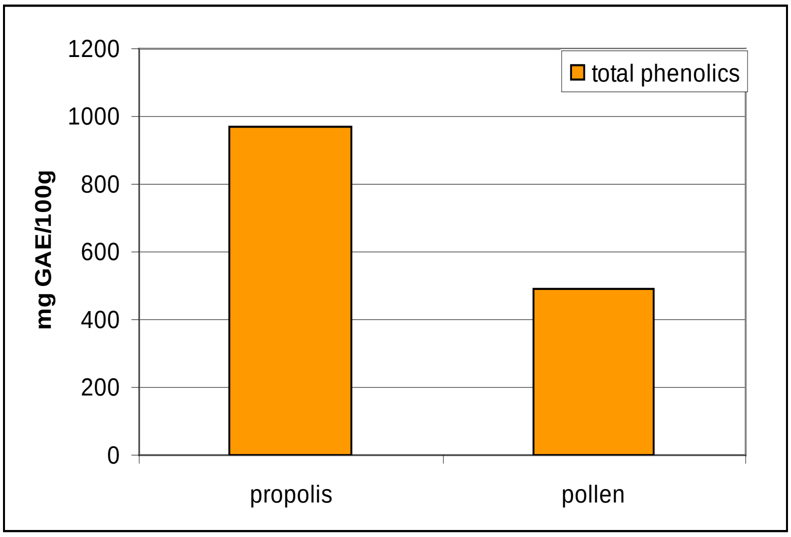

Figure 3: Mean value of total phenolics content (mg GAE/100 g) of propolis and pollen.

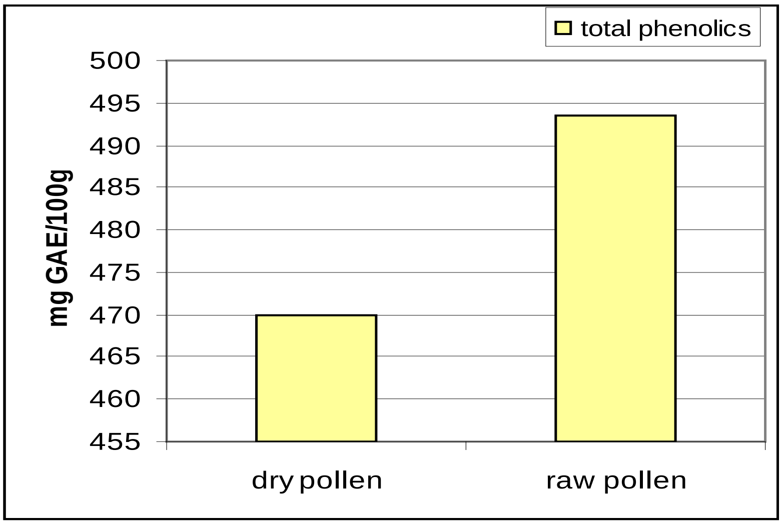

Figure 4: Mean value of total phenolics content (mg GAE/100 g) of dry and raw pollen.

Romanian propolis presents the typical composition of poplar propolis found in temperate zones, with a content of 29 ± 7% total phenolics (9 ± 4% total flavonoids and 20 ± 7% phenolic acids) (Stan et al., 2011; Mihai et al., 2009), and meets the quality control and chemical composition criteria as a high quality product, suitable for human consumption and in medicinal formulations uses (Mărghitaş et al., 2013).

In terms of the total phenolics content of bee pollen, other researchers found comparable results, respectively 23.56 mg GAE/g pollen in average (Prelipcean, 2012), or variations between 20.48 (mixture of bee pollen from *Malus domestica* and *Rubus idaeus*) and 10.08 mg GAE/g bee pollen from *Rosa canina* (Stanciu et al., 2008). Speaking about botanical origin, the highest and the lowest levels of total phenolics were found in pollens from *Pyrus communis* and *Zea mays*, respectively (Leja et al., 2007). Using different ethanolic extracts, Carpes found the content of total phenolics ranged from 30.5 to 48.7 mg GAE/g in bee pollen, respectively from 3.6 to 8.1 and 6.6 to 10.9 mg GAE/g, being solvent-dependent (Carpes et al., 2013; Carpes et al., 2007).

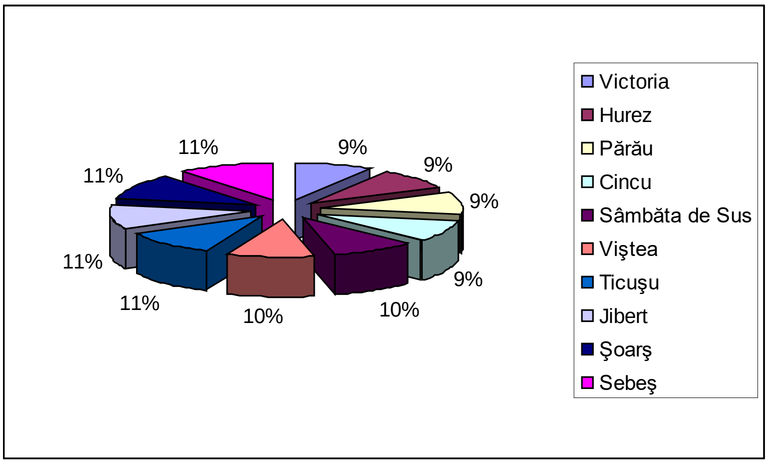

Figure 5: Total phenolics content (%) of propolis, by origin (ascending order).

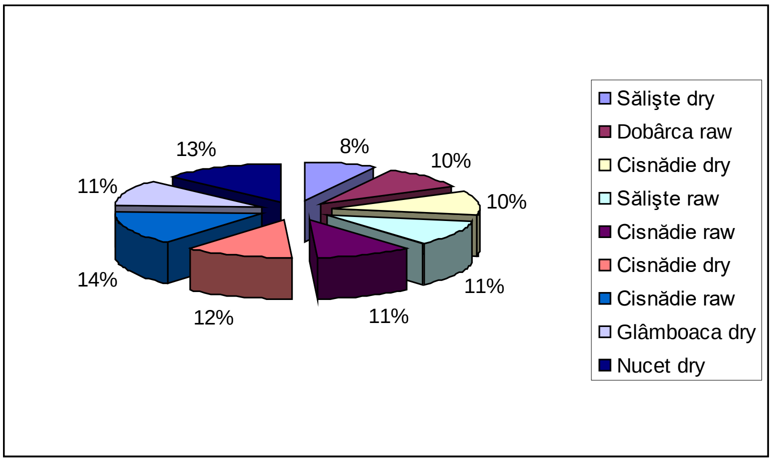

Figure 6: Total phenolics content (%) of pollen, by origin (ascending order).

Results from Kruskal-Wallis One Way Analysis of Variance for nine cases indicate no significant diferences between total phenolics content in raw and dry pollen samples (at Probability = 0.886 and Chi-square approximation = 0.020 with 1 df), meaning that dry pollen is qualitatively comparable to raw pollen if preserved under appropriate conditions. The highest content was registered in a raw pollen sample originated from Cisnădie, respectively in dry pollen sample originated from Nucet.

It seems to be a good relationship between total phenolics content of all analyzed samples and areas with low anthropogenic activity, as is sugestively illustrated in figures 5 and 6. Therefore, further research is needed because Romanian bee keeping has a long tradition in high quality products as trademarks.

The measurement of total phenolics content through Folin-Ciocalteu assay proves to be important in numerous food issues, being useful and rapid for evaluating propolis and pollen samples as potent antioxidant bee products.

CONCLUSIONS

Propolis originating from areas with low anthropogenic activity located in Braşov County provided the highest values of total phenolics, while raw pollen samples from Sibiu County were slightly more abundant in total phenolics than dry pollen.

Once more, these raw bee products (propolis especially) have proved to be a valuable source of natural antioxidants correlated with the geographical origin and with the solvent used during extraction conditions.

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THE ANALYSIS OF ADVENTIVE PLANTS INTEGRATED INTO THE ROMANIAN NATIVE VEGETATIVE COMMUNITIES

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KEYWORDS: adventive plants, categories, bioforms, origin, habitats, associations, Romania.

ABSTRACT

Among all of the adventive plants discovered on the Romanian territory, 157 species have been mentioned as integrated in the phytocenosis associations in the natural environments. The selected plants have been classified in two categories: akoisiochorophytes (89 species) and ergasiophygophytes (68 species). The adventive plants have been analyzed from taxonomic, ecological, and phytogeographical points of view. Therefore, they are distributed in 44 families, five bioforms, 14 habitats and 10 originating zones (most of them in North America, the Mediterranean Subregion and Asia).

The analyzed adventive plants are integrated into the phytocenoses of 204 associations which are divided into 21 vegetation classes.

REZUMAT: Analiza plantelor adventive din România integrate în comunităţile vegetale autohtone.

Din totalul plantelor adventive descoperite pe teritoriul României, 157 specii au fost menționate ca fiind integrate în fitocenoze ale asociațiilor mediului natural. Plantele selectate au fost clasificate în două categorii: acoisiocorofite (89 specii) și ergasiofigofite (68 specii). Plantele adventive au fost analizate din punct de vedere taxonomic, ecologic și fitogeografic. Ele sunt distribuite în 44 familii, cinci categorii de bioforme, 14 habitate și 10 zone de origine (majoritatea fiind din America de Nord, din subregiunea Mediteraneană și din Asia).

Plantele adventive analizate sunt integrate în fitocenozele unui număr de 204 asociații distribuite în 21 clase de vegetație.

RESUMEN: Análisis de plantas adventicias integradas a las comunidades vegetales en Rumania.

De entre todas las plantas adventicias descubiertas en territorio rumano, 157 se han mencionado como elementos integrados a las asociaciones de la fitocenosis en los ambientes naturales. Estas plantas se han catalogado en dos categorías: akoisiochorophytas (89 especies) y ergasiophygophytas (68 especies). Las plantas adventicias han sido analizadas desde el punto de vista taxonómico, ecológico y fitogeográfico. Los resultados indican que estas plantas pertenecen a 44 familias, cinco bioformas, 14 hábitats y 10 zonas de origen (muchas de ellas provienen de Norte América, subregión mediterránea y Asia).

Las plantas adventicias analizadas ya están integradas a una fitocenosis de 204 asociaciones, divididas en 21 clases vegetales.

INTRODUCTION

Humans have been agents of plant dissemination, since pre-history. As passive agents of dissemination humans have accidentally introduced the seeds of weeds from all over the world along with food products that have been imported on land roads, as well as on waterways. It is no accident though, that adventive plants-weeds, are frequently found in harbours and in the proximity of railway stations, from where they migrate to be integrated in ruderal communities. Adventive plants that are involuntarily proliferated by humans are called *akoysiochorophyta* (Greek *akoysios* = involuntary, *choros* = spreading, *phyton* = plant).

Humans have contributed as active agents to the expansion of cultivated plants (*ergasiophyta*), which they maintained as foods, fodder, medicine, ornaments, etc. Some *ergasiophytae* manage to escape cultures by way of passive dissemination (allochor), favored by external factors (wind, water, animals, etc.). In an initial stage, such escaped plants usually occupy empty grounds near the cultures where they gradually adapt to their new environment.

In the next stage, some of the escaped plants manage to integrate themselves in the phytocoenoses of the associations in the environment, competing with the component plants. Others disappear after some time, leaving no viable offspring. Plants that have escaped and become integrated in the environment we consider fully naturalized and assimilated; they are now part of the category *ergasiophygophyta*.

MATERIAL AND METHODS

Two categories are therefore the case among adventive plants: *ergasiophygophyta* and *akoysiochorophyta*. Let us mention that the present study, which was completed in 2012, has added 31 adventive species that were considered integrated in the (respective) vegetal communities, taken from the new bibliographic information Adventive Plants in Romania's Flora/Plantele adventive în Flora României (Sârbu and Oprea, 2011).

The taxonomic/floristic nomenclature employed is that which can be found in the works: The Flora of the People's Republic and the Socialist Republic of Romania (Orig: Flora R. P. Române and R. S. România, 1952-1976); The ecological and phyto-coenological features of the spontaneous species in Romania's flora (Original title: Caracterizarea ecologică şi fitocenologică a speciilor spontane din flora României, 1983) by Sanda V., Popescu A., Doltu I. and in The Adventive Plants in Romania's Flora (Original title: Plantele adventive din flora României, 2011) by Sârbu C. and Oprea A.

The coeno-taxonomic nomenclature of the associations is assumed from E. Oberdorfer's Pflanzensoziologie (1977). The Coeno-taxonomy and Description of the Vegetal Groupings in Romania by Sanda V., Popescu A., Barabaş N. (Cenotaxonomia şi caracterizarea grupărilor vegetale din România, 1997), and from The Adventive Plants in Romania's Flora by Sârbu C. and Oprea A. (Plantele adventive în flora României, 2011).

Abbreviations

Categories of adventive plants: Ac. = akoysiochorophyta; Er. = ergasiophygophyta.

Bioforms: Th = annual therophytes, TH = biannual therophytes; H = hemicryptophytes; G = geophytes; Ph = phanerophytes (MPh = megaphanerophytes, nPh = nanophanerophytes); Hh = helohidatophytes.

Classes of vegetation: Lm = Lemnetea; Po = Potametea; Phr. = Phragmitetea; I-N = Isoëto-Nanojuncetea; M-Ar = Molinio-Arrhenatheretea; F-Br. = Festuco-Brometea; P-Sa = Puccinellio-Salicornietea; As.ru = Asplenietea rupestris; Se-Sc = Sedo-Scleranthetea; Ca.m = Cakiletea maritimae; F.v = Festucetea vaginatae; Se = Secalietea; Or = Oryzetea; Ch = Chenopodietea; Art = Artemisietea; Pl = Plantaginetea majoris; Bi = Bidentetea tripartiti; Ep = Epilobietea; Sa.p = Salicetea purpureae; Q-F = Querco-Fagetea; R = Robinietea.

RESULTS AND DISCUSSION

The distribution of the adventive plants under analysis in taxonomic, ecological, and phyto-geographical categories

In Romania, 157 adventive species that are integrated in vegetal communities had been identified until 2012. Out of these, 89 were *akoysiochorophytae*, while the remaining 68 were *ergasiophygophytae*. Of the *ergasiophygophytae* of economic importance, some stand out – such as ornamental plants (41 species); food plants (12); fodder (13); medicinal (5); tinctorial (2); melliferous (4) and textile species (1). The adventive plants under analysis fall into 44 families, of which a majority (64.5%) belong to the following eight families: Asteraceae (34 sp. 21.7%), Brassicaceae (14 sp. 8.8%), Poaceae (14 sp. 8.8%), Fabaceae (12 sp. 7.6%), Amaranthaceae (10 sp. 6.3%), Chenopodiaceae (seven sp. 4.4%), Solanaceae (six sp. 3.8%), Scrophulariceae (five sp. 3.1%). The other 36 families (35.5%) include one to four species each.

In terms of bioforms affiliation, most adventives are therophytes (Th, Th-TH: 104 species, 66.2%), others are hemicryptophytes (H, TH-H: 31 species, 19.7%), geophytes (G: five species, 3.2%), phanerophytes (MPh, nPh: six species, 3.8%), and helohidatophytes (Hh: 11 species, 7%).

The analyzed adventive plants live in 14 types of habitats (Tab. 1). Most of these have a preference for ruderal, ruderal-segetal, or segetal habitats, which is showed by their outstanding presence in the phytocoenoses of associations having the same ecological attributes.

From the point of view of their origins (Tab. 2), most adventives originate in North America, the Mediterranean and Asia – 118 species in all (75.1%), while for six species, the origin cannot be determined.

Table 1: Habitats of adventive plants.

Habitat	Number of species	%
Ruderal	50	31.8
Ruderal-pratal	15	9.6
Ruderal-segetal	33	21.0
Segetal	17	10.8
Pratal	2	1.2
Amnicolous	1	0.6
Amnicolous-ruderal	8	5.1
Nemoral	3	1.9
Nemoral-amnicolous	5	3.1
Nemoral-ruderal	5	3.1
Arenaceous	2	1.2
Rupestral/rupicolous	1	0.6
Paludal	8	5.1
Aquatic	7	4.4

Table 2: Origin of adventive plants.

Origin	Number of species	%
Europe	5	3.1
The Mediterranean sub-region	30	19.1
The Azore Islands	1	0.6
Eurasia (including the South eight sp.)	12	7.7
Asia	31	19.7
Africa	1	0.6
North America	57	36.3
North and South America	8	5.1
South America	11	7.0
Tropical and Subtropical Areas	1	0.6

The spreading of adventive plants varying with relief forms

Most adventive plants are spread on fields and hills, and they become scarce with altitude in mountainous areas of deciduous and coniferous forests. On the alpine level, adventive plants are absent, while on the mountainous level only one species survives in Făgăraş Mountains, three species in Rodna, three species in Retezat, nine species in Bucegi, 17 species in Apuseni (Vlădeasa, Gârda de Sus) and in nord-west of Parâng, 14 species in Rarău and Ceahlău, 12 species in Perşani and 25 species in Ţarcu, Godeanu and Cerna Mountains.

The highest altitudes where the following 13 species have been identified are: *Armoracia rusticana* 930 m. s.m. (Apuseni: Vlădeasa); *Erigeron annuus* 860 m s.m. (Bucegi – Poiana Ţapului), 800 m s.m. (Rodna), 800-830 m s.m. (Măgura Mountains – Valea Sadului); *Euphorbia nutans* 1,880 m s.m. (Rodnei Mountains – Ştiol Mountains); *Galinsoga parviflora*, 860-883 m s.m. (Bucegi); *Impatiens parviflora*, 1,234 m s.m. (Făgăraş – Cascada Bâlea); *Iva xanthifolia*, 700 m s.m. (Retezat); *Juncus tenuis*, 1,400 m s.m. (Bucegi), 1,200 m s.m. (Măgura Mountains – Ghihan Mountains, Tălmaciu – Valea Sadului), 1,120 m s.m. (Apuseni – Stâna de Vale), 867-1,200 m s.m. (Retezat); *Lolium temulentum*, 1,250 m s.m. (Apuseni – Vlădeasa); *Matricaria discoidea*, 1,650 m s.m. (Cindrel, Bătrâna – Valea Sadului); *Medicago sativa*, 798 m s.m. (Bucegi); *Mimulus moschatus*, 790 m s.m. (Apuseni); *Sisyrinchium montanum*, 1,100 m s.m. (Bârgău), 1,248-1,570 m s.m. (Parâng); *Xanthium spinosum*, 730 m s.m. (Retezat).

The distribution of adventive plants in vegetation associations and classes

The 157 species of adventive plants have been identified in the phytocoenoses of 204 associations which fall into 21 classes of vegetation. We must mention that 49 associations which include 34 adventive species that, alone or along with certain indigenous species, form the names of the respective vegetal communities. Most associations, whose names include adventives, species belong to the classes Chenopodietea (16 associations), Artemisietea (nine associations), Plantaginetea majoris (five associations), and Secalietea (nine associations), which are characteristic for ruderal and segetal habitats. There are two other associations that are affiliated with the classes Lemnetea, Potametea, Phragmitetea and Robinietea, and one association is included in the classes *Festucetea vaginatae* and *Oryzetea*.

The adventive plants having the broadest extensions in coenotaxonomic units are the following 12 species: *Erigeron canadensis*, which is present in 83 associations (pratal, arenaceous, segetal, nemoral-amnicolous, nemoral, etc.) that fall into 14 vegetation classes; *Amaranthus retroflexus*, identified in 52 associations (pratal, arenaceous, segetal, ruderal) from eight classes; *Erigeron annuus*, seen in 56 associations (pratal, arenaceous, segetal, ruderal, nemoral-amnicolous, nemoral) included in 11 classes; *Xanthium spinosum*, present in 42 associations (pratal, arenaceous, segetal, ruderal, nemoral-ruderal) having 11 subordonated classes; *Galinsoga parviflora*, identified in 40 associations (pratal, arenaceous, segetal, ruderal, nemoral-amnicolous) from nine classes; *Amaranthus albus*, present in 36 associations (pratal, arenaceous, segetal, ruderal) distributed into seven classes; *Xanthium italicum*, populates the phytocoenoses of 35 associations (pratal, arenaceous, segetal, ruderal, nemoral-amnicolous) included in 11 classes; *Artemisia annua*, present in 25 associations (arenaceous and ruderal) from five classes; *Amorpha fruticosa*, found in 19 associations (paludal, pratal, arenaceous, ruderal, amnicolous) from eight classes; *Medicago sativa*, present in 10 associations (pratal, segetal, ruderal) from seven classes; *Oenothera biennis*, found in eight associations (arenaceous, segetal, ruderal, nemoral-amnicolous) from six classes; *Rudbeckia laciniata*, found in the floristic composition of eight associations (paludal, pratal, ruderal, nemoral-amnicolous) from five classes.

Due to their poor competitiveness, adventive plants are scarcely distributed, particularly in the phytocoenoses of the pratal associations from the classes Molinio-Arrhenatheretea, Festuco-Brometea and Puccinelio-Salicornietea.

An outline of the adventive plants that are analysed

Azollaceae

1. *Azolla caroliniana* Will.: Ac, Hh, aquatic, Lm, North America.

2. *A. filiculoides* Lam.: Ac, Hh, aquatic, Lm, North America.

Moraceae

3. *Morus alba* L.: Er, MPh, nemoral-riverine, Sa.p Asia (China).

Polygonaceae

4. *Fagopyrum esculentum* Moench.: Er, Th, segetal, Se, Asia.

5. *Reynoutria japonica* Houtt.: Er, G, ruderal, Art, Asia (Japan).

Chenopodiaceae

6. *Chenopodium ambrosioides* L.: Er, Th, ruderal, Che, Pl, Bi, North America, South America.

7. *C. foliosum* (Mnch.) Ascherson: Er, Th, ruderal, Che, South Eurasia.

8. *C. multifidum* L.: Ac, H, ruderal, Che, South America.

9. *C. murale* L.: Ac, Th, ruderal, Che, Art, Bi, the Mediterranean Sub-region.

10. *C. schraderianum* Schult.: Ac, Th, ruderal, Che, Africa.

11. *Kochia scoparia* (L.) Schrad.: Er, Th, ruderal, Che, Bi, South Eurasia.

12. *K. sieversiana* (Pallas) K. A. Mey: Er, Th, ruderal, Che, Asia.

Amaranthaceae

13. *Amaranthus albus* L.: Ac, Th, ruderal-segetal, F-Br, F.v, Se, Che, Art, Pl, Bi, North America.

14. *A. blitoides* S. Watson.: Ac, Th, ruderal-segetal, Se-Sc, Se, Che, Art, Pl, North America.

15. *A. blitum* L.: Ac, Th, ruderal-segetal, Se, Che, Art, Bi, the Mediterranean Sub-region.

16. *A. crispus* (Lesp. and Thev.) N. Terrac.: Ac, Th, ruderal-segetal, Se, Che, Pl, South America (Argentina).

17. *A. cruentus* L.: Ac, Th, ruderal-segetal, Se, Che, North America and South America.

18. *A. deflexus* L.: Ac, H, ruderal, Che, Pl, Sa.p. South America.

19. *A. hybridus* L.: Er, Th, ruderal-segetal, Se, Che, North America and South America.

20. *A. paniculatus* L.: Er, Th, ruderal, Che, North America and South America.

21. *A. powelii* S. Watson: Ac, Th, ruderal-segetal, I-N, Se, Che, North America and South America.

22. *A. retroflexus* L.: Ac, Th, ruderal-segetal, F-Br, Ca.m, F.v, Se, Che, Art, Pl, Bi, North America.

Phytolaccaceae

23. *Phytolacca americana* L.: Er, H, amnicolous-ruderal, Art, Sa.p, North America.

24. *Ph. esculenta* Van Houtte: Er, H, ruderal, Art, Asia.

Portulacaceae

25. *Portulaca oleracea* L.: Er, Th, ruderal-segetal, Se, Eurasia.

Molluginaceae

26. *Mollugo cerviana* (L.) Ser.: Ac, Th, arenaceous, F.v, South Eurasia.

Caryophyllaceae

27. *Agrostemma githago* L.: Ac, Th, segetal, Se, Eurasia.

28. *Silene pendula* L.: Er, Th, ruderal, the Mediterranean Sub-region.

29. *S. sibirica* (L.) Pers.: Ac, H, ruderal-segetal, Se, Che, Asia.

Euphorbiaceae

30. *Euphorbia dentata* Michx.: Ac, Th, ruderal, Che, North America.

31. *E. humifusa* Willd.: Ac, Th, segetal, Se, Asia.

32. *E. maculata* L.: Ac, Th, ruderal-segetal, Se-Sc, Se, Pl, North America.

33. *E. nutans* Lag.: Ac, Th, ruderal-segetal, Se, Pl, North America.

Fumariaceae

34. *Fumaria parviflora* Lam.: Ac, Th, segetal, Se, the Mediterranean Sub-region.

Ranunculaceae

35. *Adonis annua* L.: Ac, Th, segetal, Se, the Mediterranean Sub-region.

Brassicaceae

36. *Armoracia rusticana* (Lam.) G. M. Sch.: Er, G, (H), ruderal, Che, Art, Bi, South Eurasia.

37. *Brassica juncea* (L.) Czern. and Coss.: Er, Th, ruderal, Se, Che, Asia.

38. *B. nigra* (L.) Koch.: Er, Th, ruderal-segetal, Se, Che, the Mediterranean Sub-region.

39. *Bunias erucago* L.: Ac, TH, segetal, Se, the Mediterranean Sub-region.

40. *Camelina sativa* (L.) Cr.: Er, Th, ruderal-segetal, Se, Che, Eurasia.

41. *Capsella rubella* Reuter: Ac, Th, ruderal, Pl, the Mediterranean Sub-region area.

42. *Coronopus didymus* (L.) Sm.: Ac, Th, ruderal, Pl, South America.

43. *Diplotaxis erucoides* (L.) D. C.: Ac, Th, ruderal, Pl, the Mediterranean Sub-region.

44. *Eruca vesicaria* (L.) Cav.: Er, Th, segetal, Se, the Mediterranean Sub-region.

45. *Lepidium densiflorum* Schrad.: Ac, Th, ruderal, Se, Che, Art, Pl, North America.

46. *L. virginicum* L.: Ac, Th, ruderal, Che, Pl, North America.

47. *Sinapis alba* L.: Er, Th, ruderal-segetal, Se, Che, the Mediterranean Sub-region.

48. *Sisymbrium irio* L.: Ac, Th, ruderal, Che, the Mediterranean Sub-region.

49. *S. volgense* M. Bieb.: Ac, H, ruderal, Che, Asia.

Rosaceae

50. *Duchesnea indica* (Andrews) Focke: Er, H, ruderal, Pl, Asia.

Fabaceae

51. *Amorpha fruticosa* L.: Er, H, nemoral-amnicolous, Phr, F-Br, P-Sa, F.v, Che, Pl, Sa.p, Q-F, North America.

52. *Cytisus scoparius* Link.: Er, H, nemoral, Q-F, Europe.

53. *Lathyrus aphaca* L.: Ac, Th, segetal, Se, the Mediterranean Sub-region.

54. *L. sativus* L.: Er, Th, segetal, Se, the Mediterranean Sub-region.

55. *Medicago sativa* L.: Er, H, rudero-pratal, M-Ar, F-Br, P-Sa, Se, Che, Art, Pl, Asia (Persia).

56. *Robinia pseudacacia* L.: Er, MPh, nemoral, Q-F, R, North America.

57. *Spartium junceum* L.: Er, nPh, ruderal, Che, the Mediterranean Sub-region area.

58. *Trifolium hybridum* L.: Er, H, rudero-pratal, Phr, I-N, M-Ar, Pl, Bi, Europe.

59. *Tr. incarnatum* L.: Er, Th, rudero-pratal, M-Ar, F-Br, Se-Sc, Pl, the Mediterranean Sub-region.

60. *Trigonella coerulea* (L.) Ser.: Ac, Th, rudero-pratal, F-Br, P-Sa, Che, Art, the Mediterranean Sub-region.

61. *Vicia peregrina* L.: Ac, Th, segetal, Se, the Mediterranean Sub-region area.

62. *V. sativa* L.: Er, Th, rudero-pratal, F-Br, Se-Sc, Se, Che, Bi, the Mediterranean Sub-region.

Onagraceae

63. *Epilobium adenocaulon* Hausskn.: Ac, H, paludal, Phr, M-Ar, North America.

64. *Oenothera biennis* L.: Ac, TH, ruderal, F.v, Se, Che, Art, Pl, Sa.p, North America.

65. *O. parviflora* L.: Ac, Th, ruderal, F-Br, F.v, Che, North America.

Asclepiadaceae

66. *Asclepias syriaca* L.: Er, H, amnicolous-ruderal, Sa.p, North America.

Lythraceae

67. *Ammania verticillata* Bois.: Ac, Th, paludal, I-N, South Eurasia.

Oxalidaceae

68. *Oxalis corniculata* L.: Er, Th-TH, ruderal, Se, Che, Pl, Sa.p, the Mediterranean Sub-region.

69. *O. dillenii* Jacq.: Ac, TH-H, ruderal, Che, North America.

70. *O. stricta* L. (O. europaea Jord.): Ac, TH-H, rudero-pratal, M-Ar, F-Br, Se, Che, Pl, Sa.p, Q-F, North America.

Balsaminaceae

71. *Impatiens glandulifera* Royle: Er, Th, nemoral-amnicolous, Phr, Sa.p, Asia (India).

72. *I. parviflora* D. C.: Er, Th, nemoral-ruderal, Che, Art, Ep, Q-F, Asia.

Vitaceae

73. *Parthenocissus inserta* (A. Kern) Fritsch.: Er, nPh, nemoral, Q-F, North America.

Malvaceae

74. *Abutilon theophrasti* Medic.: Ac, Th, ruderal-segetal, Se, Che, Art, Bi, Asia (?).

Simaroubaceae

75. *Ailanthus altissima* (Mill.) Swingle: Er, MPh, nemoral-ruderal, Art, Q-F, Asia (China).

Apiaceae

76. *Coriandrum sativum* L.: Er, Th, ruderal, Pl, the Mediteranean Sub-region area.

Cuscutaceae

77. *Cuscuta campestris* Yunck: Ac, Th, rudero-pratal, F-Br, Se, Che, Art, Pl, North America.

78. *C. suaveolens* Ser.: Ac, Th, rudero-pratal, F-Br, Che, North America.

Hydrophyllaceae

79. *Phacelia tanacetifolia* Benth.: Ac, Th, ruderal, Che, Art, North America.

Heliotropiaceae

80. *Heliotropium currasavicum* L.: Ac, Th-TH, ruderal, Pl, North America and South America.

Solanaceae

81. *Datura stramonium* L.: Er, Th, ruderal, Se, Che, Asia (?), North America (?).

82. *Lycium barbarum* L.: Er, nPh, ruderal, Art, the Mediterranean Sub-region area.

83. *Nicandra physaloides* (L.) Gaertn.: Er, Th, ruderal, Che, South America.

84. *Petunia parviflora* A. Juss.: Ac, Th, ruderal, Che, Pl, South America.

85. *Solanum alatum* Mnch.: Ac, Th, ruderal-segetal, Se, Che, Art, the Mediterranean Sub-region.

86. *S. triflorum* Nutt.: Ac, Th, ruderal-segetal, Se, Che, Pl, North America.

Scrophulariaceae

87. *Cymbalaria muralis* Gaertn.: Er, H, rupestralu, F-Br, As.ru, Se-Sc, the Mediterranean Sub-region.

88. *Mimulus guttanus* D. C.: Er, H, paludal, M-Ar, North America.

89. *M. moschatus* Dougl.: Er, H, paludal, Phr, North America.

90. *Veronica peregrina* L.: Ac, Th, paludal, I-N, South America.

91. *V. persica* Poir: Ac, Th, ruderal-segetal, F-Br, F.v, Se, Che, Art, Pl, Bi, Asia.

Plantaginaceae

92. *Plantago sempervirens* Crantz: Ac, H, pratal, F-Br, SW Europe.

Lamiaceae

93. *Elsholtzia ciliata* (Thunb.) Hyl.: Ac, Th, nemoral-amnicolous, Q-F, Asia (China).

94. *Salvia reflexa* Hornem.: Ac, Th, rudero-pratal, F-Br, Se, Pl, North America.

Rubiaceae

95. *Asperula orientalis* Boiss and Hohen.: Ac, Th, ruderal-segetal, Se, Che, Asia.

Convolvulaceae

96. *Ipomoea purpurea* Roth.: Er, Th, ruderal-segetal, Se, Che, South America.

Cucurbitaceae

97. *Echinocystis lobata* (Michx.) Torr. and Gray: Ac, Th, amnicolous-ruderal, Art, Sa.p, Q-F, North America.

98. *Sicyos angulata* L.: Er, Th, ruderal, Art, Sa. P., North America.

99. *Thladiantha dubia* Bunge.: Er, G, ruderal, Che, Art, Ep, Asia (China).

Asteraceae

100. *Ambrosia artemisiifolia* L.: Ac, Th, ruderal-segetal, Se, Che, North America.

101. *A. trifida* L.: Ac, Th, ruderal, Che, North America.

102. *Artemisia annua* L.: Er, Th, ruderal, Se-Sc, F.v, Che, Art, Pl, Bi, Asia.

103. *A. lavandulaefolia* D. C.: Er, H, ruderal, Che, Asia.

104. *Aster lanceolatus* Willd.: Er, H, amnicolous-ruderal, Art, Sa.p, North America.

105. *Bidens frondosa* L.: Ac, Th, ruderal, Che, Pl, Asia.

106. *B. vulgata* Green: Ac, Th, paludal, Phr, Bi, North America.

107. *Brachyactis ciliata* Ldb.: Ac, Th, ruderal, Che, Pl, Asia.

108. *Calendula officinalis* L.: Er, Th, ruderal, Che, the Mediterranean Sub-region.

109. *Eclipta prostrata* (L.) L.: Ac, Th, riveran, I-N, Asia (?), North America.

110. *Erechtites hieracifolius* (L.) Rafin ex D. C.: Ac, Th, nemoral-ruderal, Che, Ep, Q-F, North America and South America.

111. *Erigeron annuus* (L.) Pers.: Ac, Th-TH, rudero-pratal, M-Ar, F-Br, Se-Sc, F.v, Se, Che, Art, Pl, Ep, Sa.p, Q-F, North America.

112. *E. canadensis* L.: Ac, Th-TH, rudero-pratal, I-N, M-Ar, F-Br, P-Sa, Se-Sc, F.v, Se, Che, Art, Pl, Bi, Ep, Sa.p, Q-F, North America.

113. *Galinsoga quadriradiata* Ruiz and Pavon: Ac, Th, ruderal, Se, Che, Art, Pl, Bi, Sa.p, North America and South America.

114. *G. parviflora* Cav.: Ac, Th, ruderal-segetal, M-Ar, F.v, Se, Che, Art, Pl, Bi, Ep, Sa.p, South America (Peru).

115. *Grindelia squarrosa* (Pursh.) Dunal: Ac, TH-H, ruderal-segetal, Se, Art, North America.

116. *Helianthus annuus* L.: Er, Th, ruderal-segetal, Se, Che, Bi, North America.

117. *H. decapetalus* L.: Er, H, amnicolous-ruderal, Art, Sa.p, North America.

118. *H. tuberosus* L.: Er, G, amnicolous-ruderal, Che, Art, Pl, Sa.p, North America.

119. *Inula helenium* L.: Ac, H, nemoral-ruderal, Art, Q-F, Asia.

120. *Iva xanthifolia* Nutt.: Ac, Th, ruderal, Che, Art, Pl, North America.

121. *Matricaria discoidea* D. C.: Ac, Th, ruderal, Che, Art, Pl, Bi, North America.

122. *Picris echioides* L.: Ac, Th, ruderal-segetal, Se, Che, Europe.

123. *Rudbeckia laciniata* L.: Er, H, amnicolous-ruderal, Phr, M-Ar, Art, Sa.p, Q-F, North America.

124. *Sigesbeckia orientalis* L.: Ac, Th, ruderal, Art, Asia.

125. *Silybum marianum* (L.) Gärtn.: Er, Th, segetal, Se, the Mediterranean Sub-region.

126. *Solidago canadensis* L.: Er, H, amnicolous-ruderal, Art, Sa.p, North America.

127. *S. gigantea* Aiton: Er, H, nemoral-ruderal, Art, Sa.p, Q-F, North America.

128. *S. graminifolia* (L.) Salisb.: Er, H, ruderal, Art, North America.

129. *Tanacetum parthenium* (L.) Sch. Bip.: Er, Th, ruderal, Art, the Mediterranean Sub-region.

130. *Xanthium italicum* Moretti: Ac, Th, rudero-pratal, I-N, M-Ar, F-Br, P-Sa, F.v, Se, Che, Art, Pl, Bi, Sa.p, North America (?).

131. *X. orientale* L.: Ac, Th, arenaceous, Ca.m, F.v, North America (?).

132. *X. riparium* Itzigsohn and Hertsch.: Ac, Th, ruderal, Che, Bi, Sa.p, North America.

133. *X. spinosum* L.: Ac, Th, rudero-pratal, M-Ar, F-Br, P-Sa, Ca.m, F.v, Se, Che, Art, Pl, Bi, Sa.p, South America.

Alismataceae

134. *Sagittaria latifolia* Willd.: Er, Hh, aquatic, Po, Phr, North America.

Hydrocharitaceae

135. *Elodea canadensis* Michx.: Er, Hh, aquatic, Po, North America.

136. *E. muttallii* (Planch.) H. St. John: Er, Hh, aquatic, Po, North America.

137. *Vallisneria spiralis* L.: Er, Hh, aquatic, Po, tropical and subtropical region.

Najadaceae

138. *Najas graminea* Delile: Ac, Hh, aquatic, Po, Or, the Mediterranean Sub-region area.

Liliaceae

139. *Scilla sibirica* Haw.: Er, G, nemoral, Q-F, Asia.

Iridaceae

140. *Sisyrinchium montanum* Greene: Ac, H, pratal, M-Ar, North America.

Juncaceae

141. *Juncus tenuis* Willd.: Ac, H, rudero-prat., M-Ar, Pl, Sa.p, North America.

Cyperaceae

142. *Cyperus difformis* L.: Ac, Hh, paludal, Or, Bi, Azore Islands.

Poaceae

143. *Avena barbata* Potter ex Link: Ac, Th, segetal, Se, South Eurasia.

144. *A. sterilis* L. ssp. ludoviciana: Ac, Th-TH, segetal, Se, South Eurasia.

145. *Echinochloa oryzicola* Vasing.: Ac, Hh, segetal, Or, Asia.

146. *E. oryzoides* (Ard.) Fritsch.: Ac, Hh, segetal, Or, Eurasia.

147. *E. villosa* (Thunb.) Kunth.: Ac, Th, segetal, Se, Asia.

148. *Lolium multiflorum* Lam.: Ac, Th-TH, ruderal-segetal, Se, Art, the Mediterranean Sub-region.

149. *L. remotum* Schrank.: Ac, Th, segetal, Se, Europe.

150. *L. temulentum* L.: Ac, Th-TH, segetal, P-Sa, Se, South Eurasia.

151. *Panicum capillare* L.: Er, Th, ruderal-segetal, Se, Che, North America (?).

152. *P. dichotomiflorum* Michx.: Er, Th, ruderal, Che, North America.

153. *P. miliaceum* L.: Er, Th, ruderal-segetal, Se, Che, Asia.

154. *Phalaris canariensis* L.: Er, Th, ruderal-segetal, Se, Che, the Mediterranean Sub-region.

155. *Setaria italica* (L.) Beauv.: Er, Th, ruderalo-segetal, Se, Che, Asia.

156. *Sorghum halepense* (L.) Pers.: Ac, H, ruderal-segetal, Se, Che, Art, the Mediterranean Sub-region.

Acoraceae

157. *Acorus calamus* L.: Ac, Hh, paludal, Phr, Asia.

The distribution of adventive plants in vegetal communities

Aquatic communities

1. Lemnetea W. Koch and Tx. 1954 (Lm)

In the floating aquatic communities, two adventive species are present (Fig. 1, Lm) – *Azolla caroliniana* and *A. filiculoides* – each being distributed in one of the associations Lemno-Azolletum carolinianae Nedelcu 1964, Lemno-Azolletum filiculoides (Langendock 1935) Br-Bl. 1952 (Fig. 2 Lm).

2. Potametea Tx. and Prsg. 1942 (Po)

The members of the rooted aquatic macrophites include five adventive species: (Fig. 1, Po) – *Elodea canadensis*, *E. nuttallii*, *Najas graminea*, *Sagittaria latifolia* and *Vallisneria spiralis* – which are present in the following 14 associations: (Fig. 2, Po): Ceratophyllo demersi-Elodeetum muttallii Ciocârlan et al. 1997, Elodeetum canadensis Eggler 1933, Myriophyllo-Potametum lucentis Soó 1934, Myriophyllo verticillati-Nymphaeetum luteae Koch 1926, Najadetum marinae (Oberd. 1957) Fukarek 1961, Nymphaeetum albae Vollman 1942, Nymphaeetum albo-candidae (Hejny 1950) Passarge 1952, Nymphaeetum albo-luteae Nowinski 1928, Nymphoidetum peltatae (All. 1922) Müller and Görs 1960, Potamogetonetum crispi Soó 1927, Potamogetonetum perfoliati Koch 1926, em. Passarge 1964, Potamogetonetum trichoidis J. and R. Tüxen 1965, Trapetum natantis Müller and Görs 1960, Trapo-Nymphoidetum peltatae Oberd. 1957.

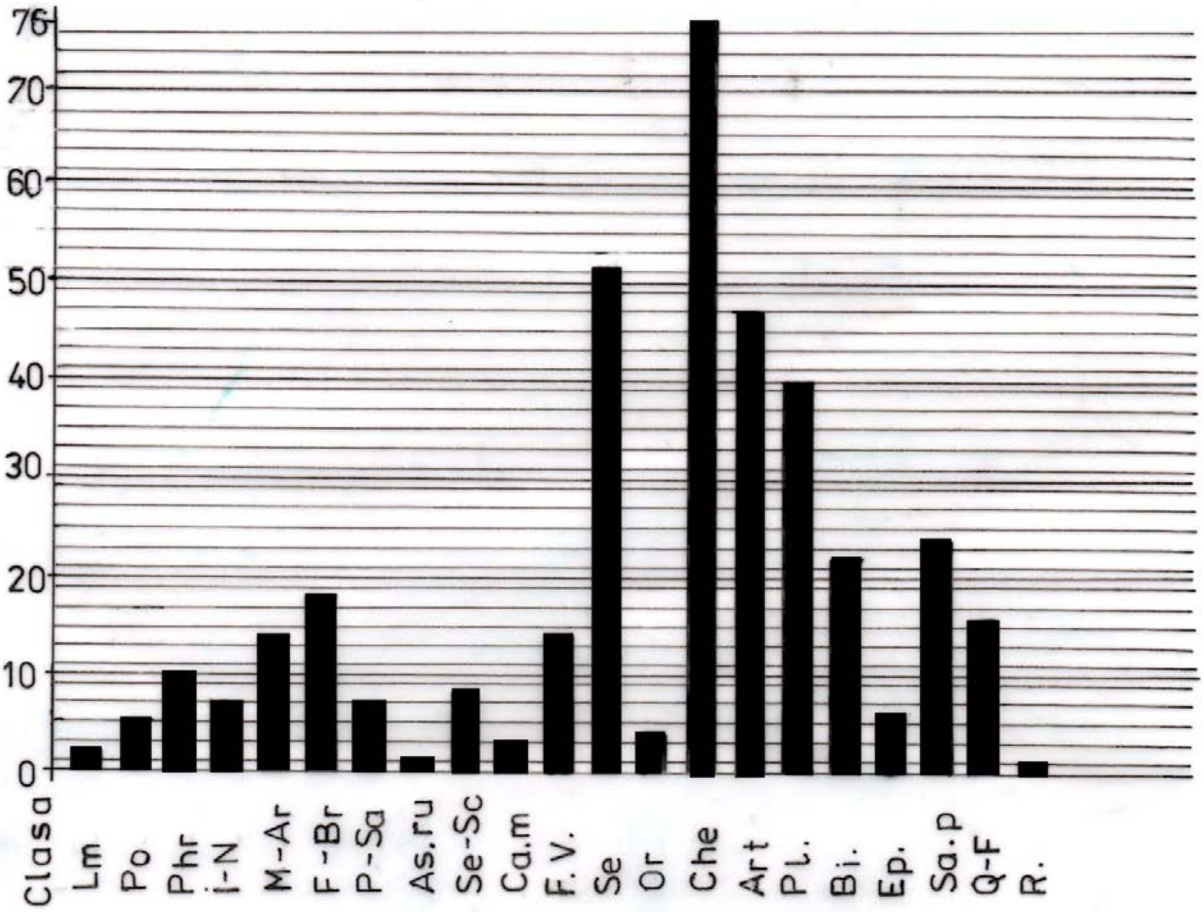

Figure 1: Statistics of adventive species
in some vegetation classes.

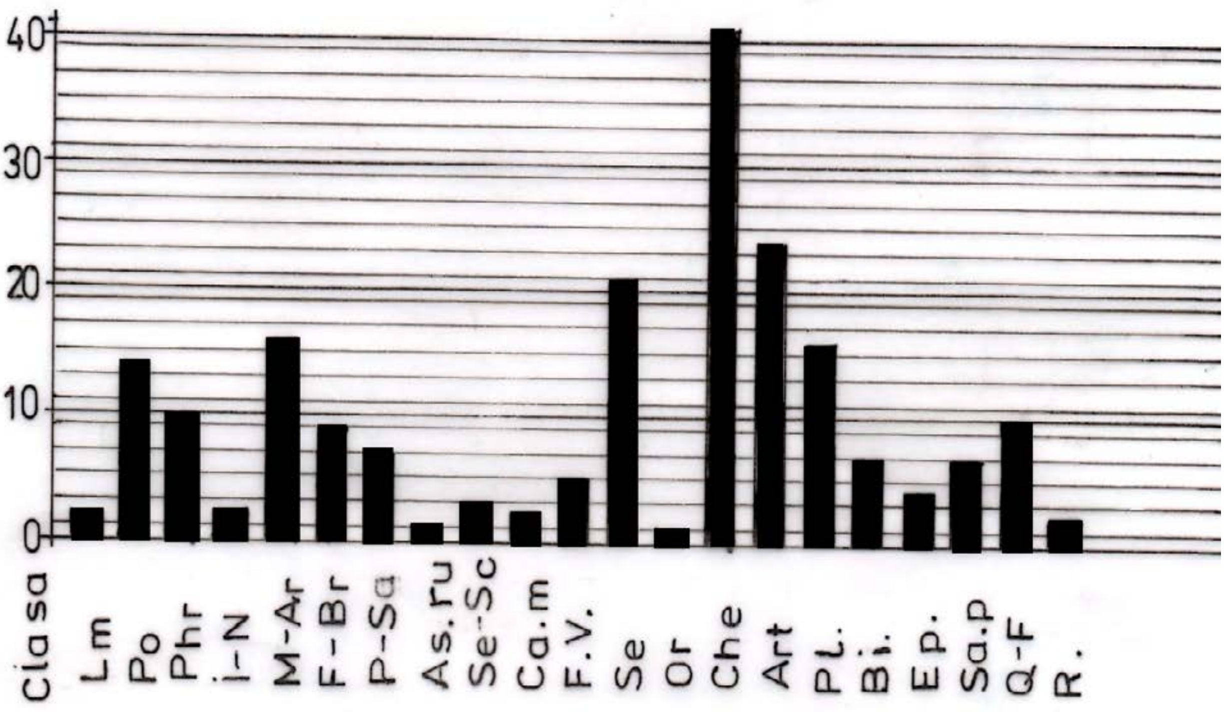

Figure 2: Statistics of associations in vegetation classes
that include certain adventive species.

Paludal amnicolous communities

3. Phragmitetea Tx. and Prsg. 1942 (Phr.)

The paludal communities include 10 adventives: (Fig. 1, Phr) which are part of these 10 associations (Fig. 2, Phr): *Acorus calamus*, *Amorpha fruticosa*, *Echinocystis lobata*, *Bidens vulgata*, *Epilobium adenocaulon*, *Impatiens glandulifera*, *Mimulus moschatus*, *Rudbeckia laciniata*, *Sagittaria latifolia*, *Trifolium hybridum*.

The following associations include in their floristic nomenclature one or two adventive species: Acoretum calami (Eggler 1933) Schulz 1941, Bolboschoenetum maritimi Eggler 1933, Caricetum gracilis Almquist 1929, Caricetum ripariae Soó 1928, Glycerietum fluitantis Br-Bl, 1925, Oenantho-Rorippetum amphibiae Lohm. 1950, Scirpo-Phragmitetum W. Koch 1926, -rudbeckiosum (Schneider-Binder, 1975) Drăgulescu 1987, Thelyiptero-Phragmitetum Ştefan et al. 1995, Typhetum angustifoliae (All. 1922) Pign. 1953, and Typhetum latifoliae Lang. 1983.

4. Isoëto-Nanojuncetea Br.-Bl. and Tx. 1943 (I-N)

In paludal, exiguous communities, there are: (Fig. 1, I-N): *Amaranthus powellii*, *Ammania verticilata*, *Eclipta prostrata*, *Erigeron canadensis*, *Trifolium hybridum*, *Veronica peregrina*, *Xanthium italicum*, being identified individually or in trees (Fig. 2, I-N) in two associations (Fig. 2, I-N): Lindernio pixidariae, -Isolepietum supinae Morariu 1943 and Pulicario-Menthetum pulegii Slavnić 1951.

Mesohygrophytic and mesophilous pratal communities

5. Molinio-Arrhenatheretea Tx. 1937 (M-Ar.)

The pratal communities that are members of this class are seldom populated, including the following 14 adventive species (Fig. 1, M-Ar.) *Epilobium adenocaulon*, *Erigeron annuus*, *E. canadensis*, *Galinsoga parviflora*, *Juncus tenuis*, *Medicago sativa*, *Mimulus guttatus*, *Oxalis stricta*, *Rudbeckia laciniata*, *Sisyrinchium montanum*, *Trifolium hybridum*, *T. incarnatum*, *Xanthium italicum*, *Xanthium spinosum* which aggregate into 16 associations (Fig. 2, M-Ar). The following 10 associations include 1-3 adventive species: Agrosti capillaris-Festucetum rubrae Horv. 1952, Agrostetum stoloniferae Burduja et al. 1956, Anthoxantho-Agrostetum tenuis Sillinger 1969, Carici leporinae-Deschampsietum caespitosae (Borza 1930) Beldie 1967, Festucetum pratensis Soó 1938, Filipendulo-Geranietum palustris Koch 1926, Lolio-Cynosuretum Tx. 1937, Lythro-Calamagrostetum epigei I. Pop 1968, Peucedano rocheliani-Molinietum coeruleae Boşcaiu 1965, and Poëtum pratensis Răvăruţ et al. 1956. In six other associations, the adventive species are seldom present.

Xero-mesophytic and xerophilous pratal communities

6. Festuco-Brometea Br.-Bl. and Tx. 1943 (F-Br.)

The pratal communities that are subordinated to this coenotaxon seldom include the following 18 species (Fig. 1, F-Br), which are assembled from nine associations: (Fig. 2, F-Br): *Amaranthus albus*, *A. retroflexus*, *Amorpha fruticosa*, *Cymbalaria muralis*, *Cuscuta campestris*, *C. suaveolens*, *Erigeron annuus*, *E. canadensis*, *Medicago sativa*, *Oenothera parviflora*, *Oxalis stricta*, *Plantago sempervirens*, *Salvia reflexa*, *Trigonella coerulea*, *Veronica persica*, *Vicia sativa*, *Xanthium italicum*, and *X. spinosum*. Most adventive plants (two to seven species) have been identified in six associations: Cynodonto-Poëtum angustifoliae (Rapaics 1926) Soó 1957, Artemisio austriacae-Poëtum bulbosae I. Pop 1970, Botriochloetum ischaemi I. Pop 1977, Festucetum valesiaco-rupicolae Csürös and Kovács 1962, Medicagini-Festucetum valesiacae Wagner 1941, and Stipetum lessingianae Soó (1927) 1947. Three associations sporadically include in their floristic nomenclature one species.

Halophilous vegetal communities

7. Puccinellio-Salicornietea Ţopa 1939 (P-Sa)

The halophilous associations do not include adventive plants, while in the oligo-halophilous communities, seven adventive species have seldom been noted (Fig. 1, P-Sa). They are assembled from seven associations (Fig. 2, P-Sa), namely, *Amorpha fruticosa*, *Erigeron canadensis*, *Lolium temulentum*, *Medicago sativa*, *Trigonella coerulea*, *Xanthium italicum*, and *Xanthium spinosum*. One or two adventive species have been found in the associations Achilleo-Festucetum pseudovinae (Magyar 1928) Soó (1933) 1945, Alopecureto-Rorippetum kerneri I. Pop 1968, Artemisio-Festucetum pseudovinae (Magyar 1928) Soó (1933) 1945, Astero-pannonici-Puccinellietum distansis Géhu, Roman, Boullet 1994, Bassietum sedoidis (Ubrizsy 1949) Soó 1964, Heleochloëtum schoenoidis (Soó 1933) Ţopa 1939, emend. I. Pop 1968, and Plantago cornuti-Agrostetum stoloniferae Soó and Csürös (1944) 1973.

Rupicolous plant communities

8. Asplenietea rupestris H. Meier and Br.-Bl. 1934 (As.ru)

In the phytocoenoses of rupicolous associations, a single adventive species has been identified (Fig. 1, As.ru) – *Cymbalaria muralis* – which is subordinated to the association (Fig. 2, As.ru) Asplenietum trichomano-rutae-murariae Tx. 1937 – cymbalariosum muralis Schneider-Binder 1969.

Communities of alluvial gravels

9. Sedo-Scleranthetea Br.-Bl. 1955 em. Moravec 1967 (Se-Sc)

The vegetal communities that are typical for alluvial gravels include in their floristic composition the following eight adventive species (Fig. 1, Se-Sc); they are gathered from three associations, namely (Fig. 2, Se-Sc): *Amaranthus blitoides*, *Artemisia annua*, *Cymbalaria muralis*, *Erigeron annuus*, *E. canadensis*, *Euphorbia maculata*, *Trifolium incarnatum* and *Vicia sativa*. The species being mentioned have been identified either individually or in pairs in the following associations: Filagini-Vulpietum Oberd. 1938, Scleranthо-Syrenietum cuspidatae Csürös et al. 1968 and Scleranthо-Poëtum compresae Borza 1959 – Cymbalarietosum muralis Borza 1959.

Litoral arenaceous communities

10. Cakiletea maritimae Tx. and Prsg. 1950 (Ca.m)

The litoral arenaceous communities being mentioned are seldom populated with the following three adventive species (Fig. 1, Ca.m): *Amaranthus retroflexus*, *Xanthium orientale* and *X. spinosum*, which are distributed either individually or in pairs in two associations (Fig. 2, Ca.m): Salsolo ruthenicae-Xanthietum strumarii Oberd. and Tx. 1950 and Scolymetum hispanici I. Pop 1961.

Continental arenaceous communities

11. Festucetea vaginatae Soó 1968 (F.v)

The continental arenaceous communities are populated by the following 14 adventive species: (Fig. 1, F.v) which originate from five associations (Fig. 2, F.v): *Amaranthus albus, A. retroflexus, Amorpha fruticosa, Artemisia annua, Erigeron annuus, E. canadensis, Galinsoga parviflora, Mollugo cerviana, Oenothera biennis, O. parviflora*, *Veronica persica*, *Xanthium italicum*, *X. orientale* and *X. spinosum*. Adventive species in groups of two to six have been noticed in the associations Aperetum spicae-venti Soó 1953, Brometum tectorum Bojko 1934, Bromo-Cynodontetum I. Pop 1970, Festuco vaginatae-Corynephoretum Soó in Aszód 1935, and Molluginetum cervianae Borza 1963.

Communities of segetal weeds

12. Secalietea Br.-Bl. 1931 em. 1951 (Se)

The vegetal communities that are part of this class are rich in adventives plants, totalling 38 species, and originating from 21 segetal associations (Fig. 2, Se). To these, 14 other species are added, which have so far been identified exclusively in crops (agrophytocoenoses), totalling 52 species (Fig. 1, Se). The adventive plants present in the phytocoenoses of the analysed associations are the following: *Abutilon theophrasti, Adonis annua, Amaranthus albus, A. blitoides, A. blitum, A. crispus, A. cruentus, A. hybridus, A. powellii, A. retroflexus, Asperula orientalis, Brassica juncea, B. nigra, Cuscuta campestris, Erigeron annuus, E. canadensis, Euphorbia maculata, Galinsoga parviflora, G. quadriradiata, Grindelia squarrosa, Helianthus annuus, Ipomoea purpurea, Lepidium densiflorum, Medicago sativa, Oenothera biennis, Oxalis stricta, Panicum miliaceum, P. capillare, Portulaca oleracea, Salvia reflexa, Setaria italica, Solanum alatum, S. triflorum, Sorghum halepense, Veronica persica, Vicia sativa, Xanthium italicum,* and *X. spinosum*. Of all the plant communities, the richest in adventive plants (having a total number of 12 species and seven infracoenotaxons of the same category) stands out as the association Amarantho-Chenopodietum albi Morariu 1943: amaranthetosum albi (Morariu) Spiridon 1970; amaranthetosum blitoidis Spiridon 1970; amaranthetosum crispi Ubrizsy 1949; amaranthetosum hybridi Morariu 1943; euphorbietosum maculatae Viţalariu 1973; solanosum triflorae Burduja et al. 1971; xanthietosum italici Burduja and Horeanu 1976. The following 14 associations include in their floristic nomenclature three to eight adventive species: Amarantho albi-Eragrostietum poeoides Morariu 1943, Consolido-Polygonetum convolvulus Morariu (1943) 1967, salvietosum reflexae (Viţalariu and Leucov 1971) Popescu et al. 1980, Cynancho acuti-Sorghetum halepensis N. Ştefan and A. Oprea 1997, Digitario-Portulacetum (Felföldy 1942) Timár and Bodrog. (1943) 1955, Erigero canadensis-Panicetum miliacei N. Ştefan 1993, Erigero-Setarietum glaucae Slonovschi 1997, Heliotropio-Cynanchetum acuti Mititelu 1971, Hibisco-Eragrostietum poaeoidis Soó and Timár (1951) 1957, Kickxieto-Scutelarietum hastifoliae Paucă 1941, Portulacetum oleracei Felföldy 1942, Portulaceto-Amaranthetum blitoidis Mititelu 1972, Setario-Digitarietum Felföldy 1942, em. Soó 1962, Setario pumilae-Sorghetum halepensae N. Ştefan and A. Oprea 1997, and Tribulo-Tragetum Soó and Timár 1954. Another six segetal associations include in their floristic nomenclature one to two adventive species. In the crops (agrophytocoenoses), 24 adventive species have been found, out of which the following 14 species are known as exclusively present in this particular habitat: *Agrostemma githago, Avena barbata, A. sterilis, Bunias erucago, Echinochloa villosa, Eruca vesicaria, Euphorbia humifusa, Fagopyrum sagittatum, Fumaria parviflora, Lathyrus aphaca, L. sativus, Lolium remotum, Silybum marianum,* and *Vicia peregrina*.

Segetal communities in rice crops

13. Oryzetea sativae Miyawaki 1960 (Or)

The segetal communities in rice crops include the following four adventive species: (Fig. 1, Or): *Cyperus difformis, Echinochloa oryzicola, E. oryzoides* and *Najas graminea*, which are present in this association alone: Echinochloo-Oryzetum sativae Soó and Ubrizsy (1946) 1948 – cyperetosum difformis Ubrizsy 1961, – scirpetosum mucronati Ubrizsy 1961 (Fig. 2, Or).

Ruderal communities in human environments

14. Chenopodietea Br.-Bl. 1951 em. Lohm. J. Tx. and Tx. 1961 (Che)

In the ruderal plant communities that are part of this class, the most adventive plants have been identified – 76 species (48.4%; Fig. 1, Che), assembled in 41 associations (Fig. 2, Che). The adventive plants include the following species: *Abutilon theophrasti*, *Amaranthus albus, A. blitoides, A. blitum, A. crispus, A. cruentus, A. deflexus, A. hybridus, A. paniculatus, A. powellii, A. retroflexus, Amorpha fruticosa*, *Ambrosia artemisiifolia, A. trifida, Armoracia rusticana, Artemisia annua, A. lavandulaefolia, Asperula orientalis, Brachyactis ciliata, Brassica juncea, B. nigra, Calendula officinalis, Camelina sativa, Chenopodium ambrosioides, C. foliosum, C. multifidum, C. murale, C. schraderianum, Cuscuta campestris, C. suaveolens, Datura stramonium, Erechtites hieracifolia, Erigeron annuus, E. canadensis, Euphorbia dentata, Galinsoga quadriradiata, G. parviflora, Grindelia squarrosa, Helianthus annuus, H. tuberosus, Impatiens parviflora*, *Iva xanthifolia, Kochia scoparia, K. sieversiana, Lepidum densiflorum, L. virginicum, Matricaria discoidea, Medicago sativa, Nicandra physaloides, Oenothera biennis, O. parviflora, Oxalis corniculata, O. dillenii, O. stricta, Panicum capillare, P. dichotomiflorum, P. miliaceum, Phacelia tanacetifolia, Phalaris canariensis, Petunia parviflora, Picris echioides, Silene sibirica, Sinapis alba, Sisymbrium irio, Sisymbrium volgense, Solanum alatum, S. triflorum, Sorghum halepense, Spartium junceum, Thladiantha dubia, Trigonella caerulea, Veronica persica, Vicia sativa, Xanthium italicum, X. riparium*, and *X. spinosum.*

The greatest number of adventive plants, three to twelve species, have been identified in the phytocoenoses of the following 33 associations: Abutilo-Solanetum nigri Mititelu and Barabaş 1987, Agropyretum repentis Felföldy 1942, Ambrosietum artemisiifoliae Viţalariu 1973, Argusio-Petasitetum spuriae Dihoru and Negreanu 1976, Atriplicetum tataricae Borza 1926, Berteroëtum incanae Sissingh and Tideman 1956, Brassicetum nigrae Zanoschi et al. 1977, Carduetum acanthoidis (Allorge 1922) Morariu 1939, Carduetum nutantis Morariu 1943, Chenopodietum muralis Br.-Bl. 1931, Chenopodio (boni-henrici)-Urticetum urentis Tx. 1931, em. Lohm. 1950, Cirsietum arvensi-lanceolati Mititelu 1972, Cynodonti-Atriplicetum tataricae Morariu 1943, Daturo-Malvetum neglectae (Althenstädt 1941) Lohm. 1950, Eragrostio (poëoidis)-Panacetum capillarae Mititelu and Ştefan 1988, Erigero canadensis-Brachyactetum ciliatae I. Pop and G. Viţalariu 1971, Galinsogo-Euphorbietum pepli Mititelu 1972, Hordeetum murini Libbert 1932, em. Passarge 1964, Hyoscyamo-Malvetum reglectae Aichinger 1933, Kochietum scopariae Oprea 1997, Malvetum neglectae Aichinger 1933, Malvetum pusillae Morariu 1943, Onopordetum acanthii Br.-Bl. (1923) 1936, Oxali-Euphorbietum pepli Viţalariu and Horeanu 1985, Panico-Chenopodietum polyspermi R. Tx. 1937, Panico capillare-Kochietum sieversianae A. Oprea 1998, Polygono avicularis-Amaranthetum crispi Vicol et al. 1971, Sclerochloo-Polygonetum avicularis Soó 1940 ex Korneck 1965, Setario-Galinsogetum Tx. 1950. Soncho (arvensis)-Erigeronetum canadensis Mititelu 1971, Soncho-Melilotetum Tx. 1942, and Xanthietum spinosi Felföldy 1942, Xanthio spinosi-Amaranthetum retroflexi Morariu 1943. In eight other ruderal associations, one to two adventive species have been found.

15. Artemisietea Lohm. Prsg. and Tx. 1950 (Art)

The adventive plants in this class include the following 47 species (Fig. 1, Art.), which are assembled from 24 associations: (Fig. 2, Art): *Abutilon theophrasti, Ailanthus altissima, Amaranthus albus, A. blitoides, A. blitum, A. retroflexus, Armoracia rusticana, Artemisia annua, Aster lanceolatus, Chenopodium murale, Echinocystis lobata, Erigeron annuus, E. canadensis, Galinsoga quadriradiata, G. parviflora, Grindelia squarrosa, Helianthus decapelatus,* *H. tuberosus, Impatiens parviflora, Inula helenium, Iva xanthifolia, Lepidium densiflorum, Lolium multiflorum, Lycium barbarum, Matricaria discoidea, Medicago sativa, Oenothera biennis, Phacelia tanacetifolia, Polygonum cuspidatum, Phytolacca americana, P. esculenta, Reinoutria japonica, Rudbeckia laciniata, Sicyos angulatus, Sigesbeckia orientalis, Silene pendula, Solanum alatum, Solidago canadensis, S. gigantea, S. graminifolia, Sorghum halepense, Tanacetum partenium, Thladiantha dubia, Trigonella caerulea, Veronica persica, Xanthium italicum* and *X. spinosum*. The associations that include two to seven adventive species in their floristic composition are the following: Ailanthetum altissimae Dihoru 1969, Arctietum lappae Felföldy 1942, Arctio-Ballotetum nigrae (Felföldy 1942) Morariu 1943, Artemisietum annuae Morariu 1943, Artemisio-Helianthetum decapetali Mititelu 1972, Astero-Rubietum caesii Kárpáti 1962, Conietum maculaţi I. Pop 1968, Cuscuto-Calystegietum sepium Tx. 1942, em. Soó 1961, Glycirrhizetum echinatae (Soó 1940 n.n Timár 1947) Slavnić 1951, Helianthetum decapetali Morariu 1967, Helianthetum tuberosi (Moor 1958) Oberd. 1967, Ivaetum xanthifoliae Fijalkovschi 1967, Lycietum barbarum Felföldy 1942, Polygonetum cuspidati Tx. and Raabe 1950, Rudbeckio-Brachipodietum silvaticae Szabó 1970, Rudbeckio-Solidaginetum canadensis Tx. and Raabe 1950, em. Soó 1961, Sambucetum ebuli Felföldy 1942, Sisymbrio-Artemisietum absinthii I. Pop 1969, Tanaceto-Artemisietum vulgaris Br.-Bl. (1931) 1949, and Tussilaginetum farfarae Oberd. 1949. Other four associations seldom include one adventive species in their phytocoenoses.

16. Plantaginetea majoris Tx. and Prsg. 1950 (Pl)

In this vegetation class, 16 associations (Fig. 1, Pl) include in their floristic composition the following 40 adventive species: *Amaranthus albus, A. blitoides, A. crispus, A. deflexus, A. retroflexus, Amorpha fruticosa, Artemisia annua, Brachyactis ciliata, Capsella rubella, Chenopodium ambrosioides, Coriandrum sativum, Coronopus didymus, Cuscuta campestris, Diplotaxis erucoides, Duchesnea indica, Erigeron annuus, E. canadensis, Euphorbia maculata, E. nutans, Galinsoga quadriradiata, G. parviflora, Helianthus tuberosus, Heliotropium currasavicum, Iva xanthifolia, Juncus tenuis, Lepidum densiflorum, L. virginicum, Matricaria discoidea, Medicago sativa, Oenotherra biennis, Oxalis stricta, Petunia parviflora, Salvia reflexa, Sisyrinchium montanum, Solanum triflorum, Trifolium hybridum, T. incarnatum, Veronica persica, Xanthium italicum, X. spinosum*. The following 10 associations aggregate in their floristic composition most adventive plants, three to eleven species: Artemisio (annuae)-Heliotropietum currasavicae Dihoru and Negrean 1975, Dauco-Matricarietum inodorae I. Pop 1966, Duschesnetum indicae Viţalariu and Horeanu 1991, Eragrostio-Euphorbietum maculatae Mititelu and Barabaş 1978, Juncetum tenuis Felföldy 1942, Lolio-Plantaginetum majoris (Linkola 1921) Beger 1930, Poëtum annuae Gams 1927, Polygonetum avicularis Gams 1927 – matricarietosum discoideae (Morariu 1967 n.n) Pázmany 1971, Potentillo (supinae)-Petunietum parviflorae Dihoru and Negrean 1975, Rorippo (silvestris)-Agrostetum stolonoferae (Moor 1958) Oberdorfer and Müler 1961. Six other ruderal associations aggregate their floristic composition in one to two adventive species.

Vegetal communities that are typical for alluvial, humid-swampy soils, as well as humid depressions that are cultivated

17. Bidentetea tripartiti Tx., Lohm. and Prsg. 1950 (Bi)

In the seven associations (Fig. 2, Bi) of this class, 22 adventive species (Fig. 1, Bi) have been identified: *Abutilon theophrasti, Amaranthus albus, A. blitum, A. retroflexus, Armoracia rusticana, Artemisia annua, Bidens frondosa, B. vulgata, Chenopodium ambrosioides, C. murale, Cyperus difformis, Erigeron* *canadensis, Galinsoga quadriradiata, G. parviflora, Helianthus annuus, Kochia scoparia, Matricaria discoidea, Trifolium hybridum, Veronica persica, Vicia sativa, Xanthium italicum, X. riparium*. The following seven associations being analyzed include in their floristic composition, two to nine adventive species: Bidentetum tripartiti (W. Koch 1926) Libbert 1932, Echinochloo-Polygonetum lapathifolii (Ujvárosi 1940) Soó and Csürös (1944) 1947, Echinochloo crus gallii-Galinsogetum parviflorae Burduja and F. Diaconescu 1976, Echinochloo-Setarietum lutescentis Felföldy 1942, em. Mucina 1993, Polygono lapathifolii-Bidentetum tripartiti Klika 1935, Xanthietum riparii Morariu 1943, and Xanthio strumarii-Chenopodietum albi I. Pop 1968.

Extant tall weeds communities in deforested grounds along streams and in sheep-folds

18. Epilobietea Tx. and Prsg. in Tx. 1950 (Ep)

There are four associations that are part of this class (Fig. 2, Ep), the adventive plants are scarce, and the class includes six species (Fig. 1, Ep): *Erigeron annuus, E. canadensis, Erechtites hieracifolia, Galinsoga parviflora, Impatiens parviflora*, and *Thladianta dubia*.

The adventive species mentioned are integrated in the associations Atropetum bella-donnae (Br.-Bl. 1930) Tx. 1931 em. 1950, Calamagrostietum epigeii Jurasek 1928, Fragario-Rubetum (Pfeiffer 1936) Siss. 1940, Telekio (speciosae)-Petasitetum albae Beldie 1967.

Nemoral-amnicolous communities of willows and underbrush

19. Salicetea purpureae Moor 1958 (Sa.p)

There live 24 adventive species (Fig. 1, Sa.p) in seven associations (Fig. 2, Sa.p). The adventives are: *Amaranthus deflexus, Amorpha fruticosa, Asclepias syriaca, Aster lanceolatus, Echinocystis lobata, Erigeron annuus, E. canadensis, Galinsoga quadriradiata, G. parviflora, Helianthus decapetalus, H. tuberosus, Impatiens glandulifera, Juncus tenuis, Morus alba, Oenothera biennis, Oxalis stricta, Phytolacca americana, Robinia pseudacacia, Rudbeckia laciniata, Solidago canadensis, S. gigantea, Xanthium italicum, X. riparium, X. spinosum*. The following seven associations include in their phytocoenoses, three to eleven species: Calamagrosti-Tamaricetum ramosissimae Simon and Dihoru 1963, Calamagrostio-Salicetum cinereae Soó and Zolyomi 1934, Hippophaë-Salicetum eleagni (Br. Bl. 1933) Br.-Bl. and Volk 1940, Myricario-Epilobietum Aichinger 1933, Salicetum albae Issler 1924, -amorphosum fruticosae Morariu and Danciu 1970, Salicetum purpureae Wendellberger-Zelinka 1952, Salicetum triandrae Malcuit 1929 – amorphosum fruticosae (Borza 1954 n.n) Coste 1975.

Nemoral communities

20. Querco-Fagetea Br.-Bl. and Vlieger 1937 (Q-F)

The deciduous communities are populated sporadically and inconsistently by 16 adventive species: (Fig. 1, Q-F), gathered from 10 associations: (Fig. 2, Q-F): *Ailanthus altissima, Amorpha fruticosa, Cytisus scoparius, Echinocystis lobata, Elsholzia ciliata, Erechtites hieracifolia, Erigeron annuus, E. canadensis, Impatiens parviflora, Inula helenium, Oxalis stricta, Parthenocissus inserta, Robinia pseudacacia, Rudbeckia laciniata, Scilla sibirica*, and *Solidago gigantea*.

The amnicolous communities of alder and ash-elm groves

21. The nemoral communities being mentioned are to a slight degree, and seldom populated with adventive plants, represented by the following eight species, gathered from two associations: *Amorpha fruticosa, Echinocystis lobata, Elsholzia ciliata, Erigeron annuus, E. canadensis, Robinia pseudacacia, Rudbeckia laciniata*, and *Solidago gigantea*.

The adventive species being mentioned, are integrated in the following associations: Aegopodio-Alnetum Kárpati and Jurkó 1961, and Telekio speciosae-Alnetum incanae Coldea 1990.

The nemoral communities of common oak and durmast oak living together with hornbeam and turkey oak, also thermophilous shrubs

22. The phyto-coenological studies undertaken so far in Romania point out the fact that the deciduous forests and thickets are to a minor degree and seldom populated by the following 10 adventive species: *Ailanthus altissima, Cytisus scoparius, Erechtites hieracifolia, Erigeron annuus, E. canadensis, Impatiens parviflora, Inula helenium, Oxalis stricta, Parthenocissus inserta*, and *Scilla sibirica*.

There have been identified one to two species in seven associations: Fraxino-Ulmetum (Tx. 1952) Oberd. 1958, Querco petraeae-Carpinetum Soó and Pócs 1957, Querco robori-Carpinetum Soó and Pócs (1931) 1957, Quercetum robori-cerris Csápody and Soó 1969, Quercetum petraeae-cerris Soó 1957, Pruno spinosae-Crataegetum Soó (1927) 1931, and Syringo-Cotinetum coggyriae (Borza 1931 n.n) Resmeriţă 1972.

Nemoral communities of *Robinia pseudacacia*

23. Robinietea Jurkó ex Hadać and Sofron 1980 (R)

According to sources as (Negulescu E. and Săvulescu A. 1956), *Robinia pseudacacia,* originating in North America, was introduced in Romania by the Turks in 1770 (which explains the popular Romanian name of "salcâm"). The first acacia forests were initiated in Oltenia (1852), aiming at settling down sandy areas. Those were followed by extensive forestation beginning in 1883, on the sands of Oltenia and on those of North East Muntenia, North Moldova, and North East Transylvania. Sometimes, acacias are found integrated in nemoral communities. Until present, the acacia forests in Romania have been granted little phyto-coenological research; they fall into the following two associations: Bromo sterilis-Robinietum (Pócs 1954) Soó 1964 and Agropyro-Robinietum pseudacaciae A. E. Szabó 1971 (Fig. 1, R; Fig. 2, R).

Relations between adventive plants, natural vegetal communities, and crop plants

Due to their poor competitiveness, adventive plants are distributed sporadically and inconsistently, particularly in the pratal and nemoral communities. In the open vegetal communities, in the ruderal and segetal habitats, they are a major presence: they live along with the indigenous weeds, and in doing so, they create some characteristic associations.

In the cereal (agrophytocoenoses) crops, the adventive plants that have joined the indigenous weeds causing great damage by consuming the water and the nutrients in the ground, the crops are significantly diminished both in quantitative and in qualitative terms.

One of the most damaging adventive weeds, having an aggressive impact on our crops, is *Ambrosia artemisiifolia.* Originating from North America, its germs were introduced involuntarily in some European countries in 1863 along with imported food products. In Romania, this plant arrived in a similar manner; it was first seen in South Banat (Orşova, Romania).

Ambrosia artemisiifolia was integrated in ruderal communities, whereby in certain phytocoenoses in Moldova (Iaşi) it prevailed (Viţalariu, 1973). From the ruderal habitats, migrated into crops, where it prevailed as an aggressive and extremely damaging agent. The first information on the taxonomy, biology, distribution and damage produced by *Ambrosia artemisiifolia*, both in Romania and in other countries, was given by Ţopa and Boşcaiu (1965).

The authors cited noted "this plant has been in full spread given the paedo-climatic conditions. It entered in expansion phase in the last decade, which sometimes results into the smothering of certain crops, including the utter loss of the crop".

For that reason, "in Romania, *Ambrosia artemisiifolia* has been declared a quarantine-level weed". Studies undertaken in the US and in some European countries also show the noxious effects of the *Ambrosia artemisiifolia* pollen released in the atmosphere, which causes allergies – especially to people who are sensitive.

In Romania, Vicol (1971) pointed out the allergenic effects of pollen, based on determining the degree of constant infection of the atmosphere (March – November) with pollen from many species (both woody and herbaceous) that are subordinated to 47 genera, among which is *Ambrosia artemisiifolia*. The prediction wasv done by Țopa and Boșcaiu concerning the expansion and the aggressivity of the species *Ambrosia artemisiifolia*.

In this vein, Hodișan stated in the abstract of his doctoral thesis (2007), that after 1991, *Ambrosia artemisiifolia* has expanded its spreading area in Romania, with the transition from "a centralised agriculture to a privately-managed one, particularly because of the failure to cultivate large areas of land, but mainly on account of disobeying the provisions of agricultural technologies and the plant-health regulations".

The research performed by the author cited, based on five-year-long studies in the field (2003-2007) on the biology and the spreading of the species *Ambrosia artemisiifolia* in such localities as Valea lui Mihai (near Oradea) and Tinca (both in Bihor County), show that at present weeds cover the whole of North-West Romania, being the cause in some areas of significant damage to crops. Up to the research by Hodișan, *Ambrosia artemisiifolia* was not known as present in Bihor County, which denotes that it has rather recently migrated from Hungary.

CONCLUSIONS

The studies undertaken in all parts of Romania show that it is necessary to monitor the spreading, and also to fight those weeds that are damaging for both agriculture and human health.

The adventive species recently acclimatised in Romania must be observed, as they tend to manifest an aggressive expansion, particularly in the crops.

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THE JUNCO-MOLINIETUM PREISING 1951 ASSOCIATION IN THE ORĂŞTIE RIVER BASIN (MERIDIONAL CARPATHIANS, ROMANIA)

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KEYWORDS: habitat 6410, floristic elements, life forms, ecological indices, Orăştie Basin, Meridional Carpathians, Transylvania, Romania.

ABSTRACT

In the current paper the authors aim at the study of phytocoenoses of the association Junco-Molinietum Preising 1951 found in the upper part of the Orăştie River basin, situated in Orăştiei Culoar and in the Şureanu Mountains, in central-western Romania.

These associations belong to the habitat 6410 type, *Molinia* pastures on carbonate soils, bogs or on silt-clay substrates (Molinion coeruleae). It is a natural habitat requiring protection through special conservation areas.

In the coenoses of the association Junco-Molinietum Preising 1951 developed on flat terrains with rich humidity grow the vulnerable species *Iris sibirica.*

This study wants to analyze the phytocoenoses of the association in terms of physiognomy, floristic composition, life forms, floristic elements and ecological indices as well as of the ecological preferences of the identified species.

REZUMAT: Junco-Molinietum Preising 1951 în bazinul râului Orăştie (Carpaţii Meridionali, România).

Autorii prezintă un studiu al fitocenozelor asociaţiei Junco-Molinietum Preising 1951, identificate în bazinul râului Orăştie situat în Culoarul Orăştiei şi Munţii Şureanu, partea central-vestică a României.

Aceste grupări se înscriu în tipul de habitat de interes comunitar 6410, pajişti cu *Molinia* pe soluri carbonatice, turboase sau luto-argiloase (Molinion caeruleae). Este un habitat natural care necesită ocrotire prin desemnarea de arii speciale de conservare.

În cenozele asociaţiei Junco-Molinietum Preising 1951 dezvoltate pe terenuri plane, cu umiditate ridicată, vegetează specia vulnerabilă *Iris sibirica.*

Fitocenozele asociaţiei sunt analizate sub aspectul fizionomiei şi compoziţiei floristice, al bioformelor, elementelor floristice şi al preferinţelor ecologice ale speciilor identificate.

RÉSUMÉ: L’association Junco-Molinietum Preising 1951 du bassin du rivière Orăştie (les Carpates Méridionales, Roumanie).

Les auteurs présentent une étude des phytocénoses de l’association des Junco-Molinietum Preising 1951, identifiées dans le bassin du rivière Orăştie, situé dans le Couloir d’Orăştie et les montagnes Şureanu, dans la partie centre-ouest de la Roumanie.

Ces groupes font partie d’un type d’habitat d’intérêt communautaire 6410, les prairies à *Molinia* avec les sols carbonatés, tourbeux ou argileux (Molinion caeruleae). C’est un habitat naturel qui nécessite d’être protégé à travers la désignation de zones spéciales de conservation.

Dans l’association Junco-Molinietum Preising 1951 les cénoses sont développées sur un terrain plat, avec une humidité élevée, où végète l’espèce vulnérable *Iris sibirica.*

Les phytocénoses de l’association sont analysées du point de vue de leur physionomie et de leur composition floristique, des bioformes, des éléments floraux et des indices écologiques.

INTRODUCTION

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

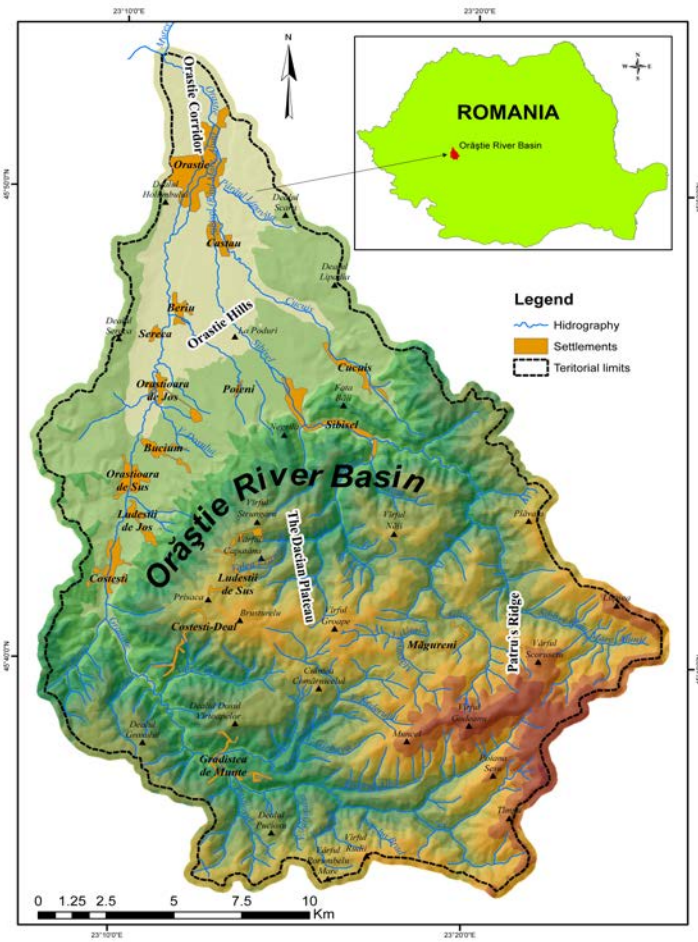

Figure 1: Orăştie River basin; basin position within Romania.

The association Junco-Molinietum Preising 1951, was identified in the Orăştie Corridor, geographically located in the northern sector of the Orăştie River basin.

The Orăştie Corridor is a typical valley corridor, displaying valley landforms such as floodplains and terraces. The terrace system is well developed, the lower and intermediate ones being strongly fragmented by the rivers of Orăştie, Sibişel and Cucuiş. At the level of the higher terraces the geomorphologic complexity becomes apparent as they superimpose on the lower piedmont (380-520 m a.s.l.), with altitudinal steps which are highly fragmented into large and elongated interfluves (Zotic, 2007).

The typical soils belong to Preluvisols (Gray Luvisols) and Luvisols (Gray Brown Luvisols) (Pătru et al., 2006).

The climate features are influenced by the landforms, the depressions and the river corridors are displaying yearly average temperatures of 7-10ºC and 600-800 mm of rainfall (Filip, 2010).

In the warm season the air circulation is generally eastward and south-eastward, carrying the humid Atlantic cyclones, which generate abundant rainfall. In the cold season the precipitations are much scarcer, as they are brought about mainly by anticyclones. (Filip, 2010)

In Romania the association was reported to appear in Banat (Borza, 1946; Boşcaiu, 1965), Maramureş, Transilvania (Borza and Raţiu, 1970; Gergely and Raţiu, 1973; Parascan and Danciu, 1976), Moldova (Pascal and Mititelu, 1971; Chifu et al., 2006), etc.

MATERIAL AND METHODS

The vegetation studies which took place 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 Junco-Molinietum Preising 1951. The vegetation research deployed the Braun-Blanquet (1964) phytocoenologic survey methods, 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.

In order to thoroughly identify the phytocoenoses of the association, we performed six phytocoenologic relevées, of which three were included in the synthetic table of the association (Tab. 1).

The sampling sites were carefully chosen within the characteristic patches of the phytocoenoses, their sizes matching 100 square metres each (Cristea et al., 2004).

The phytocoenologic worksheets contain information regarding the stational habitat conditions in which the phytocoenoses evolve: rock, soil, altitude, vegetation coverage. When we took down the taxa that define each relevée, we also gave a quantitative appraisal of the participation of 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 designed according to the methodology envisaged by Braun-Blanquet (1964) and developed by Ellenberg (1974). While framing the association into the superior coeno-taxonomic units, namely suballiance, alliance, order, class, we took into consideration the traditional ecological-floristic systems built by the authors Tüxen (1955), Braun-Blanquet (1964), Borza and Boşcaiu (1965), as well as the more recent papers by the scientists: Mucina et al. (1993), and 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 cariotype, the ordinal numbers of the relevées, the absolute altitude in metres (a.s.l.), the overall vegetation coverage (%) and the sampled surface (m^2).

The taxa nomenclature was done according to Ciocârlan (2009), and the association was analysed using the main ecological indices of the component species (Sanda et al., 2005), life forms and floristic elements, the data was displayed through spectra and diagrams (Cristea et al., 2004).

RESULTS AND DISCUSSION

The phytocoenoses of the association vegetate on flat, wet surfaces, on gleic soils with moderate to slight acid reaction.

Physiognomy and floristic composition. The characteristic and dominant species, *Molinia caerulea*, holds an average coverage of 37.5-62.5%, together with the other two characteristic species, *Juncus effusus* and *Juncus conglomeratus*.

The floristic inventory of the association totals 52 species (Tab. 1). Along with the three characteristic species of the association, the association's phytocoenoses also include cormophytes pertaining to the alliance **Molinion caeruleae** (*Carex distans, Gratiola officinalis, Iris sibirica, Selinum carvifolium,* etc.), order **Molinietalia caeruleae** (*Cirsium canum, Cirsium palustre, Filipendula ulmaria, Galium palustre, Succisa pratensis,* etc.) and class **Molinio-Arrhenatheretea** (*Agrostis stolonifera* ssp. *stolonifera, Alopecurus pratensis, Anthoxanthum odoratum, Lysimachia nummularia, Ranunculus repens, Valeriana officinalis*, etc.).

The phytocoenoses of the association host species of the class **Phragmitetea australis** (*Iris pseudacorus*, *Lycopus europaeus*, *Lysimachia vulgaris*, *Phragmites australis*) and accompanying plants (*Mentha arvensis*, *Filipendula vulgaris*, *Eupatorium cannabinum*, *Carex nigra*, *Eriophorum latifolium*, etc.).

Analysed from a life forms spectrum (Fig. 2) point of view, the association's phytocoenoses result dominated by hemicryptophytes (71.15%), followed by geophytes (15.38%), terophytes (5.76%), and helohidatophytes (3.84%).

The floristic elements spectrum (Fig. 3) highlights the fact that the Eurasian elements are predominant among the association's phytocenoeses (59.61%), followed by the Circumpolar (25%), the Cosmopolitan (9.61%), the European (3.84%), and the Adventive ones (1.92%).

The analysis of the diagram of ecological indices (Fig. 4) reveals a majority of meso-hygrophilous species (42.30%), followed by mesophilous species (30.76%), then hygrophilous species (17.30%).

If analysed thermically, one can notice the dominance of micro-meso-thermophilous species (67.26%), followed by euri-thermophilous species (26.92%), and micro-thermophilous species (5.76%).

The chemical reaction of soils outlines the species that are euri-ionical (65.38%), mildly acid-neutrophilous (19.23%), and also acid-neutrophilous (11.53%).

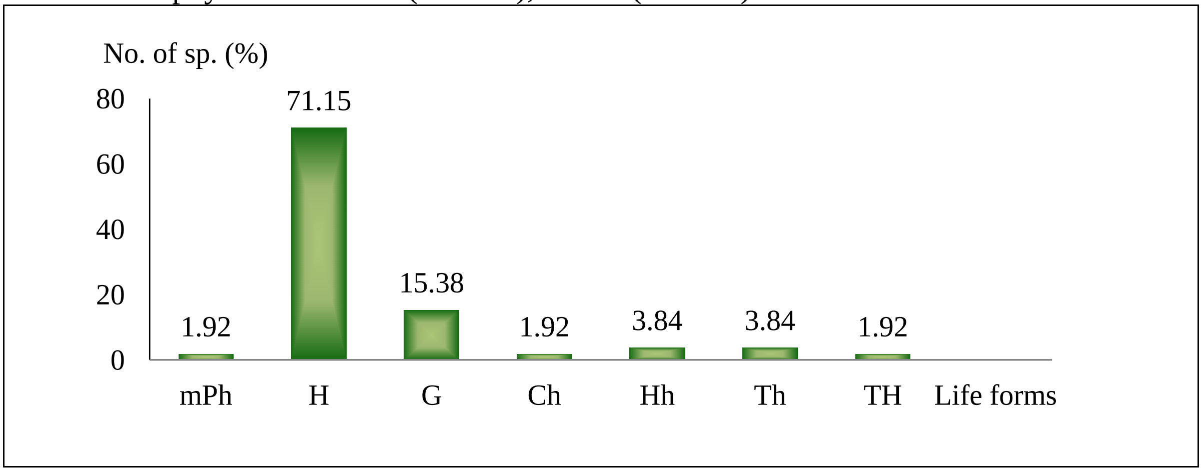

Figure 2: Life forms spectrum of the association Junco-Molinietum Preising 1951, where: mPh – Mezophanerophytes; H – Hemicryptophytes; G – Geophytes; Ch – Chamaephytes; Hh – Helohidatophytes; Th – Annual therophytes; TH – Biennial therophytes.

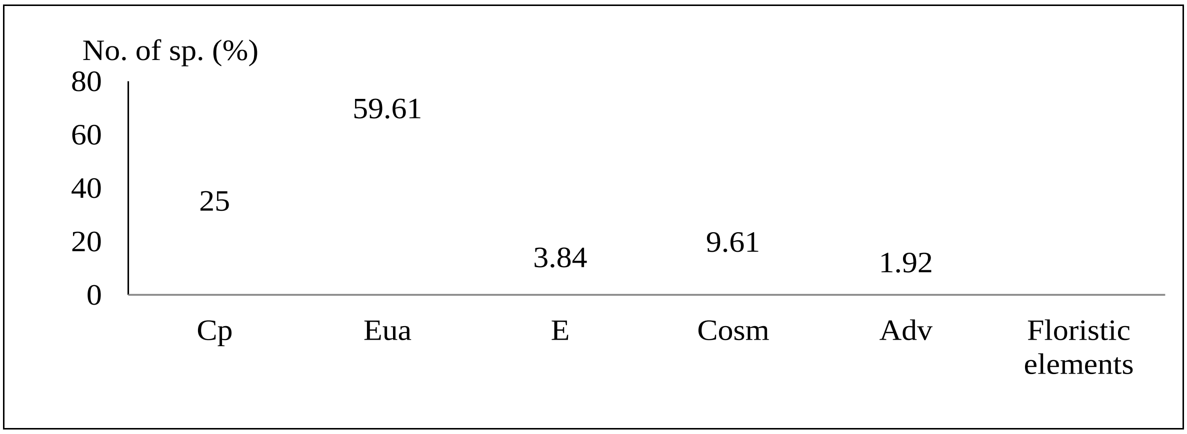

Figure 3: Spectrum of floristic elements of the association Junco-Molinietum Preising 1951, where: Circumpolar – Cp; Eua – Eurasian; E – European; Cosm – Cosmopolitan; Adv – Adventive.

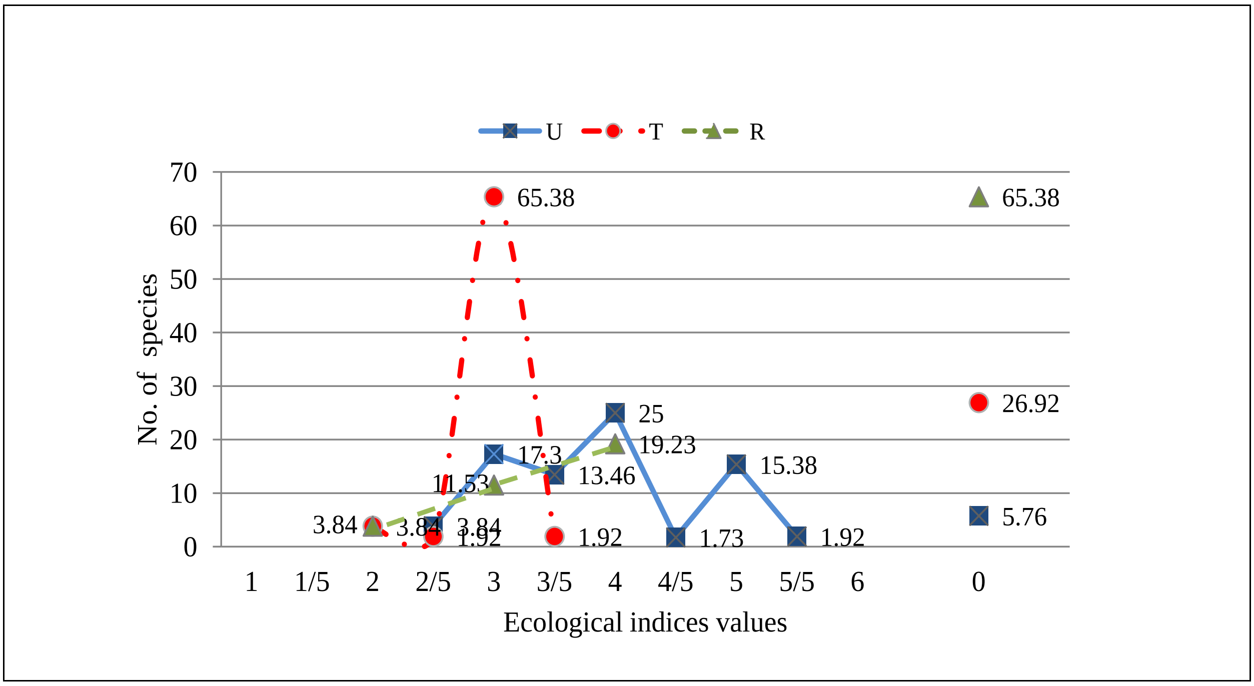

Figure 4: Diagram of ecological indices for the association Junco-Molinietum Preising 1951, where: U – humidity, T – temperature, R – the chemical reaction of the soil.

CONCLUSIONS

The behaviour of cormophytes in terms of humidity, temperature and the chemical reaction of soils emphasizes the prevalence in the association's phytocoenoses of the meso-hygrophyle, micro-meso-thermophyle and euri-ionical species.

The life form's spectrum is dominated by hemicryptophytes, followed by geophytes, whereas the spectrum of floristic elements sorts out the Eurasian species.

The existence of 5.76% terrophytes shows a certain degree of anthropisation of the phytocoenoses under analysis, determined by the settlements nearby. The high percentage of the poliploid species in the phytocoenoses of the association Junco-Molinietum Preising 1951 had an influence on the resilience of these vegetal communities to the zoo-anthropic pressure.

The association's phytocoenoses that host the vulnerable species (Boşcaiu et al., 1964) *Iris sibirica* cover small areas (around 400 m^2) by the county road 705F between the villages Căstău and Sibişelul Vechi and inside Sibişelul Vechi (Beriu township). Since the areas covered by the Junco-Molinietum Preising 1951 association border some crops, they might merge into the agricultural circuit. This is why we strongly suggest that a natural reserve should exist between Căstău and Sibişelul Vechi (Beriu township).

Table 1: Association **Junco-Molinietum** Preising 1951.

L. f.	Fl. e.	U	T	R	C	No. Land Surveys	1	2	3
						Altitude (m.s.m.)	312	340	340
						Coverage (%)	100	90	80
						Surface (m^2)	100	100	100
1	2	3	4	5	6	7	8	9	10
						Car. ass.			
H	Eua	4	3	0	P	*Molinia caerulea*	3	4	4
H	Cosm	4.5	3	3	P	*Juncus effusus*	+	.	+
H	Cosm	4.5	3	3	P	*Juncus conglomeratus*	+	+	.
						Molinion caeruleae			
H	Eua(M)	4	3	4	P	*Carex distans*	+	+	.
H	Cp	4.5	3	4	P	*Gratiola officinalis*	+	+	+
G	Eua	4.5	3.5	4.5	P	*Iris sibirica*	2	+	+
H	Eua	3	3	0	P	*Sanguisorba officinalis*	+	+	+
H	Eua	3.5	3	3	D	*Selinum carvifolium*	+	.	+
H	Eua	3.5	3	0	D	*Serratula tinctoria*	+	+	.
H	Eua	3	3	0	D	*Stachys officinalis*	+	+	+
						Molinietalia caeruleae			
G	Eua(C)	4.5	3	4.5	D	*Cirsium canum*	1	+	.
TH	Eua	4.5	3	2.5	D	*Cirsium palustre*	.	+	+
H	Eua	4.5	2	0	DP	*Filipendula ulmaria*	+	+	+
H	Cp	5	3	0	DP	*Galium palustre*	1	+	+
H	Eua	3.5	2.5	0	D	*Lychnis flos-cuculi*	+	+	+
H-Hh	Cp	4	3	0	P	*Lythrum salicaria*	+	+	+
Th	Eua	3	3	0	P	*Odontites vernus*	+	.	.
H	Eua	4	3	0	D	*Succisa pratensis*	.	1	+
H	Eua	4	3	0	P	*Symphytum officinale*	+	+	+
						Molinio-Arrhenatheretea			
H	Eua	3	0	0	P	*Achillea millefolium*	+	+	.
H(G)	Cp	0	0	0	P	*Agrostis capillaris*	+	+	+
H	Cp	4	0	0	P	*Agrostis stolonifera*	+	1	+
H	Eua	4	3	0	P	*Alopecurus pratensis*	1	+	+
H	Eua	0	0	0	P	*Anthoxanthum odoratum*		+	+
H	Eua	3	0	4	P	*Dactylis glomerata*	+	+	.
H	Eua	3	0	3	D	*Galium mollugo*	+	.	+
Ch	E	4	3	0	P	*Lysimachia nummularia*	+	+	+
H-Hh	Eua	5	3	0	P	*Myosotis scorpioides*	+	+	+
H	Cosm	3	0	0	P	*Poa pratensis*	+	.	.
H	Eua(M)	3.5	0	0	D	*Ranunculus acris*	.	+	+
H	Eua	4	0	0	P	*Ranunculus repens*	+	.	+
Hh-G	Cp	4.5	3	0	P	*Scirpus sylvaticus*	.	+	.
H	Eua	2.5	2	3	D	*Stellaria graminea*	+	.	+
H	Eua	3.5	0	0	P	*Trifolium repens*	+	+	+
H	Eua(M)	4	3	4	D	*Valeriana officinalis*	+	.	+

Table 1 (continued): Association **Junco-Molinietum** Preising 1951.

1	2	3	4	5	6	7	8	9	10
						Phragmitetea australis			
G	E	5.5	0	0	DP	*Iris pseudacorus*	1	+	+
Hh	Eua	5	3	0	D	*Lycopus europaeus*	+	+	.
H-Hh	Eua	5	0	0	P	*Lysimachia vulgaris*	+	+	+
Hh	Cosm	5	0	4	P	*Phragmites australis*	+	+	+
						Variae syntaxa			
H-G	Cp	4	3	0	P	*Mentha arvensis*	+	+	+
H	Eua	2.5	3	0	D	*Filipendula vulgaris*	+	+	+
mPh	Eua	5	3	3	P	*Salix cinerea*	+	+	+
Hh-G	Cp	5	3	0	P	*Carex acuta*	+	.	.
H	Cp	4.5	3	0	P	*Carex flava*	.	+	.
G	Cp	0	3	0	P	*Carex hirta*	+	.	.
G	Cp(Bor)	4	3	2	P	*Carex nigra*	1	.	.
H	Eua	4	3	0	D	*Eupatorium cannabinum*		+	+
G	Cosm	3	3	0	D	*Equisetum arvense*	+	.	.
H	Cp	5	0	4.5	DP	*Eriophorum latifolium*	.	+	.
G	Adv	3.5	3	4	P	*Juncus tenuis*	+	.	.
Th	Eua(C)	3.5	3	4	DP	*Myosotis sparsiflora*	+	.	.
H	Cp	3	3	0	P	*Prunella vulgaris*	.	.	+

Sampling sites: 1 by the county road 705F between Căstău and Sibişelul Vechi (25.05.2013, 15.09.2013); 2-3 Sibişelul Vechi (14.07.2012); where: L. f. – life forms: mPh – Mezophanerophytes; H – Hemicryptophytes; G – Geophytes; Ch – Chamaephytes; Hh – Helohidatophytes; Th – Annual terophytes; TH – Biennial terophytes; Fl.e. – floristic elements: Cp – Circumpolar; Eua – Eurasian; E – European; Cosm – Cosmopolitan; Adv – Adventive. Ecological indices: U – humidity; T – temperature; R – the chemical reaction of the soil. Cariotype: D – diploide, P – poliploide, DP – diploide-poliploide.

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LAND SNAIL COMMUNITY DYNAMICS ALONG THE CIBIN RIVER VALLEY (TRANSYLVANIA, ROMANIA)

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KEYWORDS: land snail fauna, biodiversity, conservation, Cibin River valley.

ABSTRACT

The paper presents the results of a study carried out during 2012-2014, with the aim of analysis of terrestrial gastropod communities from natural and anthropogenic habitats along the Cibin River valley. In total 42 land snail species were identified. The highest level of species richness and also the largest number of individuals were recorded in the mountain area. Among the dominant species in this area are *Isognomostoma isognomostomos*, *Monachoides vicinus*, and *Drobacia banatica.* In the sampling sites from the rural lowland area, the remnant willow meadows shelter land snail communities dominated by ubiquitous species. In the urban sector, the riparian habitats are heavily degraded and the land snail communities present here reflect the ambivalence of habitat conditions through the simultaneous presence of hygrophilous and mezoxerophilous species.

REZUMAT: Dinamica comunităților de gastropode terestre de-a lungul văii râului Cibin (Transilvania, România).

Lucrarea prezintă rezultatele unui studiu derulat în intervalul 2012-2014, studiu care analizează comunitățile de gastropode terestre din habitate naturale și antropizate de-a lungul văii râului Cibin. În materialul analizat au fost identificate 42 de specii de gastropode terestre. Cea mai mare diversitate specifică și totodată cel mai mare număr de indivizi au fost înregistraţi în zona montană. Dintre speciile dominante în acest sector sunt *Isognomostoma isognomostomos*, *Monachoides vicinus* și *Drobacia banatica.* În punctele de colectare din zona depresionară rurală, resturile zăvoaielor de sălcii adăpostesc comunități de gastropode terestre în care domină specii ubiquiste. În sectorul urban, habitatele ripariene sunt puternic degradate, iar comunitățile de gastropode terestre de aici reflectă ambivalența condițiilor de habitat prin prezența simultană a speciilor higrofile și a celor mezoxerofile.

RÉZUMÉ: La dynamique des communautés de gastéropodes terrestres le long de la vallée de la Rivière Cibin (Transylvanie, Roumanie).

Cet article présente les résultats de l'étude menée entre 2012-2014 avec l'objectif d'analyser les communautés de gastéropodes terrestres habritant d'habitats naturels et anthropiques le long de la vallée de la Rivière Cibin. Dans le matérial analysé ont été identifiés 42 espèces de gastéropodes terrestres. La plus grande diversité d'espèces et aussi la plus grand abondance a été trouve dans la region montagne. Parmis ses espèces dominantes dans ce secteur sont *Isognomostoma isognomostomos*, *Monachoides vicinus* et *Drobacia banatica.* Dans les points de prelevement de la region dépressionaire rurale, les restes des habitats riveranes abritent des communautés de gastéropodes terrestres dominees d'espèces ubiquiste. Dans le secteur urbain, les habitats riverains sont fortement dégradées et les communautés de gastéropodes terrestres presente reflète l'ambivalence des conditions d'habitat par la présence simultanée d'espèces hydrophiles et ceux mésoxérophiles.

INTRODUCTION

Most of the land snail species are associated with the presence of humidity, regardless of the habitat type. Moisture is one of the most important limiting factors for land snail populations. This is mainly true when the other two essential requirements, soil calcium and high pH levels are not met, as is the case on schist substrate and in spruce or mixed forests.

The Cibin hydrographic basin is located where the Southern Carpathians (Cindrel Mountains) meet the Transylvanian Depression. It consists of two distinct geological units, one of crystalline schist in the mountain area, covered by acid mountain soils, and the other represented by the sedimentary depressionary area, with argillo-illuvial soils (Posea, 1982). The mountain area is covered by spruce and mixed forests, while in the depressionary area the natural habitats are scarce, as most of the land is covered by human settlements and cultivated fields. The human impact in the area is significant as was previously shown for aquatic habitats (Curtean-Bănăduc, 2000; Curtean-Bănăduc and Bănăduc, 2001, 2004). Many activities have a negative impact on the riverine areas, being reflected in the distribution of land snails. In densely populated areas, the river valleys are one of the most important biodiversity corridors, and their disappearance affects mainly species with low mobility, such as the land snails.

The present work focuses on the variations of land snail fauna along the Cibin River valley, caused by natural changes in habitat and the human impact.

MATERIAL AND METHODS

Samples were taken from nine sampling sites located along the Cibin River valley. Among them four are situated in the mixed forest from the mountain area, starting upstream of the Cibin Gorges (S1) downstream to Gura Râului water reservoir (S4), two in rural areas, downstream of rural settlements, namely Gura Râului (S5) and Veştem (S9), and two in the urban area, in Sibiu town (S6 and S7). The geographic position of the sampling sites is indicated in figure 1 and described below.

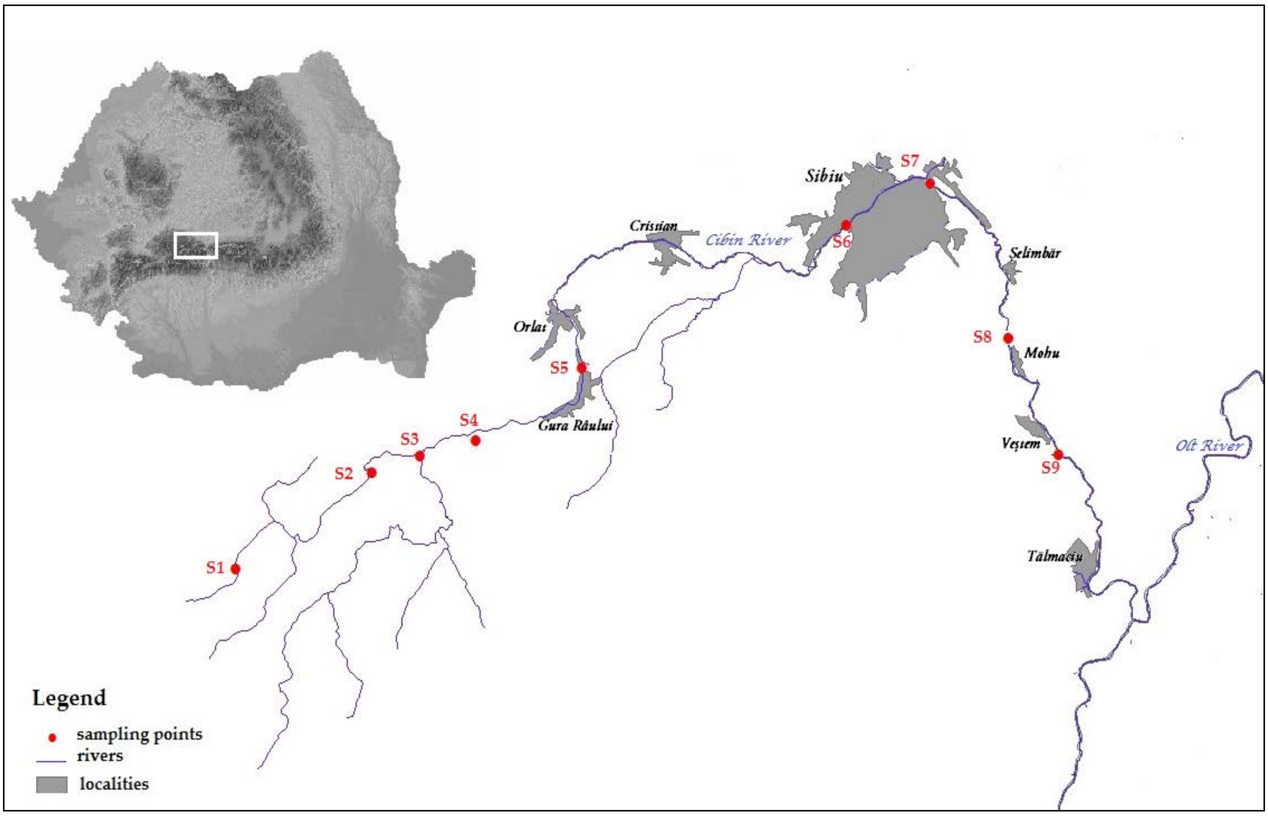

Figure 1: Location of the sampling stations.

S1 – upstream Cibin Gorges; 45.661567 N, 23.789005 E, 1,153 m altitude;
S2 – Cibin Gorges; 45.697787 N, 23.864192 E, 896 m altitude;
S3 – downstream Cibin Gorges; 45.704021 N, 23.891315 E, 698 m altitude;
S4 – near the Gura Râului water reservoir; 45.710254 N, 23.922214 E, 654 m altitude;
S5 – downstream Gura Râului locality; 45.737548 N, 23.981845 E, 507 m altitude;
S6 – upstream Sibiu – Turnişor; 45.791282 N, 24.129311 E, 415 m altitude;
S7 – downstream Sibiu – Guşteriţa; 45.806157 N, 24.178644 E, 400 m altitude;
S8 – upstream Mohu; 45.746009 N, 24.222053 E, 386 m altitude;
S9 – near Veştem; 45.707527 N, 24.250007 E, 376 m altitude.

Samples were taken from plots of 100 m^2, by the two researchers for about an hour. All the living snails and freshly empty shells from vegetation, litter and decomposing wood were collected. The visual search effort was quantified. The same amount of time (one hour) was used to collect samples in all sites. In order to collect small litter-living snail species, in every sampling point 20 litres of leaf litter was sieved (Pokryszko and Cameron, 2005). Slugs were not collected. The leaf litter was sorted in the laboratory, and the snails were determined using the identification characters and keys given by Grossu (1981, 1983, 1986 and 1987), Kerney and Cameron (1979) and Welter-Schultes (2012). The classification follows Fauna Europaea (Bank, 2011).

RESULTS AND DISCUSSION

A total of 42 land snail species was found in the area (Tab. 1). The number of species and specimens for each sampling station is represented in figure 2. The highest species richness was recorded in the sampling sites from the mountain area, although the diversity is considerably lower than usually found in forests, and associated with a water source (Cameron et al., 2011).

Table 1: List of the land snail species recorded in the nine sampling stations; the relative abundance of snail species in samples taken from the mountain area (AR% mont.), rural area (AR% rural), and urban area (AR% urban). The frequency (F%) and the relative abundance considering all nine sampling stations (AR% tot) are also presented.

Species	AR% mont.	AR% rural	AR% urban	F%	AR% tot	Sampling stations
Carichium tridentatum (Risso, 1826)	0	**8.33**	**12.82**	44.44	5.25	5, 6, 7, 8
Succinea putris Linnaeus, 1758	0	3.03	**23.076**	55.55	5.5	5, 6, 7, 8, 9
Vallonia costata (Müller, 1774)	0.66	0	0	11.11	0.125	3
Vallonia pulchella (Müller, 1774)	0.00	0.757	0	22.22	0.25	8, 9
Merdigera obscura (Müller, 1774)	0.00	1.515	0	22.22	0.5	8, 9
Chondrula tridens (Müller, 1774)	0.00	0.757	0	100	0.25	9
Ena montana (Draparnaud, 1801)	**7.30**	0	0	33.33	3.25	1, 2, 3
Cochlodina laminata (Montagu, 1803)	1.69	**16.66**	0	55.55	6.25	3, 4, 5, 8, 9
Macrogastra borealis (Boettger, 1878)	0.00	6.06	0	22.22	2	5, 9

Clausilia dubia Draparnaud, 1805	1.69	3.03	0	66.66	1.75	1, 2, 3, 5, 8, 9
Balea stabilis (Pfeiffer, 1847)	2.81	0	0	11.11	1.25	3
Balea fallax (Rossmässler, 1836)	**7.87**	6.818	0	77.77	5.75	1, 2, 3, 4, 5, 8, 9
Vestia elata (Rossmässler, 1836)	6.46	7.575	0	66.66	5.375	1, 2, 3, 5, 8, 9
Bulgarica cana (Held, 1836)	0.56	0	0	22.22	0.25	3, 4
Bulgarica vetusta (Rossmässler, 1836)	0.00	1.515	0	22.22	0.5	8, 9
Discus perspectivus (von Mühlfeld, 1816)	6.46	0	0	33.33	2.875	2, 3, 4
Euconulus fulvus (Müller, 1774)	0.84	0	0	22.22	0.375	2, 4
Zonitoides nitidus (Müller, 1774)	0.00	0	5.128	11.11	1	6
Vitrea diaphana (Studer, 1820)	3.09	0	0	22.22	1.375	1, 3
Eucobresia nivalis (Dumont and Mortillet, 1854)	1.40	0	0	22.22	0.625	1, 2
Vitrina pellucida (Müller, 1774)	0.84	0	0	11.11	0.375	3
Vitrea transsylvanica (Clessin, 1877)	0.56	0	0	22.22	0.25	1, 2
Aegopinella pura (Alder, 1830)	1.12	0	0	22.22	0.5	1, 4
Vitrea crystallina (Müller, 1774)	1.40	0	0	33.33	0.625	1, 3, 4
Oxychilus depressus (Sterk, 1880)	0.28	0	0	11.11	0.125	2
Oxychilus montivagus (Kimakowicz, 1890)	3.37	0	0	11.11	1.5	4
Oxychilus draparnaudi (Beck, 1837)	0.00	1.515	0	22.22	0.5	8, 9
Fruticicola fruticum (Müller, 1774)	6.46	**18.93**	**17.948**	100	**12.625**	1, 2, 3, 4, 5, 6, 7, 8, 9
Euomphalia strigella (Draparnaud, 1801)	0.00	4.545	5.128	44.44	2.5	6, 7, 8, 9
Monacha cartusiana (Müller, 1774)	0.00	0	**10.256**	22.22	2	7, 8
Petasina bielzi (Bielz, 1859)	0.28	0	0	11.11	0.125	1
Monachoides vicinus (Rossmässler, 1842)	**11.24**	0	0	33.33	5	1, 2, 3
Perforatella bidentata (Gmelin, 1791)	0.28	0	0	11.11	0.125	3
Perforatella dibothrion (Kimakowicz, 1884)	2.53	0	0	22.22	1.125	2, 3

Arianta arbustorum (Linnaeus, 1758)	0.28	0	0	11.11	0.125	1
Drobacia banatica (Rossmässler, 1838)	**8.99**	5.303	0	55.55	5.75	1, 2, 3, 5, 9
Faustina faustina (Rossmässler, 1835)	**7.58**	0	0	33.33	3.375	1, 2, 3
Isognomostoma isognomostomos (Schröter, 1784)	**12.92**	0	0	33.33	5.75	1, 2, 3
Cepaea hortensis (Müller, 1774)	0.28	0	**7.692**	33.33	1.5	2, 6, 7, 8
Cepaea vindobonensis (Pfeiffer, 1828)	0.00	4.545	2.564	55.55	2	5, 6, 7, 8, 9
Helix pomatia Linnaeus, 1758	1.12	**17.424**	**15.384**	77.77	**9.25**	2, 4, 5, 6, 7, 8, 9

The cluster analysis of the sampling stations performed on the Euclidean distances between the relative abundances of the snail species (Fig. 3) reveals three different groups. The land snail communities are analysed in accordance with these groups, considering distinctly the urban area, the rural area from the middle and lower course of the Cibin River and the mountain area – the upper course (Tab. 1).

The two land snail communities from the urban area (S6, S8) present the highest similarity. They are characteristic, with few species, mostly common, opportunistic snails. As the samples were taken in two sites, upstream and downstream of Sibiu, in the remains of the Cibin River meadow, where the communities are dominated by *Succinea putris*, *Fruticicola fruticum*, *Helix pomatia* and *Monacha cartusiana* (Fig. 4). The presence of both hygrophilous and mesoxerophylous species demonstrates the ambivalent character of these habitats, the presence of fragments from the original wetlands and the open dry surfaces, resulted after cutting the willows. Present in both sampling sites was *Cepaea hortensis*, a species introduced in Sibiu probably at the beginning of the 20th century (Gheoca, 2005). Only three morphs are generally present in the area: unbanded yellow, unbanded light pink and five banded shells.

The sampling stations located in the lower course of the river are also very similar concerning their land snail composition. The same *F. fruticum* and *H. pomatia* are dominant, but they are associated here with *Cochlodina laminata*, evidence of the greater extent of willow thickets on the river banks. *C. hortensis* was also found in S8, the site that is closer to the city. More than 5% of the snail community consists of *Drobacia banatica*, a species listed on Annex II of EU Habitats Directive.

Far more abundant are the land snails in the mountain area. Although the group comprising the four mountain sampling stations is less homogeneous than the previous two categories, we can point out the characteristic species for this area: *I. isognomostomos*, *M. vicinus*, *D. banatica*, *B. fallax*, *F. faustina*, and *E. montana.* The most abundant species, *I. isognomostomos*, is commonly found in Romania, in humid forests from 400 up to 1,500 m altitude, in leaf litter or under dead wood logs and rock rubble. *Balea fallax* is also a common species in the entire Carpathian chain, including the southern Carpathians, regardless of the substrate. Less common for Romania is *Perforatella dibothrion*, a Carpatic species, whose actual distribution in Romania is uncertain. *D. banatica* is also found in three of the four mountain sampling sites.

The drop in species richness and abundance occurred in S4 is most probably caused by the widening of the valley near the lake, and the consequent reduction in humidity.

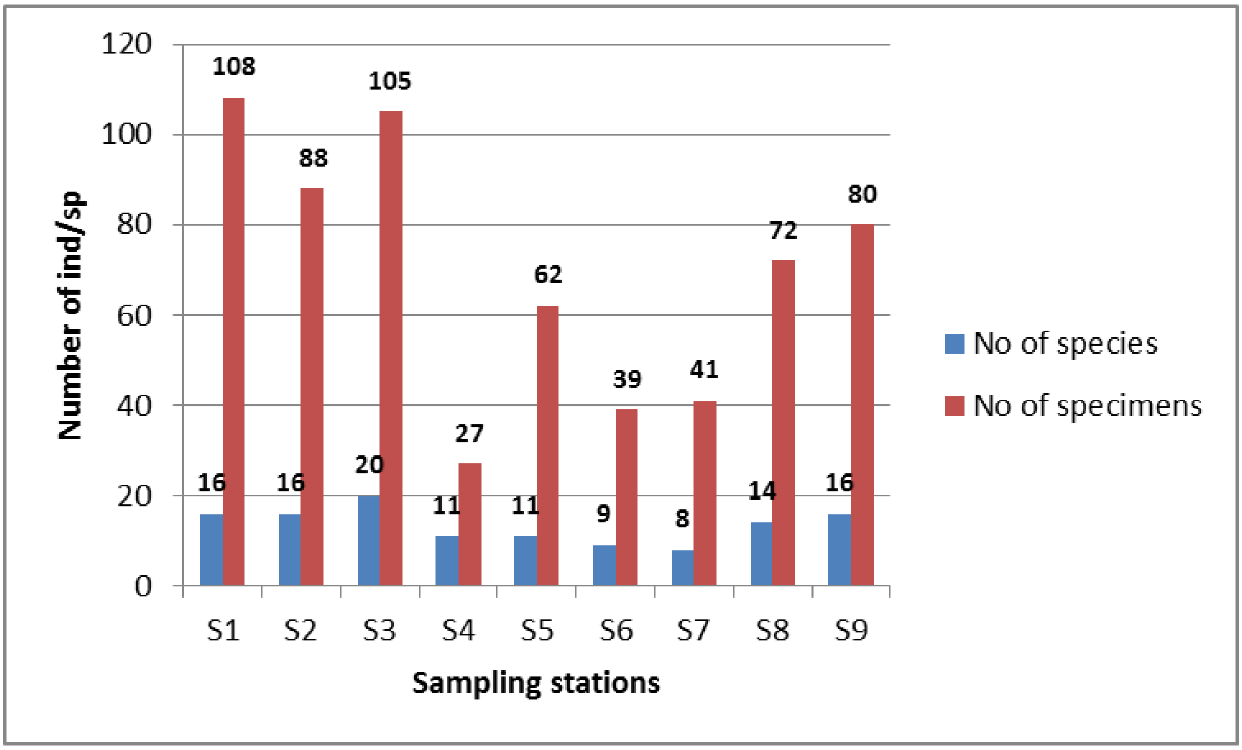

Figure 2: Number of species and specimens collected in each sampling station.

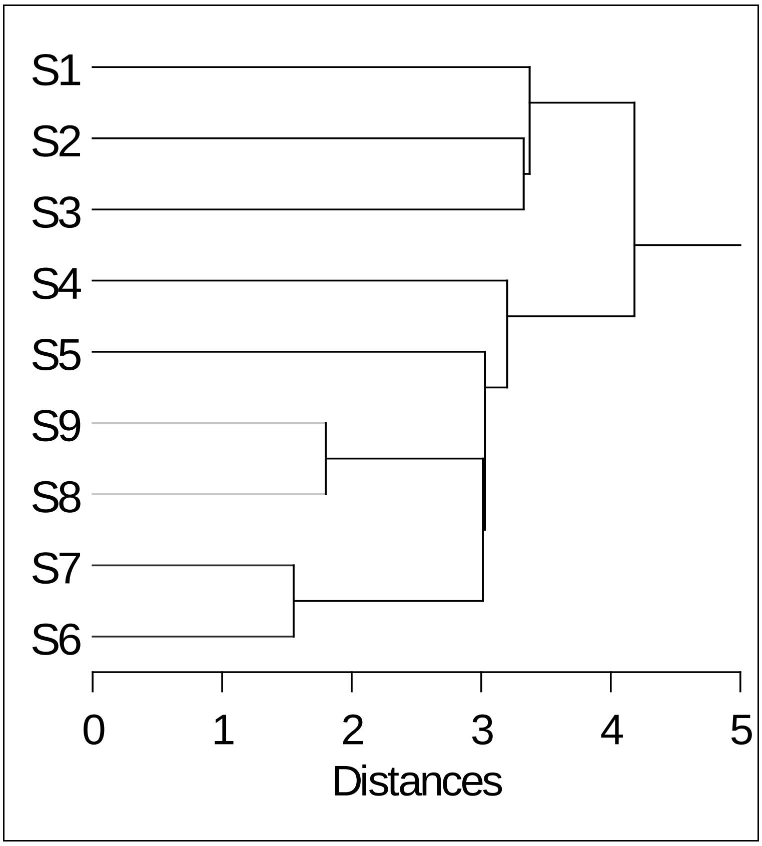

Figure 3: Cluster analysis of sampling sites based on species relative abundance (single linkage, Euclidean distance).

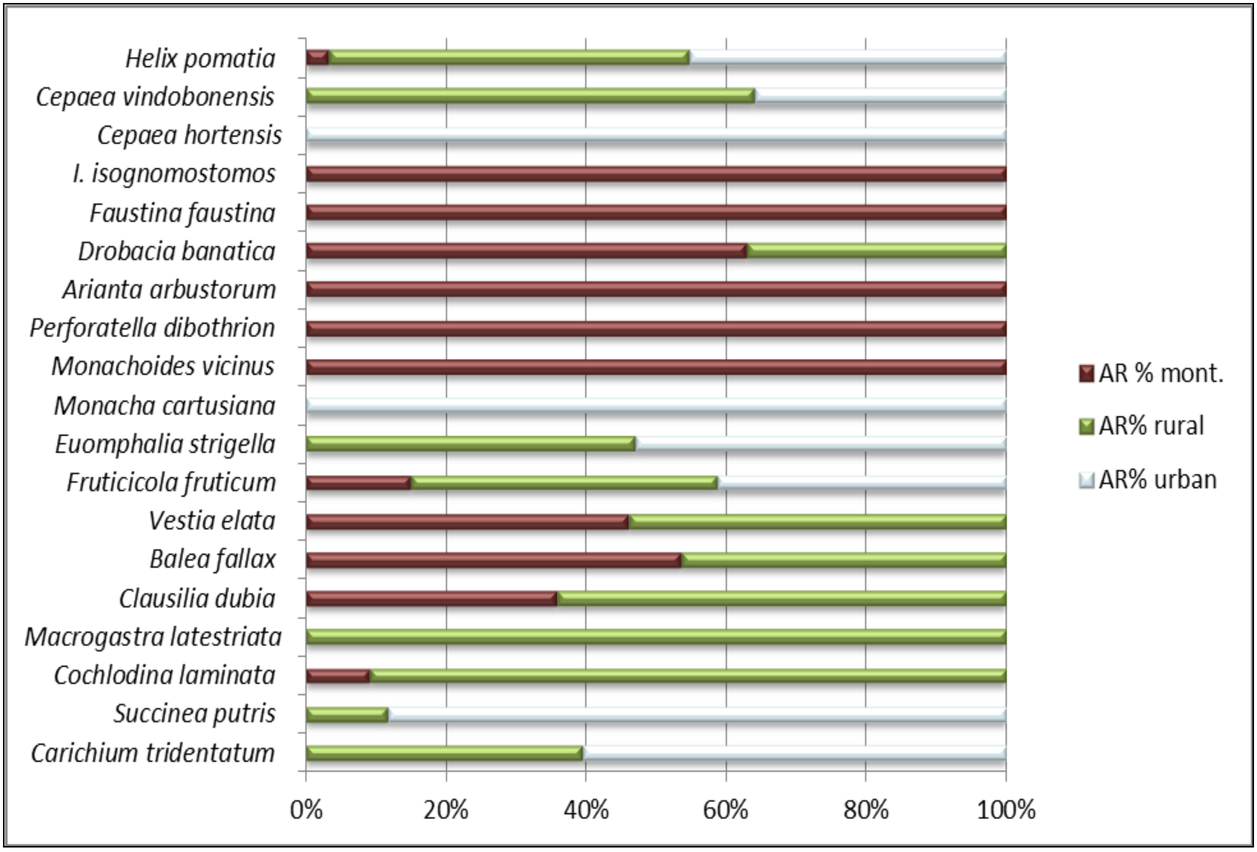

Figure 4: The relative abundance of most common species (considering frequency and abundance) in each of three sections – mountain, rural and urban sampling sites.

CONCLUSIONS

The schist substrate combined with the large amount of spruce in the mixed forests in the area is responsible for both a quite low land snail species richness and a reduced number of sampled individuals. Along the mountain river course snail communities are represented mainly by clausiliids such as *Balea fallax, Clausilia dubia, Vestia elata,* but also by typical mountain forest species such as *Ena montana, Arianta arbustorum, Eucobresia nivalis* and *Perforatella dibothrion.* Shortly after leaving the Cindrel Mountains, the river crosses a highly anthropogenic area with many human settlements, cultivated fields, riverbed exploitations and waste discharges. The human impact is evident not only regarding the water quality, but also with respect to terrestrial habitat degradation. Little natural habitat is preserved in the area. The river coppices are long gone, as the timber was cut for firewood over the last 25 years. Several islands have been preserved, generally in the proximity of villages, but most of them are used as waste depositories. Even so, some ubiquitous species are present in considerable numbers, as in the case of *Fruticicola fruticum* and *Helix pomatia*. Small islands of natural habitats can also offer shelter for other valuable land snail species. The presence of *Drobacia banatica* along the river (except the urban area) is once again an evidence of the major role of rivers in preserving land snail communities in highly anthropogenic areas, and a persuasive argument for the conservation of river banks.

Over the last century *C. hortensis* has slightly expanded its distribution along the Cibin River valley, reaching the mountain area (up to S2) and descending about 15 km downstream of Sibiu. The loss of continuity in riparian habitats diminishes the chances of dissemination in this way for newly introduced species.

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SĂLIŞTE RIVER MACROINVERTEBRATE COMMUNITIES

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KEYWORDS: Hilsenhoff Biotic Index, EPT/C, Sălişte River, Transylvania, Romania.

ABSTRACT

This study presents the description of the structure of benthic macroinvertebrate communities of the Sălişte River (Cibin Watershed) in correlation with environment parameters.

Longitudinally, benthic macroinvertebrate communities of the Săliște River have a relatively small structural variability.

In the upper flow of the Săliște River, these communities are marked by the insect larvae of the orders Ephemeroptera, Plecoptera, Trichoptera and Diptera, next to which amphipods occur in relatively smaller abundances, as well the gastropods, araneids or oligochaets, in some certain sectors. This structure is specific to the Carpathian rivers of order I (small/medium) and discloses that the anthropic impact is insignificant in this river section.

In the middle and lower flow of the river, chironomids and oligochaets are numerically prevalent, next to which ephemeropterans, trichopterans occur in fluctuating proportions, and, in some sections, amphipods and hirudineans. This structure of the benthic macroinvertebrates points out a degradation of the lotic habitats, taking into account that also here, naturally, the river and benthic communities should preserve their mountain features. For reaching the good state of the river in this sector, it is necessary to prevent the pollution by a proper management of the wastewaters and of those from zootechnics carried on in the riverside localities.

REZUMAT: Comunităţile de macronevertebrate bentonice din râul Sălişte (Transilvania, România).

Lucrarea prezintă descrierea structurii comunităţilor de macronevertebrate bentonice din râul Sălişte (bazinul hidrografic Cibin) în corelaţie cu caracteristicile de biotop.

În profil longitudinal, comunitățile de macronevertebrate bentonice din râul Săliște prezintă variabilitate structurală relativ mică.

În cursul superior al râului Săliște, aceste comunități sunt edificate de larve de insecte din ordinele Ephemeroptera, Plecoptera, Trichoptera și Diptera, alături de care, cu abundențe relative mai mici apar amfipodele și în unele sectoare gastropdele, araneidele sau oligochetele. Această structură este caracteristică râurilor carpatice de ordinul I (mici/medii) și relevă faptul că pe acest tronson de râu, impactul antropic este nesemnificativ.

În cursul mijlociu și inferioar al râului, dominante numeric sunt chironomidele și oligochetele, alături de care în proporții variabile apar efemeropterele, trichopterele și în unele sectoare amfipodele și hirudineele. Această structură a comunităţilor de macronevertebrate bentonice indică o degradare a habitatelor lotice, ținând seama că şi aici, în mod natural râul şi comunităţile bentonice ar trebui să-şi păstreze caracterul montan. Pentru atingerea stării bune a râului în acest sector, se impune prevenirea poluării printr-un management adecvat al apelor reziduale menajere și din zootehnie provenite din localităţile riverane.

ZUSAMMENFASSUNG: Die benthonischen Makroinvertebraten des Sălişte Flusses (Transilvanien, Rumänien).

Die Arbeit stellt die Strukturbeschreibung der benthonischen Makroinvertebraten- Gesellschaften des Sălişte Flusses (Einzugsgebiet des Cibins) in Korrelation mit den Kennzeichen des Biotops vor.

Im Längsprofil weisen die Gesellschaften der benthonischen Makroinvertebraten des Sălişte Flusses eine relativ geringe strukturelle Variabilität auf.

Im Oberlauf des Sălişte Flusses bestehen diese Gesellschaften aus Insektenlarven der Ordnungen Ephemeroptera/Eintagsfliegen, Plecoptera/Steinfliegen, Trichoptera/ Köcherfliegen und Diptera/Zweiflügler, neben denen mit vergleichbar geringerer Abundanz Amphipoden/Flohkrebse auftreten sowie in einigen Abschnitten Gasteropoden, Spinnen oder Oligochaeten. Diese Struktur ist charakteristisch für die Karpatenflüsse erster Ordnung (klein und mittel) und zeigt, dass in diesem Abschnitt der menschliche Einfluss unbedeutend ist.

Im Bereich des Mittel- und des Unterlaufs treten Chironomiden/ Zuckmücken und Oligochaeten numerisch dominant auf, neben denen in variablen Verhältnissen Ephemeropteren/Eintagsfliegen, Trichopteren/Köcherfliegen sowie in eingen Abschnitten Amphipoden/Flohkrebse und Hirudineen/Egel vorkommen. Diese Struktur der benthonischen Makroinvertebratengemeinschaften weist auf eine Verschlechterung der lotischen Habitate hin, wenn man davon ausgeht, dass der Fluss im natürlichen Zustand auch hier seinen montanen Charakter behalten müsste. Zur Erreichung eines guten Zustandes des Flusses in diesem Abschnitt, ist das Vermeiden der Verschmutzung durch ein adäquates Management der Haushaltsabwässer sowie aus der Tierzucht erforderlich, die aus den anliegenden Ortschaften stammen.

INTRODUCTION

The habitat characteristics are major factors, which influence the mountain lotic systems aquatic organisms populations ecological status (Bănăduc, 2001; Richards and Minshall, 1992; Brown et al., 2006; Diggins and Newman, 2009; Pastuchova et al., 2008).

The aim of the study was to analyze the benthic macroinvertebrate communities' structure of the Sălişte River, in correlation with some of the minor riverbed morphological parameters (width, depth, type of substrata). An assessment of this river ecological state was based on the macroinvertebrate communities structure.

Sălişte River springs in Cindrel Mountains at 1,000 m altitude, is a left tributary of the Cibin River, has a length of about 26 km and a basin area of 215 km^2. This basin extends over a part of Meridional Carpathians and the Transylvanian Depression (Posea, 1982) (Fig. 1) and the Tilişca, Sibiel and Orlat streams are included in its drainage (Ujvari, 1972).

MATERIAL AND METHODS

The results are based on quantitative benthic macroinvertebrate samples (61 samples) taken in 2010 (July – August) from 14 stations of the Sălişte River from its source until its confluence with the Cibin River. The sampling stations were situated approximatively at 1 km one to another (Fig. 2). In each sampling station, quantitative samples were taken from five separate points, in order to highlight the diversity of local micro-habitats. The samplings were carried out with a 887 cm² surface Surber Sampler, with a mesh net of 250 μm. The sampled biological material was fixed in 4% formaldehyde solution and was analysed with a Zeiss (65X) stereomicroscope. The invertebrate groups were identified by order, except Oligocheta, Hirudinea subclasses and Chironomidae family. The units were converted to number of individuals per square meter (ind/m²). For determining the Hilsenhoff index the indicator groups were identified to the adequate taxonomic level for this objective.

The assessed biotope variables were: riverbed width, depth, substratum types and the degree of anthropogenic change of the minor river bed. The substratum types (mud, coarse sand, sand, gravel, pebbles, cobbles and boulders) were expressed as precentages on the minor riverbed cross-section with a length of 20 m. The Hilsenhoff Biotic Index and the EPT/C ratio were used to asses the Sălişte River's ecological status, based on the macroinvertebrate communities' structure. The EPT/C ratio determined by dividing the amount of Ephemeroptera, Plecoptera and Trichoptera orders abundance to Chironomidae family abundance; balanced distribution of abundances of the four taxa is an indicator of the community equilibrium, being characteristic for the river sectors with good ecological state (Plafkin et al., 1989).

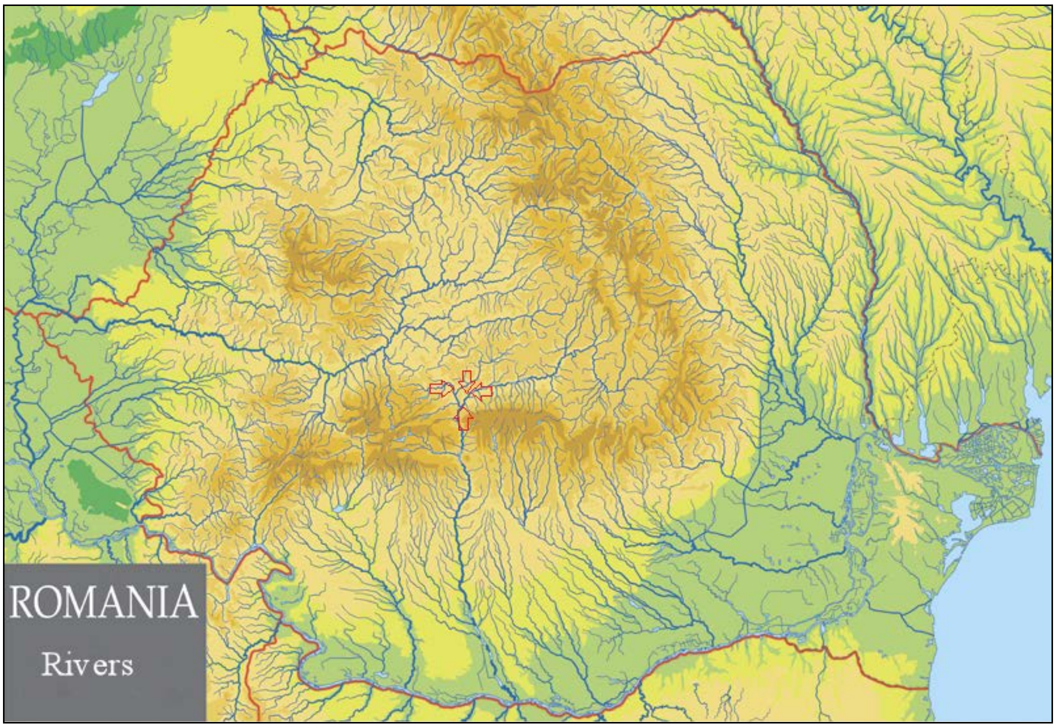

Figure 1: Sălişte Basin area; (https://en.wikipedia.org/wiki/List_of_rivers_of_Romania, modified).

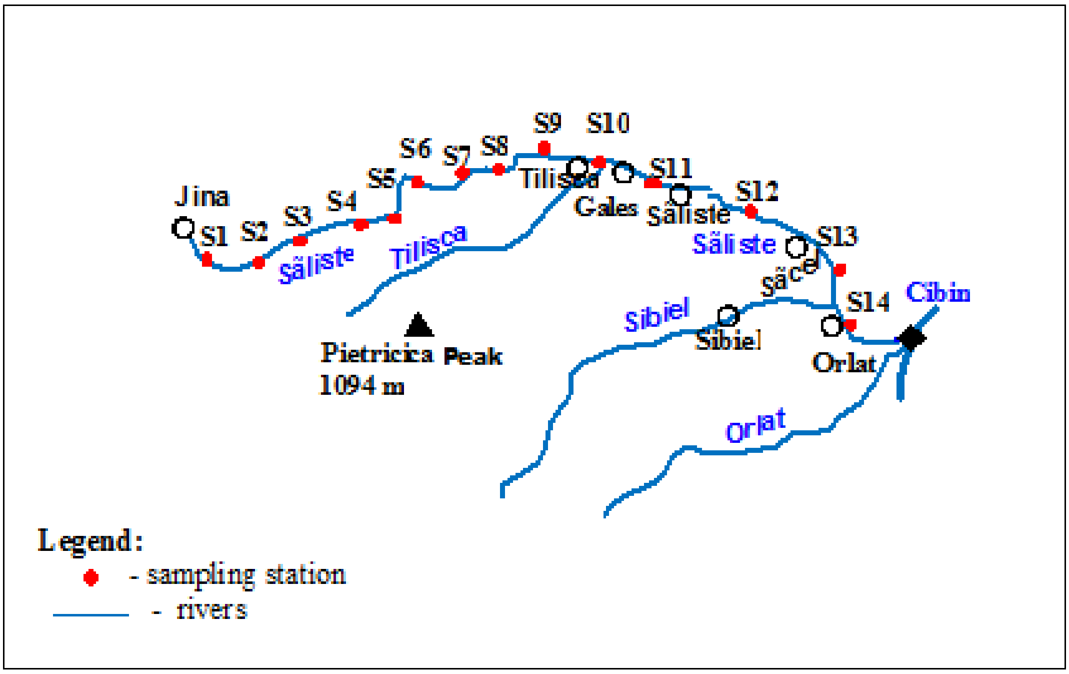

Figure 2: The location of the sampling stations (S1-S14) on the Sălişte River.

RESULTS AND DISCUSSION

The benthic macroinvertebrate groups with the largest distribution along the Sălişte River are: Oligochaeta, Amphypoda, Ephemeroptera, Plecoptera, Trichoptera and Chironomidae present almost in all the studied river sectors, with a low distribution appear Gastropoda, Araneida, Hirudinae, Diptera (other then Chironomidae) and Coleoptera (Tab. 1). Ephemenopterans, plecopterans, and amphipods high abundance is associated with the sectors that have prevalently lithologic substratum and with a natural morphodynamics of the riverbed.

Analysis of the benthic macroinvertebrates communities similarity of the 14 studied river sectors, based on the relative abundances values of taxonomic present groups, shows that they can be grouped in nineclasses (Fig. 4): I. communities where numerically codominant are oligochaetes and chironomids, present in S10, S11, S12 and S13 river sectors; II. communities where numerically codominant are chironomids, oligochaetes and mayflies, present in S5 and S14 river sectors; III. communities where numerically codominant are mayflies and chironomids, presents in S4 river sector; IV. communities where numerically codominant are mayflies, chironomids and amphipods, present in S2 river sector; V. communities where numerically codominant are mayflies and stoneflies, present in S6; VI. communities marked by mayflies, chironomids, stoneflies and amphipods, presents in S7 and S8 river sectors; VII communities where numerically codominant are chironomids and amphipods present in S1; VIII. communities where numerically codominant are mayflies and chironomids, presents in S3 river sectors; IX. communities where numerically codominant are amphipods and mayflies, presents in S9 river sector.

The benthic macroinvertebrates communities structure and the values of the biotic indices – HBI and EPT/C, reveal the existence of the folowing ecological sectors on the Sălişte River (Fig. 3).

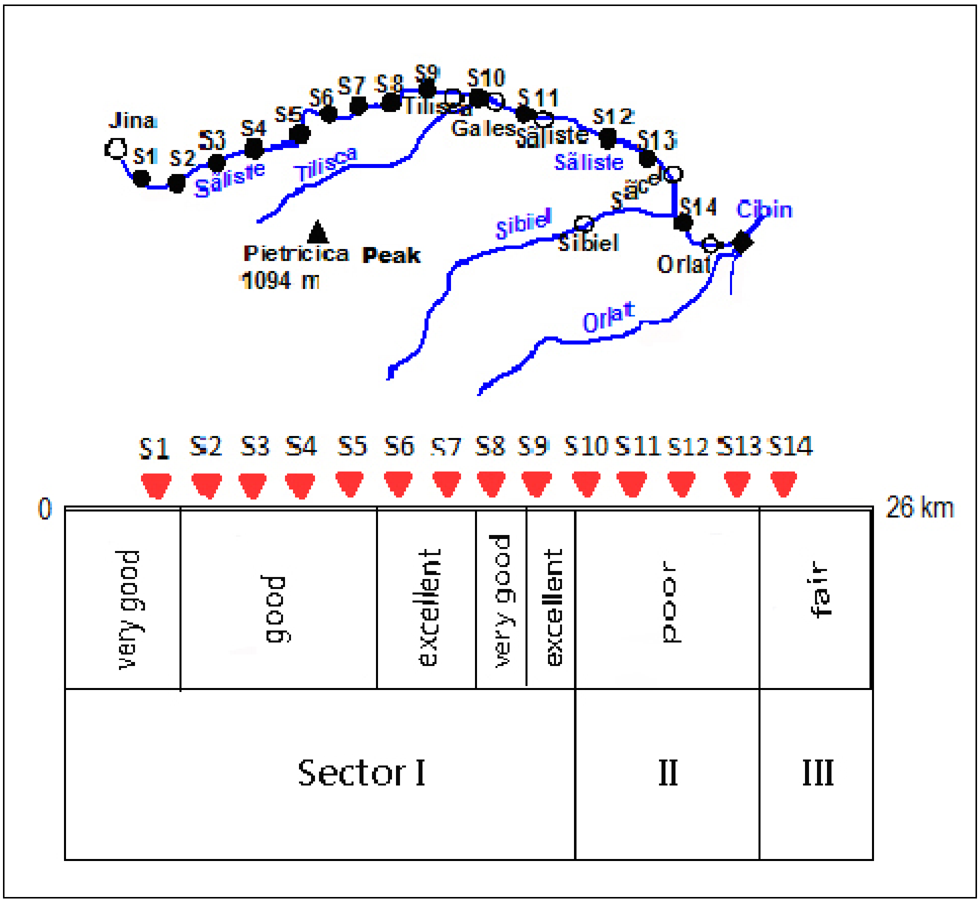

Figure 3: Classification of Sălişte River sectors in categories of quality, based on HBI values.

I. The S1 – S9 sector of the river is characterized by a good ecological status. In this area human impact is insignificant and the aquatic habitats are close to their natural state; II. The S10 – S13 sector of Săliște River (downstream Tilișca locality until downstream the confluence with the river Sibiel) is characterized by a poor ecological status due to substantial organic pollution caused by discharge of untreated wastewater from Tilişca, Galeş and Săliște locality into the river; III. In the Lower sector of Săliște River (upstream the confluence with the Cibin River) the ecological state of the river is improving in comparison with the upstream side because, at a distance of at least three km, the river no longer receives wastewater, but also due to the dilution caused by the confluence with the Sibiel River.

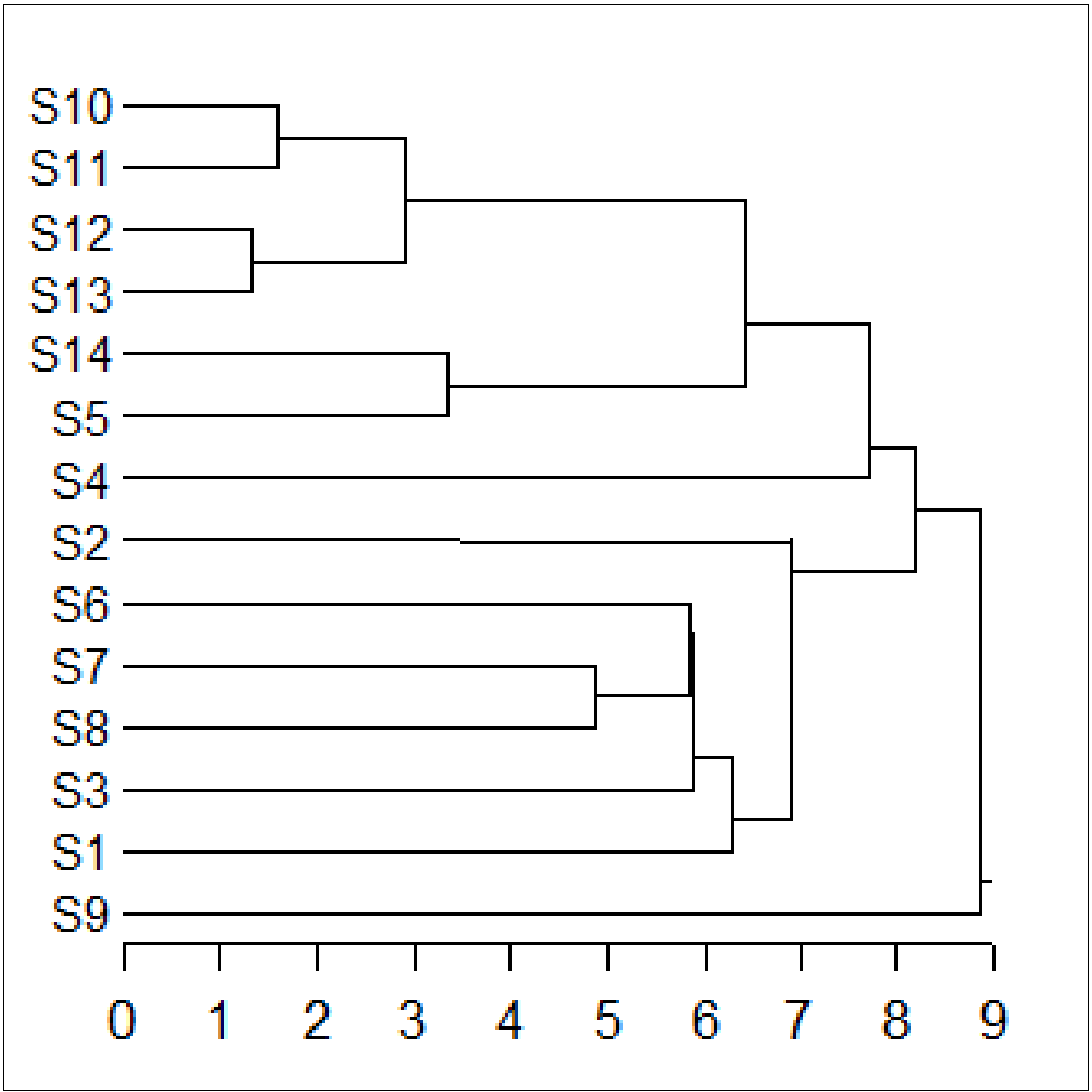

Figure 4: Benthic macroinvertebrate communities' simmilarity on Săliște River, based on the relative abundance of the taxonomic groups (Euclidean distance grouping for S1-S14 sampling river sectors).

Table 1: Benthic macroinvertebrates communities' structure in the Sălişte River (Ds – mean density, A% – relative abundance, HBI – Hilsenhoff biotic index) and riverbad caracteristics (Wm – minimum width, WA – average width;WM – maximum width; Dm – minimum depth; DA – average depth; DM – maximum depth; M – mud; S – sand; CS – coarse sand; G – gravel; C – cobbles; P – pebbles; B – boulders).

Sampling stations/ biotope parameters	Benthic macroinvertebrate communities structure			Biotic indices
	Taxons	Ds (ind./m²)	A %	
S1 Wm = 0.2 m;WA = 0.4 m; WM = 0.6 m Dm = 0.1m; DA = 0.2 m; DM = 0.3m B-30%, C-30%, S-20%; CS-20%	Gastropoda	11.27	0.8	HBI = 3.9 EPT/C = 0.58
	Araneida	5.64	0.3	
	Amphypoda	326.94	23.2	
	Ephemeroptera	90.19	6.4	
	Plecoptera	253.66	18	
	Trichoptera	50.73	3.3	
	Chironomidae	676.44	48	
S2 Wm = 0.5 m; WA = 1 m; WM = 1.2 m Dm = 0 m; DA = 0.15 m; DM = 0.3 m CS-30%; G-40%; C-30%	Oligochaeta	22.55	4.2	HBI = 4.27 EPT/C = 1.48
	Amphypoda	131.53	24.48	
	Ephemeroptera	176.63	32.87	
	Trichoptera	52.61	9.78	
	Chironomidae	154.08	28.67	
S3 Wm = 0.5 m;WA = 1 m; WM = 1.5 m Dm = 0.08 m; DA = 0.1 m; DM = 0.3 m CS-40%; C-60%	Oligochaeta	2.25	2.12	HBI = 4.57 EPT/C = 1.10
	Amphypoda	13.53	12.77	
	Ephemeroptera	22.55	21.27	
	Plecoptera	20.29	19.16	
	Trichoptera	4.51	4.25	
	Chironomidae	42.84	40.43	
S4 Wm = 0.5 m; WA = 1 m; WM = 1.5 m Dm = 0.08 m; DA = 0.1 m; DM = 0.3 m G-50%; C-30%; P-20%	Oligochaeta	5.64	5.71	HBI = 4.97 EPT/C = 1.58
	Amphypoda	2.82	2.86	
	Ephemeroptera	42.28	42.85	
	Plecoptera	8.46	8.58	
	Trichoptera	2.82	2.86	
	Chironomidae	33.82	34.28	
	Other Diptera	2.82	2.86	
S5 Wm = 1 m; WA = 1.5 m; WM = 2.5 m Dm = 0.2 m; DA = 0.4 m; DM = 0.8 m CS-20%; G-40%; C-20%; P-20%	Oligochaeta	54.11	21.05	HBI = 4.92 EPT/C = 0.85
	Amphypoda	2.25	0.88	
	Ephemeroptera	65.39	25.44	
	Plecoptera	11.95	7.02	
	Trichoptera	6.76	2.63	
	Chironomidae	105.98	41.22	
	Other Diptera	4.51	1.76	
S7 Wm = 3 m; WA = 3.5 m; WM = 4 m Dm = 0.1 m; DA = 0.4 m; DM = 0.6 m C-40%; B-60%	Oligochaeta	4.51	1.85	HBI = 3.49 EPT/C = 2.26
	Amphypoda	27.06	11.12	
	Ephemeroptera	58.62	24.07	
	Plecoptera	7.22	21.30	
	Trichoptera	22.55	9.26	
	Coleoptera	6.76	2.77	
	Chironomidae	58.62	24.07	
	Other Diptera	13.53	5.56	

Table 1 (continued): Benthic macroinvertebrates communities' structure in the Săliște River (Ds – mean density, A% – relative abundance, HBI – Hilsenhoff biotic index) and riverbad caracteristics (Wm – minimum width, WA – average width;WM – maximum width; Dm – minimum depth; DA – average depth; DM – maximum depth; M – mud; S – sand; CS – coarse sand; G – gravel; C – cobbles; P – pebbles; B – boulders).

Sampling stations/ biotope parameters	Benthic macroinvertebrate communities structure			Biotic indices
	Taxons	Ds (ind./m²)	A %	
S8 Wm = 2 m;WA = 3.5 m; WM = 4 m Dm = 0.1 m; DA = 0.3 m; DM = 0.4 m CS-30%;C-40%; P-30%	Oligochaeta	20.29	6.87	HBI = 3.86 EPT/C = 2.03
	Amphypoda	69.90	23.66	
	Ephemeroptera	63.13	21.37	
	Plecoptera	49.61	16.8	
	Trichoptera	20.29	6.87	
	Chironomidae	65.39	22.13	
	Other Diptera	6.76	2.30	
S9 Wm = 3 m; WA = 3.5 m; WM = 4.5 m Dm = 0.1 m; DA = 0.2 m; DM = 0.5 m C-30%; P-30%; B-40%	Oligochaeta	16.91	3.90	HBI = 3.70 EPT/C = 5.36
	Amphypoda	200.11	46.20	
	Ephemeroptera	101.47	23.34	
	Plecoptera	56.37	12.96	
	Trichoptera	8.46	1.95	
	Coleoptera	5.64	1.30	
	Chironomidae	31.00	7.13	
	Other Diptera	14.09	3.22	
S10 Wm = 4 m; WA = 5 m; WM = 5.5 m Dm = 0.2 m; DA = 0.35 m; DM = 1 m C-80%; P-20%	Oligochaeta	114.99	41.12	HBI = 5.96 EPT/C = 0.34
	Ephemeroptera	22.55	8.06	
	Plecoptera	9.02	3.23	
	Trichoptera	6.76	2.42	
	Chironomidae	110.48	39.52	
	Other Diptera	15.78	5.65	
S11 Wm = 4 m;WA = 5 m; WM = 6 m Dm = 0.15 m; DA = 0.2 m; DM = 0.4 m G-40%; C-40%; P-20%	Oligochaeta	144.31	41.55	HBI = 6.01 EPT/C = 0.33
	Amphypoda	6.76	1.95	
	Ephemeroptera	24.80	7.14	
	Plecoptera	9.02	2.60	
	Trichoptera	144.31	2.60	
	Hirudinea	2.25	3.25	
	Chironomidae	114.99	37.01	
	Other Diptera	18.04	3.9	
S12 Wm = 3.5 m; WA = 4 m; WM = 5.5 m Dm = 0.15 m; DA = 0.25 m; DM = 0.5 m CS-40%; G-60%	Oligochaeta	47.91	44.73	HBI = 6.22 EPT/C = 0.33
	Ephemeroptera	14.09	13.15	
	Hirudinea	2.82	2.64	
	Chironomidae	42.28	39.48	
S13 Wm = 3.5 m; WA = 4 m; WM = 4.5 m Dm = 0.3 m; DA = 0.25 m; DM = 0.4 m CS-40%; G-60%	Oligochaeta	151.07	42.40	HBI = 6.04 EPT/C = 0.42
	Ephemeroptera	54.11	15.19	
	Trichoptera	6.76	1.90	
	Hirudinaea	2.25	0.64	
	Chironomidae	142.05	39.87	

Table 1 (continued): Benthic macroinvertebrates communities' structure in the Sălişte River (Ds – mean density, A% – relative abundance, HBI – Hilsenhoff biotic index) and riverbad caracteristics (Wm – minimum width, WA – average width;WM – maximum width; Dm – minimum depth; DA – average depth; DM – maximum depth; M – mud; S – sand; CS – coarse sand; G – gravel; C – cobbles; P – pebbles; B – boulders).

Sampling stations/ biotope parameters	Benthic macroinvertebrate communities structure			Biotic indices
	Taxons	Ds (ind./m²)	A %	
S13 Wm = 3.5 m; WA = 4 m; WM = 4.5 m Dm = 0.3 m; DA = 0.25 m; DM = 0.4 m CS-40%; G-60%	Oligochaeta	151.07	42.40	HBI = 6.04 EPT/C = 0.42
	Ephemeroptera	54.11	15.19	
	Trichoptera	6.76	1.90	
	Hirudinaea	2.25	0.64	
	Chironomidae	142.05	39.87	
S14 Wm = 4 m; WA = 6 m; WM = 8 m Dm = 0.1 m; DA = 0.25 m; DM = 0.4 m CS-40%; G-60%	Oligochaeta	175.87	25.16	HBI = 5.28 EPT/C = 0.53
S6 Wm = 1.5 m; WA = 2 m; WM=2.8 m Dm = 0.15 m; DA = 0.35 m; DM = 0.8 m CS-30%; C-50%; P-20%	Amphypoda	11.27	4.91	HBI = 3.06 EPT/C = 4.69
	Ephemeroptera	82.68	36.07	
	Plecoptera	67.64	29.50	
	Trichoptera	26.31	11.48	
	Chironomidae	37.58	16.40	
	Other Diptera	3.76	1.64	
	Amphypoda	6.67	0.96	
	Ephemeroptera	153.33	21.93	
	Plecoptera	9.02	1.3	
	Trichoptera	18.04	2.58	
	Chironomidae	335.96	48.07	

CONCLUSIONS

Longitudinally, the benthic macroinvertebrate communities of the Săliște River have a relatively small structural variability.

In the upper flow of the Săliște River (S1 – S9), these communities are marked by insect larvae of the orders Ephemeroptera, Plecoptera, Trichoptera and Diptera, next to which amphipods occur in relatively smaller abundances, as well the gastropods, araneids or oligochaets, in certain sectors. This structure is characteristic to the Carpathian rivers of the Order I (small/medium) (Curtean-Bănăduc, 2005, 2008; Curtean-Bănăduc, Bănăduc, 2007; Curtean-Bănăduc and Fărcaș, 2013; Curtean et al., 1999) and reveals that the anthropic impact is insignificant within this river section.

In the middle and lower flow of the river, chironomids and oligochaets are numerically prevalent, next to which ephemeropterans, trichopterans occur in fluctuating proportions, and, in some sections, amphipods and hirudineans. This structure of the benthic macroinvertebrates points out a degradation of the lotic habitats, taking into account that also here, naturally, the river and benthic communities should preserve their mountain features. For reaching the good state of the river in this sector, it is necessary to prevent the pollution by a proper management of the wastewaters and of those from zootechnics carried on in the riverside localities.

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TERESTRIAL HETEROPTERANS (INSECTA, HETEROPTERA) OF THE SIBIU DEPRESSION

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KEYWORDS: check list, update, communities analysis, biodiversity, Heteroptera, Sibiu Depression, Transylvania, Romania.

ABSTRACT

This paper presents new data referring to the true bugs of the Sibiu Depression. In August through October of 2013 the true bugs were investigated in three localities which were chosen based on geomorphological and hydrographic considerations: Cristian, Şura Mică and Cisnădie. Four types of habitats were selected: mesophilic meadow, deciduous forest edge, riparian area and agricultural area. Terrestrial heteroptera collected from the Sibiu Depression were included in 62 species belonging to 10 families. *Bathysolen nubilus*, *Pyrrhocoris marginatus* and *Carpocoris melanocerus* are more interesting from the faunistic perspective as these species have been less recorded in Romania until the present. We have also analyzed Heteroptera communities of sampling stations, thus establishing a certain similarity between them, based on quantitative data.

REZUMAT: Heteropterele terestre (Insecta, Heteroptera) din Depresiunea Sibiului.

Studiul de față reactualizează datele referitoare la fauna de heteroptere terestre din Depresiunea Sibiului. În 2013, în cadrul a trei campanii de prelevare a probelor, au fost investigate heteropterele din trei localități alese pe considerente geomorfologice şi hidrografice: Cristian, Şura Mică şi Cisnădie. Heteropterofauna a fost colectată din patru tipuri de habitate, respectiv, pajişte mezofilă, liziera pădurii de foioase, zonă ripariană şi zonă agricolă, fiind selectat câte un astfel de habitat în fiecare dintre localități. Au fost identificate 62 specii, aparținând la 10 familii de heteroptere terestre. Se remarcă *Bathysolen nubilus*, *Pyrrhocoris marginatus* şi *Carpocoris melanocerus*, specii cu puține semnalări în fauna României. Au fost analizate comunitățile de heteroptere terestre din stațiile de colectare, stabilindu-se similaritatea dintre ele, pe baza datelor cantitative.

RÉSUMÉ: Les hétéroptères terrestres (Insecta, Heteroptera) de la dépression de Sibiu.

Cet étude réactualise les données relatives à la faune des hétéroptères terrestres de la dépression de Sibiu. En 2013, ont eu lieu trois campagnes de prélèvement des épreuves, au cadre desquelles on a fait des investigations sur les hétéroptères de trois localités, choisies en fonction de leur caracteristiques géomorphologiques et hydrografiques: Cristian, Şura Mică et Cisnădie. Hétéroptèrofaune a été collecté de quatre types d'habitats, c'est-à-dire prés de mezofila, la lisière d'un forêt à feuilles caduques, la zone riveraine et la superficie agricole, en étant sélectionné un tel habitat dans chaque localité déjà nomineé. Ainsi ont été identifiées 62 espèces, appartenant à 10 families d'hétéroptères terrestres. On remarque *Bathysolen nubilus*, *Pyrrhocoris marginatus* et *Carpocoris melanocerus*, espèces rares dans la faune de Roumanie. On a analysé les communautés d'hétéroptères terrestres de stations de collectage, en établissant leur similarité, en tenant compte de données quantitatives.

INTRODUCTION

True bugs (Heteroptera) are used as an indicator group for insect diversity in different ecosystems (Dolling, 1991; Duelli and Obrist, 1998) because in both stages larvae and adults are living in the same habitat and are very sensitive to environmental changes (Morris, 1969, 1979 in Zurbrugg and Frank, 2006; Otto, 1996, in Zurbrugg and Frank, 2006). Heteroptera is a systematic group of insects which play an important role in interrelations from natural and agrarian biocoenosis. In terms of food regime in this group there are phytophagous and zoophagous species (Dolling, 1991). Currently in Europe, heteroptera invasive species represents a topic of special interest (Rabitsch, 2008). Most of the invasive species colonize anthropogenic habitats such as agricultural crops. Few prefer colonizing the forest, including forest trees and wooded areas with non-native trees (Rabitsch, 2010).

The earliest studies on terrestrial heteroptera's fauna from the Sibiu Depression dates from the nineteenth to the twentieth centuries, studies which were made by entomologists and amateur naturalists from Sibiu, former members of the Transylvanian Society of Natural Sciences. The collected biological material can be found in the collections of the Natural History Museum in Sibiu (Schneider, 1973). This data does not provide a clear picture regarding the diversity of terrestrial heteroptera fauna of the Sibiu Depression.

Based on the information stated above we considered it appropriate to study the fauna diversity and ecology of terrestrial heteroptera. This research took place in the Sibiu Depression, on the territory of three human settlements namely: Cisnădie, Cristian and also Șura Mică (Fig. 1).

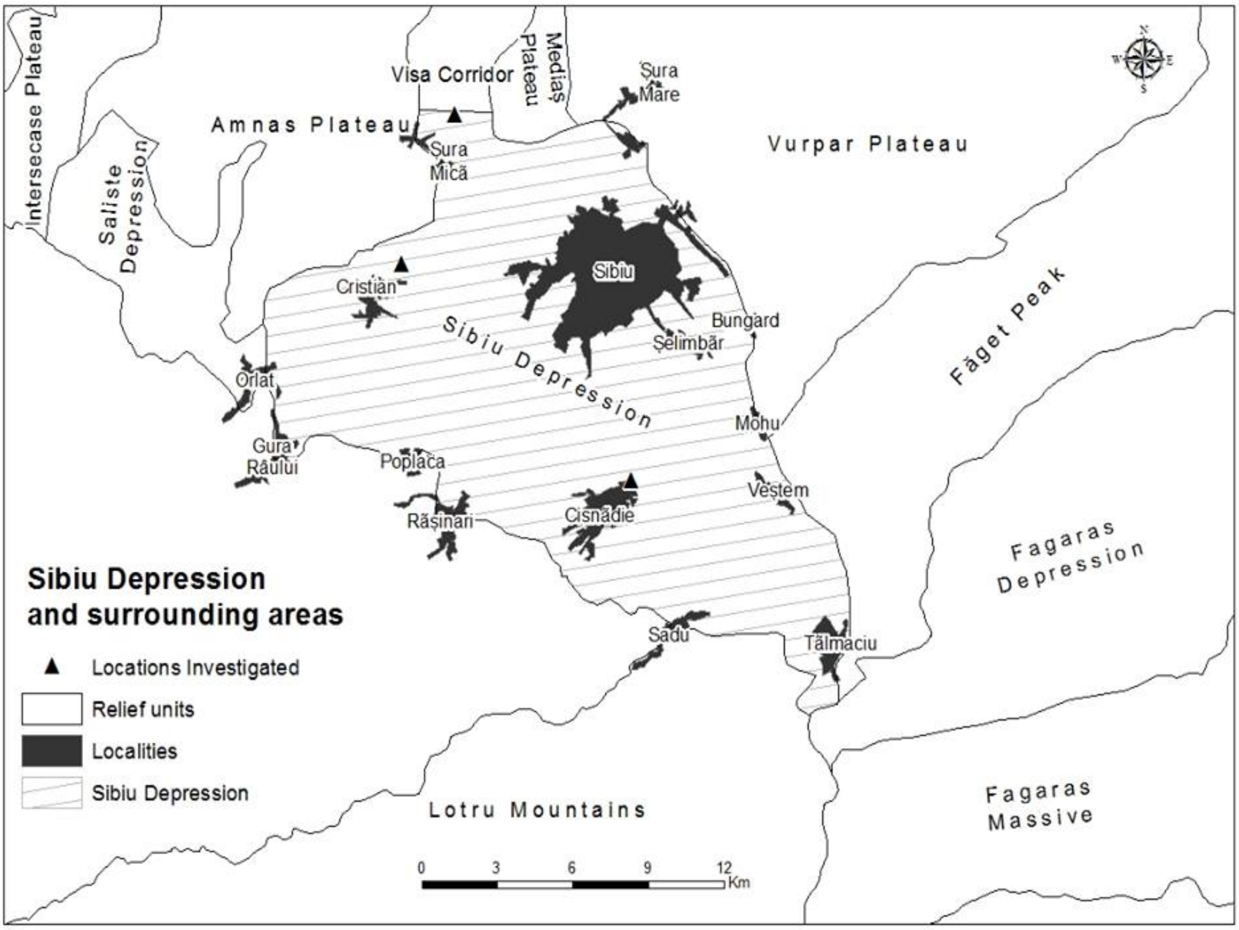

Figure 1: Map of investigated areas.

The Sibiu Depression geographical area is an integrant part of a specific contact depression corridor between Transylvanian Plateau (Hârtibaciu and Amnaș Plateau) and Meridional Carpathians (Făgăraș Mountains, Lotru Mountains, Cindrel Mountains). (Crăcea, 2007)

The arrangement of human settlements depends on the configuration of the landscape and river courses. There are three distinguished alignments arranged from west to east in relation to the Cibin River direction flow, which is the main river that drains the depression. In terms of demographic potential the most important is the central alignment which is composed of eight settlements from west to east: Orlat, Cristian, Sibiu, Bungard, Șelimbăr, Mohu, Veştem and Tălmaciu. The northern alignment is located at the contact with Hârtibaciu Plateau and includes the municipalities: Rușciori, Șura Mare and Șura Mică; the southern alignment is located at the contact with the Cindrel Mountains and includes the settlements: Gura Râului, Poplaca, Rășinari, Cisnădioara, Cisnădie, Sadu, Tălmăcel and Boița. (Crăcea, 2007)

MATERIAL AND METHODS

A locality was selected within each alignment on whose territory the collection areas have been identified as similar in order to allow relevant comparisons between them. We had collected insects from grass and bushes from four types of habitats: mesophilic meadow, deciduous forest edge, riparian area and agricultural area, coded as follows: S1-S4 in Cristian, S5-S8 in Cisnădie and S9-S12 in Șura Mică.

Geographical coordinates of collection stations are: Cristian: S1 (mesophilic meadow): 45°7'29"N and 24°2'16"E, altitude 471 m, S2 (deciduous forest edge): 45°47'33" N and 24°2'25"E, altitude 505 m S3 (riparian zone): 45°46'41"N and 24°2'51"E, altitude 428 m, S4 (agricultural area): 45°46'6"N and 24°0'52"E, altitude 470 m; Cisnădie: S5 (mesophilic meadow): 45°43'39"N and 24°9'30"E, altitude 477 m, S6 (deciduous forest edge): 45°44'35"N and 24°8'47"E, altitude 456 m, S7 (riparian zone): 45°44'38"N and 24°8'42"E, altitude 449 m, S8 (agricultural area): 45°43'25"N and 24°9'33"E, altitude 473 m; Şura Mică: S9 (mesophilic meadow): 45°49'38"N and 24°2'21"E, altitude 453 m, S10 (deciduous forest edge): 45°49'26"N and 24°1'28"E, altitude 483 m, S11 (riparian zone): 45°49'40"N and 24°2'28"E, altitude 432 m, S12 (agricultural area): 45°43'39"N and 24°2'25"E, altitude 437 m (Fig. 1).

During the three sampling campaigns from August to October of 2013, we chose the sweeping grassy vegetation method for collecting the biological material using an entomological net. All the identifications were made based on the determination keys of Kis (1984), Kis (2001), Moulet (1995), and Pericart (1998).

RESULTS AND DISCUSSION

In total, 702 true bugs individuals were collected and were identified to the species level (in the adult individuals case) and larvae were placed in proper families, some of which could be identified to the genus level.

Terrestrial heteropterans collected from the Sibiu Depression were included in 62 species belonging to a total of 10 families (Tab. 1).

Table 1: Terrestrial heteroptera collected from Sibiu Depression (no. of individuals).

Taxon	Cristian				Cisnădie				Şura Mică			
	S 1	S 2	S 3	S 4	S 5	S 6	S 7	S 8	S 9	S 10	S 11	S 12
Alydidae Family												
Alydus calcaratus (Linnaeus, 1758)	–	2	–	–	–	–	–	–	–	–	–	–
Camptopus lateralis (Germar, 1817)	3	–	–	–	1	–	–	–	–	–	–	–
Berytidae Family												
Berytinus montivagus (Meyer-Dür, 1841)	–	–	–	–	–	2	–	1	–	–	–	–
Neides tipularius (Linnaeus, 1758)	–	–	–	–	–	–	–	–	1	–	–	–
Coreidae Family												
Coreus marginatus (Linnaeus, 1758)	3	15	5	1	–	–	–	–	–	2	1	–
Bathysolen nubilus (Fallen, 1807)	–	–	–	–	–	1	–	–	–	–	–	–
Lygaeidae Family												
Beosus maritimus (Scopoli, 1763)	–	1	–	–	–	–	–	–	–	–	–	–
Emblethis denticollis Horváth, 1878	1	–	–	–	–	–	–	–	–	–	–	–
Heterogaster cathariae (Geoffroy, 1785)	–	–	–	1	–	–	–	–	–	–	–	–
Ischnodemus sabuleti (Fallen, 1826)	–	–	–	–	–	–	–	–	1	–	14	–
Lygaeus equestris (Linnaeus, 1758)	1	1	–	–	–	–	–	–	–	1	–	–
Lygaeus sp. (larvae)	–	4	–	–	–	–	–	–	–	–	–	–
Peritrechus geniculatus (Hahn, 1832)	–	2	–	–	–	1	–	–	1	–	–	–
Pterotmetus staphyliniformis (Schilling, 1829)	2	–	–	–	–	–	–	–	–	–	–	–
Spilostethus saxatili (Scopoli, 1763)	–	–	–	–	–	–	–	–	–	1	–	–
Miridae Family												
Adelphocoris lineolatus (Goeze, 1778)	1	–	–	–	–	–	–	–	–	–	–	–
Closterotomus norwegicus (Gmelin, 1790)	–	–	–	1	–	–	–	–	–	–	1	–
Deraeocoris (Deraeocoris) ruber (Linnaeus, 1758)	–	–	–	–	–	–	–	–	–	11	2	–
Lygus rugulipennis Poppius, 1911	–	–	–	20	–	–	–	–	–	–	–	–
Notostira elongata (Geoffroy, 1785)	–	–	1	–	–	–	–	–	–	–	–	–
Orthocephalus saltator (Hahn, 1835)	–	–	1	–	–	–	–	–	–	–	–	–
Polymerus unifasciatus (Fabricius, 1794)	–	–	1	–	–	–	–	–	–	–	–	–

Table 1 (continued): Terrestrial heteroptera collected from Sibiu Depression (no. of individuals).

Psallus (Hylopsallus) assimilis Stichel, 1956	–	–	2	–	–	–	–	–	–	–	–	–
Stenodema (Brachystira) calcarata (Fallen, 1807)	–	–	1	–	–	–	–	–	–	–	–	–
Stenodema (Stenodema) laevigata (Linnaeus, 1758)	–	4	21	10	–	1	5	7	3	3	–	–
Stenotus binotatus (Fabricius, 1794)	–	–	–	2	–	–	–	–	8	–	–	–
Stenodema sp. (juvenils)	–	–	–	–	–	–	–	–	10	–	–	–
Miridae (larvae)	–	–	23	–	–	–	–	–	1	–	–	–
Nabidae Family												
Nabis (Nabis) ericetorum Scholtz, 1847	–	–	–	11	–	–	–	–	–	–	–	–
Nabis (Nabis) ferus (Linnaeus, 1758)	7	–	–	14	–	13	2	4	–	18	5	4
Nabis (Nabis) riegeri Kerzhner, 1996	–	–	2	20	–	–	–	–	10	3	–	–
Nabis sp., (larvae)	5	5	4	–	–	–	–	–	3	–	–	3
Pentatomidae Family												
Aelia acuminata (Linnaeus, 1758)	1	–	–	–	–	2	–	–	8	1	–	4
Carpocoris melanocerus (Mulsant and Rey, 1852)	–	–	–	–	–	–	–	–	–	1	–	–
Carpocoris (Carpocoris) pudicus (Poda, 1761)	–	–	–	–	–	–	–	–	–	6	–	–
Dolycoris baccarum (Linnaeus, 1758)	1	–	–	–	–	–	–	–	–	–	–	–
Eysarcoris ventralis (Westwood, 1837)	–	–	–	1	–	1	–	–	–	–	–	2
Eysarcoris venustissimus (Schrank, 1776)	–	–	–	–	–	–	–	–	–	–	–	1
Eurydema (Eurydema) oleracea (Linnaeus, 1758)	–	–	–	1	–	–	–	–	1	–	–	–
Graphosoma lineatum (Linnaeus, 1758)	–	21	–	–	–	–	–	–	–	2	–	–
Holcostethus sphacelatus (Fabricius, 1794)	–	–	–	–	–	–	–	–	1	–	–	–
Neottiglossa leporina (Herrich-Schäffer, 1830)	–	–	–	–	–	–	–	–	–	2	–	–
Pentatoma (Pentatoma) rufipes (Linnaeus, 1758)	–	–	–	–	1	–	1	–	–	–	1	–
Peribalus (Peribalus) strictus (Fabricius, 1803)	–	1	1	–	–	–	–	–	–	1	–	–
Piezodorus lituratus (Fabricius, 1794)	–	–	–	1	–	–	–	–	–	–	–	–
Rubiconia intermedia (Wolff, 1811)	–	–	–	–	–	2	–	–	–	–	–	–
Sciocoris (Sciocoris) sulcatus Fieber, 1851	1	–	–	–	–	–	–	–	–	–	–	–

Table 1 (continued): Terrestrial heteroptera collected from Sibiu Depression (no. of individuals).

Staria lunata (Hahn, 1835)	–	7	–	–	–	–	–	–	–	–	–	–
Vilpianus galii (Wolff, 1802)	–	–	–	–	–	–	–	–	–	2	–	–
Pentatomidae (larvae)	–	1	1	–	–	–	–	–	–	–	–	–
Pyrrhocoridae Family												
Pyrrhocoris apterus (Linnaeus, 1758)	10	3	–	–	–	–	–	40	–	1	–	42
Pyrrhocoris marginatus (Kolenati, 1845)	1	1	–	–	–	–	–	–	–	–	–	–
Rhopalidae Family												
Corizus hyoscyami (Linnaeus, 1758)	–	–	–	–	–	–	–	2	–	3	–	–
Liorhyssus hyalinus (Fabricius, 1794)	–	–	–	–	–	–	–	–	–	1	–	–
Myrmus miriformis (Fallén, 1807)	4	1	1	42	–	–	–	–	30	–	–	1
Rhopalus parumpunctatus Schilling, 1829	–	1	–	–	–	–	–	–	–	15	–	–
Rhopalus (Rhopalus) subrufus (Gmelin, 1790)	–	1	–	–	–	–	–	–	–	–	–	–
Rophalus sp. (larvae)	9	6	–	–	–	–	–	–	–	16	–	–
Stictopleurus abutilon (Rossi, 1790)	–	–	–	–	–	–	–	–	–	7	–	–
Stictopleurus crassicornis (Linnaeus, 1758)	6	–	–	–	–	–	–	–	–	12	2	–
Stictopleurus pictus (Fieber, 1861)	2	–	–	–	1	–	–	–	–	3	–	–
Stictopleurus punctatonervosus (Goeze, 1778)	–	–	–	–	–	–	–	–	–	3	–	–
Stictopleurus subtomentosus (Rey, 1888)	–	–	–	–	–	–	–	–	–	5	–	–
Stictopleurus sp. (larvae)	–	–	–	–	–	–	–	–	–	2	–	–
Tingidae Family												
Catoplatus carthusianus (Goeze, 1778)	1	–	–	–	–	–	–	–	–	–	–	–
Dictyonota strichnocera Fieber, 1844	–	–	–	–	–	–	1	–	–	2	–	–
Kalama tricornis (Schrank, 1801)	–	–	–	1	–	–	–	–	–	–	–	–
Tingis (Tingis) auriculata (Costa, 1847)	–	–	–	–	–	2	–	–	–	–	–	–
Total number of individuals/station	59	77	64	126	3	25	9	54	78	124	26	57

In terms of frequency, the best represented species of terrestrial heteroptera from the Sibiu Depression are: *Stenodema laevigata* (Miridae Family) and *Nabis ferus* (Nabidae Family) which has the highest value – 22.22%, followed by species: *Coreus marginatus* (Coreidae Family) and *Myrmus miriformis* (Rhopalidae Family) with a frequency value of 16.67%. The last two species are among the most common coreoids in many other areas of Romania (Şerban, 2010).

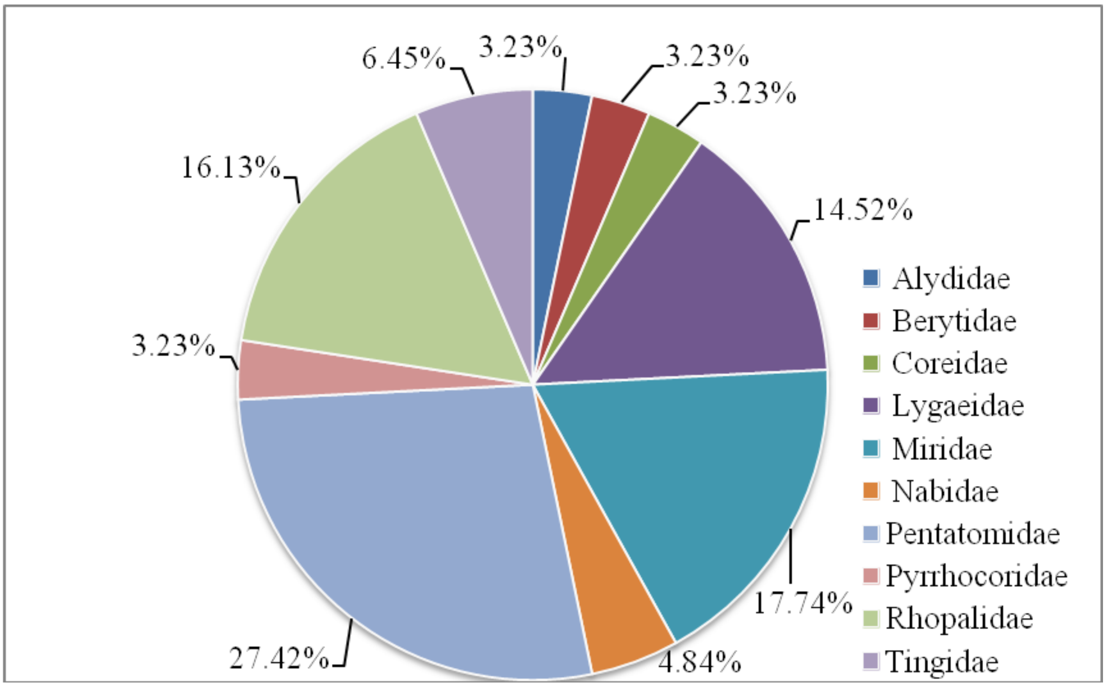

Figure 2: Percentage of families
based on the number of identified species.

Regarding the share of families based on the number of identified species (Fig. 2) we can see that the best represented is the family Pentatomidae (27.42%), followed by families Miridae (17.74%), Rhopalidae (16.13%) and Lygaeidae (14.52%). Rhopalidae (25.07%) accounted as the largest number of individuals collected followed by Miridae (19.94%) and Nabidae (18.95%) (Fig. 3).

In the present study, three rare species for Romania were identified: *Bathysolen nubilus* (Coreidae Family), a palearctic species, which occurs sporadically all over the country (Kis, 2001), *Pyrrhocoris marginatus* (Pyrrhocoridae Family), a species known in Central and Southern Europe and South Western Asia, which also appears sporadically in Romania (Kis, 2001), and *Carpocoris melanocerus* (Pentatomidae Family), a mountain species often encountered in the Alps, Carpathians and Balkans, and has been reported in Vâlcea County (Kis, 1984).

Two other new species are reported in the Sibiu Basin: *Stictopleurus pictus* and *Stictopleurus subtomentosus* belonging to the Rhopalidae Family.

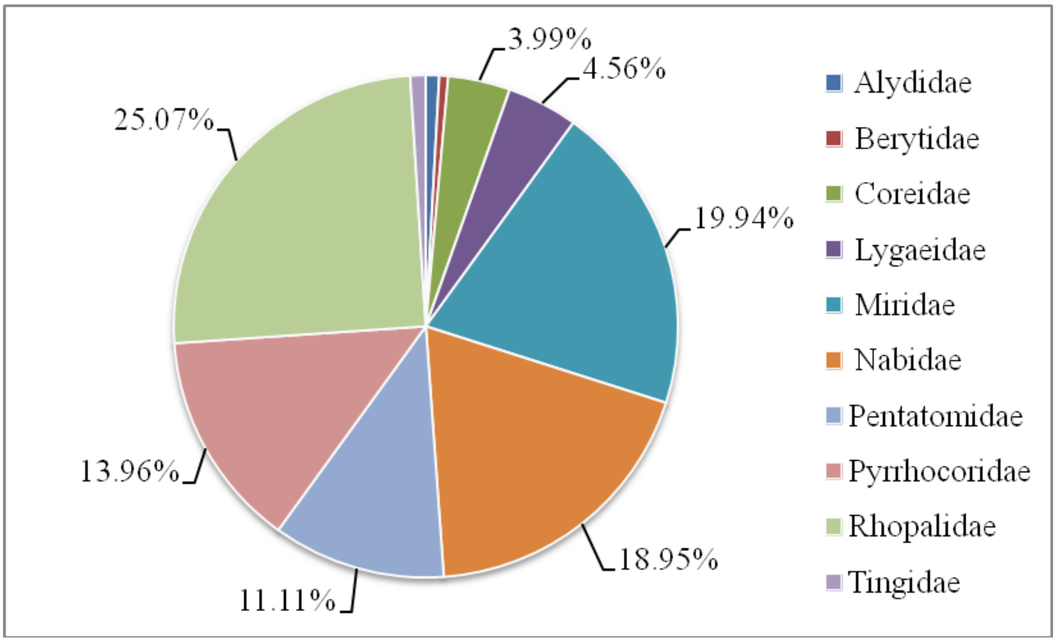

Figure 3: Percentage of families
based on the number of collected individuals.

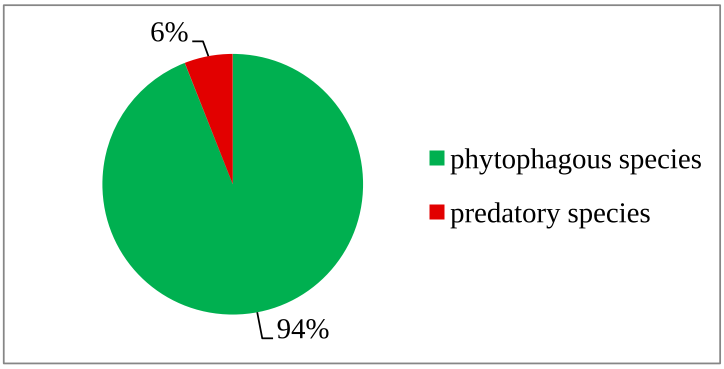

Figure 4: Proportion of terrestrial heteroptera
identified by trophic spectrum.

Terrestrial heteroptera species which had been analyzed are mostly phytophagous (polyphagous) at a rate of 94%. Only 6% were predatory, belonging to the Nabidae Family: *Nabis ericetorum*, *Nabis ferus*, *Nabis rugosus* and *Nabis* sp. (Fig. 4). Using the correlation analysis, habitats (Fig. 5) there can be arranged into four groups. There is an obvious association between the grassland habitat type in Șura Mică and the agricultural area of Cristian. Also, the relative abundances of species determine the association between agricultural areas from Cisnădie and Şura Mică. The third group of similar habitat is the lawn edge and Cristian. The fourth group consists of riparian areas of Cristian and Cisnădie and the edge of Cisnădie. Riparian habitat of Şura Mică and meadow habitats of Cisnădie are located at the far right of the graph which shows very different conditions relative to other habitats.

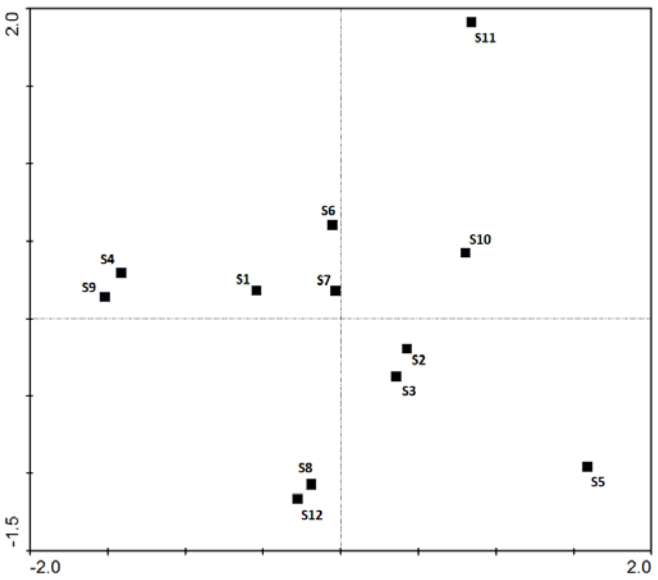

Figure 5: Correlation analysis of the habitat based on the relative abundance of species in all of the three field campaigns.

There are some groups of habitats, that correspond to a lesser extent to a particular type of habitat (such as S8-S12, S3-S7) and much less to a settlement. We could justify it based on the fact that the collected species are polyphagous.

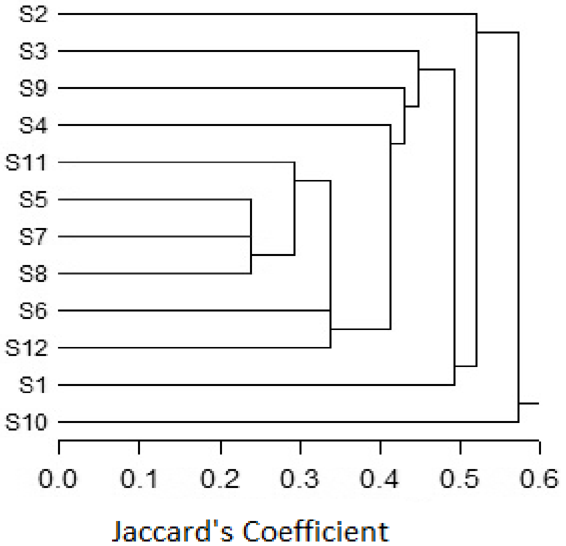

Figure 6: The degree of similarity of investigated habitats.

The similarity dendrogram of habitats based on the Jaccard index shows a similarity between S5, S7 and S8; reflecting the similar specific composition in all three of those habitats from Cisnădie: pasture, riparian and agricultural area. Similar to the above is the riparian area from Șura Mică (S11). In terms of the degree of similarity, habitats with a high diversity of species like the fringe of Șura Mica (S10) and the fringe of Cristian (S2) are very distant from other collection stations. The lowest human impact corresponds to S10 due to its difficult access while the different structure of terrestrial heteroptera communities from S2 is explained by the southern exhibition of the land (Fig. 6).

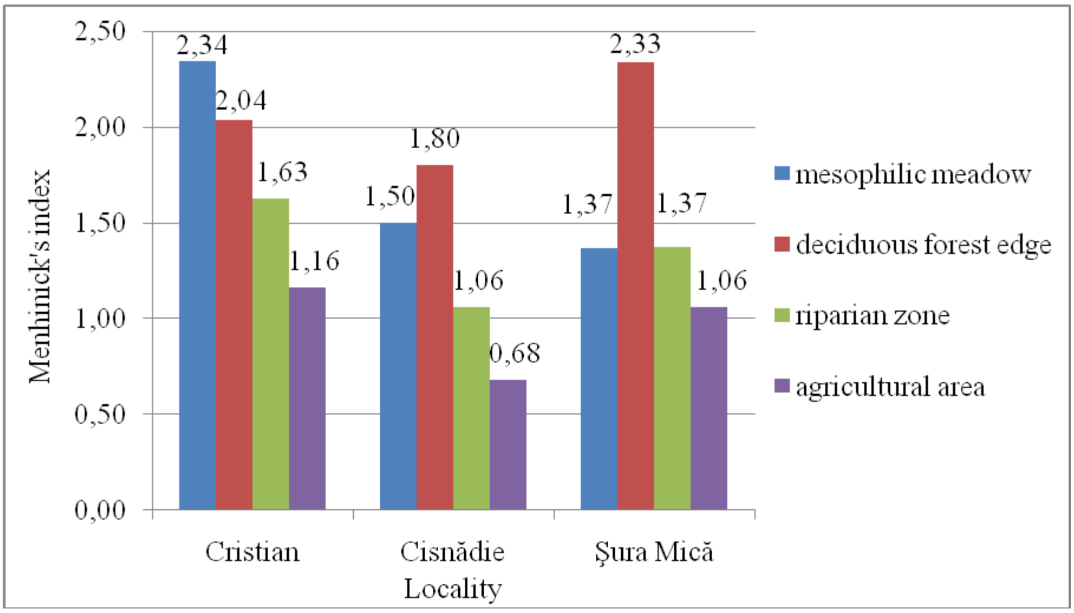

Figure 7: Menhinick index values depending on the habitats investigated.

High biodiversity was recorded in four stations: S1 (2.34), S10 (2.33), S2 (2.04), and S6 (1.80) and three stations were noted with the lowest values of biodiversity: S8 (0.68), S12 (1.06), and S4 (1.16) according to Menhinick richness index (Fig. 7). It is obvious that rich diversity is found in fringe areas, which are characterized by a greater diversification of vegetation, except for the S1 station. The explanation of this situation is that S1 is located on the ground of a research institute and unlike other grazing pastures it is only occasionally grazed by deer. The lower diversity recorded in all agricultural areas analyzed is explained by the use of insecticides, which led to a decreased diversity. Also, monoculture is one of the reasons why biodiversity is poor in these areas.

CONCLUSIONS

The current study brings a contribution to the literature by providing information concerning the diversity of terrestrial heteroptera from the Sibiu Depression.

There have been 62 identified species (belonging to 10 families), three of them being rare in Romania: *Bathysolen nubilus*, *Pyrrhocoris marginatus* and *Carpocoris melanocerus*.

Comparative analysis of habitats shows that there is a greater diversity of terrestrial heteroptera corresponding to fringe areas, while agricultural areas recorded the lowest values of diversity.

The specific composition and abundance of species do not reflect similarities between chosen sampling stations from a particular type of habitat and also do not reflect major differences between the localities which have been investigated.

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DIVERSITY OF MACROARTHROPODS ON SOUTHERN EXPOSED HILL SLOPES EXEMPLIFIED ON A PROFILE OF ŞERBUŢA VALLEY (ŞURA MARE, TRANSYLVANIA, ROMANIA)

Eckbert SCHNEIDER [1]

KEYWORDS: Macroarthropods communities, ecological gradients, species distribution, xerotermic habitats, biodiversity monitoring.

ABSTRACT

The paper presents a synthesis of systematical, ecological and biocenological researches on the macroarthropods, especially the entomofauna, realised in the last decades of the 20th century, completed with recent observations realized in the Southern Transylvanian Tableland. The study area is situated on a Southern exposed hill slope of the Şerbuţa Valley near the Şura Mare Commune, Sibiu County, with edaphic conditioned islands of stepic biocoenoses. The classes of macroarthropodes, especially Insecta with their orders, and in detail the Coleoptera with their families are analyzed in strong relation with their distribution in different habitats, disposed along ecological gradients on the Southern exposed hill profile. The remarkable biodiversity of the slope profile is highlighted.

REZUMAT: Diversitatea macroartropodelor pe pante sudice ale Podişului Transilvaniei de Sud exemplificat pe baza unui profil din Valea Şerbuţa (Şura Mare, Transilvania, România).

Lucrarea prezintă sinteza studiilor sistematice, ecologice şi biocenologice asupra faunei de macroartropode, cu privire specială asupra entomofaunei, realizate în ultimele decenii ale secolului 20, completate cu observaţii mai recente în Podişul Transilvaniei de Sud. Aria studiată este situată pe o pantă sudică a Văii Şerbuţa, comuna Şura Mare, judeţul Sibiu, cu insule de biocenoze stepice condiţionate edafic. Clasele de artropode, în special Insecta, cu ordinele sale, în special Coleoptera cu familiile incluse sunt analizate în strânsă relaţie cu distribuţia lor în diferitele habitate dispuse de-a lungul unor gradienţi ecologici pe panta sudică a Văii. Biodiversitatea excepţională a acestei pante este scoasă în evidenţă.

ZUSAMMENFASSUNG: Diversität der Makroarthropoden an Südhängen des Südsiebenbürgischen Hügellandes am Beispiel eines Hangprofils des Şerbuţa Tales (Şura Mare/Groß Scheuern, Transilvanien, Rumänien).

Die Arbeit ist eine Synthese der systematischen, ökologischen und biocoenologischen Untersuchungen der Makroinvertebraten, mit besonderer Berücksichtigung der Entomofauna, die in den letzten Jahrzehnten des 20. Jahrhunderts mit einigen rezenten Ergänzungen im Südsiebenbürgischen Hügelland durchgeführt wurden. Das Untersuchungsgebiet liegt auf der rechten Talseite des Şerbuţa Tal/Gemeinde Groß Scheuern, Kreis Hermannstadt auf einem südexponierten Hang mit edaphisch bedingten Inseln von Steppenbiozönosen. Die Klassen der Macroarthroopoden, insbesondere die Insekten mit ihren Ordnungen, vor allem die Coleopteren und ihre Familien werden in enger Verbindung mit den Habitaten eines Hangprofiles analysiert. Die außergewöhnlich hohe Biodiversität des Südhanges wird hervorgehoben.

INTRODUCTION

In the frame of a large and complex study program concerning the vegetation and fauna of the macroarthropods of xerotermic ecosystems of the Southern Transylvanian Tableland, initiated by scientists of the Museum of Natural Sciences at Sibiu in the beginning of the seventies which continued in the following decades, has also undertaken ecofaunistic and biocenological studies concerning the insects. The impulse for these researches was given by the biogeographical interest of the steppe and forest-steppe islands existing on Southern exposed slopes of the Transylvanian Tableland, which are strongly interlocked with the nemoral zone typical biocoenoses. At the same time, the study of macroarthropods in the special insects joins the complex problem concerning the existence, origin and age of the steppe and forest-steppe formations of the Transylvanian Tableland. This large and controversial topic has been discussed until recently by geobotanists (Borza, 1944; Borza and Boşcaiu, 1965; Paşcovschi and Doniţă, 1967; Csürös, 1963; Niedermaier, 1983; Schneider, 1977, 2013; Wendelberger, 1994) and will contribute to the argumentation from the entomofaunistical and zoogeographical point of view of the conception regarding the steppe and forest-steppe in Transylvania. The studies were sequentially communicated and published (Weiß, 1975a, b; Weiß, 1985; Schneider, 1976, 1977, 1978; Ceuca et al., 1977; Matic et al., 1979; Tomescu et al., 1979; Schneider, 1990; Schneider 1996 – mscr. presented at the conference on Floodplains at Altenburg/Germany), then completed by new unpublished data.

The study area is situated in the Southern Transylvanian Tableland, subunit of Vurpăr Tableland (Podişul Vurpărului) on a hill slope of the Şerbuţa Valley, a very small tributary of the Şarba Valley between the localities Şura-Mare (Groß-Scheuern) and Slimnic (Stolzenburg), on a height of 450-500 m NN, 30 km North of the Southern Carpathians and on a distance of 14 km North from the municipality of Sibiu.

Formed from Tertiary aged deposits in a tectonic depression almost surrounded by the Carpathians, the Transylvanian Tableland has a hilly, well structured relief. Depending on slope exposition and inclination, as well as the resulting insolation, it provides small scale heterogeneity in habitat conditions that are closely linked to the substrate composed of marl and sandstone layers. On the south, south-east and south-west facing slopes, the edaphic-climatic conditions are conditioning small islands of steppe or forest-steppe with characteristic biocoenoses. Following the slope of the hills, the habitats and plant communities represent a wide ecological gradient ranging from extremely dry on the top of the hills and front of the hill slope to wet habitats at the foot of the slopes and the valley plaines. Such hills with xerothermic habitats are encountered in the Transylvanian Tableland, reaching the Southern edge on the hills near Cibin Depression.

Considering the diversity of microhabitats and their specific site conditions, the objective has been to study the structure and function of characteristic ecosystems and biocoenoses of the Southern Transylvanian Tablelands hilly landscape, to inventory the habitats with their diverse macro-invertebrates fauna in the mentioned geo-morphological good delimitable and representative area – including the biogeographical composition of the fauna – and to find out appropriate management measures for the conservation of the characteristic near natural landscapes with the whole mosaic of macro and microhabitats with their diverse species.

In addition, an important objective has been the improvement of knowledge concerning ecological information about the species and the arthropod groups under the general climate conditions of the Southern Transylvanian Tableland and the microclimate conditions on the hill slopes of the studied area. Particular attention was given to the species with South-Eastern and

Eastern European distribution, as the information about these species in the area has been very small. At the same time, attention was oriented to the ecological behaviour of Central European species under the condition of the continental climate of South-Eastern Europe. Going into detail, a further task was the monitoring of the distribution of the macroarthropod species in the various microhabitats of the slope and the spatial as well as the seasonal occurrences and repartition along the chosen profile. An important objective of the study has been to present the arthropod communities for the main characteristic vegetation units of the area as representative for the hills of the Southern Transylvanian Tableland.

MATERIAL AND METHODS

The choice of the sampling points/ plots was realized along a slope with a length of 350 m and a difference in altitude of 70 m from the top of the hill to the valley plain situated in the area of the Şerbuţa Valley hills, according to typological-physiognomic and vegetation composition as well as structure criteria. This method has considered from the conception of the bio-coenological practices and experience, that plant communities with their spatial structures, their food supply and the microclimate are decisive factors for the distribution of species in a continuously site-line ("Catena") and the corresponding gradients of factors. Considering this, the samples were taken along the slope profile in the following plant communities (corresponding to the letters in the presented profile):

a. Thermophilous oak-hornbeam mixed forest (Querceto-robori-petraeae-Carpinetum);

b. Xero-thermophilous bush community edified by Small Almond (*Amygdaletum nanae*) as fringe on the forest border, Habitat type 40A0*;

c. Feathergrass community (Stipetum pulcherrimae Soó 1942 transsilvanicum, syn. Salvia nutantis-Stipetum pulcherrimae Boşcaiu et al. 1984), Habitat type 62C0*;

d. Xerothermic grassland with Earth sedge (*Carex humilis*) and Valais fescue (*Festuca valesiaca*), as. Carici humilis-Festucetum valesiacae, Habitat type 6240*;

e. Xero-mesophilous grassland community (Dorycnio-Brachypodietum pinnati), Habitat type;

f. Bush formation of Blackthorn (*Prunus spinosa*) and Whitethorn (*Crataegus monogyna*), as. Pruno spinosae-Crataegetum;

g. Thermophilous bush and tree formation (in succession) with Sessile oak (*Quercus petraea*), Field maple (*Acer campestre*), Privet (*Ligustrum vulgare*), Whitethorn (*Crataegus monogyna*);

h. Xero-mesophilous grassland edified by Heath false brome (*Brachypodium pinnatum*) and mesophilous grasslands edified by False oat-grass (*Arrhenatherum elatius*) and Meadow fescue (*Festuca pratensis*), as. Arhenatheretum elatioris;

i. Meso- to meso-hygrophilous grassland edified by Broad-leaved cottongrass (*Eriophorum latifolium*), as. Carici flavae-Eriophoretum latifolii;

j. Hygrophilous fringe edified by *Inula helenium* (*Ficaria verna*, *Caltha palustris*, *Adoxa moschatellina*) and curtain like communities of Calystegietalia (Habitat type 6430) being considered in the profile together with the gallery like willow communities under letter l;

k. Gallery-like willow communities of White willow (*Salix alba*) and Brittle willow (*Salix fragilis*), as. Salicetum albae-fragilis, corresponding to habitat type 91E0 of the EU Habitat Directive;

l. Bush formation in succession on the Northern exposed slope of the Serbuţa Valley with *Tilia cordata*, *Cornus sanguinea*, *Evonymus verrucosa* and others;

m. Thermophilous oak-hornbeam mixed forest (Querceto-robori-petraeae-Carpinetum);

n. Xero-thermophilous bush community edified by Small Almond (Amygdaletum nanae) as fringe on the forest border, Habitat type 40A0*;

o. Feathergrass community (Stipetum pulcherrimae Soó 1942 transsilvanicum, syn. Salvia nutantis-Stipetum pulcherrimae Boşcaiu et al. 1984), Habitat type 62C0*;

p. Xerothermic grassland with Earth sedge (*Carex humilis*) and Valais fescue (*Festuca valesiaca*), as. Carici humilis-Festucetum valesiacae, Habitat type 6240*;

q. Xero-mesophilous grassland community (Dorycnio-Brachypodietum pinnati), Habitat type;

r. Bush formation of Blackthorn (*Prunus spinosa*) and Whitethorn (*Crataegus monogyna*), as. Pruno spinosae-Crataegetum;

s. Thermophilous bush and tree formation (in succession) with Sessile oak (*Quercus petraea*), Field maple (*Acer campestre*), Privet (*Ligustrum vulgare*), Whitethorn (*Crataegus monogyna*);

t. Xero-mesophilous grassland edified by Heath false brome (*Brachypodium pinnatum*) and mesophilous grasslands edified by False oat-grass (*Arrhenatherum elatius*) and Meadow fescue (*Festuca pratensis*), as. Arhenatheretum elatioris;

u. Meso- to meso-hygrophilous grassland edified by Broad-leaved cottongrass (*Eriophorum latifolium*), as. Carici flavae-Eriophoretum latifolii;

v. Hygrophilous fringe edified by *Inula helenium* (*Ficaria verna*, *Caltha palustris*, *Adoxa moschatellina*) and curtain like communities of Calystegietalia (Habitat type 6430) being considered in the profile together with the gallery like willow communities under letter I;

w. Gallery-like willow communities of White willow (*Salix alba*) and Brittle willow (*Salix fragilis*), as. Salicetum albae-fragilis, corresponding to habitat type 91E0 of the EU Habitat Directive;

x. Bush formation in succession on the Northern exposed slope of the Serbuţa Valley with *Tilia cordata*, *Cornus sanguine*, and *Evonymus verrucosa*.

Considering the above mentioned research objectives, the methods used for field work have been adapted according to the objectives and differentiated for the groups included. For the research and monitoring of the fauna of Epigaion, the Barber traps method has been used (Balogh, 1958; Mühlenberg, 1989) in each sampling station being introduced: 10 traps on a distance of 2-3 m between them from the beginning of April to the end of October with emptying the traps in a time distance of two-three weeks. The content of the Barber traps resulted by sampling during a vegetation period has been sorted in the different systematic groups and determined in cooperation with appropriate specialists.

In the same time frame, quantitative samplings were taken from the herbaceous layer by striping the vegetation with corresponding nets of standard dimensions (30 cm diameter, holder of 50 cm in length) with a small demountable bag on the bottom of the nets, and applying 100 net beats on each station and sample (Balogh, 1958; Janetschek, 1982; Mühlenberg, 1989). Also, qualitative collection was taken by hand with an exhaustor and tweezers where conducted.

Collection and research on the level of entomofauna on the ligneous bush and trees, has been used with success until present. This is a widely applied method with an entomological beating umbrella (Balogh, 1958; Janetschek, 1982), and is suitable for prevailing qualitative and selective collection.

To have a more precise picture of the site condition on the studied slope profile and the ecological requirements of the species, microclimatic study was realized in 1973 by measuring with a field hygrometer the relative air humidity and the temperature in the herbaceous vegetation layer 15-20 cm above the soil surface in the sites A (thermophilous oak-hornbeam mixed forest), B (xero-termophilous bush community of Small almond), C (Feathergrass community), F (Bush formation of Blackthorn) and K (gallery like willows community) (Schneider, 1990).

From the immense entomological material obtained by quantitative and qualitative collection methods, it was not possible to treat all groups exhaustive, as each group can be the subject for a particular study. To illustrate the richness of the macroarthropods and specifically the entomofauna of the study area, synthetic tables showed an overview for the registered groups by sampling with Barber traps and by striping. In detail, some representative groups are finally treated.

RESULTS AND DISCUSSION

Being in direct dependency (phytophagous species) or indirect dependency (decomposers and zoophagous species) from the primary production of organic substance, the animal component of the terrestrial ecosystems is determined essentially by the evolution, floristic composition and ecological structure of the vegetation cover. The abundance and diversity of fauna is not only determined by the trophic situation, but also through the structure of their environment, the habitats, i.e. the microhabitats.

If we compare the distribution of the macroarthropods fauna in the different vegetation formations along the studied slope profile, a general unequal repartition of the classes can be stated. This reflects the more favourable or more extreme life conditions for the majority of species or animal groups in the different habitats (Fig. 1).

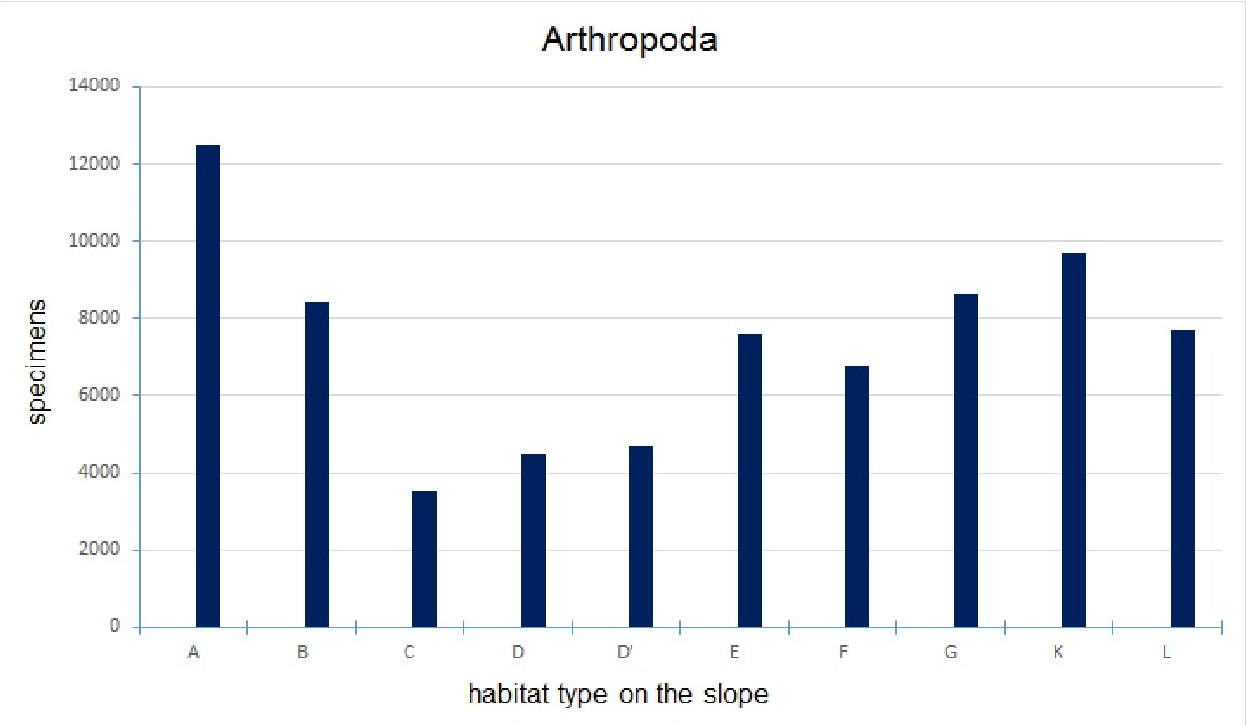

Figure 1: Integral distribution of the epigeic arthropods fauna along the studied slope profile, showing the general favourable or more extreme life conditions of the different studied habitats.

Thus the arthropods fauna have maximum abundances in forest ecosystems (sampling area A, K, G and L) and minimum abundances in the open xerothermic, steppe habitats (sampling area C, D, D’). The forests’ fringe of tall herbaceous ecoton habitats are also characterized by an abundant arthropod fauna (sampling area B, E, F) with many exclusive species, characteristic for these habitats. Although, with the most extreme site conditions, the xerothermic habitats are populated by characteristic, morpho-physiological and bionomic species that are well adapted to the extreme conditions (Fig. 1).

These conditions are also expressed by the microclimatic measurements (temperature and relative air humidity) realized on some of the habitats such as the forest habitat on the top of the hill (A), the Small Almond habitat (B), the Feathergrass steppe habitat (C), the Blackthorn and Whitethorn bush habitat (F) and the gallery-like willow habitat (K) (Schneider, 1990). The measurements show that most extreme conditions are on the upper steep front of the slope with high sun irradiation, due to the Southern exposition, i.e. the Feathergrass habitat (C), followed by the Small Almond bush (B) a forest-steppe like habitat. The temperature at the beginning of May has been 31°C in both habitat types and 34°C later on 23rd of May. These measurements are in concordance with earlier ones realized near Cluj in the "Fânaţele Clujului"/Meadows of Cluj/Klausenburger Heuwiesen by Bujoreanu in 1933, leading to the conclusion that "just the character of the extreme temperatures of the Southern exposed slopes explains the possibility of survival of some steppe relicts among a climax region with forest vegetation" (Borza and Boşcaiu, 1965).

The distribution and dominance structure of the epigeic arthropod coenoses is very visible if we compare the habitats along the studied profile (Fig. 2).

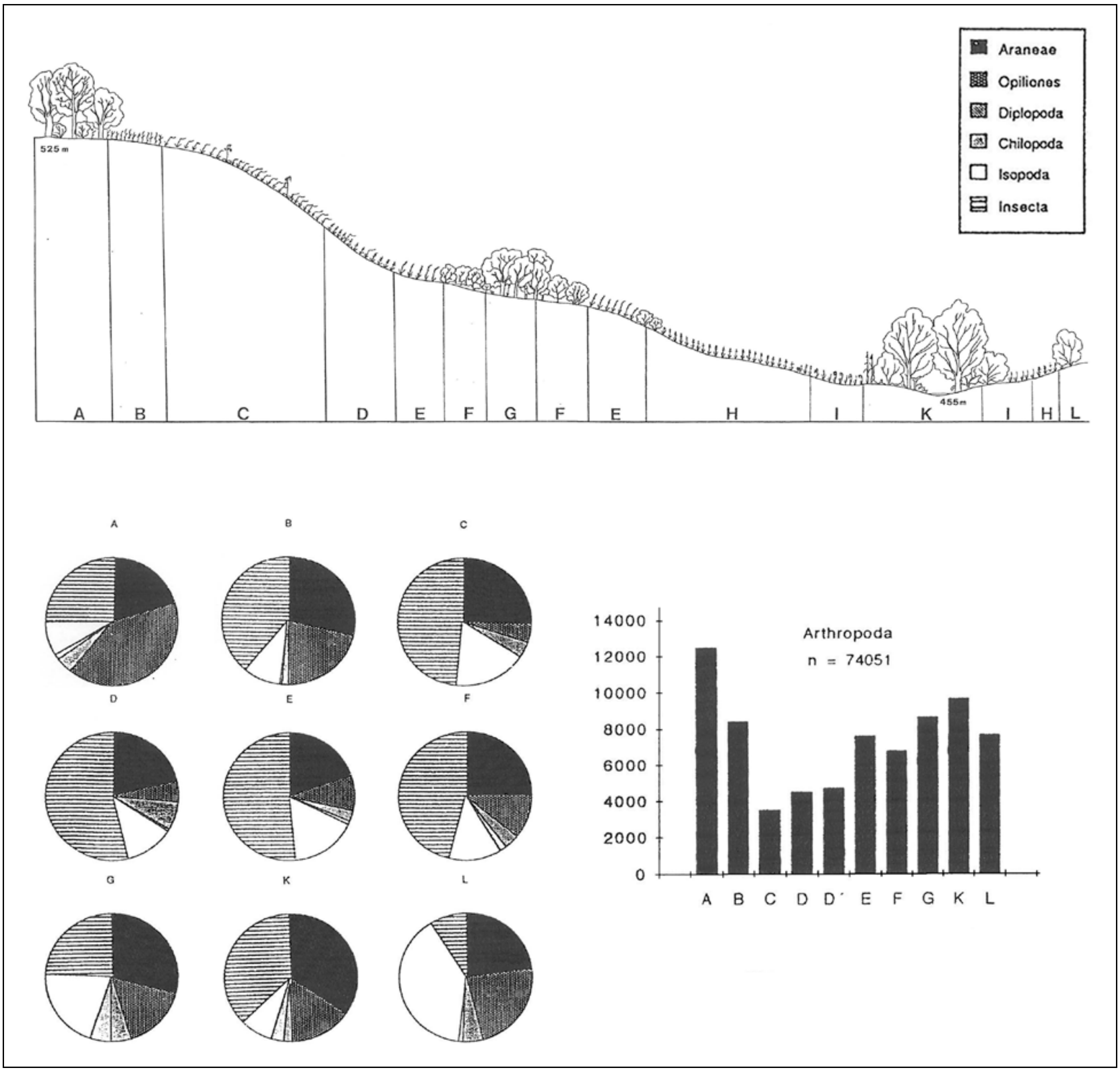

Figure 2: Profile of the slope on the right side of Şerbuţa Valley with the topographic disposal of the studied habitats/plant communities and the dominance structure of the epigeic arthropods.

In the studied slope profile with its specific ecological gradients, each present class of arthropods has a characteristic distribution, according to the site factors and the ecological needs for each group. From these groups the Isopoda (15.17%), Araneae (25.06%), Opiliones (18.11%), Diplopoda (3.84%), Chilopoda (1.66%) are given in the present paper only as a whole for exemplifying the diversity of arthropods on the hill slope (Fig. 3), as they have been the subject of other, earlier published studies (Ceuca et al., 1977; Matic et al., 1979; Tomescu et al., 1979; Weiß, 1975a, b). A comparative view on the distribution of the main classes of arthropods which populate the epigeic layer in the catena of habitats of the Serbuţa Valley, indicate a different preferential distribution characteristic for each class. Although each studied group has an euritopic representance through all studied habitats, the preferential distribution is very diverse being in concordance with the general ecological characteristics of the group (Fig. 3).

Analyzing the quantitative relation of the main arthropod classes for each sampling site with its typical habitat, it is concluded that in nearly all habitats the insects have the highest representation (Fig. 2). The main occurrence with the highest percentage of insects (dominance) is represented by the habitats of sampling areas B, C, D, E, F and K, and the lowest in the sampling area L. The most representative habitats with the highest percentage values are the open dry habitats represented by the Feathergrass community (habitat sampling site C), Xerothermic grassland with Earth sedge (habitat sampling site D) and Xero-mesophilous grassland community (habitat sampling site E). Near to these – concerning richness of insects – are the xero-thermophilous bush community edified by Small Almond (habitat sampling site B) as well as the bush formation of Blackthorn (*Prunus spinosa*) and Whitethorn (habitat sampling site F). These are followed by the sampling site K representing the gallery-like willow habitat, also including the tall herbaceous fringe community and the curtains of the Ord. Calystegietalia. These last two, the tall herbaceous fringe and the curtain of Calystegia are listed above as separate habitats (J), but for calculation and graphic presentation are considered together with the sampling site of the willow habitat. The forest habitat (sampling site A) is concerned with the dominance structure near to the habitat of the thermophilous bush and tree formation with forest species (sampling site G). The habitat with the lowest insect component is the Bush formation in succession on the Northern exposed slope of the Serbuţa Valley (sampling studied area L).

The samples taken from the Epigaion collected by Barber traps resulted in 26.779 specimens of insects (Fig. 3) corresponding to 36.16%. The Ord. Collembola took part in the mesofauna and was represented in the samples by a high number of individuals that have not been subjects of our research.

The distribution of each insect order is represented along the slope profiles A-L, showing very clear, which are the preferred and which are the less preferred, poorer populated habitats avoided by the species representing the different orders of insects (Tab. 1, Figs. 4 and 5).

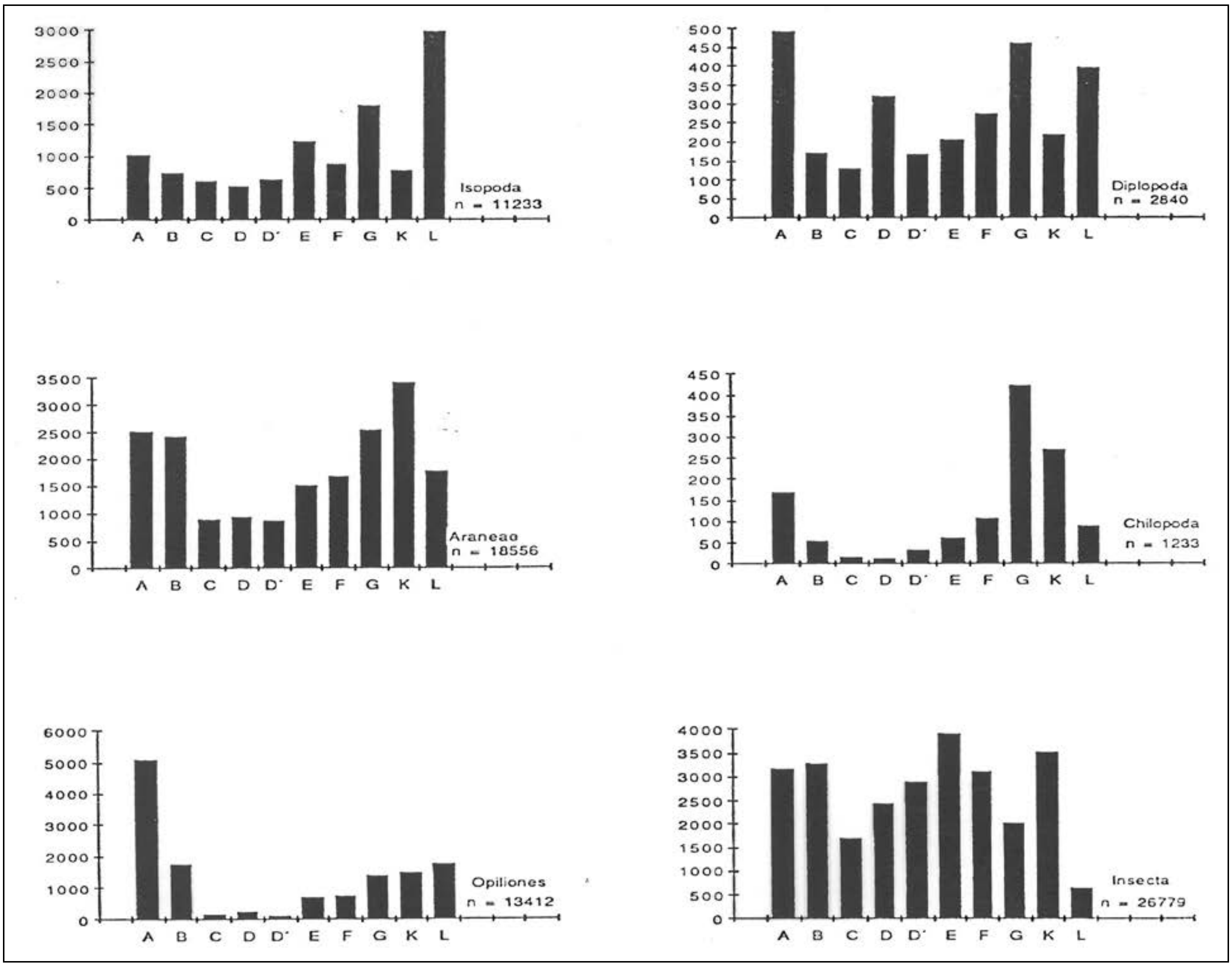

Figure 3: Characteristic distribution of arthropod classes Isopoda, Diplopoda, Araneae, Opiliones, Chilopoda and Insecta considering the number of individuals along the slope profile (A-L) according to the microclimate and the ecological requirements of each group.

Table 1: Procentual participation of orders of insects in the composition of the epigaeic entomocoenoses in the catena of habitats A-L along the slope profile in the Şerbuţa Valley.

Habitat	A	B	C	D	D’	E	F	G	K	L
Thysanura	0.69	2.13	0.41	0.08	0.03	5.69	0.42	0.88	0.06	0.61
Plecoptera	–	–	–	–	–	–	0.03	–	0.03	–
Dermaptera	0.88			2.59	0.38	0.05	0.03	0.05	–	0.15
Blattodea	0.66	11.66	25.93	10.27	5.63	18.65	12.78	2.51	0.03	2.27
Saltatoria	0.03	2	4.41	15.41	3.92	1.68	0.77	0.05	0.08	–
Homoptera	0.3	3.73	1.12	3.82	2.88	4.11	1.6	0.59	0.68	0.91
Heteroptera	0.19	0.55	0.35	4.31	2.68	0.71	0.19	0.54	0.06	0.61
Planipennia	0.03	0.21	0.23	0.04	–	–	–	–	–	–
Coleoptera	**60.37**	**22.17**	**14.99**	**17.5**	**11.54**	**17.96**	**35.66**	**32.32**	**57.22**	**54.78**
Hymenoptera	1.7	1.97	2.29	1.76	0.99	2.24	1.73	1.97	1.87	3.03
Formicoidea	**17.5**	**43.09**	**32.39**	**33.44**	**56.27**	**37**	**33.37**	**4.24**	**25.13**	**11.99**
Mecoptera	0.06	–	–	–	–	0.03	0.22	0.25	0.08	0.45
Diptera Nematocera	2.01	1.61	2.35	0.49	1.06	1.05	1.54	2.51	1.64	3.34
Diptera Brachycera	8.77	8.2	11.7	6.2	7.56	8.52	9.93	9.6	10.77	15.48
Lepidoptera	6.79	2.67	3.82	4.7	7.04	2.29	1.7	1.92	2.35	6.37

The insect orders with the highest dominance in the epigaion along the slope profile are the Coleoptera and Formicoidea, with different distribution in the different habitats along the slope, followed by Diptera Brachycera, Lepidoptera, Blattodea (Tab. 1).

The distribution of the insect orders is: Coleoptera, Formicoidea, Hymenoptera, Lepidoptera, Diptera Brachycera, Diptera Nematocera, Saltatoria, Heteroptera, Homoptera, Planipennia, Thysanura, Dermaptera, Blattodea, Mecoptera in the different habitat types (A-L) along the whole catena represents the general ecological preferences of the orders and the participation in the composition of the entomocoenoses of the different habitats. The graphic also suggest which are the preferred habitats and which are less preferred and populated (Figs. 4 and 5).

What concerns the order of Lepidoptera sampled by Barber traps in the frame of the study of the epigaion (Fig. 4), can be registered only by a certain number of species. These are the caterpillars of Psychidae, with housing like a quiver constructed of sand grains as well as fragments of plants. They are living on the soil surface and falling into the traps. The others are leaf miners, which constructed their houses of leaves and fell on the soil and in the traps sometimes. A third category of Lepidoptera entering in the traps are some species which are looking for wintering places in the lowest herbaceous layer on the soil and are falling in the traps. The greater part of Lepidoptera from the studied slope profile were collected by qualitative methods by special nets.

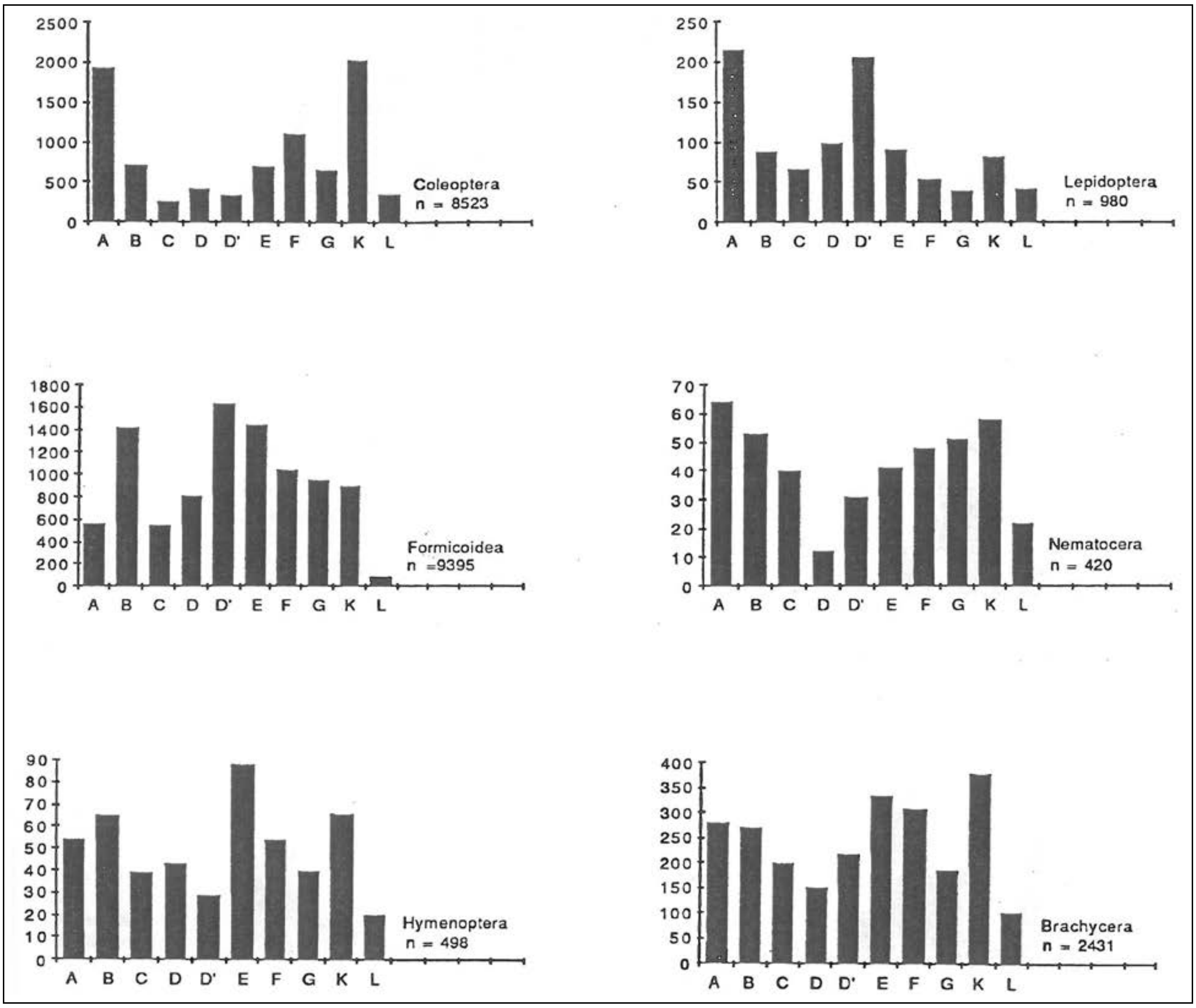

Figure 4: General quantitative distribution of the different orders of insects of the epigaion considering the number of individuals in the catena of habitats along the slope profile (A-L).

The Saltatoria specimens collected by Barber traps represents only a part of the species of this order occurring in the study area. The number of individuals (Fig. 5) reflect the movement and shifting of the individuals from one place to the other on the soil surface (epigaion) and also show in which habitat type the most individuals are represented. In the case of Saltatoria it is the habitat in the sampling area D, representing the xerothermic grassland with Earth sedge (*Carex humilis*) and Valais fescue (*Festuca valesiaca*) belonging to the association Carici humilis-Festucetum valesiacae. This shows very clearly what the preferred site conditions of species are from the Saltatoria order (Schneider, 1977).

Heteroptera are also represented with the highest number of individuals in the sampling area D. As they are phytophagous sucking insects, they are more represented in the herbaceous vegetation layers and less on the soil. Only 8.6% (264 specimens) of the studied material originated from Barber traps and 77% (2,356 specimens) from quantitative sampling methods by striping the vegetation with a corresponding net (s. methods). The other 14.4% (442 specimens) of Heteroptera has been collected by qualitative hand methods (Schneider, 1990).

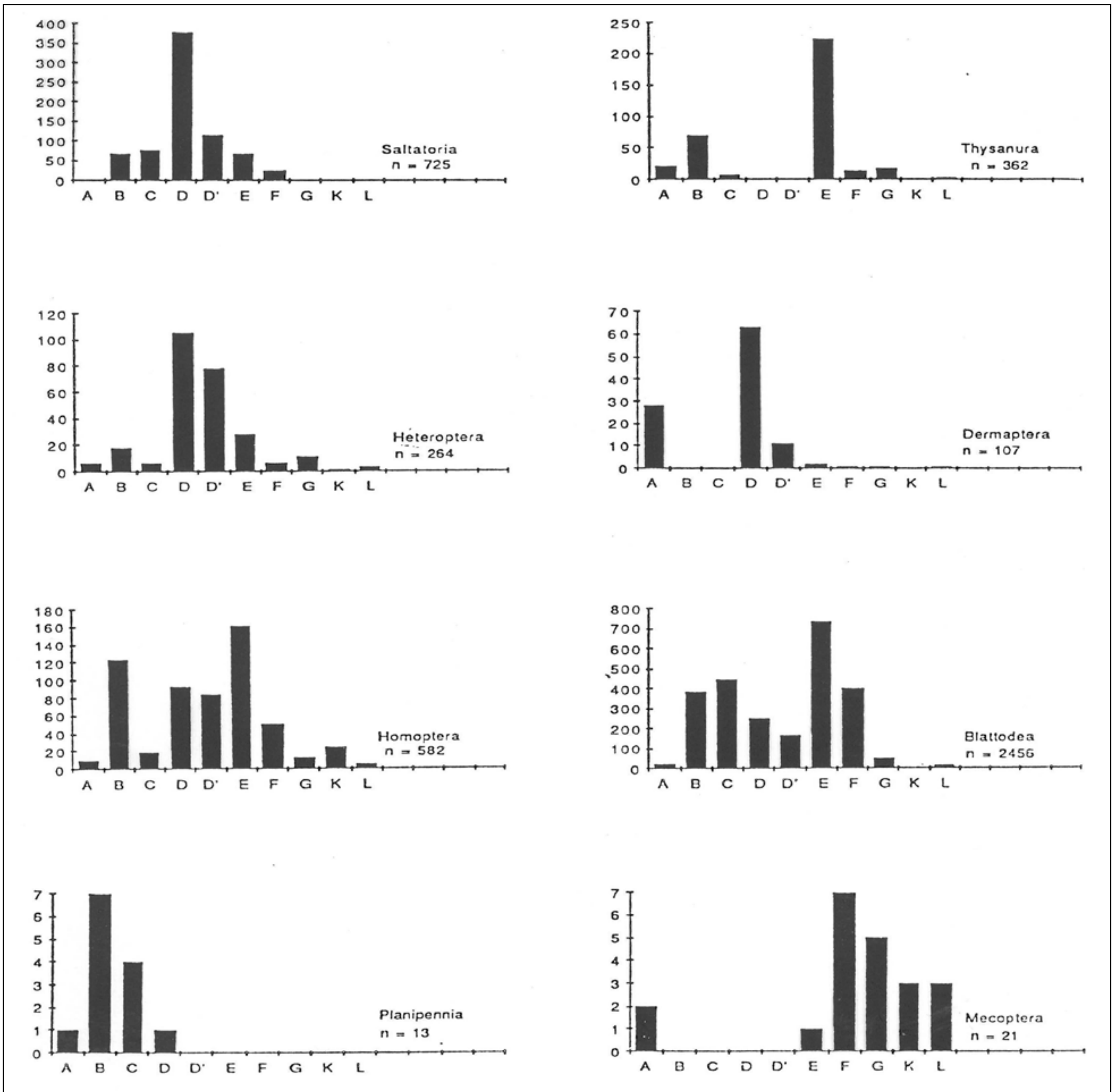

Figure 5: General quantitative distribution of the different orders of insects from the epigaion layer considering the number of individuals in the catena of habitats along the slope profile.

Table 2: Synthetic table of the Coleoptera families and their distribution on the epigaeic level of the habitats mosaic along the slope profile of Şerbuţa Valley.

Sampling stations	A	B	C	D	D'	E	F	G	K	L	n	%
Families												
Carabidae	544	83	33	111	42	60	58	22	1,248	165	2,366	27.76
Hydrophilidae	–	–	–	–	–	–	–	–	5	–	5	0.06
Histeridae	–	–	–	–	–	–	–	–	1	.	1	0.01
Silphidae	161	6	1	–	–	1	86	–	1	3	279	3.27
Catopidae	164	18	5	15	8	14	80	40	35	34	413	4.85
Colonidae	2	5	5	1	1	5	4	1	–	–	24	0.28
Liodidae	–	–	–	–	–	1	–	2	1	4	8	0.09
Scydmaenidae	1	9	1	–	1	9	–	2	6	2	31	0.36
Orthoperidae	–	–	–	–	–	1	–	–	–	–	1	0.01
Scaphidiidae	1	–	–	–	–	–	–	1	2	–	4	0.05
Staphylinidae	364	225	48	109	110	407	765	247	589	88	2,952	34.64
Pselaphidae	6	1	–	–	3	3	–	–	8	–	21	0.25
Lampyridae	29	14	2	1	3	14	8	12	34	23	140	1.64
Cantharidae	2	1	1	–	–	–	–	–	–	1	5	0.06
Drilidae	7	2	–	–	–	–	–	–	–	–	9	0.1
Malachiidae	–	10	9	–	3	5	–	–	–	1	28	0.33
Elateridae	12	–	1	3	-	-	3	-	1	1	21	0.25
Throscidae	–	–	–	–	1	–	–	–	–	–	1	0.01
Buprestidae	–	2	–	1	1	–	–	–	–	–	4	0.05
Dryopidae	–	–	–	–	–	–	–	–	8	–	8	0.09
Dermestidae	2	1	–	–	–	-	1	–	–	–	4	0.05
Byrrhidae	–	1	–	1	–	3	–	–	–	–	5	0.06
Nitidulidae	1	1	–	–	–	-	–	–	–	1	3	0.04
Erotylidae	–	–	–	–	–	1	–	–	–	–	1	0.01
Cryptophagidae	102	1	1	1	–	–	13	48	12	6	184	2.16
Lathridiidae	3	5	–	2	3	10	–	–	1	–	24	0.28
Mycetophagidae	–	–	–	–	–	2	.	.	.	.	2	0.02
Colydidae	1	–	–	–	–	1	–	–	–	–	2	0.02
Endomychidae	1	4	1	1	–	2	1	1	–	–	11	0.13
Coccinellidae	1	3	–	4	1	2	–	1	–	2	14	0.16
Ptinidae	4	8	–	–	1	3	–	2	–	–	18	0.21
Meloidae	–	–	1	–	–	–	–	–	–	–	1	0.01
Mordellidae	–	1	1	–	–	2	–	–	–	–	2	0.05
Serropalpidae	–	–	–	–	–	1	–	–	–	–	1	0.01
Lagriidae	18	6	1	–	1	2	2	2	–	–	32	0.38
Alleculidae	1	–	–	–	–	–	–	–	–	–	1	0.01
Tenebrionidae	–	–	2	86	1	6	1	–	–	–	96	1.13
Scarabaeidae	67	5	7	12	11	5	8	1	11	1	128	1.5
Lucanidae	–	–	–	–	1	–	1	1	–	–	3	0.04
Cerambycidae	–	2	3	1	3	2	–	2	1	–	14	0.16
Chrysomelidae	11	76	66	38	88	57	32	14	38	10	430	5.05
Anthribidae	–	–	–	–	–	–	–	–	2	–	2	0.02
Curculionidae	382	163	66	38	53	37	47	257	11	19	1,073	12.59
Coleoptera sp.	14	77	–	1	1	47	1	–	8	–	149	1.75
Total specimens	1,921	730	255	425	336	704	1,110	656	2,024	361	8,523	100
Total %	22.5	8.56	3	5		3.94	8.26	13	7.7	23.8	4.23	100

The Blattodea presents the highest number of individuals in the sampling site E, the habitat with xero-mesophilous grassland of community (Dorycnio-Brachypodietum pinnati) (Fig. 5). The Dermaptera prefers in general more dry site conditions as the Blattodea have; however, the highest density of individuals in the sampling area D represented by the plant xerotermic community of Earth sedge and Valais fescue, ass. Carici humilis-Festucetum valesiacae are lacking in extreme dry habitats of the sampling areas B and C represented by the Small Almond bushes (B) and stepic grassland edified by Feathergrass (*Stipa pulcherrima*) (Schneider, 1977).

The habitat type with the lowest number of individuals for the most analyzed orders of insects present in the sampling area L: bush formation in succession on the Northern exposed slope of the Serbuţa Valley (Figs. 4 and 5).

The order of Coleoptera is in general extremely rich as represented from the qualitative and the quantitative point of view, and the following presents the general results from the analysis of the Coleoptera of the epigaeic layer on family level (Tab. 2, Fig. 6).

From the analysis of the material collected by Barber traps resulted that the beetles (8,523 specimens) have a preferential unequal distribution in the habitats of the slope profile. The forest habitats, being the most populated, have the highest representatation in the sampling sites A (22.5%) and K (23.27%) and the lowest in the xerothermic grasslands C (3%) and D (5%) and D' (3.9%).

The fauna of the analyzed beetles of the habitat complex on the Southern exposed slope of Şerbuţa Valley belong to 44 beetle families. From these families there are dominant ones, including 74% of the total of beetles, these are the families of Staphylinidae (34.64%), Carabidae (27.76%) and Curculionidae (12.59%) (Tab. 2). They are followed by the Chrysomelidae (5.05%), Catopidae (4.85%), Silphidae (3.27%), Cryptophagidae (2.16), Lampyridae (1.64), Scarabaeidae (1.5%), and Tenebrioidae (1.13). All other families are represented with less than 1% (Tab. 2).

Considering the Carabidae family characteristic for the study area, which is as well important indicator for the habitats by a high number of individuals, they will be analyzed in more detail.

In the researched habitat types disposed along ecological gradients of the slope profile, 2,366 specimens of Carabidae from 71 species have been registered by collection with Barber traps. In addition eight specimens belonging to four species were collected by striping from the herbaceous layer. The identified 75 species belongs to 33 genera from which regarding the number of species and individuals the most important are Pterostichus (10 species), Harpalus (eight species), Carabus (seven species), Amara (seven species), Agonum (five species), and Abax (four species).

From the Transylvanian Basin and the neighbouring area are known about 460 species of Carabidae. From these species in the hilly area belonging to the Southern border of the Transylvanian Tableland and situated East and North from the Cibin Depression between Gușteriţa and Slimnic, on a linear distance of 16 km, has been mentioned until present 123 species of Carabidae (Schneider, 1990). The remarkable number of 75 species co-habiting along a linear profile of only 350 m, reflect the high species diversity of this site, representing 60% of the Carabidae of the reference zone between Guşteriţa and Slimnic.

The ground beetles (Carabidae) have in the study area a very non-uniform distribution. In general we stated that the forest habitats are richer in species and specimens than the open habitats. For the majority of ground beetles the most favorable habitats are in the valley plain, in the habitat of gallery-like softwood forest including also the tall herbaceous nitrophilous vegetation (station K).

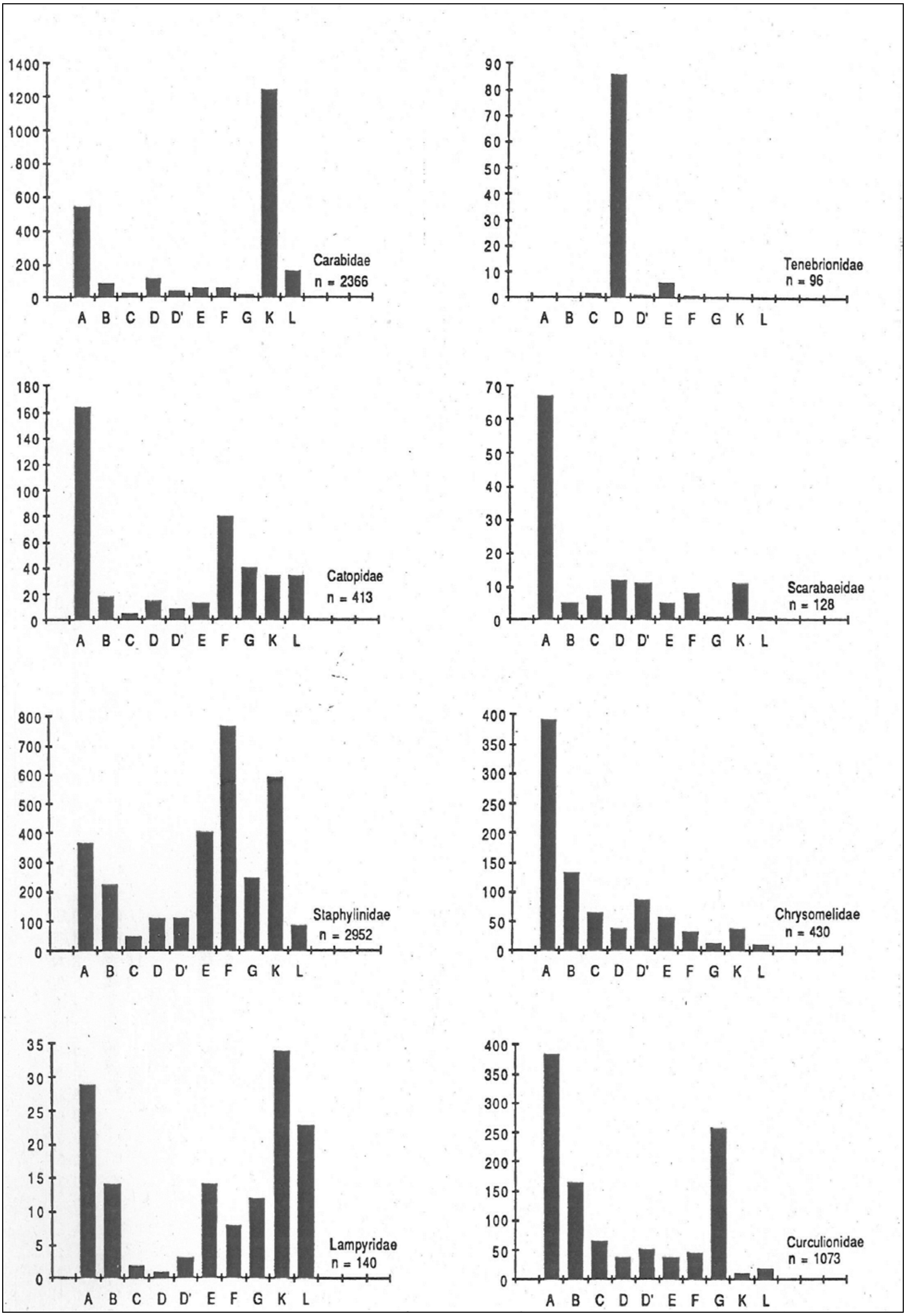

Figure 6: Types of general quantitative distribution of some representative families of Coleoptera from the epigaion of the studied habitat catena of Şerbuţa Valley.

In the studied area 69% of the total number of species have been registered, representing 52.8% of the specimens number. In second place is the habitat of the termophilous oak-hornbeam mixed forest (A), where there have been 31% of the species registered and 23% of the total of specimens. The species and specimens number is decreasing gradually in the bush habitats, reaching a minimum in the biotopes with extreme conditions, these being the habitat of sampling area C with Feathergrass (Stipetum pulcherrimae) and the habitat of sampling area (D) xerothermic grassland with Earth sedge and Valais fescue, the as. Carici humilis-Festucetum valesiacae.

Numerous experimental analyses and field observations demonstrate that for ground beetles the ecological key factor for habitat preferences is the humidity (Lauterbach, 1964; Schneider, 1977; Schneider, 1990; Bräunicke and Trautner, 2002; Müller-Motzfeld, 2004). This beetle's family is primarily bound to humid habitats, having the highest faunistic diversity in humid forests, in floodplains and along running and standing waters. This hygrophilous character of ground beetles is visible in their general distribution as well as on the microhabitats level, with small micro-spaced fragments of a giving landscape as it is represented by the study area in Şerbuţa Valley, which offers various microhabitats, disposed as a mosaic and zonal structure. At the same time it is important to know that ground beetles are predators finding their richest nutrition supply on wet soils of forests and in floodplains.

As above mentioned, the distribution of ground beetles along the slope profile is non-uniform. The analysis of this situation demonstrates that this distribution is determined through the preferential comportment of each species. The specimens of each species have a characteristic distribution along the slope profile gradient, resulting in a specific model of territorial distribution. That way, certain biotopes or groups of biotopes are populated by certain coenotic groups of ground beetles. Some species have a very small stenotopic distribution occurring only in one habitat, for example the situation of *Aptinus bombarda*. Other species are transgradient, being active in some neighboring or ecologic similar habitat such as the example of *Abax parallelus*. Mostly, they have the center of their distribution in a preferred habitat, and such is the case for *Carabus scabriusculus*, or in more similar habitats such is the case for *Pterostichus hungaricus*. Only the pronounced euribiont species have an euritopic or near to euritopic distribution and find that they are leaving in different habitat conditionss, or are migrating from a primary habitat in the neighboring habitats as is the situation for *Carabus coriaceus*.

A decisive role for the determination of the distribution type is, apart from the ecological requirements of the species and the different mobility, determined on their turn by the size of the specimens.

According to the preferential behaviour to different types of habitats, the ground beetle species of the studied area can be grouped in the below presented categories.

I. Carabidae/Ground beetles which prefer the valley plain i.e. the floodplain and river bank habitats

a. Species identified exclusively in this habitat:
Agonum assimile, *Agonum livens*, *Agonum moestum*, *Agonum obscurum*, *Amara convexior*, *Amara ovata*, *Asaphidion flavipes*, *Badister sodalist*, *Bembidion mannerheimi*, *Clivina fossor*, *Harpalus brevicollis*, *Harpalus latus*, *Nebria brevicollis*, *Pterostichus anthracinus*, *Pterostichus niger*, *Pterostichus coerulescens*, *Pterostichus nigrita*, *Pterostichus strenuous*, *Pterostichus vernalis*, and *Pterostichus vulgaris*; represented with only one specimen: *Amara aulica*, *Amara communis*, *Amara montivaga*, *Anisodactylus signatus*, *Chlaenius nigricornis*, *Pterostichus szeligetii*, and *Trechus micros*;

b. Carabidae with the distribution center in the following habitats:
Abax carinatus, Abax parallelus, Badister bipustulatus, Carabus convexus, Carabus granulatus, Carabus violaceus, Dyschirius globosus, Leistus piceus, Pterostichus oblongo-punctatus, Trechuis quadristriatus, and *Trechus secalis*;

II. Carabidae/ground beetles which prefer the oak-hornbeam mixed forest

a. Species identified exclusively in this habitat:
Amara aenea, Aptinus bombarda, Licinus depressus, Molops piceus, and *Notiophilus rufipes*;

b. Species distributed prevalent in this habitat:
Abax ater, Cychrus semigranosus, Pterostichus hungaricus, Stomis pumicatus, and *Synuchus nivalis*;

III. Carabidae/Ground beetles preferring xerotermic – steppe grasslands

a. Species identified exclusively in these habitats:
Amara eurynota, Callistus lunatus, Harpalus azureus, Harpalus signaticollis, and *Harpalus vernalis*;

b. Species with the distribution center in these habitats:
Carabus scabriusculus, Harpalus puncticollis, and *Harpalus roubali pseudodimidiatus*;

IV. Carabidae/ground beetles preferring thermophilous bush habitats

a. Species represented only in the Small Almond bush habitat:
Demetrias atricapillus

b. Species with maximum distribution in this habitat:
Dromius linearis, Dromius nigriventris, and *Microlestes maurus*;

c. Species with the center of their distribution in the bush formation on the slope, sampling station G:
Platyderus rufus;

V. Euritopic ground beetles species

Bembidion lampros, Carabus coriaceus, Carabus violaceus, Dyschirius globosus, and *Platyderus rufus*.

It can be stated that there is an evident relationship between the preferences of species for certain sites and the ecological behavior of the species on the one side and the general geographic distribution of the species on the other side. The species with the center of their distribution in the sylvo-steppe area of Eastern and South-Eastern Europe prefers the open biotopes, xerothermic steppe grasslands and are thermophilous and photophilous. The central European and Euro-siberian species of forests are hemi-hygrophilous, hygrophilous ombrophilous and oligo-stenotherm species preferring the forest area. The species with a large horizontal and vertical distribution presented in the study area a large ecological amplitude and a more or less euritopic distribution. The largest distribution seems to have in general the species of floodplains, mostly euro-Siberian fauna elements.

With their habitat preferences, the ground beetles serve as very good indicators for the ecological state of an area and can be used for ecological expertises in relation with nature ecological expertises as well as for conservation and management of protected areas (Bräunicke and Trautner, 2002). As predators the ground beetles contribute to the preservation in normal limits of the primary consumers (phytophagous species) and thereby to the state of homeostasis, the ecological equilibrium of the different ecosystems.

From the other beetle families as above mentioned, the Staphylinidae is the most represented concerning the number of individuals. Concerning the diurnal activity and ecology it is also one of the most diversified Coleoptera families. Most of the species are highly specialized and populate only certain habitats. In Central Europe there are about 1,300 known species and for Transylvania we have a number of about 1,000. From the rich material of Staphylinidae that resulted from the sampling with Barber traps (2,952 specimens) the most material has been determined to the species level. The 24 identified species together with the genera *Stenus* and *Quedius*, very rich in species, constitute 61% of the Staphylinidae from the transect of the Şerbuţa Valley. The dominant species is *Drusilla canaliculata*, with a large geographical distribution, which results also from the euritopic distribution in the study area. But the highest concentration has been observed in the ecoton habitats (sampling area B, and E) and the bush habitats (sampling area F). Some genera with the large sized Staphylinidae are *Ocypus*, *Philonthus* and *Platydracus*, which are represented with some related species. From the abundance point of view of populations and also from the preferential distribution along ecological gradients in the slope profile, the species closest to the other from the taxonomic – systematic point of view are very different in their ecological behavior, demonstrating an evolution and specialization in many directions. The most Staphylinidae from the slope profile were stated with high concentration in the forest habitats. Species which prefer open and warm habitats are *Astenus gracilis, Philonthus lepidus, Platydracus chalcocephalus, Staphylinus caesareus*, *Ocypus picipennis, Ocypus fulvipennis*, and *Zyras fulgidus*.

The Curculionidae family is rich in species (in Central Europe about 1,000 species), and exclusive in phytophagous, the nymph apodes, and evolving endobiont in plants (Rheinheimer and Hassler, 2010). For many species the state of nymph and the evolution cycle are unknown. Also for numerous species the geographical distribution is still unanswered. This situation concerns mostly species considered as rare in South-Eastern and Eastern Europe. From the 1,975 specimens of Curculionidae Rynchophora from the Barber traps of the Șerbuța Valley, 93% has been determined to the species level. The highest abundance is achieved by the epigaeic *Brachysomus echinatus* (50%) *Brachysomus hirtus* (10.6%), *Otiorhynchus raucus* (14.5%) and *Barypeithes armiger* (6%). Their distribution is more or less euritopic with a concentration in the leaf litter of the forest habitats.

Another group with smaller abundance constitutes the species more or less than the stenotop species of the steppic habitats, such are: *Otiorhynchus orbicularis*, *Otiorhynchus velutinus*, *Otiorhynchus ovatus*, *Stomodes gyrosicollis*, *Agroptochus periteloides* (with high abundance in the herbaceous layer of the Feathergrass habitat), *Trachyphloeus alternans*, *Trachyphloeus aristatus*, *Psalidium maxillosum*, and *Alophus kaufmanni*.

Of great interest from the faunistic and zoogeographical point of view is the species *Lixus cylindricus*, which evoluate on Apiaceae species and has been collected by nets in the Feathergrass community in the month, of May and June. The most interesting species from the zoo-geographical point of view is *Stephanocleonus microgrammus*. This Eastern-European species takes part of a genus with many species in desert areas of Central Asia. For the inner part of the Carpathian arch the species has been first mentioned by Bielz (1887) from the area of Cluj, but later put in doubt by Petri (1912). From that time through our earlier researches in the area (1973) the species has been documented again in the fauna of Transylvania in a thermophilous bush habitat, G section of the slope profile (Schneider, 1990). In the following time until present the species were not mentioned.

During field visits in the last seven years with control sampling it has been stated that the structure and species composition of the studied habitats along the slope profile remained almost the same. Only in the last three years the grazing by sheep is more intensive as in the years before, which is dangerous for the habitat structure and species composition as well as for the structure of the soil. Changes of the habitats can conduct a change of the zoo-coenoses of the area, which still have a good structure. In the past, the area has been exposed to a light grazing in early spring and in late autumn. In summer time the xero-mesophilous and mesophilous as well as meso-hygrophilous grassland habitats were used as meadows, and only the xerophilous grassland of Feathergrass on the front of the hill slope are not exposed to any uses. Also problematic is the uncontrolled burning in the area, as it has been stated in the last few years (2011-2014), in a small part of the area and as well in the neighboring area of the Dealul Zakel/Zakel Hill, part of the Natura 2000 SCI 0093 "Steppe islands near to Slimnic", are destroying the soil and parts of the epigeic fauna. Another danger for the high biodiversity of the area is the construction of houses in the Şerbuţa Valley, very near to the interesting habitat complex of the study area and related changes in the neighbouring habitats.

Taking into account the biodiversity high value including species as well as habitats of community interest, between them priority habitats such are Habitat type 40A0* Subcontinental peri-Pannonic scrub (xero-thermophilous bush community of Small Almond), Habitat type 62C0* Ponto-Sarmatic steppes (Feathergrass community) and Habitat type 6240* Sub-pannonic steppic grasslands (Gafta and Mountford, 2008) with their specific fauna, we propose to enlarge the Natura 2000 SCI 0093 Steppe islands near Slimnic with the studied area. This way it can be assured there is an appropriate conservation and management for the area.

CONCLUSIONS

The studied slope of the Şerbuţa Valley of 350 m length and with various and different structured habitat types presents a very high biodiversity which is shown by the various classes of arthropods with special regard to Insecta, presented with their orders and the distribution along the slope profile. Focusing on the order of Coleoptera, this is presented in more detail, with its families, as well with the repartition of specimens in the habitats along the slope profile. The family of ground beetles (Carabidae) is representative for the area and is a group with good indicators for the ecological state of the habitats.

Considering the high number of specimens and species of the area, it can be stated that from the point of view of biodiversity and of conservation, the area is of outstanding importance. The biocoenoses of the area can be considered representative for other similar southern exposed hill slopes in Southern Transylvania.

The results, even if they are realized from more than two or three decades ago, are of outstanding interest, as such complex ecological analyses were not realized before that data in Southern Transylvania. Later, such a complex study for the whole group of macroarthropodes with special regards to the insects was not continued. Only on a smaller scale was some similar research realized.

From this point of view the presented and discussed research and the obtained results are giving an impulse for similar studies and as well for the continuation of this ecological research program, which from the biodiversity point of view gives an overview of the complexity and the exceptional richness of macroarthropods, especially of the entomofauna of the Southern Transylvanian Tablelands area. The data from such studies, also from the earlier publications, are a good basis for long term monitoring with different time sheets, which allow for conclusions concerning the evolution in time of biodiversity under changing site conditions in the Southern Transylvanian Tablelands.

Ongoing from the results of this specific research, we can assume the fact that a similar diversity can be precisely encountered as well in similar site conditions of the whole Transylvanian Tableland.

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RECENT STATUS OF *NEOGOBIUS* SP. (GOBIIDAE) IN SERBIAN WATERCOURSES

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KEYWORDS: Invasive fish, distribution, *Neogobius* sp., Danube River basin, Serbia.

ABSTRACT

The Republic of Serbia (88,361 km^2) has an intricate hydrographic network formed by 66,000 km of rivers and 150 reservoirs. Distinct hydroecological conditions contribute to the diversity of its ichthyofauna comprising 94 species belonging to 26 families, of which 22 species within 10 families are non-native (allochthonous). In Serbia the Ponto-Caspian family Gobiidae is represented by the genera *Neogobius* with the species: *N. fluviatilis, N. kessleri, N. gymnotrachelus, N. melanostomus* and tubenose goby *Proterorhinus marmoratus.*

Over the past years, the range expansion of *Neogobius* sp. from their primary habitat (the Danube River and its major tributaries) to other watercourses has been observed. This may intensify competition interactions with indigenous benthic fish. Moreover, representatives of this genus can be vectors for some parasitic diseases. The overabundance of *Neogobius* sp. representatives in the new habitats disturbs the ecological equilibrium, thus further aggravating the status of the autochthonous ichthyofauna.

REZUMAT: Starea actuală a *Neogobius* sp. (Gobiidae) în cursurile de apă din Serbia.

Republica Serbia (88.361 km^2) are o rețea hidrografică complexă, formată din 66.000 km de râuri și 150 bazine hidrografice. Condițiile hidroecologice diferite contribuie la diversitatea crescută a ihtiofaunei, care cuprinde 94 specii aparținând la 26 familii, din care 22 specii aparținătoare la 10 familii sunt alohtone. În Serbia, familia Gobiidae este reprezentată de genul *Neogobius* cu speciile *N. fluviatilis*, *N. kessleri*, *N. gymnotrachelus*, *N. melanostomus* și *Proterorhinus marmoratus*.

În ultimii ani a fost observată expansiunea speciilor din genul *Neogobius*, de la habitatul primar (Dunăre și tributari) la alte cursuri de apă. Acest fapt poate intensifica competiţia cu speciile indigene. Ba mai mult de atât, reprezentanții acestui gen pot fi vectori pentru boli parazitare. Abundența speciilor din genul *Neogobius* în noile habitate perturbă echilibrul ecologic, astfel agravând și mai mult starea ihtiofaunei autohtone.

ZUSAMMENFASSUNG: Gegenwärtiger Zustand der Neogobius Arten (Gobiidae) in Fließgewässern Serbiens.

Die Republik Serbien (88.361 km^2) hat ein komplexes hydrographisches Netz, das aus 66.000 km Flussläufen und 150 Wasserspeichern besteht. Deutlich ausgeprägte hydro-ökologische Bedingungen tragen zur Diversität der Fischfauna dieser Gewässer bei, die 94 Arten aus 26 Familien umfasst, von denen 22 Arten aus zehn Familien nicht einheimisch, sondern allochton sind. Die ponto-kaspische Familie der Gobiiden ist in Serbien durch die Gattungen *Neogobius* mit den Arten *Neogobius fluviatilis*, *N. kessleri*, *N. gymnotrachelus* und *N. melanostomus* sowie durch *Proterorhinus marmoratus* vertreten.

Über die vergangenen Jahre, wurde der Umfang der Ausbreitung der *Neogobius* Arten aus ihrem ursprünglichen Habitat – der Donau und ihrer größeren Nebenflüsse in andere Fließgewässer beobachtet. Dieses könnte die konkurrenzbedingten Wechselbeziehungen mit den einheimischen benthischen Fischen verstärken. Zudem können die Vertreter dieser Gattung Überträger für einige parasitäre Krankheiten sein. Die Überfülle der Vertreter der Neogobius Arten in den neuen Habitaten stört das ökologische Gleichgewicht und verschlimmert dadurch den Zustand der einheimischen Fischfauna.

INTRODUCTION

Serbia (88,361 km^2) occupies the central region of the Balkan Peninsula. Lowlands cover the northern part (Vojvodina Province) and uplands dominate three-quarters of the country's surface area. The diversity of geologic formations and climate characteristics contribute to the rich hydrographic network formed by 66,000 km of rivers and 150 reservoirs. The majority of the country's watercourses (97% of the territory) belong to the Black Sea Basin (Danube River basin), whereas 3% are part of the Adriatic Sea and Aegean Sea basins (Karadžić and Mijović, 2007). Overall hydroecological conditions favour the development of fish communities. Permanent or temporary residence of 94 fish species belonging to 26 families, with 22 non-native (allochthonous) species within 10 families, has been recorded (Lenhardt et al., 2011).

Reasons for the presence of non-native species in Serbian watercourses are diverse, including aquaculture, spontaneous range expansion, struggle against macrophyte and plankton eutrophication, recreational fishing, etc. (Marković, 2011). The impact of non-native fish is generally negative – endangerment of autochthonous fish due to competition for trophic resources, spawning areas, new parasites, changes in habitat structure, etc. Ecological risks of fish introduction are variable across different families (Vitule et al., 2009).

The most dominant non-native fish species in Serbian open waters which are covering more than 50% of the country's area are Prussian carp (*Carassius gibelio*) and topmouth gudgeon (*Pseudorasbora parva*) – fam. Cyprinidae, pumpkinseed (*Lepomis gibbosus*) – fam. Centrarchidae, and brown bullhead (*Ameiurus nebulosus*) and black bullhead (*A. melas*) – fam. Ictaluridae) (Lenhardt et al., 2011).

With the exception of rainbow trout (*Oncorhynchus mykiss*) – fam. Salmonidae, grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*H. nobilis*) – fam. Cyprinidae (the four species present in Serbian aquaculture), the other non-native fish species have no economic importance (Marković et al., 2012).

The species with the highest diversity among the non-native fish in Serbian watercourses is exhibited by the families Cyprinidae and Gobiidae (*Neogobius* sp. including four species and *Proterorhinus marmoratus*).

MATERIAL AND METHODS

During 2010-2014 period, the occurrence of non-native fish species in some Serbian water bodies (rivers and reservoirs in Danube River basin) was monitored. Particular attention was given to the distribution of *Neogobius* representatives. Specimens were caught using conventional net and hook kits.

Standard specific methods for fish species identification were used (Simonović, 2006).

In addition to the authors' own findings, specific catch data was obtained from different recreational fishermen and also from the available specific scientific literature.

RESULTS AND DISCUSSION

Representatives of *Neogobius* sp. are permanent members of the fish communities in the lower course of the Danube (Bănăduc et al., 2014, 2016; Pavlova and Rabadjiev, 2014). The construction of the Iron Gate I Hydroelectric Power Station Dam in 1970 at 943 rkm of the river course and the formation of the Iron Gate I Reservoir (235 km^2 area) hindered anadromous migrations of some fish species. However, it was not long after the construction of the reservoir that the presence of gobiid representatives was recorded in the Serbian part of the Danube River.

Monkey (sand) goby (*Neogobius fluviatilis* Pallas, 1811) was first recorded in the Serbian part of the Danube at 988 rkm (Ristić, 1977). The ichthyologic research conducted during 2001-2008 at different locations of the Danube and some of its tributaries (Velika Morava and Tamiš rivers) suggested a very good degree of acclimation of the species (Višnjić-Jeftić et al., 2011; Lujić et al., 2013). Monkey goby inhabits the entire Danube's course through Serbia, showing the tendency to expand its range in the largest Serbian tributary – the Sava River (Piria et al., 2011). The southernmost record of the species in Serbian watercourses was in 2012 in the Zapadna Morava River (N 43°90', E 20°34') (Djikanović et al., 2013). The first record of monkey goby in the Gruža Reservoir (Zapadna Morava Basin, Danube River basin) was made on 19 August 2014 during ichthyologic research conducted by the authors (unpublished data). This reservoir is the most important recreational fishing location in Central Serbia. Further propagation of the species is expected to take place in watercourses located to the south within the Danube River basin.

Bighead goby (*Neogobius kessleri* Günther, 1861) was first recorded at 1214 rkm of the Danube (Ristić, 1977). Later records in the direct course of the Danube and Sava River confirm the population expansion of the species (Simonović, 1996). Upstream migrations and acclimation are confirmed by the reports of the fish in the middle and upper course of the Danube (Jurajda et al., 2005).

Racer goby (*Neogobius gymnotrachelus* Kessler, 1857) was recorded in the Serbian part of the Danube in the 1990s (Hegediš et al., 1991). Its highest abundance has been observed and registered in the middle course of the Danube (Višnjić-Jefti et al., 2011). The species has expanded its range to the Danube's immediate tributary the Velika Morava and its constituent Južna Morava River (the southernmost record of the species confirmed in 2010) (unpublished data).

Round goby (*Neogobius melanostomus* Pallas, 1814) (Fig. 1) was first recorded in the Serbian part of the Danube in 1998 at 861 rkm (Simonović et al., 2001). In a short period of time, the species acclimatised to the ecological conditions of the new habitat and expanded its range to the upstream of the Danube (Jurajda et al., 2005; Brandner et al., 2013). Round goby reaches the largest abundance in the lower course of the Danube River and in water bodies located within the Danube catchment area. The specific ichthyologic research conducted from 26-31 July 2014 showed overproduction of this fish species in the Silver Lake reservoir located on the right bank of the Danube (N 44°45', E 21°25'). The species is also highly abundant in the Sava River in the region of Belgrade (confluence with the Danube).

Figure 1: Round goby (*Neogobius melanostomus*) captured in Silver Lake reservoir in 30.07.2014.

The obtained results of Invasive Fish Risk Assessment of non-native fish species in Serbian watercourses suggest that the highest potential for range expansion is exhibited by *C. gibelio*, *A. nebulosus*, *A. melas*, *C. idella*, *P. parva*, *H. molitrix*, *L. gibbosus*, *Neogobius melanostomus*, *N. fluviatilis*, *N. kessleri*, *N. gymnotrachelus*, and *H. nobilis* (Simonović, 2009).

Gobiids from *Neogobius* sp. are widely distributed in the Republic of Serbia within the watercourses of the Danube Basin, particularly in open waters in the north of the country – the Vojvodina Province (Fig. 2). In recent years, these species have expanded their range to the watercourses located to the south within the Danube Basin, primarily the rivers Velika Morava, Zapadna Morava and Južna Morava. This fact and the massive presence of the species in the entire course of the Danube through Serbia confirm their high ecological plasticity.

It is difficult to estimate the role and importance of gobiids in aquatic biocenoses. The analysis of diet of autochthonous piscivorous fish in some European ecosystems indicates a high contribution of *Neogobius* sp. to the trophic spectrum of *Silurus glanis* (Copp et al., 2009), *Esox lucius* (Płąchocki et al., 2010), *Sander lucioperca* and *Perca fluviatilis* (Rakauskas et al., 2013). These data show that gobiids, although lacking commercial importance, are important members of the food chain in certain aquatic ecosystems.

Under overproduction situations, trophic and reproductive characteristics of *Neogobius* sp. representatives can endanger the living conditions of indigenous fish fauna representatives. Additionally, some species are hosts for parasites (Ondračková et al., 2005). The risk that gobiid expansion may cause the emergence of new parasitic diseases among representatives of autochthonous ichthyofauna should not be underestimated.

Although the ecology of these invasive species in Serbia is insufficiently explored, their tendency of range expansion to water bodies located south of the Danube and their overproduction threaten the indigenous fish fauna.

Therefore, *Neogobius* sp. is listed among species that, after capture, must not be released back to Serbian watercourses, for their elimination (Anonymous, 2009).

Figure 2: Map of *Neogobius* sp. distribution in Serbian watercourse.

CONCLUSIONS

The fish fauna of Serbia includes 22 non-native (allochthonous) species belonging to 10 families. Among them, four species belong to the *Neogobius* genus – *N. fluviatilis, N. kessleri, N. gymnotrachelus* and *N. melanostomus*. These were recorded in the direct course of the Danube and its tributaries.

Although the ecology of these invasive species is insufficiently explored, their tendency of range expansion to water bodies located south of the Danube and their overproduction threaten the indigenous fish.

Neogobius sp. is listed among species that, after capture, must not be released back to Serbian watercourses, for the purpose of their permanent elimination.

ACKNOWLEDGEMENTS

This study was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project no. 31011).

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BARBUS MERIDIONALIS RISSO 1826 ON SITE DECISIONS SUPPORT MANAGEMENT SYSTEM – A TRANSYLVANIAN NATURA 2000 SITE STUDY CASE

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KEYWORDS: *Barbus meridionalis*, protected areas, Romania, fish species habitat neccesities, pressures, threats, management tools.

ABSTRACT

In this specific research, the ADONIS:CE tool was used in the ecology domain to build an all-embracing blueprint management model for *Barbus meridionalis* fish species on the base of the species' conservation interest recorded necessities concerning the habitats, and the indicators which bring to light the suitable conservation status and the appropriate measures; as well as the recorded pressures and threats on this fish species.

If the recommended management proposals will not be respected in the ROSCI0132 area, the *Barbus meridionalis* fish species conservation status can decrease within the next 20-30 years.

These types of applications on species, habitats and on site based management support systems for other fish species of European conservation importance should also be realized for the ROSCI0132 protected area.

REZUMAT: Sistem suport pentru luarea deciziilor de management pentru *Barbus meridionalis* Risso 1826 – studiu de caz un sit Natura 2000 din Transilvania.

În această cercetare specifică, instrumentul ADONIS:CE a fost utilizat în domeniul ecologiei pentru construirea unui model de management pentru specia de pește *Barbus meridionalis*. Au fost luate în considerare necesităţile de habitat, indicatorii care relevă statutul de conservare favorabil și măsurile de management adecvate, presiunile și ameninţările asupra acestei specii de pește de interes conservativ.

Dacă măsurile de management propuse nu vor fi respectate în aria ROSCI0132, statutul de conservare al speciei de pește *Barbus meridionalis* va scădea în următorii 20-30 de ani.

Acest tip de sistem suport de management aplicat speciei, habitatului și sitului trebuie realizat și pentru alte specii de pești de importanță conservativă europeană, pentru aria protejată ROSCI0132.

ZUSAMENNFASSUNG: System zur Unterstützung der vorort Entscheidungen für das Management von *Barbus meridionalis* Risso 182 – eine Natura 2000 Fallstudie für Siebenbürgen.

In dieser spezifischen Untersuchung wurde in beiden Fachgebieten, der Ökologie das ADONIS:CE Instrument zum Aufbau eines Management modells für *Barbus meridionalis* verwendet. Dabei wurden die Habitatansprüche, die Indikatoren, die den günstigen Erhaltungszustand anzeigen sowie die entsprechenden Managementmaßnahmen, die Belastungen und Bedrohungen dieser Art von gemeinschaftlichem Interesse berücksichtigt.

Sollten die vorgeschlagenen Managementmaßnahmen im Gebiet ROSCI0132 nicht berücksichtigt werden, würde der Schutzstatus von *Barbus meridionalis* in den nächsten 20-30 Jahren verringern.

Die Anwendung dieses Unterstützungsystems von Arten, Lebensräumen und Management auf andere Fischarten von naturschutzfachlicher Bedeutung sollte auch für das Natura 2000 Gebiet ROSCI0132 verwirklicht werden.

INTRODUCTION

To warrant the threatened species of Europe outlive, the EU members agreed upon the Habitats Directive in 1992, in conformity with the fact that their states should accomplish the needed situation for the preservation of the species and habitats belonging to this Directive (Annex 2), in order to preserve and improve their ecological status (*, 1992).

In Romania, the Natura 2000 sites are designated for conservation interests including fish species protection. They were selected for their appropriateness in relation with the species' conservation value. The selection of these European Natura 2000 net areas was completed based on the following particularly chosen criteria: well conserved fish populations, favorable geographical locations, reduced human impact, and typical habitats. There are some eloquent elements based on which the Natura 2000 enterprise can enhance the European Union states' nature preservation: institution capacity efficacy advancing; the protected natural areas' surface expanding; ameliorate the citizens' knowledge, practical and operational management application for valuable areas from a conservation point of view. (Bănăduc, 2007, 2008, 2010, 2011; Bănăduc et al., 2012; Curtean-Bănăduc and Bănăduc, 2008; Papp and Toth, 2007)

One of the fish species of European conservation interest is *Barbus meridionalis* Risso 1826. This fish species is terra typical to the Mureș River; an area in the proximity of the study area. It is a benthopelagic, freshwater fish species. It is a short-lived species which can be found in mountainous and hilly areas rivers, which have springs in these zones. It prefers the clear and fast flowing water sectors and the hard mineral substrata. No migrations were registered until the present. The reproduction period is in the spring, and is sometimes prolonged until the beginning and middle of the summer. Its food is formed in principal of aquatic benthic invertebrates (gamarids, ephemeropterans, tendipedes, trichopterans, oligochaetes, and plant debris). (Bănărescu, 1964; Bănărescu and Bănăduc, 2007)

In Romania, the array of *Barbus meridionalis* was broken in the last century because of human activity impact, which is diverse from one watershed to another, and also from one protected zone to another (Bănăduc, unpublished data).

The structure of ichthyofauna, where *Barbus meridionalis* was identified, in Oltul Mijlociu-Cibin-Hârtibaciu Natura 2000 site (ROSCI0132) reveals relatively high, but not optimum individual numbers as a result of the human activity impact. The fragmentation on the range of this fish species populations and their not optimum abundance differs in this protected area, unveiling the effects of the Olt River basin habitat's decreasing quality. (Bănăduc, 1999, 2000, 2005; Curtean-Bănăduc, 2005, Curtean-Bănăduc et al., 2007; Curtean-Bănăduc and Bănăduc 2001, 2004; Curtean et al., 1999)

In the later-day worldwide turn in which the rivers shift in more precious resources, the anthropogenic impacts will affect the humans access to them (Curtean-Bănăduc and Bănăduc, 2012).

If this tendency is to be maintained, any general management elements will not be of enough use in different natural protected areas, because the diverse habitat elements should be assessed first. Secondly, the applied management tools have to adapt and suggest the local habitats/species characteristic conditions.

The modeling process elements are more flexible to obtain a "wide picture" of systems and actions of different domains. These elements are needed to identify the process stages for good management. Essentially, the modeling tools are comprised by software products used to make models of business organizations, and to bring out data about these models. There are three important functions: to confirm the actual state, examine the results of potential modifications, and propose plans to shift the situation in a better direction. Finally, there are various proposed options to create diagrams which involve elements of specific management (Hall and Harmon, 2005).

The important purposes of this research are: to present the actual state of the populations of *Barbus meridionalis* in ROSCI0132; to indicate the actual human impact from the point of view of pressures and threats; and to advise through management suggestions for the improvement of the fish species' preservation status based on a specially created model of management – which include habitat requirements of the fish species and habitat indicators as a decisional system for management.

MATERIAL AND METHODS

ROSCI0132 (2,826.10 ha surface, 45.682778 latitude, 24.324444 longitude, 314 to 568 a.s.l. m) is located in the Vâlcea, Sibiu and Braşov Romanian administrative territorial units. This Natura 2000 site is located in the Continental and Alpine European biogeographic regions. This Natura 2000 site was proposed also for ten species of fish of community interest-species belonging to the Annex 2 of the Habitats Directive (92/43/EEC), (*Barbus meridionalis* Risso 1826 – Natura 2000 code 1138, *Pelecus cultratus*, *Zingel zingel*, *Zingel streber*, *Romanogobio kesslerii*, *Cobitis taenia*, *Sabanejewia aurata*, *Rhodeus amarus*, *Aspius aspius*, and *Romanogobio uranoscopus*). (*, 1992)

The river sectors of the studied zone where *Barbus meridionalis* were sampled are shown in figure number 1.

The *Barbus meridionalis* individuals were sampled in 2010-2013, with fishing nets, then identified and released immediately on site.

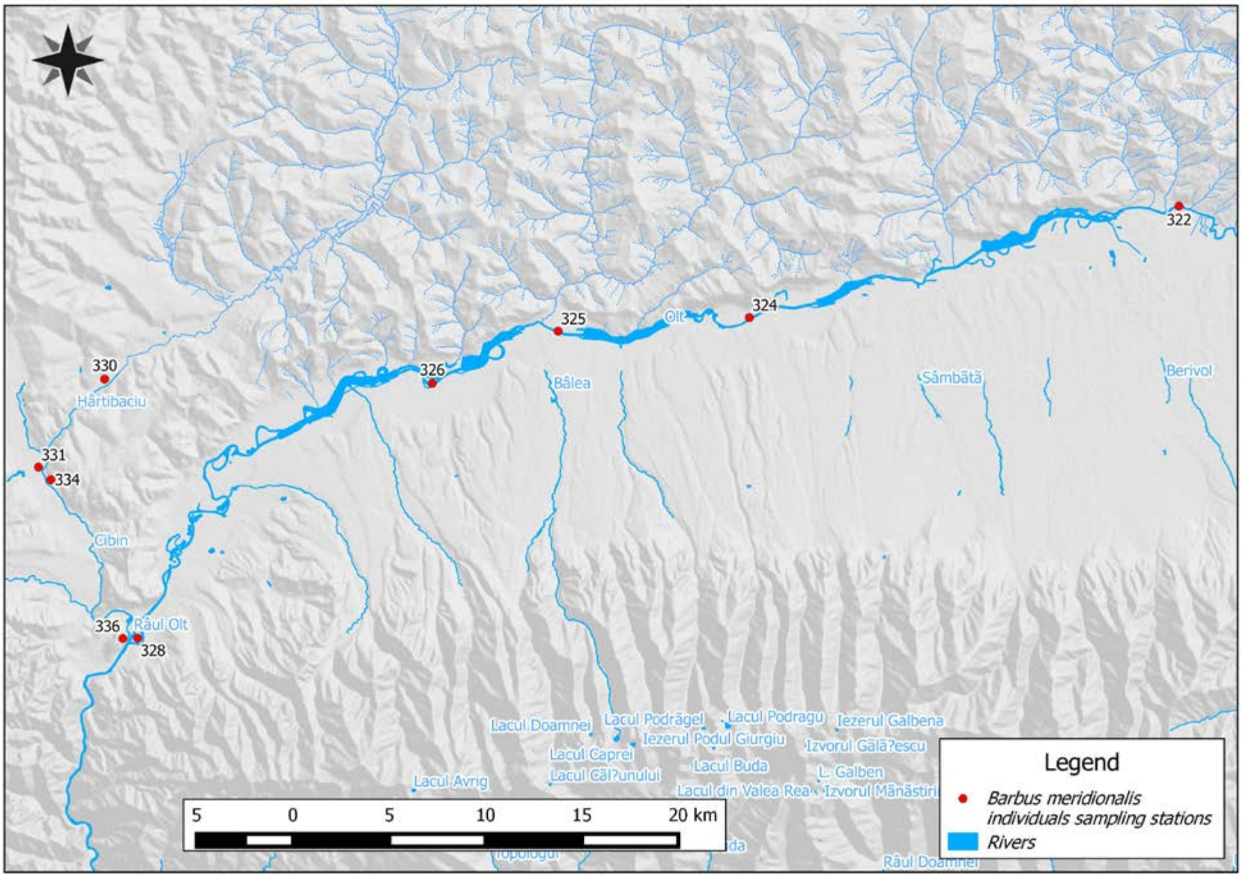

Figure 1: *Barbus meridionalis* individuals sampling stations 336 and 334 in the Cibin River; 331 and 330 in the Hârtibaciu River; 328, 326, 325, 324 and 322 in the Olt River.

The *Barbus meridionalis* species was evaluated in the study area and its ecological status was assessed in the context of the identified human impact pressures and threats, as well as on the fish population and the habitat's characteristics.

The fish species population and conservation status was assessed based on the following suggested criteria: surface distribution, equilibrate distribution of the fish individuals on age and gender classes, population sizes and a high or low number of fish in the fish associations.

The *Barbus meridionalis* species habitat necessities, pressures, and threats were studied based on their presence and/or absence, and the dependence between them and the fish species population status of conservation.

To find out the proper management elements expected to be taken to warrant this species well-being in the studied area and to bring out the needed process, an adjusted model of management was used. Therefore, ADONIS:CE was used, created by Business Object Consulting. ADONIS: Community Edition, is a free of charge tool provided by the BOC Group which can be utilized as a point of entrance to Business Process Management and is a good way to become informed with ADONIS. ADONIS:CE is a rich, stand-alone version of ADONIS with some limitations if we have to compare it with the commercial edition. Business Process Model and Notation (BPMN) is a standardized modeling language which is proper to use in order to visualise the processes. The processes can be modeled based on uniform notation (**; Bănăduc et al., 2014).

RESULTS AND DISCUSSION

Barbus meridionalis populations ecological state evaluation

The preservation status of *Barbus meridionalis* in the **Olt** River sampling sectors 328, 326, 325, 324 and 322 (Fig. 1) can be considered as medium/good in the context of: population sizes, balanced distribution of fish individuals on age and gender classes, and a medium percentage of fish individuals of this species in the local ichthyofauna structure. The habitats of the studied populations are in an average/good conservation state, in respect of *Barbus meridionalis* ecological necessities.

The preservation status of *Barbus meridionalis* fish species in the **Cibin** River sampling sectors 336 and 334 (Fig. 1) can be considered as medium. The habitats are in an average conservation state, in respect of *Barbus meridionalis* ecological necessities.

The conservation status of *Barbus meridionalis* in the **Hârtibaciu** River sampling sectors 331 and 330 (Fig. 1) can be considered as medium. The habitats are in an average conservation state, in respect of *Barbus meridionalis* ecological necessities.

Human pressures and threats

Here, the following pressures and threats on *Barbus meridionalis* individuals were found: pressures – the characteristic habitat changes or damages, poaching, the water pollution, the river continuum fragmentation caused by the hydrotechnical constructions or pollution, the deforestation of riparian vegetation; threats – modification of the characteristic habitats, poaching, the river continuum fragmentation caused by the hydrotechnical constructions or pollution, the expansion of some invasive/more tolerant fish populations (*Pseudorasbora parva, Gobio gobio, Barbus barbus*, etc.), species that are competitors with *Barbus meridionalis*; diffusion of and accidental pollution, the negative influence of multiple illegal spoil dumps (which produce a liquid that is very toxic for the near river courses); the river regulation and the riverbed overexploitation which without alternative reservoir management solutions cause the most frequent and continuos raising pressures with a relatively high negative potential for the habitat changes, as well as the anthropic modified liquid and solid flow regime of the river. As long as the habitats that ensure good conditions are diminishing because of the various anthropical impacts, every one of these river sectors which still offers adequate conditions becomes vital for the species survival; and the specific favourable habitats losses for the species which generate the appearance of the overcrowding and after that the reduction of the individual numbers and the favour of diseases, parasites and competitor fish species.

Specific requirements

Barbus meridionalis needs a relatively oxygenated and cold water, with a relatively moderate to fast water flow; no waterfalls, rocky or sandy substrata, and relatively low sedimentable suspensions. For reproduction, high water speed and relatively well oxygenated sectors with rocky substrata are needed. Both the adults and juveniles are sensitive to organic loads and pollution. (Bănărescu and Bănăduc, 2007)

Specific habitat indicators

Based on *Barbus meridionalis* presence and abundance in the researched areas, habitat indicators were suggested: water surface percentages with high speed (66%), sandy substratum surface percentages (33%), pebbles substratum surface (66%), riverine trees and shrubs vegetation corridors length percentages (100%), and water transparency (50-100 cm).

Management measures

Riverbed morphodynamics should be preserved, and the hydrotechnical works which modify the water speed and the substratum should be forbidden.

The creation of complex fish passages which should diminish the negative effect of the lotic discontinuity has appeared due to a long series of dams and lakes and semi-stagnant sectors in the riverbed mineral exploitation sectors.

The riverbed mineral exploitation should be banned for small tributaries and with a distance between them of minimum five km in the cases of medium and large rivers (Olt, Cibin, and Hârtibaciu). The mineral exploitation quantities should not be bigger than the natural refilling capacity of the rivers.

Vegetation conservation in the riverine watersheds is possible in a natural state for the sediments' erosion and transport control. The crops that do not require tillage are preferable.

In the studied species breeding period (April-July) is better to prohibit fishing and activities that could disturb the riverbed sediments.

In all sectors, the poaching is very intense and almost permanent, so it requires real control.

Keeping corridors of natural vegetation (arboreal, shrubs and herbal) with a minimum width of 50 m (Cibin and Hârtibaciu rivers) and 100-200 m (Olt River) on both banks is necessary for their function as sediment traps.

The abandonment of wastes of any kind in riverbeds and wetlands adjacent to watercourses should be prohibited.

We must maintain low anthropogenic impacts (such as organic and chemical pollution).

A seasonal monitoring system which could include the fish fauna and organic pollution elements should be implemented.

Site adjusted management model

The management model process is based on activities (squares – see below), decisions (triangles – see below), variables (circles – see below) (Figs. 4 and 5).

The principal objects used in this study to concept the *Barbus meridionalis* management model ROSCI0132 with ADONIS:CE (Hall and Harmon, 2005) are proposed below.

When we mention the word process, we refer to a set of activities to be followed in order to view management measures to be taken for *Barbus meridionalis*. To each activity, can be attached documents and present various fields – description, comments, and responsible persons – that help create a bigger picture of the whole process. During the process, can be used as decisions if there are certain parameters or certain forms of verification, accompanied by variables and generators (they represent the percentage branches or decisions that can or cannot be fulfilled). If are available activities that can take place in parallel, and merge objects with which this can be highlighted. ADONIS:CE tool allows sub-structuring activities in subprocesses for easy browsing through the basic process – it highlights the connections between processes and subprocesses.

We modelled habitat necessities of *B. meridionalis* and the conditions that allow a good conservation. The targeted process (Fig. 2 – Explorer Model groups) is *Barbus meridionalis*. The highlighted subprocesses belong to the basic model. From the starting model they can be utilised by a simple click using the Explorer window.

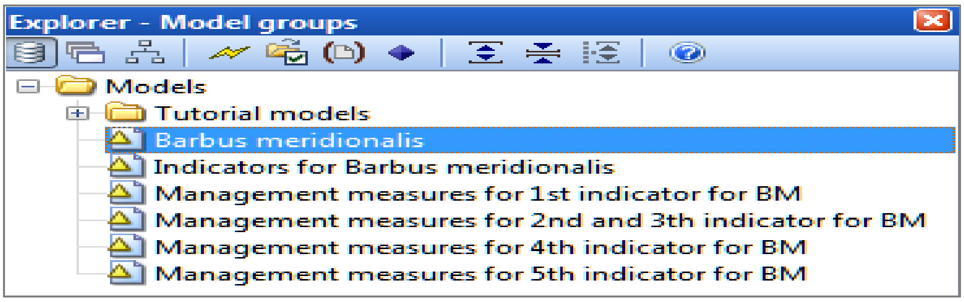

Figure 2: Table of content for modelled processes.

To better understand the connections between processes presented in the previous figure, the next (Fig. 3a, b) shows the hierarchy and inter-references between modelled processes. As it shows, the main processes are *Barbus meridionalis* and *Indicators for Barbus meridionalis*.

Basic process is *Barbus meridionalis* (Fig. 4) and it contains six activities, one subprocess and one decision. The process begins with the following activities: **Specific requirements** which describe all the habitat's critical requirements, followed by the subprocess, **Indicators for *Barbus meridionalis*** (Fig. 5 – see the next paragraph) and a decision where it is checked if the subprocess indicators are or are not in a favourable preservation state. If they are, ("Preservation_state = Yes", probability 30%) the activity **Field observations** follows and the process then ends. If they are not fulfilled, the favorable preservation state ("Preservation_state = No", probability 70%), the stated activities follow: **Other environment requirements**, **Distribution in the protected area**, **Current pressures on the species**, **Threats** (the last two activities are taking place at the same time; we used merging modelling object) then follows the last activity **Field observation,** and the process finally ends.

Subprocess **Indicators for *Barbus meridionalis*** species (Fig. 5) was modelled using five decisions, four subprocesses and also one (final) activity; **Implementation of a seasonal integrated monitoring system**. For each decision, we have to take into account the management measures for each indicator (Figs. 6-9). Only decisions 2 and 3 (**"The actual state of sandy substrate is less than 33%?"** and **"The actual state of gravel substrate weight is 66%?")** have the same management measures united in one subprocess (Fig. 7). Every decision contains data about the indicators' probability that should have a favourable conservation status (this value was determined by field measurements). For example, if the variable Sandy_substrate has the weight of more than 33%, then it should be followed by the management measures proposed for indicators 2 and 3 (Fig. 7). After attending the proposed management measures, the information returns just before the decision for the second indicator. If the decision has the required percentage, then the next indicator will be taken; if not, the proposed measures will follow. If the Sandy_substrate has weight less than 33%, then it is checked in the next indicator. And so on until it reaches the final activity; and the process ends.

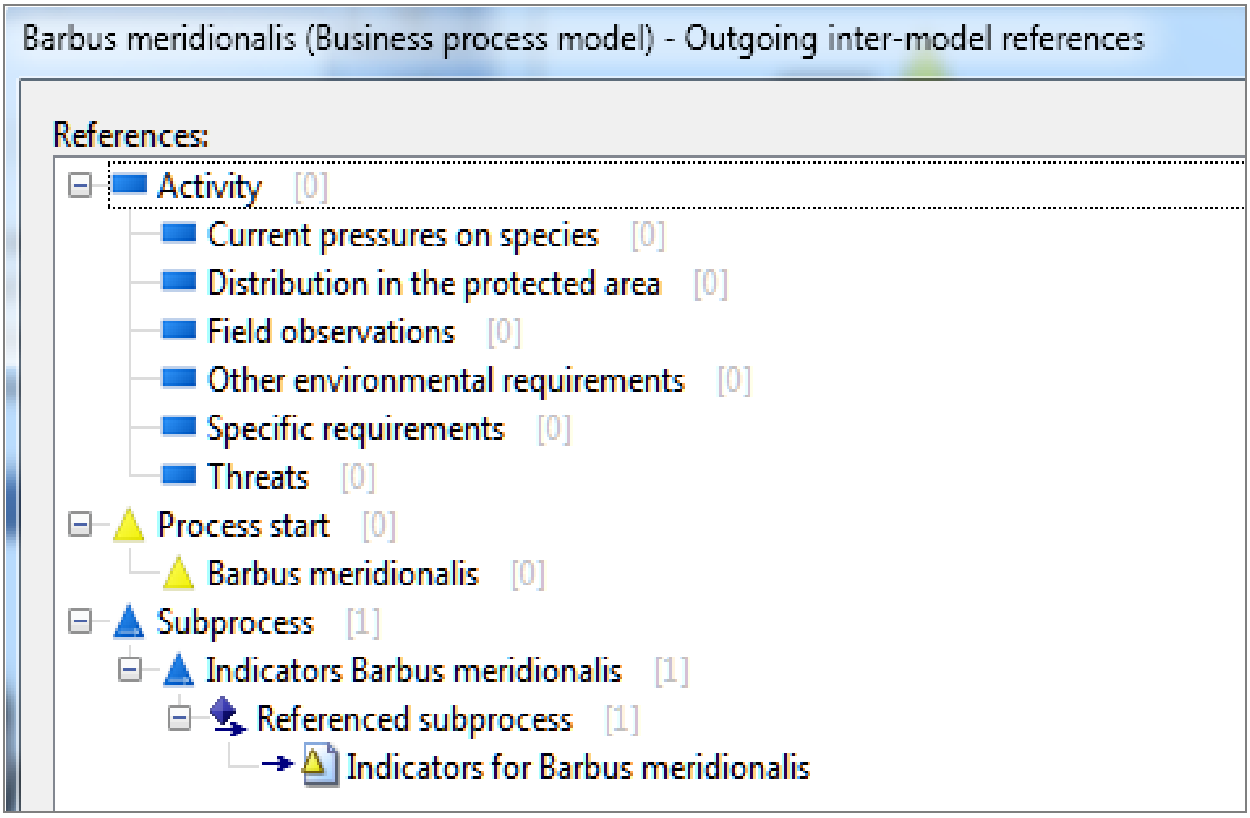

Figure 3a: Hierarchy and inter-references between modelled processes.

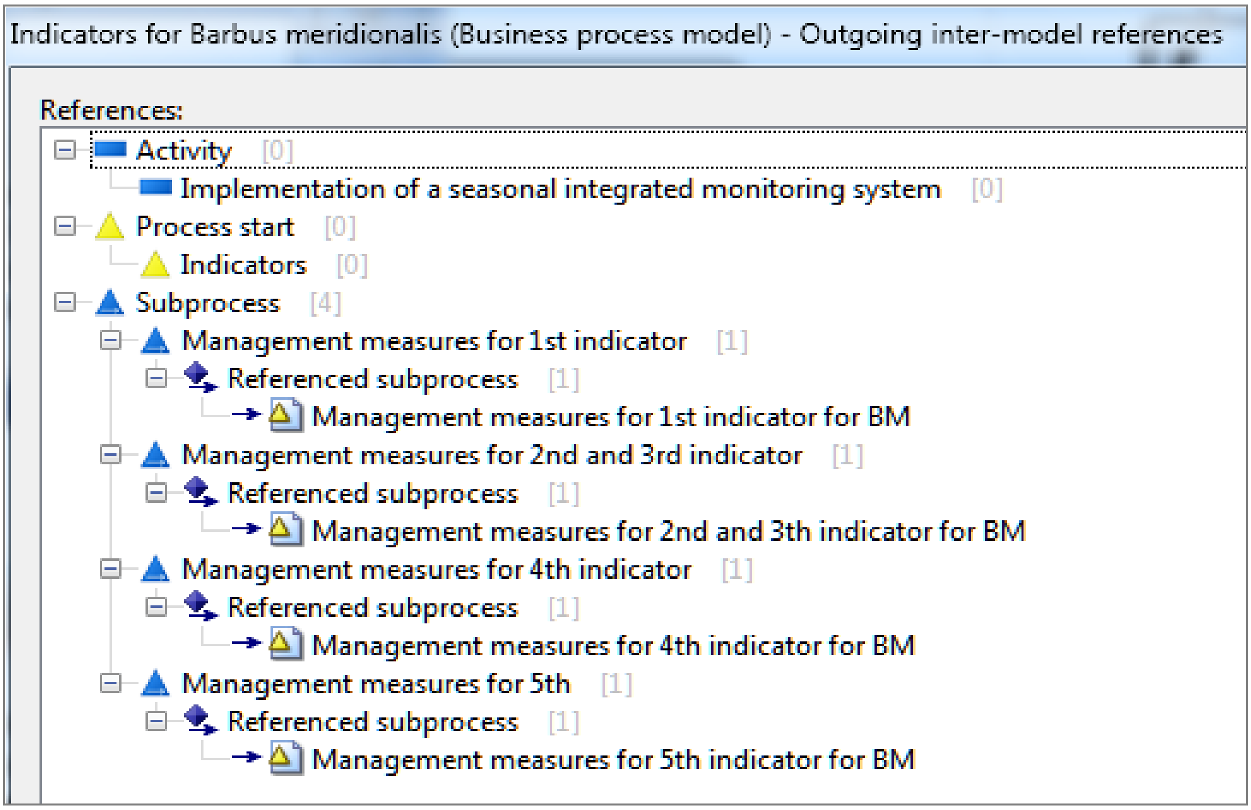

Figure 3b: Hierarchy and inter-references between modelled processes.

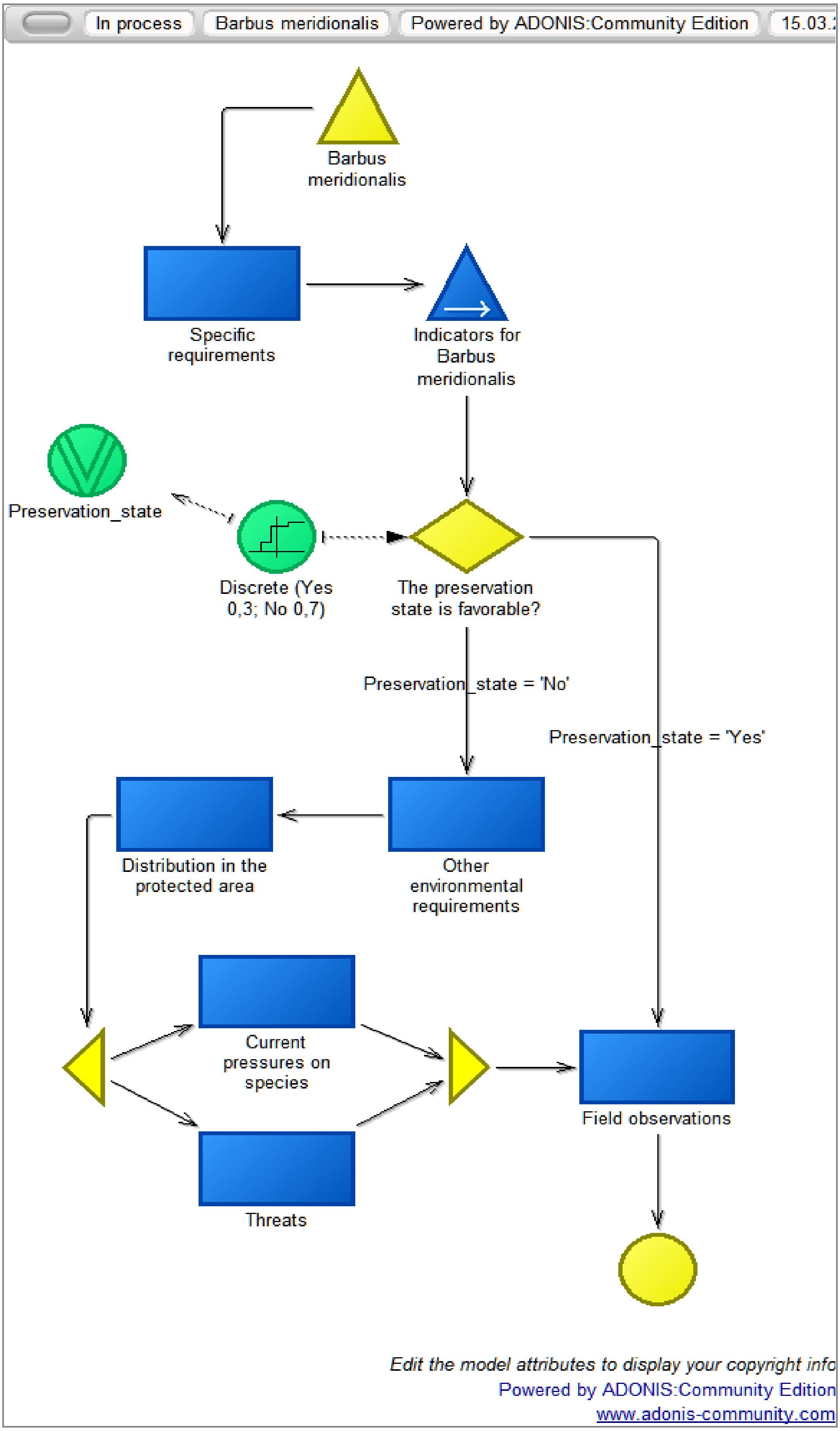

Figure 4: *Barbus meridionalis* – main process.

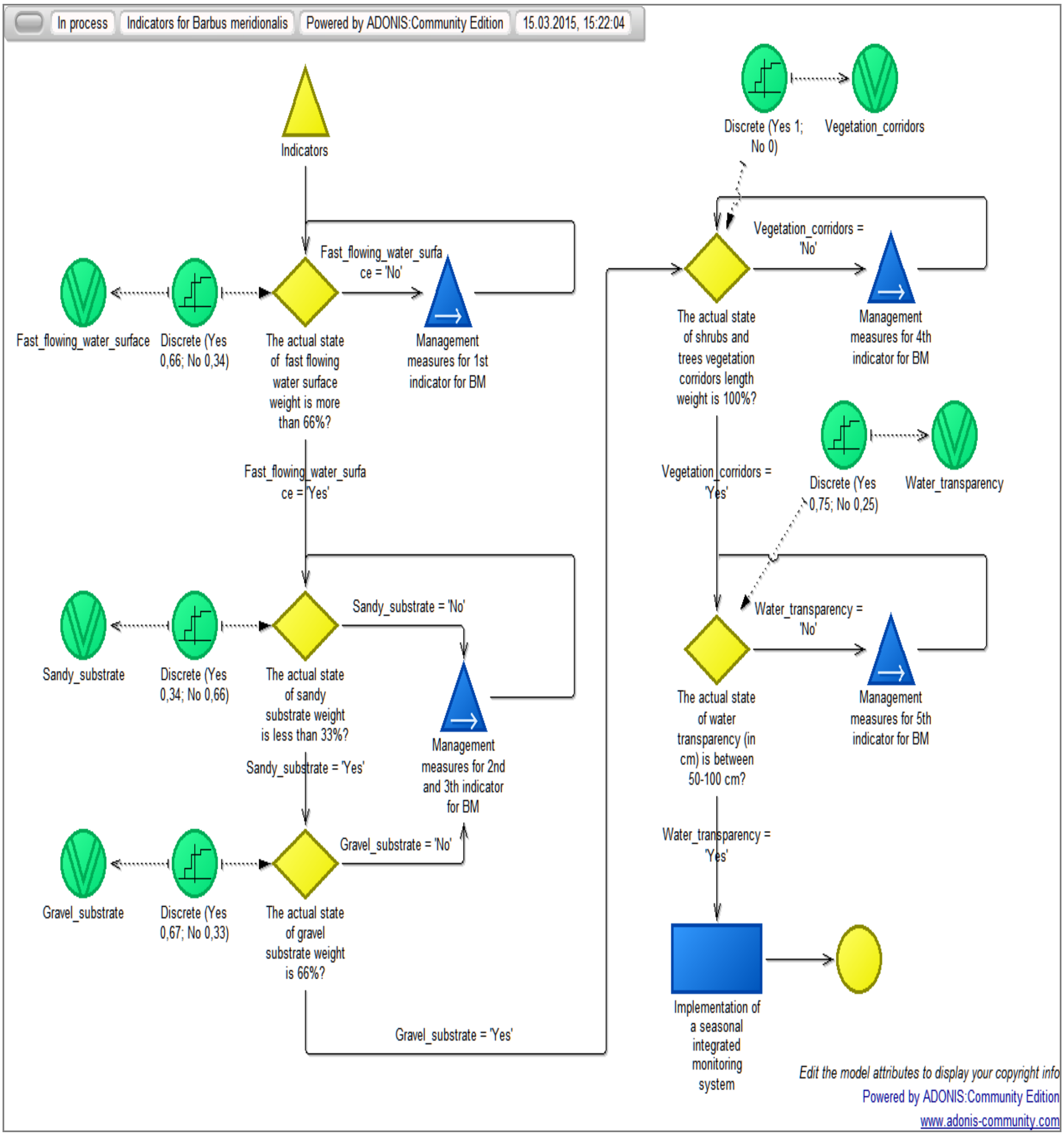

Figure 5: Indicators for *Barbus meridionalis* species.

Figures 6-9 show the subprocesses related to **Indicators for *Barbus meridionalis* species**. They are all modelled using only activities. Each activity has in its description the steps that should be followed for a good management for *Barbus meridionalis* species. For the example subprocess, the **Management measures for 5th indicator for BM** (Fig. 9) has to follow nine management measures described shortly in activities: natural riverbeds morphodynamics preserving, the riverbed mineral exploitation, vegetation conservation in the riverine watersheds, keeping corridors of natural vegetation, prohibition of waste abandonment and during the breeding period (April to June) a ban of fishing and permanent natural water regime is recommended in order to keep a low anthropogenic impact.

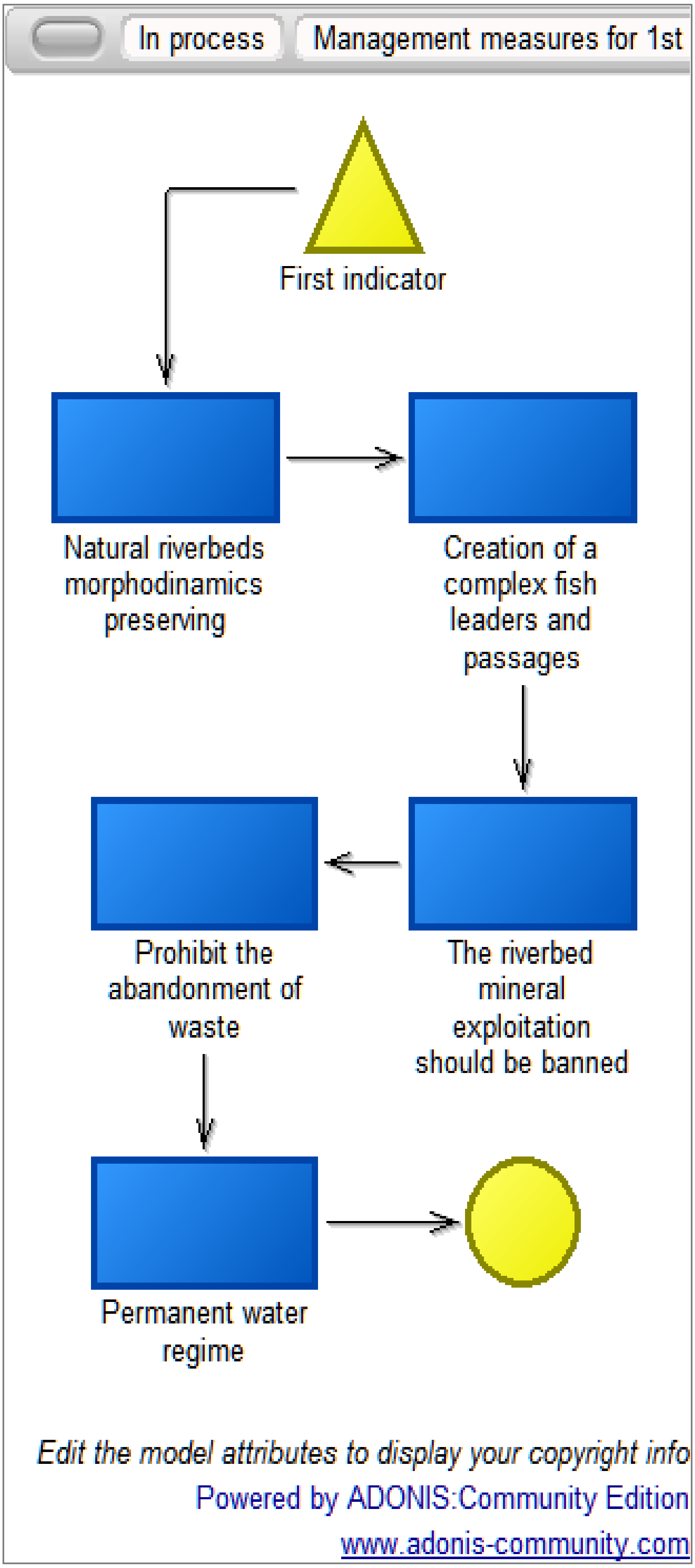

Figure 6: Management measures for 1st indicator for BM.

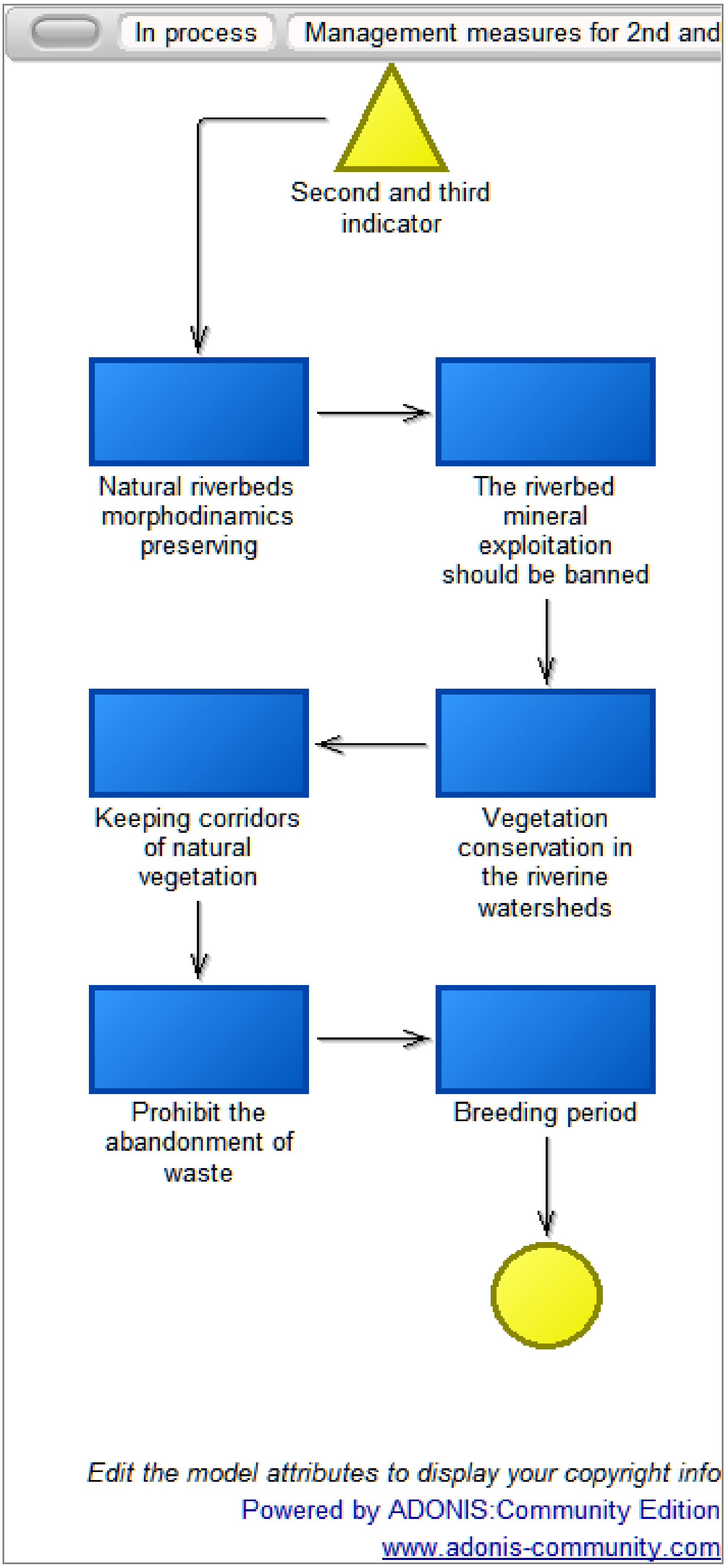

Figure 7: Management measures for 2nd and 3rd indicator for BM.

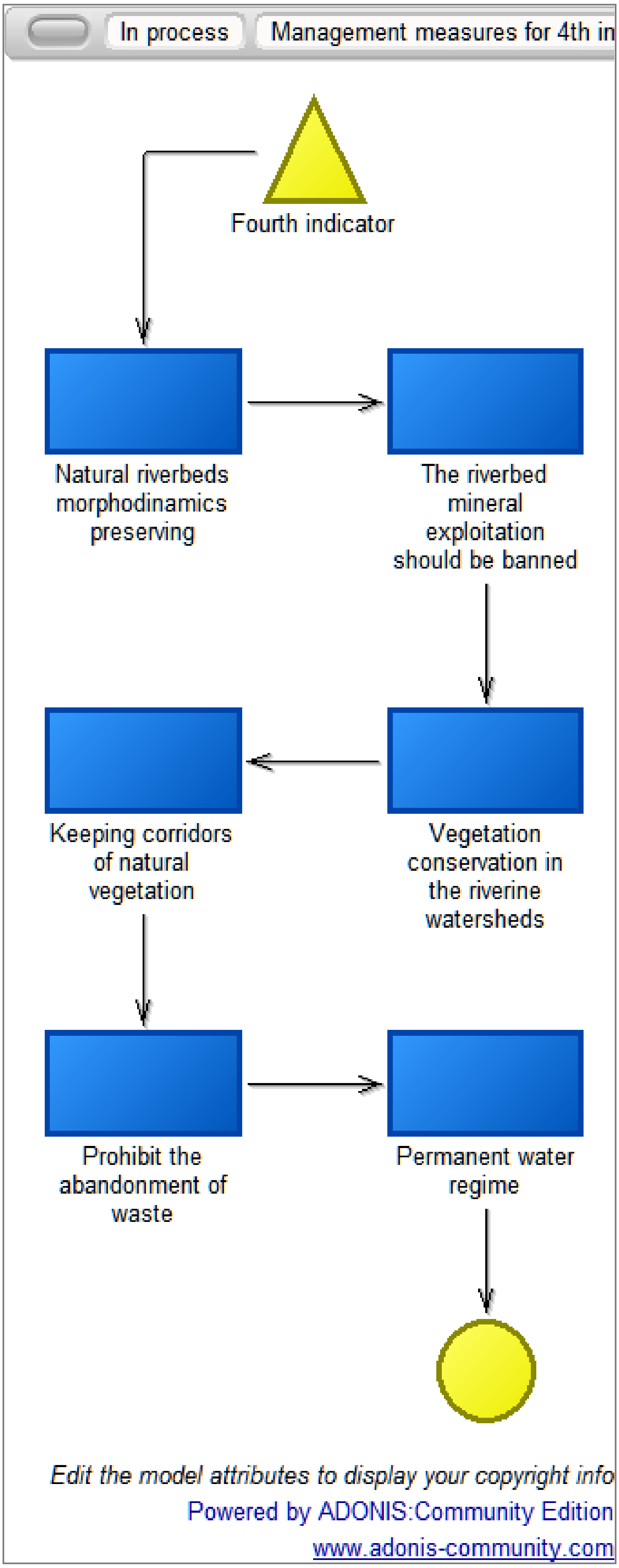

Figure 8: Management measures for 4th indicator for BM.

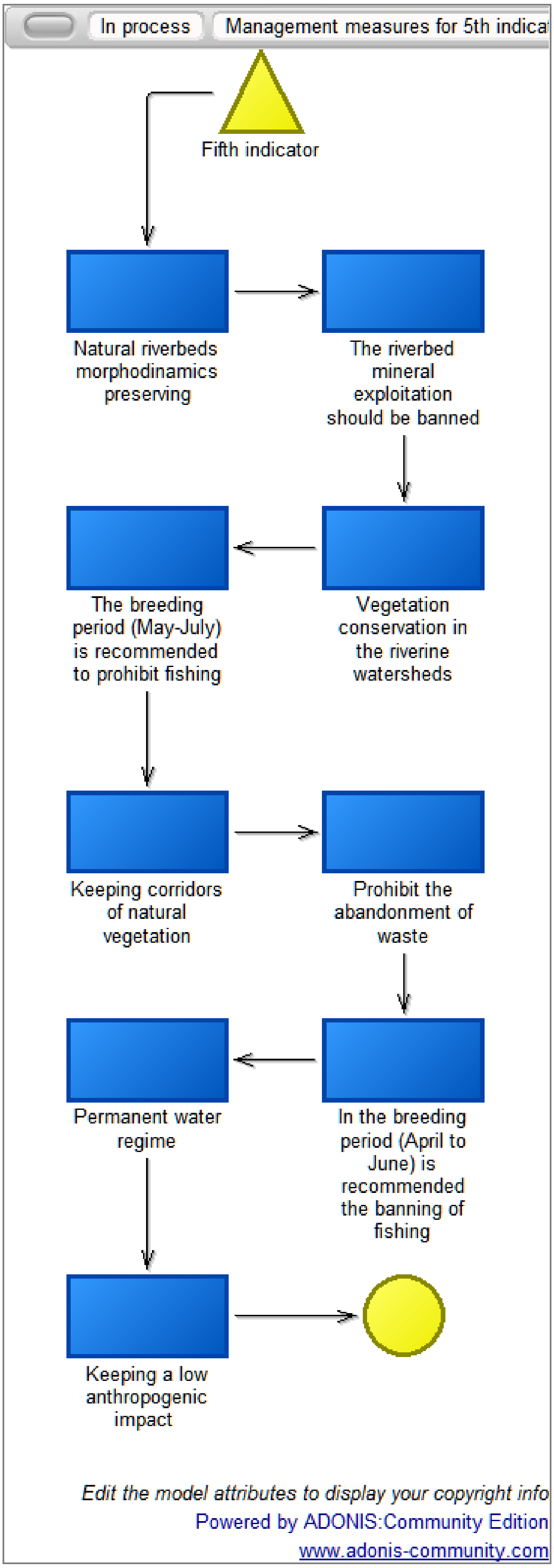

Figure 9: Management measures for 5th indicator for BM.

CONCLUSIONS

The main inventoried threats to the fish species *Barbus meridionalis* conservation status in ROSCI0132 Natura 2000 site were: poaching, characteristic habitats modification, the river continuum fragmentation, the expansion of some invasive/more tolerant fish species, pollution, illegal spoil dumps, river regulation, riverbed overexploitation, liquid and solid flow regime of the river course.

The pressures were: the characteristic habitats changing or damaging, poaching, water pollution, river continuum fragmentation, and deforestation of riparian vegetation.

Highly important for *Barbus meridionalis* species protection are: the natural riverbed morphodynamics preservation, the diminishing of the actual lotic fragmentation, the avoiding riverbed overexploitation, the riverine vegetation conservation, the ecological reconstruction of the natural morphodynamic of riverbeds, an April-July fishing ban, poaching control, waste management, decreasing organic and chemical pollution, and the implementation of a seasonal permanent monitoring system for the fish fauna.

In this research, a basic model for management decisions in order to support – the *Barbus meridionalis* fish species was realised.

The ADONIS:CE was used in this research in the ecological domain, introducing a management model of *Barbus meridionalis* fish species that contains its most important necessities regarding the habitat, the indicators that bring out a good ecological status – the accurate management to avoid and/or eliminate the pressures and threats which damage this fish species populations.

If the proposed management components do not succeed, this fish species will have a poor conservation status in the next 20-30 years.

This on-site, on habitats and on species blueprint management decisions sustaining model for *Barbus meridionalis*, should be incorporated in an integrating management model for the ROSCI0132 site ichthyofauna, for this goal similar management decisions sustaining models for other fish species of European interest should be done.

ACKNOWLEDGEMENTS

Partially this research information was acquired in the study period for POS Mediu, priority ax 4 project code SMIS – CSNR 17049 “Pentru Comunităţi Locale și Natură – Bazele managementului integrat Natura 2000 în zona Hârtibaciu – Târnava Mare – Olt (PH+ PRO MANAGEMENT Natura 2000)”.

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THE EUROPEAN BEAVER (*CASTOR FIBER* LINNAEUS, 1758), SPECIES PRESENCE IN THE MARAMUREŞ DEPRsESSION (ROMANIA)

Vasile Timur CHIŞ [1]

KEYWORDS: Romania, Transylvania, Maramureș, Maramureș Depression, European beaver (*Castor fiber* L.)

ABSTRACT

The paper refers to the appearance of the species *Castor fiber* on the upper Tisa River and its tributaries Iza and Vişeu in the Maramureș Depression. The appearance of the beaver in this area is related to the reintroduction of the species between 2001-2008 in the Hortobágy National Park on the Tisa River in Hungary. From there the beaver migrated upstream on the Tisa River being identified in 2008 in Romania on a distance of more than 400 km from its reintroduction area. In the Maramureș region have been identified three colonies: one on the "Balta lui Paviscu" in the Tisa River area in front of the locality Sarasău, a second on the Vişeu River between Bistra and Petrova and a third colony on the Iza River between the localities Vadu Izei and Onceşti.

REZUMAT: Castorul European (*Castor fiber* Linnaeus, 1758), specie prezentă în fauna depresiunii Maramureşului (România).

Lucrarea face referire la apariţia speciei *Castor fiber* pe râul Tisa şi afluenţii Iza și Vișeu, din Depresiunea Maramureşului. Apariţia castorului în această zonă se datorează reintroducerii speciei între anii 2001 şi 2008, în Parcul Național Hortobágy pe râul Tisa, în Ungaria. Din Ungaria castorul a urcat pe Tisa, astfel în anul 2008 a fost identificat în România la o distanţă de peste 400 km de zona unde a fost repopulat. În Maramureş am identificat trei colonii: o colonie pe „Balta lui Paviscu" din zona râului Tisa, în dreptul localităţii Sarasău, o colonie pe râul Vişeu, între localitatea Bistra şi Petrova și o colonie pe râul Iza, între localitatea Vadu Izei și Oncești.

ZUSAMMENFASSUNG: Der europäische Biber (*Castor fiber* Linnaeus, 1758), in der Fauna der Maramuresch Senke (Rumänien).

Die Arbeit bezieht sich auf das Auftreten der Art an der oberen Theiß und ihrer Nebenflüsse Iza und Vişeu/Wischau in der Maramuresch-Senke. Sein Vorkommen in dem Gebiet steht in Zusammenhang mit der Wiedereinbürgerung des Bibers zwischen 2001-2008 im Hortobágy Nationalpark an der Theiß in Ungarn. Von hier wanderte der Biber stromaufwärts und wurde 2008 in einer Entfernung von 400 km vom Einbürgerungsort in Rumänien beobachtet. In der Maramuresch wurden drei Kolonien festgestellt und zwar eine im Gebiet der "Balta lui Paviscu" im Theißgebiet unmittelbar gegenüber des Ortes Sarasău, eine zweite am Vişeu/Wischau-Fluss zwischen Bistra und Petrova sowie eine dritte an der Iza zwischen den Ortschaften Vadu Izei und Onceşti.

INTRODUCTION

The European beaver (*Castor fiber* Linnaeus, 1758) lives in colonies and is the largest rodent in Europe. It can reach a weight of 20 kg and a length of 1.5 m. Beavers have small heads and their bodies are covered in a thick, brown fur. They have small, webbed paws provided with claws and their posterior feet are provided with membranes. The element that makes beavers easily recognizable is the tail. A beaver's tail is flat and covered with scales. The female gives birth to a litter of up to five kits, once a year, in June, after a gestation period of three-four months. The beaver is a rodent that feeds completely on leaves, sprouts and different aquatic plants. In autumn, and especially in winter, they feed on branches and bark. (Ardelean and Béres, 2000)

Beavers had disappeared from the Maramureş Depression around 1800 due to hunting, especially for their fur, but also for their meat. (Ardelean and Béres, 2000)

Toponyms related to the presence of beavers in the Maramureş Depression are Breb Village and Breboaia Valley, from the upper basin of the Mara River.

MATERIAL AND METHODS

In the 2008-2014 period, we have researched the Tisa, Iza and Vişeu rivers to identify the beaver colonies from the Maramureş Depression.

This research was performed with the aim of assessing the population distribution and to propose some measures that are necessary to protect the species located in the Maramureş Depression.

The research area contains riverbanks, damp woods and the dead arms of Tisa, Iza and Vişeu rivers. These areas are preferred by beavers.

The colonies were identified because of the traces left by them, the constructed dams and the gnawed trees around the rivers.

RESULTS AND DISCUSSION

The research, conducted by 37 specialists located in the upper basin of the Tisa River (on a 350 km range from Tokaj locality in Hungary to Tisa springs in Ukraine) from 1998-1999 period, doesn't confirm the presence of beavers in this area. This research results were appeared in the publication "The Upper Tisa Valley" (Hamar and Sárkány-Kiss, 1999).

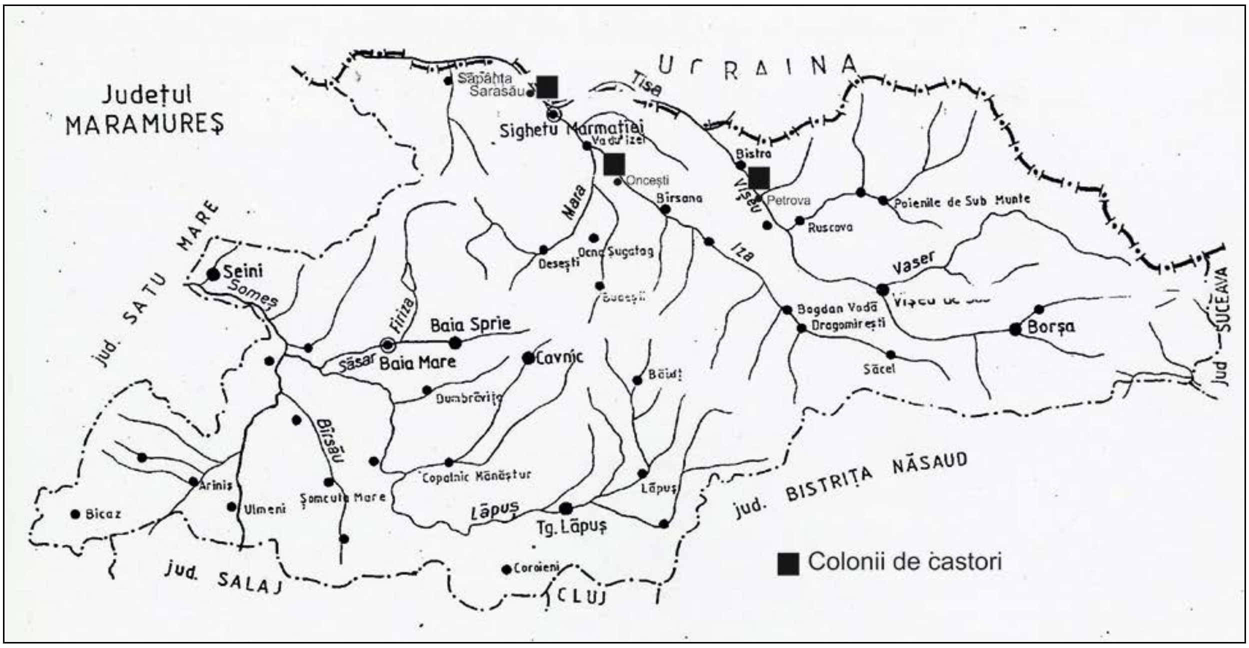

Figure 1: Map of the areas where beaver colonies (■) were identified, Maramureş County.

Also, research made until 2000, published in "Fauna de Vertebrate a Maramureşului" (Ardelean and Béres, 2000), and in 2007, published in "Zone umede din Ţara Maramureşului" (Chiş, 2007), doesn't confirm either the presence of beavers.

After some research we've identified three beaver colonies on the Tisa, Iza, and Vişeu rivers, in 2008-2014 period (Fig. 1).

The first beaver colony was found in an expedition in the Sarasău region, on the dead arm "Balta lui Paviscu" of the Tisa River. According to the traces (a constructed dam and fallen trees), I have assumed that the beaver population was established in the 2006-2007 period (Fig. 2). After the research, in 2012, 2013 and 2014, we have seen that this beaver population is present in this area, which is part of the Natura 2000 sites The Upper Tisa ROSCI0251.

The second colony was identified on 03.03.2012, between Bistra and Petrova, on the riverbank and on a dead arm of the Vişeu River. The traces left by beavers reach a distance of two km in this area (Figs. 3-6). The beaver colony was established in this area in 2010-2011. In 2012 and 2013 we've observed, after research, that the beaver population is present in this area, which is part of Maramureş Mountains Nature Park.

The third colony was found between Vadu Izei and Oncești, on the riverbank of the Iza River (Chiş, 2012) on 25.03.2012. The traces left by beavers reached a distance of two km in this area (Fig. 7). The colony had installed itself in this area in 2011. The area is part of the Natura 2000 sites Iza Valley and Solovan Hill ROSCI0264.

The beaver population reappeared after 200 years in the Maramureş Depression because of the repopulation with this species in the Hortobágy National Park and in the Tisa River region, in Hungary, in 2001 and 2008 (Bálint, 2011; Jones et. al.; 2011). In these areas 122 specimens were reintroduced, all of them with Bavarian origin (Germany) (Bálint, 2011).

In 2005, the presence of the species was reported in Ukraine, respectively a beaver colony on a channel in the Nevytske (Uzhgorod district) area along with two colonies on the Tisa River, near Drotyntsi. Also, in 2007, colonies were identified on the Latorytsia and Borzhava rivers, in Ukraine (Bashta and Pothish, 2007).

Figure 2: Dam built by beavers, at "Balta lui Paviscu", Sarasău, 2008.

Figure 3: Tree gnawed by beavers, Vişeu River, 2012.

Figure 4: Dam built by beavers on the Vişeu River, 2012.

Figure 5: Beavers burrow entrance, Vişeu River, 2012.

Figure 6: Vişeu River,
where the beaver colony was noticed, 2012.

Figure 7: Iza River,
where the beaver colony was noticed, 2012.

CONCLUSIONS

In Romania, the European beaver (*Castor fiber*) is a species protected by the Government Emergency Ordinance no. 57/2007.

The protective measures for beavers in these areas include reducing human pressure on habitats around rivers, prohibiting deforestation and infield extension in damp woods, grazing ban, prohibiting sand and gravel exploitation in areas where beaver colonies are present and dogs monitoring and control.

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INTEGRATED ECOSYSTEM SERVICES MODELING OF LOTIC ECOSYSTEMS: A CONCEPTUAL APPROACH

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KEYWORDS: ecosystem services, biodiversity, modeling, lotic ecosystems.

ABSTRACT

Ecosystem services studies are relatively recent as a research field, and their modeling poses serious problems for the involved specialist. The present paper aims to create a possible framework for such studies, and help the efforts of the involved specialists based on the information found on lotic ecosystems. A six-stage methodological construction was created, consisting of field data gathered for all the variables necessary, quantification of the various ecosystem services provided by the lotic ecosystems, two stages of data reduction and clustering, based on correlations and regressions, and on multivariate methods or non-linear models, mapping of the ecosystem services and their relations with environmental variables, including human impact; and a final stage, of interrelated modeling, where the information from the previous stages is transformed into a complete structure, which can be used for prognosis of influences on each of the systems' components.

REZUMAT: Modelarea integrată a serviciilor ecosistemice oferite de ecosistemele lotice: o abordare conceptuală.

Studiile referitoare la serviciile ecosistemice sunt un câmp de cercetare recent, iar modelarea acestor servicii ridică serioase probleme specialiștilor implicați. Prezenta lucrare își propune să creeze un posibil cadru de lucru pentru astfel de studii, ajutând eforturile celor care activează în domeniu, cu ajutorul informațiilor oferite de ecosistemele lotice. O construcție metodologică în șase faze a fost creată, constând în colectare de date din teren pentru toate variabilele necesare, cuantificarea diferitelor servicii ecosistemice oferite de ecosistemele lotice, două faze de reducere și grupare a informației, bazate pe corelații și regresii, și pe metode de analiză multivariată și modelare non-liniară, transpunerea pe hărți a serviciilor ecosistemice și a relațiilor acestora cu variabilele de mediu, inclusiv cele legate de impactul antropic, și o fază finală, de modelare integrată, în care informația din etapele anterioare este transpusă într-o structură completă, care poate fi folosită ca instrument de prognoză a influențelor asupra oricărui element al sistemului.

ZUSAMMENFASSUNG: Integrierte Modellierung der Ökosystemleistungen angeboten von Fließwasserökosysteme: ein Konzeptioneller Ansatz.

Die Studien die den Ökosystemleistungen behandeln sind ein neues Forschungsgebiet, dessen Modellierung erhebliche Probleme den beteiligten Spezialisten erstellt. Dieses Papier zielt darauf ab, einen möglichen Rahmen für solche Studien, mit Hilfe der Informationen angeboten von Fließwasserökosysteme, zu entwickeln, um die Unternehmen derjenigen die in dem Feld arbeiten zu unterstützen. Eine sex-Schritt methodologische Entwicklung wurde errichtet, bestehend aus dem Sammeln der Felddaten für alle erforderlichen Variablen, Quantifizierung der verschiedenen von Fließwasserökosystemen angebotene Ökosystemleistungen, zwei Stufen der Reduktion und Gruppierung der Information, basierend auf Korrelationen und Regressionen und multivariater Analyse- und nichtlineare Modellierungsverfahren, Kartenumsetzung der Ökosystemleistungen und dessen Beziehungen mit dem Umweltsvariabeln, einschließlich solche, die von menschlichen Auswirkungem abhängen, und ein letzter Schritt bestehend aus integrierte Modellierung, wo die Information der früheren Schritte in eine komplette Struktur, die als Instrument für Prognose der Einflüsse über jedes Element des Systems benutzt werden kann, umgesetzt wird.

METHODOLOGY

A large amount of methods are used for quantifying, processing and relating information regarding ecosystem services provided by lotic ecosystems and the relations between them, as well as their relations with environmental variables.

In order to gather as much information as possible about the investigated lotic habitats, data regarding the hydrological characteristics of the river bed, the anthropic changes in the river bed, the aquatic and riparian vegetation is necessary, and is often visually estimated on site and with the aid of photographic material. The quantification of those variables can be made, for example, in the case of the substrate, by percentage approximation of the coverage with different granulations; in the case of the riparian vegetation, in the form of the presence or absence of different arboreal species or herbaceous vegetation; in the case of aquatic vegetation, by percentage approximation of the coverage with different types of aquatic vegetation; and in the case of the anthropic changes in the river bed, by percentage approximation of the degree of change and as categories of activities from the river bed.

Ecosystem services can be estimated with the use of a large range of methods existing in the scientific literature: indices and estimators, graphical methods, statistical methods, parametric and non-parametric methods, in the case of biodiversity and other provisioning services, perception questionnaires regarding the cultural services, quantitative and qualitative data gathered by stakeholders regarding water levels and debits, etc.

The relation between different ecosystems services, or the relation between ecosystem services and biotope variables can be estimated with the help of several techniques (clustering, graphical methods, multiparametric methods, indices, indicators etc.), depending on the specificity of the data involved, on the information intended to be revealed or on the relations between the components involved in the analysis.

Finally, the compiled information is usually integrated with the help of cybernetic software capable to extrapolate the gathered information for the entire aquatic basins or a larger geographic area (MaxEnt or different versions of GIS are mainly used for such purpose).

DISCUSSION

A series of steps were identified as necessary in order to achieve the goal of integrating the values of several ecosystem services in a single model.

1. Gathering of field data

It is the first and probably the most important stage of creating an integrated model on ecosystem services provided by lotic ecosystems. Field data required for such studies range from information regarding aquatic biodiversity (microorganisms, vascular plants, aquatic invertebrates, fish populations), to data regarding hydro-morphological features of the water body (debits, levels, substrate morphology), water quality (physico-chemical characteristics, organic loadings, quality levels), information regarding human impact in the area (presence and intensity of human activities, chemical substances deployed in the river), or information regarding the cultural services provided by the water body (state of comfort, leisure value, etc.).

Each data category requires a specific methodology, making this part the most complex one in the creation of a coherent ecosystem services model. If some of the information is quantificable in-situ, such as the one regarding hydro-morphological features, several physico-chemical indicators or even some data regarding biodiversity (vascular plants, fish populations, etc.), most of the information requires additional laboratory analyses in order to be completed.

Of all the steps required for integrated modeling, gathering field data is the one that will imply the large majority of costs, and the amount of those costs is proportional with the amount of information planned to be gathered.

2. Quantification

Quantifying all the information gathered from the field in a coherent manner is probably the most difficult part of creating a complex model. Each of the ecosystem services implied and each additional information gathered has their own measurements and measuring methodology (direct observations and measurements, estimations based on photographic material, indices and estimators, etc.), therefore quantification should be supplemented by data transformation techniques, such as standardizing and normalization (z-scores, standard scores, percentual approaches, etc.), making the information coherent and proper for the next two stages of model conception.

3. Correlation and regression

Stages three and four are not mandatory in creating an ecosystem services model; however, they can help the reduction of the information from the model, making it easier to be used, with little loss of significance results.

Significant correlations and regressions between the quantified values of a specific ecosystem service and habitat characteristics or human impact variables can provide further information about the construction of the model. For example, if we can find strong correlations between public perception of the water body's importance and water quality, and between water quality and biodiversity values, we can conclude that a better public perception leads to higher biodiversity; such theoretical constructions can be used for more than two correlations, taking into consideration the cumulative error of the mathematical interpretation.

4. Multivariate analysis and other variable relating techniques

Ordination techniques are useful for relating variables, and creating clusters of information that are easier to insert into a complex model. Separating the entire information gathered from the field data into closely related clusters allows a better insight into the relations between the variables, and a simpler way to create connections between information which seems to be unrelated.

Several ordination methods are used in ecology (CCA, PCA, NMDS, regression trees, with their regular and detrended variants), and the choosing of a specific method depends on the structure of the information gathered and on the specific intentions of the researcher.

Non-linear modeling can also be useful in reducing the amount of data gathered for the construction of the model. A logarithmic model between two variables (e.g. between diversity values of a certain group and the amount of dissolved oxygen of the water) leads to the conclusion that diversity remains constant after a certain oxygen load, therefore additional measures are useless in order to obtain higher values of biodiversity for the ecosystem service.

Such mathematical constructions can also help relate the clusters of information separated through ordination methods and reveal the connections between these clusters.

5. Mapping

The simplest and most representative way to present the information selected from the previous steps is mapping. GIS modules are complex enough and can easily be used by trained specialists for such representations, allowing relations between the obtained values of ecosystem services and environmental data of different types and categories.

Their main problem seems to be the static representation of the information, as a situation at a certain point in time, with little possibility of prognosis. Newly created software, such as MaxEnt, are better at presenting prognoses and estimative values; but their use is much more difficult and needs proper knowledge in the matter.

The most common way of representation is as single type information, maps that present the values of a certain ecosystem service, usually related with little environmental data. Although limitative, such representations are useful for the final stage of a complex model.

6. Interrelated modeling

After gathering the field data, the simplification of redundancy, clustering of closely related information and constructed maps of several categories of ecosystem service values' for a given lotic ecosystem, the final stage of the model is to show their relations, and the way a punctual modification will influence the system.

A simpler way would be to create secondary maps, in which the information from two or more maps is centralized, using mathematical relations. As a basic example, summation, averaging or the lowest calculated value, depending on the ecosystem services involved, the cumulative value of ecosystem services can be expressed from a certain river sector, but such methods are rarely accurate. A more complex construction would involve relating the information from the maps with the use of the mathematical relations obtained through non-linear modeling in stage four, the most precise way in which the final product of the model would express the exact value of the services from the system. After the final maps are constructed, altering the values of an ecosystem service or of an environmental variable can be expressive as a prognosis map created in the same way, and the two maps (existing value and prognosis) can be compared in order to point out the influence (expressed as percentage, for example) that the modification had on the existing situation.

CONCLUSIONS

Although, this is not the only possible framework; the presented six stage ecosystem model service aims to provide a solution for integrating vast amounts of information, usually present in such studies, into a single coherent structure.

The presented framework can be used, in complete or partial form, by specialists in the field for the construction of mathematical models of services provided by various ecosystems.

ACKNOWLEDGEMENTS

This paper is supported by the Sectorial Operational Program Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number POSDRU/159/1.5/133675.

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EVALUAREA ȘI MANAGEMENTUL TERENURILOR DEGRADATE PRIN EROZIUNE HIDRICĂ ÎN BAZINUL SECAȘULUI MARE/ THE ASSESSMENT AND MANAGEMENT OF LAND DEGRADATION THROUGH HYDRAULIC EROSION IN THE SECAŞUL MARE BASIN

– REVIEW –

Laurian Mugurel GHEORGHE [1]

Mărioara Costea, 2014, "Evaluarea și managementul terenurilor degradate prin eroziune hidrică în bazinul Secașului Mare"/ "Assesment and management of degraded land by hydric erosion in Secaşul Mare River basin", 288 pages, Edit. Universităţii "Lucian Blaga" din Sibiu, in Romanian, ISBN 978-606-12-0887-6.

This publication is structured in ten chapters, a foreword, two annexes and a bibliography.

The publication is the result of the research realised by the author between 2011 and 2013 within the framework of the programme "Postdoctoral School for Zootechnical Biodiversity and Food Biotechnology, on the basis of Eco-economy and Bioeconomy necessary to Ecosanogenesis".

In this article the author presents geomorphological processes which have caused present-day evolution, the impact on human communities and the measures that have been taken in order to stop their progression. The author of this publication also proposes a sustainable development strategy for the hydrographic basin Secașul Mare, on the basis of her own research and analysis.

In chapter one, some general aspects are presented regarding the ecogenesis of the land, considered one of the major global environmental issues. The author carried out an assessment of the causes and frequency of land degradation through hydraulic erosion. She also makes an analysis of the situation of land degradation in Romania, including the land improvement measures.

The second chapter of the book presents the objectives of the study and the methodology used to reach the objectives.

The study area's geological and geomorphological particularities are described in the third chapter. The geological and hydro-geological conditions are important factors for the relief modelling and land degradation. Some morphometric indicators (altitude, stream order classification, declivity, aspect, stream power index, etc.) are calculated for the Secașul Mare hydrographic basin.

Other important factors for land degradation include hydrological and climate conditions, which are presented in the fourth chapter. Data from three meteorological stations (Sibiu, Sebeş, and Păltiniș) from the last 30 years were used to emphasize the role of climate in land degradation.

Chapter five is important because it includes the soil particularities. The author underlines the influence of the soil for the erosion process and describes the typology and distribution of the soils in the study area. She also makes an inventory of the pedological factors that have influenced the erosion and limit of land use.

In chapter six, the human habitat and anthropogenic pressure on the environment are presented. Human pressure is high in the Secașul Mare Basin, so the author has calculated some indicators of anthropogenic pressure for each territorial unit, including naturality index, environmental change index, degradation index and human pressure index.

The last four chapters are of major importance due to their practical application. Thus, the seventh chapter presents an inventory of the significant areas with land degradation. Analysis and interpretation of the data is carried out for the Gârbova Basin.

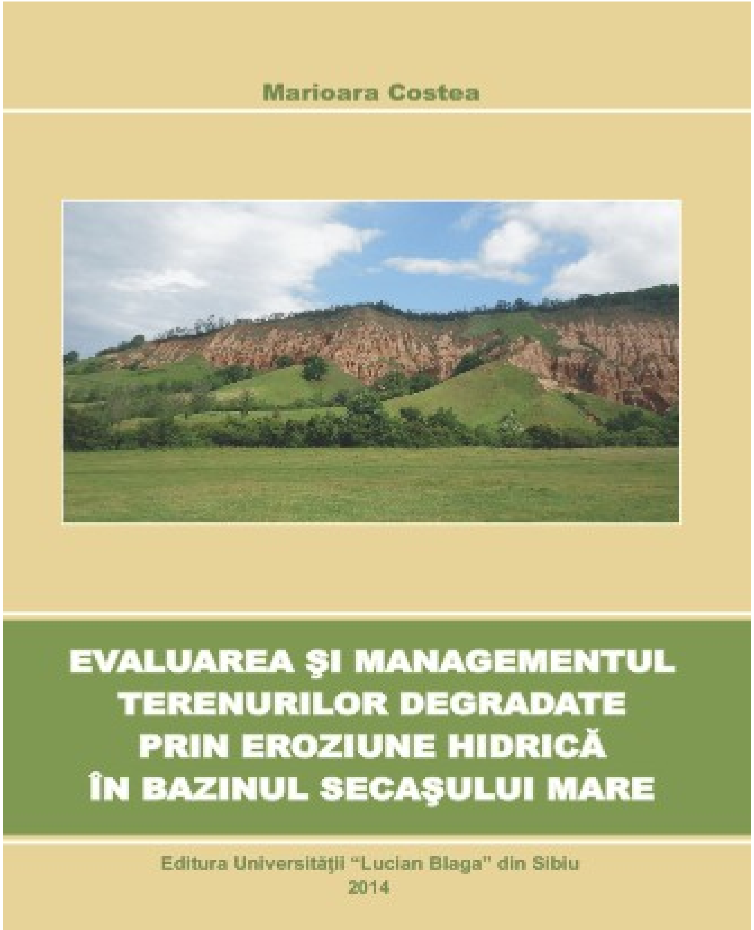
Very significant is the evaluation of the erosion and the soil loss, presented in chapter eight. In this chapter, the author uses the model RUSLE to estimate the annual average of the erosion for an extended time period, a very efficient and precise model when using GIS. Fournier index and Fournier modified index are used in order to assess rainfall erosivity in the study area. Study cases for the small hydrographic basins are also presented in this chapter.

The ninth chapter describes the perception and the attitude the population faces regarding land degradation. The results derive from the distribution of a questionnaire in the localities existing in the study area. One hundred and fourteen interviews were conducted and the structure of the questionnaire is presented in Annex 1.

Finally, the last chapter offers practical management measures and objectives, in order to reduce the land degradation and to promote a sustainable use of the land.

The descriptive part of the study is completed by a very elaborated graphic part. Good quality diagrams, charts and maps are used to facilitate the understanding of the connections between the processes presented in the study.

In conclusion, this publication is impressive by virtue of its originality, accuracy and scientific information provided. The article has application to a large number of specialists, from geomorphologisits and soil experts, to agronomists, biologists, ecologists, public servants and decision makers.



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L'IMPORTANZA DEGLI ALBERI E DEL BOSCO: CULTURA, SCIENZA E COSCIENZA DEL TERRITORIO/ THE IMPORTANCE OF TREES AND FORESTS: THE CULTURAL HERITAGE, THE SCIENCE AND THE SOUL OF THE TERRITORY

– REVIEW –

Marta Gaia SPERANDI [1] and *Tatiana MARRAS* [2]

"L'importanza degli alberi e del bosco: cultura, scienza e coscienza del territorio" is a comprehensive guide to the world of forests. More specifically, it's a study of their ecological meaning and analysis of their economic, spiritual, and cultural value.

The approach is intentionally both scientific and narrative. The book, which appears in two volumes, instigates reflections while – at the same time – offering important points for public discussion.

The aim is to persuade the reader to leave behind the anthropocentric, utilitarian vision, which only values the forest for its ability to provide society with services and goods, and embrace a new perspective, which involves considering nature in its complexity.

One of the first scientists to recognize the complexity of natural dynamic systems was Warren Weaver. In "Science and Complexity" (1948) he writes of "a sizeable number of factors which are interrelated into an organic whole".

According to Warren's definition, the forest is described in this book as a "complex biological system", a dynamic entity which involves a high number of interconnected variables, each one requiring attentive analysis to fully comprehend the final result of the combination.

The aim is to take a more integrated approach when looking at the environment by combining economic, ecological, cultural, and social aspects. In order to ensure that future generations will benefit from the wide range of goods and eco-services provided by forests, a less material and more philosophical approach is needed.

According to the authors, ethical considerations should act as principles in putting knowledge into actions, and the irrational exploitation which has sometimes been pursued shall be replaced by natural resources sustainable management.

Good management of resources should be based upon thorough knowledge of the issue and driven by good principles. Since the forest has been recognized as a dynamic living entity, we should examine it conscientiously as well as scientifically.

Up until now, North America has been the first continent to recognize the role of forest ethics in sustainable forest management (Irland, 1994; List, 2002; Erkkilä, 2005), followed by Europe, which hosted the first symposium on "European forests in ethical discourse" in 2005.

As Nathaniel Branden said in 1999, "the first step towards change is awareness" and therefore an essential part of spreading environmental consciousness among people is environmental education (UNESCO, 2014).

Key features of the book that help facilitate comprehension include the use of a clear and concise language alongside drawings and pictures.

The work is divided into eight sections, each one consisting of a collection of contributions from a wide range of authors. Every section deals with a particular aspect of the relationship between humans and forest, for instance, science, culture, art, religion, politics and economy.

Sections I-II-V-VI-VII address ecological and scientific topics, such as the issue of sustainable forest management, and give an accurate account of several features of the forest, which is recognized as a biological, aesthetic and economic entity.

In the first section, Prof. Franco Tassi ascribes “five dimensions” to the forests by recalling some of their most important functions: material, hydrological, recreational, ecological, and spiritual.

Sections II and V offer a review of the main direct and indirect factors threatening forests, such as climate change, wildfires and massive urbanization. Additionally, these sections stress the importance of adopting a sustainable management strategy to preserve biodiversity.

Urban trees, along with their role and management, are investigated in section VI, while section VII provides insight on the importance of volunteering and environmental education as tools for restoring and strengthening the bonds between humans and nature.

Sections III-IV-VIII deal with more cultural and artistic themes. The authors summarize the subject of monumental trees as well as collecting myths and tales originating from various ancient cultures, including the Egyptians, Nordic peoples and Celts. Furthermore, these sections focus on the role that nature historically played in inspiring several artists. For instance, Leonardo da Vinci was one of the first scholars to state the importance of drawing as a scientific tool. Also, Johann Wolfgang von Goethe, a key figure of the German Romantic movement, was fascinated by the Italian palms (*Chamaerops humilis*), that he observed during his trip to Italy between 1786 and 1788, and later described as follows:

“Like unto each the form, yet none alike; and so the choir hints a secret law, A sacred mystery”.

The book finishes with a collection of poems and tales about forests, which take the reader from the land of science-both feet firmly on the ground-and propels him or her to a more celestial dimension-that of the soul, art and poetry.

The strong connection between the scientific and the spiritual aspects of the forest reflects the vision that Kevin Cianfaglione (2012) refers to in the “Soplicowo” where he underlines the power of nature in seducing the human soul and inspiring a sense of beauty.

In conclusion, this book is a valuable educational tool that can be strongly recommended to students, practitioners, professionals, academics and nature lovers.

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TRANSYLVANIAN REVIEW OF SYSTEMATICAL AND ECOLOGICAL RESEARCH 16.2 (2014) – THE WETLANDS DIVERSITY

– REVIEW –

Erika SCHNEIDER-BINDER [1]

Angela Curtean-Bănăduc and Doru Bănăduc (editors), ***Transylvanian Review of Systematical and Ecological Research***, 16.2 (2014), "Lucian Blaga" University of Sibiu, Faculty of Sciences, Department of Ecology and Environment Protection. The Wetlands Diversity, 204 pages, Edit. Universităţii "Lucian Blaga" din Sibiu, ISSN 1841-7051.

Volume 16.2 of Transylvanian Review of Systematical and Ecological Research (TRSER) was recently issued by "Lucian Blaga" University of Sibiu/Romania. The publication is based mainly on some of the scientific papers presented at the fourth "Aquatic Biodiversity International Conference" which took place at Sibiu in 2013, organised by University "Lucian Blaga" of Sibiu, the NGO "Ecotur" Sibiu and the International Association of Danube Research. The editors point out that the term wetland is used in the sense of the definition following the Convention on Wetlands, signed in Ramsar/Iran in 1971, for the conservation and wise use of wetlands and their resources. Considering this, a large range of researches from different type of wetlands are included. With this volume – as also in previous volumes – we have in our hands a number of interesting subjects in the field of habitat research, biocoenoses, ecosystems and human impact on wetlands from different countries. The volume continues the series of previous volumes including systematic and ecological research around the world, thus providing a large, recognised and highly appreciated scientific journal serving as a platform for discussion and as well for sharing experience for scientists in the field of wetlands and water research.

The first paper presented by *Oana Danci* is dedicated to "Considerations regarding alpine rivers and their ligneous vegetation with *Myricaria germanica* in the Maramureş Mountains Nature Park (Romania)". The author highlights the value of the Habitats Directive habitat type 3230 mountain rivers and their ligneous vegetation with *Myricaria germanica*, an indicator species for river courses with natural hydro- and morphodynamics. Human impact on this habitat in the Rodna Mountains was presented. In order to assure appropriate management of the habitat, a set of management measures was elaborated. These measures refer to economic activities, invasive non-native species limitation, monitoring of the habitat, public awareness. The paper presents the first mention and description of the habitat type 3230 from Maramureș Mountains Nature Park.

The study presented by *Constantin Drăgulescu* refers to "The aquatic and marshy flora of the Lotru River basin (Southern Carpathians/Romania)", being a continuation of a series of floristic inventories of the main Romanian rivers of the Carpathian Mountains such are the Mureş, Sadu, Olt, Someş, Criş, Târnave and Tisa rivers. 204 plant taxa of waters and wetlands are listed in this paper, most of them being identified in the Lotru Valley basin by the author, but also by other botanists. For each species is mentioned the life form, floral element, ecological preferences for humidity, temperature, soil reaction, chorology and coenology. These data present a possibility for further flora analysis in the context of comparative studies with other river basins of the Carpathians.

The paper of *Erika Schneider-Binder*, "Comparative study of alluvial Cnidion-type meadows in the Lower Danube River basin", offers a complex ecological and phytocoenological analysis. These type of meadows of the FFH Habitat Type 6440, characteristic for the lower courses of large rivers in continental climate conditions of Europe, are presented from the Lower Danube upstream of the town of Giurgiu (river-km 510-524). The paper highlights the ecological requirements of the characteristic species, as well as the sensitivity to human-induced changes of the phytocoenoses which are cut off from regular flooding, and subject to drainage, intensification and/or abandonment. The studied meadows are compared with similar alluvial meadows from other sites of the Lower Danube River basin, and also the strong interlocking of Cnidion type meadows with those of the Agropyro-Rumicion, Molinion and Deschampsion caespitosae alliances are discussed. Here is the first mention and description of such types of flooded Cnidion type meadows (6440) from the Lower Danube.

Ahmet Öktener presents in his paper "An updated checklist of parasitic helminths of marine fish from Turkey" 161 helminth species from wild marine fish species of Turkey, including 49 monogeneans, 63 digeneans, 18 cestodes, 17 nematodes, 11 acanthocephalans and three annelids, from 88 different fish (86 native, two migratory fish) species. In comparison with a previous checklist published in 2005 the present update includes additional records and has allowed the correction of those errors and omissions that were present in the previous version. The parasite species list is arranged by phylum and class, providing parasite species name, host fish, location of host fish capture and author, and date of published record. This updated checklist would be helpful to solve disagreements among researchers.

The "Composition, abundance and diversity of the family Cichlidae in Oyan Dam lake (Ogun State, Nigeria)" is presented by *Olaniyi Alaba Olopade* and *Oluseun Peter Rufai*. The status of the family of Cichlidae in the Oyan Dam lake of Nigeria, during the wet and dry seasons of the year 2011 constitutes the base for the research and discussed results. After analysing the Cichlidae species the authors conclude that fish stocking has proven to be one of the most successful tangible tools in reservoir fisheries management and therefore they propose that the Oyan Lake should be stocked with more cichlid species in order to improve the fish stock.

In their paper concerning the "Use of poacher's catches for studying fish fauna in the water bodies of the Transcarpathian Region (Ukraine)" the authors *Alexander Didenko*, *Igor Velykopolsky* and *Andrey Chuklin* compare techniques used by poachers to capture fish in the streams and stagnant water bodies of the Tisa River basin in Ukraine. These techniques include gill nets, lift nets, screen nets, electrofishing devices, spears, concussion, and beach seine. The highest species diversity was observed in gill nets (25 species in rivers and 10 in stagnant waters), lift nets (20 species in rivers and eight in stagnant waters), and electrofishing (19 species). According to their results, the authors conclude, that poachers' catches can provide information on fish species composition and relative abundance in mountainous rivers, but there are biases associated with each technique.

Results of researches concerning the "Abundance of the alien spionid *Streblospio gynobranchiata* in relation to sediment composition along the Southern coast of the Caspian Sea" are presented and discussed by *Amir Faraz Ghasemi*, *Armin Jam*, *Mehrshad Taheri* and *Maryam Foshtomi*. Seasonal and inter-annual variations in the density of the invasive polychaete *Streblospio gynobranchiata* were monitored in the South Caspian Sea in strong interrelation with sediment conditions at five and 14 meters depths during the years 2005 and 2010. Although the percentage of total organic matter as a food resource increased from 2005 to 2010, the density of *S. gynobranchiata* decreased slightly in the same period, reaching, as conclude the authors, a balanced state. They also underline that in addition to the mentioned increase-decrease relation, the changing density of the species is also affected by other biotic and abiotic factors like intra- and interspecific competitors and pollutants.

"A survey on ionic and metabolite factors of blood serum in Kutum (*Rutilus frisii kutum*)" is presented by the authors *Majid Afkhami*, *Kazem Darvish Bastami*, *Nariman Shabani* and *Farzane Soltani*. In the study ionic parameters and metabolite factors (cholesterol, total protein, and glucose) of serum and their interrelationships were detected in 48 specimens of kutum (*Rutilus frisii kutum*) captured during spawning migration. The obtained results by these analyses can help, as the authors conclude to improve reproductive and cultivation management of this valuable species.

The main purpose of the "Research on water quality used in the milk industry in Sibiu County (Transylvania, Romania)" presented by the authors *Mihaela Tiţa*, *Adrian Dabija*, *Ovidiu Tiţa* and *Daniela Naiaretti*, is to monitor the quality of water in milk processing industry, in order to ensure food security by framing it within the limits permitted by current rules. This is an important task, as the wastewaters resulting from the milk industry are characterized by high levels of physical-chemical and microbiological properties due to their different origin and variety of composition. The results of the analyses presented by the authors confirm that the water used to receive raw milk materials has no influence on milk composition and that all the parameters analysed are compliant to the standards of existing legislation.

In their very interesting case study "*Zingel zingel* (Linnaeus, 1766) on site management decisions support system" the authors *Doru Bănăduc*, *Cristina-Ioana Cismaş* and *Angela Curtean-Bănăduc* presents the utilisation of the ADONIS:CE in the biology/ecology domain, to produce a framework management model of *Zingel zingel* species based on the species identified needs, regarding: habitat, indicators which reveal favourable conservation status, proper measures, and identified pressures on and threats to this fish species. Such a management model needs to be implemented for the sustainability of the studied species populations. At the same time the authors underline that such management systems, based on: site, habitats and species should be implemented for other fish species of conservation interest for Natura 2000 in case of the ROSCI0132 Natura 2000 site "Oltul Mijlociu-Cibin-Hârtibaciu" (Middle Olt stretch, Cibin and Hârtibaciu rivers) in Southern Transylvania.

The importance of longitudinal connectivity of rivers is highlighted in the paper "Providing longitudinal connection in case of cross sluicing on water bodies in Banat hydrographic area" by *Diana Hoancă*, *Corina Todorescu* and *Alina Roşu*. Based on the requirements of the Water Framework Directive, the authors refer to the rivers in the Banat area which are under anthropic pressures due to hydrotechnical constructions, interrupting the longitudinal connectivity of rivers with negative consequences on the aquatic ecosystems as well as on other hydrological characteristics of the rivers. On the one hand, the hydrotechnical constructions have an important socio-economic role, but on the other hand they have negative effects through the loss of longitudinal connectivity and interruption of water bodies, which can lead to the risk of not achieving the positive ecological potential of water bodies in accordance with the Water Framework Directive. The loss of connectivity has as consequence a significant loss of aquatic biodiversity, reduction or even extinction of certain aquatic species and alteration of flow process. A number of measures have been identified for the rehabilitation of the affected water courses: the removal of the hydrotechnical constructions from the water body if they have lost their functional features, building of passages for the migration of the ichthyofauna, reconnecting of affluents and disconnected arms as well as other measures intended to bring things back to their natural state. The authors underline that the implementation of these measures should be made according to the importance and the extent of their positive impact as opposed to the negative effect that might occur as a consequence of their application.

Răzvan Voicu and *Eric Merten* present in “Creating a system for upstream – downstream fish migration over the first and the second discharge sills downstream of Mănăştur Dam on the Someşul Mic River” a problem for the fish migration on the Someș River. The sugested solution proposes a system to facilitate fish migration, placed on the left bank of Someşul Mic River, in order to restore the longitudinal connectivity of Someşul Mic River in front of the Mănăştur Dam discharge sills, and to facilitate access of migratory fish species.

Marine protected areas with their problems concerning the restoration of Coral Reefs are subject of “New paradigm of co-management of MPAs in Indonesia: lessons learned from coremap” presented by Suraji, *Toni Ruchimat*, *Sudirman Saad* and *Sriyanti Wibisana*/Indonesia. The authors underline that the establishment and co-management of Marine Protected Areas (MPAs) which are conducted by Coral Reef Rehabilitation and Management Project (COREMAP) Phase II represents a new paradigm away from the top-down approach, that being the bottom-up community-based approach. Collaborative management of MPAs is exemplified by COREMAP Phase II through the sharing of responsibility between central and local government and communities, providing a unique feature in the management of conservation areas in Indonesia.

In “Bayesian update for descriptive in fisheries science” *Sedat Gündoğdu* and *Mustafa Akar* describe in the Bayesian method, which is applied to a real sample of 730 observations of Por’s Goatfish from Iskenderun Bay, in the Mediterranean Sea. The approach uses the Markov Chain Monte Carlo simulation to draw samples from the posterior distributions of model parameters by implementing the simulation in OpenBUGS software. The key aspect of this research is that when previous studies are included in the estimation, this significantly reduces the variance and uncertainty, leading to a more sufficient and reliable estimation.

The last paper by *Noorpreet Inder Kaur Dhanjal* and *Swaranjit Singh Cameotra* from India concerns the “Biodegradation of 4-Chlorobiphenil by *Pseudomonas synxantha*”. They are highlighting the stabilization and disposal of polychlorinated biphenyls (PCBs) from soil environment and wetland areas which are of great concern for health and safety purposes. Wetland remediation with microorganisms is an approach for treating PCBs. A bacterial strain was isolated from hydrocarbon contaminated soil of Ropar, Punjab, able to degrade PCBs under aerobic conditions. The bacterial strain was identified as *Pseudomonas synxantha* by 16sRNA sequencing method. This is the first report of 4-chlorobiphenyl degradation by *Pseudomonas synxantha*.

The above mentioned papers are developed on 198 pages, including maps, photos, diagrams, graphics and tables which greatly assist the understanding of the texts.

We conclude that the volume cover a large range of subjects in water and wetland research, revealing the diversity of working fields, methods and scientific approaches and the multitude of problems and impact on wetlands and their biodiversity. It is clear that in many fields deeper research is needed for finding new answers for problems in the complexity of ecosystem relations and restoration of aquatic and wetland habitats. Concerning management and restoration, the volume have a strong theoretical basis as well as practical experimental sites, in the field of wetlands management and restoration.

The editors succeeded in composing a new volume with papers corresponding to the subtitle of the volume “Wetlands diversity”. For all their hard work, they merit our appreciation and congratulations!

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