GUTÂI MOUNTAINS (MARAMUREŞ–TRANSYLVANIA, ROMANIA)

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KEYWORDS: Northern Romanian Carpathians, Gutâi Mountains, localization, geology, protected areas.

ABSTRACT

The Gutâi Mountains are located on the northern side of the Eastern Carpathians and belong to the volcanic chain Oaş – Igniş – Gutâi – Lăpuş – Ţibleş.

The massif is separated from the Igniş Mountains by the Gutâi Pass (987 m), from the Lăpuş Mountains by the Neteda Pass (1,080 m), and it is bordered by the valleys of Săsar, Cavnic, Mara and Cosău.

This paper is a detailed description of the geological structure of this massif, according to its formation and the rock types present in the central area, the Gutâi area, the Mogoşoaia volcanic structure and the Dăneşti–Cetăţele dacitic complex.

The formation of the Gutâi Mountains is the result of the volcanic activity that took place 9–11.5 million years ago.

In this massif, for the protection of the flora and fauna, a Natura 2000 site was established, including the Creasta Cocoşului, Lacul Morărenilor (Fig. 4) and Tăurile Chendroaiei reservations.

REZUMAT: Munţii Gutâi (Maramureş–Transilvania, România).

Munţii Gutâi sunt situaţi în partea de nord a Carpaţilor Orientali şi fac parte din lanţul vulcanic Oaş – Igniş – Gutâi – Lăpuş - Ţibleş.

Masivul este separat de Munţii Igniş prin pasul Gutâi (987 m), de Munţii Lăpuşului de pasul Neteda (1.080 m) şi este delimitat de văile Săsarului, Cavnicului, Marei şi Cosăului.

Lucrarea de faţă face o descriere în amănunt a structurii geologice din acest masiv, în funcţie de formarea lui şi tipul de rocă existent în zona centrală, zona Gutâiului, structura vulcanică Mogoşoaia şi complexul dacitic Dăneşti - Cetăţele.

Apariţia Munţilor Gutâi este rezultatul activităţilor vulcanice care au avut loc în urmă cu 9–11,5 milioane de ani.

În acest masiv, pentru protejarea florei şi faunei s-a creat situl Natura 2000 care cuprinde rezervaţiile Creasta Cocoşului, Lacul Morărenilor (Fig. 4) şi Tăurile Chendroaiei.

RÉSUMÉ: Les Montagnes de Gutâi (Maramureş–Transylvanie, Roumanie).

Les montagnes de Gutâi se trouvent dans la partie nord des Carpates Orientaux et font partie de la chaine volcanique Oaş – Igniş – Gutâi – Lăpuş – Ţibleş.

Le massif est séparé par les montagnes d'Igniş par le col de Gutâi (987 m), par les Montagnes de Lăpuş par le col de Neteda (1.080 m) et il est délimité par les vallées de Săsar, Cavnic, Mara et Cosău.

L'article ci-présent décrit en détail la structure géologique de ce massif, selon sa formation et le type de roche existant dans la zone centrale, la zone de Gutâi, la structure volcanique Mogoşoaia et le complexe dacitique de Dăneşti – Cetăţele.

L'apparition des Montagnes de Gutâi est le résultat des activités volcaniques qui se sont passées il y a 9–11,5 millions d'années.

Dans ce massif, a été créé un site de Natura 2000 pour la protection de la flore et de la faune des réservations Creasta Cocoşului, Lacul Morărenilor (Fig. 4) et Tăurile Chendroaiei.

INTRODUCTION

After 1968, some geographers (Coteţ, 1973) redefined the geographical limits for what was called for a long time Gutâi Mountains (after the highest peak, called Gutin or Gutâi) being individualized from the Igniş Mountains (also called Pionierilor Mountains).

In the Gutâi Mountains are the Gutâi Massif, the Mogoşa Massif and the Gutâiului Piedmont.

Around the Gutâi Massif there are steeps as well as cuvettes with periglacial lakes.

The highest peak of the massif is the Gutâi Peak (1,443 m) followed by the Gutâiului Mic Massif (1,392 m), Secătura Peak (1,392 m) and Măgura Budeştiului Peak (1,206 m). (Figs. 1 and 2).

Figure 1: The Gutâiului Mic Peak (Cei Trei Apostoli – 1,392 m) – Gutâi Peak (1,443 m) – Creasta Cocoşului.

RESULTS

Geology

The Gutâi Massif has distinct features morphologically and structurally (Dicea et al., 1978; Săndulescu et al., 1993; ***, 1999), that justify its separation of both the mountains of Igniş, as well as from of Lăpuş (also named the Văratec Mountains after the highest peak).

The magmatic rocks in this area have a NE-SW direction, diagonal to the general direction E-V of the Lăpuş Mountains, due to the orientation of Gutâiului fissure, a deep fracture which has allowed the formation of magmatic rocks.

The geology of the massif divides into the following main parts:

1. **The central area**

It lies between Şuior and Cavnic, being composed of geological formations developed on the E-V direction. In this area centrally located between Gutâi and Mogoşa, the following types of igneous rocks are presented:

- quartz andesites with pyroxene and hornblends of Şuior (complex quartz andesites);
- Cavnic-Şuior pyroxene basaltic andesites;
- andesits with pyroxene ± hornblends (the andesitic complex of Cavnic – Şuior isotopic age is 10.9–10.1 million years).

2. **Gutâi area**

It locates in the north central area and consists of andesite with pyroxene, hornblende, biotite and quartz of Gutâi (the lava flow with a maximum thickness of about 400 m), it is of 9.0 million years old, the latest eruptive rocks of the Gutâiului Massif.

Figure 2: Gutâiul Mic Peak (Cei Trei Apostoli).

3. Mogoşa volcanic structure

It lies south of the central unit, apparently with a superstructure that consists of particular types of rocks. The largest part of the Mogoşa cone consists of igneous rocks belonging to the basaltic andesites Complex of Mogoşa (11.4 to 9.5 million years old), consisting of the following varieties of igneous rocks:

- pyroxene basaltic andesites of Negreia;
- glomeroporifiric pyroxene basaltic andesites;
- pyroxene basaltic andesites of Mogoşei Valley;
- pyroxene basaltic andesite with hornblende of Mogoşa Peak.

At the base of these rocks, pyroxene dacite (± hornblends) of Morii Valley appear on a small area.

4. Dacitic complex of Dăneşti-Cetățele

There are the oldest igneous rocks of Gutâi Mountains (11.5 ± 0.5 million years) and they appear in the far SW sector, in the Dăneşti-Cetățele area. It consists of:

- dacites with pyroxene ± hornblende of Piatra Roşie-Cetățele;
- dacites (riolites) with quartz, biotite, hornblende and pyroxene of Dăneşti.

The mineralization occurring in the Gutâi Massif (Şuior and Cavnic-Bolduț) binds to the Cavnic-Şuior andesitic complex, especially pyroxene basaltic andesites of Cavnic-Şuior.

Reservations from Gutâi Montains

Reservations of national interest:

Creasta Cocoşului (Fig. 3), code 2577, mixed, 50 ha, locality Mara.

Morărenilor Lake (Fig. 4), code 2568, mixed, 20 ha, localities Breb – Ocna Şugatag (Chiş, 2007).

Figure 3: Creasta Cocoşului Reservation.

Figure 4: Morărenilor Lake.

Reservations of local interest:

Tăurile Chendroaiei – botanical, 2.46 ha, locality Deseşti.

Natura 2000 Sites:

Sites of Community Importance (SCI) – later, they will be special areas of conservation (SAC).

Gutâi – Creasta Cocoşului, code ROSCI0089, surface of 693 ha.

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THE ROLE OF THE HYDROLOGICAL FACTOR IN HABITAT DYNAMICS WITHIN THE FLUVIAL CORRIDOR OF DANUBE

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KEYWORDS: Danube River, hydrological factor, habitats dynamics, fluvial corridor.

ABSTRACT

This paper explores the connections between river hydrology and riparian habitat dynamics.

The fluvial corridor spatially integrates the active channel, and parts of its floodplain affected by periodical flooding (in general terrace I and II), and can be considered as an ecological corridor because of the size of the fluvial hydrosystem.

The river and its ecosystems depend on geomorphogenetic and biological function, thus creating an inter-dependence transposed into a *fluvial hydrosystem* concept (Amoros, 1987).

The hydrosystem is a complex of ecological systems comprised of biotopes and biocenoses specific to running waters, stagnant water bodies, and semi-terrestrial ecosystems located in the periodically flooded area of the floodplain, modeled directly and indirectly by the active force of the river.

REZUMAT: Rolul factorului hidrologic în dinamica coridorului fluvial al Dunării.

Această lucrare explorează conexiunile dintre hidrologia fluviului şi dinamica habitatelor ripariene.

Coridorul fluvial integrează din punct de vedere spațial canalul activ, zone din câmpia inundabilă (în general terasa I şi II), afectate de inundațiile periodice şi poate fi considerat ca şi coridor ecologic datorită dimensiunii hidrosistemului fluviului.

Fluviul şi ecosistemele sale depind de funcția geomorfogenetică şi biologică, creându-se, astfel o interdepență transpusă într-un concept de hidrosistem fluvial (Amoros, 1987).

Hidrosistemul este un complex de sisteme ecologice, constituit din biotopuri şi biocenoze specifice apelor curgătoare, corpurilor de apă stagnante, ecosistemelor semi-terestre localizate în spațiul zonei inundabile modelat direct şi indirect de forța activă a fluviului.

RÉSUMÉ: Le rôle du facteur hydrologique dans la dynamique du corridor fluvial du Danube.

Ce document explore les liens entre l'hydrologie fluviale avec ses changements et la dynamique de l'habitat. Le corridor fluvial intègre l'espace du canal et une partie de sa plaine inondable touchés par les inondations périodiques et pourrait être considérée comme un corridor écologique en raison de la taille de l'hydro système.

La rivière et ses écosystèmes dépend des fonctions geomorphogenetique et biologique, créant ainsi une dépendance inter-transposée dans un concept, à savoir l'hydro système fluvial (Amoros, 1987).

Le hydro système est un système écologique complexe constitué de biotopes et biocénoses spécifiques des eaux, des cours d'eau stagnante, semi-aquatiques et des écosystèmes terrestres localisés dans l'espace de plaine d'inondation modélisée directement et indirectement par la rivière la force active.

INTRODUCTION

The fluvial corridor integrates spatially the channel and also parts of its floodplain affected by periodical flooding with an extention with hydrogeomorphological discontinuities. If initial name given to the afferent area of the lower stream of river "Le Balta du Danube" and "Balta Dunării", were not used too much, and "The easily flooded area of the Danube" (Antipa, 1910) only persisted till 1960 when it have been replaced with the syntagm "Danube floodplain", this proves even from semantic point of view of the division the destruction and turning into land of the peerless natural European inheritance. Danube River could be considered as a hierarchical system which is analysed in this study from a perspective of interactions between hydrodinamics with structure and function of ecosystem.

The river and its ecosystems extention depends on geomorphogenetic and biological function and, thus had been created an inter-dependence transposed into a concept: the ***fluvial hydrosystem***, (Amoros, 1987).

The fluvial hydrosystem includes specific biocenoses of stream waters, stagnant water bodies, semi-aquatic, terrestrial ecosystems localized in the space of floodplain directly and indirectly modeled by river active force.

This concept emphasizes water-energy-matter fluxes and focuses on the way how influence the sequence or recurrence of expanding or withdrawal of a major channel and the riverine habitats.

But on the other hand, the impacts of the impoundment, river regulation and cannalization affected important riverine hydromorphological processes (the fluvial dynamics) which define the dynamic equilibrium of habitat distribution with their characteristic biota. Thus, it can be divided all these specific changes in two main categories: natural and anthropic ones; framed into factors all the environmental components such as light, water and heat and into categories of determinants those with a direct influence (litology, relief, water chemistry and also human).

HYDROLOGICAL CHANGES AND HABITAT DYNAMICS WITHIN THE FLUVIAL CORRIDOR

Hydrological changes

After 1967 – the year in which the majority of embanking and sanitation works have been finished and damming for the hydropower systems Iron Gate I and II the hydrological regime was modified within the same hydrological sector and from a hydrometric station to another.

A major component of the hydrological factor is related to flood duration and the value of hydrograph, which has recorded an eloquent dynamics in the last 4−5 decades. It is important to make correlations between these two components of the hydrological factor, because the dynamics of biotope conditions depends on the evolution of these components.

Thus, concerning the floods periods during a normal year, on terrain situated at the same altimetric level (correspondingly to 6.5 hg) – a value considered as a minimum ecological condition for the euro-american poplars and maximum for the willow species and based on these results it can be pointed out that:

- before embankment the longest floods was recorded to all hydrometric stations downstream on this sector (Călăraşi 118 days, Oltenița 108 days);
- after embankment, in the same hydrological conditions the order of hydrometric stations have been changed and for example in the proximity of Olt confluence (Corabia) the floods duration has grown at the level of the same hydrographer;

- analysing on long term 1967–2006, flood duration has continuously decreased, for example during the years with light floods and lower levels of benchmarks had an increasing frequency in the last two decades;
- before embankment the longest flood periods were specific to downstream sector of the fluvial corridor.

Wood species and alien species of poplars and willows and other species such *Quercus* sp. from Danube's floodplain are conditioned firstly by the specific hydrological regime (flood duration and phreatic level), and secondly by the inner characteristics of alluvial soils which constitutes the support of the biological activity for the habitat.

Stational factors which constrain the distribution and vitality of forest species from the fluvial corridor of Danube are as following:

- hydrological characteristics of the land (duration and frequency of the floods, velocity and the period of maintaining the flood waters, the level of phreatics);
- edaphic characteristics (fibbers, hummus quantity, water supplying capacity).

For a brief assessment of the relation between hydrological factor and habitat dynamics for this study it was agreed that it must concurrently pay attention to flood duration and vegetation season and type pointed out below; the first table (Tab. 1) represent an exemplification (data from one hydrometric station - Bechet) and the second one it is an extract from "*Encyclopedia of Inland Waters*" Linkens, 2009 (Fig. 1) which follows our paper study aims: a schematic relationship among water levels, vegetation, tolerance and time scale related to flooding and droughts. Analyzing the data from the table number 1 it can be pointed out that vegetation season (days) duration is shorter than the level of hydrograph at Bechet hydrometric station.

Table 1: Medium duration (days) of annual floods and the vegetation season between 1983–2001 measured in Bechet station flood duration (days).

Hydrographer	Year	Vegetation season
4.0	162	101
4.5	124	83
5	103	70
5.5	80	55
6	61	44
6.5	42	31
7	25	19
7.5	14	11
8.0	6	6
8.5	3	3
9.0	1	1
9.5	-	-

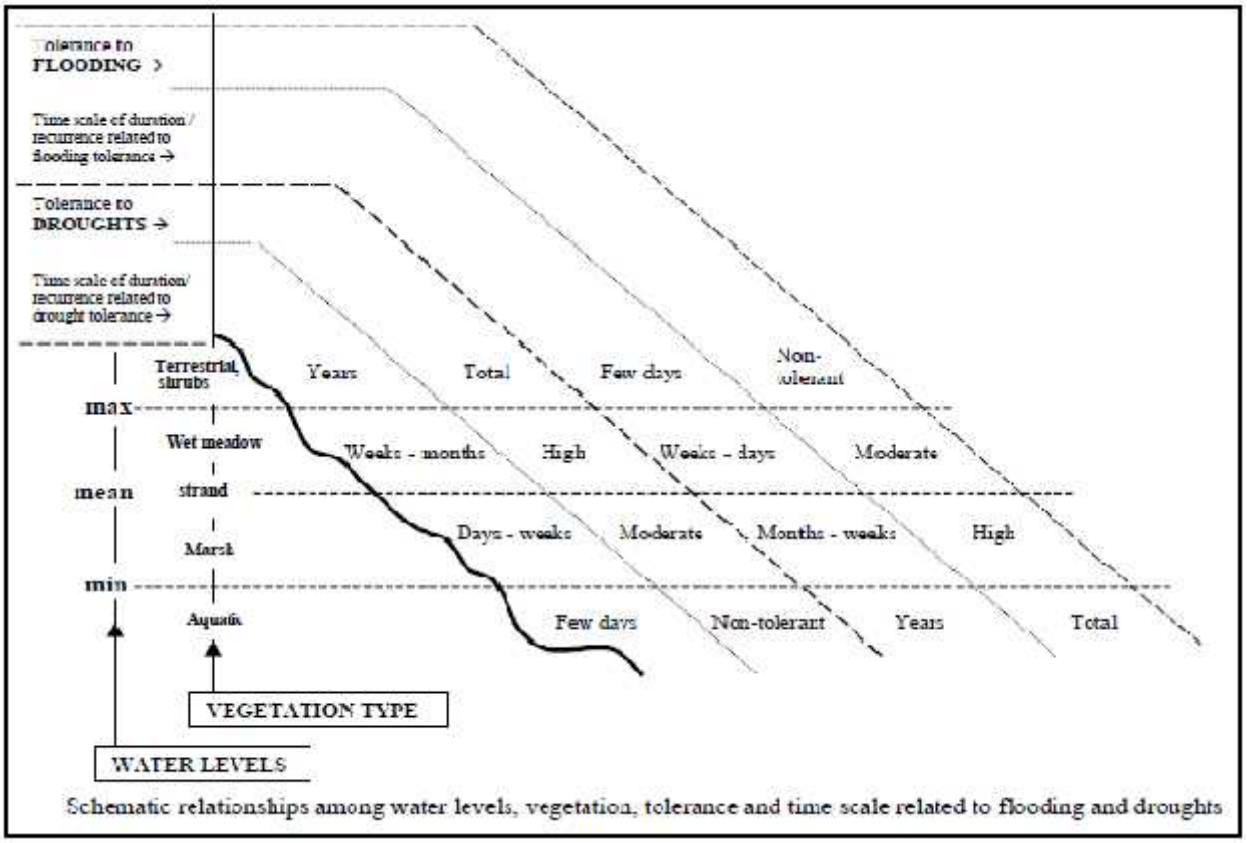


Figure 1: Schematic relationship among water levels, vegetation, tolerance and time scale related to flooding and droughts (extracted from Encyclopedia of inland waters, Linkens, 2009).

Following the consequences with a specific character, which does relate to modifications of the hydrological regime determined by the hydro-technical works within fluvial corridor and also the drought periods with a high frequency from 1982 contributed to configuration and distribution of forest ecosystems within the floodplain regions such as:

- decreasing the duration and frequency at the level of the same hydrograph;
- amplifying the oscillating character of bench mark values, increasing the maximum level and decreasing the minimum levels;
- altering the ecosystems functionality and setting of disorder periods until the restoration of the initial equilibrium of the systems;
- modifications in the hydro-geochemistry of ground waters in the vicinity;
- increasing of maximum speed of flow during the floods makes that river transport function and erosion to grow.

Embankment and sanitation caused a shrinkage of the surface water especially of the afferent lakes and lacustrine basins and the fragmentation of wetland and forest habitat. At the same time, the hydrological balance must be recalculated taking into account the underground flow from terrace along the floodplain, estimated between 2.3–11.4 m^3/day/m; for instance, in a first stage, the unsilted part of the lake Potelu, situated at about 2 hg can be supplied permanently by gravity, insuring the existence of a water layer of 1.5 m from the CO channel which crosses the Dăbuleni-Potelu-Corabia are and supplies the irrigation system Sadova-Corabia (60,000 hectares).

In other situations the terrace underground flow can be used and in the fortunate case of the Bistreț marsh it can be maintained further by simply discharging the waters of Desnățui River.

Damming had contributed to both the retention of large spring flows and the reduction of the medium and minimum discharges and, implicitly, to their levels.

Hydrologic exchange between mainstream and their aquifers also influence biological structure of the flora and fauna that occupy both habitats.

At the same time water table elevations resulting from connections between the aquifer and inundated floodplain can alter metabolism and nutrient cycling in soils and subsurface sediments, may accelerate or retard organic matter processing and can influence the productivity of riparian vegetation.

Habitat dynamics within the fluvial corridor of Danube

Before embanking works the hydrosystem floodplain, landforms and hydrological regime were corelated in a inter-dependency relation; the river erosion and accumulation functions had contributed to the process of forming new floodplain banks, which changed the hydrological regime and also the watercourse direction, affecting the riverine habitats. Decreasing the alluvial quantity-fact that was reflected by the deposition rate of alluvial materials induced a quantitative modification of accumulative relief. Some forms of vegetation lining can usefully act to reduce bed and bank erosion (riparian forests).

From the point of view of the European importance habitats (according to **Habitats Directive-** ***92/43/EEC***) within the floodplain it was possible to frame the following habitats:

- **91 E0 –** Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*, the equivalent habitat of *Salicion albae* 44.13 type from Palearctic Habitats Classification;
- **91 F0 –** Riparian forests with *Quercus robur*, *U. laevis*, *U minor*, *F. excelsior* and *F angustifolia* developed along the large river in our study sector of the corridor has a slightly distribution along the most consolidated bars settled in before the channel regularization and river embankment;
- **92 A0 –** Alluvial forest with *Salix alba* and *Populus alba* considered the most representative habitat from forest ecosystems within the Danube's lower floodplain; is the equivalent of Romanian classification; **R4406**-Panonic-Danubian forests with white poplar *Populus alb* and *Rubus caesius;* **R4407** - Danubian forests with white willow *Salix alba* and *Rubus caesius;* **R4408** - Danubian forests with white willow *Salix alba* and *Lycopus exaltatus.*

The dependence of the hydrological factor and the new modified conditions of the former wetland ecosystems it will be analyzed by exemplifying specific local cases or exposing the situation for specific vegetation types and fauna.

The agricultural practices had canceled the altitude differences between fluvial dunes and inter-dunes, intervention that induced, nowadays, some problems related to fixation of this landforms, because the vegetation layer was obliterated gradually. Negative landforms - places where water became stagnant for a long time populated with palustrine species such as *Phragmites australis*, *Typha laxmannii*, *T. angustifolia*, *Bolboschoenus maritimus*, *Schoenoplectus tabernaemontani.*

On the way the level of phreatics decreased in these negative landforms, the humidity excess was collected by the sanitation channels network and the environmental conditions for that species had disappeared.

The same process of restraining halophyte vegetation (*Salicornia prostrata*, *Suaeda maritima*, *Obione pedunculata*) it occurs the same, replacing some associations (*Puccinellia limosa*, *Puccinellia distans*) thus, preparing the habitat condition for xero-mezophyte vegetation dominated initially by associations such as *Cynodonti-Poëtum angustifoliae* or *Cynodonto-Atriplicetum tataricae*, in the vicinity of majority of human settlements.

Sanitation works reduced the water bodies and, thus, only the Danube and some major water bodies remained the domain for fish populations and the migration zones and for semi-migratory stagnophyle fish (carp, widow fish, flounder) used these areas of lower floodplain and the lacustrine basins linked with the Danube for reproduction too; these types of migration of fish population and reproduction were important for Danube flooded area as G. Antipa said (1910).

The floodplain role for fish had been shown subsequently by Antipa and its specific for widespreaded floodplain rivers and in one of his researches reveal that zoning fish population it's linked by the status and quality of flooded region, the growing rate of these populations it's determined by the period these species of fish spent in these places; nowadays, due to human impact in the Danube floodplain the traditional places of reproduction has lost their surface and importance.

Because the human modification of the channel and water bodies, altering the biotopes by sanitation works in wetland surfaces of the floodplain, irrigation systems and increasing process of agricultural mechanization some of the cited species by Bănărescu (1964) are considered extinct in lack of no observation of their presence after 1979 (*Chondrostoma nasus*, *Tinca tinca* and *Barbus barbus*). These interventions within Danube hydrosystem had reduced the ***biodiversity function of ecosystems*** situated within fluvial corridor Danube.

The specific hydrological regime characterized by periodical flooding determines the evolution process of vegetation; within the floodplain, in places with a high degree of deposition of alluvial material take place *syngenesis*, *neo-formation processes*, biocenosis passes the *stadial colonization*, consolidation and stabilization (willow and poplar) species that are perfectly adapted to occupy new terrains with accumulation alluvial material; after flood's withdrawal until autumn the willow species grow up about 1 meter high; next year willow and poplar can reach 2–3 meters higher (Figs. 2a, b), consolidating their roots in alluvial material and creating in a short time a new forest.

Figure 2a: Neo-formation phenomenon of alluvial forest ecosystems from dyke-river bank area Bechet – Dăbuleni sector (February–March, 2010).

Figure 2b: Neo-formation phenomenon of alluvial forest ecosystems from dyke-river bank area Bechet – Dăbuleni sector (February–March, 2010).

This phenomenon has been observed in the proximity of the confluence with Jiu River in 2010 during the early spring floods, in the area situated between dyke and bank in Bechet (Fig. 3); the sustenance of forest ecosystems is realized by the periodically floods and depositions which cover the favorable land for these types of ecosystems capable to fix the alluvial material, to contribute to continuous accumulation processes, protecting banks and stabilization of phenomenon and functions for maintaining the ***hydrosystem equilibrium*.**

The deposition was interrupted and the quantity of alluvial materials has diminished - an inappropriate consequence upon the alluvial forests and after 20–30 years the process of rarefaction could not regenerate because of the dense vegetation layer; gradually, poplar and willow get seared under the attack of different species of fungus and pest; alluvial forest ecosystems convert into sparsness grass land and, then, into lower floodplain lawns ecosystems.

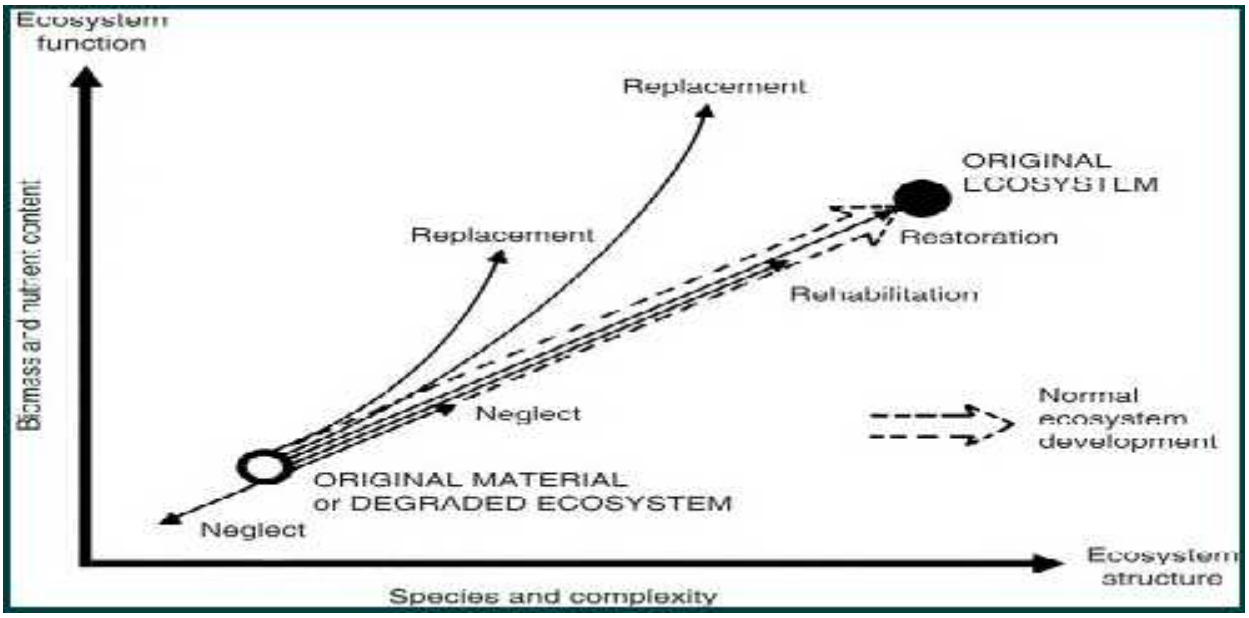
Riparian forests are complex and dynamic ecosystems that depend on flood pulses for primary productivity, biodiversity and functioning. River dynamics affect the architecture, the species and habitat distribution, the nutrient cycling of all forest communities living in floodplains, in close relation with the frequency, the duration and the kinetic energy of surface waters, the annual amplitudes of the groundwater, and the porosity of the substrates.

Softwoods, hardwoods and white poplars may be connected by successive stages in a number of cases, in function of environmental gradients and river processes. Salix bush communities colonize the most dynamic parts of the river and the islets.

All these communities may coexist at small scales. On the edges of the floodplain, where floods are not very dynamic, forest composition changes: alder colonizes old channels while ash-alder distributes on more elevated terraces.

The ecosystem metamorphosis cycle is controlled and conducted by new floods and siltings which cover the land with the alluvial material recreating the appropriate environment conditions for alluvial forest ecosystems (Frontier et al., 2004**)**.

This could be resumed as a short description of Danube floodplain ecosystem dynamics which had been directly affected by channel regularization, interruption of longitudinal connectivity of Danubian hydrosystem as Bradshaw modeled the relation between structure and function of ecosystems (Fig. 3).



3: Relation between ecosystem structure and function – Bradshaw mode.

The hydrological characteristics of the riverine terrains as duration and frequency for floods, speed and type of flowing of flood waters, the level of phreatics, all considered as stational factors that highly condition the distribution and vitality of forest's species from lower Danube fluvial corridor. Disturbances, such as periodic flooding, play major roles in the development of vegetation patterns in alluvial botomlands (Johnson et al., 1985; Day et al., 1988; Kirkman and Sharitz, 1994) and control some plant communities that persist in dynamic equilibrium (e.g. Hack and Goodlett, 1960; Pickett, 1980; Osterkamp et al., 1995; Hack and Goodlett, 1960; Pickett, 1980; Osterkamp et al., 1995) with no temporal loss of species compositional integrity.

The distribution of forest ecosystems is connected with the spatial development degree of the floodplain; the embankments from longitudinal profile of the river had limited the intensity of periodical floods and thus the hydrosystem equilibrium was affected, restraining floodplain extention and its riverine habitats typology.

In this study it was made reference only to the relation between plant communities and the hydrological factor and for this study it was neglected the other component of the biota: the fauna. Major land conversion with agricultural new destinations of the flooded terrains generated major modifications in population's structure and specific fauna distribution within floodplain's geographical space. An interesting and well-documented article "Vânatul şi pădurile de luncă" (Paşcovschi, 1968) stated about alluvial forests from the fluvial corridor (main stream and the secondary or tributaries of Danube) constitutes a "*complex of specific interrelated biotopes and the ecological factor with the higest impact upon them is periodical flooding*". For large mammals and other terrestrial species high water level means a real threat to population communities especially during the reproduction period, and thus the alluvial forests do not represent a proper habitat for terrestrial species during the high floods, only after the water withdrawal moment. High spring floods of Danube (2006) had a high impact, reorganizing the plant communities and the structure of population and represented a threat also for birds, destroying nests places situated on soil or on the fluvial bars, islets which are partly destroyed or remodeled by the river active force during the flooding period; Bistreț Lake 2006 spring flood situation (Fig. 4a, b).

Figure 4a: Bistreț Lake – spring floods 2006 and vegetation changes in lake's ecosystem.

Figure 4b: Bistreț Lake – spring floods 2006 and vegetation changes in lake's ecosystem.

CONCLUSIONS

Variability in natural systems has been recognized as a valuable characteristic, resulting in species richness and biodiversity.

On the other hand, hydrology has been stated as one of the most important driving variables that shape landscapes and habitats at several scales.

Such variability, however, has been barely quantified and related to the assumed ecological benefits. Patterns of high and low flows are essential for ecological sustainability and biodiversity.

Natural ecosystems such as forests and wetlands play a valuable role in managing the hydrological cycle.

ACKNOWLEDGEMENTS

I would like to thank to Mrs. Pătroescu for her advices.

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ANTHROPOGENIC CHANGES IN THE GEOMORPHOLOGICAL SYSTEM. A CASE STUDY: SIBIU DEPRESSION (SIBIU–TĂLMACIU SECTOR), TRANSYLVANIA, ROMANIA

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KEYWORDS: Sibiu Depression, anthropogenic changes, geomorphological risk.

ABSTRACT

The paper presents the disfunctions of the geomorphological system induced by anthropogenic changes to the landscape of the Sibiu Depression. There are a number of natural and anthropogenic processes given its natural conditions, resources exploitation, land use, transport infrastructure and other human activities. The territorial evolution of urban and rural settlement, the concentration of industrial enterprises and road traffic has led to a high level of dysfunctions at the geomorphological level. The intensity and regularity of current reshaping processes, as well as their diversity, has led to an extremely varied range of geomorphological risk phenomena. This is exaggerated by hydro-climatic stress and especially by anthropogenic change against a convenient geological background (clays, marls, sands, etc.). The alluvial plains and riverbeds are subject to water and sediment discharge transit, which leads to alluviation and clogging processes or to floods. Accelerated modelling processes on slopes are associated with: pluvial denudation, mass gravitational dislodgements, clay exploitation, traffic stress, etc., which confer to the relief a very high geomorphological risk potential.

REZUMAT: Modificări antropice în sistemul geomorfologic. Studiu de caz: Depresiunea Sibiului (sectorul Sibiu–Tălmaciu).

Acest studiu prezintă disfuncţiile de ordin geomorfologic induse de modificările antropice în peisajul Depresiunii Sibiului. Evoluţia teritorială a aşezărilor urbane şi rurale, concentrarea spaţiilor industriale şi a traficului pe căi de comunicaţie au determinat o serie de modificări la nivel geomorfologic. Intensitatea şi regularitatea proceselor actuale de modelare, precum şi diversitatea lor, determină o paletă extrem de variată de fenomene de risc geomorfologic. Acesta este amplificat de stresul hidro-climatic şi în special de modificările antropice pe un fond geologic favorabil (argile, marne, nisipuri, etc.). Şesul aluvial şi albiile râurilor sunt afectate de procesele de transport şi descărcare de aluviuni, care determină revărsări aluvionare sau inundaţii. Acestea se asociază cu o modelare accelerată a versanţilor prin procese asociate pluviodenudării şi procese gravitaţionale. Exploatarea argilelor, stresul exercitat de trafic şi expansiunea edilitară conferă reliefului un potenţial de risc foarte mare.

ZUSAMMENFASSUNG: Anthropogene Veränderungen in geomorphologischen Systems. Case Study: Depression von Sibiu (Sibiu/Hermannstadt–Tălmaciu Sektor).

Die Studien presenteert geomorfologische dysfunctionalität geïnduceerde bei den menschen in der Landschaft Sibiu Depression. Territoriale Entwicklung der städtischen und ländlichen Siedlungen, Industrie und Verkehr Konzentration auf Verkehrswege führten zu einer breiten Palette von geomorphologischen Veränderungen. Die Intensität und Regelmäßigkeit der aktuellen Prozess-Modellierung und ihre Vielfalt führt zu einer Vielzahl von Phänomenen sehr geomorphologischen Risiko. Dies wird durch Stress hydro-klimatische und anthropogene Veränderungen zu besonders günstigen geologischen Untergrund (Ton, Mergel, Sand, etc.) verstärkt. Alluvialen Ebenen und Flussbetten von Transport-prozessen und Satzauswurf betroffen. Sie verursachen Überschwemmungen, alluvi-alen oder Hochwasser. Sie sind mit beschleunigtem Modellierung der Pisten verbunden. Ausbeutung von Tonen, Verkherstress, der durch den Ausbau der kommunalen Verkehrs ausgeübt und Erleichterung sehr groß potenzielles Risiko.

INTRODUCTION

The Sibiu Depression is one of the most anthropic influenced area, as a result of human settlements development, natural resources exploitation and location in an area of maximum hydrographic and communication routes convergence. The natural conditions are positive factors in the development, socio-human and economic evolution of settlements in the Sibiu Depression and represent, in fact, the factors that have conditioned and guided the anthropic changes historically and presently.

The anthropic changes with historical character from the depression sector between Sibiu and Tălmaciu were, in the beginning, insignificant and had little impact on the Cibin bed and on the slopes, as they followed the geometry of the relief and were made accordingly to the habitat potential of the environmental conditions. Organization and further development of the old settlements had and still has a natural base completed by the geographic location of the depression, respectively of Sibiu city, at the intersection of some important communication routes:

- quasi-horizontal surfaces of the terraces and Cibin meadow, on which the old settlements hearths were organized (Sibiu, Guşteriţa, Turnişor, Şelimbăr, Bungard, Mohu, Veştem, Tălmaciu);
- continental-temperate climate with oceanic influences and insignificant climate risk;
- surface water resources (Cibin River) and rich and high quality groundwater, easy to exploit and providing the long-term necessary consumption;
- varied land of high fertility for agriculture;
- the presence of forest areas in the vicinity, with a role in air refreshing, in pollutants absorption, and in ecological systems revival;
- main road and railroad routes of national and international importance that ensured the connection between settlements, as well as the main connection axis between the historical provinces: Transylvania, Muntenia and Oltenia.

Recent and relatively current changes are significant in the considered depression sector, being imposed by the spatial and functional development of the settlements and, in the particular case of Sibiu city, by the coverage in its influence area of increasingly distant rural settlements.

ANALYSIS CRITERIA

Etymologically speaking, the term anthropic change of a geographic system, regardless of its nature and dimensions, is indicating the transformation action, the change of appearance, form and content of that system. Given the time and space evolution, as well as the multiplicity and the extent of changes in the geographic area of Sibiu Depression, the identification and analysis of anthropic changes have been made based on two criteria: time and diversity.

Given the geosystem depression complexity and the anthropic impact proportions, our analysis especially followed, divided by localization, the geomorphologic subsystem at the eastern limit of Sibiu Depression, in contact with Hârtibaciu Plateau, respectively the subsystem of Cibin meadow and Hârtibaciu Plateau slope in the Sibiu – Tălmaciu sector (Fig. 1). Time criterion has a decisive character and subordinates the diversity of changes criterion; the multitude of forms of anthropic transformation of the geographical area and their extent are the result of the association of physico-geographic and economic factors (agriculture, commerce, industry, transport development, presence of national and European interest communication routes, etc.) and of the propagation in time of the urban influence of Sibiu over the Depression's territory. The analysis is based on direct observations in the field, mapping and also interpretation of topographic maps published at different periods of time.

RESULTS AND DISCUSSIONS

The geomorphologic potentialof Sibiu Depression and anthropic changes occurring in Sibiu and Tălmaciu sector

Located at the northern border of Cindrel and Lotru mountains, Sibiu Depression is characterized by morphometric features (hypsometry, fragmentation, declivity, exposure) and morphological (current geomorphologic processes, slopes and river beds dynamics) that reveal, on one hand, the geological influence (by lithology and structure), and, on the other hand, the current modeling conditions (climate, hydrological regime of drainage, degree of vegetation cover, anthropic intervention on the relief forms, etc.).

In the analyzed sector, the altitudes range from 380 m in Cibin River meadow, at Tălmaciu, to 613 m at Chicera Veştemului, on the slope of Hârtibaciu Plateau, the average altitude being over 450 m (Fig. 1). The 400 m isohypse circumscribes the Cibin River meadow in this sector and insinuates at the base of the structural steep of the plateau. Landscape fragmentation has values that fall within the range 0-0.5 km/km^2 in the Cibin meadow and terraces, and up to 2-2.5 km/km^2 on the slope front. The relief energy also varies depending on the form, with values from 0-10 m on the alluvial plain of Cibin River, to 80-100-140 m at the contact between the meadow and slope front. The slopes have differentiated values on the analyzed sector, from minimum values of 0-3-5° at the level of Cibin bed and major tributaries, to values of 10-15-35°, specific to the structural steep and its basal glacis, up to 60° encountered in the area of clay mining of Guşterița Hill and in the conglomerate area of Tălmaciu. In terms of frequency, the slopes ranging from 10 to 30° are dominant here, values favorable to triggering and manifestation of the pluviodenudation processes and gravitational displacements.

The current landscape dynamic is induced primarily by natural factors: the lithologic and structural contact between the crystalline of the two mountainous units and the sedimentary deposits of the Hârtibaciu Plateau, as well as by the local and allochthonous hydrographic network action, against a background composed of gravels, sands, marls and clays, with harder cores. The slope processes generated by pluvial denudation predominate: surface washing, gully erosion, gullying, torrentiallity (Grecu, 1992, 1997). Erosion, transport and storage processes succeed also along the valleys; allochthonous rivers (Cibin River and Sadu River) with fairly large flows, discharge at the exit from the mountainous area large amounts of materials in the form of alluvial cones or glacises, which were absorbed by the local hydrographic network, with variable flows throughout time, contributing to fragmentation of these accumulative structures and to the degradation of the interfluvial surfaces and slopes by origins retrogressive withdrawing on hydrographic basins of I and II order (Fig. 1).

In main riverbeds, the accumulation on convex banks and erosion of concave banks are developing, the latter having the effect of slopes disruption and triggering of certain slope processes (landslides, collapse). It is the situation of the valleys Seviş, Tocilelor, Cisnădie and Sărăţii, lower order tributaries of the Cibin River in the Sibiu Depression (Sandu, 1998; Costea, 2002). Along the Cibin River valley, between Sibiu and Tălmaciu localities, the meadow is directly governed by the watercourse and slope processes from adjacent areas (plateau slope), where superficial and shallow landslides, dropouts, torrentiallity, gullying, etc., are dominating (Velcea and Costea, 2006).

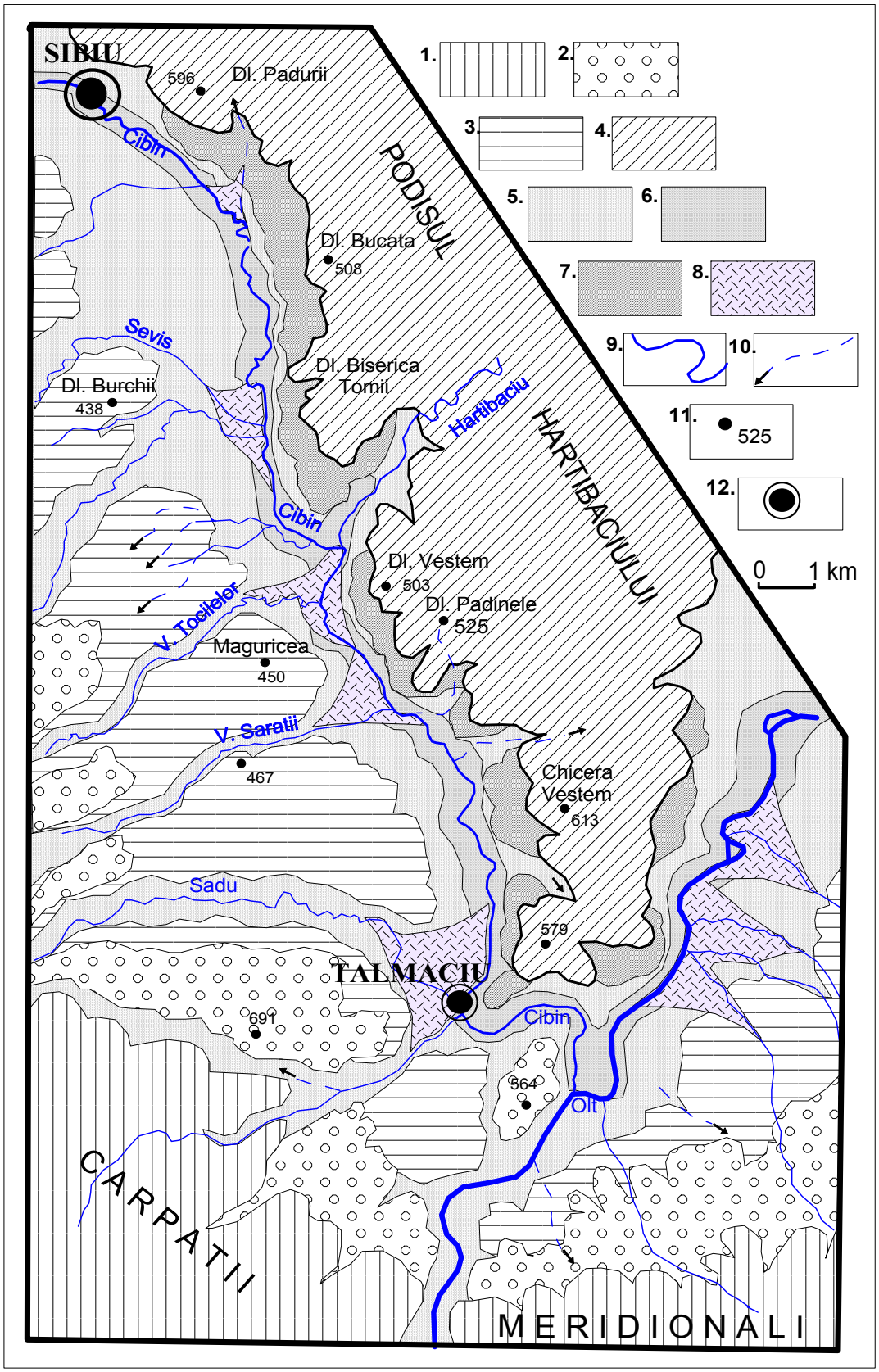

Figure 1: The geomorphologic potential of the eastern sector of Sibiu Depression, between Sibiu and Tălmaciu 1. Mountains; 2. Piedmont hills; 3. Fluvial terraces; 4. Tableland; 5. Cibin and his affluents meadows (alluvial plane) 6. Accumulation area; 7. Landslides glacis; 8. Alluvial fans; 9. Permanent hydrographic network; 10. Temporary hydrographic network with regressive erosion of the spring area; 11. Summits; 12. Urban settlements.

The studied natural factors of morphodynamics are amplified by the anthropic factors, their role in shaping the landscape being much nuanced, closely related with the scale and diversity of the carried out activities. We mention in this regard the agricultural, pastoral and also industrial activities, watercourses embankment, drainage, deforestation, forest plantations, as well as the urban expansion and arrangement of spaces for various social, commercial and leisure needs. Finally, the degree of development of communication routes should be emphasized, which converge to the main economic centers of the depression (Sibiu, Tălmaciu) and establish relations with neighboring regions.

Exploitation of forest resources in the past and a drastic reduction in forest cover at about 20% of the area formerly occupied by forests, has led to the exacerbation of geomorphologic processes, affecting the depression area, especially at the piedmonts and structural steeps level that are bordering the depression in this sector.

Currently, agricultural land abandonment and installation of sheepfolds around springs, leads to soil degradation by nitrification, to surface erosion accentuation and to herbaceous vegetation destruction. The fruit growing areas have been largely abandoned, here low intensity degradations setting up, with damaging potential in long term. The anthropic terraces are shaped by the actual geomorphologic processes that increase in intensity and weaken the productivity of the lands.

Excavations made to extract clay for brick manufacture at Guşterița Hill (Sibiu) (Fig. 2) or for the ring highway development (at Mohu or north of Sibiu, in Şura Mare Hill) (Fig. 3) are circumstances for slopes disruption and cores for accentuation of the processes of gully erosion, gullying, sliding, collapse and degradation of the slopes. The deluvial input due to gravitational processes causes slopes congestion and the formation of a sliding glacis with increased instability at their base. Also, the presence of clays in thick packages and their intensive exploitation for industry or roads construction explains the pronounced slopes morphodynamic and the intake of coluvio-proluvial material from the riverbeds with nonsequent character that fragment the slope.

As for the impact of traffic, is carried on rail and road communication routes, we mention some imbalances related to mechanical stress (compression, landslides, collapse), river embankments destruction, where hydrographic arteries are accompanied or crossed by roads with heavy traffic (over Cibin), by construction of bridge piers (over Cibin and Sadu), acting as obstacles for alluvial deposits inside riverbeds, as well as the undersized bridges and footbridges crossing the hydrographic arteries and over which an intense traffic is in progress (Cisnădie, Sărății, Tocile and Sadu).

The eastern sector of Sibiu Depression, between Sibiu and Tălmaciu is, therefore, a strongly anthropic interfered area, characterized by permanent transfer of information, matter and energy between anthropic components and physico-geographical components of the geosystem, transfer reflected in morphodynamics but also in other physico-geographical components. Material and information flow transit can be balanced or forced – in which case certain parameters are exceeded (thresholds or resistance limits), leading to the transformation of natural and anthropic predisposing factors in risk generating factors (Grecu and Comanescu, 1998). Depending on the rate of expression, the intensity and type of action (combination of natural and anthropic processes), within this contact area we distinguish a series of effects and failures of the systems, which we will illustrate in a synthetic form, studying the case of Cibin meadow (Ielenicz, 1993; Costea, 2006) and Hârtibaciu Plateau slope (Tab. 1).

Figure 2: Cuesta degradation through clay exploitation on Guşterița Hill.

Figure 3a: Slopes morphology changes through excavations
(Biserica Tomii Hill, Mohu).

Figure 3b: Slopes morphology changes through excavations;
(Şura Mare Hill/North of Sibiu).

Table 1: Anthropic changes and their effects on the geosystem in Sibiu-Tălmaciu sector.

	Cibin Meadow	**Hârtibaciu Plateau Slope**
Favorable factors	- main riverbed asymmetry in Sibiu - Tălmaciu sector - sand and Quaternary gravel friable deposits - groundwater near the surface (0.5 - 1 m) - soaking - phreatic appearance to date - arrangement of communication routes (roads, railways) along the major riverbed - agricultural use of the meadow - chemical and mechanical processes on alluvial deposits - location of industrial buildings and households - deposits compaction - bridge feet piers location in the minor riverbed	- petrography - sands, clays, clay-marl deposits and Panonian sand and marl deposits (Guşterița), Sarmatian deposits (Mohu), conglomerates (Tălmaciu) - monoclinal structure - slope front - layer ends attacked by current geomorphologic processes - existence of remodeled pleistocene landslide - pronounced declivities (25 – 45˚) - relief energy 40-80-100-150 m - favorable exposure S – SE, N – NE, influencing the moisture regime from soil and substrate
Actions **-**natural and anthropic processes associations	- moderate erosion in the thalweg - the tendency to install an equilibrium profile demonstrated by thalweg concavity index C = 0.68 (BL – Olt River) C = - 2 x (Hdx - Hdy)/(Ho - Hdy) + 1 where: Ho - initial point altitude Hdy - major confluence altitude that serves as a BL Hdx – the altitude of the point situated at the half-way between the initial point and the BL - lateral erosion of the riverbed concave banks - lateral mobility of the riverbed - banks disruption - accumulation in the convex banks or near bridge piers from minor riverbed - excavations in the minor riverbed for gravel exploitation and swirl erosion activation - mechanical stress in the major riverbed (traffic, buildings congestion) - settlement processes	**Geomorphological processes associated with the quarry exploitation and uncovering** - current geomorphologic processes: landslides taken by gullying and torrentiallity - clays exploitation in industrial system for the brick factory Guşterița – Pădurii Hill - quarrying and stripping Şura Mare Hill - Mohu Hill for the ring road - grazing - animal paths taken by gully erosion and gullying processes - settlement - slopes loaded with construction (district Guşterița, Mohu) **Slope massive deforestation and grubbing** for - the location of settlements - obtaining and expansion of arable land, pastures - the establishment of perennial plantation (Viile Sibiului) - settlements development by urban expansion
Effects	- erosion, transport and riverbed accumulation processes redirection - changes in minor riverbed profile - islands and shore banks accumulation - minor riverbeds obstructing at the passage under bridges/culverts and the emergence of barriers for the solid discharge - occurrence of anthropic landforms - cuts, embankments - meadow overcrowding with facilities and constructions	- cutting groundwater sources and the springs development to date - deposits aeration regime changes - force ratio change (balance and deviation) in cut slope deposits mass - creation of new onset plans for meteorization (wetting - drying, freezing - thawing, chemical action) - taking over surfaces cut by pluvial denudation - oak tree area reduction (Pădurii Hill and isolated in Biserica Tomii Hill and installing secondary grasslands with *Agrostis* and *Festuca)* - area reduction of coppices along Cibin
Dysfuncti-onalities	- banks and slopes local disruption - ring road embankment degradation by the action of washing and gully erosion - increased land compaction - floods - loss of soil fertility - pollution and waste disposal in minor and major riverbeds	- deep degradation of the slopes and interfluves - ravines, trenches and torrential bodies accentuation - suffosion progress to deep erosion - weakened slopes resistance - cracks parallel to the slope line at the upper excavation limit - triggering of new deep landslides and collapses estimated by the Cruden - volume relationship of over 26 cubic meters

The immediate effects and long-term induced dysfunctionalities caused by the anthropic changes that had and still have taken place in the Sibiu Depression, in the Sibiu - Tălmaciu sector, enable us to shape certain risk areas, especially the ones related with geomorphologic risk (Grecu, 1997; Sandu, 1998; Costea, 2007);

- **low to moderate risk areas** – which includes the high stability areas of the high Cibin meadow and terraces, with a relatively low morphodynamic, with settling processes induced by a high anthropic pressure given by habitat and traffic, with average production potential of surface rill erosion processes, gullying terrace tops and glacises;

- **moderate to high risk areas** – which include the Cibin floodable meadow, the lower meadows of its tributaries and the sliding glacis from the base of the slope, with a diverse use (grassland, farms, industrial objectives), frequently associated with moisture excess due to the presence of springs and of near surface groundwater, and directly subjected to the influence of water courses (overflows, floods) and of riverbed and slope processes: accumulations, meander formation, side erosion, disruption and collapse of banks;

high to severe risk areas – comprising the entire area of the western slope of the Hârtibaciu Plateau, between Sibiu and Tălmaciu localities, with reduced stability induced by high slope values and relief energy, with a very active morphodynamic subordinate to mass displacement processes, torrentiality and gullying, and with a high reactivation potential due to high precipitation and the presence of coastal springs, and with severe risk cores caused by industrial exploitation of clays and municipal pressure.

CONCLUSIONS

The anthropic modifications of the Cibin meadow and of the slope of Hârtibaciu Plateau were gradual and directly linked to key moments of the dynamics of Sibiu city as a pole of attraction and socio-economic development. Stages of development and urban-industrial evolution had the immediate effects of a land use change and a reorganization of the functional areas by: expansion of residential area, reducing the industrial area from the city center and relocating it to compact and complex industrial areas in NV, N, E and SE of Sibiu; positioning and extension of existing commercial area at the city extremities; revival at a different scale of the role as a pole of attraction and as a railroad, road and air communication node.

At the same time, however, human modeling of the depression area on the Sibiu - Tălmaciu sector had as side effects the change of morphometric and morphographics features of the relief forms by cutting, leveling or stripping, and a major impact in shaping of certain immediate effects, accelerating the geomorphologic processes in certain areas, and in the acquisition of the hazard character, as well as the generation of certain manifestations with risk character (Tab. 1).

The human intervention also was conducted on the hydrographic network (through corrections, damming, banks establishment, exploitation of construction materials from the riverbed, etc.), on vegetation (massive deforestation, ruderalisation, spontaneous species extinction), on soils (change of productivity by reforming, drainage, etc.), as well as on climatic conditions (by creating new complex and elementary topoclimates).

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EFFECTS OF HEAVY METALS POLLUTION IN A SELECTED ROMANIAN AREA ON THE ACTIVITY OF SOIL INVERTASE

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KEYWORDS: Heavy metals, Soil pollution, Lead, Cadmium, Zinc, Copper, Soil invertase.

ABSTRACT

Heavy metals continue to pose serious problems of environmental pollution. In the present study we investigated the influence of high concentrations of heavy metals (lead, zinc, cadmium, copper) on soil invertase activity from various sites of contaminated soils of a Romanian area with a strong history of non-ferrous metallurgical industry development. Lead (48.60–790 mg/kg dry matter) and zinc (110.25–1019.00 mg/kg dry matter) were predominant in all the samples analyzed. Our results showed lower invertase activity in heavy metal-contaminated soils compared to that of a control soil sample. Soil samples with maximum values recorded for lead (790 mg/kg) and cadmium (22.50 mg/kg) showed the lowest invertase activity (6.54 µg glucose/g fresh soil/h), while a control sample from a non-polluted area showed high enzymatic activity correlated with low values of concentrations of heavy metals. A set of four regression equations was obtained, which describe the relationship between enzyme activity and heavy metals contamination. The strongest inhibitory effect was recorded for cadmium. The results obtained demonstrate that a high level of heavy metals has adversely affected the activity of soil invertase.

REZUMAT: Efectele poluării cu metale grele într-o arie selectată din România, asupra activității invertazice din sol.

Metalele grele continuă să pună probleme grave de poluare a mediului. În studiul de față, am investigat influența concentrației de metale grele (plumb, zinc, cadmiu şi cupru) asupra activității invertazice din sol, din diverse locații cu soluri contaminate dintr-o zonă din România, cu istorie în dezvoltarea industriei metalurgice neferoase. Pb (48.60–790 mg/kg materie uscată) şi Zn (110.25–1.019 mg/kg materie uscată) au fost predominante în toate probele analizate. Rezultatele noastre au arătat o activitate invertazică mai mică în solurile contaminate cu metale grele, în comparație cu activitatea invertazică din proba de control. Probele de sol cu valori maxime înregistrate pentru plumb (790 mg/kg) şi cadmiu (22.50 mg/kg) au arătat cea mai mică activitate invertazică (6.54 µg glucoză/g sol proaspăt/h), în timp ce proba de control provenită din zona nepoluată a arătat un nivel ridicat de activitate enzimatică corelat cu valori scăzute ale concentrațiilor de metale grele. A fost obținut un set de patru ecuații de regresie, care descriu relația între activitatea invertazică şi contaminarea cu metale grele. Un efect puternic inhibitor a fost înregistrat pentru cadmiu. Rezultatele obținute demonstrează că nivelul ridicat de metale grele, a afectat negativ activitatea invertazică din sol.

RÉSUMÉ: Les effets de la pollution à métaux lourds sur une surface sélectionnée en Roumaine sur l'activité de l'invertase dans le sol.

Les métaux lourds continuent à poser des graves problèmes de pollution de l'environnement. Dans l'étude présente nous avons investigué l'influence de la concentration des métaux lourds (plomb, zinc, cadmium et cuivre) sur l'activité de l'invertase dans le sol dans plusieurs sites à sols contaminés d'une région de Roumanie ayant développé dans le passé l'industrie métallurgique non ferreuses. Le Pb (48.60–790 mg/kg matière sèche) et le Zn (110.25–1.019 mg/kg matière sèche) ont prédominé dans toutes les échantillons analysés. Nos résultats ont montré une activité de l'invertase plus faible dans les sols contaminés avec des métaux lourds, par comparaison à l'activité de l'invertase de l'échantillon témoin. Les échantillons de sol à valeurs maximales enregistrées pour le plomb (790 mg/kg) et de cadmium (22.50 mg/kg) ont eu la plus faible activité de l'invertase (6.54 µg glucose/g sol frais/h), pendant que l'échantillon de control provenu de la zone non polluée a montré un niveau élevé d'activité enzymatique corrélé à des valeurs plus faibles des concentrations de métaux lourds. Un set de quatre équations de régression ont été obtenues, décrivant la relation entre l'activité de l'invertase et la contamination à métaux lourds. Un fort effet inhibiteur a été enregistré pour le cadmium. Les résultats obtenus montrent que le niveau élevé des métaux lourds a affecté de manière négative l'activité de l'invertase dans le sol.

INTRODUCTION

Currently, soils becoming more polluted related to the great variety of compounds used in agricultural and industrial practice. It was shown that the type of predominant activities in any given region determined the type of contamination in that area (Oliveira and Pampulha, 2006; Lee et al., 2002; Konopka et al., 1999).

Regarding the contamination with heavy metals, the most commonly encountered heavy metals include Pb, Cd, Zn, Hg and As. These heavy metals represent a serious human health hazard. In humans, most exposure to high level of heavy metals occurs as a result of occupational hazards in heavy metal-related industries. But these extensive human activities may have great negative impact on the environment, including soil, air and water.

The indicators for soil quality are chemical, physical and biological. Regarding the biological indicators for soil quality, the most common types are those related to microbial biomass (content, composition and diversity), microbial activity (respiration), and enzymatic activity.

In soils, the source of enzymes is represented by soil microorganisms, plants and animals. The largest amounts of enzymes are provided by microorganisms due to their high biomass, rapid metabolism and short life cycle under favorable conditions (Speir and Ross, 1978). Soil enzymes are partly fixed, being adsorbed on clay or humic colloids (Makoi and Ndakidemi, 2008). In soil solution, enzymes have a short period of existence, consequently their activity is reduced (Burns, 1981).

Oxidoreductases, transferases and hydrolases, have been the most studied enzymes in soil due to their role in the oxidation and release of inorganic nutrients from organic compounds (Ladd, 1978).

Although the study of enzymes began a few decades ago, we still have a rudimentary understanding of the factors that control the production of enzymes and their activity in natural conditions. This fact greatly limits the ability to interpret the enzyme activities in the context of ecosystems. To better understand this issue, in-depth studies are needed to elucidate the intimate mechanisms of enzyme activity in terrestrial and aquatic ecosystems.

A better understanding of the role of chemical, biological, physical and agronomic factors that influence the functions of soil enzymes, will further define the importance of these enzymes in soil processes and allow the introduction of appropriate management techniques to maximize the benefits that can be gained from such enzymes (Makoi and Ndakidemi, 2008).

As bioindicators they are the most sensitive ones to environmental variations and can record long-term effects of pollution, our objective of the present study was aimed at elucidating the relationship between invertase activity and high concentration of heavy metals in polluted soils from Romanian area. Final purpose of the investigation is to find new bioindicators for the soil quality characterization, with possible applications in monitoring and management of soils.

MATERIALS AND METHODS

Soils indicated as samples 1–8 were taken from different sites of Copşa Mică area/Romania (Fig. 1), as follows: Slimnic (pasture as control soil sample), Prombat, Copşa Mică–Micăsasa (cornfield), Copşa Mică–Micăsasa (pasture), county border with Alba County, Copşa Mică (town hall), Copşa Mică (town) and Valea Viilor (agricultural land). Sampling depth was 0–20 cm. Sampling locations were chosen in relation with the nature of pollution sources and pollutants (development of non-ferrous metallurgical industry in the chosen area), the degree of uniformity of the landscape and the characteristics of dominant soil types. Selection of pollution points was made in relation to distance from pollution source (0.5-1.0-2.0-4.0-7.0 km) in different directions depending on the dispersion of pollutants.

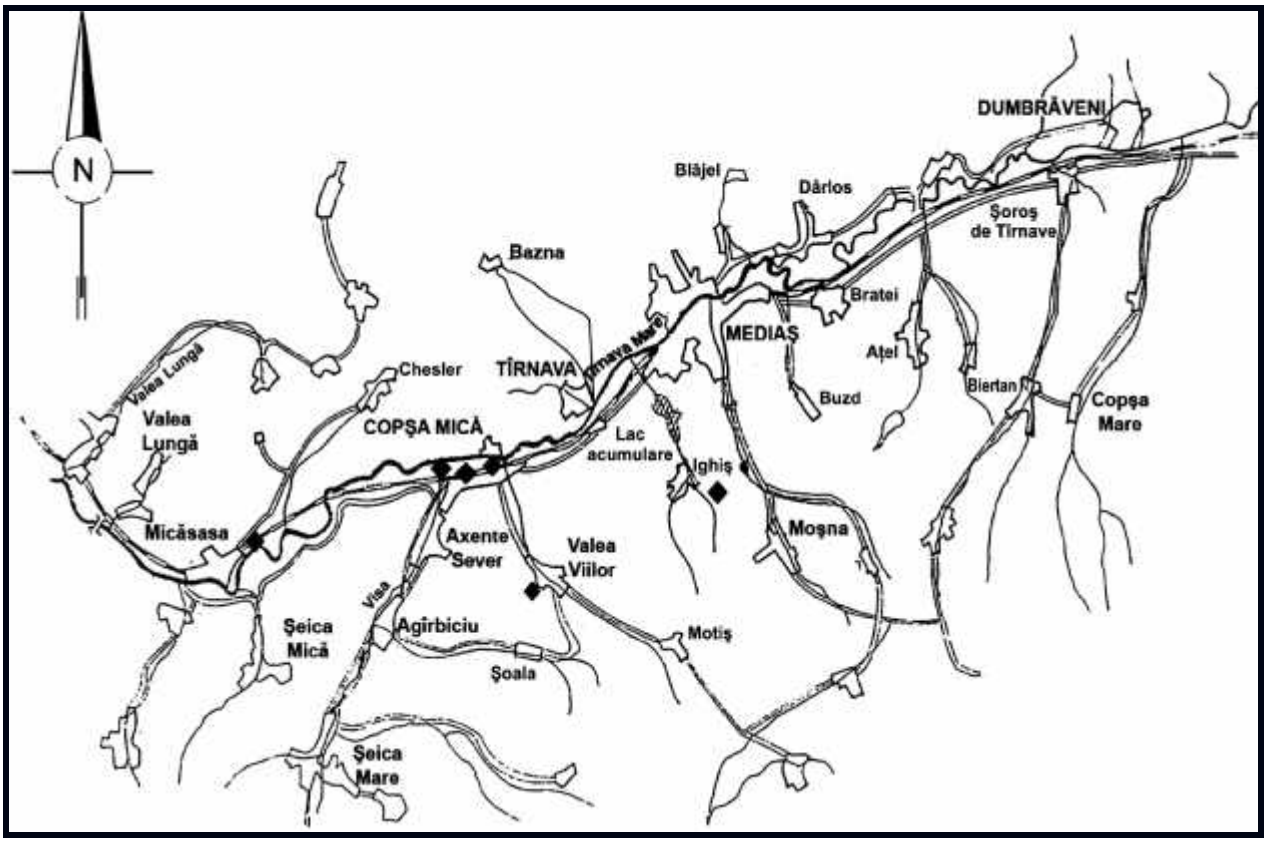

Figure 1: Map of soil sampling sites, Copşa Mică, Romania
(adapted from "*Lucian Blaga*" University of Sibiu Report, 2006).

Sampling procedure was performed by the Environmental Protection Agency of Sibiu/Romania, according to General Procedure PG-18 (Order no. 756/1997 MAPPM).

Samples were sieved (0.5 mm) and stored at 4°C before analysis. pH was determined in a distilled water soil suspension according to standard analytical methods.

Determination of heavy metals concentration

After preliminary preparation and digestion, soil samples were analyzed for total and mobile heavy metals using Atomic Absorption Spectrophotometric (AAS) method, at the Laboratory for physical-chemical analysis of the Environmental Protection Agency of Sibiu/Romania.

Assay of invertase activity

Activity assay was performed in the presence of toluene. Inverstase activity was determined as described by Mishra et al. (1979). 3 g of fresh soil was mixed with 6 ml of 5% saccharose solution and 6 ml Sorensen buffer pH 5.4. The mixture was incubated for 22 hours at 30°C under continuous stirring. After incubation, the reaction mixture was centrifuged at 3500 rpm for 10 minutes. The concentration of sugars after saccharose hydrolysis in supernatants was determined by 3.5-dinitrosalicylic acid reagent (DNS). The obtained solutions were heated in boiling water bath for 5 minutes. After dilution, the absorbance at 540 nm was measured using the CE 1021 spectrophotometer (Cecil Instruments Limited). Enzyme activity was expressed as µg glucose/g fresh soil/h.

All experiments were performed in duplicate.

Statistics

For the mathematical modeling of obtained data, regression analysis was used. (STATISTICA software). The significance was determined with t-student test to a level of significance $\alpha = 0.02$ (Sîrbu and Benedek, 2004).

RESULTS AND DISCUSSIONS

The content of some heavy metals (Pb, Cd, Zn and Cu) from the investigated soil samples are presented in the table number 1. The results showed a variation of the level of heavy metals based on the location of sampling, inside the polluted area. Sample 1, which was considered the control sample has the lowest concentration of heavy metals, while samples 6 and 7, taken from the town Copşa Mică recorded the highest concentrations.

Table 1: pH and concentrations of Pb, CD, Zn and Cu (mg/kg dry matter) of the investigated soil samples.

Soil samples	Soil depth (cm)	pH	Heavy metals			
			Pb (mg/kg)	Cd (mg/kg)	Zn (mg/kg)	Cu (mg/kg)
1	0–20	8.10	45.70	0.00	0.15	0.38
2	0–20	7.60	363.00	7.70	178.25	18.85
3	0–20	7.80	253.00	11.00	425.00	34.95
4	0–20	7.41	364.00	8.48	476.50	20.13
5	0–20	8.07	74.50	3.05	110.25	9.92
6	0–20	6.87	790.00	22.50	1012.50	71.73
7	0–20	7.09	638.00	13.10	1019.00	159.10
8	0–20	7.44	48.60	2.64	133.75	9.99

As shown in the table number 1, Pb (48.60–790 mg/kg dry matter) and Zn (110.25–1019.00 mg/kg dry matter) are predominant in all analyzed samples. Lower concentrations are recorded for cadmium and copper, in all samples. Regarding sample 1, there was no cadmium present, while zinc and copper were found in very small amounts.

Soil invertase activity in the various analyzed samples is shown in the table number 2.

Data from the results presented in the table number 2 show a significant variation in the value of the eight samples regarding the invertase activity. As expected, the greatest enzyme activity was recorded for sample 1 (45.39 µg glucose/g fresh soil/h) which was taken from a pasture near Slimnic area (situated at about 30 km from the polluted area Copşa Mică).

The high invertase activity provided evidence of an increased soil microbial population. The lowest enzyme activity was recorded for sample 6 (6.54 µg glucose/g fresh soil/h) which was taken near Copşa Mică City hall.

Table 2: Soil invertase activity in the investigated samples.

Soils samples	Invertase activity (µg glucose/g freshsoil/h)
1	45.39
2	13.93
3	9.78
4	8.33
5	15.15
6	6.54
7	12.42
8	24.33

The two extreme values were correlated with data presented in the table number 1, which summarizes the concentrations of heavy metals in the investigated samples. Soil samples with maximum values recorded for lead (790 mg/kg) and cadmium (22.50 mg/kg) showed the lowest invertase activity (6.54 µg glucose/g fresh soil/h), while sample 1 coming from non-polluted area showed high enzymatic activity correlated with low values of concentrations of heavy metals.

These data suggest an inverse correlation between concentration of heavy metals and soil invertase activity. Due to the complex nature of relationships between the enzymes and the physicochemical and biological properties of soil, there exist many variables that influence soil processes. A very important variable that should be taken into account in analyzing the relationship between heavy metal pollution and invertase activity is soil reaction. Enzymes are particularly sensitive to soil pH. Also, bioavailability of heavy metals in soil is influenced by pH. In terms of mobility and bioavailability of heavy metals, of particular interest is the cation exchange capacity, which was shown to be correlated to the nature and type of soil, the amount of clay that exists as well as soil particle surface area (Barbu and Sand, 2004).

We realized a mathematical model of the obtained data, in which regression analysis was used. STATISTICA software was used for selecting and verifying models. The significance was determined with t-student test to a level of significance $\alpha = 0.02$ (Sîrbu and Benedek, 2004). Regression curves and associated equations are shown in the figures 2-5

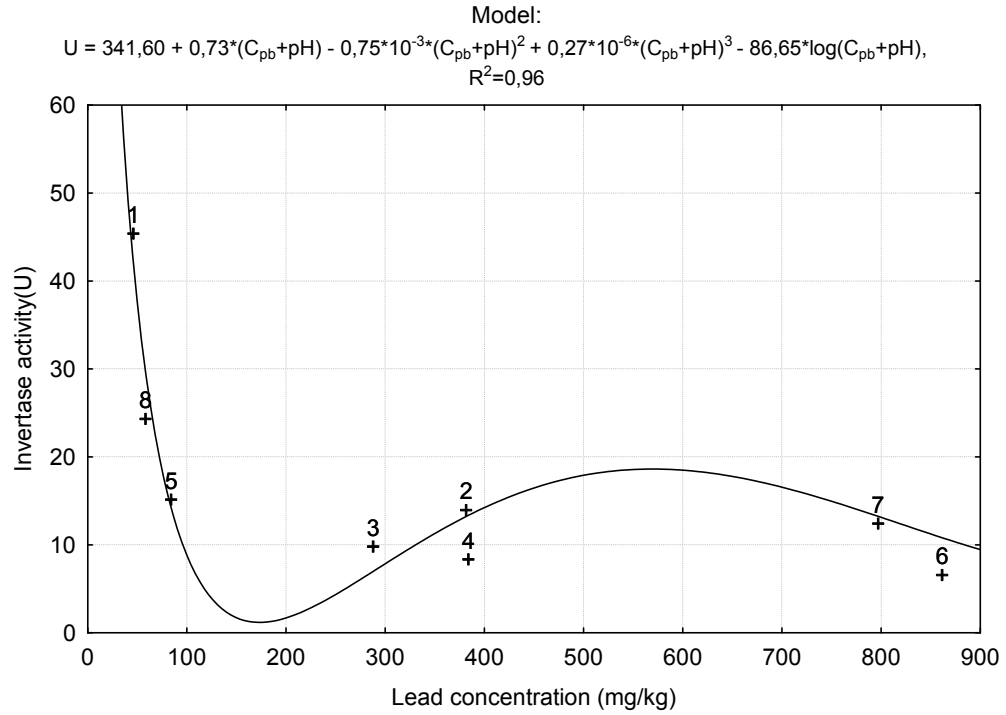

Figure 2: Invertase activity in soil
in relation with the lead concentration and pH.

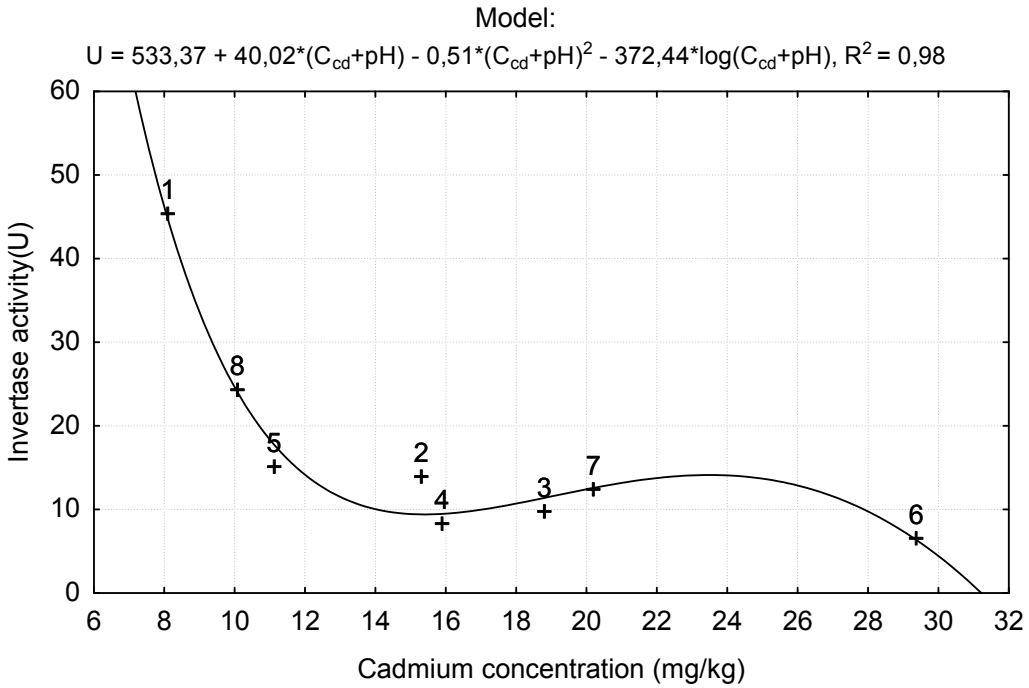

Figure 3: Invertase activity in soil
in relation with the cadmium concentration and pH.

All four regressions indicate a decrease in invertase activity with increasing concentration of heavy metals, confirming our hypothesis that the two variables are in inverse correlation.

The slopes of the four equations show a major decrease in enzyme activity in the region of lower concentration of heavy metals (lead, cadmium, zinc and copper) and a relatively slow decrease after a certain concentration.

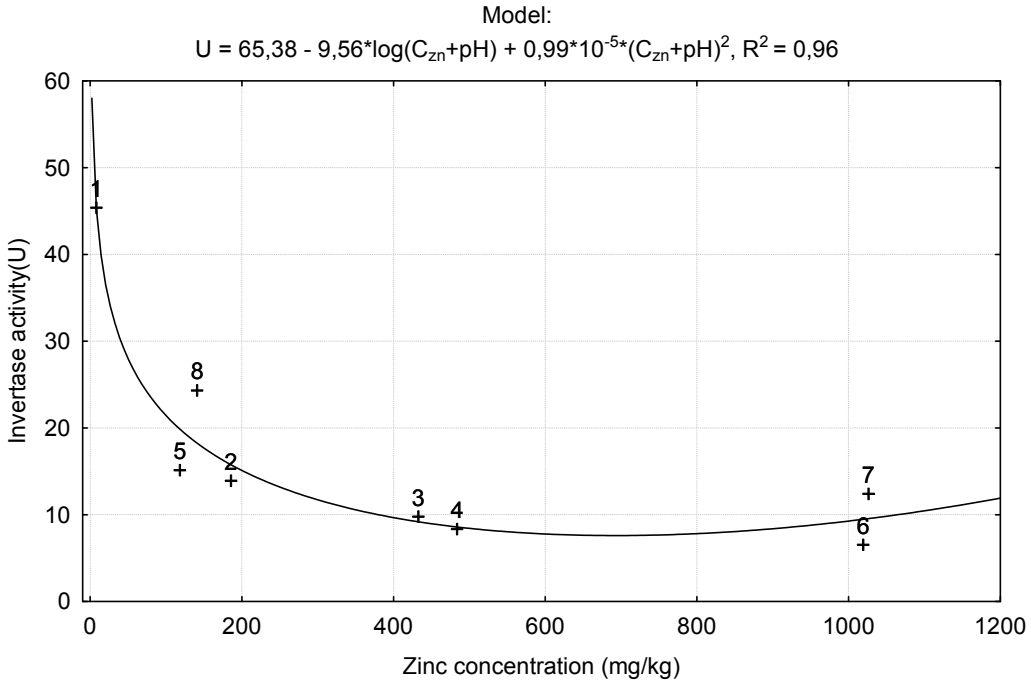

Figure 4: Invertase activity in soil
in relation with the zinc concentration and pH.

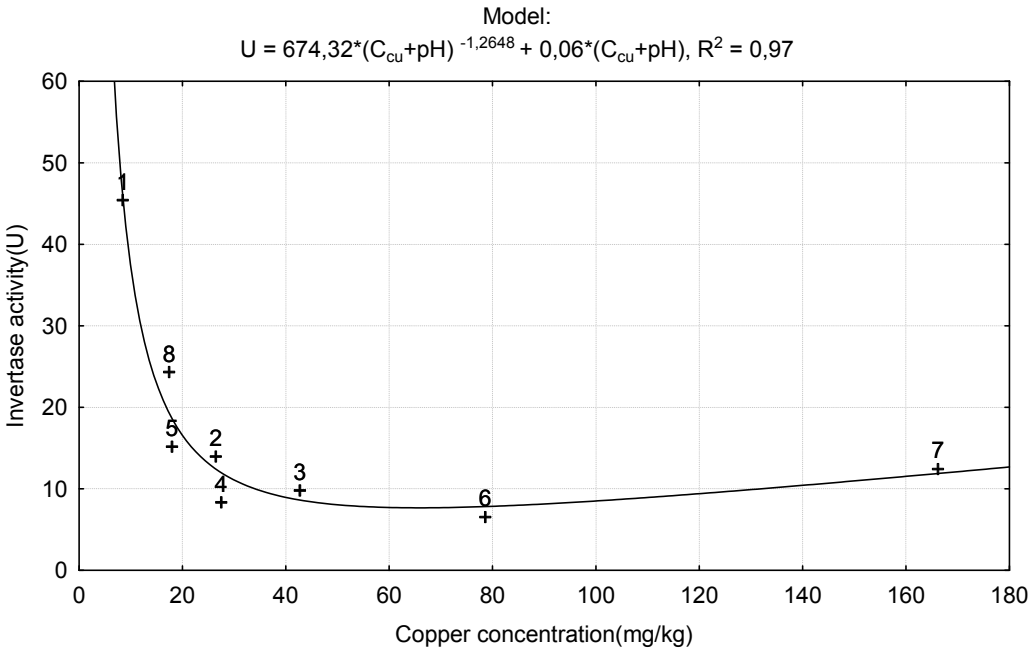

Figure 5: Invertase activity in the soil
in relation with the copper concentration and pH.

The presence of inflection points and variable slopes in the regression curve indicates a nonlinear relationship. These observations confirm our hypothesis that the relationship between invertase activity and heavy metal concentration is nonlinear.

Taking into account the indices that show the degree of matching between the theoretical model and the observed values (R^2 value), we can state that pH affects the activity of the investigated heavy metals in this study.

Lead activity is influenced by soil pH to a greater extent than other heavy metals. In soil it is mainly present as phosphate compounds like $Pb_5(PO_4)_3OH$, $Pb_3(PO_4)_2$ and $Pb_5(PO_4)_3Cl$. The last form is the most insoluble of phosphates and can control the solubility of Pb^{2+} ions in a wide range of pH values, especially in soils with high phosphorus content (Luduşan, 2007).

Although the cadmium concentration in soil is relatively small compared to the other heavy metals, there is a correlation coefficient $R^2 = 0.98$ between cadmium and invertase activity when taking into account soil pH. This indicates a strong inhibitory effect of cadmium on invertase and can be used to detect this metal in an early stage of contamination.

Similarly, Shuqing et al. (2007) found in their studies regarding soil enzymatic activities, a decreased activity of phosphatase, urease and catalase by 74%, 22% and 23% in conditions of cadmium pollution. Phosphatase was found the most sensitive to cadmium of the enzymes.

Copper ions can cause changes in the active center of invertase and urease structure, thus they can decrease the levels of invertase and urease and inhibition of decomposition of both sugar and urea. This mechanism of suppression may be related to the formation of complex compounds between copper ions and sulfhydryl and imidazolyl groups from invertase and urease (Fu and Yang, 2007). Other studies demonstrated that silver ions attach to the histidine residues of the enzyme and consequently inactivates invertase (Van den Ende and Van Laere, 1995).

In a Bulgarian study regarding short-term and long-term exposure to copper and zinc in microcosm experiments, workers evaluated the rate of inhibition on different enzymes activities, and found that copper proved to be more toxic than zinc (Kenarova and Radeva, 2010). In this investigation, among enzyme activities, invertase proved to be less sensitive than dehydrogenase, phosphatase and amylase. Authors did not find any significant correlation between metal concentrations and the rate of enzymes' inhibition. The models described in this paper are statistical, and they can not be generalized to other systems being valid only to describe the relationship between the variables studied in the present investigation. For future application of the described statistical model regarding monitoring and land management, description of similar patterns for each case may be needed. Equations can be used in both directions, the approximate concentration of heavy metals depending on the enzyme activity, and vice versa.

CONCLUSIONS

The following conclusion can be drawn from the investigation conducted on samples of soil contaminated with heavy metals from Copşa Mică area in Romania:

1. Invertase proved to be sensitive to increased concentrations of heavy metals (lead, cadmium, zinc and copper) in soil and can provide quantitative and qualitative information on the pollution with these metals;

2. Inhibitory action of heavy metals is carried out differently, cadmium having the strongest inhibitory activity. Lead showed to be more strongly influenced by pH;

3. There is an inverse correlation between invertase activity and heavy metals concentrations studied in this paper. This relationship is nonlinear and can be described mathematically by a set of

nonlinear equations; at lower concentrations of heavy metals, invertase activity shows large variations, and after a certain threshold heavy metals concentration affects invertase activity in a smaller extent; equations describing this relationship can be applied only in this particular case;

Being given that the inhibitory action of heavy metals on enzymes takes place at a chemical level by altering the protein structure of enzymes, the model may indicate a direction of research for the discovery of a deterministic model that can be applied to all systems.

ACKNOWLEDGEMENTS

We acknowledge the Laboratory of Physical-Chemical Analysis of the Environmental Protection Agency of Sibiu, Romania, who provided soil samples of determined heavy metals concentration.

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NEW CONSIDERATIONS REGARDING THE GENUS *CENTAUREA* L. FROM TRANSYLVANIA (ROMANIA)

Ghizela VONICA [1]

KEYWORDS: Romania, Transylvania, *Centaurea* L. 1737 species, taxonomic studies, critical species, morphological differences, involucral bracts.

ABSTRACT

The genus *Centaurea* is one of the most complicated genera because it shows a great morphological diversity. For this reason, in Romania it has been little studied in the scientific literature. This paper presents the species of the genus *Centaurea* that grows in the Transylvania area. The study includes some morphological observations of *Centaurea* species from Transylvania and the description of some critical species from this area. The observations were made on voucher specimens (accepted species and their synonyms) of the Herbaria of the Natural History Museum, Sibiu, and some other species were observed in the field. This study compared the characteristics of the involucral bracts, inflorescences and achene features, with keys to determine the principal species of *Centaurea*. Some critical species were compared with species collected from the Transylvania area in the years 2010 and 2011.

REZUMAT: Noi considerații, privind genul *Centaurea* din Transilvania (România).

Genul *Centaurea* este unul dintre cele mai complicate genuri ale familiei *Compositae* (*Asteraceae*) deoarece prezintă o mare diversitate morfologică. Acest gen a fost mai puțin abordat în România în literatura de specialitate. Inventarul speciilor de *Centaurea* din Transilvania este redat prin observații morfologice ale acestora, dar şi descrierea speciilor critice din această zonă. Studiile au fost făcute pe materialul herborizat (taxoni acceptați şi siononimiile acestora) al Muzeului de Istorie Naturală din Sibiu, iar acestea au fost completate cu date din teren. Acest studiu s-a bazat pe compararea câtorva caracteristici ale speciilor de *Centaurea*, în special foliolele bracteale din componența inflorescențelor şi forma achenelor, fiind considerate la majoritatea speciilor principalele chei de determinare. Comparările s-au făcut şi pe material colectat în cadrul cercetărilor din teren, în anii 2010–2011.

ZUSAMMENFASSUNG: Neue Forschungen zur Gattung *Centaurea* in Transilvanien, (Rumänien).

Die Gattung *Centaurea* ist eine der umfangreichsten Gattungen der Familie *Compositae* (*Asteraceae*). Es gibt eine grosse Bandbreite in der Erscheinung und Vielfalt. Darin kann auch die Ursache liegen, da die Gattung *Centaurea* in der wissenschaftlichen Arbeit in Rumänien wenig untersucht worden ist. Die vorliegende Arbeit konzentriert sich auf die Arten der Gattung *Centaurea*, die im Becken Siebenbürgens vorkommen. Die Arbeit zeigt einige Erscheinungsformen von *Centaurea* Arten und beschreibt einige besondere Arten in diesen Gebiet. Unsere Beobachtungen beruhen einmal auf den im Museum vorhandenen Exemplaren und auf der direkten Beobachtung einiger Arten in diesem Gebiet. Dabei wurden mehrere Merkmale der Arten von *Centaurea* miteinander verglichen Flugblätter, Hüllblätter, Struktur und Form des Blütenstandes. Auf dieser Weise wurden die wichtigsten Arten bestimmt. Einige besondere Arten wurden darüber hinaus mit den Arten verglichen die in Siebenbürgen in den Jahren 2010–2011 gesammelt wurden.

INTRODUCTION

Centaurea is a large genus with a tital of nearly 250 species that belongs to the tribe *Cardueae*, one of the largest in the *Compositae* (Susanna Garcia-Jacas et al., 2007, 2009).

This genus is one of the most complicated one because it shows great morphological diversity and the species can easy hybridize (Pétit et al., 2001; Vonica and Cantor, 2011b). The biggest and the most important problem of this genus on the Romanian national territory is the ambigous determination and also the taxonomy, which has been changed several times over the years (Greuter et al., 2001; Vonica and Cantor, 2011a). However, more recent molecular analyses of the genus and of subtribe *Centaureinae*, together with studies of morphology, pollen type, karyology and biogeography have enabled the natural limits of *Centaurea* to be established with greater confidence (Garcia-Jacas et al., 2000, 2001, 2006; Greuter, 2003; Susanna et al., 1995; Wagenitz and Hellwig, 1996).

After this scientific revision, *Centaurea* genera from Romanian flora reduces considerably, which counted 168 species and many subspecies in older classifications (Prodan, 1930; Nyárády and Prodan, 1964). Today, flora of Romania recognized only 54 species, without hybrids (Ciocârlan, 2009). The present paper related part of these species, from Transylvania with a short description of involucral bracts and some traits of achenaes.

MATERIALS AND METHODS

The study of the *Centaurea* genus species systematics was made from the morphological point of view, taking in consideration other observations of European sinathorologists. The paper is a comparative morphological approach, including investigation of involucral bracts and achenaes morphology studies.

The species of *Centaurea* from Transylvania (Romania) were grouped based on characters of bracts, pappus, cypsela and corolla of marginal flowers proved to be useful in systematical delimitation (Hellwig, 2004; Özler, 2009; Wagenitz, 1955). Where the delimitation was extremely difficult due to hybridization and introgression form, the species were treated like a group or an aggregate (Ochsmann, 2000, 2001; Garcia-Jacas, 2000, 2001; Koutecký, 2007, 2009). The observations were made on vauchers specimens that can be found in the Natural History Museum Herbarium from Sibiu, but also in the field. We checked 1360 herbarium samples (species, hybrids and their synonims) of *Centaurea* from Nyárády Herbarium. For the research observation measurements on the bracts involucres of the *Centaurea* inflorescence were made. In the field observations were made on the *Centaurea atropurpurea* populations from Cheile Turzii (CJ), Făget Forest (CJ), Roşia de Secaş (AB); *C. orientalis* L. from xero-mesophytic meadows of Bărcuț (BV); *C. scabiosa* L. populations from Zackel Hill (SB), Loamneş (SB); *C. nervosa*, population from Retezat Mountain; *C. stoebe* group from the Porumbac Valley (SB) and species from *C. phrygia* group from Ocna Sibiului (SB), the Porumbac Valley (SB) and Retezat Mountain. The *Centaurea* species from Transylvania were grouped after subgenus delimitation, *Centaurea* subgenus, *Lopholoma* subgenus and *Cyanus* subgenus. The *Cyanus* subgenus was kept in this paper because of the results of a recent study at molecular level showing that *Cyanus* is sensu stricto related to other species from genus *Centaurea*.

RESULTS AND DISCUSSIONS

Taxonomic complexity of *Centaurea* genus arises from the morphological, karyological and pollen diversity (Susanna et al., 1995; Wagenitz and Hellwig, 1996). Nearly 300 species of the genus *Centaurea* are problematic and none of the early attempts to subdivide the genus has been widely accepted (Bremer, 1994; Garcia-Jacas et al., 2006; Sussana and Garcia-Jacas, 2007; Wagenitz and Hellwig, 1996).

From the *Centaurea* subgenus, in Transylvania grows three endemical taxons, different species and their hybryds from *C. stoebe* group., *C. jacea* group, *C. phrygia* group, *Spiny* group and *Cnicus*. *Centaurea stoebe* L., (described in *Sp. pl.: 914, 1753*), 2n (18, 36). (syn. *Centaurea rhenana* Boreau, *Centaurea stoebe* L. pro parte).

This species is part of *C. stoebe* group, because many species hybridize, following by introgression in many cases and taxonomically is very difficult to describe (Ochsmann, 2000, 2001; Vonica and Cantor, 2011a, 2011b). Species with many small capitula which in some cases show synaptospermy. The appendages vary from nearly entire and orbicular to triangular and regular ciliate and they are decurrent. Stems is 30–80 (–100) cm long, corymbosely branched at about the middle. Capitula is solitary, between 12 and 15 mm long and the bracts have a prominent veins on the dorsal surface. The appendages are pale brown to black, with 4–10 fimbria on each site. Pappus is cca. 1–2.5 mm long, or shorter.

Centaurea stoebe subsp. *stoebe*, 2n (18), (**s**yn. C. *maculosa* Lam., *C. rhenana* Boreau). Usually biennial plant with involucre 6.5 x 11 mm, apendages with 6–10 fimbria on the one site. (Ochsmann, 2001; Spaniël, 2008)

In Romania, this species was described as *C. rhenana* Boreau and *C. stoebe* var. *stoebe* (Ciocârlan, 2009; Nyárády and Prodan, 1964; Prodan, 1930). Population of *C. stoebe* subsp. *stoebe* from Porumbac Valley (SB), have a single-stemmed and growths in opened field because it does not support the competition, from field observation and according also with Ochsmann (2000).

Centaurea stoebe subsp. *micranthos* (Gugler) Hayek, 2n (36), (described in *Repert. Spec. Nov. Regni Veg.*, *Beih. 30 (2): 766*, *1931*), (syn. *Centaurea maculosa* Lam. subsp. *micranthos* Gugler, *C. biebersteinii* DC. subsp. *biebersteinii*, *C. biebersteinii* subsp. *australis* (A. Kern.) Dostál, *C. australis* A. Kern., *C. biebersteinii* DC. *C. micranthos* (Griseb.) Hayek, *C. australis* A. Kern) (Euro+Med, 2006; NyH.)

Based on the Euro+Med Database (Euro+Med, 2006), both species, *C. stoebe* subsp. *australis* (Pančić ex A. Kern.) Greuter and *Centaurea stoebe* subsp. *micranthos* (Gugler) Hayek are accepted because their taxonomy are unclear, but Ochsmann (2000) accepted from both just subsp. *micranthos*. In flora of Romania, this subspecies is treated as *C. micranthos* S.G. Gmel ex. Hayek species (Ciocârlan, 2009). The observation on the voucher specimens of this taxon from herbarium, have an involucre ovoid, 11 mm long and 7 mm width, the appendages are mucronate with 4–7 fimbria on the each site (Fig. 1).

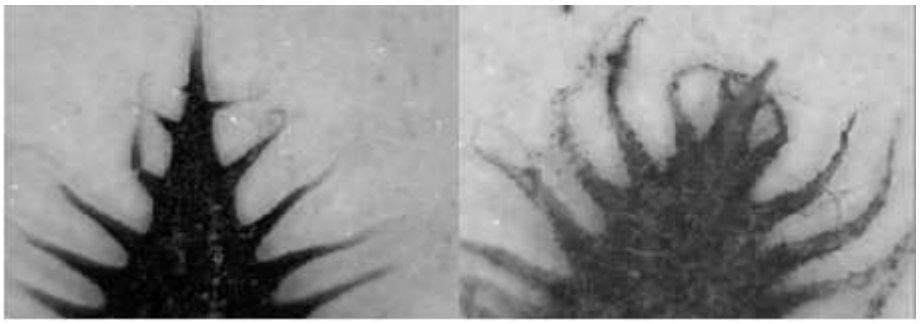

Figure 1: *Centaurea stoebe* subsp. *micranthos* from Nyárády Herbarium, appendages shape (left – inv. no. 115618, right – inv. no. 115630).

According to other florists, an important difference between the two monocarpic, and tetraploids polycarpic. Both subpecies have differences in the life cycle, the number of florets, the shape of capitula, and the shape of young rosette leaves were the best discriminant characters. Diploids produced significantly more seeds per capitulum and had more capitula per plant than tetraploids. In contrast, the vast majority of European tetraploids continued to flower in both seasons by regenerating from multiple secondary rosettes, demonstrating a predominantly polycarpic life cycle. On the other way, it was observed that subsp. *stoebe* and subsp. *micranthos* are genetically isolated due to the different ploidy level and no intermediate forms occur (Mráz, 2011; Ochsmann, 2000).

Centaurea reichenbachii DC., (described in *Prodr. 6: 583. 1838*), (syn. C. *reichenbachioides* Schur, C. *reichenbachii* Schur, *C. biebersteinii* var. *papposa* Simonkay., *C. calvescens* Pancic, *C. dacica* Borza, *C. reichenbachioides* Hayek, *C. stoebe* ssp. *calvescens* (Pančić) Hayek, *Acosta calvescens* (Pancic) Holub, *A. reichenbachioides* (Hayek) Holub) (Euro+Med, 2006). This xeric saxicolous calciphyle species is endemic in Transylvania, being present on the eastern side of the Apuseni Mountains (western Carpathians) and around the Iron Gates. The *Centaurea reichenbachii* is very similar to the ruderal and much widespread *Centaurea biebersteinii* DC. The achenes have a very short pappus, seem to be much elongated than the ones of *Centaurea biebersteinii* and dark brown or blackish, not light brown or light grey. Wagenitz (2007) described the syntype of *C. reichenbachii*, from Göttingen University (GOET001309), collected from, Transylvania (Romania), Dumbrava Nuşeni (BN).

Centaurea jacea aggregate is recognized by rounded, entire appendages or only slightly denticulate appendages of involucral bracts, while in the other taxa, the appendages are ovate to triangular and regularly or irregularly fimbriate on margin. Besides, the accepted species from this subspecies/cytotypes of *C. stoebe* is in their life history traits, diploids being aggregate, were recognized many hybrids between sect. *Jacea* with sect. *Acrolophus* and sect. *Jacea* with sect. *Lepteranthus* (Hayek, 1918; Koutecký, 2008).

Centaurea jacea L, (described in *Sp. Pl.: 914. 1753*), 2n (22, 44), (syn. *Centaurea pratensis* (Lam.) Salisb., *C. variabilis* H. Lév. [non Bartl. 1825], *C. jacea* subsp. *jungens* Gugler, *C. decipiens* Thuill, *C. jacea* subsp. *decipiens* (Thuill) Celak, *C. amara* subsp. *decipiens* (Thuill), *C. pratensis* Thuill, *C. jacea* subsp. *pratensis* Celak, *C. subjacea* (Beck) Hayek, *C. jacea* subsp. *subjacea* (Beck) Hyl., *C. debeauxii* subsp. *thuillieri* Dostál, *C. thuillieri* (Dostál) Duvign. and Lambinon, *C. decipiens* var. *subjacea* Beck., *Cyanus jacea* (L.), *Jacea pratensis* Lam., nom. nov.) (Euro+Med, 2006e; NyH). *C. jacea* is a perennial species with steam sparingly branched from the middle, involucre ovoids, appendages rounded, slightly denticulate to pectinate-lacerate, usually covering bracts, pale brown, darker in the centre. Achenes have 3 mm with pappus absent or very short. The included taxon from this species are: *C. pannonica*, *C. banatica*, *C. subjacea*.

Centaurea jacea subsp. *jacea*, 2n (44) is the same with *jacea* sp. (syn. *Centaurea jacea* L. s. str.). This subspecies share a number of traits considered as diagnostic for *C. jacea* sensu stricto, especially the pappus wich is lacking or shorter than 0.5 mm. Bract appendages are variable in color, irregularly incised, with teeth 0.5–2.5 mm long. Capitulum 4–12 mm broad, often distinctly higher than wide with periferic ray florets (Dostál, 2000).

Centaurea jacea subsp. *angustifolia* (DC.) Gremli, (described in *Excursionsfl. Schweiz, ed. 2: 248. 1874*), (syn. *Centaurea amara* var. *angustifolia* DC., *C. angustifolia* Schrank [non Mill. 1768], *C. duboisii* Boreau, *C. pannonica* (Heuff.) Simonk., *Jacea pannonica* (Heuff.) Soják, *C. jacea* subsp. *pannonica* (Heuff.) Hayek, *C. amara* var. *pannonica* Heuff., *C. angustifolia* Schrank, *C. amara* var. *pannonica* Heuff, *C. jacea* subsp. *amara* (L.) Rothm. nom. inval.

(Hayek, 1918; Euro+Med, 2006)). This subspecies is preliminary accepted because in the Romanian flora this species is treated as *Centaurea pannonica* (Heuff.) Simonk, and the west-European database (Euro+Med, 2006, Global Compositae Checklist) treated *Centaurea pannonica* (Heuff.) Simonk species like a synonym of *C. jacea* subsp. *angustifolia* (DC.) Gremli. Capitula of this species is solitary or in dense corymbs, 15 × 10–12 mm, ovoid-globose or cylindrical; appendages orbicular, almost covering the appressed bracts, with blackish or yellowish-brown centre, the margin white or pale reddish-brown, entire, lacerate or irregularly denticulate. Achenes 3 mm, greyish-brown; pappus absent.

Centaurea jacea subsp. *banatica* Hayek, (described in *Verh. K. K. Zool.-Bot. Ges. Wien 68: 203. 1918*), (syn. *Centaurea banatica* Hayek, *C. rocheliana* (Heuff.) Dostál, *C. jacea* var. *rocheliana* Heuff., *C. banatica* Rochel apud Reichenb., *C. jacea* var. *banatica* Wierzb, *C. jacea* Griseb and Schenk, *C. jacea* Schur, *C. amara* Nym, *C. vulgaris* Simonk., *C. jacea* subsp. *banatica* Hayek, *Cyanus jaceus* Baumg.), (Hayek, 1918; Euro+Med, 2006; NyH).

The population from the Turzii Keys (CJ) has the capitula solitary. Involucre 13 × 11–12 mm, ovoid-globose; appendages 5–6 mm wide, covering the distinctly veined bracts, orbicular, light-brown, denticulate, the central vein produced into a very short mucro to middle bracts. Achenes 3 mm, pale brown and pappus is absent. The differences compared with *C. jacea*, is the de wide of the bracts wich is 1.5–2.5 mm (thinner than *C. jacea*).

Centaurea subjacea Beck. is a hybrid and a synonym of *C. x preissmannii* Hayek, described in *Denkschr. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 70:714, 1901.*, (syn. *Centaurea x subjacea* (Beck) Hay, *C. x stiriaca* Hayek, *C. decipiens* var. *subjacea* Beck, *C. jacea* subsp. *subjacea* (Beck) Hyl., *Jacea subjacea* (Beck) Soják). After Euro+Med (2006), this hybrid seems to be a subsp. of *Centaurea macroptilon*, but Koutecký (2009) has studied this species from morphological and geographical point of view and seems to be a hybrid of *C. jacea*, namely *C. jacea* x *C. melanocalatia.* Some times the name *C. subjacea* is used for *C. jacea* x *C. phrygia*, *C. jacea* x *C. nigrescens*, *C. nigrescens* or for *C. macroptilon* (Koutecký, 2009; Vonica and Cantor 2011, NyH).

Centaurea nigrescens Willd., (described in *Sp. Pl. 3: 2288. 1803*), (syn. *Jacea nigrescens* (Willd.) Soják, *Centaurea dubia* subsp. *nigrescens* (Willd.) Hayek, *C. jacea* subsp. *nigrescens* (Willd.) Čelak., *C. pratensis* subsp. *nigrescens* (Willd.) P. Fourn. *C. rotundifolia* (Bartl.) Hayek pro parte). The capitula of this species is solitary, pedunculate with an involucre up to 12 mm in diameter and bracts laxly imbricate. Appendages of the bracts are 1-1.5 mm length, triangular, not covering bracts (Fig. 2), blackish-brown, the fimbriae 6–8 on each side, pale brown, scarcely longer than the width of the very narrow margin. Florets are purple, the outer not radiate. Achenes have 3 mm and pappus is absent, sometimes with a very short pappus (Dostál, 2000; Vonica and Cantor, 2011a; NyH.).

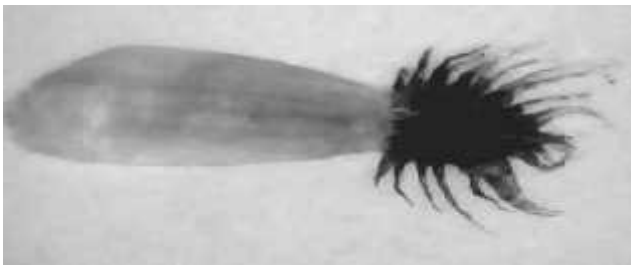

Figure 2: *Centaurea nigrescens*, from Nyárády Herbarium, appendages shape (inv. no. 115.702).

Centaurea macroptilon Borbás, (described in *Magyar Orv. Természz. Vándorgyül. Tört. Vázl. Munk. 23: 192*), 2n (44), (syn. *Centaurea jacea* subsp. *oxylepis* (Wimm. and Grab.) Hayek, *C. jacea* subsp. *macroptilon* (Borbás) Hayek, *C. macroptilon* subsp. *oxylepis* (Wimm. and Grab.) Soó, *C. oxylepis* (Wimm. and Grab.) Hayek., *C. osmanica* Conrath., *Jacea oxylepis* (Wimm. and Grab.) Soják, *J. macroptilon* subsp. *oxylepis* (Wimm. and Grab.) Dostál, *J. macroptilon* (Borbás.) Soják).

Included taxa in *C. macroptilon* are: *Centaurea degeniana* J. Wagner, *C. degenianiformis* Prodan, *C. magocsyana* J. Wagner, *C. oxylepis* (Wimm. and Grab.) Hayek, *C. pseudodegeniana* Prodan, *C. pseudomagocsyana* Prodan, *C. pugioniformis* Nyár., *C. subjacea* (Beck) Hayek. (Euro+Med, 2006; NyH).

Koutecký (2008) treated *Centaurea oxylepis* and *Centaurea macroptilon* like a different species, because these two taxa are very similar morphological, but they differ in geographic distribution. Morphologically, both stand between *C. jacea* aggr. and *C. phrygia* aggr.

Centaurea phrygia aggregate includes all the species which are morphologically characterized by a special shape of appendages of involucral bracts. They are ovate to linear with a pectinate-fimbriate margin, attenuated into a filiform, laterally fimbriate acumen; terminal fimbria are longer than lateral and the appendages are recurved from the involucre in the upper part forming a "sheath" around the involucre. The pappus of the achenes is always present and usually about 1 mm long. Up to six taxa are reported in literature from Central Europe, including both diploids and tetraploids (Koutecký, 2009).

Centaurea phrygia L., (described in *Sp. Pl.: 910. 1753*), 2n (22, 44), (syn. *Jacea phrygia* (L.) Soják, *J. plumosa* Lam., nom. illeg., *Centaurea austriaca* Willd., *C. conglomerata* C. A. Mey., *C. phrygia* subsp. *austriaca* (Willd.) Gugler, *C. phrygia* subsp. *phrygia*).

Koutecký (2008) has studied all these species from morphometrical and genetical point of view, and he found two ploidy levels. He concluded that the north-European plants should be named *C. phrygia* subsp. *phrygia***,** because these species are identical with the diploid cytotype. For tetraploid subspecies can be adopted *Centaurea phrygia* subsp. *erdneri* (J. Wagner) Koutecký. In conclusion, it is better (possible) to treat the cytotype as separate taxa, because both citotypes are separated geographically. The diploids occur in lower altitudes of central, northern and north-eastern Europe, and in the East Carpathians, wheres the tetraploids may be confined to the mountain altitudes af the W Carpathians and adiacent E Sudetes.

This taxon, included from Transylvanian flora, the following taxa: *Centaurea phrygia* subsp. *carpatica* (Porcius) Dostál, *C. phrygia* subsp. *indurata* (Janka) Stoj. and Acht., *C. phrygia* L. subsp. *phrygia, C. phrygia* subsp. *melanocalathia* (Borbás) Dostál, *C. phrygia* subsp. *pseudophrygia* (C. A. Mey.) Gugler, *C. phrygia* subsp. *rarauensis* (Prodan) Dostál, *C. phrygia* subsp. *ratezatensis* (Prodan) Dostál, *C. phrygia* subsp. *razgradensis* (Velen.) Greuter, *C. phrygia* subsp. *stenolepis* (A. Kern.) Gugler.

Centaurea phrygia subsp. *indurata* (Janka) Stoj. and Acht., (described in *Stud. Centaur. Bulg.: 71. 1935*), 2n (22), (syn. *Centaurea indurata* Janka, *C. nigra* Baumg., *C. microptilon* Griseb. and Schenk, *C. pratensis-nigrescens-vochinensis-microptilon-indurate* Schur. *C. indurate* Simk.) (Koutecký, 2008). In the flora of Romania this subspecies is described under the *C. indurata* Janka name. Involucre of this subspecies has 1.0–1.3 cm, with long appendages (0.6–1.05 cm) and wide from 0.4 to 0.6 mm. On each side of the existing appendages, with 9–14 lateral fimbrias and the bottom of the appendage is black or can be also dark-brown and light brown to appex (Ciocârlan, 2009; NyH).

Centaurea phrygia subsp. *carpatica* (Porcius) Dostál, (described in *Bot. J. Linn. Soc. 71: 207. 1976*), 2n (44), (syn. *Centaurea plumosa* var. *carpatica* Porcius, *C. carpatica* (Porcius) Porcius, *Jacea carpatica* (Porcius) Soják, *C. plumosa* var. *carpatica* Porcius, *C. carpatica* Formánek, *C. rodnensis* (Simonk.)). In Romania, this subspecies is endemic in Rodna Mountains, and it is described under *C. carpatica* subsp. *carpatica.* Both names are accepted by the European florists but the molecular analysis put the *C. carpatica* species in *C. phrygia* group (Dostál, 2000). Involucre of this subspecies has the longest appendages 10.3 to 16.9 mm with the lower part of appendages, widely lanceolate to ovate, 0.9 to 2.2 mm. Achenes are 3.6 to 4.3 mm long, without pappus (Ciocârlan, 2009; Formánek, 1887; Euro+Med, 2006; NyH).

Centaurea phrygia subsp. *melanocalathia* (Borbás) Dostál, (described in *Bot. J. Linn. Soc. 71: 207. 1976*), (syn. *Centaurea melanocalathia* Borbás, *C. nigriceps* Dobrocz., *C. phrygia* subsp. *nigriceps* (Dobrocz.) Dostál, *Jacea melanocalathia* (Borbás) Holub, *J. phrygia* subsp. *melanocalathia* (Borbás) Soják.). This subspecies has an unclear status because the characters described by recent floras was misinterpreted. After Koutecký's observations (2008), this taxon is without any doubts a hybrid between *C. jacea* and *C. phrygia* s. str. The diagnosis which can be found in the flora of Romania are unclear and without a typification of this name, it can not describe and assigned the name to *C. melanocalathia* (Ciocârlan, 2009; Nyárády and Prodan, 1964; Prodan, 1939).

Centaurea phrygia subsp. *pseudophrygia* (C. A. Mey.) Gugler, (described in *Mitt. Bayer. Bot. Ges. 1: 408. 1904*), 2n (22), (syn. *Centaurea pseudophrygia* C. A. Mey., *Jacea pseudophrygia* (C. A. Mey.) Holub, *C. elatior* (Gaudin) Hayek, *Centaurea phrygia* var. *elatior* Gaudin, *J. elatior* (Gaudin) Soják, *J. phrygia* subsp. *elatior* (Gaudin) Dostál).

In different diagnosis of European floras, this species is described under the names *C. pseudophrygia* C. A. Mey. and *C. elatior* (Gaud.) Hayek. In flora of Romania, this species appear under *Centaurea phrygia* name. Koutecký (2008) has studied this species in Europa, from morphological and genetical point of view and it seems that *C. pseudoprygia* is identical with *C. elatior*, the only difference is the geographical distribution. In conclusion, is better to use *C. pseudophrygia* C. A. Mey. for the population from the northern part of the East and in the West Carpathians and *C. elatior* Gugler is used for population from South Carpathians and the southern East Carpathians. This species/subspecies is characterized by very long (9.4–14.5 mm long and 0.6–1.2 mm wide) and strongly recurved appendages with basal part of appendages lanceolate or narrowly lanceolate, gradually attenuated into the thin fimbriate acumen. Achenes have 3.0–3.9 mm long and they have pappus 0.7–1.5 mm long (Hardy et al., 2001; Koutecký, 2008, NyH).

Centaurea phrygia subsp. *stenolepis* (A. Kern.) Gugler, (described in *Ann. Hist.-Nat. Mus. Natl. Hung. 6: 168. 1907*), 2n (22, 44), (syn. *Centaurea stenolepis* A. Kerner, *Centaurea cetia* (Bech) Wagner). The new florists describe this taxon like a subspecies of *C. phrygia* and flora of Romania tratead like *C. stenolepis*. From the genetical point of view, this species is included in *C. phrygia* aggregate (Koutecký, 2008)). The involucre of this species has 0.9–1.5 cm wide, the longest appendages 7.2–12.0 mm long and 0.4–0.9 mm wide with 10–16 lateral fimbriae on each side (Fig. 3). The appendages are strongly recurved, also forming a dense "sheath" around the involucre and the lower part of appendages is black to brown or can be ochre to the distal part (Koutecký, 2008; NyH).

Figure 3: *Centaurea phrygia* subsp. *stenolepis*, Nyárády Herbarium, appendages shape (inv. no. 116139).

Centaurea phrygia subsp. *ratezatensis* (Prodan) Dostál, (described in *Bot. J. Linn. Soc*. 71: 207), 1976, (syn. *Centaurea ratezatensis* Prod.). The flora of Romania described this taxon under *C. pseudophrygia* subsp. *ratezatensis* (Prodan) Ciocârlan. Based on the observation on voucher specimens and in the field, this taxon has a stem up to 100 cm, sparingly branched. The leaves are green, subglabrous, ovate. Involucre is ovoid, 2 × 1 cm; the appendages are entirely covering bracts, those of the middle bracts are triangular-lanceolate with dark brown colour and the apex of the bracts is subulate (Fig. 4). The appendages of subsp. *retezatensis* are longest as subsp. *stenolepis*, with 15–16 lateral fimbriae on each side (Ciocârlan, 2009; Dostál, 2000; NyH).

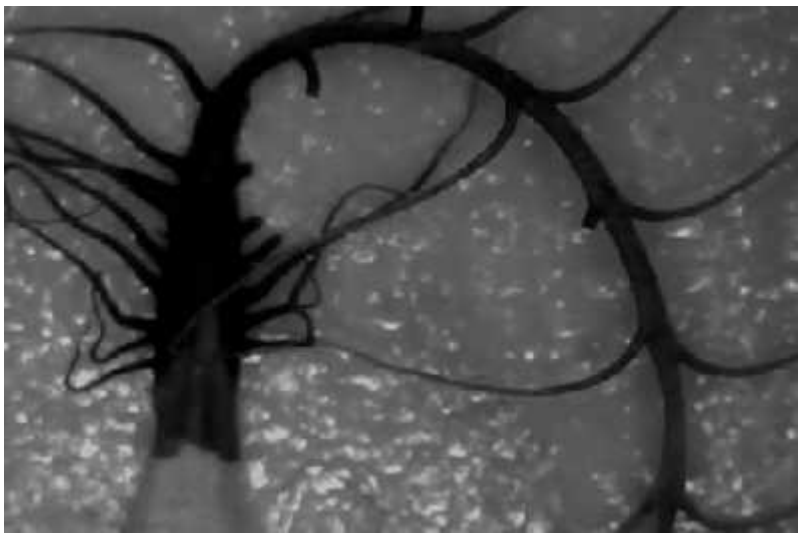

Figure 4: *Centaurea phrygia* subsp. *retezatensis*, collected by. Bădărău, 2011, from Retezat Mountains, "locus classsicus" Fata Fetii, (appendages shape).

Centaurea nervosa Willd., (described in *Enum. Pl.: 925. 1809*), 2n (22), (syn. *Centaurea plumosa* A. Kern., nom. illeg., *C. uniflora* subsp. *nervosa* (Willd.) Bonnier and Layens, *C. plumosa* Lam., *C. austriaca* Roch., *C. phrygia* L., *C. phrygia* Reich., *C. phrygia* Gaud., *C. phrygia* Host., *C. nervosa* Koch., *C. nervosa* Maly., *C. nervosa* Nym., *C. cirrata* Rchb., *Jacea cirrata* (Rchb.) Soják, *Cyanus austriacus* Baumg., *Lepteranthus hygrometicus* Cass.). This Eastern vicariant species has a simple stem with one capitulum. The involucre is 12–25 mm in diameter, ovoid-subglobose with the appendages of inner bracts ovate, imbricate, blackish- brown, the acumen lanceolate- setaceous, plumose-f imbriate, recurved at the apex. The appendages have 20–30 fimbriae on each side, and the achenes have 3–4 mm with longes of pappus 0.5–1 mm (Bancheva and Gorgov, 2010; Koutecký, 2007; Euro+Med, 2006; NyH).

Other part of *Centaurea* species from Transylvania are classified in the "Spiny group", and can be distinguish because they have well developed spines on the phyllaries (Wagenitz and Hellwig, 1996). The "Spiny group" tentatively circumscribed by Wagenitz and Hellwig (1996) was confirmed by the molecular study of Garcia-Jacas et al. (2000), where it is called the "western group". It includes many annuals and some show a transition towards autogamy up to cleistogamy. This is heterogeneous subgroup, difficult to subdivide.

Centaurea iberica Trev. ex Sprengel, (described in *Syst. Veg. 3: 406. 1826*), (syn. *C. calicitrapa* Marsch, *C. iberica* Griseb, *C. iberica* Boiss, *C. iberica* Nym., *C. calicitrapoides* Borb, *Calicitrapa iberica* Schur). Capitula of this species is surrounded by the leaves, and is nearly sessile. Involucre has 8–14 mm in diameter and the bracts has appendages scarious with one apical spine (15–30 mm), and 1–3 basal spines (mean 3 mm) (Dostál, 2000; Euro+Med, 2006; NyH).

Centaurea calcitrapa L., (described in *Sp. Pl.: 917. 1753*), (syn. *Centaurea adulterina* DC., *C. calcitrapoides* L., *C. horrida* Ten. [non Badarò 1824], *C. myacantha* DC., *C. calcitrapa* subsp. *horrida* Arcang., *C. calicitrapa* Host., *C. calicitrapa* Bartl., *C. adulterine* Maly, *C. calicitrapa* Gren, *C. calicitrapa* Celak, *Rhaponticum calicitrapa* Scop., *Calicitrapa stellata*, *Calicitrapa hippophaestum* Gart., *Calicitrapa hippophaestum* Baumg., *Calicitrapa stellata* Cass., *Calcitrapa stellaris* Hill, *Hippophaestum vulvare* Gray, *Calicitrapa hippophaestum* Schur). From the molecular point of view, *C. calcitrapa* is an exception, because, is included in "western group" and in fact it is part from eastern European species. Garcia-Jacas (2000) concluded that *C. calicitrapa* Trev. is particulary closely related to *C. iberica* and might be simply a cleistogamous colonizing race of the eastern *C. iberica* (Garcia-Jacas et al., 2000; NyH).

Centaurea solstitialis L., (described in *Sp. Pl.: 917. 1753*), 2n (16), (syn. *Calcitrapa solstitialis* (L.) Lam., *Centaurea pseudosolstitialis* Debeaux). The observation on the vouchers specimens shows that the yellow inflorescence is solitary with a diameter between 6.5 and 13.5 mm. The bracts are broadly ovate and the apical spine of the appendages are more longer than the others. The pappus of the achenae are almost double the lenght of the achenae. In the flora of Transylvania, this species is very rare, because the soil and climate conditions are not favorable for development of this species (Dostál, 2000; NyH).

Centaurea solstitialis subsp. *adamii* (Willd.) Nyman., (described in *Consp. Fl. Eur.: 430. 1879*) is an included taxa of *C. solstitialis*, and it is preliminary accepted by the European florists. The basionym is *Centaurea adamii* Willd., (syn. *Calcitrapa solstitialis* subsp. *adamii* (Willd.) Soják, *Centaurea damanti* Lojac., *C. lappacea* Ten., *C. solstitialis* subsp. *lappacea* (Ten.) Arcang., *C. solstitialis* subsp. *mitis* (Ces.) Arcang., *C. solstitialis* var. *mitis* Ces., *C. solstitialis* L. f. *adami* (Willd.) Prod. et Nyar.). The differences from *C. solstitialis*, this subspecies has the apical spine not longer than the others spines (Ciocârlan, 2009; NyH).

Centaurea benedicta (L.) L., (described in *Sp. Pl.: 1296. 1763*), with the basionym *Cnicus benedictus* (L.) L., (syn. *Carbenia benedicta* (L.) Arcang, *Cnicus bulgaricus* Panov.). This species is the only which was not accepted by the east European florists and romanian flora as included in *Centaurea* genus. *Cnicus* genus was very heterogeneous, of its five original species, two are now assigned to *Cirsium* Mill., one to *Carduus* L., a one to *Stemmacantha* Cass. It was united with *Centaurea* in 1764 by Linnaeus and the same author has kept it apart because has a unusually aberrant appearance of its achenes. Has achenes with distinctly ribbed and has an outer pappus of 10–11 stiff bristles. Garcia–Jacas (2006) and Bremer (1994), put this species in *Centaurea* genus because many other characters point to a close affinity with the *Jacea* group from *Centaurea*, namely spiny phyllary appendages, presence of marginal florets, type of crystals, inner structure of the achenes, and the pollen of the *C jacea* type. The *Centaurea benedicta* has also the same chromosome number (2n = 22) as *Jacea* group and in both it is indicated sesquiterpenlactone cnicin, wich has been also found in several species of *Acrolophus* group and *Calcitrapa* group (Bremer, 1994). *Centaurea benedicta* L. is a cultivated plant on Transylvania from medicinal point of view and sometimes is wilderness.

The second subgenus from *Centaurea* genus is *Lopholoma*, and it was treated at some time as a separate genus by various florists. This subgenus comprise species with fairly large capitula, the appendages are decurrent and often ending in a spine. The pollen type of this species is *Centaurea scabiosa*.

Centaurea orientalis L., (described in *Sp. Pl.: 913. 1753*), (syn. *Colymbada orientalis* (L.) Holub, *Centaurea tatarica* Willd, *C. orientalis* Baumg., *C. tatarica* Rchb., *C. orientalis* Host., *C. rubescens* DC.). This species is quite frequent in southern and eastern Romania but very rare in Transylvania where it occurs only in two known locations, Bărcuț, (Braşov County) and Bălăuşeri (Mureş County). Bădărău (1996) was described from Transylvania, a hybrid beteen *C. orientalis* and *C. scabiosa* subsp. *spinulosa*, and few varieties. This species is to be considered and protected in Transylvania as a regional rare endangered species. In population from Bărcuț (BV), it was found C. *orientalis* and *C.x neglecta*. The differences between these species are the colour of flowers and the shape of the appendages wich are ovate, with a brown central spot, mucronate at the apex to *C. orientalis* and appendages with an apex c. 3 mm at *C. x neglecta* (Fig. 5).

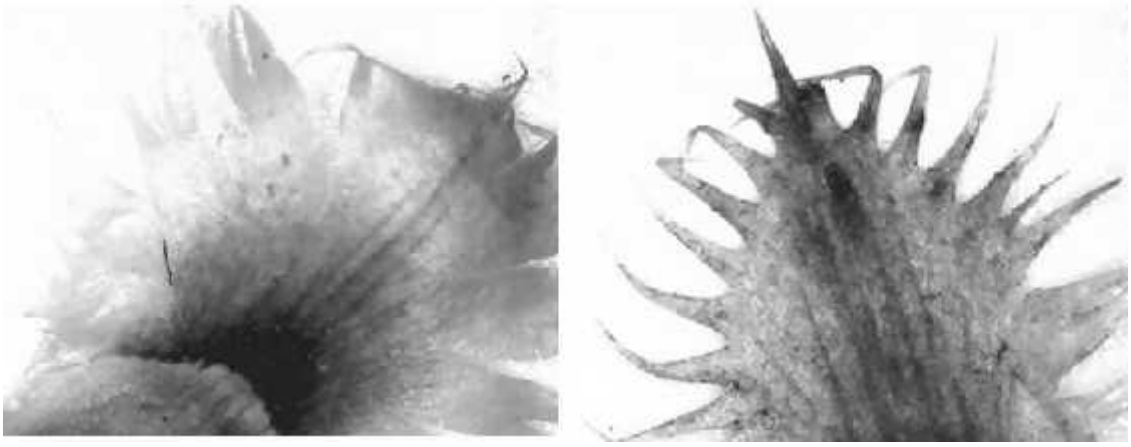

Figure 5: *Centaurea orientalis*, collected from Bărcuț meadows (BV), (appendages shape, left- *C. orientalis*, right- hybryd).

Some European florists describe *C. x neglecta* Bess. as a synonym of *C. salonitana* Vis. wich are not growing in Transylvania and flora of Romania is described as a species, not a hybrid. There are necesary more studies regarding this aspect for a good description.

Centaurea atropurpurea Waldst. and Kit. [non Olivier 1801], (described in *Descr. Icon. Pl. Hung.: 121. 1802*), (syn. *Centaurea atropurpurea* Waldst. et Kit., *C. atropurpurea* Host., *C. calcocephala* De Cand., *C. atropurpurea* Maly, *C. calocephala* Willd., *C. calcocephala* Rchb., *C. atropurpurea* Heuff., *Colymbada atropurpurea* Holub, nom. nov., *Cyanus atropurpureus* Baumg.). In flora of Romania, this species is known under this name, but the florists (Euro+Med, 2006; GCC, 2009; IPNI, 2008) have accepted under *C. atropurpurea* Olivier (in *Voy. Emp. Othoman, ed. 4: 313. 1801*), wich is another species and *Centaurea atropurpurea* Waldst. and Kit. is keeping under the name *Centaurea calocephala* Willd (in *Enum. Pl.: 928. 1809*) to ovoid further confusions (Euro+Med, 2006).

In Romania this species occurs in southern Apuseni Mountains, western Meridional Carpathians, Banat Mountains, Poiana Rusca. In the hilly areas, it can be found only in the Transylvanian Basin (south-western and western parts, only on limestones). From field observation, *C. atropurpurea* presents many morphological differences according to soil conditions. In the mesophilic meadows, the steam is smaller and segments of the leaves are thinner and on the mesoxeric calciphile saxicole rocky grassland, this species has a long stems (100–150) cm, and segments of the leaves 7–20 mm wide.

Centaurea kotschyana Heuff., (desc. in *Flora 18: 245. 1835*), (syn. *Colymbada kotschyana* (Heuff.) Holub, *Cyanus atropurpureus* Baumg., *Centaurea calcocephala* Vis., *C. kotskyana* Maly, *C. kotschyana* Heuff., *C. kotskyana* Hayek., *C. kostschyana* Nym, *C. atropurpurea* Freyn et Brandis, *Centaurea heuffelii* Rchb., *C. heuffelii* Vis) (Euro+Med, 2006 Plant Database). *Centaurea kotschyana* Heuffel belongs to the same evolutive group of section *Acrocentron* of the subgenus *Lopholoma* with *Centaurea atropurpurea* Waldst. et Kit., and other species from southern Bulgaria- northern Greece. The main differences of *Centaurea kotschyana* has seemingly being the ovate bracts and fimbriaes white at apex, arising gradually (NyH).

Centaurea scabiosa L. Greuter, (described in *Sp. Pl.: 913. 1753*), (syn. *Colymbada scabiosa* (L.) Holub, *Centaurea coriacea* Willd., *C. scabiosa* subsp. *coriacea* (Willd.) Arcang., *C. scabiosa* subsp. *vulgaris* (W. D. J. Koch) Hayek, *C. scabiosa* var. *vulgaris* W. D. J. Koch, *Scabiosa variifolia* Loisel.) (Euro+Med, 2006).

Included taxa of *Centaurea scabiosa* from Transylvanian Basin are: *C. scabiosa L.* subsp. *scabiosa*, *C. scabiosa* subsp. *adpressa* (Ledeb.) Gugler, *C. scabiosa* subsp. *sadleriana* (Janka) Asch. and Graebn., *C. scabiosa* subsp. *spinulosa* (Spreng.) Arcang. These species make the *C. scabiosa* group because in Transylvania has many hybryds with other species of *Centaurea* (Vonica and Cantor, 2011a).

Centaurea scabiosa subsp. *spinulosa* (Spreng.) Arcang. (described in *Comp. Fl. Ital.: 390. 1882*), (syn. *Centaurea spinulosa* Spreng., *C. spinulosa* Rochel., *C. spinulosa* Heuff., *C. spinulosa* Spreng., *C. spynulosa* Nym., *C. apiculata* subsp. *spinulosa* Roch., *C. apiculata* subsp. *spinulosa* (Spreng.) Dostál, *C. coriacea* Host, *C. coriacea* Schl., *C. scabiosa* Maly, *C. stereophylla* Griseb et Schrenk., *C. scabiosa* var. s*pinulosa*, Griseb et Schenk., *Colymbada spinulosa* (Spreng.) Holub, *Colymbada apiculata* subsp. *spinulosa* (Spreng.) Dostál, *Cyanus coriaceus* Baumg., *Cyanus scabiosus* Baumg.) (Euro+Med, 2006).

Observation on dried samples collected from Transylvania related that these species of *Centaurea* have appendages with 8–12 fimbriae (1-2 mm) on each side and the apical spine has 3–5 mm long. In Flora of Romania (Ciocârlan, 2009), it was described under name, *C. apiculata* subsp. *spinulosa* Roch. or *C. spinulosa* Roch.

Cyanus subgenus belong to *Centaurea* genus wich was also another genus because is very distinctive, but most authors have kept it as a section in *Centaurea*. Today it is recognized as a subgenus or as an informal group within the genus *Centaurea* (Dostál, 2000; Garcia–Jacas et al., 2001; Wagenitz and Hellwig, 1996). It can recognize after the appendages wich are decurrent nearly to the base of the phyllaries and dentate to ciliate, but never spiny. The plants are the leaves undivided to pinnatifid, more or less decurrent and nearly always tomentose. Achenes are conspicuously barbate at the margins of the insertion areole. The marginal sterile florets without staminodes, the smooth pollen type associated with a reaction pollen presentation mechanism, and the lateral hilum of the seed. Pollen type is *Centaurea cyanus* and for other species from *Cyanus* subg. (*Perennes*), is *Montana* pollen type.

Centaurea cyanus L. (described in *Herb. Brit. 1: 82. 1769*), (syn. *Centaurea cyanus* L., *C. cyanocephala* Velen., *C. hortorum* Pau., *C. lanata* Roxb., *C. pulchra* DC., *C. umbrosa* A. Huet ex Reuter, *C. cyanocephala* Velen., *C. hortorum* Pau., *C. cyanus* var. *denudata* Suksd., *C. cyanus* subsp. *coa* Rech., *C. segetalis* Salisb., *Jacea segetum* Lam., *Cyanus segetum* Hill, *Cyanus arvensis* Moench, *Cyanus vulgaris* Delarbre, *Setachna cyanus* (L.) Dulac, *Leucacantha cyanus* (L.) Nieuwl. and Lunell (Muñoz and Devesa, 2010), Euro+Med, 2006).

Centaurea mollis Waldst. and Kit., (described in *Descr. Icon. Pl. Hung. 243. 1806*), (syn. *Cyanus mollis* (Waldst. and Kit.) J. Presl and C. Presl, *Cyanus montanus* Baumg., *Cyanus montanus* subsp. *mollis* (Waldst. and Kit.) Soják, *Centaurea montana* Wahl., *C. montana* Rohr. et Mey., *C. montana* subsp. *mollis* (Waldst. and Kit.) Gugler, *C. mollis* Zawad., *C. montana* De Cand., *C. mollis* Gunth, *C. axillaries* Wimm., *C. carpatica* Formánek [non Porcius], *C. javornikiensis* Formánek). This perennial species with branched rhizome has an ovoid involucre with 12–18 mm in diameter and the appendages are long-decurrent with short black teeth. Achenes have 6–7 mm and the pappus 1–1.5 mm.

Centaurea triumfettii All. (described in *Auct. Syn. Stirp. Horti Taurin.: 16. 1773*) (syn. *Centaurea axillaris* W., *Centaurea triumfettii* All. ssp. *axillaris*) (Euro+Med, 2006). The first of the conflicting species is *Centaurea triumfettii*, which traditionally has been considered to be a difficult taxon. Most of the current taxonomy of the group is based on vegetative characters such as the presence of sterile rosettes, the presence of tap roots or tubers, and the shape and indument of the leaves.

The most recent taxonomic concept in the framework of the Euro+Med Plant Database (Euro+Med, 2006) recognises 13 species within the *C. triumfettii* group in its whole distribution area, with further 13 species, and 4 subspecies classified within *C. triumfettii* as "included taxa".

Similar confusing classifications are presented in several national floras or identification keys (Dostál, 2000), and the *C. triumfettii* group is considered to be a taxonomically difficult group with plants that are hard to determine. Several examples of natural hybrids have also been suggested within the *C. triumfettii*, but hybridization and its possible influence on the morphological variation have not been studied further by biosystematics.

Included taxa in *Centaurea triumfettii* All. group from Romania are: subsp. *axillaris* (Čelak.), subsp. *stricta* (Waldst. and Kit.) Dostál and subsp. *angelescui* (Grinț.) Dostál.

The multivariate morphometric analyses maked by Olšavská (2009) revealed a clear separation of *C. triumfettii* group between Alpine populations and populations in the western Carpathians and Pannonia. The results proved that *C. triumfettii* subsp. *triumfettii* do not occur in the western Carpathians and Pannonia. According to identification keys by Dostál (2000) and Olšavská (2009), populations from west Carpathian, may be treated as *C. triumfettii* subsp. *stricta* or *C. triumfettii* subsp. *axillaris*. However, the results of the morphometric analyses presented here do not allow these two subspecies to be distinguished because these two subspecies

are close in their morphology. In Flora of Romania, this subspecies must be treat under *Centaurea triumfettii* subspecies *stricta* (Waldst. and Kit.) Dostál (Euro+Med, 2006; Olšavská et al., 2009).

Centaurea triumfettii subsp. *axillaris* (Čelak.) Stef. and T. Georgiev, (described in *Spis. Bulg. Akad. Nauk. 44: 160. 1931*), (syn. *Centaurea variegata* Lam., *C. variegata* Lam. subsp. *variegata* var. *aligera* Gugler, *C. triumfettii* All. ssp. *aligera* (Gugler) Dostál, *C. montana* L., *C. montana* Scop., *C. triumfettii* All., *C. seusana* Chaix, *C. axillaris* Willd., *C. montana* L. subsp. *axillaris* (Willd.) Rouy). It seems that *Centaurea triumfettii* subsp. *aligera* (*C. axillaris* Willd.) is a misapplied names (Dostál, 2000), Euro+Med, 2006).

Centaurea triumfettii All. ssp. *stricta* (Waldst. and Kit.) Dostál, (described in *Acta Bot. Bohem. 10: 72. 1931*), (syn. *Centaurea stricta* Waldst. and Kit**.**, *Cyanus strictus* (Waldst. and Kit.) Soják, *Cyanus triumfettii subsp. strictus* (Waldst. and Kit.) Dostál, *Centaurea triumfettii* subsp. *stricta* (Waldst. and Kit.) Dostál, *Centaurea ternopoliensis* Dobrocz.).

After Olšavská's studies (2009), the analyses from the western Carpathians and Pannonia proved that no populations should be classified as *C. triumfettii* subsp. *triumfettii*, just only *C. trumfettii* ssp. *axillaris*.

Centaurea pinnatifida Schur., (basionym*: Centaurea triumfettii* All. subsp. *pinnatifida* (Schur) Dostál), (syn. *Cyanus pinnatifidus* (Schur) Holub Included taxa: *C. pinnatifida* subsp. *pinnatifida*, *C. pinnatifida* subsp. *sooanus* (Borhidi) Greuter). Is an endemic species in Romania (Southern and Eastern Carpathians).

CONCLUSIONS

This paper is a description of *Centaurea* species recorded from Transylvania and problems of their determination. Morphological observations on *Centaurea* group systematic were made taking in consideration other morphological observation at European level in addition with molecular, palynological analysis from different floras.

Some species described in Romania flora, such as *C. micranthos*, *C. rocheliana*, *C. pannonica*, *C. indurata*, *C. stenolepis*, *C. melanocalatia*, *C. pseudophrygia*, *C. ratezatensis*, *C. apiculata* have been described as synonyms or subspecies have been dubbed. These species were treated like subspecies, because were included from molecular, palinologically, morphologically, geographically analysis point of view as subtaxon. Taking in consideration these aspects and for easily understanding the further studies, *C. micranthos* is treated like *C. stoebe* subsp. *micranthos*, *C. rocheliana* is treated like *C. jacea* subsp. *banatica*, *C. carpatica* is treated like *C. phrygia* subsp. *carpatica*, *C. peudophrygia* is treated like *C. phrygia* subsp. *pseudophrygia*, *C. stenolepis* as *C. phrygia* subsp. *stenolepis* because were included in taxa after molecular and morphological analysis. On the other way, *Centaurea benedicta* species, was included in *Centaurea* genus from the molecular point of view by other florists and it was treated in this genus, as a results.

Following the proposal of changing the type species of the *Centaurea* genus, some species were excluded from this genus. In accordance with west-European florists, *Centaurea ruthenica* Lam species (wich is synonym of *Rhaponticoides ruthenica* (Lam.) M. V. Agab. and Greuter), it was not treated in this paper because it was included by them in *Rhaponticoides* genus after molecular, palinologically and morphologically analysis.

Where the limits of *Centaurea* genus are not well defined, as suggested treating the species as a group of genus, e.g. *C. stoebe* group, *C. phrygia* group, *C. scabiosa* group and *C. triumfettii* group. These species require a detailed morphological description because where the hybrids are too many and too difficult to determine.

Some Transylvanian species have new morphological data which can be easy used in the determination of *Centaurea* genus, given an accumulated to morphological data to define the limits of the group.

AKNOWLEDGEMENTS

The author is very grateful to N. Garcia-Jacas and to S. Alfonso from Botanical Institute of Barcelona, who during my documentary stage in this institution, have been helping with critical discussions and have been making constructive suggestions, especially on nomenclature and systematics.

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TURKEY OAK (*QUERCUS CERRIS*) FROM RONIŞOARA DEPRESSION (MARAMUREŞ, ROMANIA)

Anton BACEA [1]

KEYWORDS: *Quercus cerris*, Turkey oak, Ronişoara Depression, Ronişoara Basin, Maramureş Depression, Maramureş.

ABSTRACT

This paper presents the distribution of stands of *Quercus cerris* in the Ronişoara Depression. Isolated specimens of this species present in depression indicate the northernmost point of distribution area in the country. Description of the station and of the stands was based on data from forest management plans production unit IV Ronişoara of Sighet Forest District.

Although few authors when describing the area of distribution, have mentioned the presence of Turkey Oak in Maramureş, they have not mentioned its occurence in the Ronişoara Depression. In this depression oak forests are well represented by three species: *Quercus petraea* ssp. *petraea*, *Quercus robur* and *Quercus cerris*.

REZUMAT: : Specia cerul (*Quercus cerris* L.) din Depresiunea Ronişoara, Maramureş

În lucrarea de faţă este prezentată distribuţia arboretelor din Depresiunea Ronişoara, în a căror compoziţie se găseşte *Quercus cerris*. Exemplarele izolate din această specie prezente în depresiune, indică fapt punctul cel mai nordic al arealului de răspândire din ţară. Descrierea staţiunii şi a arboretului s-a făcut pe baza datelor din amenajamentul silvic al unităţii de producţie IV Ronişoara a Ocolului Silvic Sighet.

Deşi doar câţiva autori au menţionat în lucrările de specialitate, în descrierea arealului de răspândire, prezenţa speciei în Maramureş, fără a o menţiona din Depresiunea Ronişoara, totuşi aceasta este prezentă într-o proporţie mai mică şi în Depresiunea Ronişoara. În această depresiune, cvercineele sunt bine reprezentate prin trei specii: *Quercus petraea* ssp. *petraea*, *Quercus robur* şi *Quercus cerris*.

ZUSAMMENFASSUNG: Die Zerreiche (*Quercus cerris* L.) in der Ronişoara Senke, Maramuresch.

In vorliegender Arbeit wird die Verbreitung der Waldbestände dargestellt, in denen die Zerreiche (*Quercus cerris* L.) vorkommt. Die einzelnen vorhandenen Exemplare dieser Art, liegen in der Ronişoara Senke, am nördlichsten Verbreitungspunkt der Art. Die Standortbeschreibung und die der Waldbestände wurden anhand des Forsteinrichtungswerks der Produktionseinheit IV Ronişoara des Forstamtes Sighet durchgeführt.

Obwohl nur einige Autoren in ihren Arbeiten betreffend das Verbreitungsareal der Art, ihr Vorkommen in der Maramuresch angeben, ohne jedoch die Ronişoara Senke zu erwähnen, kommt die Zerreiche auch hier vor. Die Eichenbestände der Senke sind aus drei Arten: *Quercus petraea* ssp. *petraea*, *Quercus robur* und *Quercus cerris* aufgebaut.

INTRODUCTION

Quercus genus (*Fagaceae* family) includes tree species, rarely shrubs, with alternate, deciduous or persistent leaves (indigenous species have deciduous leaves, juveniles have marcescent leaves), and is a systematic group of great biological wealth in forest ecosystems, having also an important role in the overall balance of production and protection functions of forests in areas assigned to the distribution of these species.

In Romania, *Quercus* genus is represented by 5–9 species, depending on their taxonomic classification (Georgescu and Morariu, 1948, Stănescu et al., 1997; Şofletea and Curtu, 2007) and covers about 1.13 million hectares, which means 18.2% of the total forest fund, being the third after beech (*Fagus sylvatica* L. – 30.7%) and spruce (*Picea abies* L. (Karst) – 22.9%).

In Maramureş Depression, *Quercus* genus is represented by three species: *Q. petraea* (Matt.) Liebl. ssp. *petraea* (Liebl.) Soó – oak, *Q. robur* L. – pedunculate oak and *Q. cerris* L. – Turkey oak, in very small proportion, these species are also found in the Ronişoara Basin (Bacea, 2011).

RESULTS

Species systematics

According to systematic classification of *Quercus* genus, Turkey oak (*Quercus cerris* L.), which is the object of present study, is part of: *Fagaceae* family, *Fagales* order, *Hamamelidae* subclass (*Amentiferae*), *Magnoliate* class (*Dicotyledonatae*), *Magnoliophytina* subphylum (*Angiospermae*), *Spermatophyta* phylum (Popovici, Moruzi and Thomas, 2003; Şofletea and Curtu, 2004, 2007). The following are the taxonomic classifications of *Quercus cerris* according to several authors.

According to taxonomic classification of native oak trees (Tutin et al., 1993), *Quercus cerris* L. is part of: *Fagales* order, *Fagaceae* family, *Quercus* genus, *Cerris* subgenus. According to Nixon, 1993, the species is part of: *Quercus* genus, *Quercus* subgenus, *Quercus* section s. l. (sensu lato), *Cerris* group, and according to Ciocârlan, 2000, is part of: *Fagales* order, *Fagaceae* family, *Quercoidae* subfamily, *Quercus* genus.

In Romanian is popularly called *Cer*, in German: *Die Zerreiche*, in French: *Chêne chevehu*.

Natural distribution area of Turkey oak

Turkey oak is a mediterranean and submediterranean species with longitudinal distribution from the Iberian Peninsula to Asia Minor (Fig. 1).

Outside of its southern area are Corsica Island, Balearic Islands, Sardinia, Cyprus and Crete. Towards the European mainland it reaches the most in Hungary and Romania, but not exceeding 50° N parallel (Şofletea and Curtu, 2004, 2007).

In the area of Turkey oak in Romania (Fig. 2), there are two important areas: first area of distribution includes low altitude forests, from silvosteppe to the hills, up to about 500–600 m, in Oltenia and Muntenia, and the second area comprises mainly of hill forests from west and south-west of the country, beginning from south of Satu Mare and west of Sălaj (but isolated specimens reach up to Maramureş, at Sighetu Maramației) to Banat (Şofletea and Curtu, 2004, 2007).

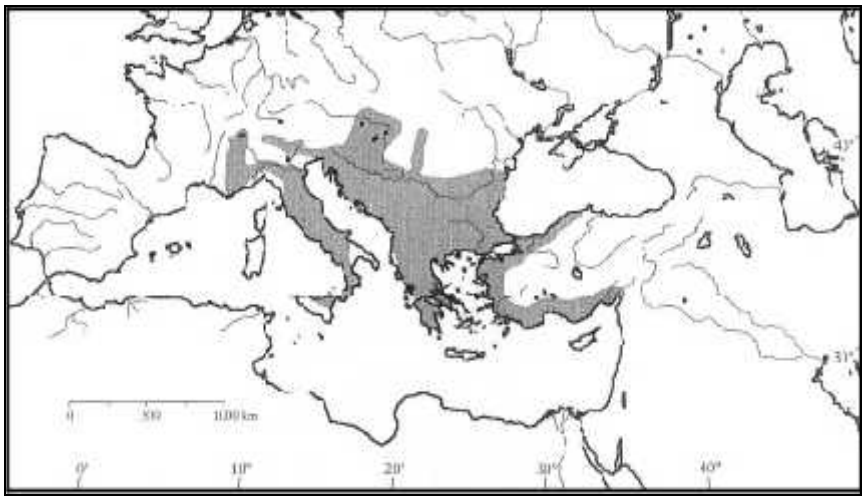

Figure 1: Natural distribution area of Turkey oak (*Quercus cerris* L.)
(according to Pignatti, in 1982, from Bussotti 1998; Şofletea and Curtu, 2007).

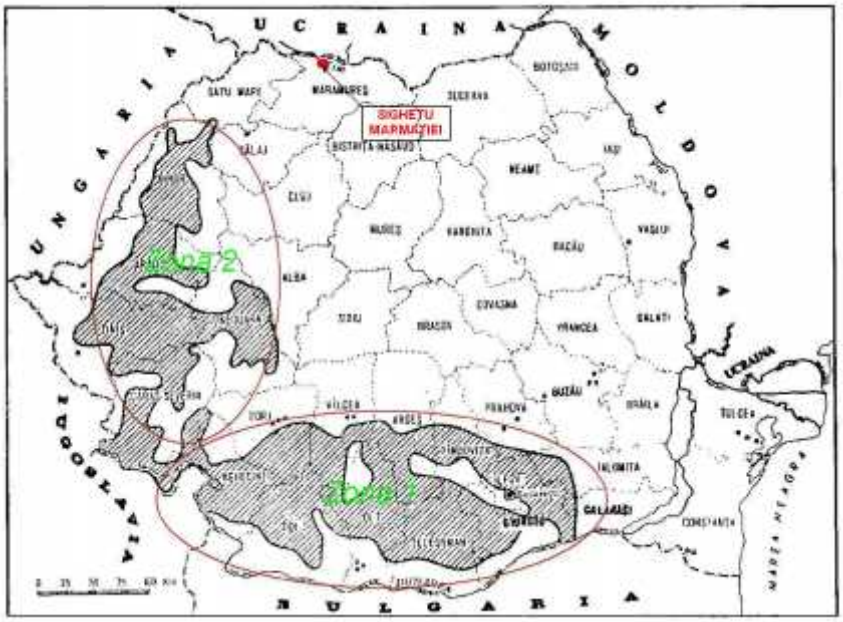

Figure 2: Natural distribution area of Turkey oak in Romania
(according to Stănescu et al., 1997; Şofletea and Curtu, 2007).

West of Apuseni Mountains, the last of scarce Turkey oak stands reach up to about 900 m altitude and isolated specimens, small and in bad shape reach up to 1,000 m altitude, in contact with beech forests. It is distributed mostly inside Transylvania, in Hunedoara County, up to Alba County border, but it is missing from the Transylvanian Plateau, Moldova and in Dobrogea can be found in a relatively small area (Şofletea and Curtu, 2007).

It occupies about 3% of the forests of our country, 180,000 hectares effective surface, respectively 510,000 hectares with Turkey oak in composition (Şofletea and Curtu, 2007).

Morphological characteristics

Turkey oak (*Quercus cerris*) is a autochthonous tree, up to 30–35 m high and 1.50 m diameter, with taproots, often with straight cylindrical trunks and ritidom (Fig. 3) formed early, thick, hard, with deep longitudinal cracks, brick red in depth.

The crown is narrow and focused to the tip of the stem rich in foliage (Stănescu et al., 1997).

Young stems (Fig. 3) are gray-green or brown, often pubescent with small buds, ovate, provided with numerous filamentous stipele, persistent, longer than the buds (Şofletea and Curtu, 2007).

Leaves (Fig. 3) are elliptical to ovate-oblong, sometimes ovate-lanceolate, 5–15 cm long, with acute tip and narrow or cordate base, the edges are pinnate-fidate, whole lobes or lobules, triangular, acute, terminated with a short mucron. The leaves are leathery, the upper side is shiny dark green, rough, and the lower side is gray or yellowish, tomentose (at maturity only along the ribs); they have between 4–8 (10) pairs of lobes, and stems are clearly visible, long up to 2–2.5 cm, often having stipele at the base (according to Stănescu et al., 1997; Şofletea and Curtu, 2004, 2007). The young leaves are marcescent (remain dry on branches without falling on the ground).

Figure 3: *Quercus cerris* L.: ritidom, shoot, leaves and cups (photo A. Bacea).

The flowers are unisexual monoecious, the male inflorescences are grouped in thin aments, and the female inflorescences are solitary or grouped by 2–8 in spiciform inflorescences, sessile or pedicellate (Stănescu et al., 1997).

The fruits (acorns) are sessile or with a short pedicel, solitary or up to 4 in a bundle. Achene is big, 2–4 cm long, ovoid-cylindrical, truncated and with mucronate tip; the cup (Fig. 3) includes achenes on about half surface, is hemispherical, with many elongated scales (spiked, divergent, double bended, woody) (Şofletea and Curtu, 2007). Seed germination is hypogeous.

Ecological characteristics

Turkey oak generally grows on plains and hills, in silvosteppe and oak subzone, with affinity for lands with warm climates, with long growing season, being a relatively thermophilic species (euthermal-mesothermal). Severe winter frosts are not well supported, causing frost fissures. It is drought tolerant, falling within the category of mezoxerophytes-xerophytes species (relatively xerophytes) (according to Şofletea and Curtu, 2007).

Soils on which Turkey oak grows are often heavy, composed of clay-loam or clay, hard permeable, with poor internal drainage, moderately to strongly podzolic due to hydrogenesis. In fact, Turkey oak shows a fairly large amplitude to the seasonal dynamics of soil moisture, consuming plenty of water during periods when it is excessive, but reducing the intake during summer droughts. In terms of light requirements, Turkey oak is a heliophile species (according to Şofletea and Curtu, 2004, 2007).

Biological characteristics

The main biological characteristics of the species are:

- Flowering period is usually in May (Stinghe and Sburlan, 1941; in Nicolescu, 2009);
- Maturity is earlier than other native oaks, at 50–60 years;
- Fruits ripening time is usually in September (according to Przemetschi and Vasilescu, 1937; Dediu and Miron, 1955; Enescu and Enescu, 1956; in Nicolescu, 2009);
- Fructification periodicity is, on average, 2-3 years (according to Rădulescu, 1956; in Nicolescu, 2009), 3–5 years (according to Stănescu et al., 1997; Iancu et al., 1996; Şofletea and Curtu, 2007) or 6–7 years (according to Dediu and Miron; in Nicolescu, 2009);
- Maturation is biennial, is the only native oak species with maturation in the second year;
- Grows from the tree stub for a long time, vigorous and abundant (Antonescu, 1900; Schlich, 1910; in Nicolescu, 2009), to advanced age 40–50 years (Iancu, 1999) or sometimes produces root sprouts, but rarely;
- Growth of young seedlings is more active than oak and English oak, but later is overtaken by these species;
- Longevity is the lowest of all native species of oak, only rarely exceeding 200–300 years (according to Şofletea and Curtu 2007).

Turkey oak location in Ronişoara Depression

Ronişoara Depression, in which *Quercus cerris* species is present, is situated in the large geographical unit of the Carpathians, Eastern Carpathians branch, Maramureş and Bucovina Carpathian group, Maramureş Depression. (Oancea, 1987; Velcea et al., 1987)

Forests from Ronişoara Depression in which *Quercus cerris* is present, are located on the territory of Rona de Sus and Rona de Jos localities in northern Maramureş County, Transylvania, Romania.

Total area of stands with Turkey oak in composition is 22.8 ha and is located in the production area IV Ronişoara administered by Sighet Forest District, Forestry Department Baia Mare, National Forest Department - ROMSILVA.

Overall, the production unit has the following geographical coordinates: 47°49’47”–47°56’84” north latitude and 23°58’42”–24°09’47” east longitude.

From physico-geographical point of view, the studied territory is located in the Central European province; Carpathian subprovince; land of Eastern Carpathians; Volcanic Mountains land; Oaş–Gutâi–Văratic district; the northern group, and from geographic point of view is situated in Maramureş depression, more specifically in Ronişoara Depression. (Badea, Gâştescu, and Velcea, 1983)

From geological point of view, the territory is situated within the Orogen unit of Carpathians, intermontane depressions subunit (Maramureş Depression).

Ronişoara Depression location within the geographic area of Maramureş Depression is presented in the figure number 4.

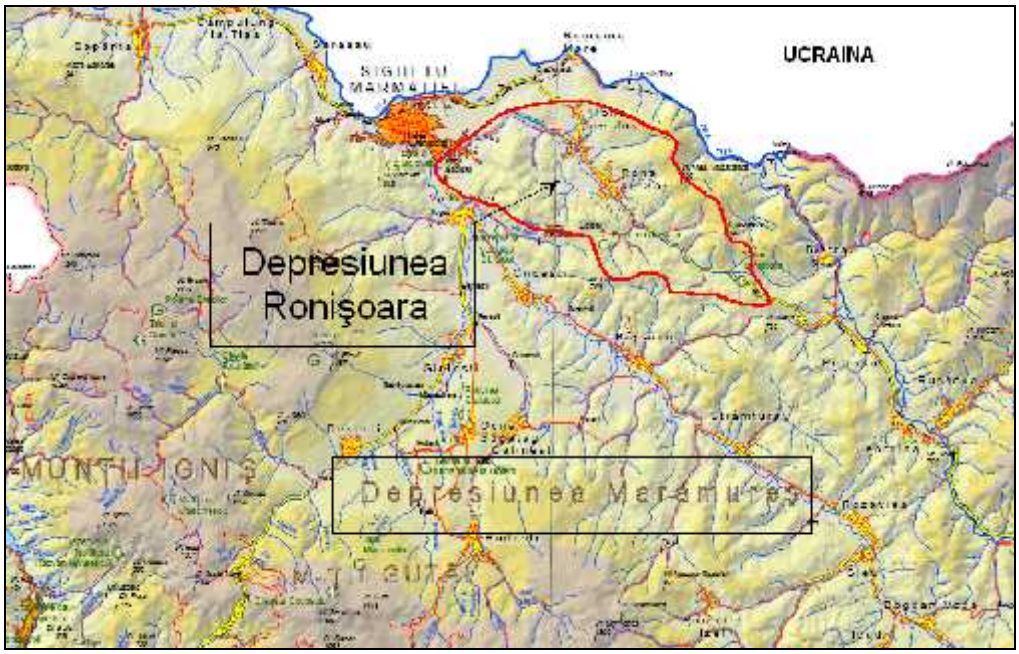

Figure 4: Ronişoara Depression location within the geographic area of Maramureş Depression.

The territory of production unit IV Ronişoara is part of Maramureş hills group, situated between Şeaua Moisei and Tisa Valley, which separates Iza Valley from Vişeu Valley. Hills from the last section close a small depression, called Ronişoara or Rona, quoted by Posea, 1980.

Distribution of parcels on which Turkey oak is found, in the Ronişoara Basin, is shown in the figure number 5.

Figure 5: Distribution of parcels with Turkey oak, in the Ronişoara Basin (Google Earth).

The analysis of the parcels distribution, shows two distinct groups, one consists of parcels 6, 7, 205 and 207, which represents the north-west Turkey oak group and the other group is composed of parcels 43 and 133, which represents the south-eastern Turkey oak group, the distance between them is about 6-7 km.

The main parcel characteristics

According to the data from forest management plans of production unit IV Ronişoara in Sighet Forest District, parcels with Turkey oak in composition, are the following: 6, 7, 43, 133, 205 and 207, with total area of 22.8 ha. Station description, in which Turkey oak is present, is presented in the table below (Tab. 1)

Table 1: Station description, in which Turkey oak is present.

Parcel (a.u.)	Area (ha)	Composition	Station type	Forest type	Soil type - subtype	Exposition	Slope (°)	Altitude (m)
6	10.1	8Go 2Ce	6.1.5.2.	511.3	2201	S	30	350 – 420
7	6.1	9Go 1Ce	6.1.5.2.	511.3	2201	SE	30	330 – 430
43	0.6	7Go 2Ca 1Ce	5.1.5.2.	511.3	2201	SW	20	460
133	1.3	5Go 4Ce 1Ca	6.1.3.2.	513.1	2401	NE	26	410 – 470
205	3.6	8Go 1St 1Ce	6.1.5.3.	511.1	2201	S	25	350 – 440
207	1.1	4St 4Go 1Ce1Ca	6.1.5.2.	511.3	2201	E	20	420

These stands are included in production and protection functional Group II, functional category 1B - forests intended to mainly produce high quality thick wood and timber.

In terms of forest formations where the Turkey oak species is present, there are pure oak forests and mixed forests with oak. Tree species that form mixed stands are sessile oak (*Quercus petraea* ssp. *petraea*), pedunculate oak (*Quercus robur*) and hornbeam (*Carpinus betulus*), and the proportion of participation of the species in composition is between 10–40%.

Minimum altitude at which species occur in parcel 7 is 330 m and maximum altitude is 470 m, average altitude is 400 m and the relief energy is 140 m. The predominant slope exposition is sunny (S, SW) 14.3 hectares (63%) and partly sunny (E, SE) 7.2 ha (31%), and the shaded exposition (NE) 6% occurs in plot 133. The slope is in the range 20°–30° which falls within moderately slope category, and the main relief unit in the analyzed parcels is corrugated slope 100%.

In terms of forest vegetation distribution, these forests are integrated in: Central European Region - East Carpathian Province - Carpathians Subprovince - Maramureş and Rodna Mountains District.

According to the latitudinal zoning, Turkey oak species from Ronişoara Depression belongs to the nemoral deciduous forests of Central Europe, mesophilic forests subzone. According to the altitudinal zoning of vegetation, the species is found in hilly area, which comprises of sessile oak forests mixed with oak, and according to geobotanical regionalization based on forest fitoindicators, forests are part of the Carpathian region.

The type of forest station (Chiriţă et al., 1977) on which these forests grow are: 6.1.5.2. – Hills with sessile oak or Turkey oak, Hungarian Oak forests and Hungarian Oak-Turkey Oak forests (*Quercetum frainetto-cerris*) with medium bonitation, stagnic preluvisols, middle edaphic - FD_2, GoCeGâ. Bm. T_{III}. H_{E-I}. Ue_1 (mesotrophic soils overly-oligohydric, dry-wet) from hilly oak forests level (of sessile oak, Turkey oak,

Hungarian oak and mixtures of these) and mixed forests on hilly area (FD_2) and 5.1.5.2. Hills with sessile oak with medium bonitation, medium edaphic luvisol with *Festuca heterophylla* +/- *Luzula albida* - FD_3, Go. Bm. T_{II}. H_{II}. Ue_{2-1} (oligomezotrophic soil, mezohydric, wet-dry-wet), from hilly sessile oak level, beech forests and beech-sessile oak forests (FD_3), characterized by medium productive potential 84% and high productive potential 16%.

Natural forest types (Paşcovschi and Leandru, 1958) from these stands are 511.3. – sessile oak forest with mull flora, medium productivity (79%), 511.1. – normal sessile oak forest with mull flora, higher productivity (16%) and 513.1. – coastal sessile oak forest with grasses and *Luzula luzuloides*, medium productivity, parcel 133 occupies an area of 1.3 hectares (5%).

By the type of habitat, according to Romanian habitats (Doniță et al., 2005), types of forest in parcels 6, 7, 43, 133, 205 and 207, from the Ronişoara Basin correspond to: Geto-Dacian oak forests (*Quercus petraea*) with *Dentaria bulbifera* (R4128). This habitat type corresponds to Natura 2000 habitat classification type 91Y0 - Dacian oak and hornbeam forests.

These types of forest correspond to: *Dentario bulbiferae-Quercetum petraea* Resmeriță (1974) 1975; and the type of ecosystem 5116 – Oak forest with *Asperula-Asarum-Stellaria* (Lazăr et al., 2007).

Soil types determined in the parcels are: soil 2201 – typical preluvisol (typical brown argillic), profile: *Ao-El-Bt-C*, which covers an area of 21.5 ha (94%) and 2401 – typical luvisol (typical brown luvic) profile: *Ao-El-Bt-C* (6%), belonging to luvisols class (Târziu, 2006).

Main characteristics of Turkey oak stands

Effective area of Turkey oak in Ronişoara Basin is 3.68 ha (23%) of the total area of 22.8 ha. Description of Turkey oak species inside the parcels is shown in the table below (Tab. 2).

Table 2: Description of Turkey oak species inside the parcels.

Parcel (a. u.)	Efective area (ha)	Regeneration type	Age (years)	Average diameter (cm)	Average height (m)	Production class	Consistency	Volume		Average annual growth (mm/y)
								m^3/ ha	m^3/ a. u.	
6	2.02	LT	60	28	19	2	0.16	39	394	1.3
7	0.61	LT	75	28	20	3	0.07	18	110	0.4
43	0.06	IN	10	4	3	3	0.09	1	1	0.3
133	0.52	LT	80	30	21	3	0.28	81	105	1.5
205	0.36	LT	70	28	20	3	0.08	21	76	0.5
207	0.11	LT	70	32	21	3	0.07	20	22	0.4

The characteristics of Turkey oak stands from Ronişoara Basin are: origin, regeneration type, age, production class and condition of vegetation.

According to origin, the stands are natural, developed from seeds and from shoots or suckers. According to regeneration type, the trees are from shoots (LT), regenerated by vegetative means, except trees from parcel 43, in which the trees originated from seed through natural seeding (IN), and the average age is 60 years and production class is III, except parcel 6, which is class II.

Regarding the state of vegetation, Turkey oak stands are within the normal state of vegetation, it follows that the stands are located in the areas with medium bonitation. Natural pruning (branch removal) is 50% of the tree height, consistency is included in the category with nearly full consistency (K = 0.7 to 0.9).

Average diameter of trees in parcel 133 is, at the age of 80 years, 30 cm, average tree height is 21 m and average diameter of trees in parcel 43 at age 10, is 4 cm, and average tree height is 3 m.

Largest volume of timber per hectare is achieved in parcel 133 (81 m^3), in the entire administrative unit is 105 m^3 and the total volume of timber according to forest management plans is 708 m^3.

Minimum average annual growth of the Turkey oak is in parcel 43 of 0.3 mm/year at age 10, maximum growth in parcel 133, 1.5 mm/year at the age of 80 years and the average annual growth is 0.7 mm/year.

CONCLUSIONS

This paper presents the distribution of stands from Ronişoara Basin, in the composition of which is *Quercus cerris* and also the station and stands description based on data from the administrative plan of production unit IV Ronişoara of Sighet Forest District.

Only a few authors have mentioned in scientific papers, describing the spreading area, the presence of Turkey oak in Maramureş (Georgescu and Morariu, 1948), namely Sighet (Haralamb, 1967), where isolated specimens can appear also in Maramureş, at Sighetu–Marmaţiei (Şofletea and Curtu 2004, 2007), but it is mentioned in the hilly oak forests and sessile oak in Maramureş, where occupies the main layer of trees (Ardelean and Béres, 2000).

All over Transylvania this species is found on hills, only in Maramureş is found on plains (Haralambos, 1967) and in Ronişoara Depression appears as two groups: on the slopes with sunny and partly sunny exposition, with an altitude between 330 and 470 m, but there are trees spread in the parcel 84A of Ronişoara Natural Forest Reserve which is located on Hera Hill. It is worth noting that from the natural range of species distribution, specimens isolated in this depression are actually the most northern of the country.

The hilly area on which this species grows is most affected due to immediate vicinity to human activities (anthropic factor), large areas being cleared for the need to cover building materials market, either for firewood or for expansion of pastures and meadows (Boar, 2005).

The wood is inferior compared to other species of oak, with wide sapwood, yellowish-red, red heartwood, visible annual rings, hard, heavy, but less durable in contact with the air, water resistant, has a heavy odor, it is hard to work with, has few uses in industry, but remains highly regarded as firewood (has the same value as that produced by species like beech and hornbeam).

Quercus genus in Ronişoara Depression is well represented by three species *Quercus petraea* ssp. *petraea*, *Quercus robur* and *Quercus cerris* (in very small proportion), therefore we can speak of high biodiversity of oak species in depression.

Keeping a good proportion of this species would be appropriate due to abundant fructification; seeds (acorns) are important food for game (wild boar and bear) and also for birds (jay).

The main stress factors and potential negative limitations in the habitat where the species is found are: lack of clear site limits, inadequate forest management, improper timber extraction, repeated regeneration from shoots, illegal cutting, grazing and livestock passing through habitat especially in spring and autumn, burning vegetation on the land surrounding the habitat, invasion of forest species (Lazăr et al., 2007).

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CONTRIBUTIONS TO THE PHYTOCOENOLOGICAL STUDY OF THE NARD GRASSES IN THE UPPER CATCHMENT BASIN OF THE ORĂŞTIE RIVER (ROMANIAN CARPATHIANS)

Valeriu-Ioan VINŢAN [1] and *Petru BURESCU* [2]

KEYWORDS: phytocoenoses, association, grasslands, floristic elements, life forms, ecological indices, *Nardus stricta*, *Viola declinata*, Orăştie.

ABSTRACT

In the present paper we aim at a phytocoenological study of the coenoses of the association *Violo declinatae-Nardetum* Simon 1966 (of the *Nardo-Callunetea* Preising 1949 class) as identified in the upper catchment basin of the Orăştie River situated in the Şureanu Mountains of central-western Romania.

The characterisation of the analysed association and the presentation of the synthetic table of the association was achieved by selecting the most representative sampling sites in the natural grasslands consisting of *Nardus stricta* with *Viola declinata* from the upper catchment area of the Orăştie River.

The phytocoenoses of the association *Violo declinatae-Nardetum* Simon 1966 present in the upper catchment basin of the Orăştie River, having a low diversity of just 27 species, boast the presence of two Carpathian endemic bellflower species (*Campanula serrata* and *C. rotundifolia* subsp. *polymorpha*), and exhibit a moderate conservational value.

This study aims to analyse the phytocoenoses of this association from the physiognomic, floristic composition, life forms and floristic elements, as well as from the perspective of ecological indices.

REZUMAT: Contribuţii la studiul fitocenologic al nardetelor din bazinul superior al râului Orăştie (Carpaţii Româneşti)..

În prezenta lucrare, facem un studiu al cenozelor asociaţiei *Violo declinatae-Nardetum* Simon 1966 (clasa *Nardo-Callunetea* Preising 1949), identificate în bazinul superior al râului Orăştie, situat în Munţii Şureanu (Carpaţii Meridionali), din partea central-vestică a României.

Caracterizarea asociaţiei studiate şi prezentarea tabelului sintetic al asociaţiei au fost realizate prin selectarea celor mai reprezentative relevee efectuate în pajiştile de *Nardus stricta* cu *Viola declinata* din bazinul superior al râului Orăştie.

Fitocenozele asociaţiei *Violo declinatae-Nardetum* Simon 1966, prezente în bazinul superior al râului Orăştie, cu o biodiversitate scăzută (27 specii), au în componenţa lor 2 endemite carpatice (*Campanula serrata*, *Campanula rotundifolia* ssp. *polymorpha*), prezintă o valoare conservativă moderată.

Acest studiu îşi propune să analizeze fitocenozele asociaţiei sub aspectul fizionomiei şi compoziţiei floristice, bioformelor, elementelor floristice şi indicilor ecologici.

RÉSUMÉ: Contributions à l'étude phytocenologique des nardetes du bassin supérieur du rivière Orăştie (Les Carpates Roumains).

Dans cet article nous faisons une étude phytocenoloqique des cénoses de l'association *Violo declinatae-Nardetum* Simon 1966 (classe de *Nardo-Callunetea* Preising 1949) identifiées dans le bassin supérieur de la rivière d'Orăştie, situé dans le Şureanu montagnes (Carpates Méridionales) du centre-ouest de la Roumanie.

La caractérisation de l'association étudiée et la présentation du tableau synthétique de cette association ont été réalisées en sélectionnant les enquêtes menées dans les prairies du *Nardus stricta* et *Violo declinata* du bassin supérieur de la rivière d'Orăştie.

Les phytocénoses de l'association *Violo declinatae-Nardetum* Simon 1966 présentes dans le bassin supérieur du rivière Orăştie, d'une biodiversité réduite (27 espèces) et composées de deux endémiques des Carpates (*Campanula serrata*, *Campanula rotundifolia* ssp. *polymorpha*), présentent une valeur de conservation modérée.

Cette étude vise à analyser les phytocénoses du point de vue de leur physionomie et de leur composition floristique, des bioformes, des éléments floraux et des indices écologiques.

INTRODUCTION

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

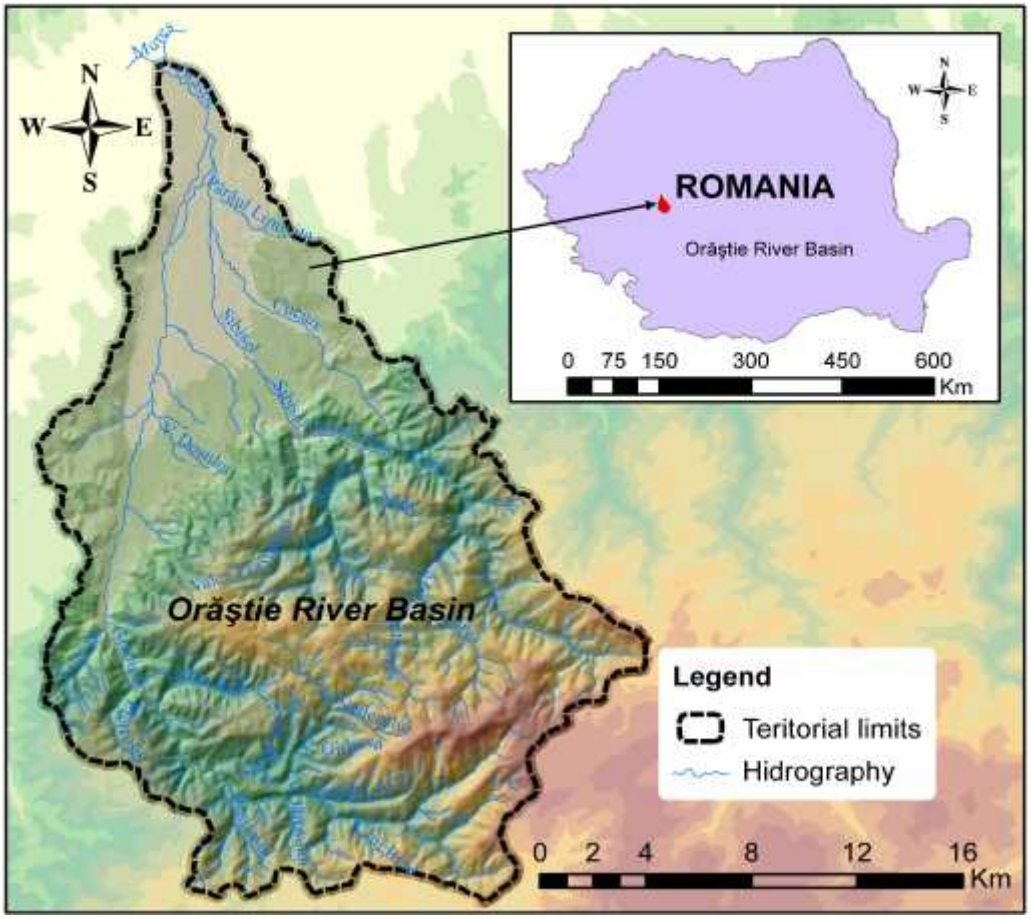

Figure 1: The position of the Orăştie River basin in Romania.

The Şureanu Mountains consist of meso-metamorphic and epi-metamorphic schists surrounded peripherically by some areas of sedimentary rocks (sandstones, conglomerates, limestones) (Trufaş, 1986). We must add that within the studied territory only a fraction of Şureanu Mountains is included, the west-north-western one commonly known as the Orăştie Mountains or the Mountains of the Dacian Fortresses.

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

The thermal differences between the outskirts of the mountains and the high ridges are of roughly 10 degrees Celsius. Towards their north-western limits, due to warm air incursions from the Banato-Crişana plains, the average temperatures range from 9 to 10 degrees Celsius.

In winter, the average temperatures vary between minus 2 and minus 7 degrees Celsius, in spring they rise by 6 to 12 degrees, in summer they reach 8 degrees on the mountain tops and over 19 degrees on the outskirts, while in autumn the average temperatures decrease by 5.5 to 7 degrees as compared to those in summer months.

The rainfall amounts in multiannual average to approximately 550–600 mm in the outskirts and to over 1,000 mm in the high altitude central parts. In the whole of Transylvania the rainfall quantum is 500 to 700 mm per year (Pătru et al., 2006).

In Europe the nard grasses are spread in all of the highlands of the Pyrenees, Alps, Tatra, Carpathians, Appenines, Balkans, etc., down to as low as 700–800 m altitude in valleys (Maruşca et al., 2010). South-eastern Carpathian nard grasslands with *Nardus stricta* and *Viola declinata* are spread all throughout the Carpathian range in Romania at altitudes of 800 to 2070 meters and on patches of 1,000 to 2,000 hectares; they exhibit a moderate conservational value and stand for a top priority European habitat (Doniță et al., 2005). Along with the characteristic species, *Nardus stricta* and *Viola declinata*, other innumerable species of *Poaceae* genera: *Festuca rubra*, *Festuca ovina*, *Agrostis tenuis* etc., remnants of former associations such as *Festuco rubrae-Agrostetum capillaris*, *Potentillo-Festucetum ovinae* which this phytocoenosis replaced subsequent to a process of soil acidification and compression (Maruşca et al., 2010).

These grasslands are present in the Eastern Carpathians, the Southern Carpathians, and the Western Carpathians, as described by a series of authors quoted in the reference list: Pop et al. (2002), Grigoriu et al. (2004), Niculescu (2004), Maruşca et al. (2010).

Thorough floristic and phytocoenologic research has never before been carried out on the nard grasslands with *Viola declinata* in the upper catchment basin of the Orăştie River. On reviewing the literature we came across some descriptions of the nard grasslands in the Şureanu Mountains, written by Simtea and Cernelea (1985), whereas Borza (1959), realises a study in the Sebeş River valley of the Şureanu Mountains..

MATERIALS AND METHODS

The vegetation studies of the upper catchment basin of the Orăştie River (central-western Romania) were carried out between the years 2009 and 2011 targeting all types of sites indicative of the association *Violo declinatae-Nardetum* Simon 1966. The vegetation research deployed the phytocoenologic survey methods drawn up by Braun-Blanquet (1964), adjusted according to the particularities of the studied region. The sampling technique and the annotations (quantitative appraisals) were performed according to the indications given by Borza and Boşcaiu (1965). The associations were identified using the species for the recognition, without neglecting the differential and dominant species.

In order to thoroughly identify the phytocenoses of the association, we performed a total of 12 phytocoenologic sampling incursions, of which 7 incursions were included in the synthetic table of the association (Tab. 1). The sampling sites were carefully chosen within the pristine patches of the phytocoenoses, and were 100 square metres of size (Cristea et al., 2004)..

Table 1: Association *Violo declinatae-Nardetum* Simon 1966 in the Orăştie River basin.

L. f.	F. e.	U.	T.	R.	No. Land Surveys	1	2	3	4	5	K	AD m (%)
					Altitude (m. s. m.)	1280	1320	1440	1450	1620		
					Exposition	NE	N	NE	S	SV		
					Slope (º)	6	2	2	6	8		
					Coverage (%)	100	95	100	95	95		
					Surface (m^2)	100	100	100	100	100		
0	1	2	3	4	5	6	7	8	9	10	11	12
H	Carp-B	3.5	2	3	*Viola declinata*	+	+	+	+	+	V	0.50
H	E	0	0	1.5	*Nardus stricta*	5	5	5	5	5	V	87.5
Potentillo-Nardion												
TH	Carp-B	3.5	2	2	*Campanula abietina*	+	+	+	.	.	III	0.30
H	End-Carp	2	0	3	*Campanula rotundifolia polymorpha*	+	+	.	.	.	II	0.20
H	End-Carp	0	2.5	0	*Campanula serrata*	+	.	+	.	.	II	0.20
Ch	Eua	2	2	2	*Veronica officinalis*	.	+	.	+	.	II	0.20
Nardetalia* et *Nardo-Callunetea												
H	Circ	3	1	2	*Festuca nigrescens*	1	+	1	+	1	V	3.20
H	Eua	4	1	0	*Potentila erecta*	+	+	+	+	.	IV	0.40
H	Eua	4	3	2	*Hypericum maculatum*	.	+	+	+	.	III	0.30
H	Eua	2.5	0	0	*Hieracium pilosella*	+	.	.	+	.	II	0.20
H	Eua	3	0	3	*Luzula campestris*	.	+	+	.	.	II	0.20
H	E	0	3	2	*Danthonia decumbens*	+	.	+	.	.	II	0.20
Th	Ec	3	3	0	*Euphrasia stricta*	+	.	.	+	.	II	0.20
H	Eua	3	3	3	*Polygala vulgaris*	+	.	.	.	.	I	0.10
Vaccinio-Piceetea												
Ch	Circ	0	2	1	*Vaccinum myrtillus*	+	+	+	+	+	V	0.50
nPh	Circ	2.5	2.5	1.5	*Bruckentalia spiculifolia*	+	+	+	+	+	V	0.50
H	Circ	2	0	1	*Deschampsia flexuosa*	+	+	+	+	+	V	0.50

0	1	2	3	4	5	6	7	8	9	10	11	12
Ch	Circ	3	2	1	*Vaccinum vitis-idaea*	.	.	.	+	+	II	0.20
Variae syntaxa												
Ch	P-Pan	1.5	4	0	*Thymus glabrescens*	.	+	+	+	.	III	0.30
H	Circ	0	0	0	*Agrostis capillaris*	.	+	.	.	+	II	0.20
H	Eua	2.5	2	3	*Stellariia graminea*	.	+	+	.	.	II	0.20
H	Ec	2.5	0	0	*Carlina acaulis*	.	.	+	.	.	I	0.10
H	E	2.5	2.5	2	*Luzula luzuloides*	+	.	.	.	.	I	0.10
H	Eua	3	3	0	*Hypericum perforatum*	.	.	.	+	.	I	0.10
H	Eua	2.5	3	3	*Ranunculus polyánthemos*	.	.	.	+	.	I	0.10
H	Eua	2	3	4	*Silene nutans*	+	.	.	.	.	I	0.10
.	.	.	.	.	*Polytrichum strictum*	.	.	+	.	.	I	0.10

Sampling sites: 1. Rudele; 2-3. Meleia; 4. Poiana Tâmpu; 5. Steaua Mică; 03.08.2010; where: L. f. - life forms: H - Hemycriptofites; Ch - Chamaephytes; Th - Euterophytes; TH - Hemiterophytes; F. e. - floristic elements: Eua - Eurasian; nPh - Nanophanerophytes; Circ - Circumpolar; E-European; Ec – Central European; Carp-B – Carpatho-Balkan; P-Pan – Pontic-Pannonian; End-Carp – Carpathian endemism; Ecological indices: U – humidity; T – temperature; R – the chemical reaction of the soil.

The phytocoenologic worksheets contain various information regarding the stational habitat conditions in which the phytocenoses evolve: rock, soil, altitude, exposition, slope, vegetation coverage. At the same time when we took down the taxa that define each sampling site we also gave a quantitative appraisal of the participation of each and every species with respect of abundance and dominance, in accordance with the method proposed by Braun-Blanquet and Pavillard (1928), and we penciled in the overall existing vegetation coverage using the method designed by Tüxen (1937) and Ellenberg (1974).

The synthetic table of the association was concocted according to the methodology designed by Braun-Blanquet (1964) and improved by Ellenberg (1974). By framing the association into the superior coeno-taxonomic units, namely suballiance, alliance, order, class, we took into consideration the traditional ecological-floristic systems developed by Tüxen (1955), Braun-Blanquet (1964), Borza and Boşcaiu (1965), Soó (1964–1980), as well as the more recent papers by researchers such as Mucina et al. (1993), Borhidi (2003), Sanda et al. (2008).

The phytocoenologic table for this association consists of information pertaining to the floristic and coenologic composition of the plant population rendering the phytocoenosis, the life form, the floristic (phytogeographic) element, the ecological indices of humidity (U), temperature (T), soil reaction (R), the ordinal number of the sampling site, the absolute altitude (metres above sea level), the exposition, the overall vegetation coverage (%), the sampled surface (square metres). In the last two columns of the table we marked the synthetic

phytocoenologic indices, namely the constance of species (K) and the average abundance-dominance (ADm). The constance of species (K) whose classes are marked by Roman digits from I to V, stands for the degree of coenotic fidelity of each species. The values of the synthetic phytocoenologic indices, constance (K) and average abundance-dominance (ADm), were calculated using the methods proposed by Braun-Blanquet and Pavillard (1928), Cristea et al. (2004).

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

RESULTS AND DISCUSSIONS

The phytocoenoses of the association *Violo declinatae – Nardetum* Simon 1966, present in the upper catchment basin of the Orăştie River, the Şureanu Mountains (central-western part of the Romanian national territory), occupy the high flat lands and the gently inclined slopes (2 to 8 degrees) with varied exposition (N, NE, S, SV), present at altitudes of around 1280–1620 m. The overall vegetation coverage is between 95% and 100%. This specific association prefers spodisoils with short profiles, poorly aerated and acid (Pop et al., 2008).

The phytocoenoses of the association *Violo declinatae-Nardetum* Simon 1966 (Fig. 2), were identified in the following places: Rudele, Meleia, Poiana Tâmpu and Steaua Mică.

The physiognomy and the floristic composition. The physiognomy of the association is given by the characteristic and edifying species *Viola declinata* (K = V, ADm = 0.50%) and *Nardus stricta* (K = V, ADm = 87.50%). In the floristic composition of the association there are also the species subordinated to the **alliance *Potentillo-Nardion*** Simon 1959 (*Campanula abietina*, *Campanula rotundifolia* ssp. *polymorpha*, *Campanula serrata*), followed by the ones subordinated to the **order *Nardetalia*** Oberdorfer 1949 and to the **class *Nardo-Callunetea*** Preising 1949 (*Festuca nigrescens*, *Potentila erecta*, *Hypericum maculatum*, *Hieracium pilosela*, *Luzula campestris*). Apart from these species which are characteristic of the coeno-taxa subordinating the association, a small number of species transgressed from the **class *Vaccinio-Piceetea*** (*Vaccinum myrtillus*, *Bruckentalia spiculifolia*, *Deschampsia flexuosa*). In the phytocoenoses of this association some Carpathian endemits were identified as following: *Campanula rotundifolia* ssp. *polymorpha*, *Campanula serrata* (Ciocârlan, 2009).

The life forms spectrum (Fig. 3) emphasizes the large majority of the hemi-cryptophytes (H = 73.07%; *Viola declinata*, *Nardus stricta*, *Festuca nigrescens* and *Luzula campestris*), which suggests the presence of a moderately cool climate towards excessively continental favouring the herbal vegetation in the mountainous grasslands. The presence of the chamephytes (Ch = 15.38%; *Vaccinium myrtillus*, *Vaccinum vitis-idaea*) in the life forms spectrum suggests the presence of a cool and wet climate resembling that of the boreal zone. The annual and biannual terophytes share a small percentage (Th + TH = 7.68%; *Campanula abietina*, *Euphrasia stricta*), indicating an intensive sheep grazing.

Figure 2: *Violo declinatae – Nardetum* Simon 1966 association
around the Steaua Mică Peak
(Şureanu Mountains).

The floristic elements spectrum (Fig. 4) is dominated by the Eurasian species (Eua = 38.46%), followed by those European (E = 11.53%) and those Central-European (7.69%), totalling 19.22% of the entire floristic elements. The large presence of the Eurasian elements (*Veronica officinalis*, *Hieracium pilosela, Polygala vulgaris*) is due to the presence of a moderate continental climate, whereas that of the European elements (*Danthonia decumbens, Luzula luzuloides*) and Central-European ones (*Eupharasia stricta, Carlina acaulis*), is closely linked with the excessively continental, even dry, climate in which these species grow. The circumpolar elements (Circ = 23.07%; *Festuca nigrescens, Vaccinium myrtillus, Vaccinum vitis-idaea*), are present in a significant share, due to the low temperatures in the upper catchment area of the Orăştie River. The Balkan-Carpathian species (Carp-B = 7.69%; *Viola declinata, Campanula abietina*) are characteristic of the above mentioned mountainous ranges. The Pannonian-Ponthic elements (P-Pan = 3.84%), are linked to the ancestral climate of the former Pliocene lakes of Pannonia and Ponthus. In the region there grow endemits, (End = 7.69%), not to be found elsewhere in the world.

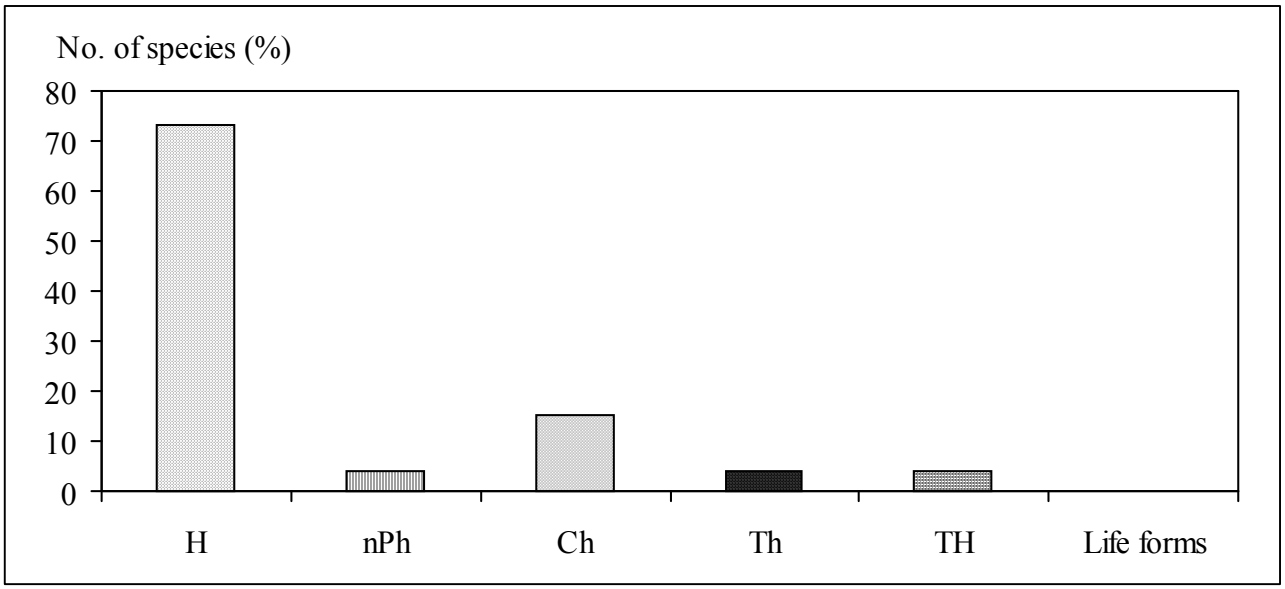

Figure 3: The life forms spectrum of association *Violo declinatae-Nardetum* Simon 1966, where: H – Hemicryptophytes; nPh – Nanophanerophytes; Ch – Chamaephytes; Th – Annual terophytes; TH – Biennial terophytes.

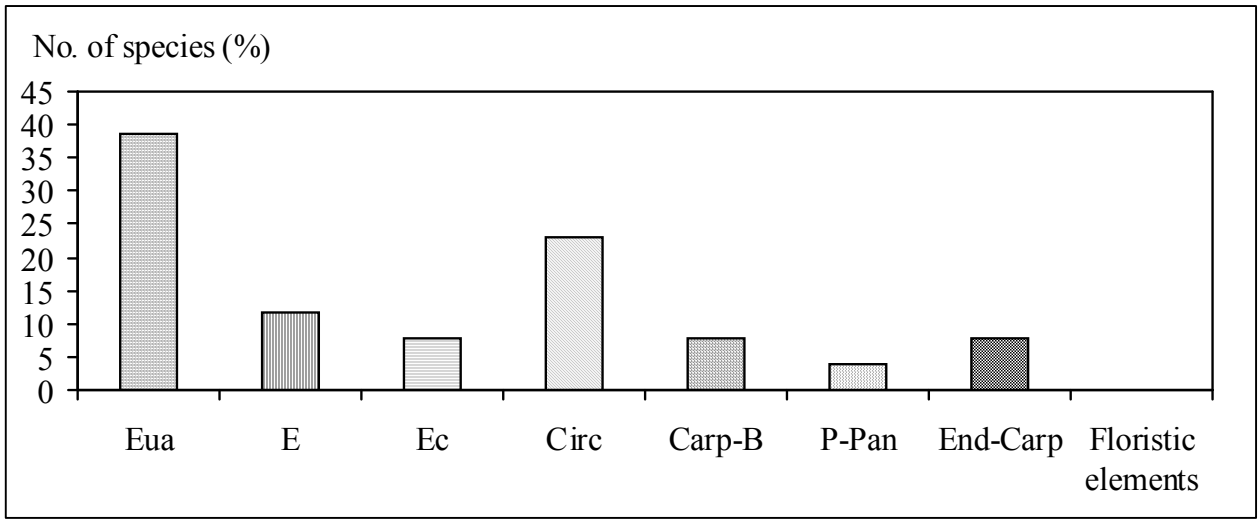

Figure 4: Spectrum of floristic elements of the association *Violo declinatae-Nardetum* Simon 1966, where: Eua - Eurasian, E – European, Ec – Central European, Circ – Circumpolar, Carp-B – Balkan-Carpathian; P-Pan – Ponto-Panonic; End-Carp – Carpathian endemists.

The analysis of the diagram of ecological indices (Fig. 5) reveals a majority of xero-mesophylous species ($U_{2-2.5}$ = 38.46%; *Veronica officinalis, Hieracium pilosella, Bruckentalia spiculifolia, Deschampsia flexuosa, Carlina acaulis*), growing on dry soils in places with a small and just seasonal water deficit, followed by mesophylous species ($U_{3-3.5}$ = 30.76%; *Viola declinata, Campanula abietina, Festuca nigréscens*), growing in places with sufficient humidity, they being amphitolerant to soil humidity (U_0 = 19.23%; *Nardus stricta, Campanula serrata, Danthonia decumbens, Vaccinum myrtillus*), meso-hygrophylous species growing in places with higher humidity ($U_{4-4.5}$ = 7.69%; *Potentila erecta, Hypericum maculatum*) as well as xerophylous species ($U_{1-1.5}$ = 3.84%; *Thymus glabrescens*), which grow in places with a seasonal water deficit.

The behaviour towards the temperature regime stresses out the great percentage of microthermal species adjusted to cold places ($T_{2-2.5}$ = 34.61%; *Viola declinata, Campanula abietina, Campanula serrata, Vaccinum vitis-idaea*), followed by micro-mesothermal species which need a temperature regime of 6ºC-10ºC ($T_{3-3.5}$ = 26.92%; *Danthonia decumbens, Euphrasia stricta, Polygala vulgaris, Ranunculus polyánthemos*) as well as eurithermal ones which are adjusted to a high amplitude of thermal variability (T_0 = 26.92%; *Nardus stricta, Campanula rotundifolia* ssp. *polymorpha, Potentila erecta, Hieracium pilosella*). The criophylous species adjusted to constantly low temperatures ($T_{1-1.5}$ = 7.69%; *Festuca nigréscens, Potentila erecta*) and the moderately thermophylous ones, which need a temperature regime of 10ºC-15ºC ($T_{4-4.5}$ = 3.84%; *Thymus glabrescens*), have much smaller percentages.

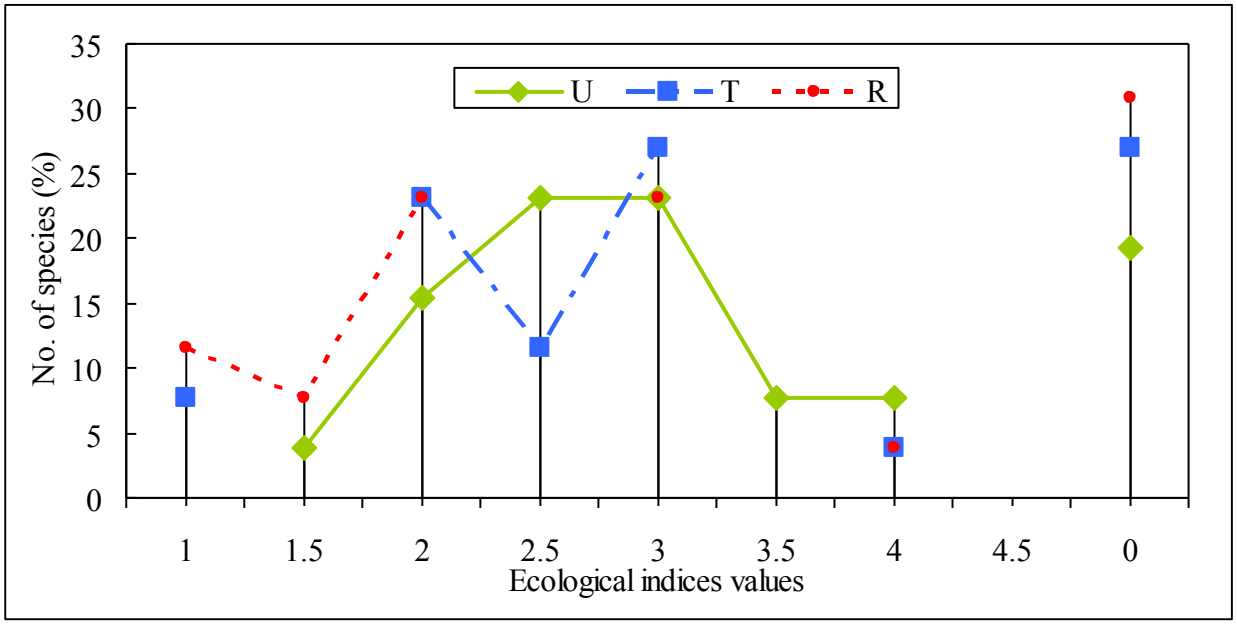

Figure 5: Diagram of ecological indices for the association *Violo declinatae-Nardetum* Simon 1966, where: U – humidity, T – temperature,
R – the chemical reaction of the soil.

The chemical reaction of soils is transparent in the corresponding percentages of the following ecological categories: euri-ionical with much tolerance towards the chemical reaction of soils (R_0 = 30.76%; *Campanula serrata*, *Potentila erecta*, *Hieracium pilosella Euphrasia stricta*), acidophylous favouring strongly to moderately acid soils (R_2 = 23.07%; *Campanula abietina*, *Veronica officinalis*, *Hypericum maculatum*), acido-neutrophylous linked with moderately to weakly acid soils (R_3 = 23.07%; *Viola declinata, Luzula campestris*, *Polygala vulgaris*). The highly acidophylous species growing on highly acid soils have a considerable percentage (R_1 = 19.23%; *Nardus stricta*, *Vaccinum myrtillus*, *Deschampsia flexuosa*, *Vaccinum vitis-idaea*), as compared to the weakly acid or neutrophylous species growing on neutral to weakly acid soils (R_4 = 3.84%; *Silene nutans*). The great share of the highly acidophylous (R_1 = 19.23%) and acidophylous species (R_2 = 23.07%) in the phytocoenoses of the association *Violo declinatae – Nardetum* Simon 1966, in the upper catchment basin of the Orăştie River is due to the highly acid or moderately acid pH of the soil developed on acid rocks (micaschists, quartzites, silica sandstones, quartziferous sands etc.) (Pătru et al., 2006).

Pop et al. (2002) make a synthetic analysis of the *Violo declinatae-Nardetum* Simon 1966 association, based on the surveys performed by multiple botanists in Cluj County (Gilău Mountains, Mare Mountain, Băişoara Mountain, Vlădeasa Mountain).

The comparison between the nard grasses with *Viola declinata* analysed by Pop et al. (2002) in Cluj County and those we investigated in the upper basin of the Orăştie River brings up a series of similarities and differences.

The floristic inventory of the nard grasses with *Viola declinata* from Cluj County includes 83 chormophyte species, 2 bryophyte species and 2 species of lichens, the majority of the species being characteristic of the ***Nardo-Callunetea*** Preising 1949 **class**, the ***Nardetalia*** Oberdorfer 1949 **order** and of the ***Potentillo-Nardion*** Simon 1959 **alliance** that subordinates the association (32.50%), as well as for the coenotaxa of the ***Molinio-Arrhenatheretea*** **class** (38.50%). The phytocoenoses of the *Violo declinatae-Nardetum* Simon 1966 association from the upper basin of the Orăştie River consists of 26 chormophyte species and 1 bryophyte species, the majority of the species being characteristic of the coenotaxa subordinating the association (51.85%), 14.81% are species transgressed from the *Vaccinio-Piceetea* class, while 33.34% are accompanying species.

The life forms spectrum is dominated by hemicryptophytes 71.10% (Cluj County), 73.07% (Orăştie River), followed by camephytes 9.60% (Cluj County), 15.38% (Orăştie River), terrophytes 9.60% (Cluj County), 15.38% (Orăştie River), nanofanerophytes 1.20% (Cluj County), 3.84% (Orăştie River). The phytocoenoses of the *Violo declinatae-Nardetum* Simon 1966 association in Cluj County also include some geophytes (8.40%), life forms which are not present in the upper basin of the Orăştie River.

The floristic elements spectrum reveals a high percentage of Eurasian species: 33.70% (Cluj County), 38.46% (Orăştie River basin), followed by the European species: 20.50% (Cluj County), 11.53% (Orăştie River basin), Central-European 16.80% (Cluj County), 7.69% (Orăştie River basin), Circumpolar 15.30% (Cluj County), 23.07% (Orăştie River basin). The Dacian-Balkan elements (8.40%), the Alpine-Carpathian ones (2.40%) and the Cosmopolitan ones (2.40%) are present only in Cluj County, while the Balkan-Carpathian elements (7.69%), the Carpathian endemits (7.69%) and the Ponthus-Pannonian ones (3.84%) are to be found only in the upper basin of the Orăştie River.

The ecological indices diagram for the phytocoenoses of the Cluj County reference association reveals that based on humidity, the majority of the species are

mesophylous and mesohygrophylous (55.53%), as compared to the xero-mesophylous (28.50%) being present in a much lower percentage, while in the upper basin of the Orăştie River, the mesophylous and mesohygrophylous species (38.45%) have a percentage close to that of the xero-mesophylous species (38.46%).

For what the temperature factor is concerned, among the phytocoenoces of the *Violo declinatae-Nardetum* Simon 1966 association from the Cluj County, the eurithermal species are predominant (40.90%), followed by the microthermal (28.90%) and the cryophylous ones (8.40%), while in the upper Orăştie River basin the microthermal species represent the majority (34.61%), followed by the micromesothermal and the eurithermal ones in equal percentages (26.92%), followed by the cryophylous elements (7.69%).

In the phytocoenoces of the association analyzed by Pop et al. (2002) in Cluj-Napoca, the chemical reaction of soils is illustrative of the percentage values for the following ecological categories: eurionical (32.50%), acid-neutrophylous (28.90%), highly and moderately acidophylous (27.70%). For what the Orăştie River upper basin is concerned, the chemical reaction of the soil differentiates a majority of eurionical species (30.76%), followed by acidophylous (23.07%), acid-neutrophylous (23.07%), highly acidophylous (19.23%) and weakly acid-neutrophylous (3.84%) species.

The percentage differences with respect of the physiognomy and floristic composition, the ecological indices, the life forms, and the floristic elements are due to the positioning (altitude, climate, land forms, rock formations, soil) of the different places harbouring the phytocoenoses of the association, as well as to the human impact (through grazing, use of fertilizers in hopes of bettering the productivity etc.) on the nard grasses of the two regions (Cluj County and Orăştie River basin).

The long presence of nard grasses in the above-the-tree-line highlands determined an increase of the soil pH and their wide spreading in the territory, unlike the grasses from the partially grazed highlands where there transgressed the species of *Festuca nigrescens* and *Agrostis capilaris.* The nard grasses from the upper catchment basin area of the river Orăştie (Şureanu Mountains) exhibit a poor floristic composition due to grazing and unfavourable climatic and vegetation conditions. These grasslands stand for a natural environment for important species of flora (they harbour Carpathian endemits), and have an important role in the protection of slopes against erosion. By maintaining landscape diversity and specificity, the tourist ratings of these highlands increase (Pop et al., 2008).

CONCLUSIONS

The phytocoenoses of the *Violo declinatae-Nardetum* Simon 1966, association cover at different rates the high plateaux and the gently inclined slopes of Rudele, Melea, Poiana Tâmpu and Steaua Mică in the upper catchment basin of the Orăştie River (central-western Romania). The grasslands of the above mentioned locations extend on a surface of approximately 400 ha, 60–70% of which are occupied by the phytocoenoses of the *Violo declinatae-Nardetum* Simon 1966 association.

Doniţă et al. (2005) state in the ″Habitatele din România″ that the south-eastern Carpathian grasslands of *Nardus stricta* and *Viola declinata* are classified as part of R 3609 habitat (R 3609 being the habitat's code), an European priority habitat with a moderate conservational value.

The grasslands of *Nardus stricta* and *Viola declinata* researched by us, are part of the Grădiştea Muncelului-Cioclovina Natural Reserve (sit Natura 2000). The Natura 2000 network includes the most important natural areas that ensure the protection of vulnerable European flora, fauna and habitats. The aim of the protective actions is to preserve these habitats on the long run, and if necessary to restore the favourable conservational status.

In these grasslands, special management measures are mandatory: the return of the traditional grazing, which allows for the conservation of this sort of habitat; avoiding overgrazing, which brings about a downgrading of the floristic composition, as well as the dismissal of mobile sheep enclosures, which brings about the changing of the vegetation type, forbidding the practice of soil enrichment using carbonates, which is likely to bring about the extinction of the species *Nardus stricta* (Maruşca et al., 2010).

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*** http://www.gradiste.ro, accessed in 6 January 2012

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WET HABITATS IN MOSAIC PATCHES WITH DRY HABITATS ON HILL SLOPES OF THE SOUTHERN TRANSYLVANIAN TABLELAND (ROMANIA)

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KEYWORDS: dry slopes, seepage water, wet habitats, xero-mesophilous grasslands, reed communities.

ABSTRACT

On many of south-facing hills in the Transylvanian Tableland, small wetland communities can be found nestling between the dry or semi-dry grasslands on the middle and lower parts of the slope, distinguishing by the dominance of Common Reed (*Phragmites australis*) or the occurrence of other indicator plants for wetness or for soils well saturated with water. These patches are influenced by the structure of the hills, with their layers of different permeability. When the infiltration water passing through the sandy layers arrives on the less permeable marl and clay layers, it runs along the layer and seeps out on the slope. In such places influenced by water seepage the vegetation changes to reflect this wetness, as does the vegetation of the surrounding area.

On the basis of vegetation samples from the southern Transylvanian Tableland, we present these changes in the vegetation showing the mosaic structure that develops between patches of wet and dry habitats occurring on the dry south-facing slopes of the tableland.

REZUMAT: Habitate umede în structuri mozaicale cu habitate uscate pe pantele colinelor din Podişul Transilvaniei de Sud (România).

Pe numeroase coline cu expoziție sudică din Podişul Transilvaniei se întâlnesc incluse în pajiştile xero- şi xeromezofile ale pantelor mijlocii şi inferioare suprafețe mai puțin întinse de fitocenoze umede, care se disting prin dominanța trestiei (*Phragmites australis*) sau prin prezența altor specii indicatore de umiditate sau soluri ude, bine îmbibate cu apă. Aceste suprafețe mai mici de vegetație umedă sunt condiționate de structura colinelor cu strate de sedimente, având permeabilitate diferită. Când apa de infiltrație trece prin stratele de nisip, ajungând deasupra stratelor greu permeabile de marne şi argilă, curge de-a lungul acestui strat, ieşind la suprafața pe pantă prin mustiri de apă. În aceste locuri, influențate de apa ieşită la suprafață prin mustiri sau uşoare scurgeri, vegetația se schimbă devenind mai umedă față de vegetația înconjurătoare.

Pe bază de relevee, realizate în diferite locuri pe astfel de pante, în Podişul Transilvaniei de Sud sunt prezentate schimbările vegetației, înfățişând structura mozaicată a petecelor de habitate umede şi uscate, care pot fi găsite împreună pe pantele în general uscate ale podişului.

ZUSAMMENFASSUNG: Feuchte Habitate in Mosaikstrukturen mit Trockenhabitaten an Hängen im Hochland von Süd-Siebenbürgen (Rumänien).

An vielen südexponierten Hängen im Siebenbürgischen Hügelland finden sich eingebettet in Trocken- und Halbtrockenrasen der mittleren und unteren Hanglagen oft kleine Flächen von feuchterer Vegetation, die sich durch die Dominanz von Schilfrohr (*Phragmites australis*) oder Vorkommen anderer Feuchte- und Nässezeiger auszeichnen. Diese sind bedingt durch die Schichtenstruktur der Hügel, die eine unterschiedliche Durchlässigkeit haben. Dort wo das eindringende Wasser auf eine undurchlässige Ton- oder Mergelschicht stößt, sickert es über der Schicht am Hang an die Oberfläche und bedingt kleinräumig einen Wechsel der vorherrschenden Vegetation.

Anhand von Vegetationsaufnahmen von verschiedenen Stellen im Hochland von Süd-Siebenbürgen wird der kleinräumige Wechsel der Vegetation mit nahe beieinander liegenden Mosaikstrukturen feuchter und trockener Habitate an den Trockenhängen veranschaulicht.

INTRODUCTION

On Southern exposed hill slopes of the Transylvanian tableland frequently can be observed in the midst of xerophilous and xero-mesophilous grasslands smaller patches of wet habitats (Schneider, 1996). They are located in the middle and lower part of the slope and mostly edified by Common reed (*Phragmites australis*), frequently also by Cotton grass (*Eriophorum latifolium*) and other species indicating wetness or moderate wetness, such as *Parnassia palustris, Epipactis palustris*, *Cirsium canum, Carex vulpina, Lythrum salicaria, Cirsium oleraceum*, *Succisa pratensis* and others. These islands of wet habitats on the slopes are related to the geomorphological structure of the hills, build by sediment deposits of the Tertiary age with an alternation of sand, marl, gravely marl and clay layers. Due to the different permeability of these various layers dependent by the grain size of sediments, the water penetrates through the more permeable sandy layers, arriving above a marl or clay layer, where it is discharging on the surface as sources or in many places as seepage water on the hill slopes. On these particular sites, small patches of a type of wet communities develops, being surrounded by phytoceonoses of the communities Carici-Chrysopogonetum and Dorycnio-Brachypodietum edified mostly by xero-mesophilous and mesophilous species larger spread on these slopes. The Common Reed (*Phragmites communis*) forms often larger areas which are surrounded by the vegetation of the above mentioned communities. Such types of vegetation influenced by seeping water are encountered in many places of the Transylvanian tableland, in the so called "Transylvanian Plain"/Câmpia Transilvaniei and the Southern Transylvanian tableland, giving in some places a particular aspect. Whitout knowing the geomorphological structure it is difficult to understand how it is possible to find on these Southern exposed slopes patches with wet vegetation dominated by Common reed or other wetness indicators.

MATERIALS AND METHODS

During recent field researches (2009–2011) on the hills of the Southern Transylvanian tableland in the area of Sibiu County (Ighişu Vechi, Zlagna, Motiş, Boarta, Mihăileni, Movile) the mosaic pattern of the vegetation on the Southern exposed slopes has been studied. Samples were taken following the method of Braun-Blanquet (1964) and included in phytocoenological tables with indication of the site conditions (exposition, slope inclination), covering degree, number of species in each sample and locality. The abbreviations for localities used in the tables are: Bo = Boarta, Igh = Ighişu Vechi, Mot = Motiş, Mov = Movile, Zl = Zlagna.

The samples have been analysed following the indicator values for wetness (W-I) according to the scale of Ellenberg et al. (2001). This scale is well known around Europe, including the transition values, as well as the indication of strong changes of the conditions and for flooded area (Tab. 1). For the species which are not included in the list of Central European species, the indicator values for South-Eastern Europe which corresponds - apart from the transition values - to the values of Ellenberg et al. 2001, values according to Sanda et al., 1983, Kovács, 1979, Pop et al., 1978, have been used. In the same time, own long term observations where taken into account for the indicator value considerations.

The species are arranged in the table following the wetness indicator values, to show the mosaic patches of wet, moderate wet, moderate dry and dry vegetation and the representants of each species group. The nomenclature of the included species is based on Ciocârlan (2009).

Table 1: Correspondence of Wetness Indicator Values (W-I) according to the Central European scale (Ellenberg et al., 2001) and the Romanian scale/Central-South-Eastern Europe (Sanda et al., 1983).

RO		Central Europe	
1	xerophyte	1	Indicator for strong dryness
		2	Transition value between 1 and 3
2	Xero-mesophyte	3	Indicator for dryness, occurring more frequent on dry soils as on fresh soils, and lacking on wet soils
		4	Transition value between 3 and 5
3	mesophyte	5	Indicator for soils with moderate wetness (freshness indicator/Frischezeiger) lacking on soils with moisture and on soils frequently drying out
		6	Between 5 and 7
4	Meso-hydrophyte	7	Indicator for wetness, in particular good soaked with water, but not permanent moisture
		8	Transition value between 7 and 9
5	hydrophyte	9	Indicator for moisture wet trough soaking wetness
		10	Indicator for changing water level
6	ultrahydrophyte	11	Water macrophytes with roots in the water and leafes on the surface of the water, also swimming plants on the water surface
		12	Submerged water macrophytes
0	amphitolerant	x	Indifferent comportment
		~	Indicator for strong changes (moderate wetness and wetness, changing between wetness and soaking wetness)
		=	Indicator for flooded area

RESULTS AND DISCUSSIONS

On the studied Southern exposed slopes, has been identified in the midst of xero-mesophilous meadows patches of wet vegetation. They are typical for dry slopes with seepage waters on the front of the hills and can be divided in two groups. The ones representing very small patches edified by wetness indicator species, characteristic for sites with punctual, small water outlets (Tab. 2) and the others representing larger seepage area with good delineated wetland communities (Tab. 3).

The small patches occur as a mosaic in the phytocoenoses of the xero-mesophilous association Carici humilis-Chrysopogonetum grylli and Dorycnio-Brachypodietum pinnati, and can be considered only as a small formation/facies of the mentioned community (samples 6-11). These patches includes characteristic wetness indicator species such as *Epipactis palustris* (W-I 9), *Parnassia palustris* (W-I 8), *Cirsium canum* (W-I 8), the first two occurring with high frequency (sampling 6-11), and are surrounded almost by xero-mesophilous species characteristic for the alliance Cirsio-Brachypodion and the associations of Carici humilis-Chrydopogonetum (sample 2-5) and Dorycnio-Brachypodietum (sample 1). The most abundant-dominant species are the Golden barb grass (*Chrysopogon gryllus*), *Dorycnium herbaceum* from the pea family and *Brachypodium pinnatum*. In some samples *Carex humilis*, *Botriochloa ischaemum*, *Anthericum ramosum* have higher frequency and partly higher abundance – dominance values.

Table: 2 Xero-mesophilous grasslands of the Dorycnio-Brachypodietum and the Carici-Chrysopogonetum associations with small inclusions of species indicating seepage water; data of sampling: Ighiş and Zlagna 20.08.2009, Motiş 25.08.2009.

	Number of sample	1	2	3	4	5	6	7	8	9	10	11
	Locality	Igh	Igh	Igh	Zl	Mot	Igh	Zl	Zl	Zl	Zl	Mot
	Exposition	S	S	S	SE	SE	S	S	SSE	SW	S	S
	Slope inclination	10	45	45	40	40	35	40	35	30	35	25
	Covering degree %	100	70	75	95	90	95	90	80	95	80	85
	Number of species	30	33	20	38	46	21	17	22	32	18	31
W-I												
4	**Brachypodium pinnatum**	4	+	1	2	.	3	+	+	+	.	.
3	*Chrysopogon gryllus*	.	3	3	4	4	+	4	3	4	3	3
3	*Dorycnium herbaceum*	3	3	1	1	2	2	+	2	1	3	2
3	*Scabiosa ochroleuca*	+	+	.	+	+	+	.	+	+	+	+
3	*Asperula cynanchica*	+	+	+	+	+	+	.	.	+	+	.
3	*Falcaria sioides*	.	+	.	.	+	.	.	+	+	+	.
3	*Anthericum ramosum*	.	+	.	1	+	.	2	+	1	1	.
3	*Linum hirsutum*	.	+	+	.	.	.	+	.	.	.	.
3	*Medicago falcata*	.	+	+	.	+	.	.	.	.	.	+
3	*Pimpinella saxifraga*	+	+	.	+	+	+	+	.	+	.	.
3	*Botriochloa ischaemum*	.	2	1	.	1	3	.	.	.	+	2
3	*Dianthus carthusianorum*	.	+	+	.	+	+	.	+	+	.	+
3	*Centaurea apiculata spinulosa*	+	1	+	+	.	+	.	.	.	.	.
3	*Koeleria macrantha*	.	+	2	.	.	.	.	+	.	.	.
3~	*Filipendula vulgaris*	+	.	.	.	+	.	.	.	.	.	.
3	*Centaurea scabiosa*	+	.	.	.	.	+	.	.	.	.	.
3	*Phleum phleoides*	.	+	+	.	+	.	.	.	.	.	+
3~	*Hypericum elegans*	.	+	.	.	.	+	.	.	.	.	.
3	*Thalictrum minus*	.	+	.	.	.	.	+	.	.	.	.
3	*Onobrychis viciaefolia*	.	+		.	+	.	.	+	.	+	+
3	*Euphorbia cyparissias*	.	.	+	.	1	.	.	.	.	.	.

3	*Prunella grandiflora*	.	.	.	1	.	.	1	+	1	+	.
	Number of sample	1	2	3	4	5	6	7	8	9	10	11
	Locality	Igh	Igh	Igh	Zl	Mot	Igh	Zl	Zl	Zl	Zl	Mot
	Exposition	S	S	S	SE	SE	S	S	SSE	SW	S	S
	Slope inclination	10	45	45	40	40	35	40	35	30	35	25
	Covering degree %	100	70	75	95	90	95	90	80	95	80	85
	Number of species	30	33	20	38	46	21	17	22	32	18	31
W-I												
3	*Peucedanum oreoselinum*	.	.	.	+	+	.	.	+	+	+	.
3	*Seseli annuum*	.	.	.	.	+	.	.	.	+	.	+
3	*Eryngium campestre*	.	.	.	.	+	.	.	.	.	.	+
3	*Veronica spicata*	.	.	.	.	+	.	.	.	.	.	+
4	*Salvia verticillata*	1	.	.	+	+	.	.	.	+	.	+
4	*Lotus corniculatus*	+	.	.	.	+	.	.	.	+	.	+
4	**Coronilla varia**	+	+	.	.	+	+	.	.	+	.	.
4	*Campanula glomerata*	+	.	.	.	+	.	.	.	.	.	.
4	*Carlina vulgaris*	+	.	.	.	.	+	.	.	+	.	.
4	*Agrimonia eupatoria*	+	+	.	.	.	+	+	.	+	+	.
4~	*Silene vulgaris*	.	.	.	.	+	.	.	.	.	.	+
4	*Galium mollugo*	+	.	.	.	.	+	.	.	.	.	.
4	*Cichorium intybus*	+	.	.	.	.	.	.	.	.	.	.
4	*Rhinanthus rumelicus*	+	.	.	+	.	.	.	.	.	.	.
4~	*Galium verum*	+	+	+	.	.	+	.	.	.	.	.
4~	*Ononis villosa*	+	.	.	.	+	.	.	.	.	.	+
4	*Tragopogon dubius*	+	.	.	.	.	.	.	.	.	.	.
4	*Crepis setosa*	.	+	.	+	.	+	.	.	.	.	.
4	*Achillea millefolium*	.	+	+	.	.	.	.	.	+	.	.
4	*Lembotropis nigricans*	.	.	.	+	.	.	+	+	+	.	.
4~	*Ranunculus polyanthemos*	.	.	.	+	.	.	.	.	+	.	.
4	*Knautia arvensis*	.	.	.	.	+	.	.	.	+	.	.
4	*Centaurea jacea*	.	.	.	.	+	.	.	.	.	.	+
4~	*Senecio jacobaea*	.	.	.	.	+	.	.	.	.	.	+
1	*Campanula sibirica*	+	+	.	+	+	.	.	.	+	.	+
1	*Artemisia campestris*	.	1	2	.	.	.	.	.	.	.	.
1	*Astragalus onobrychis*	.	+	.	.	+	.	.	.	.	.	+
1	*Centaurea micranthos*	+	.	.	.	+	.	.	.	.	.	.
1	*Astragalus austriacus*	.	.	.	.	+	.	.	.	.	.	+
2	*Carex humilis*	.	2	.	+	.	.	.	2	2	+	.
2	*Jurinea mollis*	.	+	+	+	.	.	.	.	.	.	.
2	*Thymus pannonicus*	.	+	+	+	.	.	.	+	+	.	.
2	*Onobrychis arenaria*	.	.	+	.	+	+	.	.	+	.	.
2	*Chamaecytisus albus*	.	+	.	.	.	.	.	+	.	+	.
2	*Potentilla arenaria*	.	.	.	.	+	.	.	+	+	.	+
2	*Linum austriacum*	.	.	.	.	+	.	.	.	.	.	+
2	*Bupleurum falcatum*	.	.	.	.	+	.	.	.	.	.	+
5	*Leontodon autumnale*	.	.	.	.	+	.	.	.	.	.	+
5	*Prunella vulgaris*	.	.	.	.	+	.	.	.	.	.	+
6	*Erigeron annuus*	+	+	+	.	+	.	.	.	.	+	+
x	**Briza media**	+	.	.	.	.	.	+	+	.	.	.
x	*Euphrasia rostkoviana*	.	.	.	.	.	.	+	+	.	.	.
x~	*Centaurium pulchellum*	.	.	.	.	.	.	+	.	.	.	+

x	*Campanula rotundifolia*	.	.	.	+	.	.	+	+	+	+	.
	Number of sample	1	2	3	4	5	6	7	8	9	10	11
	Locality	Igh	Igh	Igh	Zl	Mot	Igh	Zl	Zl	Zl	Zl	Mot
	Exposition	S	S	S	SE	SE	S	S	SSE	SW	S	S
	Slope inclination	10	45	45	40	40	35	40	35	30	35	25
	Covering degree %	100	70	75	95	90	95	90	80	95	80	85
	Number of species	30	33	20	38	46	21	17	22	32	18	31
W-I												
9~	***Epipactis palustris***	.	.	.	.		+	**1**	**.**	**.**	+	+
8~	***Parnassia palustris***	.	.	.	.	.	+	**1**	+	+	+	**2**
8~	*Cirsium canum*	.	.	.	.	.	.	+	.	.	.	+
7=	*Inula britannica*	+	.	.	.	+	.	.	.	.	.	.
7~	*Ranunculus repens*	.	.	.	.	.	.	.	+	+	.	.
x=	*Agrostis stolonifera*	.	.	.	.	.	.	.	+	+	+	.

Note: Other species, with A-D value + in one sample: sample 1: 5~ Odontites serotina, x Rubus caesius, 6 Artemisia vulgaris, 4 Echium vulgare; sample 2: 3 Viola hirta, 4 Crataegus monogyna, x Plantago lanceolata; sample 3: 3~ Asparagus officinalis; sample 4: 2 Salvia nutans, 3 Aster amellus; sample 5: 3 Helianthemum nummularium, 3 Stachys recta, 3 Quercus pubescens, 2 Astragalus monspessulanus, 2 Achillea setacea, 2 Allium fuscum, x~ Elymus repens; sample 6: 1 Asyneuma canescens; sample 7: 4 Daucus carota; sample 8: 6 Holcus lanatus; sample 9: 4 Leucanthemum vulgare, 5 Leontodon hispidus, 3~ Senecio erucifolius; sample 10: x Agrostis tenuis; sample 11: 2 Teucrium chamaedrys.

The second example of wet vegetation on Southern exposed slopes concerns the abundance-dominance of Common reed (*Phragmites australis*) on larger seepage area with good delineated wetland communities (Tab. 3). Apart from the Common reed which is represented with high abundance-dominance values and high frequency, the thistle species *Cirsium oleraceum* occurs also with high frequency and abundance-dominance value. Beside the thistle other characteristic species of wet hay meadows occurs. The frequency of *Cirsium oleraceum* in the phytocoenoses of Common reed and the occurrence of some wet meadow indicator species such are *Succisa pratensis, Selinum carvifolia*, *Cirsium canum*, *Lythrum salicaria*, *Pulicaria dysenterica*, *Agrostis alba* and other many species of the wetness indicator groups 7, 8 and 9 indicates a transition to the wet hay meadows of *Cirsium oleraceum* (Burkhart, Dierschke, Hölzel, Nowak and Fartmann 2004). Also species of the group 5 and 6 with moderate wetness and transition to more wet soils are represented (Tab. 3). It seams, that this type of meadows, which occurs on the bottom of small valleys of the Transylvanian tableland, has been larger spread on seepage area of the slopes, near the patches of Common reed, but they were abandoned in the last decades.

But these reeds occurring on the seepage area in larger scale as the punctual patches of *Parnassia palustris* and *Epipactis palustris* above discussed (Tab. 2) are also surrounded by the associations Dorycnio-Brachypodietum, Carici-Chrysopogonetum, in the neighbouring area, being also nearby the mesophilous meadows with *Festuca pratensis* and *Arrhenatherum elatius*.

A particular situation occurs also on a smaller seepage area, where between the layers of clay, marle and sand are also small inclusions of salt layers. In these cases, the seeping water is more or less salty, fact indicated by lightly halophilous species, such as *Schoenoplectus tabernaemontani*, *Triglochin palustre* and *Mentha pulegium* (Tab. 3, samples 10 and 11). These patches, encountered near the village Boarta on slopes of the Buia Valley (Sibiu County), are surrounded by dry phytocoenoses of Gold Barb grass (*Chrysopogon gryllus*) and also by the grasses *Botriochloa ischaemum* and *Cleistogenes serotina*. In some parts of the studied Transylvanian tableland also an other types of seepage are with smaller or larger patches of Cotton grass (*Eriophorum latifolium*) can be found (Fig. 1). All these areas have the characteristic aspect of small fens.

Table 3: Common reed (*Phragmites communis*) phytocoenoses on the Southern exposed slopes with seepage waters; Data of sampling: Motiş 25.08.2009, Boarta and Movile 12.09.2010.

	Number of sampling	1	2	3	4	5	6	7	8	9	10	11
	Locality	Mov	Mov	Mov	Mov	Mov	Mov	Mov	Mot	Mot	Bo	Bo
	Slope inclination	25	20	25	25	20	30	35	20	20	15	15
	Covering degree %	100	100	85	100	100	100	100	80	80	80	100
	Number of species	31	20	9	11	18	26	15	13	24	12	8
W-I												
10	***Phragmites australis***	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**2**	+	**1**
10	***Schoenoplectus tabernaemontani***	.	.	.	.	.	.	.	.	.	**4**	**4**
11	*Schoenoplectus lacustris*	.	.	.	.	+	.	.	.	.	.	.
9=	*Epilobium parviflorum*	+	.	.	.	+	.	.	+	.	.	.
9=	**Lycopus europaeus**	.	.	.	+	+	.	.	.	.	.	.
9=	*Cucubalus baccifer*	.	.	.	+	.	.	.	.	.	.	.
9=	*Iris pseudacorus*	.	.	.	.	+	.	.	.	.	.	.
9=	*Carex gracilis*	+	.	.	.	.	.	.	.	.	.	.
9=	*Mentha aquatica*	.	.	.	.	.	.	.	+	.	+	.
9=	*Triglochin palustre*	.	.	.	.	.	.	.	.	.	.	+
9~	*Epipactis palustris*	.	.	.	.	.	1	.	.	.	+	.
9~	*Salix cinerea*	.	.	.	.	.	.	.	+	.	.	.
9~	*Carex acutiformis*	.	.	.	.	.	.	.	.	+	.	.
8	*Angelica sylvestris*	1	+	.	.	+	.	.	+	1	.	.
8	*Agrostis gigantea*	.	.	.	.	+	1	2	.	+	.	.
8	*Symphytum officinale*	.	+	+	.	+	.	.	.	+	.	.
8	*Equisetum palustre*	.	.	.	+	.	+	.	+	.	.	.
8	*Equisetum telmateia*	.	.	.	.	.	.	.	.	**3**	.	.
8	*Filipendula ulmaria*	.	.	.	.	.	+	.	.	.	.	.
8=	*Epilobium hirsutum*	+	+	+	.	.	.	.	.	.	.	.
8=	*Humulus lupulus*	.	.	.	.	.	.	.	.	+	.	.
8~	*Mentha arvensis*	.	.	.	.	+	+	.	.	.	.	.
8~	*Cirsium canum*	+	+	+	+	.	1	+	+	.	+	.
8~	*Lythrum salicaria*	+	.	.	.	+	+	.	+	+	+	.
8~	*Lysimachia vulgaris*	+	+	.	.	1	+	.	.	.	+	.
8~	*Thalictrum flavum*	+	.	.	.	.	+	.	.	.	.	.
8~	*Parnassia palustris*	.	.	.	.	.	.	.	+	.	+	.
7	***Cirsium oleraceum***	**3**	**2**	**+**	**3**	**3**	**+**	**2**	**.**	**2**	.	.
7	*Eupatorium cannabinum*	+	2	.	+	.	+		.	+	.	.
7	*Succisa pratensis*	.	.	.	.	.	2	.	+	+	+	+
7	*Selinum carvifolia*	.	.	.	.	.	.	.	.	+	.	.
7	*Juncus effusus*	.	.	.	.	.	+	.	.	.	.	.
7=	*Cyperus fuscus*	.	.	.	.	.	.	.	+	.	.	.
7=	*Mentha pulegium*	.	.	.	.	.	.	.	.	.	+	+
7~	*Juncus inflexus*	.	.	.	.	+	2	.	.	.	.	.
7~	*Deschampsia caespitosa*	.	.	.	.	.	.	.	.	+	.	.
7~	*Pulicaria dysenterica*	.	.	.	.	+	+	.	.	.	+	+
7~	*Geranium palustre*	.	.	.	.	.	.	.	.	+	.	.
6	*Ranunculus acris*	+	.	.	.	.	.	.	+	+	.	.
6	*Calystegia sepium*	+	+	.	.	.	.	+	.	.	.	.
6	*Artemisia vulgaris*	+	+	.	.	.	.	+	.	+	.	.
6	*Dipsacus laciniatus*	+	.	+	.	.	.	.	.	.	.	.
6	*Festuca pratensis*	.	+	.	.	.	.	.	.	.	.	.
6	*Urtica dioica*	.	.	.	.	.	.	.	.	+	.	.
5	*Anthriscus sylvestris*	+	+	.	.	.	.	+	.	.	.	.

	Number of sampling	1	2	3	4	5	6	7	8	9	10	11
	Locality	Mov	Mov	Mov	Mov	Mov	Mov	Mov	Mot	Mot	Bo	Bo
	Slope inclination	25	20	25	25	20	30	35	20	20	15	15
	Covering degree %	100	100	85	100	100	100	100	80	80	80	100
	Number of species	31	20	9	11	18	26	15	13	24	12	8
W-I												
5	*Geranium pratense*	+	+	.	.	.	.	+	.	.	.	.
5	*Galeopsis speciosa*	+	.	.	.	.	.	+	.	+	.	.
5	*Vicia cracca*	+	+	.	.	.	.	.	.	.	.	.
5	*Dactylis glomerata*	+	+	.	.	.	.	.	.	.	.	.
5	*Heracleum sphondylium*	+	.	.	.	.	.	+	.	.	.	.
5	*Arrhenatherum elatius*	+	.	+	.	.	.	.	.	.	.	.
5	*Inula helenium*	.	.	.	+	.	.	.	.	.	.	.
5	*Centaurea phrygia*	.	.	.	.	.	.	.	.	+	.	.
5	*Galeopsis tetrahit*	.	.	.	.	.	.	.	.	+	.	.
4	***Achillea millefolium***	+	.	.	.	+	+	.	.	.	.	.
4	*Pastinaca sativa*	.	+	.	.	+	.	+	.	.	.	.
4	*Knautia arvensis*	+	.	.	.	.	+	.	.	.	.	.
4	*Brachypodium pinnatum*	.	.	.	.	.	+	+	.	.	.	.
4	*Cichorium intybus*	.	+	.	.	.	.	.	.	+	.	.
4	*Clinopodium vulgare*	.	.	.	.	.	.	+	.	.	.	.
4	*Stellaria graminea*	.	.	.	.	.	.	.	.	+	.	.
4	*Lathyrus sylvestris*	.	.	.	.	.	+	.	.	.	.	.
4	*Tragopogon pratensis*	+	.	.	.	.	.	.	.	.	.	.
4	*Coronilla varia*	+	.	.	.	.	.	.	.	.	.	.
4~	*Ononis arvensis*	.	.	.	.	.	.	.	+	.	.	.
3	*Inula bifrons*	.	.	.	.	.	.	+	.	.	.	.
3	*Centaurea scabiosa*	+	.	.	.	.	.	.	.	.	.	.
3	*Thalictrum minus*	.	.	.	.	+	.	.	.	.	.	.
3	*Medicagio falcata*	+	.	.	.	.	.	.	.	.	.	.
3~	*Senecio erucifolius*	.	.	+	+	.	.	.	.	.	.	.
2	*Artemisia campestris*	.	.	.	.	.	.	+	.	.	.	.
x	***Solidago canadensis***	.	.	+	+	.	+	.	.	+	.	.
x	*Galium aparine*	+	+	.	.	.	.	.	.	.	.	.
x	*Rubus caesius*	.	.+	.	+	+	.	.	.	+	.	.
x	*Cirsium arvense*	.	+	.	+	.	+	.	.	.	.	.
x	*Campanula rotundifolia*	.	.	.	.	.	+	.	.	.	.	.
x	*Potentilla erecta*	.	.	.	.	.	+	.	.	.	+	+
x	*Centaurea jacea*	+	.	.	.	.	.	.		.	.	.
x~	*Salvia verticillata*	+	.	.	.	.	.	.	.	.	.	.
x~	*Calamagrostis epigeios*	.	.	.	.	.	1	.	.	.	.	.
x~	*Elymus repens*	.	.	.	.	.	+	.	.	.	.	.
	Chara sp.	.	.	.	.	.	.	.	.	.	2	3

Figure 1: Seepage area with Cotton Grass (*Eriophorum latifolium*) community on the lower slope in the Buia Valley near Boarta, Sibiu County, 25.05.2008 (photo E. Schneider-Binder).

CONCLUSIONS

The particularities of slopes with area of seepage water between dry grasslands on Southern exposed slopes are discussed on the basis of examples from the Southern Transylvanian tableland hills, around some villages from Sibiu County. These vegetation patches presents a particular situation with strong interrelation between dry, moderate dry, moderate wet and wet vegetation. From the ecological and phytocoenological point of view, they were less in the attention of botanists and ecologists until present.

There are small areas with punctual seeping water, where the wet plant groups composed mainly by *Epipactis palustris* and *Parnassia palustris* develops a particular aspect in the frame of a meadows edified by xero-mesophilous species of the Cirsio-Brachypodion alliance. On the other hand there are areas covered by Common reed (*Phragmites australis*) and other wetness indicators conditioned by larger areas of seepage water. These seepage areas are also in strong relation with the dryer meadows of the surrounding areas.

An other particular situation is given by the salt layers included in the structure of the other layers of clay, marl and sand. Due to the salty seepage water, small patches of halophilous vegetation occurs in the area surround by larger areas of dry and moderate dry vegetation without any indicator species for salt vegetation.

The different areas of seepage waters are of interest as a special phenomena conditioned by the layer structure of the Transylvanian tableland. Also they present interest in the whole mosaic structure of the slope vegetation of the tablelands, contributing to the high biodiversity of the area. Taking into account these aspects, they are of interest for the management of such type of sites from the point of view of biodiversity conservation.

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STRUCTURE DYNAMICS OF MIXED FOREST STANDS FROM THE CINDREL MOUNTAINS (TRANSYLVANIA, ROMANIA)

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KEYWORDS: Romanian Carpathians, mixed forest, stands dynamics.

ABSTRACT

The mixed forest stands of *Abies alba*, *Picea abies* and *Fagus silvatica* have different growth patterns than do pure stands. This study was conducted at two different levels, first at vegetation cover level, using data from forest management plans, and second at stand level, using 18 sample plots. The accepted theory for studying stand dynamics was the natural fundamental series theory. The results at vegetation cover level indicate that the species most affected by human activities is white fir, which is present at only two and three percent in the third and forth age classes, respectively. At stand level the dynamics of diameters seems to have similar patterns to those of the pure stands. However, this statistical approach, using the Weibull model and stratification techniques, does not describe the interdependencies between the species, thus missing one of the most important characteristic of the ecosystem, its integrality.

REZUMAT: Dinamica structurii arboretelor amestecate din Munții Cindrel (Transilvania, România).

Arboretele amestecate de *Abies alba*, *Picea abies* şi *Fagus silvatica* au tipare de creştere diferite de arboretele pure. Studiul a fost realizat pe două nivele diferite, mai întâi la nivel de covor vegetal, folosind date din amenajamentele silvice, apoi la nivel de arboret, folosind date din 18 suprafețe de probă. Teoria acceptată pentru studiul dinamicii structurii arboretelor a fost teoria seriilor naturale fundamentale de dezvoltare. Rezultatele, la nivelul covorului vegetal, arată că cea mai afectată specie de către activitatea umană este bradul care este prezent cu numai două, respectiv trei procente în a treia şi în a patra clasă de vârstă. La nivel de arborete, dinamica diametrelor pare să aibă tipare similare arboretelor pure. Oricum, această abordare statistică, folosind modelul Weibull şi stratificarea, nu descrie interdependențele între specii, pierzând una dintre cele mai importante caracteristici ale unui ecosistem, integralitatea sa.

RÉSUMÉ: La dynamique des peuplements mélangés des Montagnes Cindrel (Transylvanie, Roumanie).

Les peuplements mélangés composés de *Abies alba*, *Picea abies* et *Fagus sylvatica* ont des schémas de croissance différents des peuplements pures. L'étude a été réalisé à deux niveaux différents, d'abord au niveau du tapis végétal, utilisant des données des aménagements, en suite au niveau des peuplements, utilisant les données de 18 surfaces d'échantillonnage. La théorie acceptée pour l'étude de la dynamique des peuplements est la théorie des séries naturelles fondamentales de développement. Les résultats au niveau du tapis végétal montrent que l'espèce la plus affectée par l'activité humaine est le sapin, qui participe seulement avec deux respectivement trois pourcents dans les troisième et quatrième classes d'âge. Au niveaux des peuplements, la dynamique des diamètres semble avoir des schémas de variation similaires au peuplements pures. Toujours, cette approche statistique, en utilisant le modèle Weibull et la stratification, ne décrit pas l'interdépendance entres les espèces, manquant l'une des plus importantes caractéristiques d'un écosystème, son intégralité.

INTRODUCTION

It is known that in a mixed forest stand the growing patterns of the tree species are different from the growing patterns of the same species observed in pure forest stands. This reality might be explained by the high integrality of the forest ecosystem.

Further on, in this article, the notion of structure refers to the manner of a system internal organization which gives to the system its specificity. The forest represents an inhomogeneous macro system. That is why for managing the forest, it has to be divided into units, respectively in more homogenous systems, called forest stands. (Giurgiu, 1979).

Usually, the more complex is the structure of a forest ecosystem, the higher the number of possibilities for a multifunctional role of the forest.

For each forest stand an optimum structure exists that ensures the sustainability and the multifunctional role of the forest ecosystem. Finding at least the main characteristics of a structure considered to be an optimum one, for a certain forest stand, gives some reference points in the management of the forest.

In this article I am presenting some dynamics of the mixed resinous (*Abies alba*, and *Picea abies*) with beech (*Fagus sylvatica*) forest stands, located in Cindrel Mountains from Parâng Massif in Romania's Meridional Carpathians, known abroad as Transylvanian Alps. The studied area covers more than 900 km^2 and is bordered by the rivers Sadu, Frumoasa and Sebeş at the East, South and West and by the Transylvania plateau at north.

MATERIALS AND METHODS

In order to conduct a forest stand dynamics study the methodology chosen used the natural fundamental development series theory. According to this theory, the forest stands at different ages, located in the same site conditions and to which are or were applied the same actions during their existence, can be considered as different development phases of the same forest stand. Therefore, some stand dynamics of a certain forest type can be obtained by studying different forest stands, from the same forest type, that are at different development stages.

The stand dynamics study was conducted at two levels, firstly at the vegetation cover level and secondly, at forest stand level. The study at the vegetation cover level gives ideas regarding the dynamic of the tree species in the area. Further on, in order to check the viability of the findings at the vegetation cover level and to study other biometric variables that are describing the dynamics of the tree species, the study is conducted at a more detailed stand level.

The statistical methods are used for the both studied levels.

For studying dynamics at the vegetation cover level, the forest management plans of the area were used. Based on these plans, a database was established. Further on, an analysis of the species dynamics in all the stands was done using age classes with a width of 20 years.

At stand level, the dynamics is studied using 18 sample plots, out of which 13 are square-shape plots with an area of 0.25 ha, four are rectangular shape plots of 50m/25m and one is a polygonal shape lot of 0.17 ha The used sampling procedure was deliberate sampling. In each of the plots biometric and position data were measured. More than 30 mathematical models were tested to evaluate the best way to describe the trees diameter dynamics. The Weibull function was considered to be the best one for the established sample plots.

RESULTS AND DISCUSSIONS

Regarding the dynamics of age classes, it can be seen from the diagrams from Figures 1 to 8 that the white fir (*Abies alba*) has a very low percentage of participation in the age classes III and IV, where it is present only with 2% respectively 3%, from the total above ground wood volume.

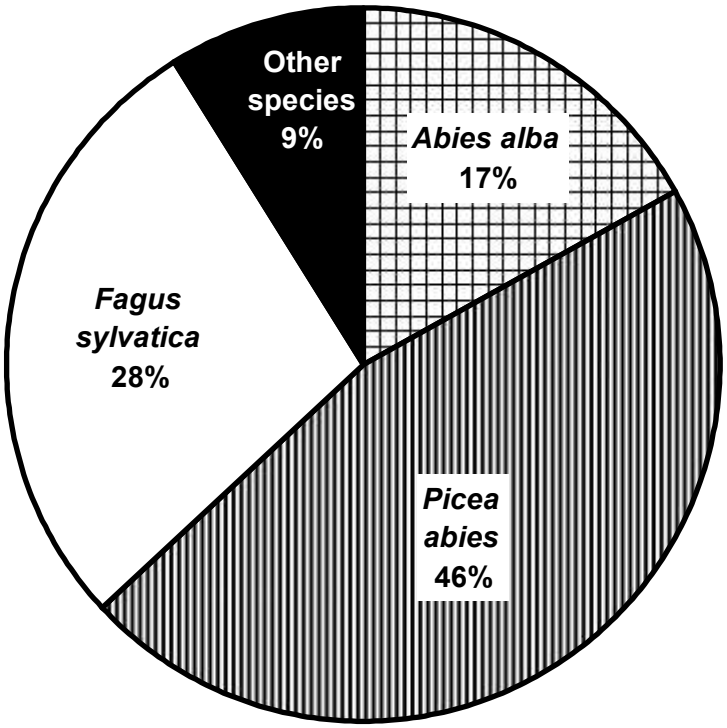

Figure 1: Stand structure for the Ist age class.

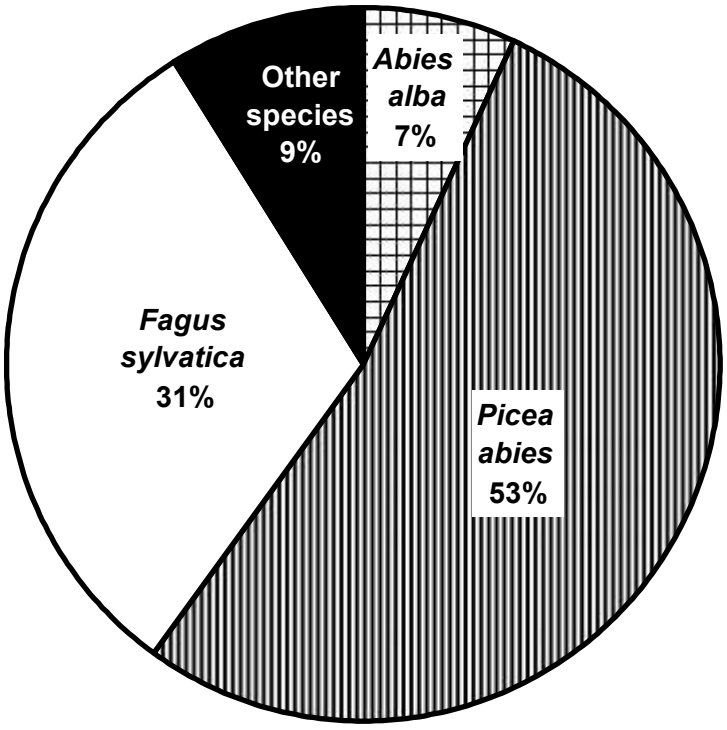

Figure 2: Stand structure for the IInd age class.

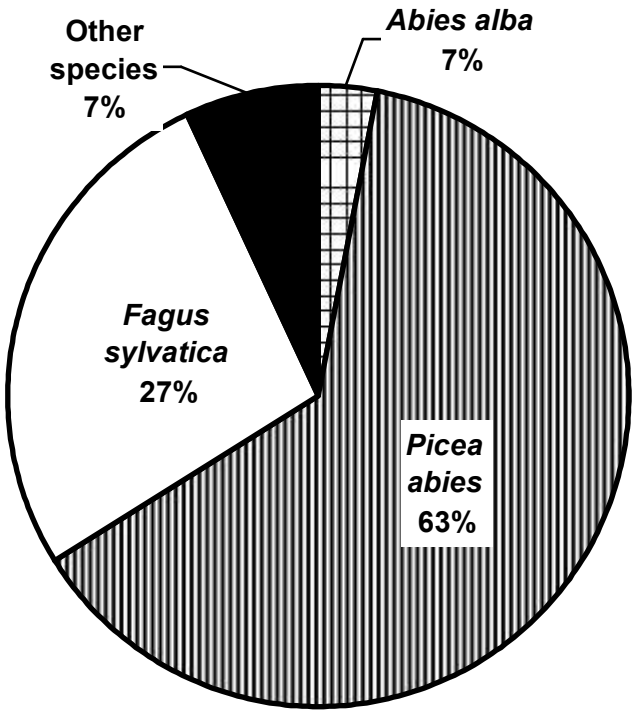

Figure 3: Stand structure for the IIIrd age class.

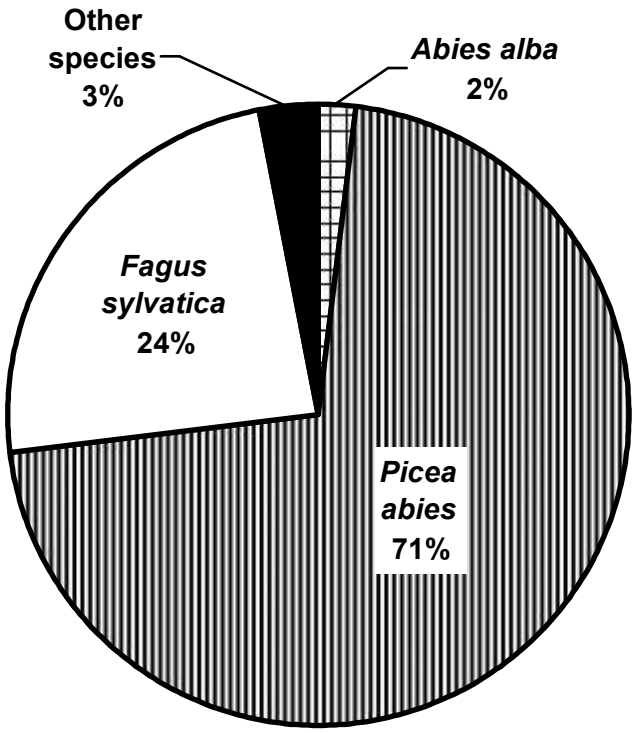

Figure 4: Stand structure for the IVth age class.

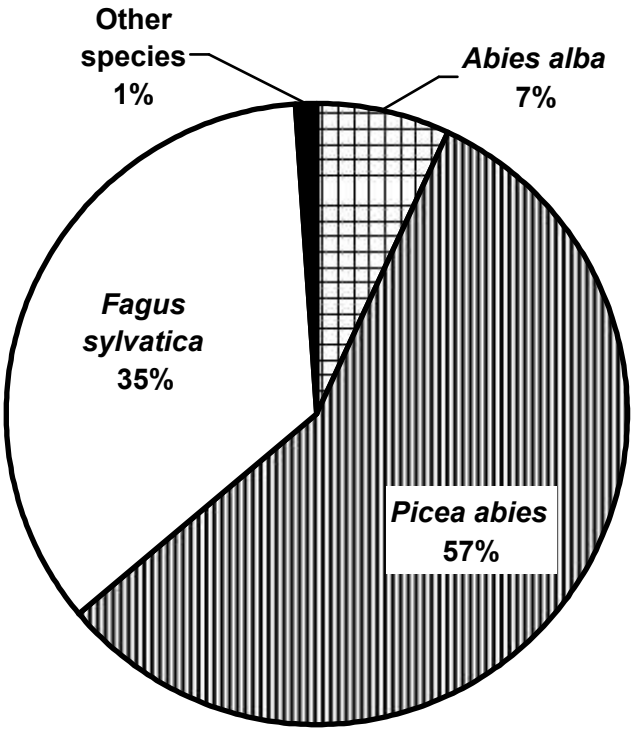

Figure 5: Stand structure for the Vth age class.

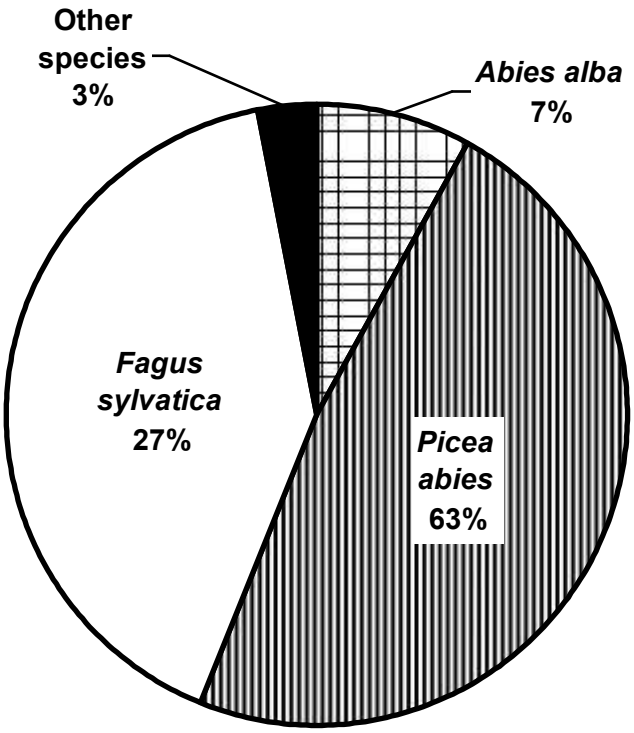

Figure 6: Stand structure for the VIth age class.

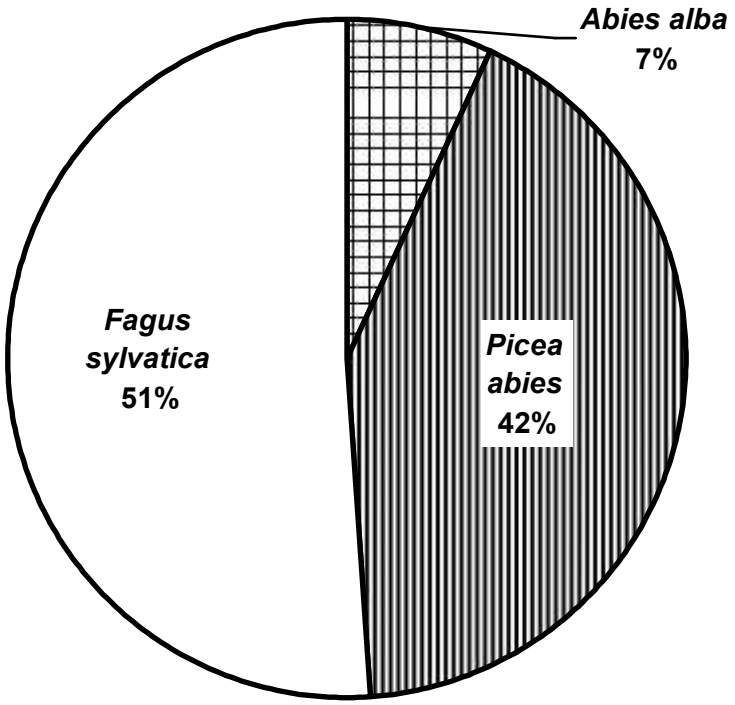

Figure 7: Stand structure for the VIIth age class.

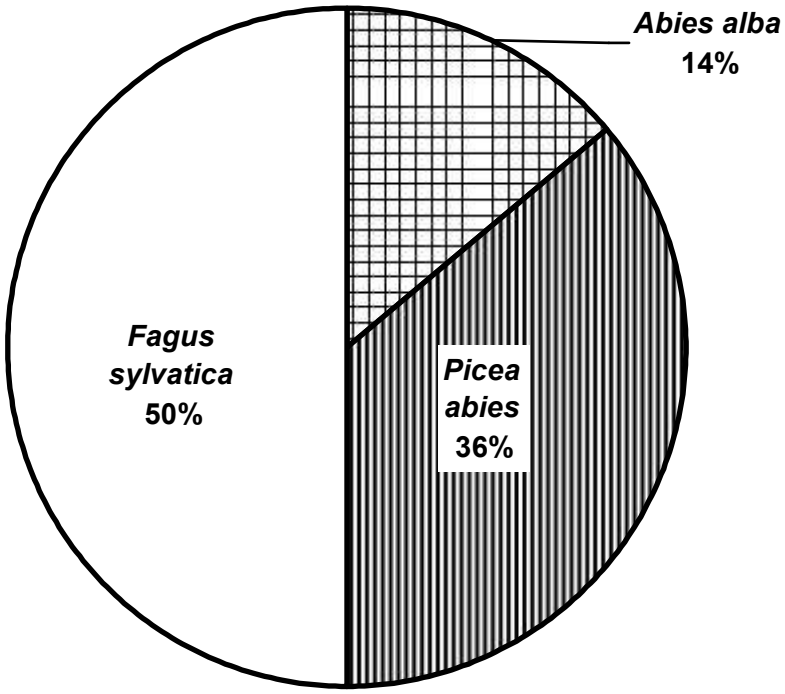

Figure 8: Stand structure for the VIIIth age class.

Further on the volumes of the *Abies alba* are increasing to 7% for the age classes V and VII, 8% for age class VI, and 14% for the stands that are in the age class VIII. The white fir has a percentage of participation in the first two age classes of 17% respectively 7%. This dynamic of the white fir can be explained as a result of different ecological and social realities. The decrement of fir in the third and the forth age classes might be explained by a slow growing of the fir compared with spruce and beech at this age, which is overlapping with the fact that 40 to 80 years ago, when the previous forests were harvested, the regeneration period was too short for fir, or by the clear cuts done in the studied mixed forest stands. According to the management plans, the only one from the tree species that was introduced by plantations, more than 40 years ago was the spruce. The relatively higher percentage of fir in the first two age classes might be explained by the fact that the fir was introduced by plantations.

Regarding the dynamics of *Fagus silvatica* volumes on age classes, it can be seen that the percentage of participation in the total above ground standing volumes is increasing with the increment of the age of the stands. Therefore *Fagus sylvatica* is a productive species only if the stands are managed with long production cycles.

The spruce has a maximum extent in the third and the fourth age classes, as a result of the spruce plantations made in the past.

The species recorded as different species are decreasing from 9% in the first and the second age classes to less than 1% in the 7th and 8th age classes. This dynamic is explained by the fact that these species are eliminated from most stands by the dominant species, due to the slow increment of these species at an advanced age. The species recorded here are especially *Betula pendula*, *Acer pseudoplatanus*, *Sorbus aucuparia*, *Carpinus betulus*, *Ulmus glabra*, *Salix caprea*, *Pinus sylvestris* and *Larix decidua*. Moreover, some of the species mentioned above are considered non desirable from productive perspectives, and are cut during the forest management operations. It should be mentioned here that, in the Cindrel Mountains, the human activities had influenced and are still influencing the vegetation cover. For example, a wide area from the resinous-beech vegetation altitudinal level is presently covered with secondary meadows, used mostly as grazing land. This ancient human activity led to a decrease of the area covered by mixed forest stands. For these reasons, nowadays only an area of 4,506 ha is covered by forests from the first three production classes in the mixed forest stands altitudinal level.

Another activity that led to the decrease of the areas covered by mixed forest stands was logging, which altered the stands natural structures by selected cuttings and by spruce plantations.

The factors mentioned above led to a smaller area covered by mixed forest stands considered as natural fundamental forest, than the average 20 to 30% of the rest of the North slope of Romania's Meridional Carpathians.

The dynamics of the mixed forest stands are presented here from the variation in time of the trees diameter, considering different sample plots as different development stages of the same forest, according to the natural fundamental series theory.

In order to analyze the stands diameter dynamics, the populations were stratified according to the species criteria.

Some descriptive statistical parameters of the relative diameters of the trees are listed in the tables 1 and 2.

It is important to notice that the spruce has, with two exceptions, a smaller variation coefficient than the beech and the fir, probably as a result of the larger light necessity of the species in the given conditions.

Table 1: The relative diameters standard deviations of the species (variation coefficient); AA – *Abies alba*, FS – *Fagus silvatica*, PA – *Picea abies*.

Plot number		1	2	3	4	5	6	7	8	9
Age class		V	VI	III	VI	V	V	VI	IV	IV
Species	FS	0.40	0.41	0.42	0.47	0.45	0.44	0.37	0.41	0.56
	AA	-	-	-	0.52	0.49	0.64	0.39	-	-
	PA	0.29	0.45	0.31	0.41	0.36	0.56	-	0.38	0.48

Table 2: The relative diameters standard deviations of the species (variation coefficient); AA – *Abies alba*, FS – *Fagus silvatica*, PA – *Picea abies*.

Plot number		10	11	12	13	14	15	16	17	18
Age class		V	IV	VI	VI	VI	V	VIII	IV	IV
Species	FS	0.35	0.35	0.36	0.28	0.41	0.52	0.58	-	0.67
	AA	-	0.88	-	-	-	0.14	-	-	-
	PA	0.25	0.52	0.58	0.41	0.48	0.31	-	0.27	0.31

DISCUSSION

Considering that most of the biometric parameters of a forest stand are corelated with the diameters of the trees, the diameter dinamic of the trees is modeled further using Weibul model. The Weibull model consist on a polinomial function combined with an exponential model. It was designed to model life expectation of complex systems. (van Laar, 1997). The considered function for the collected data is:

$$f(x,\alpha,\beta,\gamma) = \begin{cases} \frac{\gamma}{\beta}\left(\frac{x-\alpha}{\beta}\right)^{\gamma-1} e^{-\left(\frac{x-\alpha}{\beta}\right)^{\gamma}}, x \geq 0 \\ 0, x < 0 \end{cases}$$

where:
α – location parameter of the curve;
β – scale paremeter of the curve;
γ – shape paremeter of the curve;
x – the considered variable;
e – Euler's e.

From the below figures (Hanzu, 2011) (Figs. 9, 10 and 11) it can be seen that the stand dynamics are respecting the dynamics of pure stands, the curves being leptokurtic for the first age classes and rather platykurtic for the last age classes.

Simultaneously, the values for skewness of the curves are decreasing with the increment of age, but are never negative. However, this statistical approach of the stand dynamics by creating artificial strata of the data is not useful in describing the integral dynamic of the stand.

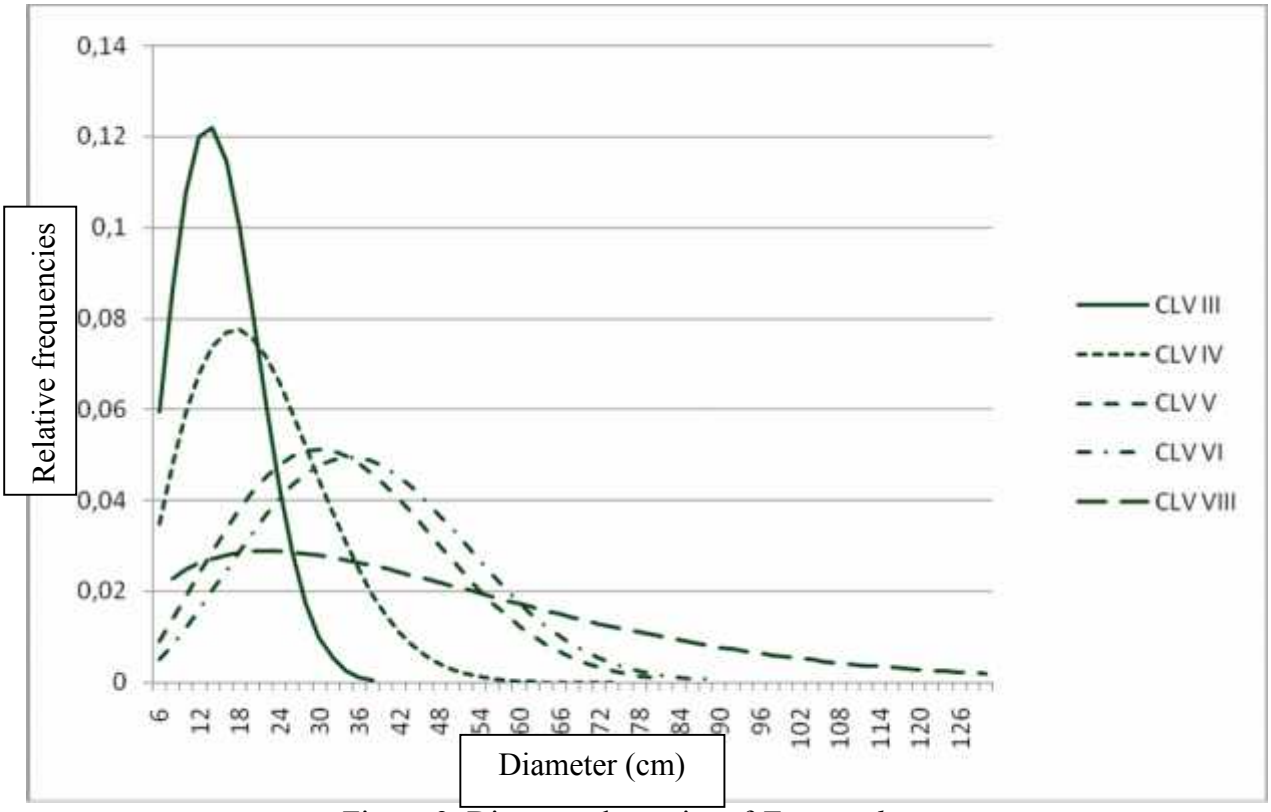

Figure 9: Diameter dynamics of *Fagus sylvatica*
(stands from 40 to 60 years old; CLV – age class).

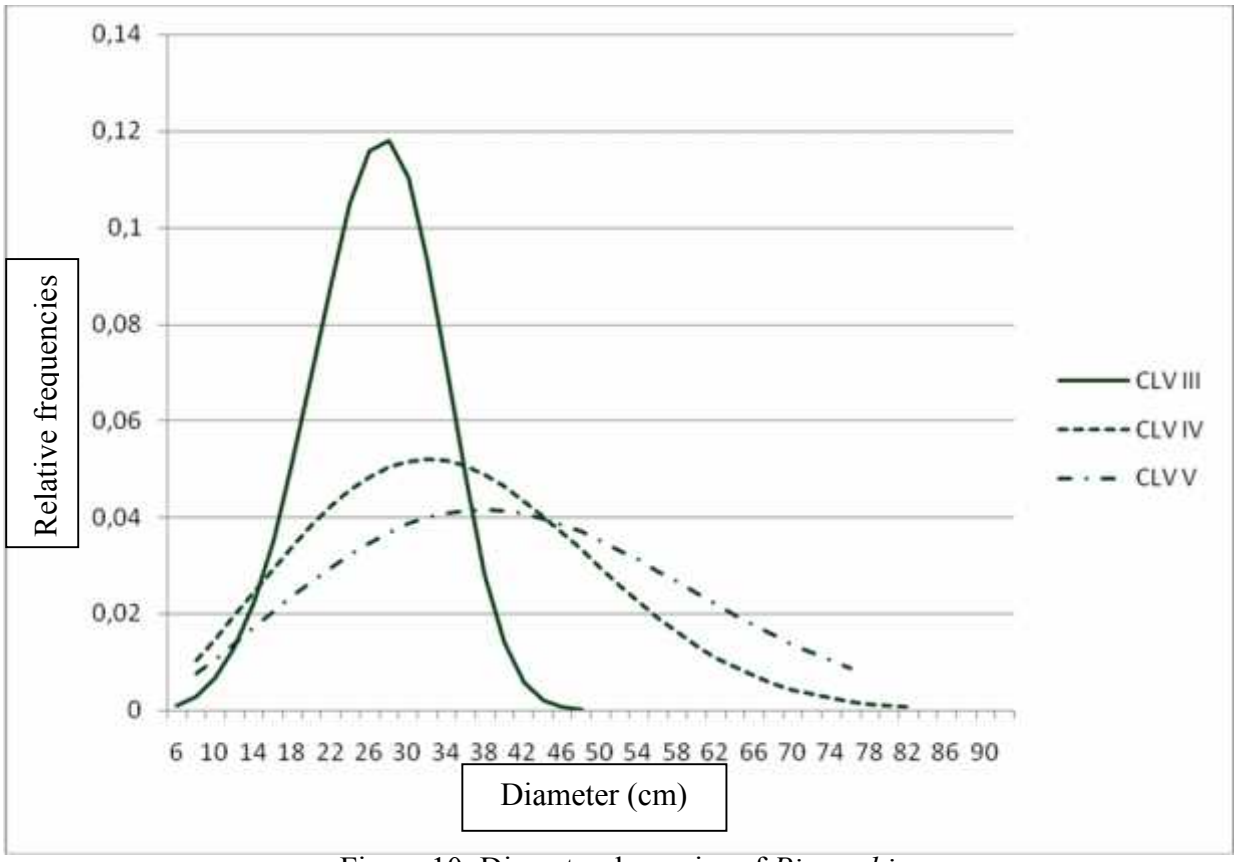

Figure 10: Diameter dynamics of *Picea abies*
(CLV – age class).

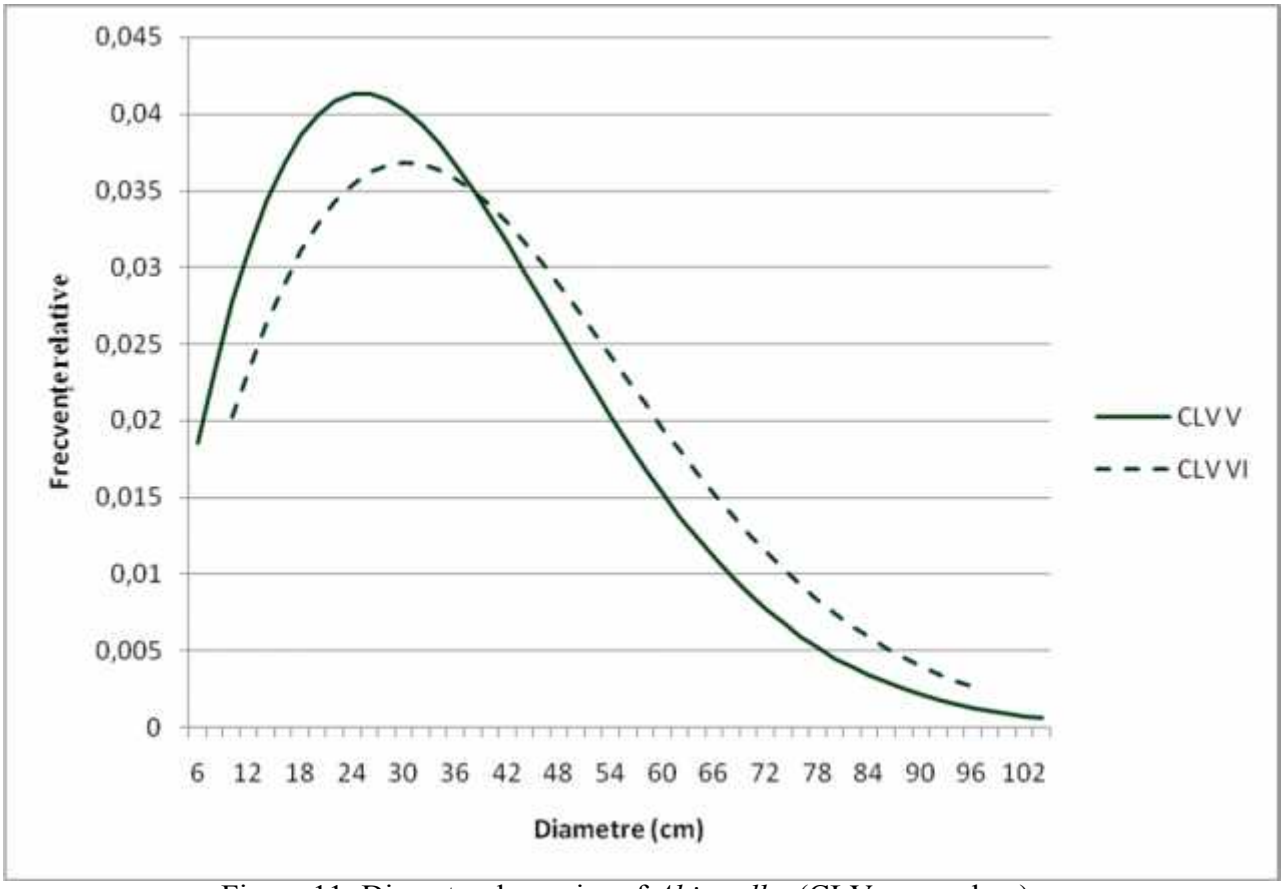

Figure 11: Diameter dynamics of *Abies alba* (CLV – age class).

CONCLUSIONS

As seen above, the dynamics of the vegetation cover is influenced by past and present human activities. The most sensitive species in the mixture to human activities seems to be the white fir. Possible growing patterns can also be drawn from the volume percentage of each species participation in the mixture.

As for the dynamic of the diameter, it can be modelled satisfactory using Weibull model. The overall trend of the stand diameter dynamics is the one known for pure stands.

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AFFORESTATION WORKS AND THE 1976-2010 NATIONAL PROGRAM APPLIED IN THE FOREST OFFICE MARA (MARAMUREŞ, ROMANIA)

Olimpiu CHIŞIU [1]

KEYWORDS: afforestation works, National Program indicators, increase and decrease of forest areas.

ABSTRACT

The aim of this research was to use a single indicator, the afforestation indicator over time. To this end, the national provisions strictly regarding this indicator were extracted. Based on these data, the surfaces needed to be planted in 5 years or one year intervals in the Mara Forestry were calculated. Thus, using the values of the National Program, the percentages were calculated for each interval, and then they were applied to the total surface of the Mara Forestry. The resulting plan was calculated for each interval of five years, for the entire locally managed surface of the forestry. Using these data, conclusions were drawn on the time evolution of the surfaces where the afforestation works took place in the Mara Forestry.

REZUMAT: Împăduriri şi Programul național 1976–2010 aplicat în Ocolul Silvic Mara (Maramureş, România).

Lucrarea de față își propune urmărirea unui singur indicator şi anume cel de împădurire. În acest scop, s-au extras prevederile stabilite la nivel național, legate strict de acest indicator. Pornind de la aceste date s-au calculat suprafețele ce revin a fi plantate în intervale de 5 ani sau de un an în cadrul Ocolului Silvic Mara. Astfel, utilizând valorile din Programul Național, s-au calculat procentele pe fiecare interval, iar apoi, acestea s-au aplicat suprafeței totale a Ocolului Silvic Mara, rezultând planul calculat pe fiecare interval de 5 ani, la nivel de ocol. În funcție de aceste date, s-au tras concluzii privind evoluția în timp a suprafețelor pe care s-au executat şi se execută lucrări de împăduriri la nivelul Ocolului Silvic Mara.

ZUSAMMENFASSUNG: Aufforstungen und das nationale Programm 1976–2010 bezogen auf den Bezirk des Forstamtes Mara (Maramuresch, Rumänien).

Die vorliegende Arbeit setzt sich zum Ziel einen Indikator und zwar den der Aufforstung zu verfolgen. Zu diesem Zweck wurden die auf nationaler Ebene festgelegten, allein diesen Indikator betreffenden Vorgaben berücksichtigt. Ausgehend von diesen Daten wurden die Flächen berechnet, die im Abstand von fünf Jahren oder auch einem Jahr im Forstamt Mara zur Aufforstung vorgesehen waren. Auf Grund der Werte aus dem nationalen Programm wurden die Prozentzahlen für jede Periode berechnet und dann auf die Gesamtfläche der Wälder im Forstbezirk Mara bezogen. Daraus ergab sich der für den Zeitraum von je fünf Jahren auf Forstbezirksniveau berechnete Plan. In Abhängigkeit von diesen Daten wurden Schlussfolgerungen betreffend die zeitliche Entwicklung der Flächen gezogen, auf denen im Forstbezirk Mara Aufforstungen durchgeführt wurden

INTRODUCTION

The 1976–2010 National Program is prepared in the form and character of a law (***, Law no. 15 April 1976), which established the evolution of the main indicators of forestry (afforestation, timber harvesting, care work, problems of mechanization, forest roads, etc.) for a period of 35 years at a national level. The values of these indicators are set on intervals of 5 years for all administrative levels, but also every year, at county and Forestry level.

MATERIAL AND METHOD

This paper aims to follow a single indicator, the afforestation indicator. To this end, the national provisions regarding strictly this indicator were extracted. Based on these data, the surfaces needed to be planted in 5 years or one year intervals in the Mara Forestry were calculated. Thus, using the values of the National Program, the percentages were calculated for each interval, and then they were applied to the total surface of the Mara Forestry, resulting in a plan calculated for each interval of five years, at the sylviculture department (Tab. 1).

Table 1: Calculation of Forestry at surfaces based on figures from the National Program.

Specifications	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	Total
National Program - thousands ha	248.4	233.2	304.0	234.0	212.0	216.0	213.0	213.0	177.0	127.0	2177.6
Calculated %	11.0	11.0	14.0	11.0	10.0	10.0	10.0	10.0	8.0	6.0	100.0
Total plan sylv. dep. - ha											4546.6
Sylv. dep plan - ha	518.6	486.9	634.7	488.6	442.6	451.0	444.7	444.7	369.6	265.2	4546.6
Sylv. dep achievements - ha		265.8	872.7	1089.0	901.0	600.5	327.0	274.0	95.0	88.0	4513.0

Out of the District level's records plan figures distributed by the County Forest Inspectorate (name of the Forest Department at that time, 1976) were extracted and the two sets of results were graphically represented (Tab. 1). Graphical representation (Fig. 1) reflects the fact that the calculation method of the planned afforestation works is correct because the two graphs are identical in shape, and outlines the gap between the values resulting from calculation and those adopted as the plan of implementation at the district level (values adopted are about 100–200 ha higher, depending on the time interval proposed).

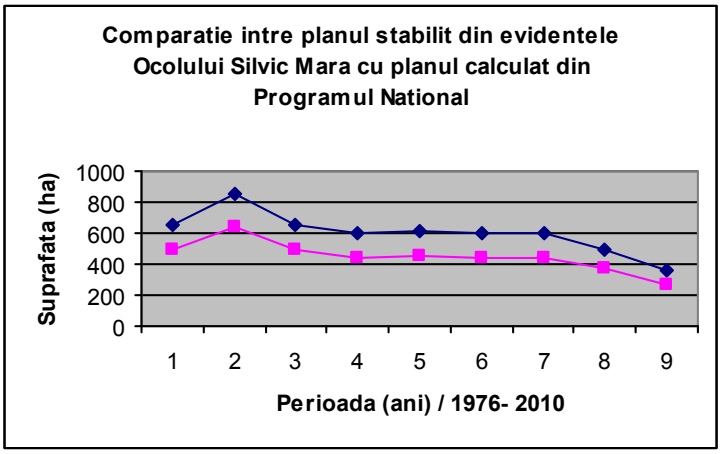

Figure 1: Graphical representation of surfaces calculated and planned.

Table 2: Areas planned and calculated according to the National Plan.

Period (years)	Records Plan (ha)	Plan calculated according to the National Program (ha)
1966-1970	656.6	486.9
1971-1975	856.0	634.7
1976-1980	658.9	488.6
1981-1985	596.9	442.6
1986-1990	608.2	451.0
1991-1995	599.7	444.7
1996-2000	599.7	444.7
2001-2005	498.4	369.6
2006-2010	357.6	265.2
Total	**5432.0**	**4028.0**

DESCRIPTION OF THE AREA OF APPLICATION OF THE PROJECT

Mara Forestry is part of the Forestry Directorate of Maramureş in the National Forest Department - ROMSILVA SA. The forest area (16,087.2 ha) managed by the Mara Forestry covers public property forests located in the north of the country, the upper and middle basin of the Tisa River, the northern limit of Maramureş County, on the northern side of Oaş-Gutâi volcanic mountains in river basins Iza and Mara.

In terms of administrative area, the district is located in the county of Maramureş, the forests being located in the municipality and villages of Bârsana Sighet, Strâmtura, Călineşti, Budeşti, Ocna Şugatag, Deseşti, Giuleşti and Vadu Iza. Neighborhoods, limits and boundaries of the public property forests managed by Forestry Mara are presented in the table number 3.

Table 3: Neighborhoods, limits, boundaries.

Cardinal points	Neighbourhood	Forestry boundaries		Borders
		Type	Name	
NORTH	Forest Sighet	Natural	- Iza River from the confluence with the Tisa River to Vadu Iza, Stejarului and Hurgoiului peaks, up to Hijii Hill	- edge of forest, pasture, meadows, agricultural land
	Forest Ruscova	Natural	- Hijii Hill, Plăiuț Peak, Plăiuț Summit up to the south of Fața Ploștii Peak	
EAST	Forest Dragomireşti	Natural	- Fața Ploștii Peak, Ploștii Summit up to Iza River, then Fața Sălți, Măgurii Summit, Sermeteş Summit up to Roşia Peak	- edge of forest, pasture, meadows, agricultural land
SOUTH	Forest Strâmbu Băiuț	Natural	- Roşia Peak, Prislop Summit, Plosca Peak, Roata Peak	- edge of forest, pasture, meadows, agricultural land
		Natural	- Roata Peak - Gutin Peak	
	Forest Târgu Lăpuş	Natural	- Gutin Peak, Gutinului Summit, Secătura Peak, Dealului Summit, Paltinului Summit, Vălău Peak	
	Forest Baia Sprie			
WEST	Forest Baia Mare	Natural	- Vălău Peak, Iezerele Summit, Igniş Summit, Piatra Runcie Summit, Brazilor Summit	- edge of forest, pasture, meadows, agricultural land
	Forest Sighet	Natural	- Brazilor Summit, Trei Măguri Summit, Țiganul Summit, Piatra Țiganului Summit up to the river Tisa	

Most of the limits are clear and stable. Within limits, the forests are bordering, besides the mentioned uses, also areas of private forests (private forests returned to their former owners in accordance with laws 18/1991 and 1/2000).

Current district boundaries, as they were recorded in the minutes of the first Conference of arrangement, coincide with the previous arrangement. These limits are the ones set at the 1963 arrangement, in a well-defined geographical framework.

RESULTS AND DISCUSSION

Table 4 and the figure 2 examine the evolution of the surfaces planned for planting and the actual fruition. Compared to the initial planning, two scarce moments can be spotted: the period between 1966 – 1970 (it represents the debut of the planned afforestation works) which is poorly motivated because it is related to lawsuits; the period from 1989 to 2010, which registers the largest deficit of works, because it is influenced by historical, economic and social fluctuations

Table 4: Effective surface evolution and achievements planned.

Year	Plan	Achievements
1966-1970	656.6	265.8
1971-1975	856	872.7
1976-1980	658.9	1089
1981-1985	596.9	901
1986-1990	608.2	600.5
1991-1995	599.7	327
1996-2000	599.7	274
2001-2005	498.4	95
2006-2010	357.6	88
Total	**5432**	**4513**

Between these two moments an overcome and a peak exceeding the achievements from planning can be observed, recorded in the period 1976–1989. This peak period is marked by the moment of the implementation of the National Program (1976) and the historical moment, in 1989, after which the achievements have a downslope and historical minimum values below the threshold values recorded at the beginning of the first works of afforestation (1966).

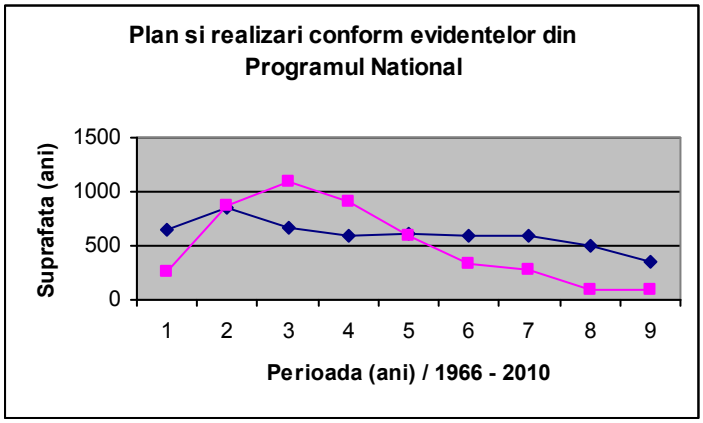

Figure 2: Evolution of the surface planned and actual surface.

We would be tempted to contest the figures achieved in the peak period, because we know the way the report of the plan figures was made in the communist period. The argument that supports the reports to prove their correctness is the fact that, unlike other sectors of the economy, in forestry there are the so-called "witnesses" who can affirm or disprove the existence or absence of these achievements in the areas planted forests. In other words, if we planted forest areas with an appropriate composition, means that the figures reported are correct. And we are entitled to believe the veracity of the data reported because the surfaces covered with forest vegetation exist

in the field (except irrational forest exploitation of private property, as appropriate).

From the figure number 2 it follows that the surplus of the afforestation works made is half the deficit registered in the range studied, so that overall, the plan established by the National Program has not been achieved. The points of intersection of the two graphs represent two important moments, namely: the first - is reaching for the first time proposed provisions and second, the historical moment represented by 1989.

After this year, 1989, accomplishments go on a downward slope, the decrease being caused by the lack of funds to be allocated for afforestation work (co-signed in chronic shortages district) and forest restitution made hesitantly and influenced by political turnover in Romania at that time.

The graph number 3 details the achievements of afforestation works on intervals of one year and has the specific form of normal distribution (Gauss curve), but asymmetric, with the curve's maximum recorded in the first period of the project. On the graph it is observed that there were attempts to maintain the achievements set in the initial plan, but since 2003, the achievements' curve is relatively constant, without large fluctuations, stabilized at the minimum level recorded for the whole period considered. This indicates that afforestation works will remain and continue at this stage, without any conditions to increase, due to the lack of funds necessary to carry out afforestation works.

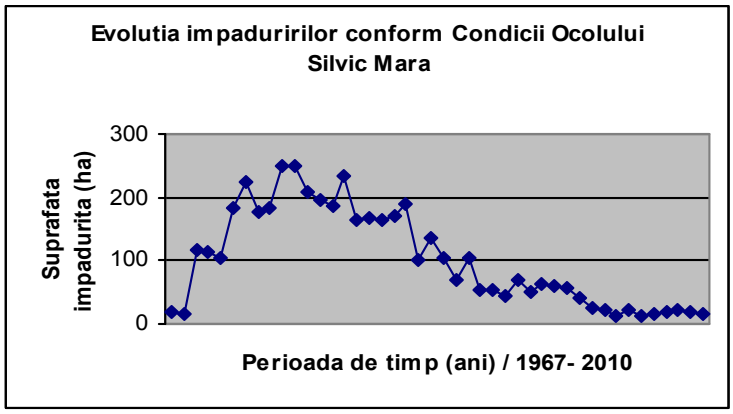

Figure 3: The afforestation works in the period 1967–2010.

In order to track more closely the evolution of the afforestation works in the period 1976–2010, we agreed upon the introduction of the following indicators, where: Ip = index of planting Sp = area planted annually or every 5 years St = total area of the district (annual or every 5 years or 10 years)

This index tracks the share of the district's surface represented by the area planted. This is important because the total area of the district is affected periodically by forest restitution and is continuously decreasing. So, we have the planted areas located on a downslope, continuously decreasing, but also the total area of the district is in constant decline. Graphically representing this index (Fig. 4), we see that it has the same shape as in the figure 3, which confirms that although the district area is declining, this does not influence the level of achievement of afforestation works. This level is low and tends to remain constant at a historic low for the next few years.

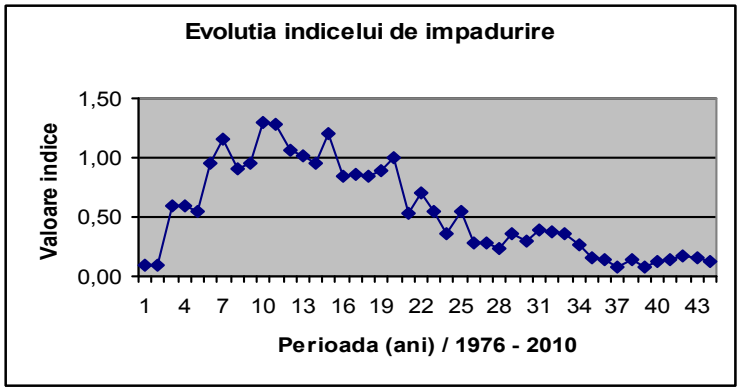

Figure 4: The evolution of afforestation index for the period 1976–2010.

The graph number 5 shows the achievements starting from 1976 and ending with 2010. This clearly illustrates the large deficit regarding the works of afforestation. Although the plan is in decline at constant levels, we see that its minimum is still three times higher than the achievements. Establishing a constant plan at some level is a normal procedure which is set according to the cutting or the planting plans on other lands. The disturbances produced at the economic, historical, social levels and other interests in Romania (after 1989) led to a stabilization of the level of afforestation at about 30% from the level proposed.

The baseline was established in terms of social and economic climate history of a different character (the time before 1989). This can be very simply noticed out of the fact that in the returned surfaces, although it's necessary, the afforestation works are carried out at a very low level. After 1989 (the last point of intersection of the two curves in the figure 5) there was, after a big drop in 1990, an attempt to return to the plan in 1991, followed by the collapse of their minimal accomplishments today. The whole period from 1991 to 2000 (when the figure achievements stabilizes at a minimum, but constant) is characterized by oscillations with constant downward trend. This trend is caused by periods of restitution of forests in the various laws of the land, the last major crash being in 2000 (Law 1/2000). If in 1991 (the year of adopting Law 18/1991 - the first law of restitution of forest areas), the surfaces covered by the afforestation work dropped sharply compared to the plan, they knew a slight recovery in 1992 (the year that the sylviculture department bypass the face of lack of funds for afforestation), followed by an even more dramatic decrease in 1993, down which shall be final without any possibility of recovery.

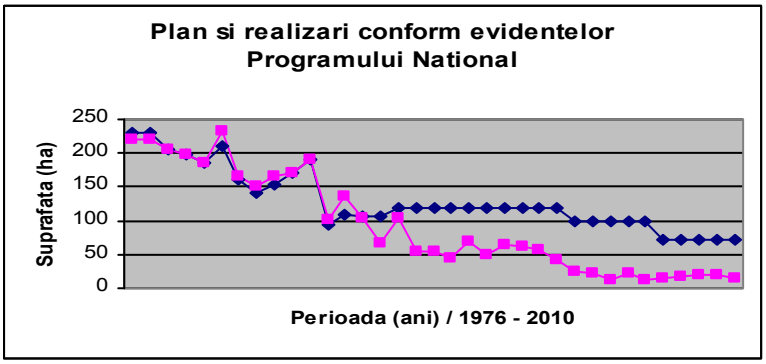

Figure 5: Plan records and achievements under the National Program 1976–2010.

CONCLUSIONS

The provisions of the National Program proved to be correct due to the fact that its provided figures were achieved in the period before 1989 ("witnesses" who certify these data are represented by the existing forest areas).

National Program provisions could have been achieved during the last years as well, with the condition of a normal development of the Romanian society through rational management and compliance regarding the regime for the returned areas the forest.

Overall, the afforestation has an evident deficit stabilized at a very low level.

Return to normal conditions established by the program can only be achieved through a spectacular leap of increasing afforestation works similar to the 60s and 70s.

Currently, afforestation works can not achieve quantitative high due to limited financial possibilities, the lack of constraints for those who do not meet the forest regime, a reduced number of nurseries (eleven existing in 1989, four in 1999), special crop failure (winter trees, wood pulp, mulberry, walnut, cherry, fruit trees – underbrush, cranberry, mountain ash – forest belts, rosin pin, euramerican poplar, etc.).

AKNOWLEDGEMENTS

The author thanks to Mr. G. Timofte, responsible for the culture and recovery department within Forestry Mara, for logistical support, guidance and technical support given to the development of this work.

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VEGETATION OF ROMANIA IN POPULAR LANGUAGE: RESULTS OF ETHNO-PHYTOSOCIOLOGICAL INVESTIGATIONS

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KEYWORDS: Ethno-phytosociological questionnaire, folk phytocoenonyms, vegetation, Romania.

ABSTRACT

The results are presented here of an ethno-phytosociological questionnaire of 171 questions that respondents answered with one or more terms designating names of plant groups (phytocoenoses). So far 653 Romanian folk phytocoenonyms have been recorded, of which 562 are nominated as spontaneous plant groups and 91 agrocoenoses. Of the 562, a total of 146 refered to forest, 106 to scrub, 89 to meadows and pastures, 132 to weeds or ruderals and 89 to aquatic and paludal vegetation. Most folk phytocoenonyms named plant associations and alliances, and fewer referred to taxonomic orders and classes.

REZUMAT: Vegetația României în limbaj popular. Rezultate ale unor investigații etnofitososiologice.

Este prezentat un chestionar etnofitosociologic cu 171 întrebări la care cei intervievați au răspuns cu unul sau mai mulți termeni desemnând nume de grupări vegetale (fitocenoze). S-au consemnat până în acest moment 653 de fitocenonime populare românești, 562 desemnând grupări vegetale spontane, iar 91 agrocenoze. Din cele 562, un număr de 146 se referă la păduri, 106 la tufărișuri, 89 la pajiști, 132 la buruienișuri și 89 la vegetația acvatică și palustră. Cele mai multe fitocenonime populare numesc asociații și alianțe vegetale și mai puține ordine și clase de vegetație.

RÉSUMÉ: La végétation de Roumanie en langage populaire. Les résultats d'une étude etnophytosociologique.

On présente un questionnaire etnophytosociologique à 171 questions auxquels les répondants ont donné un ou plusieurs termes désignant des noms d'associations végétales (phytocénoses). Jusqu'a présent nous avons obtenu 653 phytocénonymes populaires roumaines, dont 562 désignent des associations végétales spontanées et 91 agrocénoses. Des 562, un nombre de 146 font référence aux forêts, 106 aux association arbustives, 89 aux pâturages, 132 aux associations de plantes rudérales et 89 à la végétation aquatique et palustre. La plus part des phytocénonymes populaires nomment des associations végétales, très peu d'entre elles faisant référence aux ordres et classes taxonomiques..

INTRODUCTION

In our ethnobotanical investigations conducted over 40 years (1969–2011) in 380 Romanian localities, we recorded plants names and uses, and plants ecology and coenology, in the view of Romanian peasants (Drăgulescu, 1985, 1992, 1995, 2010). The information was collected using an ethnophytocoenologic questionnaire that, at its largest form had almost 250 questions. In this paper we published a version with 171 questions (in Romanian and in English), representing only those questions to which answers were received. They are grouped according to the type of vegetation (wood, grass, terrestrial, aquatic, spontaneous, cultivated). Within each type of vegetation the plant groups are grouped by altitude from those alpine-subalpine to those mountain, then hilly and plain coenosis.

Answers to questions are noted in bold. These are terms recorded by the author from the peasants, but also words noted from various dictionaries and reference books. There have been identified 653 Romanian folk phytocoenonyms, 562 nominated spontaneous plant groups and 91 agrocoenoses. From those 562, a number of 146 refers to the forests, 106 to the thickets, 89 to the meadows, 132 to the weeds and 89 to the aquatic and paludal vegetation of interest in many ecological and ecophysiological studies.

ETHNOPHYTOSOCIOLOGICAL QUESTIONNAIRE

Locality and county:
Date:
Name of the person interviewed:
Address:
Place and year of birth:
Schools graduated:
Occupation/profession:

QUESTIONS

- questions should be asked, as far as possible, in the field, so that the respondents can see the phytocoenosis;

- for each phytocenosis, respondents will have to mention also the kind of environmental conditions (the altitude using terms like: at the plains, in meadows, on the plateau/hill/mountain; the exposure/slope, in popular terms: in front or behind; the type of soil: fat, heavy, slight, loamy, clayey, sandy, rocky, salty; the humidity: wet, damp, dry; where that certain plant group develops and to list the plants that they know from that coenosis);

- the exposition/slope, in popular terms: in front or behind; the type of soil: fat, heavy, light, loamy, clayey, sandy, rocky, salty; the humidity: wet, damp, dry; on which that plant group develops and to list the plants that they know from that coenosis;

- when the answer for the same question contains two or more terms which are not perfect synonyms, details to distinguish those terms will be asked (example: “codru is the mountain forest”, “crângul has younger trees”, “bărcul is smaller”);

CHESTIONAR ETNOFITOSOCIOLOGIC

Localitatea şi judeţul:
Data:
Numele persoanei chestionate:
Adresa:
Locul şi anul naşterii:
Şcoli absolvite:
Ocupaţia/profesia:

ÎNTREBĂRI

- întrebările se vor pune, pe cât este posibil, în teren pentru ca cei chestionaţi să vadă fitocenozele în cauză;

- la fiecare fitocenoză, persoanele chestionate vor trebui să spună şi în ce condiţii ecologice (altitudinea redată în termenii: la şes, în lunci, pe podiş/platou/deal/munte; expoziţie/versant, în grai popular pe faţă, în dos; tip de sol: gras, sărac, greu, uşor, argilos, lutos, nisipos, pietros, sărat; umiditate: umed, jilav, reavăn, uscat; unde se dezvoltă gruparea vegetală respectivă şi să enumere speciile de plante pe care le cunosc din cenoza în discuţie);

- expoziţie/versant, în grai popular pe faţă, în dos; tip de sol: gras, sărac, greu, uşor, argilos, lutos, nisipos, pietros, sărat; umiditate: umed, jilav, reavăn, uscat; unde se dezvoltă gruparea vegetală respectivă şi să enumere speciile de plante pe care le cunosc din cenoza în discuţie;

- când se răspunde la aceeaşi întrebare, cu doi sau mai mulţi termeni şi aceştia nu sunt perfect sinonimi se vor cere amănunte pentru diferenţierea acelor termeni (ex. „codru este la munte”, „crângul are copaci mai tineri” „bărcul este mai mic”).

I. Woody vegetation
1. Natural/spontaneous vegetation
1.1. Forests

1. What is the name of a bigger or smaller group of trees/the place where a lot of trees grow?

2. How is called a young, dense forest?

3. How is called a small forest?

4. What is the name of spruces (*Picea abies*) group/forest?

5. What is the name of the spruces (*Picea abies*) with silver firs (*Abies alba*) group/forest?

6. What is the name of the silver firs (*Abies alba*) group/forest?

7. What is the name of the pines (*Pinus sylvestris*) group/forest?

8. What is the name of the larches (*Larix decidua*) group/forest?

9. What is the name of the yews (*Taxus baccata*) group/forest?

I. Vegetație lemnoasă
1. Vegetație naturală/spontană
1.1. Păduri

1. Cum se numeşte gruparea mai mare sau mai mică de arbori/locul pe care cresc mulți arbori/copaci?
(**bărc, berc, bunget, codru, crâng, dumbravă, orman, pădurărie, pădure, rădiu, rediu, stârmină**)

2. Cum se numeşte o pădure tânără deasă?
(ciritel, ciritiş, crâng, desiş, hăciugă, hățiş, higiu, huceag, huci, lăstăriş, mladă, pădurice, păhuişte, păriş, prăjiniş, rădiu, săditură, sâhlar, sâhlă, selbă, síhlă, sihlete, sâhlişte, silhă, sâlhă, silhiş, tâlhiş, târşar, târşete, tihăraie, tihărie, tuzuc, țihlă, țâhlă)

3. Cum se numeşte o pădure mică?
(bărc, berc, checheriş, chichiriş, huceag, pădurice)

4. Cum se numeşte pădurea de molizi (*Picea abies*)?
(molidiş, milidviş, silhă)

5. Cum se numeşte pădurea de molizi cu brazi?
(brădet, brădeto-molidiş, brădiş, molidiş, molidişo-brădet, molidviş, silhă, târşete)

6. Cum se numeşte pădurea de brazi (*Abies alba*)?
(brădişte, brazişte, brădăniş, brădet, brădiş, brădişte)

7. Cum se numeşte pădurea de pini (*Pinus*)?
(chinet, pinet)

8. Cum se numeşte gruparea/pădurea de zade/larițe (*Larix decidua*)?
(cădriniş, lăricet, zădiş)

9. Cum se numeşte gruparea/pădurea cu tise (*Taxus baccata*)?
(tisărie)

10. What is the name of the forest with spruces, silver firs and beeches forest? What is the name of mixed deciduous and coniferous forest?

10. Cum se numeşte pădurea de molizi cu brazi şi cu fagi? Cum se numeşte pădurea de amestec foioase cu răşinoase?
(brădeto-făget, făgeto-brădet, făgeto-brădiş)

11. What is the name of beeches (*Fagus sylvatica*) forest?

11. Cum se numeşte pădurea de fagi (*Fagus*)?
(bucovină, făget, făgiş)

12. What is the name of the forest with beech and hornbeam?

12. Cum se numeşte gruparea/pădurea de fagi cu carpeni?
(cărpineto-făget, făgeto-cărpinet, făgeto-cărpiniş)

13. What is the name of the hornbeams (*Carpinus betulus*) forest?

13. Cum se numeşte pădurea de carpeni (*Carpinus betulus*)?
(cărpeniş, cărpiniş, cărpinet)

14. What is the name of the forest with beech and sessile oaks?

14. Cum se numeşte pădurea de goruni cu fagi?
(goruneto-făget, făgeto-goruniş, făgeto-gorunet)

15. What is the name of the sessile oaks (*Quercus petraea, Quercus dalechampi, Quercus polycarpa*) forest?

15. Cum se numeşte pădurea de goruni (*Quercus petraea, Quercus dalechampi, Quercus polycarpa*)?
(bunget, gărână, gorână, goroniş, gornet, gorunet, goruniş, goronişte, gorună, gorunişte)

16. How is called the mixed forest with sessile oak and pedunculate oak?

16. Cum se numeşte pădurea de amestec de stejari cu goruni?
(bunget, goruneto-stejăret, goruneto-stejăriş, goroniş, goruniş, stejăreto-gorunet, stejărişo-gorunet, stejăreto-goruniş, stejărişo-goruniş)

17. What is the name of the forest with oaks (*Quercus* spp.) with hornbeams (*Carpinus betulus*)?

17. Cum se numeşte pădurea de stejari/goruni cu carpeni?
(carpino-gorunet, carpino-goruniş, carpino-stejăret, carpino-stejăriş, stejăreto-cărpinet, goruneto-cărpinet)

18. What is the name of the pedunculate oaks (*Quercus robur*) forest?

18. Cum se numeşte pădurea de stejari (*Quercus robur*)?
(berc, bunget, goroniş, goruniş, rădiac, rediş, rediu, stejăriş, stejăret, stejărişte, stejărie, stejărime, stejeriş, tufăniş, zăbran)

19. What is the name of the forest with pedunculate oaks and turkey oaks (*Quercus cerris*)?

19. Cum se numeşte pădurea de stejari cu cer?
(cereto-stejăriş, cereto-stejăret, stejăriş, stejăret, stejăreto-ceret, stejăreto-ceriş)

20. What is the name of turkey oaks (*Quercus cerris*) group/forest?

20. Cum se numeşte gruparea/pădurea de ceri (*Quercus cerris*)?
(ceret, ceriş)

21. What is the name of turkey oaks (*Quercus cerris*) with hungarian oaks (*Quercus frainetto*) group/forest?

21. Cum se numeşte gruparea/pădurea de ceri cu gârniţe?
(cereto-gârnițet, gârnițeto-ceret, gârnițeto-ceriş)

22. What is the name of hungarian oaks (*Quercus frainetto*) forest?

22. Cum se numeşte pădurea de gârniţe (*Quercus frainetto*)?
(gârnicet, gârnițet)

23. What is the name of the maples (*Acer* spp.) forest?

23. Cum se numeşte pădurea de arţari/paltini/jugaştri (*Acer* spp.)?
(arțăriş, jugăstriş, păltinet, păltiniş, păltinişte)

24. What is the name of ash (*Fraxinus* spp.) group/forest?

24. Cum se numeşte gruparea/pădurea de frasini (*Fraxinus* spp.)?
(frăsinet, frăsiniş)

25. What is the name of the birch (*Betula* spp.) group/forest?

25. Cum se numeşte gruparea/pădurea de mesteceni (*Betula* spp.)?
(mestecănet, mestecăniş, mestecănişte, mestecărie, mesteciş)

26. What is the name of the limes/lindens (*Tilia* spp.) group/forest?

26. Cum se numeşte gruparea/pădurea de tei (*Tilia* spp.)?
(teiş)

27. What is the name of the mountain ashes (*Sorbus*) group?

27. Cum se numeşte gruparea/locul cu scoruşi de munte (*Sorbus*)?
(scoruşet)

28. What is the name of the elms (*Ulmus*) group? What is the name of the land with elms (*Ulmus*)?

28. Cum se numeşte gruparea/locul cu ulmi (*Ulmus*)?
(ulmet)

29. What is the name of the poplars/aspens (*Populus*) group/forest?

29. Cum se numeşte gruparea/pădurea de plopi (*Populus*)?
(plochiş, plopar, plopărie, plopăriş, plopărişte, plopet, plopiş, plopişte)

30. What is the name of the false acacies (*Robinia pseudacacia*) group? What is the name of the land with false acacias (*Robinia pseudacacia*)?

30. Cum se numeşte gruparea/locul cu salcâmi/acăţi (*Robinia pseudacacia*)?
(acăţiş, dăfiniş, salcâmă, salcâmărie, salcâmiş, salcâmişte)

31. What is the name of the European bird cherries (*Prunus padus*) group/forest?

31. Cum se numeşte gruparea/ zăvoiul/pădurea de mălini (*Prunus padus*)?
(măliniş)

32. What is the name of the alders (*Alnus glutinosa, Alnus incana*) group? What is the name of land with alders (*Alnus glutinosa, Alnus incana*)?

32. Cum se numeşte gruparea/locul cu arini/anini (*Alnus glutinosa, Alnus incana*)?
(aniniş, ariniş, arinişte, crină)

33. What is the name of the land with alders and willows?

33. Cum se numeşte locul cu arini şi sălcii?
(arinişo-sălciş, arinişo-răchitiş, sălceto-ariniş, sălcişo-ariniş, zăvoi)

34. What is the name of the willows (*Salix*) group? What is the name of the land with willows (*Salix*)?

34. Cum se numeşte gruparea/locul cu sălcii/răchite (*Salix*)?
(berc, luncă, mlajă, răchitiş, sădechiu, sălcet, sălcăriş, sălcime, sălciniş, sălciş, zăvoi)

35. What is the name of the place/land from the forest where grows much wood garlic/ramsors (*Allium ursinum*)?

35. Cum se numeşte locul din pădure unde creşte multă leurdă (*Allium ursinum*)?
(leurdiş, leurdişte)

36. What is the name of the forest edge and what plants grow there?

36. Cum se numeşte marginea pădurii şi ce plante cresc acolo?
(brâu, dungă, lizieră)

37. How is the land where a (part of) the woods burned called?

37. Cum se numeşte locul în care a ars o (parte de) pădure?
(arsătură, arsură, arşiță, jarişte, pârjol, pârjolitură, pârleală, pârlitură, pojarniță)

38. What is the name of the place without trees from a forest/the clear cut forest?

38. Cum se numeşte tăietura de pădure/locul fără arbori dintr-o pădure?
(ciunget, colnă, colnic, curătură, gărână, laz, luminiş, ochi, păraş, pârloagă, poiană, ponor, posadă, prelucă, pripor, prisacă, râtaş, runc, săcsie, secătură, seci, tăietură, tânărog, târsaică, târsă, târsătură, târsoc, târşeală, târşitură, tog, zarişte)

39. What kind of groups of plants growing, over the years, in cuts of forests?

39. Ce fel de grupări de plante se dezvoltă, cu anii, în tăieturile de păduri?
(besecăniş, bisăcăniş, frăgăriş, socet, târsoc, zmeuret)

I. Woody vegetation
1. Natural/spontaneous vegetation
1.2. Bushes

40. What is the name of place/land with many shrubs/bushes?

41. What is the name of the alpine thicket with dwarf willows (*Salix herbacea, Salix retusa, Salix reticulata*)?

42. What is the name of the thicket with rhododendrons (*Rhododendron*)?

43. What is the name of the thicket with dwarf pines (*Pinus mugo*)?

44. What is the name of the thicket with junipers (*Juniperus*)?

45. What is the name of the thicket with blueberries (*Vaccinium myrtillus, Vaccinium gaultherioides*)?

46. What is the name of the thicket with cowberries (*Vaccinium vitis-idaea*)?

47. What is the name of the thicket with blueberries, cowberries and raspberries?

48. What is the name of the thicket with raspberries (*Rubus idaeus*)?

49. What is the name of the thicket with blackberries/brambles (*Rubus*)?

50. What is the name of the thicket with wild roses (*Rosa*)?

I. Vegetaţie lemnoasă
1. Vegetaţie naturală/spontană
1.2. Tufărişuri

40. Cum se numeşte locul cu multe tufe/arbuşti?
(bărc, berc, boroagă, bunget, cățân, ceritel, ciritiş, desiş, hăciugă, hălăciugă, hățiş, hâns, huceag, huci, rădiu, smid, smidă, smidiş, smiget, stufărie, stufăriş, tâhlăriş, tâlhiş, tufărie, tufăriş, tufărişte, tufet, tufiş, tufişte, țăcăliş, țâhliş, țârlici, țuhă)

41. Cum se numeşte gruparea/desişul alpin de sălcii pitice (*Salix herbacea, Salix retusa, Salix reticulata*)?
(răchițişişte)

42. Cum se numeşte gruparea/desişul cu smirdar/bujor de munte (*Rhododendron*)?
(smirdăriş)

43. Cum se numeşte gruparea/desişul cu jneapăn/jip (*Pinus mugo*)?
(cățâniş, jâpiş, jepiş, jnepeniş, jnepenişte)

44. Cum se numeşte gruparea/desişul cu ienupăr (*Juniperus*)?
(cetiniş, ienupăriş)

45. Cum se numeşte gruparea/desişul cu afini (*Vaccinium myrtillus, Vaccinium gaultherioides*)?
(afinet, afiniş, afunet, afuniş)

46. Cum se numeşte desişul cu coacăze/merişoare (*Vaccinium vitis-idaea*)?
(**merişorişte**)

47. Cum se numeşte locul cu tufe de afini, merişori şi zmeuri?
(padiş)

48. Cum se numeşte gruparea/desişul cu zmeuri (*Rubus idaeus*)?
(padiş, smeuret, smeuriş, smid, zmăuret, zmeurăt, zmeuret, zmeuriş, zmeurişte)

49. Cum se numeşte gruparea/desişul cu muri (*Rubus*)?
(muriş, murişte, rugărie, ruget)

50. Cum se numeşte gruparea/desişul cu măceşi (*Rosa*)?
(ruget, smid, spinet, spiniş, spinişte)

51. What is the name of the thicket with brideworts (*Spiraea*)?

52. What is the name of the thicket with elders (*Sambucus nigra, Sambucus racemosa*)?

53. What is the name of the thicket with privet (*Ligustrum vulgare*)?

54. What is the name of the thicket with hazels (*Corylus avellana*)?

55. What is the name of the thicket with alder buckthorn (*Frangula alnus*)?

56. What is the name of the thicket with dogwoods (*Cornus sanguinea*)?

57. What is the name of the thicket with cornels/cornelian cherries (*Cornus mas*)?

58. What is the name of the thicket with spindles (*Evonymus*)?

59. What is the name of the thicket with lilac (*Syringa*)?

60. What is the name of the thicket with cranberrybushes (*Viburnum opulus*)?

61. What is the name of the thicket with black brooms (*Cytisus nigricans*)?

62. What is the name of the grouping/place/land with thorns (*Crataegus, Prunus spinosa,* etc.)?

63. What is the name of the thicket with hawthorns (*Crataegus*)?

64. What is the name of the thicket with blackthorn/sloe (*Prunus spinosa*)?

51. Cum se numeşte gruparea/desişul cu taulă (*Spiraea*)?
(ciritel)

52. Cum se numeşte gruparea/desişul cu soci (*Sambucus nigra, Sambucus racemosa*)?
(socet)

53. Cum se numeşte gruparea/desişul cu lemnul câinelui (*Ligustrum vulgare*)?
(măliniş)

54. Cum se numeşte gruparea/desişul cu aluni (*Corylus avellana*)?
(alunet, aluniş, tufărişte, tufet, tufişte)

55. Cum se numeşte desişul cu cruşini (*Frangula alnus*)?
(sălbiş)

56. Cum se numeşte desişul cu sângeri (*Cornus sanguinea*)?
(sângeret)

57. Cum se numeşte desişul cu corni (*Cornus mas*)?
(cornet)

58. Cum se numeşte gruparea/desişul cu salbă moale/râioasă (*Evonymus*)?
(sălbiş)

59. Cum se numeşte desişul cu lilieci (*Syringa*)?
(măliniş)

60. Cum se numeşte gruparea/desişul cu călini (*Viburnum opulus*)?
(călinet, căliniş, călinişte)

61. Cum se numeşte gruparea/desişul cu drob (*Cytisus nigricans*)?
(drobiş)

62. Cum se numeşte gruparea/locul cu mărăcini (*Crataegus, Prunus spinosa* etc.)?
(hâns, mărăciniş, smidă, spinet, târniş)

63. Cum se numeşte gruparea/desişul cu păducei (*Crataegus*)?
(mărăciniş)

64. Cum se numeşte gruparea/desişul cu porumbari (*Prunus spinosa*)?
(mărăcinet, mărăciniş, smid, spinărie, spinăriş, spinet, spiniş, târniş)

65. What is the name of the thicket with european buckthorn (*Rhamnus cathartica*)?

66. What is the name of the thicket with Christ's thorn (*Paliurus spina christi*)?

67. What is the name of the thicket with sea buckthorn (*Hippophae rhamnoides*)?

68. What is the name of the clematis group (*Clematis vitalba*)?

65. Cum se numeşte gruparea/desişul cu verigari (*Rhamnus cathartica*)?
(sălbiş)

66. Cum se numeşte gruparea/desişul cu păliur (*Paliurus spina christi*)?
(păliuriş)

67. Cum se numeşte gruparea/desişul cu cătină albă (*Hippophae rhamnoides*)?
(cătiniş)

68. Cum se numeşte gruparea/desişul de curpen (*Clematis vitalba*)?
(curpănărie, curpenet, curpeniş, curpenişte, curpiniş)

I. Woody vegetation
2. Crops

69. What is the name of the place cultivated with fruit trees?

70. What is the name of the place cultivated with apple trees?

71. What is the name of the place cultivated with pear trees?

72. What is the name of the place cultivated with plum trees?

73. What is the name of the place cultivated with walnut trees?

74. What is the name of the place cultivated with grape wine?

I. Vegetaţie lemnoasă
2. Culturi

69. Cum se numeşte locul cultivat cu pomi fructiferi?
(livadă, ogradă, pomăret, pomărie, pomărişte, pomărit, pomet, rât, sad)

70. Cum se numeşte locul cultivat cu meri (*Malus*)?
(meriş)

71. Cum se numeşte gruparea/desişul cu lemnul câinelui (*Ligustrum vulgare*)?
(măliniş)

72. Cum se numeşte locul cultivat cu pruni (*Prunus*)?
(perjărie, prunărie, prunet, pruniş, prunişte, târşală)

73. Cum se numeşte locul cultivat cu nuci (*Juglans regia*)?
(nucet)

74. Cum se numeşte cultura/locul cultivat cu viţă de vie (*Vitis vinifera*)?
(vie)

II Herbaceous vegetation
1. Terrestrial herbaceous vegetation
1.1. Spontaneous vegetation
1.1.1. Meadows

75. How do you call the place/land in a forest without trees and shrubs?

II. Vegetaţie ierboasă
1. Vegetaţie ierboasă terestră
1.1. Vegetaţie spontană
1.1.1. Pajişti

75. Cum se numeşte locul fără copaci şi fără tufe dintr-o pădure?
(colnic, luminiş, ochi, poiană, pripor, prisacă, rarişte, zarişte)

76. What is the name of the ground covered with grass used as fodder?

76. Cum se numeşte terenul acoperit cu iarbă folosită ca nutreț?
(jip, pajişte)

77. What is the name of place with grass where animals graze?

77. Cum se numeşte locul cu iarbă în care pasc animalele?
(canara, ierbărit, imaş, izlaz, luncă, păscut, păscălău, păscăneț, păscătoare, păscătorie, păscătură, păştiune, păşunare, păşunat, păşună, păşune, păşunet, prelucă, obrejă, orman, rât, silişte, sit, suhat, suhăție, ştimar, tabun, tânărog, toloacă)

78. What is the name of place with grass where the plants are mowed to make hay?

78. Cum se numeşte locul cu iarbă unde plantele se cosesc pentru a face fân?
(cosalău, cosaştină, cositură, fânaț, fănărie, fâneață, garişte, tânărog, tog)

79. What names do the grasslands have depending on their altitude?

79. Ce nume poartă pajiştile în funcție de altitudinea la care se află?
(de şes, de deal, de munte)

80. What types of grasslands growing on wetter soils?

80. Ce tipuri de pajişti se dezvoltă pe solurile mai umede?
(**rogoziş, şuvăriş, şovăriş târsiş, târsişte, târsoc**)

81. What types of grasslands growing on drier soils?

81. Cum se numesc grupările de plante de pe soluri uscate?
(**coliliş, colilişte, năgăruş, obsigiş, sădiş, sădiniş**)

82. How do you call the groups of plants from salty soils? How is called the salty land?

82. Cum se numesc grupările de plante de pe soluri sărate? Cum se numeşte terenul sărat?
(sărătură, slatină, soloneț)

83. How do you call the groups of plants developed on sand? What is the name of sandy soil?

83. Cum se numesc grupările de plante dezvoltate pe nisipuri? Cum se numeşte terenul nisipos?
(nisipişte)

84. How do you call the plant groups from lands which are broken, trodden by people, animals, carts? What is the name for these lands?

84. Cum se numesc grupările vegetale de pe terenurile tasate, călcate, bătătorite de oameni, animale, atelaje? Cum se numesc aceste terenuri?
(bătătură, troscotiş)

85. What is the name of the meadow with bent sedge (*Carex curvula*)?

85. Cum se numeşte pajiştea cu coarnă (*Carex curvula*)?
(cornişte)

86. What is the name of meadow with tufted hair grass (*Deschampsia caespitosa*)?

86. Cum se numeşte pajiştea cu târsă (*Deschampsia caespitosa*)?
(târsiş, târsişte, târsoc)

87. What is the name of group/land with wood fescue (*Festuca drymeia*)?

88. What is the name of meadow with rough meadow grass (*Poa trivialis*), moor grass (*Molinia coerulea*)?

89. What is the name of group/land with many strawberries (*Fragaria*)?

90. What is the name of meadow with bent grasses (*Agrostis stolonifera, Agrostis capillaris*), fescues *Festuca rupicola, Festuca rubra*)?

91. What is the name of meadow with meadow grasses (*Poa*)?

92. What is the name of meadow with brome and false brome (*Bromus, Brachypodium pinnatum*)?

93. What is the name grouping/place where grow needle grass, mat grass (*Stipa capillata, Nardus stricta*)?

94. What is the name grouping/place where grow feather grasses (*Stipa*)?

95. What is the name of meadow with golden beard/love grass (*Chrysopogon gryllus*), beard grass (*Botriochloa ischaemum*)?

II. Herbaceous vegetation
1. Terrestrial herbaceous vegetation
1.1. Spontaneous vegetation
1.1.2. Weeds

96. What is the name of the arable place/terrain left uncultivated?

87. Cum se numeşte gruparea/locul cu scradă (*Festuca drymeia*)?
(scrădiş)

88. Cum se numeşte pajiştea cu şuvar, şovar (*Poa trivialis, Molinia coerulea*)?
(şuvăriş, şovăriş)

89. Cum se numeşte gruparea/locul cu mulţi fragi (*Fragaria*)?
(frăgăriş, frăgăret)

90. Cum se numeşte pajiştea cu păiuşuri (*Agrostis stolonifera, Agrostis capillaris, Festuca rupicola, Festuca rubra*)?
(păiuşet, păiuşinet, păiuşiş)

91. Cum se numeşte pajiştea cu firuţe (*Poa*)?
(firuţişte)

92. Cum se numeşte pajiştea cu obsigă (*Bromus, Brachypodium pinnatum*)?
(obsigărie, obsigiş)

93. Cum se numeşte gruparea/locul în care creşte negară (*Stipa capillata, Nardus stricta*)?
(cipăniş, năgăruş)

94. Cum se numeşte gruparea/locul în care cresc colilii (*Stipa*)?
(coliliş, colilişte)

95. Cum se numeşte pajiştea cu sad/sadină (*Chrysopogon gryllus, Botriochloa ischaemum*)?
(sădiş, sădiniş)

II. Vegetaţie ierboasă
1. Vegetaţie ierboasă terestră
1.1. Vegetaţie spontană
1.1.2. Buruienişuri

96. Cum se numeşte locul/terenul arabil lăsat necultivat?
(hat, mejdină, moină, morhoancă, morogan, moruncă, nadaz, năvăloacă, noroi, obleagă, ogor, orlişte, orpie, paragină, părăginătură, pârloagă, pârlog, pârnojie, ponor, rât, toloacă, ţelină)

97. What is the name of the place full of weeds?

97. Cum se numeşte locul plin cu buruieni?
(bălărie, buruieniş)

98. What is the name of the narrow place, between fields?

98. Cum se numeşte locul îngust, nearat dintre ogoare?
(brazdă, călușire, dorjincă, forgaşă, haşpor, hat, hotar, mejă, mejdină, meşghie, metă, m(i)ezuină, răzor, sirincă, slog, şărămboi)

99. What is the name of the weeds from weeding plants crops?

99. Cum se numesc buruienişurile din culturile de plante prăşitoare?
(costreişte, costreț, costriş, lobodiş, lobodişte, mohoriş, mohorişte, ştiriş, ştirişte)

100. What is the name of the weeds from unweeding plants crops?

100. Cum se numesc buruienişurile din culturile de plante neprăşitoare?
(mohoriş, mohorişte, turiţiş, turiţişte)

101. What is the name of the field from which grain have been harvested?

101. Cum se numeşte terenul de pe care s-au secerat cerealele?
(mirişte, miriştină, năvoloacă, orlişte, secerătură, secerişte)

102. What weeds grow in pastures near the sheepfolds, stables?

102. Ce buruienişuri se dezvoltă în păşuni, lângă stâne, staule?
(şteghiş, urzicărime, urzicet)

103. What kind of weeds grow on the garbage/waste and debris/rubble?

103. Ce buruienişuri se dezvoltă pe gunoaie şi molozuri?
(bozet, bozieş, boziş, cucutiş, cucutişte, şteghiş, urzicărime, urzicet)

104. What weeds grow on the rivers shores in lowland?

104. Ce buruienişuri se dezvoltă pe malurile râurilor de şes?
(troscotiş, turiţiş, turiţişte, urzicărime, urzicet)

105. How do you call the weeds from the mountain streams banks?

105. Cum se numesc buruienişurile de pe malurile pârâurilor de munte?
(brustăniş, brusturărie, brusturet, brusturime, brusturiş, buciniş, căptălăniş, lăpuşet, lăpuşniş)

106. How do you call the weeds with burdock (*Arctium*), butterbur (*Petasites*), large yellow oxeye (*Telekia speciosa*)?

106. Cum se numeşte buruienişul cu brusturi (*Arctium, Petasites*, *Telekia speciosa*)?
(brustăniş, brusturărie, brusturet, brusturime, brusturiş, căptălăniş, lăpuşet, lăpuşniş)

107. How do you call the weeds with archangel/angelica (*Angelica*)?

108. How do you call the weeds with dock, mountain rhubarb (*Rumex* spp.)?

109. How do you call the weeds with rosebay willowherb (*Epilobium angustifolium*)?

110. What is the name of the place full of ferns?

111. What is the name of the thicket with dwarf elders/daneworts (*Sambucus ebulus*)?

112. How do you call the weeds with nettles (*Urtica*)?

113. How do you call the weeds with thistles, teasels (*Carduus, Dipsacus*)?

114. How do you call the weeds with hemlock (*Conium maculatum*)?

115. How do you call the weeds with mallows (*Malva*)?

116. How do you call the weeds with melilots/sweet clovers (*Melilotus*)?

117. How do you call the weeds with knotgrass/knotweed (*Polygonum*)?

118. How do you call the weeds with sow thistle/milk thistle (*Sonchus*)?

119. How do you call the weeds with pigweed/amaranth (*Amaranthus*)?

120. How do you call the weeds with absinthe/wormwood (*Artemisia absinthium*)?

107. Cum se numeşte buruienişul cu angelică/buciniş (*Angelica*)?
(buciniş)

108. Cum se numeşte buruienişul cu ştevie/şteghie (*Rumex* spp.)?
(ştegărie)

109. Cum se numeşte buruienişul cu zburătoare (*Epilobium angustifolium*)?
(besecăniş, bisăcăniş)

110. Cum se numeşte locul plin de ferigi?
(fericet, ferigărie, feriget, ferigiş)

111. Cum se numeşte gruparea/buruienişul cu bozi (*Sambucus ebulus*)?
(bozet, boziş, bozişte)

112. Cum se numeşte buruienişul cu urzici (*Urtica*)?
(urzicărime, urzicet)

113. Cum se numeşte buruienişul cu scaiuri (*Carduus, Dipsacus*)?
(scăiş, spinet, spiniş, spinişte)

114. Cum se numeşte buruienişul cu cucută (*Conium maculatum*)?
(buciniş, cucutiş, cucutişte)

115. Cum se numeşte buruienişul cu nalbe (*Malva*)?
(nălbiş)

116. Cum se numeşte buruienişul cu sulfini (*Melilotus*)?
(sulfiniş)

117. Cum se numeşte buruienişul/locul cu troscot (*Polygonum*)?
(troscotiş)

118. Cum se numeşte buruienişul cu susai (*Sonchus*)?
(susăiş)

119. Cum se numeşte buruienişul cu ştir (*Amaranthus*)?
(ştiriş, ştirişte)

120. Cum se numeşte buruienişul cu pelin (*Artemisia absinthium*)?
(peliniş, pelinişte)

121. How do you call the weeds with bur marigold (*Bidens*), cleavers/goosegrass (*Galium aparine*)?

122. How do you call the weeds with couch grass/wheatgrass (*Agropyron*), Bermuda grass/dog grass (*Cynodon dactylon*)?

123. How do you call the weeds with goosefoot (*Chenopodium*), orache (*Atriplex*)?

124. How do you call the weeds with creeping thistle (*Cirsium arvense*)?

125. How do you call the weeds with bristle grass (*Setaria*)?

126. How do you call the weeds with cockspur (*Echinochloa*), Aleppo grass (*Sorghum halepense*)?

II. Herbaceous vegetation
1. Terrestrial herbaceous vegetation
1.2. Crops

127. How do you call the place which is plowed (everyyear)?

128. What is the name of place (near home) cultivated with flowers and vegetables?

129. How is the culture/place cultivated with cereals called?

130. What is called culture/place cultivated with maize (*Zea mays*)?

121. Cum se numeşte buruienişul cu turiță (*Bidens, Galium aparine*)?
(turiţiş, turiţişte)

122. Cum se numeşte buruienişul cu pir (*Agropyron, Cynodon dactylon*)?
(piriş, pirişte)

123. Cum se numeşte buruienişul cu lobodă (*Chenopodium, Atriplex*)?
(lobodiş, lobodişte)

124. Cum se numeşte buruienişul cu pălămidă (*Cirsium arvense*)?
(pălămidiş, polonidiş)

125. Cum se numeşte buruienişul cu mohor (*Setaria*)?
(mohoriş, mohorişte)

126. Cum se numeşte buruienişul cu costrei (*Echinochloa, Sorghum halepense*)?
(costreişte, costret, costriş)

II. Vegetaţie ierboasă
1. Vegetaţie ierboasă terestră
1.2. Culturi

127. Cum se numeşte locul care se ară (an de an)?
(agru, arabil, arător, arătură, câmp, glie, ogor, ogorâşte, orpie, plan, ponov, răzor, sat, ţarină)

128. Cum se numeşte locul (de lângă casă) cultivat cu flori şi verdeţuri/legume?
(boscea, grădină, grădinuţă, ogradă, sad, telechi, telenchi)

129. Cum se numeşte cultura/locul cultivat cu cereale?
(grâne, holdă, lan)

130. Cum se numeşte cultura/locul cultivat cu porumb/cucuruz/păpuşoi (*Zea mays*)?
(ciocălăişte, cucuruzaştină, cucuruze, cucuruzişte, mălaie, mălăină, mălăişte, mălăiştină, păpuşoină, păpuşoişte, păpuşoiştină, păpuşorniţă, ponov, porumbişte, tenchişte, tulujişte)

131. What is the name of the culture/place cultivated with wheat (*Triticum*)?

132. What is the name of the culture/place cultivated with barley (*Hordeum sativum*)?

133. What is the name of the culture/place cultivated with oat (*Avena sativa*)?

134. What is the name of the culture/place cultivated with (*Secale cereale*) called?

135. What is the name of the culture/place cultivated with rice (*Oryza sativa*) called?

136. What is the name of the culture/place cultivated with clover (*Trifolium*) called?

137. What is the name of the culture/place cultivated with alfaalfa (*Medicago*) called?

138. What is the name of the culture/place cultivated with pea (*Pisum sativum*) called?

139. What is the name of the culture/place cultivated with potato (*Solanum tuberosum*) called?

140. What is the name of the culture/place cultivated with beet (*Beta vulgaris*) called?

141. What is the name of the culture/place cultivated with hemp (*Cannabis sativa*) called?

142. What is the name of the culture/place cultivated with flax (*Linum usitatissimum*) called?

143. What is the name of the culture/place cultivated with cabbage (*Brassica oleracea*) called?

131. Cum se numeşte cultura/locul cultivat cu grâu (*Triticum*)?
(grâne, grânețe)

132. Cum se numeşte cultura/locul cultivat cu orz (*Hordeum sativum*)?
(orzărie, orzişte)

133. Cum se numeşte locul cultivat cu ovăz (*Avena sativa*)?
(ovăzărie)

134. Cum se numeşte locul cultivat cu secară rye (*Secale cereale*)?
(secăriş, secărişte)

135. Cum se numeşte cultura/locul cultivat cu orez (*Oryza sativa*)?
(orezărie, rizerie)

136. Cum se numeşte cultura/locul cultivat cu trifoi (*Trifolium*)?
(trifoişte)

137. Cum se numeşte locul cultivat cu lucernă (*Medicago*)?
(lucernărie)

138. Cum se numeşte cultura/locul cultivat cu mazăre (*Pisum sativum*)?
(măzărişte)

139. Cum se numeşte cultura/locul cultivat cu cartofi/crumpeni (*Solanum tuberosum*)?
(crumpenişte, grumpenişte)

140. Cum se numeşte cultura/locul cultivat cu napi/sfeclă (*Beta vulgaris*)?
(năpişte)

141. Cum se numeşte locul cultivat cu cânepă (*Cannabis sativa*)?
(cânepărie, cânepişte)

142. Cum se numeşte cultura/locul cultivat cu in (*Linum usitatissimum*)?
(inişte)

143. Cum se numeşte cultura/locul cultivat cu varză/curechi (*Brassica oleracea*)?
(curechişte, vărzărie)

144. What is the name of the/place cultivated with water melon (*Citrullus vulgaris*) called?

144. Cum se numeşte cultura/locul cultivat cu pepeni/lubenițe/harbuzi (*Citrullus vulgaris*)?
(bostană, bostănărie, harbuzărie, pepenărie, pepenet, pepenişte, pepeniştină)

145. What is the name of the/place cultivated with sunflower (*Helianthus annuus*) called?

145. Cum se numeşte cultura/locul cultivat cu floarea soarelui (*Helianthus annuus*)?
(soreață)

146. What is the name of the/place cultivated with garlic (*Allium sativum*) called?

146. Cum se numeşte cultura/locul cultivat cu usturoi/ai (*Allium sativum*)?
(aişte)

147. What is the name of the/place cultivated with onion (*Allium cepa*) called?

147. Cum se numeşte cultura/locul cultivat cu ceapă (*Allium cepa*)?
(cepărie, cepişte)

II. Herbaceous vegetation
2. Aquatic and paludal vegetation

II. Vegetație ierboasă
2. Vegetație ierboasă acvatică şi palustră

148. What is the name of the place with stagnant water/with water in excess?

148. Cum se numeşte locul cu apă stătătoare/cu exces de apă?
(lac/lake: **balcău, bălătău, bâlc, iezer, tău**
baltă/pool: **bahnă, bară, băhniş, bălăştioagă, băltac, băltău, băltină, băltoacă, băltoi, bâlc, rât, stârmină**
mlaştină/swamp: **balcău, bară, mlacă, moceră, mocirlă, ploştină, rât, smârc, smârdie, stârmină, strichaveță, şaltău, şestină, tălbăriță, târmoacă**)

149. How do you call the groups of plants from mountain streams?

149. Cum se numesc grupările de plante din izvoarele de munte?
(răsiş)

150. What is the name of the watery place with layer of mosses (especially *Sphagnum*)?

150. Cum se numeşte locul apătos cu strat gros de mușchi (mai ales *Sphagnum*)?
(mlacă, mlaştină, mociră, molhaş, tinov, turbărie)

151. How is called the group/cluster of (*Carex*)?

151. Cum se numeşte gruparea/pâlcul de rogoz(uri) (*Carex*)?
(rogoziş, rogozişte, rogoziştină, rogozărie)

152. How is called the group/cluster of kingcup, marsh marigold (*Caltha palustris*)?

152. Cum se numeşte pâlcul cu calcea calului (*Caltha palustris*)?
(călciş, scălciş)

153. How is called the group/cluster of burr reed (*Sparganium*)?

153. Cum se numeşte pâlcul de buzdugan (*Sparganium*)?
(şovăriş)

154. How is called the group/cluster of rush (*Juncus*)?

155. What is the name of the vegetation made of underwater and floating plants in ponds/lakes/canals with freshwater where dominating are water starwort species (Callitriche) and water crowfoot (*Batrachium*)?

156. What is the name of (small) clusters of vegetation on the mud of ditches/small ponds with less water which in summer dry, clusters consisting of galingale (*Cyperus flavescens, Cyperus fuscus*), toad rush (*Juncus bufonius*), mudwort (*Limosella aquatica*), spike rush (*Eleocharis ovata, Eleocharis acicularis*), pennyroyal (*Mentha pulegium*) mousetail (*Myosurus minimus*)?

157. What is the name of the group/cluster of the sweet grass (*Glyceria*)?

158. What is the name of the group/cluster of the club rush/bulrush (*Schoenoplectus*)?

159. How is the cluster of the flag iris/yellow flag (*Iris pseudacorus*)?

160. What is the name of the layer/blanket of plants that floats on water in pools/lakes/canals consisting of duckweed (*Lemna, Spirodella*) peştişoară (*Salvinia*), frog tongue (*Hydrocharis*), frog silk/wool (*Spirogyra, Conferva, Cladophora, Tribonema*)?

161. What is the name of the grouping with white water lilies (*Nymphaea*) or yellow water lilies (*Nuphar luteum*)?

162. What is the name of the grouping with water chestnut (*Trapa natans*)?

154. Cum se numeşte buruienişul cu pipirig (*Juncus*)?
(mocioriş, pipirigiş)

155. Cum se numeşte vegetaţia formată atât din plante subacvatice cât şi plutitoare din bălţile/lacurile/canalele cu apă dulce în care domină speciile de steaua bălii/drenţe (*Callitriche*) şi piciorul cocoşului de baltă (*Batrachium*)?
(drenţişte)

156. Cum se numeşte pâlcul (mic) de vegetaţie de pe mâlul şanţurilor/băltuţelor/ adânciturilor cu apă puţină şi care vara seacă, pâlc format din căprişor (*Cyperus flavescens, Cyperus fuscus*), iarba broaştei (*Juncus bufonius*), mâliţă (*Limosella aquatica*), pipiriguţ (*Eleocharis ovata, Eleocharis acicularis*), busuiocul cerbilor (*Mentha pulegium*) sau codiţucă (*Myosurus minimus*)?
(mâlişte, pipirigiş)

157. Cum se numeşte gruparea/ pâlcul de mana apei (*Glyceria*)?
(măniş)

158. Cum se numeşte gruparea de pipirig mare (*Schoenoplectus*)?
(pipirigiş)

159. Cum se numeşte pâlcul de stânjenel de baltă (*Iris pseudacorus*)?
(boghiţiş, cătiţiş)

160. Cum se numeşte stratul/pătura de plante care pluteşte deasupra apei în bălţi/lacuri/canale formată din lintiţă (*Lemna, Spirodella*), peştişoară (*Salvinia*), limba broaştei (*Hydrocharis*), mătasea/lâna/straiul broaştei (*Spirogyra, Conferva, Cladophora, Tribonema*)?
(mătreaţă, smântână)

161. Cum se numeşte gruparea cu nuferi albi (*Nymphaea*) sau galbeni (*Nuphar luteum*)?
(nufăriş)

162. Cum se numeşte gruparea cu cornaci (*Trapa natans*)?
(ciuliniş)

163. What is the name of the vegetation consisting of floating and underwater plants in ponds/lakes/canals with freshwater where dominating are pondweed species (*Potamogeton*)?

163. Cum se numeşte vegetaţia formată atât din plante plutitoare cât şi subacvatice din bălţile/lacurile/canalele cu apă dulce în care domină speciile de broscariţă (*Potamogeton*)?
(broscăţiş)

164. What is the name of the unterwater/submerged vegetation in ponds/lakes/channels increased consisting of hornwort (*Ceratophyllum*), water milfoil (*Myriophyllum*), stonewort (*Chara*)?

164. Cum se numeşte vegetaţia crescută sub apă în bălţi/lacuri/canale (subacvatică/submersă) formată din cosorul bălţii (*Ceratophyllum*), peniţa apei (*Myriophyllum*), năjar (*Chara*)?
(brădiş, brădiş de apă, cosoriş, năjăriş)

165. What is the name of the reed (*Phragmites australis*) grouping/clumps?

165. Cum se numeşte gruparea/pâlcul de stuf/trestie (*Phragmites australis*)?
(culare, nadăş, nadeş, nadiş, roră, stohan, stufăriş, stufărie, stufăraie, treştiiş)

166. What is the name of the floating island of reeds and other plants?

166. Cum se numeşte insula plutitoare de trestie şi alte plante?
(cocioc, năcladă, plaur, plav, plavie)

167. What is the name of the cattail (*Typha*) grouping/cluster?

167. Cum se numeşte gruparea/pâlcul de papură (*Typha*)?
(păpuranişte, păpuriş, păpurişte, rât)

168. What is the name of the group/cluster of sea club rush (*Bolboschoenus maritimus*)?

168. Cum se numeşte gruparea/pâlcul de rogoz de sărătură (*Bolboschoenus maritimus*)?
(rogoziş)

169. What is the name of the place/forest/grassland where is not allowed exploitation activities of local resources (cutting trees, grazing, mowing, hunting, fishing)?

169. Cum se numeşte locul/pădurea/pajiştea în care nu se permit(eau) localnicilor activităţi de exploatare a resurselor (tăieri de arbori, păşunat, cosit, vânat, pescuit)?
(apărătură, branişte, opritură)

170. Are/were customs/traditions/ which take place/were held on the border, in a forest, meadow, pasture, field, river?

170. Sunt/au existat obiceiuri/datini/ care se desfăşoară/se desfăşurau pe hotar, într-o pădure, poiană, pajişte, ogor, râu?
(boboteaza, botezul Ionilor, buzduganul sau cununa, caloianul, drăgaicele, Ispasul, maialul, luatul manei culturilor, nedeile, ocolitul în pielea goală al ţarinei cu culturi, Paştele Blajinilor, plugarul, Sângiorgiul)

171. Is there any legend about a place or a forest, a grassland, a marsh?

171. Există vreo legendă despre vreun loc de hotar ori pădure, pajişte, baltă?

CONCLUSIONS

The most folk phytocoenonyms call plant associations and alliances as they are characterized by phytocoenologists (for example: brădeto-molidiş, ceret, păltiniş leurdişte, bisăcăniş, zmeuret, aluniş, cornet, sădiş, scrădiş, boziş, cucutişte, păpuriş, etc.) and fewer orders and classes of vegetation (molidiş, făget, stejăriş, rogoziş, etc.).

The total of all those 653 Romanian phytocoenonyms shows awareness of the vegetation by Romanians. Them are a precious treasure of botanical knowledge and linguistic related continuity which can be exploited by linguists and also by phytocoenologists.

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FOREST CERTIFICATION – A MARKET TOOL FOR THE IMPLEMENTATION OF ENVIRONMENTAL POLICIES IN THE TIMIŞ FOREST DIRECTORATE (BANAT, ROMANIA)

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KEYWORDS: Forest certification, responsible management, environmental values, market mechanism.

ABSTRACT

The authors consider that successful implementation of environmental protection policies depends upon economic levers. Such an economic lever is for Timiş Forest Directorate the obtaining of a FSC certificate.

It is noticeable that although the average quality of the wood sold by Timiş Forest Directorate in 2005, 2006, 2007 and 2008 is visibly decreasing compared to 2003 and 2004, the average price curve for saw timber and timber veneer has been recovering starting with 2006 and 2007, when it reached an equal level of price (or even higher in the case of timber veneer) to that of 2003 and 2004. The inflexion of the buying price curve for saw and veneer timber begins in 2006 and 2007, from the moment of the obtaining of the FSC certificate, for which a period of 1 to 2 years is required for advertising and creating the chain of custody.

REZUMAT: Certificarea pădurilor - un mecanism de piață pentru implementarea politicilor de mediu la Direcția Silvică Timiş (Banat, România).

Autorii pleacă de la premisa că asigurarea succesului implementării politicilor de protecția mediului depinde de utilizarea pârghiilor economice. O astfel de pârghie economică s-a dovedit a fi la Direcția Silvică Timiş, sistemul de certificare a pădurilor după principiile FSC (Forest Stewardship Council). Se observă faptul că, deşi calitatea medie a masei lemnoase valorificate de către D. S. Timiş în anii 2005, 2006, 2007 şi 2008 este în scădere vizibilă față de anii 2003 şi 2004, curba prețului mediu de valorificare a sortimentelor de gater şi de furnir se redresează începând cu anii 2007 respectiv 2006, ajungând la valori comparabile (sau chiar mai mari în cazul furnirului) cu cele din anii 2003 şi 2004.

Inflexiunea curbei preturilor de adjudecare a sortimentelor de gater şi de furnir se produce în anul 2007, respectiv 2006, din momentul obținerii certificatului de calitate a managementului forestier (FSC) fiind necesară o perioada de 1-2 ani pentru publicitate şi crearea lanțurilor de custodie.

RESUMEN: La certificación de los bosques – un mecanismo de mercado para la implementacion de las políticas de medio ambiente en la dirección forestal de la provincia de Timiş. (Banat, Rumania).

Los autores consideran que el éxito de la implementación de las políticas de protección de medio ambiente depende de la utilización de medidas económicas. Un ejemplo de medida económica de este tipo, que se ha implementado en la Dirección Forestal de la Provincia de Timiş, ha sido el sistema de certificación forestal aplicado según los principios del FSC (Forest Stewardship Council). Se observa el hecho que aunque la calidad media de la masa leñosa comercializada por la Dirección Forestal de la Provincia de Timiş entre los años 2005, 2006, 2007 y 2008 baja visiblemente en comparación con los años 2003 y 2004, la curva del precio medio de vendida de los tipos de madera de aserradero y madera contrachapada se restablece a partir de los años 2007 respectivamente 2006, llegando a valores comparables (y

hasta mayores en el caso de la madera contrachapada) con los de los años 2003 y 2004. La inflexión de la curva de los precios de adquisición de los tipos de madera de aserradero y madera contrachapada se produce en el año 2007, respetivamente 2006, a partir del momento de la obtención del certificado de cualidad de la gestión forestal (FSC), necesitando un periodo de 1-2 años para publicidad y creación de la cadena de custodi.

INTRODUCTION

The impulses generated by the genetic code of human species, combined with religious motivation, pushed the Earth's population towards conquer and master of the environment and natural resources. Limited by the level of the technical development, the population created a huge pressure on the nature reserves of the planet, exploiting them sometimes till exhaustion. This pressure was felt more conspicuous as the economic development was accelerated and the demographic expansion was more accentuated. Between nature's strategy, which looks for maximum stability and perennity, and society's strategy, which looks for higher socio-economic advantages, there is a contradiction (Giurgiu, 1979).

The negative effects on natural ecosystems didn't delay to appear, the first signals being offered by the disappearance of some sensitive species in certain areas with habitat changes. These changes were observed in Romania too, some of them being observed during 1 or 2 generations (Satchinez Swamp). As a reaction to these negative effects a series of environmental policies were adopted during the time with more or less visible effects.

To ensure the successful implementation of environmental protection policies it is necessary to use economic levers. This is how the forest certification systems appeared, based on the respect of certain principles and standards regarding the sustainable use of resources.

The forest certification systems appeared as a reaction to the declaration of United Nations Conference on Environment and Development that took place in Rio de Janeiro in 1992: "the forest resources should be sustainably developed to fit the social, economic, ecological, cultural and spiritual needs of present and future generations".

According to a report published in 2003 by UNECE (United Nations Economic Commission for Europe), the first forest certification activities were undertaken in 1993, reaching in 2003 almost 160 million hectares of certified forest – approximately 5% of Earth's forest surface (Rametsteiner, 2003). According to the same sources in 2009 there was approximately 10% of certified forests from the Earth's total.

Across the time several forest certification systems were created. The most frequently used were: PEFC (Programme for the Endorsement of Forest Certification Schemes), FSC (Forest Stewardship Council), SFI (Sustainable Forestry Initiative), CSA (Canadian Standards Association), ATFS American Tree Farm System and RNCFC (Russian National Forest Certification System), and others. All the major certification systems (excepting FSC) are functioning under the PEFC umbrella.

FOREST CERTIFICATION IN ROMANIA

The pressure of environmental policies imposed the adoption of a forest certification system also in Romania. Spain and Romania started the procedure for the FSC forest certification in 2002–2003, while Great Britain, Czech Republic, Belgium and Denmark initiated procedures for PEFC certification in the same period.

The first initiative to create a working group on forest certification took place in 1999 in Braşov. The action was finalized in 2003 when the National Working Group for Forest Certification) was actually created. The aim of this group was to promote the forest certification in Romania and to develop national certification

standards for the forest management in accordance with the requirements of the Forest Stewardship Council. In Romania around 1 million ha. of state and private owned forests (15.5%) obtained FSC forest management certificates. The Romanian National Forest Administration ROMSILVA (2011) owns FSC certificates for approximately 650,000 ha, within 4 forest directorates (Arad, Neamţ, Suceava, Timiş). Currently the National Working Group for Forest Certification works on the finalising of the National FSC Standards (4th version) and on the harmonization with other countries from the Carpathian Eco-region (Slovakia, Ukraine, Poland, Bulgaria).

FOREST CERTIFICATION, A FUNCTIONAL MARKET MECHANISM FOR TIMIŞ FOREST DIRECTORATE

The forest certification system developed by Forest Stewardship Council (FSC) was adopted by Timiş Forest Directorate in 2005, being one of the first 8 certified forest directorates in Romania. After the termination of the 5 years term of the first FSC certificate, the Timiş Forest Directorate chose for a re-certification, belonging today to the group of 4 certified forest directorates mentioned above.

FSC certification system stipulates 10 principles from which 4 (Principles 6, 7, 8 and 9) have as main characteristics the conservation of environmental values:

6TH FSC PRINCIPLE – ENVIRONMENTAL IMPACT –The forest management has to preserve the biological diversity and the values that derive from it, the water resources, soils, landscapes and unique and vulnerable ecosystems, and by this means, to mantain the ecological functions and the forest integrity.

7TH PRINCIPLE – THE MANAGEMENT PLAN – There is a management plan which is permanently updated. The long-term management objectives and the means to achieve them will be clearly defined. The management plan and the annexed documents will contain environmental protection measures based on environmental assessments.

8TH PRINCIPLE – MONITORING AND EVALUATION – The monitoring has to be established to offer precise data on the current forest status, forest production, chain of custody, activity management and their social and environmental impact.

9TH PRINCIPLE – THE MAINTAINING OF THE HIGH CONSERVATION VALUE FORESTS – The management of these areas will look for the maintaining of at least the current level, or the enhancement of the characteristics that are defining these forests. The decision making regarding the management of these areas will be done with maximum precaution.

For Timiş Forest Directorate the forest certification has been proven to be a market mechanism that brought consistent material advantages:

In between 1990 and 2000 more than 80% of the timber sold from the state owned forests, managed by RNP within Timiş County, was converted timber. From this 90% of the volume was sold as firewood for the population to heat the homes or as building lumber for constructions and repairing.

In between 1990 and 1997 the selling price of the standing timber was imposed by the Ministry of Finances, at an undervalued level (2.7$ in 1992, 5.4$/cubic meter in 1995), compared to the global price, and a lot less than the price of the EU market which was functioned as an authentic market economy. Once the round timber export was liberalized, a series of positive aspects appeared. But the standing timber prices remained undervalued, especially for precious woods (14.5$/cubic meter in 2000 and 13.2$/cubic meter in 2002).

Due to the increase in number of the companies that were exploiting the forest and processing the primary timber (in Romania there were 107 companies active in 1990 and 4012 in 2000), starting with 2002 a minimum percentage of 65% from the annual exploited timber was sold as standing timber, while only 15% to 30% was sold as converted timber, from which a big amount was firewood for the population (Fig. 1).

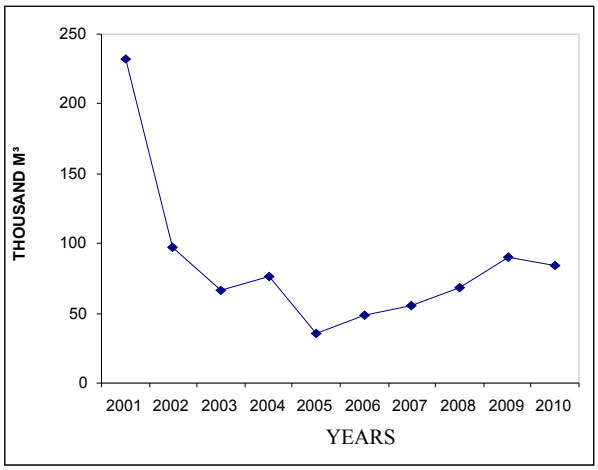

Figure 1: The evolution of the amount of converted timber sold by Timiş Forest Directorate.

The substantial development of the furniture industry and other finite timber products (in Romania there were 114 active companies in 1990 and 2,679 in 2000) made that starting with 2002 a bigger percentage of the converted timber to be sold to business operators (67% in the year 2008) (Fig. 2).

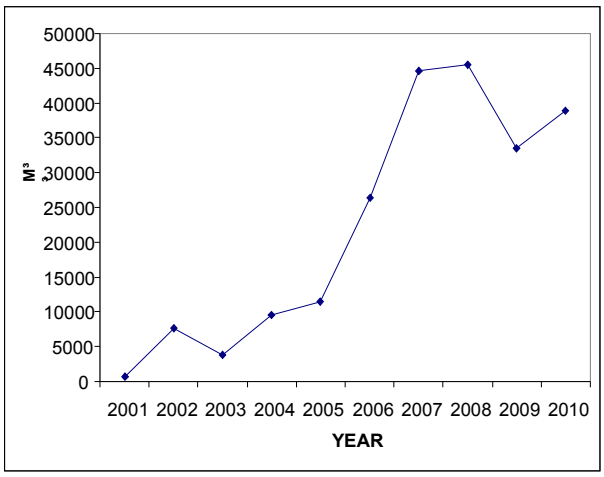

Figure 2: The evolution of the amount of converted timber sold by Timiş Forest Directorate to business operators.

Starting with 2002 the organization of auctions for converted timber selected according to the EU requirements, led to a growth of the timber price, reaching remarkable results, close to the EU values. This situation, as well as an increasing demand of the economic agents, led to an ascendant average price evolution (AP) until 2004.

Starting with 2005 the RNP marketing policy suffered a major modification. The market requirements and the economic needs led to a progressive increase of the sold veneer timber. Compared to previous years when business operators were capitalizing only valuable assortments from valuable species, starting with 2005 the same operators were capitalizing the entire range of timber resulted from the exploitation of coupes,

through delivery of services or direct labour (Figs. 3 and 4). This made the average starting price (SP) for tenders to decrease from 102 euro/cubic meter in 2004 to 73 euro/cubic meter in only two years (2006), maintaining these values until 2008, corroborated with a decrease in average quality (shown by the calculated price – CP -). Normally, the average buying price curve (BP) follows the average starting price (SP) curve (Fig. 5).

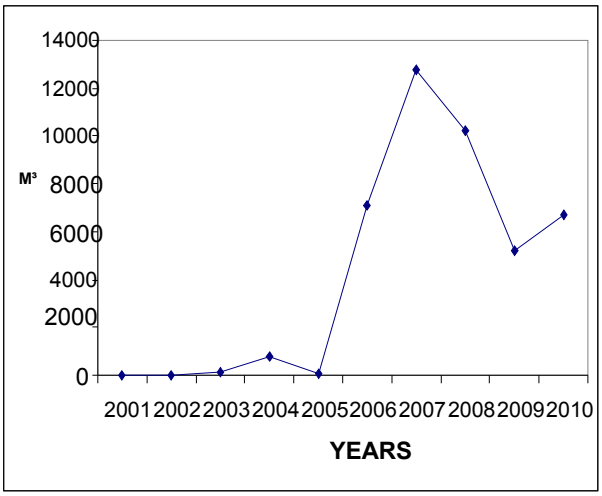

Figure 3: The evolution of the amount of firewood sold by the Timiş Forest Directorate to business operators.

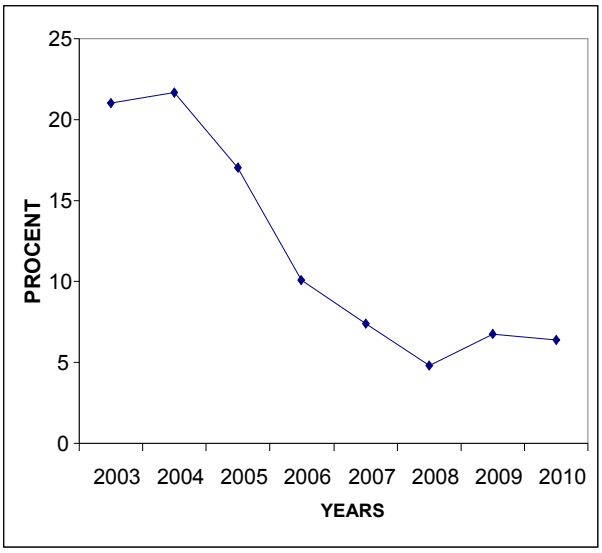

Figure 4: The evolution of the percentage of veneer timber from the total volume of timber sold by Timiş Forest Directorate to business operator.

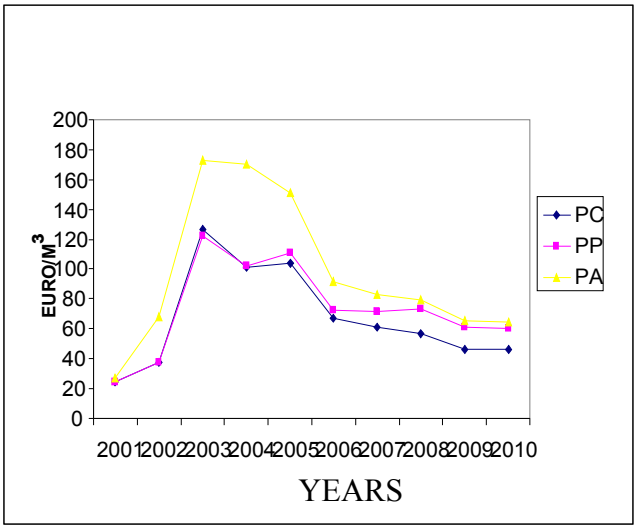

Figure 5: The evolution of timber price sold by Timiş Forest Directorate to business operators.

The economic effect caused by the implementation of the forest certification is visible especially in the case of veneer and saw timber. The necessary and compulsory conditions to benefit from this favourable effect are on one hand the adequate selection and presentation of the timber and on the other hand the advertising, which in many cases is very aggressive and related to the owning of a forest management quality certificate. Thus, Timiş Forest Directorate currently collaborates with 11 companies interested in buying timber from forests with certified forest management.

Table 1: The evolution of the main timber assortments that were traded by Timiş Forest Directorate.

YEAR	SAW		VENEER		%
	cubic meter	euro/cubic meter	cubic meter	euro/cubic meter	
2003	5754	82	1532	344	21
2004	6626	89	1829	375	22
2005	9550	89	1957	364	17
2006	19570	77	2201	463	10
2007	29428	79	2355	466	7
2008	18689	86	953	408	5
2009	24322	57	1768	324	7
2010	28850	60	1967	295	6

We can notice that the inflexion of the selling price curve for saw and veneer timber is produced in 2007 and 2006, from the moment of the obtaining of the forest management quality certificate being necessary a period of 1-2 years for marketing and creation of the chain of custody (Figs. 6 and 7).

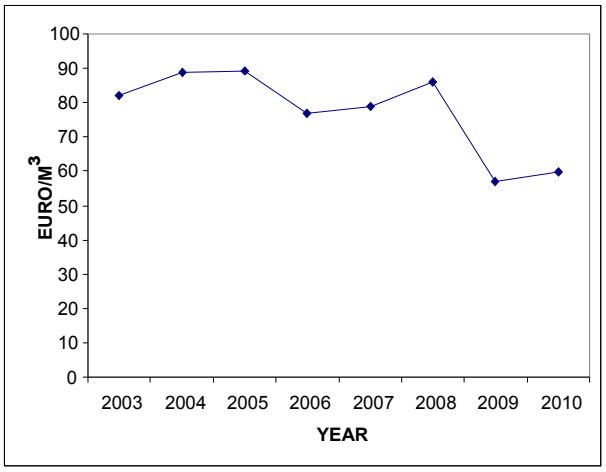

Figure 6: The price evolution for the saw timber assortments that were traded by the Timiş Forest Directorate.

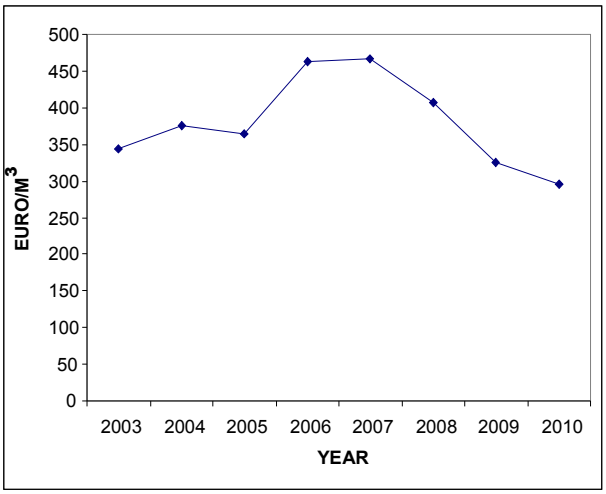

Figure 7: The price evolution of the veneer timber assortments which were traded by Timiş Forest Directorate.

In case of saw timber the demand growth is less visible for beech and A type certified oak, cherry and maple timber. The economic crisis effects were strongly felt in 2009, leading to a decrease in demand for A type certified oak, cherry and maple saw timber and a loss of demand for certified beech saw timber. This situation, corroborated with the known price drop for all the timber assortments, led in 2009 to a drop of average selling price for saw timber at the Timiş Forest Directorate, with approximately 30% compared to the maximum level reached in 2008.

In case of veneer timber assortments the price growth after the obtaining of the forest management quality certificate is less obvious, the average selling price in 2006 being of 462 euro/cubic meter compared to 364 euro/cubic meter in 2005. Taking into account that the veneer timber is capitalized through two big tenders each year (spring and autumn) the effect of the economic crisis was mostly felt in 2008 (through the negative effect created on the autumn tender).

If we take for example the Turkey oak saw timber assortment (Fig. 8) we can notice that the buying prices are in a continuous growth starting with 2005. In 2010, once the economic situation of the Timiş County timber market was redressed, the buying price grew and reached the values from 2008.

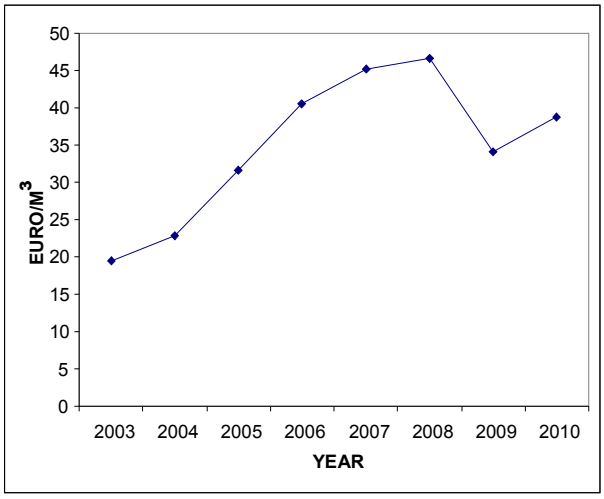

Figure 8: The price evolution for Turkey oak saw timber traded by Timiş Forest Directorate.

If we refer to oak vener timber assortment (Fig. 9), we can notice that the price evolution follows the same rule as the veneer timber prices in general (which is obvious if we take into account the large percentage of oak veneer from the total veneer timber). It is important to note the price evolution in 2010 (at the beginning of October 2010 the validity of the FSC certificate expired). During the first half of the year, under the influence of the economic redress, a price curve redress was noticed too and normally it would have followed a rise. Without the capacity of delivering certified timber, a series of business operators didn't participate in the autumn international tender and the oak veneer log price dropped in the second half of the year, in average with approximately 200 lei/piece.

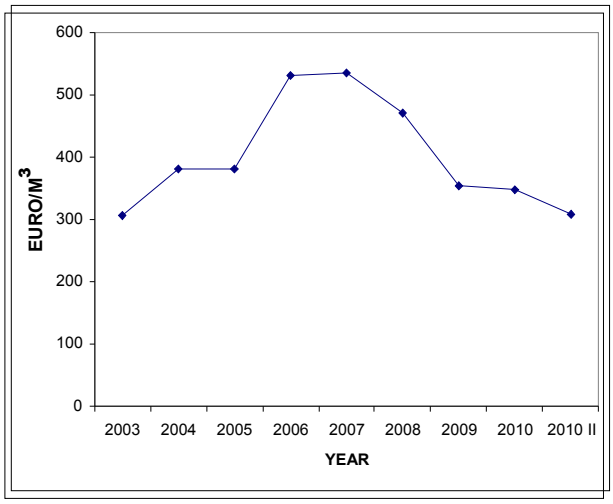

Figure 9: The price evolution of oak veneer logs traded by Timiş Forest Directorate.

If we analyse the main business operators that are buying saw logs (Tab. 2) we can observe that after the obtaining of the forest management quality certificate, the companies that were producing lumber and semi-finished products started to directly buy (not through intermediaries) converted timber from the Timiş Forest Directorate, to ensure the chain of custody continuity.

Table 2: The evolution of volumes and prices of saw timber bought by the main companies from Timiş County.

Specifications		Company A		Company B		Company C	
		Volume (cubic meter)	Price (euro/cubic meter)	Volume (cubic meter)	Price (euro/cubic meter)	Volume (cubic meter)	Price (euro/cubic meter)
2001	Spring	129	159				
	Autumn						
2002	Spring						
	Autumn						
2003	Spring						
	Autumn						
2004	Spring						
	Autumn			343	95		
2005	Spring						
	Autumn						
2006	Spring						
	Autumn					834	129
2007	Spring	210	226	353	91	1796	158
	Autumn	93	201	844	107	1058	170
2008	Spring	183	226	2306	93	1092	172
	Autumn	208	195	177	120	238	141
2009	Spring	80	126			456	103
	Autumn	191	121			499	117
2010	Spring	845	168	1350	45	444	123
	Autumn	566	150	777	53	353	95

The analysis was performed on a group of three companies buying oak logs (Company A and Company C) respectively Turkey oak logs (Company C). Company A is a foreign company, while companies B and C are Romanian.

To better observe the price dynamics the data from two periods of the year (spring and autumn) was analysed, when the two international converted timber tenders are taking place, and when a sufficiently large volume of timber is offered to business operators to better capture the market trends.

We can observe that in most of the cases the prices had an ascendant trend until the spring of 2008. Then, under the economic crisis effects, the prices dropped until the beginning of 2010. A new buying price drop can be observed at the end of 2010 when Timiş Forest Directorate didn't beneficiate from the forest management quality certificate.

Analysing the companies that are buying logs for aesthetic oak veneer we observe that their direct presence into the Timiş County timber market is more consistent after 2005 (the year of the obtaining of the certificate) (Tab. 3).

Table 3: The evolution of volumes and prices for veneer logs bought by the main buying companies from Timiş County.

Specifications		Company D		Company E		Company F	
		Volume (cubic meter)	Price (euro/cubic meter)	Volume (cubic meter)	Price (euro/cubic meter)	Volume (cubic meter)	Price (euro/cubic meter)
2001	Spring						
	Autumn						
2002	Spring						
	Autumn						
2003	Spring	137	256				
	Autumn						
2004	Spring					8	318
	Autumn						
2005	Spring						
	Autumn			204	385		
2006	Spring			285	524	13	392
	Autumn			257	519	6	417
2007	Spring	71	375	310	538		
	Autumn	31	450	365	573		
2008	Spring	37	372	310	508		
	Autumn	51	354			13	386
2009	Spring	61	250	218	268	7	491
	Autumn	71	388	237	305	21	487
2010	Spring	157	309	180	311	84	449
	Autumn	245	313	48	275		

The buying prices are respecting the same rule previously presented: ascendant trend until 2008, then a drop under the influence of the economic crisis, redress in spring 2010, and then a drop after the expiring of the validity term of the forest management quality certificate (autumn 2010). We can also notice that after the expiring of the certificate there were companies that didn't want to buy logs from Timiş Forest Directorate, because they were working exclusively with certified timber (the case of company F is not unique at the Timiş Forest Directorate), leading to a decrease in competition for certain timber assortments.

CONCLUSIONS

After analysing the above presented data we can observe the fact that although the average quality of timber sold by the Timiş Forest Directorate in 2005, 2006, 2007 and 2008 is visibly decreasing compared to 2003 and 2004, the average price curve for saw and veneer logs is redressing starting with 2007 and 2006, reaching an equal level of prices (or even higher in case of veneer timber) with those from 2003 and 2004. At the same time from the analysis of the evolution of bought timber volumes and prices offered by companies that are representative for the Timiş Forest Directorate, we can notice the same fact, that the forest certificate system implementation had a significant impact on the timber market. A series of companies, with foreign or Romanian capital, noticed after a short period of forest certification implementation the opportunity to enter new markets (especially in Western Europe) and as a result they bought timber in big quantities, directly (without intermediaries) and as a consequence at higher prices.

For Timiş Forest Directorate the obtaining of the forest management quality certificate led to economic benefits, both regarding the increase in demand on the timber market for converted and standing timber assortments and regarding the growth of the average buying price for working timber assortments.

It is also expected that the forest certification will bring in the future substantial image advantages, the possibility to access funds and establish partnerships, by demonstrating an ecological and socio-economical responsible management.

Taking into account on one hand the economic advantages, previously presented, and on the other hand the responsible management principles from the ecological point of view (and not only) which are promoted by the forest certification, we can state that the certification works as a market mechanism for the implementation of environmental policies. This mechanism becomes more and more useful in a forestry system in which the economic factor tends to overwhelm the ecological and social principles of the forest management.

AKNOWLEDGEMENTS

The present study was accomplished in the frame of the PHARE CBC RO 2003/005-702.01 "Romanian-Hungarian Corridor for Biodiversity Conservation" coordinated by the Oradea Forestry Directorate. Special gratitude for those who lead this project and scientific research, namely Mr. A. Moş and Ms. M. Petrovici.

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www.certificareforestiera.ro

FSC www.fsc.org

PEFC www.pefc.org

UNECE www.unece.org

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MORPHO-FUNCTIONAL POLYMORPHISM AND ITS IMPORTANCE IN THE ACHIEVEMENT OF THE REPRODUCTIVE POTENTIAL OF *PARAMECIUM CAUDATUM* EHRNB. STRAIN

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KEYWORDS: *Paramecium* caudatum, morpho-functional polymorphism, reproductive potential.

ABSTRACT

The present paper presents morphofunctional polymorphism particularities and their importance in the reproductive potential on ciliates, exemplifying with different cultures of *Paramecium caudatum*, species with high plasticity and the capacity of rapidly increasing its numerical effective, under identical and favorable development conditions. The results showed a high heterogeneity of the individuals inside the population, and the numerical proportion of different morphs, for different biotopes, is not identical, proving that the species presents multiple ecological valences and an important adaptation potential to environmental factors, in concordance with the intrapopulational numerical effective feed-back mechanism, which foresees the presence inside a population of at least two different genotypes, each one with its advantages in ecological conditions far from optimum, increasing its adaptive possibilities.

REZUMAT: Polimorfismul morfo-funcţional şi importanţa sa în atingerea potenţialului reproductive al speciei *Paramecium caudatum* Ehrnb.

Prezenta lucrare prezintă particularităţile polimorfismului morfo-funcţional al ciliatelor şi importanţa acestuia în potenţialul reproductiv, exemplificând cu diferite culturi de *Paramecium caudatum*, specie cu o mare plasticitate şi o capacitate ridicată de creştere numerică, cultivate în condiţii de dezvoltare identice şi favorabile. Rezultatele arată o eterogenitate ridicată a indivizilor din cadrul fiecărei populaţii, iar proporţia numerică a diferitelor morfe pentru condiţii diferite de biotop este extrem de variată, demonstrând valenţele ecologice multiple şi potenţialul adaptativ important al speciei, în concordanţă cu mecanismul de feed-back al efectivului numeric intrapopulaţional, care prevede ca în fiecare populaţie să existe cel puţin două genotipuri diferite, fiecare cu avantajele proprii în condiţii ecologice diferite de optim, crescând în acest mod posibilităţile adaptative.

RÉSUMÉ: Morfo-funcional polimorfismo y su importancia en el logro del potencial reproductivo de Paramecium caudatum Ehrb. tensión.

El presente trabajo presenta particularidades morfofuncionales polimorfismo y su importancia en el potencial reproductivo en ciliados, ejemplificando con diferentes culturas de Paramecium caudatum, especies con alta plasticidad y la capacidad de aumentar rápidamente su efectivo numérico, en condiciones idénticas y favorables de desarrollo. Los resultados mostraron una alta heterogeneidad de los individuos dentro de la población, y la proporción numérica de los diferentes morfos, por biotopos diferentes, no es idéntico, lo que demuestra que la especie presenta múltiples valencias ecológicas y un potencial importante de adaptación a los factores ambientales, en concordancia con el intrapoblacional numérica eficaz mecanismo de retroalimentación, que prevé la presencia en el interior de una población de por lo menos dos genotipos diferentes, cada uno con sus ventajas en las condiciones ecológicas lejos del óptimo, aumentando sus posibilidades de adaptación.

INTRODUCTION

The functional role and the position inside the ecosystem of an organism are determined by its physiological particularities. The type of nutrition characterizes its affiliation to a certain trophic level, the intensity of the metabolism – the degree of participation to the metabolism of the community, the reproductive speed – its reproductive possibilities, the tolerance to environmental conditions – its geographical extent, the composition of the nutritive base and of excretion products – the relations with other organisms of the community. Finally, its ethology, similar to other functions, represents an adaptive reaction of the organism to the variable conditions of the environment, being focused on assuring its normal functioning.

Because the character of the interaction between a population and the biotic and abiotic environment is mostly determined by its heterogeneity (Kaplan, 1971; Бурковский, 1984), polymorphism, as a universal phenomenon, is today studied under different aspects: biochemical, ethological etc. The study of the degree of polymorphism of the clones as discrete population units, including the morphologic and reproductive parameters, is of high importance in solving the general problem of inter- and intrapopulational variability (Хмелева, 1988).

Morphologic and physiologic heterogeneity of individuals from a population is one of the most important adaptations towards an increasingly efficient use of potentially vital resources. Darwin's formula: „the highest life sum is assured in the case of its maximum diversity" reflects not only on species richness, but also on intrapopulational richness (Константинов, 1986). The population obtained from an exconjugant consists of a high number of genetically identical individuals. Mutations that eventually occur can be realized inside the phenotype only through a sexual process – conjugation or autogamy – where a new macronucleus is formed. According to exiting data, conjugation appears naturally rather rare (once a year) . In this way, genetic composition of the clones remains virtually unchanged for a large period of time. Also, individuals appear to be identical at first sight.

In this context, the aim of our investigation was the research of morphofunctional polymorphism particularities and the determination of their importance in realizing the reproductive potential on ciliates, using *Paramoecium caudatum* as example.

MATERIAL AND METHODS

A culture of *Paramoecium caudatum* Ehrnb (Family Parameciidae, Ordo Hymenostomatida, Class Holotricha, Phyllum Ciliophora) was used as biological material, species with high plasticity and the capacity of rapidly increasing its numerical effective. In the same time, numerous aspects of the organism's and population's natural vital activity are not understandable without knowing the mechanism of *Paramoecium's* activity inside laboratory.

The basic culture used for investigation was obtained by culture cloning from Moldavia aquatic basins, inside the CCP „Argonaut" Laboratory of the Human and Animal Biology Department of the State University of Moldavia. At the same time, for some experiments, a *P. caudatum* culture was provided by Dr. S.I. Fochin from the Russian Academy Institute of Zoology in Sankt Petersburg. Since ciliates development is highly dependent on temperature and light conditions, the *P. caudatum* culture was kept in strict conditions (temperature, light, nutritional support etc.) for around two years.

Investigations regarding the estimation of morphofunctional polymorphism on the *P. caudatum* clone were made by standardizing the conditions of exponential growth of the reproductive rate. On this purpose, identical and favorable development conditions were ensured for all the organisms from cultivators.

The lab cultivation of *P. caudatum* was conducted according to methods described on literature (Losina-Osinsky, 1931; Зеликман, 1965; Хаусман, 1988).

Transparent glass flat footed vessels, with volumes of 10, 50, 100 and, respectively, 1000 ml were used for cultivation. The water for nutritive media used for ciliates cultivation was taken from the aqueduct, and declorinated before its use, being left for 7-8 days in open air, in glass vessels and periodically stirred with a glass baguette. Water was filtered before use. As water evaporated from experimental vessels, fresh water was added in order to maintain a constant level.

A nutritive media obtained from dissolving bread yeast *Saccharomyces cerevisiae* (1 g of dry yeast/1 l water) was used for culture maintenance. In order to obtain a mass culture of *Aerobacter*, the prepared media was incubated for 2-3 days in a thermostat at 22^0 C.

The start culture was prepared by selecting *Paramoecium* individuals with a microcapillary and transferring them on microcosme with nutritive solution. Few days later, when the *P. caudatum* numeric effective reached the plateau and density was at its highest, few daughter cells were separated and transferred to microaquariums with fresh nutritive solution, maintained at the same temperature until a dense culture was obtained. This culture was used as a primary material for experimental research. Selected individuals were inoculated inside small flasks with 1 ml of nutritive solution. Quantitative evaluation of the samples was conducted on a daily basis. The method was firstly used by Maupas (1889) for determination of division frequency depending on food and temperature.

RESULTS AND DISCUSSIONS

A natural population consists of a large number of individuals, differing through their life cycle phases, their physiological state, size and other parameters that determine population diversity. The character of the population's relations with biotic and abiotic environment are mostly dependent on its heterogeneity. For that cause, the diverse population would complexly react even at the change of a single factor (Silitrari, 1998; Nogueira, 2009).

The clone can be defined as an accumulation of phenotypic carriers of the same genome, with autonomic connections with the external environment. A large part of the natural growth of a population can be described by the way it acts in a culture. Maintaining the ciliates in strict conditions allows the observing of such population growth particularities, impossible to estimate in complex and ever-changing natural conditions.

A special attention was accorded to research on the growth potential of ciliates populations. Table 1 is presenting the variation of numerical parameters of the *P. caudatum* clone for a ten days period.

Following the investigations it was settled that, although the entire population was obtained from a single exconjugant and the individuals should be genotypic identical, the strain seems to be very heterogeneous. In that order, maximum values of the effective are surpassing 2.8 to 9.6 times the minimum values.

Table 1: Temporal variation of numerical effective (Nt) and of the specific reproductive rate (C_w) of *P. caudatum* at 20-21ºC (research period - 10 days; n=1000, N_1=1 ex/ml).

τ (days)	Total numer of individual with eliminations			Total numer of individual without eliminations			Reproductive rate (Cw)		
	average± erorr	*min*	*max*	*average± erorr*	*min*	*max*	*average± erorr*	*min*	*max*
1	8,34 ± 0,38	0	20	8,77 ± 0,35	2	20	2,09 ± 0,42	0,69	2,99
2	35,19 ± 1,68	0	74	37,84 ± 1,48	4	74	1,77 ± 0,03	0,69	2,15
3	51,79 ± 2,58	0	106	54,51 ± 2,41	9	106	1,29 ± 0,02	0,73	1,55
4	67,66 ± 5,03	0	238	73,54 ± 5,01	4	238	1,02 ± 0,02	0,35	1,37
5	69,10 ± 4,94	0	244	78,52 ± 4,81	11	244	0,84 ± 0,01	0,48	1,10
6	74,47 ± 5,09	0	226	77,57 ± 5,07	12	226	0,69 ± 0,01	0,41	0,90
7	79,88 ± 6,25	0	419	84,08 ± 6,29	1	419	0,59 ± 0,01	0,00	0,86
8	37,39 ± 3,30	0	196	38,95 ± 3,34	1	196	0,42 ± 0,01	0,00	0,66
9	22,30 ± 1,71	0	72	24,78 ± 1,71	1	72	0,33 ± 0,01	0,00	0,47
10	51,50 ± 6,09	0	463	54,84 ± 6,33	2	463	0,36 ± 0,01	0,07	0,61

The measurements made throughout the 10 days season show a strict uniformity of the reproductive parameters values. Therefore we consider that individual density is leveling throughout the entire period, even though in some intervals a slight, insignificant decrease of the reproductive rate.

The reproductive rate is presenting an increasing trend throughout the ten days, with maximum values in day 2 and day 7, with 41.05% and, respectively, 43.01%. Although the relative frequency from the other days is lower (between 20.80 and 36.96%), no eliminations are observable (Fig. 1).

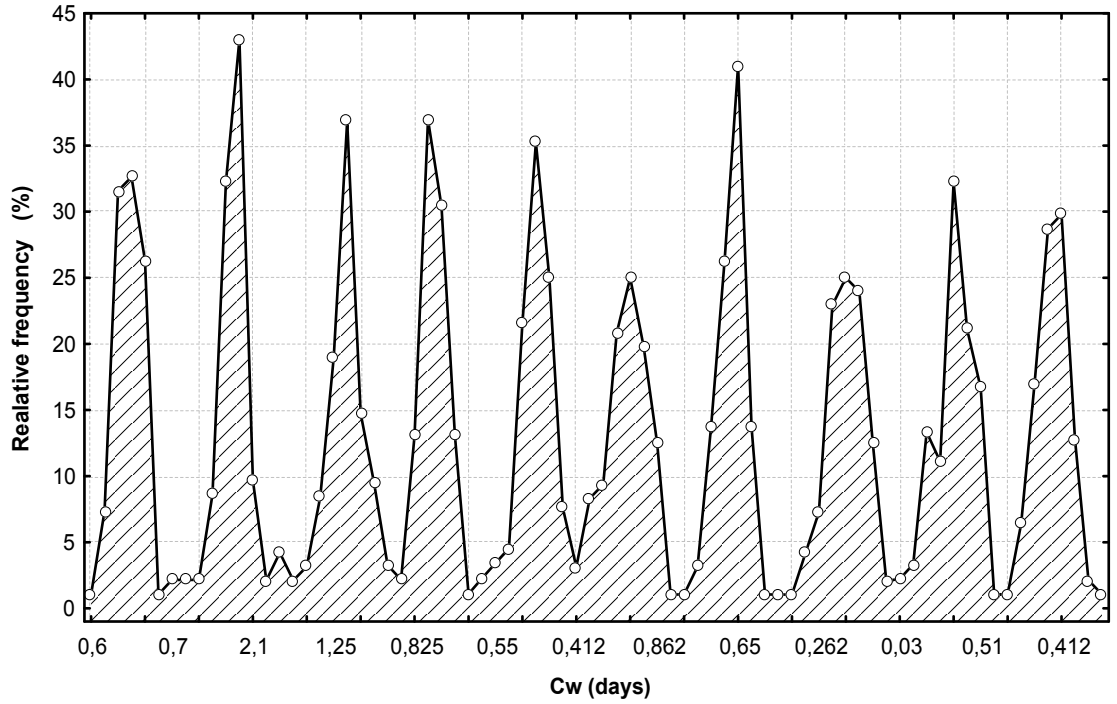

Figure 1: Specific reproductive rate polymorphism at *P. caudatum* individuals for 10 days (n = 929, t = 21°C).

In conclusion, we should mention that intrapopulational polymorphism of the laboratory clone of *P. caudatum* is concordant with the feed-back mechanism of the numeric effective, stating that at least two genotypes should be present inside a population, each one with advantages within imperfect ecological conditions, increasing the adaptive possibilities

In order to find out how the ciliate population reacts at different periods of the day, the degree of their binary divisions was recorded. The results show the same pattern as the reproductive rate's time dependence (24 h). The amount of heterogeneity is the same for the chosen research domain. The analysis of the reproductive rate is presented in the table number 2.

Table 2: Reproductive rate polymorphism of the *P. caudatum* clone (period = 24 h, t = 21ºC).

Nr. d/r	Upper limit	Lower limit	Center	Frequency	
				absolute %	relative %
1	0.00	0.02	0.01	6	0.63
2	0.30	0.32	0.31	4	0.42
3	0.50	0.52	0.51	6	0.63
4	0.62	0.64	0.63	13	1.37
5	0.72	0.74	0.73	17	1.80
6	0.82	0.84	0.83	49	5.18
7	0.88	0.90	0.89	13	1.37
8	0.94	0.96	0.95	54	5.71
9	1.00	1.02	1.01	20	2.11
10	1.04	1.06	1.05	43	4.55
11	1.08	1.10	1.09	23	2.43
12	1.12	1.14	1.13	89	9.41
13	1.16	1.18	1.17	26	2.75
14	1.20	1.22	1.21	84	8.88
15	1.24	1.26	1.25	10	1.06
16	1.26	1.28	1.27	52	5.50
17	1.28	1.30	1.29	6	0.63
18	1.32	1.34	1.33	31	3.28
19	1.34	1.36	1.35	6	0.63
20	1.36	1.38	1.37	32	3.38
21	1.38	1.40	1.39	9	0.95
22	1.40	1.42	1.41	53	5.60
23	1.42	1.44	1.43	9	0.95
24	1.44	1.46	1.45	59	6.24
25	1.46	1.48	1.47	19	2.01
26	1.48	1.50	1.49	52	5.50
27	1.50	1.52	1.51	19	2.01
28	1.52	1.54	1.53	34	3.59
29	1.54	1.56	1.55	3	0.32
30	1.56	1.58	1.57	23	2.43
31	1.58	1.60	1.59	19	2.01

Nr. d/r	Upper limit	Lower limit	Center	Frequency	
				absolute %	relative %
32	1.60	1.62	1.61	9	0.95
33	1.62	1.64	1.63	4	0.42
34	1.64	1.66	1.65	10	1.06
35	1.66	1.68	1.67	4	0.42
36	1.68	1.70	1.69	8	0.85
37	1.70	1.72	1.71	7	0.74
38	1.72	1.74	1.73	4	0.42
39	1.74	1.76	1.75	7	0.74
40	1.76	1.78	1.77	7	0.74
41	1.78	1.80	1.79	1	0.11
42	1.80	1.82	1.81	1	0.11
43	1.82	1.84	1.83	1	0.11
Average = 1.251		Standard deviation 0.284			

This explains the fact that the *P. caudatum* population presents a physiological heterogeneity regarding its reproduction, well established throughout the cultivation period. Is some situations, individuals exposed in microcosme with favorable nutritional support and 20° C did not reproduce for 168 h (7 days). On other case, as much as four binary divisions were observed in the first 24 h (Figure 2).

The experimental laboratory data presented in Figure 2 shows that in the first 48 h the relative frequency is high (5.2-5.7%, even up to 8.88%), while at the end of the cultivation period (52 h), this value is considerably lower (0.1-0.4%).

At last, it is mentionable the fact that the laboratory results allowed the determination of the time between the generations of the ciliates. A correlation was established between the time of a generation (48-52.4 h) and the reproductive rate between 0.1 and 8.9, at a temperature of 21° C.

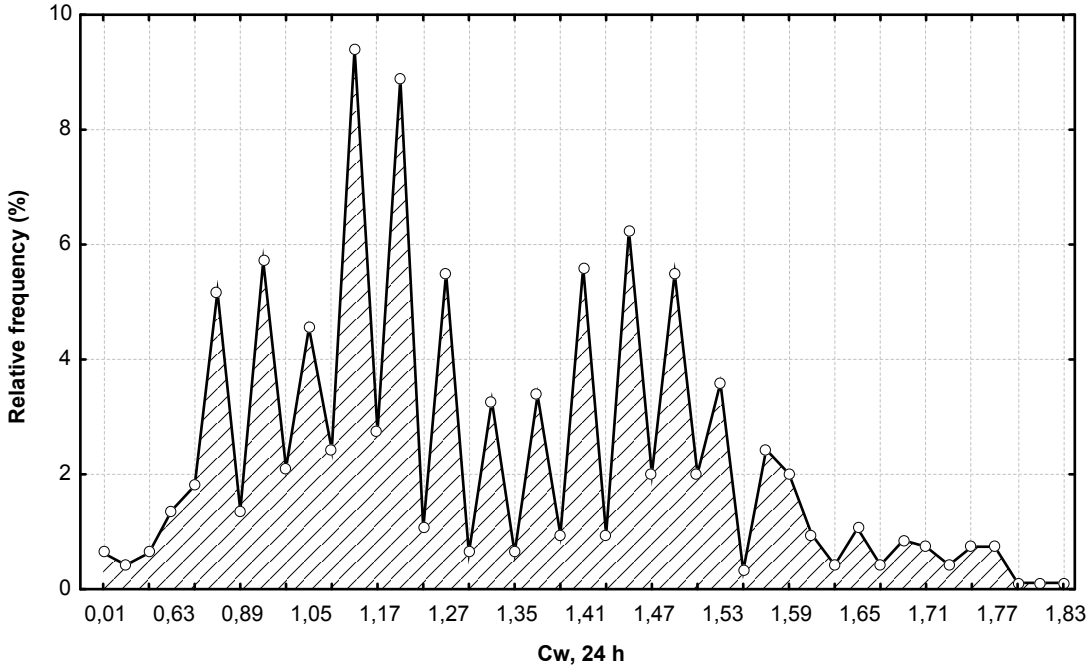

Figure 2: Specific reproductive rate polymorphism at individuals of the *P. caudatum* strain for 24 h (n = 964, t = 21^0 C).

For microorganisms cultivation on culture media, the dynamic of cellular division and the establishment of a generation period are of high importance. A generation period (g) is the time interval necessary for a cell to divide, making its mark for the doubling of its population. In cultivating microorganisms on culture media in normal culture vessels, their growth curves are observed. Those curves are determining the population's evolution in laboratory conditions.

Throughout the growth and development of the ciliates, a series of modifications appear: the number of viable organisms is different, the division rhythm is unequal, being high in the first phases and diminishing progressively afterwards.

CONCLUSIONS

The analysis of the time dependent reproductive rate and the relative frequency of the *P. caudatum* individuals demonstrates a high heterogeneity of the individuals inside the population. Therefore, it can be confirmed the invariability of the individual density from a culture, in experimental conditions.

The numerical proportion of different morphs, for different biotopes, is not identical. The heterogeneity of the population represents a evolutionary and adaptive strategy of the species. Intense polymorphism proves that the species presents multiple ecological valences and an important adaptation to environmental factors.

Intrapopulational polymorphism observed at the laboratory clone of *P. caudatum* is in concordance with the intrapopulational numerical effective feed-back mechanism (Ghilearov, 1990), which foresees the presence inside a population of at least two different genotypes, each one with its advantages in ecological conditions far from optimum, increasing its adaptive possibilities (Konstantinov, 1958, 1986).

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CRITERIA FOR ASSESSING MANAGEMENT OF WASTE COLLECTED FROM THE HUMAN POPULATION

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KEYWORDS: management, household waste, selective collection, expenses

ABSTRACT

The present paper suggests a number of criteria to assess the management of waste collection activities, based on real situations observed in waste collection from households.

In defining the criteria below we addressed the practical and theoretical efficiency of this activity, one considered fundamental in any society.

These criteria were designed to be put into practice by both economic agents operating in the sewage disposal system and by the environment authorities.

REZUMAT: Criterii pentru evaluarea gestionării deşeurilor colectate de la populaţia umană.

Lucrarea de faţă propune o serie de criterii pentru evaluarea gestionării/ managementului activităţilor de colectare a deşeurilor, bazate pe situaţii reale observate în colectarea deşeurilor provenite din gospodării.

Pentru definirea criteriilor de mai jos am studiat eficienţa practică şi teoretică a acestei activităţi considerată fundamentalăîn orice societate.

Aceste criterii au fost concepute pentru a fi puse în practică atât de agenţii economici care lucrează la sistemul de canalizare, cât şi se către autorităţile de mediu.

RESUMEN: Criterios para la evaluación de la gestión de residuos recogidos de la población humana.

El presente documento propone una serie de criterios para evaluar la gestión de las actividades de recolección de residuos, a partir de situaciones reales observadas en la recogida de residuos domésticos.

En la definición de los criterios que a continuación se dirigió a la eficacia práctica y teórica de esta actividad considerada fundamental en cualquier sociedad.

Estos criterios fueron diseñados para ser puesto en práctica por ambos agentes económicos que operan en el sistema de alcantarillado y por el medio ambiente authoritie.

INTRODUCTION

Activities in the private and corporate sector generate waste that can generally be classified into two main categories: private waste (from households) and industrial waste (from the economic agents). Waste generated by the population is collected by special salubrity services paid by the citizens.

A defective management of the collection, transport, sorting, treatment and disposal activities can impact negatively both the society and the environment.

We designed a specific set of criteria for the proper assessment of private waste management activities.

RESULTS

The designed specific set of criteria for the proper assessment of private waste management activities are the following.

1. Energetic efficiency is a broad term describing how to obtain a specific effect, object or benefit (egg. Obtaining a product, lighting, heat, movement of a vehicle etc.) using less energy. Saving energy means lower costs, but also an environmental friendly attitude. Applied to the case of the waste collected from households, energetic efficiency can be approached from two different viewpoints:

EFEN (GD) – the total amount of energy required to collection, transportation, sorting, final disposal and all the other activities directly or indirectly related to waste management. The unit for EFEN: a ton of oil equivalent (toe) is a unit of energy: Amount of energy released by burning one tone of oil. Given that several types of energy is involved in the waste-related activities, we present the conversion factors below [5,6]

1 t diesel = 1.01 tep
1 m^3 diesel = 0.98 tep
1 gasoline t = 1.05 tep
1 m^3 gasoline = 0.86 tep
1 t biodiesel = 0.86 tep
1 m^3 biodiesel = 0,78 tep
1 t bioethanol = 0,64 tep
1m^3 bioethanol = 0.51 tep
1 MWh = 0.086 tep

The recovery of energy per ton of collected waste represents the amount of energy recovered via incineration processes. Suggested unit: W/t. Currently this indicator can be applied only to organizations engaged in incineration. The best known example is represented by cement plants, which take significant amounts of waste to be burnt. This indicator is quite difficult to be estimated because of the broad range of materials, each having its specific caloric value. We add to this the humidity of the materials, which significantly alters the amount of the energy really recovered. Caloric value of a fuel is the amount of heat released by 1 kg of solid, liquid or gas fuel, by combustion. Units for caloric power are [4]:

- solid, liquid MJ / kg or kcal / kg
- gas MJ / MCN or kcal / MCN (normal conditions)

Due to the complexity of that calculation, the energy recovered from waste can be estimated by statistical methods. A method applicable for cement plants is carried out through the following empirical calculation:

C.e.r. = $Q(C_1 - C_2)$, where

C.e.r. - Amount of energy recovered

Q - cement production for a period of time that has used waste for incineration

C_1 - Specific fuel consumption required to develop a tone of cement without resorting to incineration.

C_2 - actual fuel consumtion recorded when the production processes used incineration.

This criterion can be used as such in the analysis of the efficiency of specific waste activities. But taking into consideration that when performing energy recovery from waste, the numerical value of this coefficient is subtracted from the total value of energy efficiency proposed EFEN (GD) - the first criterion proposed - in order to have a fair value of the indicator.

2. The distances taken for DP-CD waste collection are an indicator useful in optimizing the routes of vehicles involved in this process. Regionally, DP-CD also indicates the efficiency of the organizations in applying the principle of proximity, or more simply put, how long the waste “walk around” does. For the DP-CD indicator, we suggested the unit km/t of collected waste. In three km we have three components, namely:

DP-CD = D1+D2+D3

Where

D1 - distance from the depot to the first point from which waste collection is made D2 - The distance from the first point of waste collection (where collecting of the waste began) to the last collection point, from where the truck will go to the landfill or to the sorting station.

D3 - distance from the last point of collection to the landfill or sorting station. The unit of DP-CD is kilometers.

Obviously, transportation is most efficient at carrying out the least number of kilometers to collect one ton of waste. To minimize DP-CD will be necessary to perform route optimization programs, enlarging special vehicles for collecting waste from households and other organizational measures.

3. Waiting time of vehicles at entering the warehouse: depending on the number of vehicles that have left the fleet, they will return irregularly, at various time intervals. As generally the deposits/storing stations have only one reception line (scale) and a single trail to the storage area (final or for sorting), vehicles have to wait, to be taken as “first come, first served.”

Given this, such a situation can be modeled in stochastic mathematical theory known as awaiting. The terms recognized in describing possible situations in the theory of waiting are [2]:

- Customers, in this case the incoming vehicles,
- Server, to the factual situation described - landfill operators
- Channel service – row
- Population, in the particular case we have a finite population representing the number of trucks operating
- Inter-arrival time, i.e. time elapsing between two consecutive arrivals of customers at row
- Serving time - time that a customer is served
- Discipline of expectation - which relate to the order of serving the customers waiting in line.

In the specific case of landfills, the discipline model that fits best is "first come, first served" (also known as the FCFS - First Come, First Served).

Literature mentions that the most common notation for different classes of models is Kendall's.

Regarding the inter-arrival time distributions the best known are [2]:

• Poisson arrivals, (notation M, which comes from the Markova property "lack of memory") with inter-arrival times of independent and identically distributed exponential density:

$$f(t) = \lambda e^{-\lambda t}, t \geq 0,$$

Where λ is the parameter for Poisson arrivals, known as the arrival rate and 1 / λ is the average arrivals.

• k-Erlang arrivals (notation E_k) with distribution function

$$F(t) = \int_0^t \frac{k\lambda (k\lambda x)^{k-1} e^{-k\lambda x}}{(k-1)!} dx \ , \ t \geq 0$$

• general arrivals (notation G) the inter-arrival times are independent and identically distributed with arbitrary distribution function F (t), t ≥ 0.

4. Regarding the time of service of the vehicle, between the entering and leaving the warehouse (service time), there is a similar distribution.

Thus, if λ is the rate of arrivals and μ of servicing (models M / M) [2] we denote by

$$a = \frac{\lambda}{\mu} = \frac{1/\mu}{1/\lambda} = \frac{timp \cdot mediu \cdot de \cdot service}{medie\_timpi\_\text{int}er\_sosire}$$

, volume of traffic average time of service

Average time int arrival.

Among the given waiting models, we suggest a single server model [http://en.wikipedia.org/wiki/M/M/1_queue] , the type M / M / 1 / ∞, for the particular case of the arrival at the landfill/ sorting station. In this case, the inter-arrival time distribution is exponential for the parameter λ:

$F(t) = 1 - e^{-\lambda t}$, t≥0,

and the service is also exponentially distributed, the parameter μ:

t≥0.

Consequently, the vehicles' arrivals rate is given by:

, k = 0,1,2,…….

while the service rate is given by:

, k = 0,1,2,…….

So that we won't have a never ending queue, it is necessary and sufficient that [2]: < 1.

This should be considered as there are many special vehicles for waste collection in urban areas, and also there may be more operators providing specific services. Besides these, there are people who sometimes carry non hazardous household waste or similar items (accepted for storage) directly to the deposit, on their own. The mathematical model suggested above is a general case that includes all assumptions listed.

Considering the state of statistical equilibrium and noting p_j the limit probability that j customers are in the system (j-1 in a row and one unloading), that the main features of the model (in statistical equilibrium) are [2]:

L = average number of customers in system $= \frac{a}{1-a}$

L_q = average number of customers in a row $= \frac{a^2}{1-a}$

p_0 = probability that the server is free = $1-a$

$\sum_{j=1}^{\infty} p_j$ = probability that the server is busy = a

W_q = Average waiting time $= \frac{a}{\mu(1-a)}$

W = average time spent in the system:= $\frac{1}{\mu(1-a)}$

5. Costs per tone of waste collected include the following categories:

- Acquisition and maintenance costs of specific equipment (vehicles for collection and transport, the repair and overhaul, bins etc).

- Expenses for staff salaries, in the collection sector
- Expenses for salaries of administrative and technical staff.

6. Costs per tone of deposited waste include the following categories:

- Acquisition and maintenance costs of specific equipment (trucks for compaction, their repair and overhaul etc.)

- Expenses for salaries of the staff in the storage sector
- Expenses for salaries of administrative and technical staff.

7. Expenses for environmental protection:

Monitoring of environmental factors

- Purchase of materials and equipment necessary for wastewater treatment
- Purchase of protection materials
- Maintenance of all the above.

Assessment criteria 6,7 and 8 cover the expenses. When it comes to the average price, the only valid value is the harmonic one. Studies state that this is the only correct average value.

Application:

Given the quantities of waste purchased from p different areas, the costs per tone for each area are $p_1, p_2, ...p_p$. Thus, the costs will be:

$$S_i = Q_i * p_i$$

In this case, the average unit price will be given by the formula:

$$p_m = \frac{S_1 + S_2 + ... + S_p}{\frac{S_1}{p_1} + \frac{S_2}{p_2} + ... + \frac{S_p}{p_p}},$$

Which is the harmonic average value with the share of expenditures for each area. The above method can be used to calculate the next indicator, if one takes into account that the ratio of man / hours allocated can be considered as an expense (not expressed in money).

8. The ratio man / hours allocated per tone of collected waste: the unit man-hours / t indicates several issues regarding the quality of management of the organization:

- Experience / skills of existing teams in this field
- Quality of equipment used - The management / organization of the stages of the work.

9. The relation between the administrative staff and the staff directly involved in production is a secondary indicator, but it is important in assessing the functional structure of the organization. This can be used for a benchmarking analysis used for comparing the performance of the organization and other similar institutions (competitors or not). Benchmarking is applied in many commercial sectors, with good results, especially in sales sector. This method of assessing and comparing management performances is not common in environmental activities. To its efficiency, this method must first identify the best practices of waste collection from households. The universality of benchmarking allows innovative ideas from other fields to be also put into practice in waste management.

10. The number of non-compliance observed by the internal or/and external audit, compared to number found by a third audit investigation.

11. The number of special situations - this category may include various aspects such as:

- Detection of toxic and hazardous waste that were (or not) stored
- Fires caused by external causes
- Fires caused by internal causes (auto-ignition of the waste, or of gas eliminated by them, etc.)
- Natural disasters.

12. The number of penalties applied by supervisory authorities: in a specific period of time chosen for the analysis, we can find out the number of inspections of environmental authorities or other authorities and the number of sanctions applied. This analysis clearly indicates non-compliance / non-conformities. Following the analysis, appropriate measures can be taken so that similar situations do not recur. Also, you can compare the number of nonconformities observed in a given time interval and draw conclusions regarding the progress, stagnation or decline of the management.

13. The frequency of measurements regarding waste composition: variable, even more than others, as it evolves with relatively large amplitudes, generally due to these main reasons:

- Development of products and their packaging
- Price trends
- Changes in patterns within specific geographical area

- Evolution of seasons
- Other causes.

All these variables produce a permanent change in the composition of waste. The composition of waste with a higher frequency leads to a more accurate assessment of the potential for exploitation of waste collected. At the same time, an accurate estimation (as close to real values, unknown, but estimated statistically) of the waste composition will have a positive impact on collection management activities, by revealing early targets that won't be reached (also because of waste composition.).

14. The degree of selective collection is a criterion that shows both the performance of management of collection activities carried out by operators and also the degree of environmental education of the population served. It is obvious that the cost for collecting 70% of mixed waste is way higher than for collecting only 50% of mixed waste. I argue the introduction of this criterion in the nowadays practice of waste from households, as there are operators who mix the wasted once delivered selectively by the population (such as paper, cardboard and plastic, that are thrown into the same truck, together with the mixed content of the bin). This is an extremely inefficient management of waste collection, unfortunately still in practice in some areas. This example is not unique and points out a more serious approach on efficient waste collection issues from the population than from the operators.

The degree of selective waste collection can be expressed mathematically by the formula: Degree of selective collection= $\frac{C_1}{Ctotal} x100\%$,, in which C_1- Selective waste collected from households C_{total} - Total quantity of waste collected from households.

15. Applying Benchmarking environmental analysis or other specific analyzes related to waste management activities - existing models of good practice, and opportunities to use them to improve their management.

16. The existence of a procedure for detection and disposal of hazardous waste collected. Hazardous waste is found in small amounts in the quantities of waste collected from households, but their presence remains. As a consequence, their undetected presence and admission to storage is a systematic waste management error. Therefore we considered necessary to develop a procedure for detecting existing hazardous waste in the waste collected from households. To achieve such a process, we should take into account the specific conditions of each area in part, meanwhile promoting alternatives to eliminate this category of waste, accessible (even incentive) for the population.

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MANAGEMENT OPPORTUNITIES FOR THE PROTECTED AREA "PRUTUL DE JOS" IN MOLDAVIA

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KEYWORDS: climate, soil, hydrology, geology, flora and vegetation, fauna, management.

ABSTRACT

This paper presents important aspects related to the problem of biodiversity conservation and sustainable development in the Scientific protected area „Prutul de Jos", having as main goals the determination of the influence of the sources of pollution on the state of the protected area and the use of relevant information for the development of the Management Plan for the Prut river according to the provisions of the EU WFD. The protected area „Prutul de Jos" is an important part of the Danube Delta, located in the southern part of the Republic of Moldova, at 35 km from the Prut river confluence with the Danube, and includes four types of ecosystems: water, wetland, meadow and forest, creating favorable conditions for many species of vertebrates and invertebrates, especially for migratory species of birds included in the Red book as a rare species for Europe. This area is a RAMSAR zone, habitat for birds and part of the Green Corridor of the Lower Danube region, threatened by oil extractions, infrastructure development and port cargo and passenger terminal development on the Moldavian part of the Danube bank, as well as agriculture and pastoring activities in the buffer zones of the protected area and plans of renovating the irrigation system using water from Prut river. The information shows the importance of the protected area in biodiversity conservation and supports the transboundary cooperation towards the elaboration of a management plan for the protected area, as well as the criteria for its monitoring and the factors to be monitored.

REZUMAT: Oportunități de management pentru aria protejată "Prutul de Jos" din Moldova.

Lucrarea de față prezintă aspecte importante ale problemei conservării biodiversității și dezvoltării durabile în Rezervația Științifică „Prutul de Jos", având ca obiective principale stabilirea impactului surselor de poluare asupra stării ecologice a ariei protejate și folosirea informațiilor pentru dezvoltarea planului de management al râului Prut conform Directivei Cadru Apă. Aria protejată „Prutul de Jos"este o parte importantă a Deltei Dunării, fiind situată în sudul Republicii Moldova, la 35 km de confluența Prut-Dunăre, ce include patru tipuri de ecosisteme: acvatice, zone umede, pășuni și păduri, oferind condiții favorabile pentru multe specii de vertebrate și nevertebrate, în special pentru păsările migratoare, dintre care multe sunt cuprinse în Lista Roșie a speciilor rare din Europa. Este o zonă de importanță RAMSAR, habitat pentru păsări și parte a Coridorului Verde al Dunării de Jos, amenințată de exploatări de petrol, dezvoltarea infrastructurii și planuri de dezvoltare portuară pe malul Dunării dinspre partea din Republica Moldova, precum și agricultură și păstorit în zonele tampon ale ariei protejate și planuri de refacere a sistemului de irigație ce ar capta o considerabilă parte din debitul râului Prut. Informațiile prezentate arată importanța deosebită a zonei din punct de vedere al biodiversității și susțin cooperarea interstatală/transfrontalieră în vederea elaborării unui plan de management pentru protejarea zonei, precum și criteriile pentru monitorizare și factorii recomandați a fi monitorizați.

ZUSAMMENFASSUNG: Oportunităţi de management pentru aria protejată "Prutul de Jos" din Moldova.

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INTRODUCTION

Management Plan for „Prutul de Jos” area serves as a basic document for the sustainable use of natural resources in the southern part of Moldavia, which is included as a part of the Danube Delta, for which a special management plan has to be developed according to the provisions of the EU Water Framework Directive. This document will contribute to the achieving of the overall objective of the Directive - good ecological status of water by 2015, including ecosystems of protected areas.

Provisions of the management plan for the protected area will become an integrated part of the whole Prut river management plan, which will be developed in cooperation with riparian countries (Republic of Moldova, Romania and Ukraine). This plan will also become an integrated part of the Management Plan for the whole Danube river basin, which will be implemented by the year of 2015. An essential role in the frame of the Integrated River Basin Management Plan belongs to the management of the protected areas and development of modalities on sustainable use of protected areas in for biodiversity conservation, protection of the habitats, and creation of the favorable conditions for the extension of the network of protected areas.

Presented management opportunities for the protected area „Prutul de Jos” will be implemented through different projects, which presume involvement of different stakeholders from both parts of the lower Prut region. It presumes close cooperation of the experts and local authorities from Moldova and Romania in the coordination of the plans for the regional development, evaluation of impacts of different social and economic activities, cooperation with international institutions. A main aspect of the implementation of this plan is attraction of the best practices from different domains in the Lower Prut region for the prosperity of the people living in the region from both sites of the Prut river and sustainable use of natural resources in the region.

RESULTS AND DISCUSSIONS

The policy of the Republic of Moldova is aimed at the European integration and cooperation with EU member states in implementation of different Directives developed by EU Commission and adopted by European parliament. One of the tools for the cooperation of the Republic of Moldova with EU Institutions is Action Plan Republic of Moldova – European Union which presumes harmonization of the environmental practices according to the relevant EU Directive. Water Framework Directive of the EU is one of the most comprehensive in the field of environment and its implementation is based on the development of the Integrated River Basin Management Plan.

The Republic of Moldova has signed in 1994 and ratified in 1999 the Convention on the cooperation for the protection of the Danube River Basin and actually actively participates in the activities under the International Commission for the Protection of the Danube River basin (ICPDR). The protected area „Prutul de Jos" was included in the year of 2000 from the Republic of Moldova in the Program „Gift to the Earth" as an integrated part of the Lower Danube Green Corridor. In the frame of this program there were selected sites for wetland restoration, estimation of the capacities of wetland areas for the nutrient reduction, evaluation of the habitats, etc.

In the frame of several projects (supported by WWF, REC Moldova, ICPDR, National Commission of the Republic of Moldova for UNESCO) and initiatives of the central and local public authorities there was expressed a commitment for the cooperation in implementation of activities according to the Management Plan. NGOs and public institutions also expressed theirs' disposability for the cooperation and implementation of the management plan for the Prut river basin and launched initiative „For the clean Prut", which was supported by NGOs from Moldova and Romania.

Site selection

The Lower Prut area was included in the list of vulnerable zones on the base of the evaluation of the data on social and economic development, impact of activities undertaken in 70th, actual impact identified in the frame of the Danube pollution Reduction Program in the years 1999-2001. This zone presents an interest in regard to the construction of the oil terminal near the village of Djurdjulesti (confluence of the Danube and Prut rivers), development of relevant infrastructure and construction of new industrial and agricultural facilities in the settlements of the Lower Prut region.

According to the plans of the regional development the construction of the network of roads, railways, reconstruction of the lands for irrigation and growing of the amount of mineral fertilizers use, etc. will increase. All these can affect the state of the ecosystems of the Lower Prut region, including scientific protected area „Prutul de Jos". In this context the development and implementation of the Management Plan for the protected area and its possible extension will contribute to the conservation of the habitat in the Lower Prut region, lead to the „good ecological state" of water ecosystems and will serve as a base for decision making for the basin district „Prut".

Selected areas have to correspond to a certain set of objectives for the national policy for information of the decision makers for the in the field of environment and public institutions on:

- State of environment in the protected area and its correspondence to the designated objectives;
- Influence of the human activities on the state of protected area „Prutul de Jos" and pollution sources;
- Efficiency of the pollution control policy and environmental protection in the Lower Prut region.

At the same time the monitoring network has to provide necessary information for implementation of the obligations of the Republic of Moldova for

the international Conventions ratified by Moldova, on international and bilateral agreements in regard to environment. Recently the countries from the central and Eastern Europe have signed a common agreement on providing the information to the European Environmental Agency on the state of environment and on main ecological problems in the country.

Another issue, which has to be taken into consideration in the designing of monitoring network, is EU Water Framework Directive (WFD). This Directive is a part of legislation on the ecology of the river basins. According to the Directive the management of waters has to be organized on the basin level. EU member states have to collect information on the state of rivers, lakes and shallow aquifer.

Countries outside EU do not have any obligations for the implementation of the EU WFD, but they commit to collect the data for comparison of the results on the European level and introduce relevant basin management practices of the rivers common with EU.

National data and monitoring systems have to be presented in a form, which will allow achieving of next goals:

- Determination of the influence of the sources of pollution on the state of protected area „Prutul de Jos";
- The use of relevant information for the development of the Management Plan for the Prut river according to the provisions of the EU WFD.

Description of the scientific protected area „Prutul de Jos"

Scientific protected area „Prutul de Jos" was created according to the Governmental Decision nr. 209 from 23 April 1991 and cover the area of 1691 ha. Protected area is located in the southern part of the Republic of Moldova in the distance of around 35 km of the Prut river confluence with the Danube. Beleu lake is a main part of the protected area with the surface of 620 ha. This lake is connected with the Prut river through channel Manolescu which is 3,9 km long; with the width till - 38 m and depth - 4,5 m.

The difference in the relief level between channel and Prut river is around 1m.

Scientific protected area „Prutul de Jos" is located in the Cahul district between localities Crihana Veche and Slobozia Mare. In the year 2000 this area was declared as „Ramsar zone" and became an integrated part of the Green Corridor of the Lower Danube region. Management plan is developed for the area of 2000 ha, which includes also adjacent areas, wetlands and forests of the Prut valley.

Area's location and boundaries

Scientific protected area „Prutul de Jos" is placed in the south-western part of the Republic of Moldova in the Prut valley near its confluence with the Danube. Administrative this area belongs to the Cahul district. The valley of the Prut river is shared by the Republic of Moldova and Romania. The length of the zone is around 25 km and the width varies from several hundred meters till several kilometers. Coordinates of the Beleu lake are 45"36'32 N and 28"9'14 E.

Western boundary of the zone is Prut river, which forms the border with Romania. Southern border is located on the Danube river and on a short distance form the border with Romania. Actually the length of the Danube river in Moldova is around 400 m.

„Prutul Inferior" (Lower Prut) region includes ten localities with a population of around 25000 people. Water ecosystems (besides Prut river) are represented by shallow lakes, which often dry out during the summer period. Northern part of the region (the valley of the Prut river was desiccated in the middle of 70th) is used in the agricultural activities for last 30 years. Unauthorized fishing and pasturing, illegal trees cutting in the valley of the river present a great problem for environmental and public authorities of the region.

Right slopes of the Prut river form eastern border of the selected zone. Localities are located in the lower part of the slopes with partial entering to the Prut river valley. Agriculture is the most important sector of local economy and extends after the borders of the selected area. The network of local roads is in inappropriate state and is used mainly for local needs (traffic between localities).

Recently there was constructed an oil terminal on the Moldavian part of the Danube bank together with the relevant infrastructure, which is presumed to be further developed in the nearest 5-7 years (port cargo and passenger terminal, development of the navigation on the Prut till Cahul town as it was till the end of 50th).

The most nature affected activities in the region are oil extractions, which are being developed in the upper part of the Beleu lake. These activities are performed according to the Governmental decision, which allowed in 1995 to make such works for the period of 20 years. Petrol resources of the oil field are estimated in the volume of 600 000 tones and actually around 7000 tones are extracted annually. Oil leakages had place from the drilled wells, which have been abandoned for last 50 years of last century. Actually these leakages and construction of the access roads to the oil wells cause significant impact on the state of water ecosystems of the Beleu lake.

Natural conditions of the Prutul de Jos region are attractive for many bird species of the international importance: *Pelecanus onocratalus, Botaurus stellaris, Ardea purpurea, Egretta alba, Ardeolla ralloides, Platalea leucorodia etc.* Total number of bird special in the selected area included in the Red Book consists from 20 species. Areas covered by reed belts in the protected zone serve as a habitat for many species of birds and animals. Nature conservation activities in the protected area „Prutul de Jos" are performed according to the regime for protection of the protected areas. According to the Law on the Fund of the Protected Areas adopted by the Parliament of Moldova (Decision nr. 1538-XIII from 25.02.98) protected area „Prutul de Jos" has a Scientific Reservation status.

Climate

Climate in the Lower Prut region is moderate-continental with a short and tempo rate winters and long and warm summers. Average precipitation rate is around 450 mm. In the summer period precipitations can be rather rare. Snow falling happens in the period December-March.

Evaporation from the surface of the Beleu and Manta lakes is around 850 mm/year. Water filtration trough soils and substrate is on the level of 30%.

Spring temperature in the region is relatively high (till 20°C). First half of the summer is characterized with torrential rains, while second half of the summer period is rather dry. Autumn in the region is rather warm till November and by the end of this month the temperatures drop down rather quickly. Main wind direction is north and north-east with average speed of 2-5 m/sec.

Climate in the region is under influence of the Black sea. Winters are mild. Negative temperatures happen during winter period. Snow stratum is in average 5-10 cm. Water ecosystems are covered by ice for 60-65 days. Snow melting starts in March and continues for 10 - 15 days.

Soils and substrate

Alluvial soils are developed in the valley of the Beleu lake. Humus content is 3-5%. They are also characterized with high content of silt and clay material (more than 60%). Meadow chernozems are developed in the lower part of the slope. Reaction of the soil profile with 5% HCL starts from the surface. The content of the clay part of the soil varies in the limits 40-45%. The content of humus (>1%) is till the depth of 50 -70 cm. Soils from slopes watershed are presented by carbonate cernozems with different level of erosion. The strata of humus varies in the limits of 30-45 cm. with the content of 1 – 2,5% and strongly depends on erosion processes, which are extremely developed on the slopes with the

inclination of 15-17 degrees. The content of carbonates on the soils surface is on the level of more tha 3%. Soils from the upper parts of the slopes are presented by usual cernozems with humus content 3-3,5%; content of carbonates more than >1% is tested on the depth of 10-15 cm and humus content >1% is till the depth till 1m.

Subsoil's substrate with loess and calcar are mainly developed in the upper parts of watersheds. The content of clay fraction is around 35%. In the valley of the Prut river the content of this fraction is higher (37-40%), while in the wetlands of the Manta and Beleu lakes the values of clay content are till 60-70%. According to the ecoregion distribution of the EU Water Framework Directive Lower Prut region is in the ecoregion 12 „Pontic Province" and in the frame of the Danube river basin sub-regions. Erosion processes are large developed on the slopes and cause growing of the ravine network. Average density of ravine network is around 0,5 km/km2. Slope soils are supposed to the erosion due to the agro technical processing and application of unsustainable agricultural practices in the region. The volume of annual erosion material is estimated on the level of several tones per ha. Land slides are presented by high humidity mixed clay and sandy rocks. Freatic water levels are met in the strata of such rocks. Average depths of these strata are in the limits of 3-7 m. Usually this stratum forms the land slide body.

Hydrology

Main aquifers in the Prut basin are presented by Quaternary - Neocene N1S2 (sand) deposits and N1S1 deposits. Deep aquifers are covered by impermeable rather significant strata. The layer of the aquifer reduces from the margin of the Prut basin towards river and linkage between deep aquifer and river is rather insignificant. Significant impact of the deep aquifers on the river is little probable in spite of deep aquifers are alimented by regional flow.

Ground waters presented in this part of the Prut basin are associated with terraces placed in parallel with the river and are well developed in the southern part of the basin. Average depth of such aquifers is around 5 - 10 m, sometimes till 10 - 15 m. Potentiometer modeling of the „natural" surfaces demonstrated that flow of the underground waters is directed from north to the south. The hydraulic gradient of this aquifer is around 0.0002, reducing from the potentiomenric surface for 14 m longitudinal.

Data on the level of underground waters collected from wells indicate that there is a significant declining of the aquifer N1S1 from 25 m till 40 m and „natural" regime of waters from the deep strata is strongly changed. Testing of the wells, which are in use showed that water here is accumulated from the aquifer N1S2 and its conductivity is rather good. Aquifer N1S1 is the most important one from the basin, but is rather deep, around 500 m and abstractions for a middle or long term depend on its provision with the water from the regional underground flow from north to south.

The drainage system was built in the region in the 70th. Total surface of the irrigated lands is around 10000 ha. Desiccated wetland areas from the Prut river valley consist around 30% of the selected zone (public lands).

Geology

Selected area belongs to the Lower Prut area and is represented by the bloc of flexible rocks, which have been very active during geological development of the region. During the Carbon period this bloc appeared on the surface and is supposed to the intensive exogenic denudation and erosion. In the Miocene and Pleistocene periods the accumulation of the sediments in this period led to the formation of the mother rocks formed in this period of time. Main types of the rocks are: pebble, gravel, sand, sandy calcar and rocks with *Rhinoceros, Longirostris, Anancus arvernensis, Margaritifera flabellatiformis,*

Potomida stoliczka, etc. A stratum of the alluvial rocks in the selected area is around 20-25 m and refers to the Neogen and Quaternary periods.

Reflux of the Sarmatian Sea (1-2 mln years ago) caused formation of the Prut river valley in the region of nature protected area. The width of the left side of the Prut river valley varies from 40-50 m in the segment Colibas-Valeni till several kilometers near Beleu lake. Near Valeni village Prut river meets anticlinal relief and forms meander.
Relatively deep valleys of the small rivers are oriented in the sub-meridianal direction. The depth of the valleys of such rivers varies 100-120 m. The river network density is 0,1-0,2 km/km2. Land slide processes are met with average frequency cca 0,5 ha/km2. Erosion processes of the river banks could be estimated as cca 20-30 cm per year.

River Prut elevation (sea level) in the upper part of the protected area is 4,55 m and at the confluence with the Danube – 2,67 m lower than Danube level.

Mother crystalline rocks of the Pre-Cambrian age form the base on which sedimented rocks were formed. It is estimated that basic rocks are on the depth of 1300-2500 m under soil surface. Only some wells reached the Pre-Cambrian rocks surface and the depth was mainly estimated on the base of geophysics studies.

The Pre-Cambrian are covered by sediments formed during Jurassic, Paleogene, Neogene and Quaternary periods and have different width. Normally these rocks are developed in the big depressions of slopes in which the Prut river basin is located. The surface of the Quaternary deposits is covered by ravines and land slides.

The state and legal rights

Sustainable management presumes clear state of property of lands, which are included in the protected area and which will assure harmonization of relations among different stakeholders, development of opportunities and modalities for inclusion of lands in the limited use regime, including prohibiting of any economic activities.

According to the institutional regulation the lands of the protected areas belong to the „Moldsilva" Agency, which coordinate all aspects of the land use. The statute of the scientific reservation „Prutul de Jos" this zone is strict protected and any access has to be coordinated with protected area administration and border control office.

Adjacent to the Beleu lake territories (aproximatively 450 ha) are under agricultural activities and belong to private owners (farmers, cooperatives and magistrate of the villages).

On the base of the discussions with local public authorities it was clarified that lands near protected area could be transferred in the property of the protected area „Prutul de Jos" with the right of their use for pasture in the dry period of the year. These lands could serve as a tampon area for the nature rezervation. Local public authorities expressed their confirmed disponability for the promotion of the organic farming in the Prut river valley and non application of the agrochemicals on the lands near protected area.

According to statute of the scientific rezervation „Prutul de Jos" any economic activity in the borders of the protected area is strictly prohibited. Research activities have to be coordinated with the Academy of Sciences and administration of the protected area. In the year of 1995 the upper part of the Beleu lake was given in concession to American company „Redeco" for exploitation of the oil resources for 20 years. In the year of 2003 the Parliament has emitted special decision according to which oil extraction can be developed.

The lands outside protected area are used without any special conditions according to the Soil Code, other laws and normative.

State of the protected area

Due to the use of lands of the protected area „Prutul de Jos" for the installation and use of the equipment for oil extraction, construction of the roads for access to the oil wells in the upper part of the Beleu lake, its ecosystems are strongly affected by pollution with oil products, technical wastes, noise of the mechanisms etc. Construction of the roads affected ways of migration, deteriorated the habitats for nesting of birds, led to the siltation of the lake etc.

Drainage works near protected area also affected negatively the state of water ecosystems (wetlands, swamps, etc) and hydrological regime of the Beleu lake. Agricultural use of lands in the tampon zone led to the deterioration of the natural vegetation and faunistic complex. Agricultural activity in the area between Manta and Beleu lakes is going with the fertilizers and pesticides use on an insignificant level.

Other plans

Actual plans on the land use in the lower Prut region presume development of the transport infrastructure, construction of the living houses, renovation of the irrigation system outside protected area, construction of the port facilities in the lower part of the Prut river and navigation till Cahul town, development of the organic agriculture, etc.

Management of infrastructure

Main stakeholders of the region

Staff of the protected area „Prutul de Jos" performs observations on the state of environment, assures protected regime and monitoring activities.

Management of the protected area, tampon zone and area between Beleu and Manta lakes is performed through decisions issued by the Cahul Council. Responsibility of local public authorities refers to the distribution of lands for different purposes (construction, roads, agricultural activities, etc).

Any economic activity has to be coordinated with local district Council, which issues relevant authorizations.

Administration of the „Prutul de Jos" protected area, in cooperation with the Association „Moldsilva", Ministry of Environment, local public authorities is responsible for assurance of the strict protected regime in the protected area. Local State Ecological Inspectorate assures following to of the environmental criteria in economic activities, estimates the level of impact on environment, presentation of relevant documents to the court, etc.

Involvement of NGO community is assured according to provisions of the law on public access to information on the state of environment and participation of public institutions in the process of decision making. Any project on economic activity has to pass public expertise with the participation of the representatives of the NGO community on all phases of decision making. NGOs participate in organizing of the public events on salubrization of the territories, public awareness campaigns, public alarm in case of emergencies, and information on activities, which could have an impact on the state of environment.

Research institutions assure scientific research in cooperation with administration of the protected area.

At the same time, it is important to mention that technical assurance of the protected area is insufficient. Administration does not have computers and data base on the state of environment of the protected area. Monitoring on the state of environment is organized on the fragmentary base and does not cover all components of environment. The state of the biodiversity practically is not monitored and ways of migration of species are not identified.

The international institutions, which are active in the Danube basin in the present (ICPDR, REC Moldova, UNDP/GEF, World Bank etc), participate in the development of management plans, attraction of investments to the region, preparing and implementation of projects for cooperation in the lower part of the Danube Basin.

Ecological and biological values

Ecosystems vegetation and ecological processes

There are 4 types of ecosystems in the protected area: water, wetland, meadow and forest. Water ecosystems occupy 1300 ha; wetlands – 140 ha; forests – 150 ha; meadow – 100 ha. strict protected area covers 168,3 ha. On the elevated sites the grass vegetation is mainly presented by *Elytrigia repens,* associations of Salicetum (albae) elytrigiosum (repenti), Salicetum phragmitosum (australis), S. rubosum (caesii), S.typhosum (latifoliae) are also registrated.

Flora and Vegetation

Flora

On the base of research performed (Postolache, 1995) in protected area "Prutul de Jos" 160 species of vascular plants were identified. Majority of species belong to families: Asteraceae - 21 species, Poaceae - 20, Cyperaceae and Lamiaceae include 7 species for each, rest 35 families are presented by 1-5 species. Biomorfological analysis showed predomination of the perennial plants - 64 species, while one year - 40 species.

Vegatation

Water and wetland vegetation.

Main part of the surface of the protected area (aproximatively 2/3 of the protected area) is occupied by Beleu lake with an average depth of 0,5-1,5 m. Maximal depth – 2 m.

After construction of the digs in certain sectors in the upper part of the Beleu lake its surface increased till a total of 1500 ha.

The shallow part of the lake is cca 1000 ha.

Water vegetation includes 14 species of vascular plants. Water fitocenozes are presented by a various forms. Part of them is rooting on the subacvatic substrate, other are not connected with the substrate and can migrate. These species are divided in sub aquatic and natante species.

Subacvatic vegetation without roots is presented by *Ceratophyllum demersum, C. submersum*, *Potamageton crisi,* etc. Natant Vegetation includes 8 species of vascular plants, from which most spread ones are: *Lemna minor*, *Salvinia natans*. Water vegetation with a root systems presented by: *Potamogeton pectinatus, Potamogeton perfoliatus,* etc. Vegetation multiplied by water and air is presented by cca 20 species from which the most spread ones are: *Nymphoides peltata* and partially, *Nymphaea alba, Phragmites australis*, *Typha angustifolia, T. latifolia*, *Scirpus tabernaemontani, Alisma plantago-aquatica* etc.

10 associations of vegetation were described:

- *Ass.* Ceretophylletum demersum (Soo, 1927), Hild 1956, Ben Hartoget Segal 1964.

Presents an association of large spread plant community in the littoral part of the Beleu lake and develops well in the colmatated waters. It vegetates in open waters and also in waters with low circuit near the banks. *Ceratophyllum demersum* – dominant species from this association. In the natant strata next species are met: *Lemna minor, Salvinia natans, Nymphoides peltata, Spirodela polyarhiza, Potamogeton crispi, Vallisneria spiralis,* etc;

- Ass. Lemnetum minoris Muller et Gors Presents an association of plants in northern part of the Beleu lake, where

waters are not affected by winds and waves. Plants community is presented by mixed fitocenozes with the species like *Lemnetum minoris, Nymphoidetum peltatae*. In general in fitocenozes species like *Lemna minor* predominate with important role of *Ceratophyllum demersum*.

- Ass. Spirodela-Salvinietum natantis (Slavic, 1956). This association is developed in stagnated waters, very rare in running waters. It predominates in the north-western part of the lake near reed belts and is presented by *Salix cinerea*. Its optimal development happens in the second half of the summer period, when *Salvinia natans* covers 90-100% of the surface. It is associated with *Ceratophyllum demersum.*

- Ass. Potametum lucentis (Hueck 1931). This association develops in not flowed and slowly running waters, on shallow, mezotrofic spaces on the margins of swamps in the north-western part of the Beleu lake. Main species - *Potamogeton lucens*, *Lemna minor, Ceratophyllum submersum* and *Vallisneria spiralis.*

- Ass. Potametum pectinati (Horvatic, 1931). This association develops in running and not running waters and is presented by *Potamogeton pectinatus, Potamogeton nodosu*. All together there are 8 species of this association on the water ecotype.

- Ass. Nymphaetum albae (Volmar, 1947). This association prefers not running, but well aired waters of the northern part of the Beleu lake. It developed on the margins of the reed belts on the littoral with the depth till 0,5-2 m, with running waters and reduced content of nutrients. It is presented by 10 species with predomination of: *Nympoides peltata, Ceratophyllum demersum, Potamogeton crispi, etc* .

- Ass. Nymphaidetum pelatae (Allcorge, 1922). This association covers significant areas, preferring waters with low exchange rate and depth till 60-70 cm with a solid substrate on the margin of swamps, where flows of water are weak. It is developed in the northern part of the protected area. Main specie is - *Nymphoides peltata* with *Salvinia natans, Lemna minor and Potamogeton pectinatus, Ceratopyllum demersum*t. The plant community of this association is presented by 18 species. Optimal development of this association is at the end of spring – beginning of summer.

- Ass. Trapetum natantis (Muller et Gors 1960). This association is developed in the calm waters on the solid substrate. It supports forming of the sapropel. It grows near the banks with the water depth 50-150 cm, fitocenozes resist to large water fluctuations and partially grow on the terrestrial conditions.

- Ass. Scirpo- Phragmitetum (W. Koch, 1926). This association is developed in waters with low exchange rate. It occupies large areas in the northern and north-western parts of the Beleu lake with the depths 0,8-1,5 m. It is presented by species typical for reed belts like:*Phragmites australis, Typha angustifolia,* and also by species developing in waters *Salvinia natans, Spirodela polyrrhiza.*

- Ass. Typhetum angustifoliae (Allorge, 1922), Pignatti 1953**.** This association is presented in the north-eastern part of the lake and is on the contact with the association *Scirpo-Phragmitetum.* Vegetation of these associations plays an important role in the process of water colmatation. Water depth for species of these associations is 0,8 m. Substrate is formed from clay material. Dominated species is *Typha angustifolia* (35-85%) with *Sparganium erectum, Bolboshoenus maritimus.*

Meadow vegetation. This association is developed on the elevated places of the protected area in its western part near Prut river. The most spread species are: *Agrostis stolonifera, Potentilla reptans, Elytrigia repens, Bolboshoenus maritimus, Juncus gerardi,* etc.

On the elevated parts of the south-west part of the Beleu lake the wetland landscape was formed. Plants associations were formed in function of altitude of the territory. Littoral zone is presented by associations: Eleocharidetum palustris, Bolboschoenetum maritimi, etc. Main of them are:

- Ass. Caricetum ripariae (Knapp et Stoffer, 1962). Occupies small territories in the eastern part of the protected area on the lands lower than wetlands with domination of *Carex riparia,* in association with *Agrostis stolonifera*, *Potentilla argentea*, *Ranunculus repens*. Hydrofile species predominate (45%) of flora of association.

- Ass. Agrostidetum stoloniferae (Ujvarosi,1941) Burduja et all. 1956. Grass communities of *Agrostis stolonifera* are developed on the terrestrial part in the north-west of the area. It occupies elevated lands with the freatic waters on the depth of 0,5-1m. Grass vegetation is well developed with altitude of 1,2 m. This vegetation covers 80-100% of the soil and consists from 3 strata. Floristic diversity is rather high, dominating: *Agrostis stolonifera, Potentilla anserina, P.reptans, Juncus gerardii, Roripa sylvestris, Plantago lanceolata*.

- Ass. Eleocharidetum palustris (Schenikov, 1919). This association of plants is presented in a littoral part of the Beleu lake with stagnated waters in its north-western part on the wet soils. Communities of this association are in transition from wetland to mezofil vegetation with monodominant communities of *Eleocharis palustris* with participation of other species, which support floods.

- Ass. Bolboschoetum maritimi (Eggler 1933). This association forms on the more elevated, in comparison with previous association, places of the lake littoral in its north-west, on the soils of wetland areas with high clay content. Main species are *Bolboschoeneta maritimi*, *Puccinellia distans, Agrostis stolonifera, Eleocharis palustris, Typha angustifolia, Potentila reptans, Ranunculus repens.*

Forest vegetation

Forest vegetation occupies insignificant areas in the north-eastern part of the protected area with the surface cca 200 ha. Forest formations occupy elevated areas. Southern part of the rezervation is occupied by solitary species of tree plants.

Forest vegetation is presented by the communities of *Salix alba*, *Salix fragilis*, *Populus alba* and *Fraxinus palise*. On the contact zone with the forest vegetation meadow association formed with *Salix triandra, S. viminalis, S.cinerea*.

Willow associations

Such association formed in the northern part of the protected area forming the belt on the Beleu lake bank. In some places these trees association is added with the reeds on the places with fresh sediments of sands and silt.

Main components of plant vegetation consists from arbustive species: *Salix triandra, Salix cinerea, Salix viminalis.* In some places solitaire species are presented by: *Swida sanguinea, Tamarix ramosissima, Humulus lupulus.* Grass strata is non-uniformed and develops in function of availability of water (underground level). The most spread species are: *Phragmites australis*, *Potentilla repens*, *Agrostis stolonifera* and *Elytrigia repens.*

Willow forests

Such forests are formed on the elevated relief forms. Species diversity is presented mainly by *Salix alba* with insignificant participation of other species like *Populus canescens, Salix fragilis, Fraxinus pallise, Ulmus laevis*. On the margins of the willow forests *Acer negundo* can be met. These trees reproduces by seeds and roots. Next trees species could be met in the willow forest *Sambucus nigra*, *Swida sanguinea, S. australis*, *Ligustrum vulgare*, *Euonymus europaea*, *Viburnum opulus*.

Grass vegetation is well developed. In many places the level of covering of the soil by grass is 80-100% and in many cases there are no dominant species in vegetation community. The most often are met: *Ranunculus reptans*, *Potentilla reptans*, *Antriscus sylvestris*, *Urtica dioica*, *Dactylis glomerata*. Next associations of grass vegetation have been observed *Salicetum (albae) rubosum(caesii)* and *Salicetum (albae) phragmitetum(australis*).

Fauna

Scientific rezervation „Prutul de jos" is known for its favorable conditions for development of rich fauna diversity. On a relatively small space several types of ecosystems are met (water, wetland, meadow and forest) with a big ecological potential. Many fauna species of vertebrate animals are met as migratory, for reproduction, nutrition, and rest. Protected area is also important for the migratory species of birds, because it is placed on the ways of migration of birds from Eastern Europe to the Danube Delta – main habitat for vulnerable species.

Nevertebrates

Entomofauna is very poor studied. Around 150 species of insecta are known in the region. There are 10 species of heteroptere in the Beleu lake, which serve as a nutrition for fish: *Corixa punctata, Sigara nigrolineata, S. snistrata, S. falleni, Aquarius palludum, Gerris thoracicus, G. lacustris* or damage young fish *Hyocoris cimicoides, Notonecta viridis, N. glauca*.
The degradation of water, meadow, wetland and forest ecosystems led to the deterioration of the living conditions for many species. Illegal trees cutting also affected habitat for mammals and birds.

Fish of the Beleu lake consists from 23 species, which mainly come from the Danube or Prut rivers in the period of reproduction. Beleu lake is favorable for reproduction of 18 species, which return back to the river waters. Economically valuable species are: *Abramis brama*, *Rutilus rutilus*, *Cyprinus carpio*, *Stizostedion lucioperca*, *Silurus glanis*, *Alosa kessleri pontica*, *Esox lucius*. Species included in the Red Book of Moldova are: *Hucho hucho* and *Umbra umbra*. Ecological capacities of the Beleu lake has strongly reduced for last decades as for species reproduction as for development of the fish caviar. Main reasons for this are: siltation of the Manolescu channel, construction of the access roads to the oil boreholes and pollution with oil products.

Herpetofauna of the protected area is presented by 9 species of amphibian, or 69,2% of species of the country. The most spread are *Rana ridibunda* and *Rana lessonae*. During spring-summer period in favorable places for reproduction *Bufo viridis* predominates. In some years water ecosystems are intensively populated by *Rana ridibunda*. *Pelobates fuscus* is a species included in the Red Book of Moldova.

Water ecosystems are also populated by *Emys orbicularis*, and in protected zones one could meet *Coluber caspires*. Both species are included in the Red Book of Moldova.

Snake fauna is presented by 7 species or 50% of total snake species number in Moldova. The most important are steppe species: *Lacerta viridis*, *Lacerta agilis*, *Coluber caspins*. In the wetland areas the most frequent are: (*Natrix natrix*) and water snakes *Natrix tesellata*, *Emys orbicularis*.

Ornitofauna of protected area is presented by 189 species. The most important is order Passeriformes with 60 species or 57,7% of bird species in Moldova. Relatively large is presented orders: Caradriiformes (29 species), Anseriformes (23 species), Falconiformes (19 species). The biggest part of nesting species belong to order Ciconiiformes (13 species).

From total number of bird species 123 of them (65,1%) reproduce in the area; 176 (93,1%) - migrate; 55 (29,1%) – come for winter and 23 (12,2%) – local species.

As a result of the penetration of the willow species in the reed belts a favorable conditions for nesting of species *Ardeola raloides, Egretta garzetta, Ardea cinerea, Nicticorax nicticorax, Platalea leucorodia*, followed by *Plegadis falcinellus, Egretta alba, Phalacrocorax carbo, Phalacrocorax pygmaeus and Ardea purpurea* have been created.

Majority of the water and swamp species nest in cantons 3 and 4 of the protected area. Fish consuming species nest in the cantons 1 and 2. Species needed trees for nesting populate canton 4 and are also met in the willow space between lake and Prut river.

Protected area serves as a habitat for *Ciconia nigra* during autumn migration. They build nests for 20-30 individuals, *Egretta alba* - 20-25 individuals, *Egretta garzetta* - 100-150 of birds, *Ciconia ciconia* – 40-50 individuals.

Due to a rather close distance to the Danube Delta protected area hosts hundreds of species of *Pelecanus onocrotalus*, and *Pelecanus crispus*.

Informational bulletin Bird Life International in regard to the state of birds population in Europe (2004) indicate that population of many species has a tendency for reduction and outlines necessity for development of new policies for the protection of birds in all European countries, including the republic of Moldova. The state of species in danger (European Threat Status - ETS) in regard to birds includes several categories: SP – Status provisional, NE – Not Evaluated, S – secure, DD – Data Deficient, L – Localized, H – Depleted, D – Declining, R – Rare, VU – Vulnerable, E – Endangered, CR – Critically Endangered. There were inregistrated 4 species in danger in the Lower Prut region: *Anser erythopus*, *Circus macrourus*, *Aquila calanda* and *Falco cherrug*, which can be met during migration period. From the most vulnerable group 10 species were registrated: 3 from order Anseriformes, 2 from Charadriiformes also from orders Gaviiformes, Falconiformes, Galliformes, Gruiformes and Coraciiformes. The group of species, which are in decreasing consists from 36 species. It is necessary to attract attention to the group of species with limited resources in Europe. There 28 species from this list in the lower Prut region. The presence of species with different categories of ETS needs special habitats and it is necessary to develop a set of measures for reduction of impact on the wetland area under RAMSAR.

One of the ways for the resolving of the problem for the fauna protection is development of the pilot projects on revitalization of the species in danger, especially for such as: *Platalea leucorodia*, which is included in the Red Book of Moldova and 60% of individuals of this species live in protected area „Prutul de jos".

Mammals in the wetland area RAMSAR are presented by 34 species or 47,2% of all list of mammals in Moldova. The most spread one is order Rodentia - 14 species or 41,2% from teriofauna, Carnivore (23,5%), Insectivore (14,7%) etc. There are 5 mammal species included in the Red Book - *Lutra lutra*, - *Mustela lutreola*, - *Mustela erminea*, - *Felis silvestris*, *Crocidura leucodon*. Great importance for the presence of amphibiotic species is due to the Danube Delta, which is rather close to the protected area. This species come to the „Prutul de Jos" from Delta. The problem of amphibiotic species has been discussed on many international events and it was recognized that main problem is associated with the deterioration of the habitat of this species, agresivity of American species in the Euroasiatic areal. Based on that it is important to develop a pilot project aimed at the protection of these species.

Social and economic features

Social and economic activities

Protected area "Prutul de Jos" with the surface 1671 has a strict protected regime. There are no other protected areas in the Lower Prut region in the Republic of Moldova.

Recreație

There are no touristic objects in the region. Recreational activities are: unauthorized fishing and swimming in the Beleu lake.

Forestry/Silviculture

Forestation activities presume restoration of the protection green belts forests in the region, which are strongly affected by illegal trees cutting. Tress planting campaign is developed as public action „Greening of native motherland". Total surface of forested areas in the protected zone consists around 30%. Planting of new tress is performed mainly in ravines of the adjacent areas. Practically al ravines were forested during 2006 - 2010. The percentage of lived trees is 30 -40%. Planting of new tress has to be repeated.

Hunting and fishing

These types of activities are prohibited in the protected area. There are no data on unauthorized fishing and hunting in the protected area and in the region. According to estimations made during the field trips unauthorized fishing could be estimated as 0,5 - 1 tones per year from the Beleu lake. Recreational fishing has place practically in all communities from the region. This is unofficial fishing on a rather low scale as a type of recreational activities. Fish species used for fishing are carp or species caming to the Lower Prut for nesting.

Water use

Actually stations for water pumping for irrigation practically do not exist in the region. At the same time there are plans for renovation of the irrigation systems on the areas with volumes of watering 2000 -3000 m^3 per 1 ha. This means that around 2-3% of the Prut river flow could be used for irrigation.

Education and research

Scientific activities refer to the estimation of the quality of the components of environment in the frame of the state command. In addition to it scientific activities are performed in the frame of different projects developed in the region in the period 2006-2011. Activities under this projets were mainly aimed at the identification of the reference conditions for the pontic province ecoregion.

Social and economic activities outside the protected area

Nature conservation

Evaluation of the state of habitats and biodiversity showed that due to the impact on the landscapes in the basins of small rivers, natural regume of the landscapes is strongly affected by different types of human activities (mainly agriculture). At the same time some areas could be designated for protection of the migratory bird and animal species, periods of vegetation development, fish nesting etc.

Actually adjacent territories belong to the local public authorities - 450 ha. These lands are not used in agricultural activities and in the dry periods of the year could be used for pasture. On the base of discussions with local authorities (village primarias) these lands could be transferred to the protected area „Prutul de Jos" as a tampon zone and to be used by local population for domestic animals farming during dry period of the year.

In the limits of protected area agricultural activity is limited and covers around 30% of the territory. Application of agrochemicals is practically absent. Lands adjacent protected area are used for pasture. Animal farms near protected area are absent and pasture is organized privately on a relatively small scale. According to the estimations based on the results of the consultation meetings with inhabitants (Valeni and Slobozia Mare) number of cattle could be estimated as 300. Agricultural activities are developed outside wetland areas and cover watersheds on the level of around 80%.

Silviculture

Forest vegetation is developed mainly on upper part of the watersheds, which are associated with the Tigeci elevation. Main species of the forests here are: oak, acacia, willow, etc. Actually all these forests are strongly deteriorated and represent new plantations of the IV-V class of production with the reduced (till 0,6) consistency. Trees species are normally 4-18 m high

Forest resources are also developed in the wetlands and on elevated places in the meadows 5% and 1% respectively.
Wetland forests are presented by the belts near the Prut river with the species as: *Salix triandra, Salix purpurea* and *Salix viminalis*, *Populus alba* and *Populus nigra*, *Salix alba, Quercus robur* and *Fraxinus exelsior*, *Quercus robur, Ulmus laevis* and *Ulmus caprinifolia*, *Populus nigra*, *Populus alba*.

Hunting and fishing: Enterprises for commercial fishing are developed mainly on a big water bodies administrated by the State Concern „Apele Moldovei" and used by local commercial authorities. Production produced from fishing activities is designated mainly for local market and fish is mainly from the fish ponds situated on the banks of the Prut river and lake Manta. Fishing activities have reduced for last 10-15 years, but still remain a valuable source of alimentation for local population. There were conflicts between official fish farmers and unauthorized fishers in the region.

Recreation

There is a balneological resort in the town of Cahul with annual capacity for 6000-7000 patients. The excursions to the „Prutul de Jos" protected area could be included in the program of their stay as the resort.

Water and solid material use

Rural localities are assured with a very modest centralized system for water supply. Normally it is organized by using artesian boreholes and shallow wells. Centralized treating of waste waters is practically not developed. Waste waters from WWTPs from the town of Cahul are released to the Prut river in the volume of 20000 m^3. The most important pollutants are BOD (around 20 000 tones per year) and nutrients.

There are several carriers (ravines and land slides) in the region Lower Prutului used for extraction of the construction material. Annual extraction could be estimated on the level of 600 m^3, clay and sand material - 150 m^3 per year.

Education and research

Actually there are University of Cahul and Lower Danube University in the Lower Prut region. Environmental courses are studied in the frame of educational curriculums and license works. Technical equipment of educational process is very poor (lack of analytical equipment, chemicals, computers, etc).

Research activities in the region are performed in the frame of the state command and different grants, projects in cooperation with international Institutions. The results are presented in different reports and are published in local mass-media, scientific journals, etc.

Economical aspects and population

The most important branch of local economy is agriculture. Industrial activity is very poor developed and consists only 4% of local economy. Population involved in agricultural activities is cca 98%; in industry - 0,07%; in industrial fishing - 0,01%; in public services - 1,9%; other activities - 0,02%. Total population in the sector Cahul - Djurdjuleşti - 32,9 thousand people (without town of Cahul).

Land use in the past

Practically all territory of the Lower Prut valley was desiccated in the middle of 70th. Beleu lake was used for oil extraction in 50th. For the 50 year period this region was a border of the USSR with a very limited access of population to the Prut river and Beleu lake.

Monitoring program for the protected area „Prutul de Jos"

a) Criteria for the monitoring of the protected area.

For the development of the program of monitoring a pragmatic approach was used for development of basic activities, which allows maximal avoiding of difficulties in data collection and obtaining of verified information on environmental quality in the protected area „Prutul de Jos". A number of indicators, samples and frequency of sampling have to correspond to the demands for information needed for implementation and correction of the integrated management plan for river basins.

These criteria are:
- needs of local authorities in environmental information on necessary actions;
- needs of local environmental authorities and NGOs for control of the efficiency of implemented measures;
- needs of donor agencies for estimation of the success of financial resources invested in management of the protected area;

- organizing of the information exchange;
- identification of the reference conditions for the Lower part of the Prut river and use of data for development of the management plans for Lower Danube and Prut districts of the Danube basin.

b) Monitoring stations and criteria for their selection

Monitoring network of the protected area has to be relevant to the objectives of national policy for decision making and public Institutions and NGOs on:
- State of environment in the protected area „Prutul de Jos" and on adjacent territories;
- Applicability of the obtained results from the monitoring network to the number of objectives presumed in certain documents (management plan, program of measures, estimation of transboundary impact, etc);
- Influence of the activities and pollution sources on the state of protected area and estimation of capacities of ecosystems for certain types of activities (tourism, organic farming, etc.);
- verifying of the efficiency on the pollution control and protection measures in the reservation.

At the same time system of monitoring has to provide information according with the criteria and obligations of the country in the frame of international Conventions, bilateral agreements. Actually Eastern European countries signed an agreement with European Environmental Agency on providing of this institution with the data on the state of environment on their territories, including protected areas.

Thus for the development of the monitoring network recommended stations have to:
- Assist in determination of the influence of point sources of pollution;
- Fit to the criteria for incorporation in the international network on the evaluation of the state of environment and identification of the reference conditions for the ecoregion according to the EU WFD;
- Correspond to the EU WFD.

For the performing of the monitoring of the protected area „Prutul de Jos" it is necessary to identify the network of sampling, list of parameters necessary for obtaining of relevant information, including those obligatory for EU WFD and Danube Convention, estimation of costs, and reporting system.

Selection of stations for the protected area and research activities have to be organized according to the case-study methodology, which is based on the selection of the most typical zones from reservation.

According to the studies performed next case-studies were identified:

- areas with forest vegetation;
- water ecosystems (Beleu lake, channels connecting Prut river with the lake);
- wetland areas with the grass vegetation;
- agricultural areas.

For the description of each case-study it is necessary to include in the program of monitoring research activities, which will allow collection of relevant information and on this base to prepare an annual report on the state of environment in the protected area with the proposals aimed at its improvement or conservation, performing of economic activities on adjacent areas, argumentation of the development plans for protected area and tampon zone.

Monitoring of water ecosystems

Beleu lake is essential part of the protected are. Main source of water for the lake is Prut river, which also has to be included in the monitoring program with the stations on entrance and exit from Beleu lake. Beleu lake has to be monitored in its upper, middle and lower parts. Monitoring of sediments has to be organized on the same stations on water quality. Liquid phase of the sediments should be also analyzed for estimation of capacities of pollutants to migrate from sediments to water.

Monitoring of the soil quality

Soil samples from the reservation have to be collected according to the distribution of the functional areas. Studies on flora and biomass of vegetation should be harmonized. Every functional zone has to be sampled from soil profile (soil profile the most typical for the functional zone) and with the soil samples from the surface – 0 - 20 cm. For every functional zone is recommended sampling with the frequency – 1 sample per 10 ha. Soil profiles should be sampled 1 time for 2 years and surface soil samples 1 time per year.

Monitoring of transboundary pollution

Monitoring of the state of the protected area has to include observations on transboundary pollution. This could be achieved by collection of the snow samples immediately after snow falling and in a certain period of exposition (10 – 20 days depends on the duration of the non snow period). The difference in concentration of pollutants will allow evaluation of the transboundary pollution. Atmospheric precipitation as rains should be analyzed during the year in the lower part of the protected area.

Monitoring of local pollution

According to the estimations of the human activities in the region main source of pollution are agricultural activities and pollution associated with municipalities (forming of the runoff) which can reach protected area.

The monitoring elements were selected based on:
- analysis of activities on adjacent territories;
- indicators of the state of ecosystems, included in the annexes of the EU WFD;
- resources and capacities of local institutions to perform relevant analysis (equipment, staff, finance);

Monitoring of underground waters

Monitoring of underground waters needs general characterization of water units and details of the process, which are indicated in relevant recommendations. After this it will be necessity to develop a research monitoring for the five year period, which will allow re-characterizing the state of underground water resources of the protected area. The network of monitoring stations for underground waters will be identifies on the base of size of the aquifer, its complexity and human impact (land use, population density, abstractions, etc). The

experience from previous studies on adjacent territories shows that one monitoring station has to be placed in the protected area (for characterization of relevant geological complex) and another one on the territory affected by human activities.

Monitoring of the underground waters in Moldova is performed by the AgeoM, Institute of Geophysics and Sanitary Epidemiological Service (waters used for drinking supply). Hydrogeological monitoring should also serve to the evaluation of the linkage between surface and ground waters.

Monitoring of the protected areas

Description of the biodiversity and habitats showed that due to the human activities it is rather difficult to find strict protected areas. This could be areas selected for more strict protection regime in a certain periods of the year as period of birds' migration or nesting, etc. Research activities performed in this domain allows creation of the data base on the state of biodiversity and at the same time these studies showed gaps, which have to be completed as a result of the monitoring program.

Objectives for the monitoring activities in the protected area „Prutul de Jos" have to be developed for the conservation and where possible for the amelioration of the state of environment. At the same time water bodies in the protected area and adjacent territories serve as a habitat for many rare species, which are protected on a global level. That is why one of the objectives for monitoring of the protected area „Prutul de Jos" could be conservation of the state of environment (water, soils, sediments) on a good level from qualitative and quantitative points for supporting of the species, which depend on the water habitats in protected area and adjacent lands. Implementation of this objective includes monitoring on the state of biodiversity for estimation of the efficiency of the undertaken measures.

Table 1. Activities for monitoring of the protected area „Prutul de Jos"

Environmental component	Ingredient	Frequency	Place for sampling
Water	TDS	Trimestrial	Upper, middle and lower part of the Beleu lake.
	N tot	Monthly	
	N NO3	Monthly	
	NNH 4	Monthly	Prut (upstream and downstream of the protected area „Prutul de Jos)
	N N0 2	Monthly	
	P tot	Monthly	
	P min	Monthly	
	Oxygen dis	Monthly	Upper channel (entrance to the Beleu lake) and after Beleu lake near the confluence with the Prut river
	CBO	Monthly	
	CCO	Monthly	
	Oil products	Monthly	
	Cu	Trimestrial	
	Zn	Trimestrial	
	DDT	Trimestrial	
	HCH	Trimestrial	
	Fotosintez	Monthly	
	Hydrobiological parameters (zoo and fito plankton, zoobentos, water	Trimestrial	

	vegetation, algae, etc) Primary production Hydrological monitoring	 Trimestrial Water levels (daily), water volumes – trimestrial, in case of emergency – daily	
Atmospheric precipitations	TDS, pH, nitrogen and phosphorus, fixed residuals, heavy metals (in the strata of snow), quantity of precipitations	Lower part of the protected area (terrestrial)	Snow immediately after falling and after 10 - 20 of exposition. During winter period in relevant weather conditions Rains – trimestrial.
Sediments, liquid and solid phases	Humus pH N tot N NO3 NNH 4 N N0 2 P tot P min Oxygen dis CBO CCO Oil products Cu Zn DDT HCH Granulometric analysis Exchange ions	Once for 3 years 2 times per year. 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 1 time per year 1 time per year 1 time per year 1 time per year 1 time per 3 years 1 time per 2 years	Upper, middle and lower parts of the Beleu lake, wetland areas.
Soil	Humus pH N tot N NO3 NNH 4 N N0 2 P tot P min Cu Zn DDT HCH humidity	Once for 3 years 2 times per year. 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 2 times per year 1 time per year 1 time per year	Functional zones of protected area (forested, covered by grass vegetation, agricultural lands, pasture, turism, etc.)

	Granulomentric analysis Exchangeable ions	1 time per year 1 time per year 1 time per 3 years 1 time per 2 years	
Biodiversity	Flora: Taxonomy, vegetation associations, selection of the reference species, abundance of populations, biomass, capacity for reproduction (seeds, etc) Fauna: Taxonomy composition, faunistic complexes, identification of the reference species for observations on fauna, number of nests, capacity for reproduction, abundance of populations, state of rare and reference species. Edafic flora and fauna Rare and included in the Red Book species	Trimestrial	Functional zones of the protected area (forests, meadows, water ecosystems, wetlands, agricultural lands, used for pasture, tourism, etc.)
Hazards	Droughts, floods, low and high temperatures, torrential rains, ice regime, etc.	Yearly	Protected and adjacent areas, analysis of historical and statistical data, evaluation of economic activities and theirs' prejudice for the state of protected and adjacent areas (nature and economic aspects)
Hydromorfological alterations	Development of the barrage network, exploiting of the river bed material from the Prut river and adjacent areas, etc.	Annually	Protected and adjacent areas, places, where exploitation activities are having place (to be identified before monitoring activities) r. Prut, Beleu lake, etc.

Monitoring activities in the protected area „Prutul de Jos"

Performing of the monitoring activities has a goal to produce data on the state of ecosystems in the protected area „Prutul de Jos" through physico-chemical analysis, hydrobiological, hydrological and biodiversity studies. Ingredients and frequency for monitoring have to be determined on the base of analysis of social and economical activities in the Lower Prut region. On the base of the evaluation studies performed in the region one could propose activities presented in the table 1.

Performing of analysis, monitoring stations for sampling will be revised and complemented according to the development of the protected area, land use on adjacent territories and social and economic activities in the Lower Prut and Danube Delta region. It is important to harmonize monitoring activities and plans for social and economic development with Romanian authorities from the Lower Prut region.

Monitoring of the vegetation includes analysis of water flora **(**Ass. Ceratophylletum demersi; Lemnetum minoris; Spirodela-Salvinetum natans; Potametum lucentis; Nymphaetum albae; Trapetum natantis; Scipro-Phragmitetum and Typhetum angustifoliae)*,* *a* **grass vegetation** (Ass. Eleoharidetum palustris; Bolboschoetum maritimi)*,* **wetlands (**Ass. Caricetum ripariae*; Agrostideta stoloniferae*)*,* a **forest vegetation** (Ass. Salicetum rubosum; Salicetum phragmitetum) *a* rare species of flora (*Nymphaea alba, Trapa natans, Salvinia natans, Vitis sylvestris, Fraxinus palise, Sagitaria sagitifolia.*

Monitoring on the diversity of fauna includes evidence of rare invertebrate terrestrial and water species, fish diversity of the Beleu lake in the period of reproduction, rare amphibians and reptilian species (*Coluber jugularis*; *Emys orbicularis*), appearance of the invasive species and vagabond dogs, evolution of the specific diversity of water birds from family. Anatidae, and order Ciconiformes.

CONCLUSIONS

The problem of the conservation of the biodiversity and sustainable development in the Lower Prut region is a bilateral issue of Moldova and Romania of the regional and continental importance as a part of the Danube Delta region. The success of the biodiversity conservation depends on the complex integrity of different types of ecosystem, which create good conditions for reproduction and nutrition of different species of flora and fauna. RAMSAR wetland area from the left side of the Prut river on the territory of Moldova on the distance between Manta and Beleu lakes include area of around 8500 ha of water, meadow, forest and wetland ecosystems.

Lower Prut region offer favorable conditions for many taxonomic groups of vertebrate and invertebrate species, especially for ornitofaună as a place for nutrition, nesting and resting during migration. This sector has international importance for the vulnerable migratory species of birds included in the Red book as a rare species for Europe.

Diversity of the communities of birds in the RAMSAR wetland area is presented by 189 species. The most numerous order (60 species) are presented by Passeriformes, Anseriformes (20 species) and waders (22 species). According to the arrivals and density of species majority of them come for nesting (50%) and migratory (31,0%), species, which permanently live in the area consist 10%, coming for winter period – 6,0% and occasional species – 3% from total number. The arboreta complex is populated with 63 species of birds from which 37 are Passeriformes, 10 species with a day life activity, 12 species Ciconiformes, etc. There are 21 migratory and reproduction species, included in the Red Book of Moldova. Some of them are protected on the European and global level.

There were 34 mammal species registrated in the RAMSAR wetland area. The most spread ones are orders Rodentia with 14 species, order Carnivora is presented by 8 species, adapted to the diverse condition of life: amphibiotic (*Lutra lutra, Mustela lutreola, Ondatra zibethicus*), wetlands (*Mustela erminea*), forested areas (*Felis silvestris, Meles meles*), agrocenoze (*Vulpes vulpes, Mustela nivales*). From this list 5 species are included in the red Book of Moldova.

Reptilia group has 7 species. Two, *Emys orbicularis* and *Coluber jugularis* are included in the Red Book of Moldova. The most frequent species is *Nartix natrix*.

Amphibians are presented by 11 species. The most frequent ones are *Rana ridibunda, Rana lessonae, Bufo viridis*. Species *Pelobates fuscus* is included in the Red Book of Moldova.

The role of wetland areas in the conservation of the diversity of animals could be also determined by percentage of populations of birds, which live in the protected area „Prutul de Jos" .

The diversity relatively high of vertebrate animal communities as well as terrestrial and water invertebrate, vulnerable and threatened to be extinct species from Lower Prut region are determined by ecological capacity of environment from both banks of the river. In some cases bird species nest in the left side of the river and aliment on its the right side and vice versa. Short distance from the Danube Delta also causes a significant presence of the vulnerable and threatened to be extinct species of animals.

Presented information demonstrates importance of the wetland areas in the conservation of the animals' diversity and significance of the wetlands from the right side of the Prut in sustainable development of riverine communities and could serve as a driving force for the interstate cooperation and creation of the transboundary biosphere reservation in the region.

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NEW SCIS PROPOSAL REGARDING THE ICHTIOFAUNA AFTER THE ALPINE BIOGEOGRAPHIC SEMINAR FOR ROMANIA, SIBIU (TRANSYLVANIA, ROMANIA) 9-12 JUNE 2008

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KEYWORDS: Romania, Alpine region, Natura 2000, SCIs proposals, *Eudontomyzon mariae, Eudontomyzon vladykovi, Eudontomyzon danfordi, Barbus meridionalis, Gobio uranoscopus* and *Cottus gobio*.

ABSTRACT

The main objectives of the European Community in the environment issue are the protection, conservation and also the improovement of the environment quality, in the conditions of the rational use of the resources and services of the ecosystems. In the last decades the biodiversity conservation was one of the main objectives in this rspect.

This paper main goal is to offer some data and arguments in the favour of the proposal of some new Natura 2000 sites for different fish species. At the Alpine Biogeographic Seminar for the Romanian national teritory (helded at the „*Lucian Blaga*" University of Sibiu, Sibiu, 9-12 June 2008), it was decided the fact that the areals of some fish species are insuficiently covered with Natura 2000 sites, so new proposals were asked by the European Union representatives.

As a consequence this scientific paper deal with some new such Natura 2000 sites proposals, to be accepted at a potential second Alpine Biogeographic Seminar for the Romanian national territory.

These proposals of Community interest sites presented in this paper are based on the original data of the author and specific criteria (well preserved fish populations; stable fish populations; healthy fish populations; typical natural habitats; relatively low human impact; favorable geographical position), regarding the following protected fish species: *Eudontomyzon mariae, Eudontomyzon vladykovi, Eudontomyzon danfordi, Barbus meridionalis, Gobio uranoscopus* and *Cottus gobio.*

REZUMAT: Propuneri de noi SCI-uri referitoare la ihtiofaună după Seminarul Biogeografic al zonei Alpine pentru România, Sibiu (Transilvania, România) 9-12 iunie 2008.

Principalele obiective ale Comunității Europene în domeniul mediului sunt protecția, conservarea şi de asemenea îmbunătățirea calității mediului, în condițiile utilizării raționale a resurselor şi de asemenea a serviciilor ecoistemelor. În ultimele decenii, conservarea biodiversității a fost unul dintre principalele obiective în această privință.

Scopul acestei lucrări este acela de a oferi date şi argumente în favoarea propunerii unor noi situri Natura 2000 pentru diferite specii de pești. La Seminarul Biogeografic pentru regiunea Alpină, pentru teritoriul național al României (care s-a desfăşurat la Universitatea „*Lucian Blaga"* din Sibiu, în 9-12 iunie 2008) s-a decis faptul că arealele unor specii de peşti sunt insuficient acoperite de situri Natura 2000, astfel noi propuneri au fost cerute de reprezentanții Uniunii Europene.

Propunerile de Situri de interes comunitar prezentate în această lucrare se bazează pe date originale ale autorului şi criterii specifice (populații de peşti bine menținute, stabile şi sănătoase; habitate naturale tipice; impact antropic relativ scăzut; poziție geografică favorabilă), referitoare la următoarele specii protejate de peşti: *Eudontomyzon mariae, Eudontomyzon vladykovi, Eudontomyzon danfordi, Barbus meridionalis, Gobio uranoscopus* şi *Cottus gobio*.

RÉSUMÉ: Propositions pour des nouvelles SIC concernant l'ichtyofaune à la suite du Séminaire Biogéographique de la zone Alpine pour la Roumanie, Sibiu (Transylvanie, Roumanie) 9-12 juin 2008.

Les objectifs principaux de la Communauté Européenne dans le domaine de l'environnement sont la protection, la conservation mais aussi l'amélioration de la qualité de l'environnement, dans les conditions de l'utilisation raisonnée des ressources et des services des écosystèmes. Durant les dernières dizaines d'années, la conservation de la biodiversité a été un des principaux objectifs à ce regard.

Le scope de cet article est d'offrir des données et des argument a la faveur de la proposition des nouveaux sites Natura 2000 pour des différentes espèces de poissons. Au Séminaire Biogéographique pour la région Alpine, pour le territoire national de la Roumanie (qui a eu lieu à l'Université „*Lucian Blaga"* de Sibiu, le 9-12 juin 2008) a été convenu le fait que les habitats de certaines espèces de poissons sont insuffisamment couverts par des sites Natura 2000, donc des nouvelles propositions ont été demandées par les représentants de l'Union Européenne.

Les propositions pour des Sites d'Intérêt Communautaire présentées dans cet article se base sur des données originales de l'auteur et sur des critères scientifiques (des populations de poissons bien maintenues, stables et en bonne santé; des habitats naturels typiques; un impacte anthropique relativement faible; une position géographique favorable), concernant les espèces de poissons protégées ci-dessous: *Eudontomyzon mariae, Eudontomyzon vladykovi, Eudontomyzon danfordi, Barbus meridionalis, Gobio uranoscopus* et *Cottus gobio*.

INTRODUCTION

The main objectives of the European Community in the environmental field of interest are the conservation, the protection and also the improvement of the environment quality, in the condition of the rationale use of the existing resources and services of the ecosystems. The biodiversity conservation constituted a main objective of the EU in the last quarter of century.

To elaborate its environmental policies the European Community structures takes in consideration the scientific and technical available information, the environmental conditions characteristic for different regions of the Community and the need for an equilibrated development of all its component regions, the result benefits and the involved costs.

The action frame at the European Community level, to preserve the biodiversity was established based on the Habitats Directive (92/43/EEC) and Birds Directive (79/409/EEC).

These both European Directives have as objective to protect and sustain the biodiversity in the European Union through the creation of a protected areas network (Natura 2000 net), in which to conserve habitats and species characteristic for the European biogeographic regions.

In this moment Romania contributes to the European natural heritage with an around of: 47% of the national territory covered by natural and semi natural ecosystems; 780 types of habitats; 3700 superior plant species; 33085 invertebrate species and 717 vertebrate species. (Bănăduc, 2001)

Romania is the country with the highest biogeographic diversity of all the European Union countries and the country which joined the European Union in 2007, with a total of five biogeographic regions: continental, alpine, pannonic, pontic and stepic.

There are few ways through which the Natura 2000 net initiative in our country can improve its nature protection: extension of the natural areas surface; the creation and implementation of correct management plans for these protected areas; institutional capacity building; raising awareness.

One important element of the implementation of these two Directives is the establishment of an optimum Natura 2000 sites network on the Romanian territory too.

In spite of the fact that the Biogeographic Seminars for the Romanian national teritory were done (helded at the *Lucian Blaga* University of Sibiu, in 9-12 June 2008), it was decided at the end of this very important event, the fact that the areals of some fish species are insuficiently covered with Natura 2000 sites, so new proposals were asked by the European Union representatives.

As a consequence this scientific paper deal with some new such Natura 2000 sites proposals, to be accepted at a potential second Alpine Biogeographic Seminar for the Romanian national territory.

These proposals of Community interest sites presented in this paper are based on the original data of the author and specific criteria (well preserved fish populations; stable fish populations; healthy fish populations; typical natural habitats; relatively low human impact; favorable geographical position), regarding the following protected fish species: *Eudontomyzon mariae, Eudontomyzon vladykovi, Eudontomyzon danfordi, Barbus meridionalis, Gobio uranoscopus* and *Cottus gobio.* In the context of the obvious strong lobby of the economic activities sector in Romania which will oppose to more/many such proposals acceptance at the Alpine Biogeographic Seminar for the Romanian national territory, it is important an equilibrated assessment of these species status and future prospects!

MATERIALS AND METHODS

According to the European Natura 2000 initiative the following site selection criteria were used in this specific study: well preserved fish (of Community interest - oCi) populations; stable fish (oCi) populations; healthy fish (oCi) populations; typical natural habitats (oCi); lowest (as possible) human impact presence; favorable geographical position (possibility of species spreading in more than one hydrographic watersheds); best option for species/habitat (oCi) in relation with the needed future Natura 2000 areas management.

This paper is based on the original scientific data, no older than seven years. It has to be stated that no complete data are available to definitely and comprehensively statute and border the local stable fish populations. Further multiannual fish populational field studies are needed for the needed specific quantitative aspects fulfilment.

This paper focused on the following fish species: *Eudontomyzon mariae, Eudontomyzon vladykovi, Eudontomyzon danfordi, Barbus meridionalis, Gobio uranoscopus* and *Cottus gobio* species, Annex II fish species.

All the sampled individuals were sampled with net tools or through electrofishing, after their identification they were immediately released in their native habitats for obvious conservative reasons.

RESULTS AND DISCUSSIONS

Eudontomyzon mariae (Berg, 1931) - Natura 2000 code 2484 (Cicar, Ukrainian brook lamprey, Ukrainische lamprete, Lamproie d'Ucraine).

A general fact sheet is presented due to the fact that some Natura 2000 administrations members are not able for the moment to identify this species and the associated assessment, monitoring and management actions are impossible in this circumstance. This species body is cylindrical in its anterior part. The body height represents around 5.3 - 7.0% of its total length. The two dorsal fins have a significant space between them and are not tall. In the month of June-July, immediately before this species reproduction period the two dorsal fins start to grow and finnaly touch one to another. The adult's individuals are colloured dark brown on their back with

light brown sides and the ventral face is silver. Aso there are some individuals which are almost black. This species is living in mountainous rivers. The larvae of this species are living long periods of time in mud substratum. The larvae metamorphosis happened in the autumn season. (Bănărescu, 1969; Oţel, 2007). In the Romanian national territory this species has a relatively low spreading area and can be considered as a species with a high vulnerability. This species is protected by: Bern Convention, European Habiats Directive 92/43, IUCN Red List and OUG 57/2007.

Eudontomyzon mariae can be considered a criticaly endangered species, of which conservation is of high importance in the present.

Regarding the *Eudontomyzon mariae* species, at the Alpine Biogeographic Seminar for Romania from Sibiu, 9-12 June 2008, there were underlined some final conclusions about the proposed sites as being insufficient moderate. One or few additional sites were required for this species on the Romanian national territory. Some new sites in this respect are proposed below.

Proposed sites. The relatively short lotic sectors with proper ecologic conditions for this noncomercial species, and the posibility to be wrongly identified make it a species characterised in general by old and sometimes triky information, reason for which new samppling campagnes were necessary. As a result of such field campaigns in the last years, in this paper some Natura 2000 sites or part of sites/sectors can be proposed: Gilort River (Jiu River Watershed) the main course, adjacent wetlands, tributaries, minimum 500 m to 1 km from the confluence, between 300 m and 850 m altitude (between Baia de Fier and Mirosloveni localities); Cisnădiei-Valea Argintului River (Cibin River watershed) the main course between 550 m altitude and to around 750 m altitude; Lotrioara River (Olt River watershed) the main course between 450 m and 900 m altitude; Doamnei River (Argeş River basin) the main course between the altitudes of 470 m (Domneşti locality) and 700 m (the confluence of upstream the Nucşoara locality); Buzău River, the main course between the 550 m altitudine (upstream Băile Siriului) and 700 m altitudine (upstream Zabratău); Moldova River, the main course and the tributaries around 650 m altitude (upstream Câmpulung Moldovenesc) and 850 m altitude (Breaza); Suceava River, the main course and in the tributaries between 500 m (Straja) and 700 m altitude (Romanian - Ukrainean border).

Adding the above proposed lotic sectors in the European Natura 2000 network can be asured the best posible (based on actual known data) coverage and conectivity for this important for conservative reasons fish species. One important missing steping stone/s should be possible to be find by future ichtiological studies in the middle part of the Eastern Romanian Carpathians. (Bănăduc, 2008)

Eudontomyzon vladykovi (Oliva and Zanandrea, 1959) - Natura 2000 code 2485 (Cicar, River lamprey, Lamproie de riviere, Donau-Bachneunauge).

A general fact sheet is presented due to the fact that some of the Natura 2000 administrations members are not in the position to identify this species and the associated ecological assessments, monitoring and management activities are not possible in this situation. General fact sheet. The maximum body height of this species represent 6.5 - 7.5% of its total lenght. The two dorsal fins are rather tall and one near the other. The body is slightly narrowed in its anterior side. The adults of this species are coloured in dark grey with a whitish ventral part. The adults reach around 156 - 201 mm. (Bănărescu, 1969) This species living in the mountainous zone, in a very restricted area in Romania. The metamorphosis is happen in the autumn season. The adults are not feeding. The reproduction period is June - July, period after which the adults die. (Bănărescu, 1969)

In Romania this species can be considered as a species with a very high degree of vulnerability. The species is protected by: Low 13/1993, Bern Convention, European Directive 92/43, and Low 462/2001.

Concerning the *Eudontomyzon vladykovi* species, at the Alpine Biogeographic Seminar from Sibiu, Transylvania, Romania, 9-12 June 2008, there were raised some conclusions about its proposed sites as scientific reserve. The presence of this species on the Romanian national territory should be clarify for all the ichtiologists present there. One very important new site in this respect is proposed below.

Proposed site. The short lotic sectors and extremely few areas with optimum ecologic conditions for this noncomercial but very valuable from conservative point of view species, and the posibility to be wrongly identified make it a species characterised in general by old and sometimes triky information (in fact, till now, a lot of the specialists belive that this species exist no more in the Romanian national territory) reasons for which new samppling campagnes were highly necessary. As a result of such field campaigns in the last years, in this paper a Natura 2000 site or part of sites/sector can be proposed: Upper Timiş River in the Timişului Gorge. (Schneider et al., 2011)

Eudontomyzon vladykovi is the most critically endangered species of the Cyclostomata Class on the Romanian national territory, of which conservation is extremely urgent and serious in the present.

Important missing stepping stones for an optimum connectivity should exist to the southern Romanian and Serbian areas of interest.

More research in this specific area should be done in this respect in the near future! (Bănăduc, 2008; Schneider et al., 2011).

Eudontomyzon danfordi (Regan, 1911) - Natura 2000 code 4123. (Cicar, Danube lamprey, Donau-Lamprete, Lamproie du Danube)

A general fact sheet is presented due to the fact that some Natura 2000 sites administrations members are not able to make a difference among Ciclostomata species, and the actions for their assessment, monitoring and management are impossible in this context. General fact sheet. The body is relatively compressed laterally in its anterior region. The body height represents around 5.0 - 7.7% of the total body length. The two dorsal fins have a space between them, space which represent 2.3 - 6.8% of the body length. The first dorsal fin is not tall and rounded, the second one is taller. The adults are dark grey colloured and their ventral side is yellow-white. This species is living in mountainous rivers. The larvae of this species eat invertebrates and the adult fish. (Bănărescu, 1969) In Romania has a relatively large spreading area. There were registered reductions in its area of spreading due to the human impact negative effects. The presence of this fish in rivers/rivers sectors is unequal due to its relation with slow moving muddy areas in which the larvae ussualy stay. In Romania it can be considered as a species with a medium vulnerability. The species is protected by: Low 13/1993, Bern Convention, European Directive 92/43, and OUG 57/2007.

About the *Eudontomyzon danfordi*, at the Alpine Biogeographic Seminar from Sibiu 9-12 June 2008, there were underlined conclusions about its proposed sites as insufficient moderate. One or few additional sites were required for this species on the Romanian national territory. Some new sites in this respect are proposed below.

Eudontomyzon danfordy can be considered an endangered species, of which conservation is important in the present.

Proposed sites. The relatively short lotic sectors with good ecologic conditions for this noncomercial species, and the posibility to be wrongly identified make it a species characterised in general by old and triky information, reasons for which new samppling campagnes were necessary. As a

result of such field campaigns in the last years, in this paperwork some Natura 2000 sites or part of sites/sectors are proposed for this fish species: Vişeu River (Tisa River basin) the main course between the altitude of 900 m (upstream Borşa locality) and 650 m altitude (Baia Borşa area); Târnava Mare River, the main course, at least between the altitudes of 500 and 750 m; Orăştiei River, the main course and some tributaries (the Mureş River basin) at least between 400 m altitudine (upstream Costeşti) and 550 m altitudine (the confluence through Grădiştea de Munte); the main course of Timiş River between (including) its springs which form the Trei Ape Lake and Armeniş locality sector.

Including the above mentioned lotic sectors in the Natura 2000 network can be asured its improvement.

More research can also improve this proposals.

Barbus meridionalis Riso, 1827 - Natura 2000 code 1138 (moioagă, moiță, jamlă, mreană pătată, mreană vânătă, mreană de munte, mreană de vale; Forellenbarbe, Semling, Afterbarbe; Barbeau truite, Truitat, Turquan, Mediterranean barbell).

A general fact sheet is presented due to the fact that this species can be misidentified with other *Barbus* genus species by the European Natura 2000 sites administrations members and the needed biological assessment, monitoring and management activities are not possible in this circumstance. General fact sheet. Elongated body. The superior profile of this species body is an obvious ascendant curveline from the snout to the dorsal fin but without to reach the dorsal fin. The last simple radia of the dorsal fin is thin, flexible and also not jagged. The ventral fins are inserted in a position backward to the dorsal fin insertion. The dorsal fin edge is plain or slightly fluted. The lips are more fleshy and developed in comparison with the species *Barbus barbus*. The posterior whiskers are sometimes long, exceeding the eye. The back of its body is colloured dark brown-rusty, with darker and lighter spots, the flanks of the body are yellow-rusty with obvious spots, the ventral side is light yellow. The dorsal and caudal fins are with accentuated spots, the rest of the fins are rather yellowish. The whiskers are yellowish with no red axis. It can reach a maximum length of around 28-30 cm. (Bănărescu, 1969; Bănărescu and Bănăduc, 2007) Relatively well spreaded on the Romanian national territory (Bănăduc 2006, 2007a, 2007b), this species can be considered in the last decades as being a species with an extending areal here. It is threatened mainly by pollution, habitat destructions and water abstraction. This species is protected under: the IUCN Red List and Habitats Directive.

Regarding the *Barbus meridionalis* species, at the Alpine Biogeographic Seminar for Romania, from Sibiu 9-12 June 2008, there were underlined specific conclusions about its proposed sites as insufficient minor status. More sites were required for this species on the Romanian national territory. Some new sites in this respect are proposed below.

Proposed sites. Crişul Alb River (between Gurahonț and Ineu); Mara River (from Mara locality to the confluence with the Iza River); Timiş River (downstream the confluence with Teregova till the proximity of the Peştere and Constantin Daicoviciu/Căvăran villages); Sebeş River (Caraş-Severin County, from the middle of the distance between Turnu Ruieni and Borlova to the Carbonifera neighbourhood of the Caransebeş city; Nera River (downstream Sasca Montană to the national border between Romania and Serbia); Vâlsan River (its middle sector to its confluence with Argeş River); Putna River between 7 km downstream Garoafa and to Vânători; Gilort River (Jiu River basin) at least between the localities Baia de Fier and Mirosloveni; Motru River from Cernaia to Glogova. (Bănăduc 2006, 2007a, 2007b)

More scientific researches can also improve this proposals.

Gobio uranoscopus (Agassiz, 1828) - Natura 2000 code 1122 (porcuşor de vad, chetrar; Smalleye gudgeon, Goujon uranoscope, Steingressling, Steinkresse; Danube Gudgeon)

A general fact sheet is presented due to the fact that some Natura 2000 administrations members are not able for the moment to identify this species and the associated assessment, integrated monitoring and management actions are impossible to be done by them. General fact sheet. The body and caudal peduncule are rather thick and cylindrical. At the lips joining points it is a posteriour extension which seem like a second pair of wiskers. The annus orifice is more close to the anal fin than the ventral fins. The chest is completely covered with scales. In Romania is living the subspecies *Gobio uranoscopus friči* Vladykov 1925. The dorsal profile is slightly convex and the ventral profile is horizontal. The snout is rather sharp. The eyes look much upward. The ventral fins are inserted under the dorsal fin insertion or a litle backward. The caudal fin is deeply holed, the lobes are rounded and equal or almost equal (the inferior lobe is a litle longer). The edge of the dorsal fin is slightly holed. The dorsal side is greyish-greenish or brown-redish colloured. The back side scales have black edges. Behind the dorsal fin are 2 or 3 big dark spots. On the flanks of the body are 7 to 10 big rounded spots. The ventral side of the body is white-yellowish. At the caudal fin base are two white spots. On the lateral line scales are two small blak spots. On the dorsal and caudal fins are two rows of blak spots. It can reach around 13 cm length. (Bănărescu, 1969; Bănăduc 2003, Bănărescu and Bănăduc, 2007) This fish species is relatively rare on the Romanian national territory, and can be considered in the last decade as being a species with an decreasing areal here. It is threatened in special by pollution, habitat destructions and water abstraction. The species is protected under: the Bern Convention and Habitats Directive.

Regarding the *Gobio uranoscopus* species, at the Alpine Biogeographic Seminar meeting from Sibiu 9-12 June 2008, there were underlined some final conclusions about its proposed sites as insufficient minor status. More sites were required for this species on the Romanian national territory. Some new sites in this respect are proposed below. Crişul Alb River from upstream the Gurahonţ locality to the Ineu city; Şieu River (Someşul Mare River basin) upstream the confluence with Someşul Mare River; Mureş River from Târgu Mureş locality to Deda locality; Doamnei River (Argeş River basin) the main course between the altitudes of 470 m (Domneşti locality) to 700 m (the confluence of upstream the Nucşoara locality); Someşul Mare River from Dej locality to upstream of Năsud locality. (Bănăduc, 2007)

Including the above mentioned lotic sectors in the Natura 2000 network can be asured this fish species status improvement.

More research can also improve these proposals.

Cottus gobio Linnaeus, 1758 - Natura 2000 code 1163 (Zglăvoacă, Bullhead, Sculpin, Groppe).

A general fact sheet is presented due to the fact that some Natura 2000 administrations members are not able for the moment to identify this species and the associated assessment, monitoring and specific management actions are not possible in this circumstance. General fact sheet. Elongated and thick body. The profile of the body it is slightly convex between the tip of the snout and the eyes, backward is almost horizontal, the head is just a litle lower than the body. The head is dorso-ventral accentuated flattened and thicker than the body. The eyes are situated in the anteriour part of the head, are semi-spheric and looking upward. The superior part of the eye is often covered by a pigmented eyelid easy to be confused with the sorounding skin. Two pairs of small, distanced and simple nostrils; the anteriour pair is situated much in the front of the eyes position. The

inter-orbitary space is slightly holed. The snout is rounded. The mouth is big and terminal, its ends reach an under eye position or near this specific area. The teeth are small. The caudal peduncule is lateraly compressed. The dorsal fins are close, the first is low with a convex edge, the second with a plain edge. The anal fin is inserted a little after the second dorsal fin insertion. The pectoral fins are big and broad, and their tips usualy reach or overdraw the annus orifice. The caudal fin have a convex edge, sometimes is almost plain. The lateral line is complete, on the midle of the caudal peduncule, reach the caudal fin base. The dorsal part of the body is brown with some marbled-like spots. The ventral part of the body is light-yelowish or white. In the posteriour part of the body are 3 to 4 dark transversal lines. The dorsal, caudal and also the pectoral fins have brown spots distributed in longitudinal lines. The annal and ventral fins are not spoted. It can reach around 13 cm length. (Bănărescu, 1969; Bănărescu and Bănăduc, 2007) Relatively well spreaded on the Romanian territory, can be considered in the last decade as being a species with a slightly decreasing areal here, mainly due to the hydrotechnical constructions and habitat destructions. The species is protected under: Bern Convention and Habitats Directive.

Regarding the *Cottus gobio* species, at the Alpine Biogeographic Seminar for Romania, Sibiu 9-12 June 2008, there were underlined conclusions about its proposed sites as insufficient minor status. More sites were required for this species on the Romanian national territory. Some new sites in this respect are proposed below.

Proposed sites. The upper Timiş River course and its tributaries till the Teregova - Armeniş sector; Mureş River and its tributaries from upstream the Toplița locality till Ditrău area; Moldova River from Breaza locality to the confluence with Putna River; Teleajen and Telejenel rivers upstream the dam from the upper Teleajen River.

Including the above mentioned lotic sectors in the Natura 2000 network can be asured the improving of the ecological status for this protected fish species.

More research can also improve these proposals.

ACKNOWLEDGEMENTS

The author thank for the support to the European Social Fund through Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/89/1.5/S/63258 ”Postdoctoral school for zootechnical biodiversity and food biotehnology based on the eco-economy and the bio-economy required by eco-san-genesys”, and also to Ecotur Sibiu NGO and WWF Danube-Carpathians.

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TRICHOPTERELE DIN ROMÂNIA VOLUMUL I CLASA INSECTA, ORDINUL TRICHOPTERA, SUBORDINELE SPICIPALPIA ŞI ANNULIPALPIA – BIOINDICATORI AI APELOR DULCI (IN ROMANIAN)/ THE TRICHOPTERANS OF ROMANIA, SUBORDERS SPICIPALPIA AND ANNULIPALPIA – BIOINDICATORS FOR FRESH WATERS

- REVIEW -

Angela CURTEAN-BĂNĂDUC [1]

Constantin Ciubuc, published in Romanian, under the care of MiniEd Publishing House, Iaşi, First Edition 2010, 299 pp. ISBN: 978-973-9369-27-5, The trichopterans of Romania, suborders Spicipalpia and Annulipalpia – Bioindicators for fresh waters.

The author have published an excelent life time exqisite work which start with an introductary part composed of: introduction, general part (external morphology of the imago life stage), larvae, pupae, trichopterans biology and research methods.

The main part of this work is based on an exhaustive systemathic material.

First an identification taxonomical key for the Trichoptera Order famylies is presented.

After that for every species are offered data regarding: dimensions, description in detail, colours, genitalia, elements of biology and ecology, general geographical distribution and specific geographical distribution in the Romanian national territory. All this material is presented together with excelent colour binocular images and maps.

From the systemathical point of view the following groups belonging to the suborder Spicipalpia Ross, 1956 were presented:

I. superfamily Rhyacophiloidea Stephens 1836, family Rhyacophilidae Stephens 1836; subfamily Rhyacophilinae Stephens 1836; genus *Rhyacophila* Pictet, 1834 (with taxonomical key for the genus *Rhyacophila*); group *vulgaris*, species: *Rhyacophila nubila* (Zetterstedt, 1840), *Rhyacophila fasciata* Hagen, 1859, *Rhyacophila obliterata* McLachlan, 1863, *Rhyacophila polonica* McLachlan, 1879, *Rhyacophila mocsaryi* Klapálek, 1898, *Rhyacophila torrentium* Pictet, 1834, *Rhyacophila armeniaca* Guerin – Ménéville, 1843, *Rhyacophila flava* Klapálek, 1898, *Rhyacophila fagarashiensis* Botoşăneanu, 1964; group *tristis*: *Rhyacophila tristis* Pictet, 1834; *Rhyacophila aquitanica* McLachlan, 1879, *Rhyacophila carpathica* Botoşăneanu, 1995, *Rhyacophila orghidani* Botoşăneanu, 1952, *Rhyacophila obtusa* Klapálek, 1894, *Rhyacophila cibiniensis* Botoşăneanu and Marinkoviç, 1967; group *glareosa: Rhyacophila glareosa* McLachlan, 1867, *Rhyacophila fischeri* Botoşăneanu, 1957, *group sibirica: Rhyacophila laevis* Pictet, 1834; group *philopotamoides: Rhyacophila philopotamoides* McLachlan, 1879, *Rhyacophila doehleri* Botoşăneanu, 1957, *Rhyacophila motasi* Botoşăneanu, 1957, *Rhyacophila confinium* Botoşăneanu, 1957, *Rhyacophila kimminsiana* Botoşăneanu, 1958, group *stigmatica: Rhyacophila furcifera* Klapálek, 1909.

II. superfamily Glossosomatoidea Wallengren, 1891, family Glossosomatoidae Wallengren, 1891; subfamily Glossosomatinae Wallengren, 1891 (with taxonomical key for the genera of the subfamily Glossosomatinae); genus *Glossosoma* Curtis, 1834 (with taxonomical key for the species of the genus *Glossosoma*), *Glossosoma boltoni* Curtis, 1834, *Glossosoma conformis* Neboiss, 1963, *Glossosoma discophorum* Klapálek, 1902, *Glossosoma intermedium* (Klapálek, 1892); genus *Synagapetus* McLachlan, 1869 (with

taxonomical key for the species of the genus *Synagapetus*), *Synagapetus moselyi* (Ulmer, 1938), *Synagapetus armatus* McLachlan, 1879, *Synagapetus iridipennis* McLachlan, 1879, *Synagapetus slavorum* (Botoşăneanu, 1960); genus *Agapetus* Curtis, 1834 (with taxonomical key for the species of the genus *Agapetus*), *Agapetus fuscipes* Curtis, 1834, *Agapetus ochripes* Curtis, 1834, *Agapetus belareca* Botoşăneanu, 1957, *Agapetus delicatulus* McLachlan, 1884, *Agapetus laniger* (Pictet, 1834), *Agapetus rectigonopoda* Botoşăneanu, 1957.

III. superfamily Hydroptiloidea Stephens, 1836, family Hydroptilidae Stephens, 1836 (with taxonomical key for the subfamilies of the family Hydroptilidae), subfamily Hydroptilinae Stephens, 1834 (with taxonomical key for the genera of the subfamily Hydroptilinae); tribe Stactobiini Botoşăneanu, 1956; genus *Stactobia*, McLachan, 1880 (with taxonomical key for the species of the genus *Stactobia*), *Stactobia caspersi* Ulmer, 1950, *Stactobia maclachlani* Kimmins, 1949; genus *Stactobiella* Martynov, 1924, *Stactobiella risi* (Felber, 1908); tribe Hydroptilini Stephens, 1834; genus *Agraylea* Curtis, 1834, *Agraylea sexmaculata* Curtis, 1834, *Agraylea multipunctata* Curtis, 1834; genus *Allotrichia* McLachlan, 1880, *Allotrichia pallicornis* (Eaton, 1873); genus *Hydroptila* Dalman, 1819 (with taxonomical key for the species of the genus *Hydroptila*); group *sparsa*, *Hydroptila sparsa* Curtis, 1834; *Hydroptila lotensis* Mosely, 1930, *Hydroptila angustata* Mosely, 1939, *Hydroptila simulans* Mosely, 1920; group *oculta*; *Hydroptila occulta* (Eaton, 1873), *Hydroptila taurica* Martynov, 1934; group *tineoides*, *Hydroptila tineoides* Dalman, 1819; group *pulchricornis*, *Hydroptila pulchricornis* (Pictet, 1834), *Hydroptila aegyptia* Ulmer, 1963, group *forcipata*, *Hydroptila forcipata* (Eaton, 1873); group *vectis*, *Hydroptila vectis* Curtis, 1834; genus *Oxyethira* Eaton, 1873, *Oxyethira falcata* Morton, 1893, *Oxyethira flavicornis* (Pictet, 1834); tribe Orthotrichiini Nielsen, 1948; genus *Orthotrichia* Eaton, (with taxonomical key for the species of the genus *Orthotrichia*), group *angustella*, *Orthotrichia angustella* (McLachan, 1865); group *costalis*, *Orthotrichia costalis* Curtis 1834, *Orthotrichia tragetti* Mosely, 1830; genus *Ithitrichia* Eaton, 1873, *Ithitrichia lamellaris* Eaton, 1873.

From the systemathical point of view the following groups belonging to the suborder Annulipalpia Martynov, 1924 were presented:

I. superfamily Philopotamoidea Stephens, 1829; family Philopotamidae Stephens, 1829 (with taxonomical key for the genera of the family Philopotamidae); genus *Philopotamus* Stephens, 1829, *Philopotamus montanus* (Donovan, 1813), *Philopotamus variegatus* (Scopoli, 1763); genus *Wormaldia* McLachlan, 1865 (with taxonomical key for the species of the genus *Wormaldia*); group *occipitalis*, *Wormaldia occipitalis* (Pictet, 1834), *Wormaldia subnigra* McLachlan, 1865; group *pulla*, *Wormaldia pulla* (McLachlan, 1878).

II. superfamily Hydropsychoidea Ross, 1967; family Polycentropodidae Ulmer, 1903; (with taxonomical key for the genera of the family Polycentropodidae), genus *Neureclipsis* McLachlan, 1864, *Neureclipsis bimaculata* (Linnaeus, 1758), genus *Holocentropus* McLachlan, 1878 (with taxonomical key for the species of the genus *Holocentropus*), *Holocentropus stagnalis* (Albarda, 1874), *Holocentropus picicornis* (Stephens, 1836), *Holocentropus dubius* (Rambur, 1842), genus *Cyrnus* Stephens, 1836, (with taxonomical key for the species of the genus *Cyrnus*), genus *Cyrnus crenaticornis* (Kolenati, 1859), *Cyrnus trimaculatus* (Curtis, 1834), genus *Polycentropus* Curtis, 1835 (with taxonomical key for the species of the genus *Polycentropus*), *Polycentropus flavomaculatus* (Pictet, 1834), *Polycentropus irroratu* Curtis, 1835, *Polycentropus excitus* Klapálek, 1894, *Polycentropus schmidi* Nowak and Botoşăneanu 1965, *Polycentropus ierapetra* Malicky, 1962 ssp. *Slovenica* Malicky, 1998; genus *Plectrocnemia* Stephens, 1836, (with taxonomical key for the species of the genus *Plectrocnemia*), *Plectrocnemia*

conspersa (Curtis, 1834), *Plectrocnemia brevis* McLachlan, 1878, *Plectrocnemia minima* Klapálek, 1899, *Plectrocnemia kisbelai* Botoşăneanu, 1967; family *Ecnomidae* Ulmer, 1903, genus *Ecnomus* McLachlan, 1878, *Ecnomus tenellus* (Rambur, 1842), family *Psychomyiidae* Walker, 1852, (with taxonomical key for the species of the genus *Psychomyiidae*), genus *Lype* McLachlan, 1878, (with taxonomical key for the species of the genus *Lype*), *Lype phaeopa* (Stephens, 1836), *Lype reducta* (Hagen, 1868), genus *Psychomyia* Latreille, 1829, *Psychomyia pusilla* (Fabricius), genus *Tinoides* Curtis, 1834 (with taxonomical key for the species of the genus *Tinoides*), *Tinoides rostocki* McLachlan, 1878, *Tinoides kimminsi* Sykora, 1962, *Tinoides unicolor* (Pictet, 1834), *Tinoides polifurclatus* Botoşăneanu, 1956, *Tinoides raina* Botoşăneanu, 1960, *Tinoides pallidus* McLachlan, 1878, family *Hyropsychidae* Curtis, 1835, (with taxonomical key for the subfamilies of the family *Hyropsychidae*), subfamily *Diplectroninae* Ulmer, 1951, genus *Diplectrona* Westwood, 1840, *Diplectrona atra* McLachlan, 1878; subfamily *Hydropsychinae* Curtis, 1835, (with taxonomical key for the genus of the subfamily *Hydropsychinae*), genus *Cheumatopsyche* Wallengren, 1891, *Cheumatopsyche lepida* (Pictet, 1834), genus *Hydropsyche* Pictet, 1834 (with taxonomical key for the species of the genus *Hydropsyche*), group *instabilis-fulvipes* *Hydropsyche instabilis* (Curtis, 1834), *Hydropsyche fulvipes* (Curtis, 1834), *Hydropsyche peristerica* Botoşăneanu and Marinkoviç 1966, *Hydropsyche saxonica* McLachlan, 1884, *Hydropsyche sinuata* Botoşăneanu and Marinkoviç 1966, *Hydropsyche emarginata* Navas, 1923, group *pellucidula*, *Hydropsyche pallucidula* (Curtis), *Hydropsyche incognita* Pitch, 1993, *Hydropsyche botosaneanui* Marink, 1966, group *guttata*, *Hydropsyche contubernalis* McLachlan, 1865, *Hydropsyche contubernalis* McL., 1865 ssp. *Iranica* Mal. 1977, *Hydropsyche modesta* Navas, 1925, *Hydropsyche bulgaromanorum* Malicky, 1977, *Hydropsyche ornatula* McLachlan, 1878, *Hydropsyche bulbifera* McLachlan, 1878, the group of isolated species, *Hydropsyche angustipennis* (Curtis, 1834).

The publication is ended with a systematic index of the trichopterans species of the Romanian territory, an index of the localities where the author identified the biological material in his field treeps and in the analysed bibliography, the identified localities on the Romanian map (period 1952–1975 and partial 1986–2010).

Based on 84 bibiographical sources and on a very important lifetime field and laboratory experience, this publication is first of all a priceless working tool for the specialists in this field of expertise, regarding the adults of the suborders Spicipalpia and Annulipalpia of the Romanian territory.

Based on the quality of this special work other similar publications are to be expected regarding the adults of other suborders of trichpterans.

Also the larvae of this important bioindicator group can be an important task for the future of this important Romanian researcher, Mr. Constantin Ciubuc.

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TRANSYLVANIAN REVIEW OF SYSTEMATICAL AN ECOLOGICAL RESEARCH 8 (2009) - THE WETLANDS DIVERSITY

- REVIEW -

Teodora TRICHKOVA [1]

Angela Curtean-Bănăduc, Doru Bănăduc and Ioan Sîrbu, 2009. Transylvanian Review of Systematical and Ecological Research, 8 - The Wetlands Diversity, 214 pages, Ed. Universității "Lucian Blaga" din Sibiu, ISSN 1841-7051.

Wetlands are recognized worldwide as diverse and very productive natural ecosystems. They support rich biodiversity especially this of fish and waterfowl and they serve as habitat of many other animals and plants, including many endangered and threatened species. Further, they provide a wide range of ecosystem services that contribute to human well-being, and in some wetland types this may include services relating to climate change mitigation and adaptation. For instance, wetlands help in water purification and waste treatment, flood control and storm protection; they ensure a stable, long-term supply of groundwater, and they provide recreational opportunities. Considering the values of wetlands and the necessity of their conservation and wise use in the spirit of the Ramsar Convention on Wetlands (1971), the editors of the ***Transylvanian Review of Systematical and Ecological Research*** series dedicated Volume 6 to the ***Wetlands Diversity***. Some of the included contributions are result of the *Aquatic Biodiversity International Conference, Sibiu, Transylvania, Romania, 2009* and present data from diverse wetlands around the world. A broad definition of the term wetland, as used in the Ramsar Convention, is accepted, including: marine/ coastal wetlands (estuaries, lagoons, tidal flats, near-shore marine areas, coral reefs, rocky marine shores, etc.); inland wetlands (lakes, rivers, springs, swamps, marshes, wet grasslands, waterfalls, peatlands, etc.); and human-made wetlands (reservoirs, fish ponds, rice fields, salt pans, etc.).

This Volume is also dedicated to the memory of Acad. Dr. Petru Mihai Bănărescu (1921-2009), highly distinguished Romanian hydrobiologist, ichthyologist and naturalist. Bănărescu has embraced the field of zoology and developed a special interest in ichthyology. His studies focused on the systematic of fresh water fish, the fish zoogeography and the revision of systematic within the Cyprinidae, as well as the Cobitidae fish families and their zoogeography. For his valuable scientific contribution, Bănărescu becomes in 1976 foreign member of the American Society of Ichthyology and Herpetology and in 1988 - honorific member of the European Society of Ichthyology. In 1991, the scientist was admitted as correspondence member of Romanian Academy and in 2000 became titular member of the highest cultural and scientific forum in Romania. Due to his devoted work, Bănărescu was recognized national wide and worldwide as the greatest scientific authority concerning the Eurasian Cyprinidae and the taxonomy of Cobitidae - within this group he discovered new genres, subgenres, species and subspecies. In Bănărescu enclosed his work in more than 300 books and scientific papers, published in some of the most prestigious professional journals in the world, namely: Zoogeography of fresh waters; General introduction to fishes: Acipenseriformes; Principles and problems of zoogeography; General distribution and dispersal of fresh water animals; Cyprindae; The freshwater fishes of Europe; Distribution and dispersal of freshwater animals in North America and Eurasia; Zoogeography of Fresh Water Fishes: Africa-Madagascar and Satellite Islands, South America, Central America and Caribbean Intermediary Areas, Australian.; Pisces – Osteichthyes, etc.

The 15 papers in the Volume explore different aspects of the wetlands diversity, included in 5 thematic sections: *Biotopes*, *Biocenosis, Ecosystems, Human Impact* and *Protection and Conservation*.

The *Biotopes* section present a first review paper entitled"*Najas* spp. growth in relation to environmental factors in Wadi Allaqi (Nasser Lake, Egypt)" by Hoda Yacoub. The study aims to evaluate the pattern of *Najas* spp. (aquatic plant) distribution along the shores of Allaqi, Lake Nasser, to identify the effect of physico-chemical variables on the growth and on the expansion of the plants.

The second reviewed paper of this section present "Effects of temperature and salinity on the larvae of two subtidal *Nassariid* gastropods, *Nassaius siquijorensis* and *Nassaius crematus* (Gastropoda, Nassariidae)" by Qian Zhao, Paul Kam Shing Shin and Siu Gin Cheung. This study investigated how two major environmental factors, temperature and salinity, affected the survival, behaviour and physiology of the larvae of two dominant scavenging gastropods, *Nassarius siquijorensis* and *Nassarius crematus*.

The third reviewed paper of this section present "Determination of optimum range of salinity in hatching rate of *Artemia urmiana* (Günther, 1899)" by *Tahere Bagheri* and *Aliakbar Hedayati*. In this paper, in order to determine the optimum temperature and salinity conditions for hatching of *Artemia urmiana*, it was studied the effect of three levels of temperature (25, 30, 35°C) and three levels of salinity (25, 30, 35 ppm), together with three time intervals (24, 26, 28 hours) after hydration on the percentage hatching of cyst.

There are five contributions in the Volume dealing with *Wetlands Biocoenosis*. The first one "Distribution of dissolved nucleic acids in the soil of southern Jordan" by *Mohammed Wedyan* and *Khalil Altaif* provide information on the DNA and RNA dynamics in soil of southern Jordan in order to provide quantitative estimates of DNC distribution and accumulation.

The second paper of this section "Terrestrial snail communities in southern Transylvanian (Romania) alluvial forests" by *Voichiţa Gheoca* studied the snail communities in southern Transylvanian alluvual forests.

The third paper "Occurence of planktonic Rotifera in Thar Desert (Sindh, Pakistan)" by *Wazir Ali Baloch, Syed Iftekhar Hussain Jafri* and *Anila Naz Soomro* studied the distribution of rotifer species in relation to water quality in Thar desert of \sindh, Pakistan.

The fourth paper of this section "The Maramureş Mountains Nature Park (Romania) mayfly (Insecta, Ephemeroptera) communities diversity analyse" by Angela Curtean-Bănăduc, presents the structure and diversity analyse of Ephemeroptera larvae communities of the Vişeu River basin (Tisa, Danube basin).

The last paper of this section "Multidisciplinary evaluation of the function and importance of the small water reservoirs: the biodiversity aspect" by *Ladislav Pekárik, Tomáš Čejka, Zuzana Čiamporová-Zatovičová, Alžbeta Darolová, Daniela Illéšová, Marta Illyová, Zuzana Pastuchová, Emil Gatial* and *Fedor Čiampor*, aim the improvement of the knowledge on the biodiversity of aquatic ecosystems influenced by small water reservoirs and to bring innovative methods of the multidisciplinary ecological research.

There are three contributions in the Volume dealing with *Ecosystems*.

The contribution of Erika Schneider-Binder through the paper "Floodplain forests along the lower Danube" is related to the the results of the studies conducted in the floodplain forests along the Lower Danube, with emphasis on near-natural black poplar and white poplar forests, poplar-elm forests as well as the few remaining oak-elm floodplain forests that have been studied on various sections along the Romanian-Bulgarian Danube.

The second contribution of this section is "Spreading and Ecology of *Manayunkia caspica* Annenkova 1928 (Polychaeta) in Serbian Danube stretch" by

Vesna Martinovic-Vitanovic, Natasa Popovic, Snezana Ostojic, Maja Rakovic and *Vladimir Kalafatic*, study which found that *M. caspica* in the Serbian part of the Danube a Ponto-Caspian relic, an invasive species, shifted the limit of its distribution upstream in the Danube, which is the main corridor for its spreading from the east/south east (Bulgaria, Romania) to Central Europe.

Teodora Trichkova, Tihomir Stefanov, *Milen Vassilev* and *Mladen Zivkov* in "Fish species diversity in the rivers of the north-west Bulgaria" reveal the dynamic of the fish species of conservation concern in the North-West Bulgaria rivers.

The next section *Human impact* include two appers.

The first paper of this section is "Assessment of water microbiologic pollution in Durres's Harbour basin (Albania)" by Laura Gjyli and Lindita Mukli, present results regarding the different water quality situation in Durres harbor, based on microbiologic assessment.

The last contribution in this section is "Environmental effect and threat of ballast water;" by Aliakbar Hedayati and Tahere Bagheri, where the authors discuss the ballast water as being one of the four greatest threats to the world's oceans.

Two papers are concerned with the *Protection and Conservation* of the wetlands diversity. The first one is a paper of *Anca Voicu, Mugur Ştefănescu, Mihaela Marilena Lăzărescu, Doina Cîrstea* and *Cătălina Pantelimon* entitled "Microorganisms with biotechnological potential present in oil residues pulluted aquifer and groundwater", presenting *Aeromonas*, *Brevundimonas*, *Micrococcus*, *Pseudomonas*, *Vibrio* genera, as microorganisms, which could be of potential interest for rehabilitation of environments polluted with oil residues by means of ecological bioremediation techniques.

The last contribution of this section and of this Volume is "Aquatic health assessment: a methodological proposal for Mexican aquatic ecosystems" by *Jacinto Elías Sedeño-Diaz* and *Eugenia López-López*, where the authors analyzed and discuss aquatic ecosystem health and environmental stress concepts, upon the advances that in freshwater topics have been carried out in the National School of Biological Sciences (NSBS) Mexico. An integrated protocol to freshwater ecosystem health assessment with water quality index, trophic state index, biomarkers battery and bioindicators, has been presented, forming part of the new generation of quantitative assessment of freshwater ecosystem health.

The high variety of themes and issues discussed in the Volume shows the necessity of such scientific forum devoted to Wetlands Diversity. Hopefully the ***Transylvanian Review of Systematical and Ecological Research*** editors will continue this tradition.

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