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# **THE GEMOLOGICAL RESOURCES IN HUNEDOARA DISTRICT AND IMPORTANCE IN THE ART OF THE ROMAN CIVILIZATION**

**VIRGIL GHIURCĂ**

*Universitatea „Babeş-Bolyai”, Cluj-Napoca*

*Catedra de Geologie-Paleontologie*

*str. M. Kogălniceanu nr. 1*

*3400 Cluj-Napoca*

## ***REZUMAT***

Pe baza proiecțiunilor gemologice efectuate de autor și cercetărilor sporadice efectuate de numeroși amatori, sunt prezentate și localizate principalele iviri de pietre de podoabe, precum și numeroasele varietăți sub care ele apar în cadrul județului Hunedoara. Prin potențialul său gemologic, județul Hunedoara se înscrie, grație rezervelor sale, pe primul loc în țară. Aceste resurse bogate desigur că nu au trecut neobservate nici în trecutul istoric din timpul ocupației romane a Daciei. Mineralele și chiar rocile cu calități de gema au fost utilizate de romani la confecționarea unor obiecte de cult sau de podoabă, cum ar fi: intaliile, amuletele, pietrele de inel și, mai rar, camee. O mică parte din aceste obiecte de artă din domeniul glipticei, găsite în așezările romane din județ, au ajuns în diferite muzee arheologice din țară (Cluj, Alba Iulia, București) și implicit ele se află și în Muzeul Civilizației Dacice și Romane din Deva.

**INTRODUCTION.** This work tries for the first time to perform a correlation between the present gemological resources in the district and how much were they known and used in the Roman epoch. It was a series of administrative, military and civilian Roman centres in the district. Some of gems found in the area have been described in the literature. Except the main administrative centre, the capital of Roman Dacia (Ulpia Traiana Sarmizegetusa), other Roman settlements, such as the camp from Micia

(Vețel), the therms from Germisara (Geoagiu-Băi – Aqua calide), Ad aquas (Călan), the camp from Cingău, rustic cottages at Cincis, Deva, and the Roman gold mines from Brad, Baia de Criș, Băița, are also known on the actual territory of the district. The archaeological researches on these Roman sites started in the XVIIIth century and continued up to nowadays. The research lead to the discovery – nearly the many sites of different nature – of cultured and artefacts in the glptic domain (intails and cameo). The most of these gems got in the possesion of some private persons and in the museums from Wien and Budapest. However, a small amount of them are displayed in the museums of Cluj, Alba Iulia, București and Deva. In the Museum of Cluj there are also deposited 41 gems (39 intails and 2 cameo), found in the Roman camp of Micia (Vețel in present). I had the opportunity to study them in 1980 for finding that much of the local gemological resources were known and used in the Roman epoch. Since then, our knowledge in the gemological and archaeological domains has evolved and now we can bring new explanations in these domains. Unfortunately, we haven't had the opportunity to study from this point of view the gems from the museums of Deva and Alba Iulia.

## **GEMOLOGICAL RESOURCES IN THE HUNEDOARA DISTRICT**

Minerals and rocks with gemological qualities are generated by the three principal types of rocks which made up the terrestrial crust: metamorphic, magmatic and sedimentary. From these, the magmatic domain oneself brings about roughly 99% from the global production of gems minerals.

The geology of the Hunedoara district which has an area of 7617 kmp, consist of about 47% sedimentary deposits, 30% metamorphic rocks, and 23% magmatic rocks (intrusive and extrusive).

– The sedimentary domain is represented in district by Jurassic, Cretaceous, Paleogene and Neogene formations. They occur in the Metaliferi, Bihorului and Zarandului Mountains, Mureș' passage, covering a surface of about 3579.52 kmp.

– The metamorphic domain is well represented in the Sebeș, Retezat and Poiana Ruscă Mountains, in the crystalline island of Rapolt, amounting to a surface of about 2284.80 kmp.

– The magmatic domain is well developed in the Retezat Mountains (granites), Metaliferi Mountains (ophiolites, banatites and Neogene eruptions), covering a surface of about 1752.68 kmp.

From the district there are known till in present over 202 occurrences of minerals and rocks with gemological qualities. Through the great frequency of these occurrences, the Hunedoara district is on the first place in the Romanian gemologic potential (considered as being of 100% and appreciated for each from the 39 districts partly), with a percentage of 12.80 (fig.1).

## I. THE SEDIMENTARY DOMAIN (47% = 3579.52 kmp)

Even almost one half from the district surface represents the sedimentary domain, it is a weak producer of quality gemological minerals.

– From this domain the sole agates (sometime fossiliferous) and jaspes deposits placed in the Paleogene lacustre continental sedimentary deposits and which is partly situated at the boundary of the Techereu locality (the Scaiuului, Dumbrăviței valleys and in the Lazuri and Fătăciune sites). The source of these gems are the Fața Băii conglomerates, and the overlying Valea Almașului gravels which occur on rather extended areas. Some galets of these conglomerates (locally named „bebee") may contain agates with very intense venatures and colourations, and polichromatic and monochromatic jaspes, containing sometimes fossils. We must apartly remark that at Techereu may occur numerous agates generated by magmatic rocks (related to banatites – geoda or filonian agates, or to ophiolites – filonian agates). Unlike these, the bebee's agates always occur as very well ruled galets.

– The silicified woods occur as a rule in sedimentary formations of various ages, being usually reworked (because of their high hardness) in the alluvial deposits of the area. Black silicified woods occur in the Bodii's brook, being reworked from the Cretaceous deposits. A higher concentration of silicified (opalized) woods in situ occur in the Panonian deposits on the territory of Prăvăleni locality, where, on Tarniței valley and on Hoarna Tarniței summit trees trunks substituted by yellowish coloured opals occur, within volcano-sedimentary formations. Trunks and fragments of silicified woods – sometime transformed into monochrome (white – bluish) agates, rarely polichromatic, occur in the volcano-sedimentary formations from the zone situated north of Mureș, in the area between the localities Sârbi (to

east) and Burujuc (to west). Similar silicified woods appear in the same formations situated south of Mureş in the localities Dobra – Lăpugiu de Jos – Fintoag and Tisa.

– Fossiliferous limnical silicolites (lacustrine) occur in Panonian deposits in many more areas, the most important being the occurrence from the Sanatorium of Brad. There occur opals and more particularly red and yellow jaspers including fresh-water fossils. Grey silicolites with many bog fossilized plants occur at Vaţa de Jos – Băi (in the Gruiu site and possible in other areas also).

– The presence of the amber in Cretaceous deposits from Curechiu has been recorded still in the last century in the Valea Carelor in the place named Troiţa. Also in the last century, at Petroşeni, the presence of a black amber variety, named Bielzit, was noted. Amber traces are also known from the Badenian deposits from Răchitova (The Basin of Haţeg).

– Red radiolarites are noted from Cretaceous deposits of Curechiu but they occur also in other areas with Cretaceous deposits.

– Polichrome mosaicated and pastelated jaspers occur in the Cretaceous deposits of Valea Bodii from Techereu.

– Some siliceous accidents of Mandelstein type may occur in the Jurassic deposits of Vălişoara, from Brad.

– The travertines from Geoagiu and Bampotoc may offer materials for ornamental plaques.

– Even some well preserved Badenian fossils from Lăpugiu de Sus and Buituri may present extremely aesthetic aspects which make them utilizable for ornamental objects.

– Almost all the valleys deposits, which cross areas with jaspers, agates, opals, silicified woods, limnical silicolites, and radiolarites contain fragments from these varieties.

## II. METAMORPHIC DOMAIN (30% = 2284,80 kmp)

This domain is well developed in the southern part of the district, in the Retezat, Poiana Rusă and Cibin Mountains, and the resources are rather limited from gemological point of view. A little bit of a crystalline occurs to the north of Mureş, making up the crystalline island of Rapolt.

From the minerals of gemological importance we mention the jaspers, the grey quartz, and the syderite from the iron mines barren gangue from Ghelar, Govăjdia and Teliuc.

Even in the frame of Sebeş – Lotru crystalline micashistes with garnets occur, garnets with gemological had not been pointed out till now qualities.

The bluish shade dystene which occurs in the dystenites from the Şureanu Mountains may also be found and reworked in Valea Jiului Transilvan and in Valea Streiului.

On the same valleys the occurrence of beryl, tourmaline, perhaps in gemiferous varieties, reworked from the pegmatites which occur on the superior waterways of these valleys, is not excluded.

The transparent, greenish sometimes quartz, the rock cristal variety (or quartz of alpine type) may be collected from abandoned quarry from Siglău (Uricani).

The last century reference material cites the presence of chrysoprase at Iscroni in the place named Piatra Zigata and Coasta lui Rus. In the frame of serpentinites from here it wouldn't be excluded the occurrence of the jade or nephrite too.

Black lydiens may occur, reworked in the rivers deposits whose origins are the metamorphite.

Large gallets occur in Valea Streiului (between 20 and 50 cm in diameter) of white-yellowish metasilicolites which may proceed from the Retezat Mountains and which may be used both in gemology and in technique (mortars and laboratory pistils).

From the rocks of gemological or ornamental interest we mentioned the black serpentines with white veins which occur in Valea Dobrii in Dealul Gruiului and the greenish serpentinites from the Iscroni, Livadia, Petriala, Jieṭ, and Sibișel areas.

The talc which may be used for make up some art articles, is found in diverse varieties at Cerișor, Leleșe, and in others areas of Poiana Rusca Mountains.

The marble occurs in the old Roman quarry from Valea Bistrei in the Lunca Cernei de Jos, de Sus areas, and to the west of Sarmisegetuza at Gura Bordului.

The occurrence of some varieties of aventurinic quartzites in the deposits of valleys which cross the metamorphic rocks wouldn't be excluded.

The strongly folded green shales which occur in the immediate neighbouring of Deva city (to west) constitute a good ornamental stone.

### III. THE MAGMATIC DOMAIN (23% = CCA 1151,68 kmp)

Various intrusive and extrusive bodies occur in situ or both in the metamorphic and in sedimentary domain. According to the age of the ore depositions, the following regions are distinguished:

– The Proterozoic Region includes the granites of The Retezat Mountains and which are sterile from gemological point of view until present.

– The Ophiolitic Region is well developed in The Metaliferi Mountains and is characterized from petrographic point of view through varienties of gabbroes, peridotites, spilites, ortophires, anamesites, dolerites, andesites, dacites, and riolites. Ophiolites occur as a continue strip, which between Valea Balșei to the East and Valea Cerbiei to the West. They had been deposited in three stages unfolded in Jurassic and Cretacic.

– The Banatitic (Laramic) Region included granites, grandiorites, diorites, andesites, dacites and riolites bodies deposited in Late Cretaceous – Paleogene. They occur preeminently on the west side of the district. More recent, the bodies and the agglomerates on the north and the south sides of Mureș, associated till recently to the Neogene magmatism, are considered as belonging also to the banatites, on the basis of their absolute age (59 mil years).

– the Neogene Regions is well developed in the Săcărâmb – Brad – Bucuresci – Vălișoara, Caraci – Zarand areas, and include andesite, dacite, and riolite bodies occurred in Badenian – Sarmatian, rich in gold – silver deposite.

We present the main gemiferous regions in the district as it follows:

**1. THE OPHIOLITIC REGION.** This region constitutes one of the most important generating gemological minerals areas, especially of chryptocristaline quartz type (chalcedonies, agates, jaspers). All the valleys which cross the ophiolitic area, beginind with Valea Balșei (Geoagiului) to the east and continuing up to Valea Cerbiei to the West, rework in their deposits different varieties of mono and polichrome chalcedonies, policoloure agates and varied coloured jaspers, released by alteration, disintegration phenomena from ophiolites.

At Techereu village, on Valea Mărgelușelor occur black augite crystals, perfect crystallized and utilizable for gemology. Greenish and glossy augite crystals also occur at Valea Jepii (Poienița) and Poiana. In the ophiolites, placed in the northern part of Brad, in the Ribița area, coloured jaspes and

radiolarites particulary occur. Unlike of Alba district (Răchiș) where on limited areas, in the more acid terms of ophiolites, great concentrations in chalcedony and agates may appear, the ophiolites in Hunedoara district contain only sporadic and disparate occurrences.

**2. THE BANATITIC (LARAMIC) REGION.** In this region on the one hand granite bodies which cross the ophiolitic plate, i.e. those from Vața de Sus – Tătărești de Criș – Căzănești and those from Cerbia – Almaș Săliște, occur. Garnets and vesuvianite occurrences utilizable for gemology are related to the skarn area of the body from Vața de Sus.

Also of the banatitic area, on the other hand, the andesites, dacites, and riolites extrusions and the agglomerates associated to them newly occur, well developed to the north and south of Mureș. To the north of Mureș they are ordered in the south side of the ophiolitic and of the Mesozoic deposits areas. They start on Lunga – Brănișca to the east and they continue up to Valea Zamului to the west. The banatites from the Hunedoara district areas constitute the main minerals with gemological qualities generating formation. From those areas, numerous varieties of coloured chalcedony (white, carneol, sarder, heliotrope, saphirine, plasma, Mokka chalcedony etc.) and agates (monochrome, polichrome, mossiformes, rubanate, tubular etc.) and yellow, red, brown, green, breciformes jaspers. Also in these areas monochrome and polichrome silicified (agatized) woods occur, too.

Among the chalcedonies and of the agates, the weak transparent rather translucide white varieties are usually prevalent. Samples with varied veins, slightly visible can be picked from the gravels in the valleys east from Valea Lungă to the west on the brooks from Bacea, Cuies, Ulieș, Gurasada, Runcșor, Brădățel, Câmpuri de Sus, Câmpuri Surduc, Tătărești, Burjuc, and Zam.

South of Mures they can be picked beginning with Valea Dobrei in the east and from the brooks which cross Abucea, Lăpușnic de Jos, de Sus, Panc – Săliște localities. The area continue to the west of Valea Mare with the brooks which cross Fintoag, Lasau, Tisa localities up to Pojoga to the west. As a rule, the gem minerals are not found in situ in these areas and they do not form rich concentrations in strictly localized perimeters.

Unlike of these areas, at Techereu large, concentrations of agates occur on strictly localized perimeters, such as the right side of Pârâul Bodii, where in one slope, gravels, many filonian or of geod agates are found. This deposit of agates is known from centuries, and they were been processed

at Vienna and Budapest. They are in connection with the banatite bodies which occur on the higher course of the valley.

**3. THE NEOGENE REGION.** Also the gold – silver ores with natural gold from Brad – Săcărâmb area and from the adjacent areas are particularly in connection with this region. Opals and the fossiliferous polichrome jaspers form Brad are in indirect connection (as origin) with the volcanics of this region, even they are localized in sedimentary deposits. Sporadic quartz, opale, and jaspers occurrence are known also from the mining galleries in the area and may be collected from the sterile of the mines or from the rock occurrences appearing in the area. Opals occurrences such as those from Ociu, Ocișor, Vața de Jos, and Basarabasa are in connection with the agglomerates and the volcanics from the Zarandului area. In the same areas, chalcedony and jaspers seldom occur.

In conclusion, one can assert with certainty that the Hunedoara district's area owns an important gemologic potential which, through their great variety and the multitude of the occurrence areas, places it on the first position in the country. Here has been put the basis of the first gemological and technical manufactured workshop belonging to the state or to the private persons which partly account of these resources.

We concluded that some of these resources were known and used until the pre-historic stages (palaeolithic and neolithic) and that they were used, manufacturing of some gems during the Roman occupation of Dacia (106-271).

## GEMOLOGY AND ARCHAEOLOGY

We shall try in the following section to estimate how much the Romans in the localities from Hunedoara district knew a part of these gemological resources and the size in which they had been used in the manufacturing of some artefacts of glyptic domain. The comparison and the correlation with the Roman gems were done on the basis of a rich collected and manufactured gemological material from the numerous examined occurrences in the Apuseni Mountains (between Gilău and Zam) and particularly in the frame of the Hunedoara district.

Starting from these premises, I studied in 1980 a part of the Roman gems preserved in The Museum of History of Transylvania in Cluj, using a stereoscopic binocular microscope. 57 gems of which 41 proceed from

the Roman camp of Micia (the Vețel locality in present) have been studied, and on which I have compared with the corresponding mineralogical varieties of my private gems collection, consisting of collected materials in the Apuseni Mountains. The 41 gems of Micia are represented by 39 intalies and by two camees.

These 41 Roman gems of Micia are manufactured of the following mineral varieties:

– 21 gems (from which 20 intalies and one cameo) are manufactured from a red variety of chalcedony named carneol, with no identical correspondent in the gemological resources of the Apuseni Mountains. Unlike of carneol varieties in this country, those of the Roman gems present almost constantly some black tufites distributed in the form of some clouds or flakes which possibly would constitute either some specific elements or fusion inclusion. To be able to prove their origin, possibly Indian, we have required some gems manufactured of carneol from India. Unfortunately, the Indian carneoles do not resemble the carneol of the Roman gems, but they are similar to those from The Apuseni Mountains. The problem of these carneolic gems remains, in absence of others data, unsolved.

- 3 gems are manufactured in carneolic agate;
- 3 gems are manufactured in monochromatic agates (white in different intensity, degrees/shades – 2 intalies and one cameo);
- 2 gems are manufactured in green jasper;
- 9 gems are manufactured in red jasper;
- 1 gem is manufactured in brown jasper;
- 1 gem manufactured in lapis-lazuli proceeding from Afghanistan;
- 1 gem in blue glass.

In all: 41 gems.

Considering their structure, texture, and colour (at the binoculaire microscope) the material of the Roman gems with the raw materials and with the gems manufactured of autohtone materials, we concluded that the three following pieces are manufactured in chalcedony and white agates similar to those which appear in the agglomerates from Valea Mureșului.

– The intalie no. inv. 4641 (Micia) having represented a fantastic animal on it (gryll) is not manufactured in rock crystal (according to Teposu L.) but in a translucide chalcedony with fine specific white inclusions which occurs frequently on Valea Mureșului.

– The intalie no. inv. 4622 (Micia – masculine nude) is not manufactured in lazurite but in a white agatiforme chalcedony which contains a little geode with crystals of quartz and which is identically to the similar autohton resources from Valea Muresului.

– The cameo no. inv. 4662 (Micia) having represented a woman's head on it, is manufactured in a matted-white chalcedony, similar to those of the banatites to the north and south of Mureş.

Two intalies are manufactured in carneolic autohtone agates:

– the intalie no. inv. 4635 (Micia – feminine bust) is manufactured in light colours up to white carneologic agate;

– the intalie no. inv. 4634 (Micia – emperor bust) is also manufactured in carneolic agate.

The following 12 roman gliptical pieces are manufactured in different jaspers (green, brown, red) varieties which can frequently be found in the agglomerates of Valea Mureşului.

– the intalie no. inv. 4623 (Micia – Isis) is manufactured in green autohtone jasper;

– the intalie no. inv. 4639 (Micia – Krater) is manufactured in a green jasper variety;

– the intalie no. inv. 4632 (Micia – Isis, awkwardly performed) is manufactured in a brown jasper, frquently found on Valea Muresului.

– the next nine intalies, no. inv. 4636 (Micia – Isis), no. inv. 4640 (Micia – eagle), no. inv. 4650 (Micia – Mercurius), no. inv. 4651 (Micia – Mercurius) no. inv. 4645 (Micia – Mars), no. inv. 4642 (Micia – gryll, fantastic animal), (Micia – Mars), no. inv. 4642 (Micia – gryll, fantasic animal), no. inv. 4633 (Micia – Nemesis), no. inv. 4747 (Micia – polip-fish), no. inv. 4744 (Micia – Ceres) are manufactured in different red jaspers varieties. We consider that all the pieces manufactured in varieties of jaspers of different colours procced from the neighbouring of the Roman camp of Micia.

In conclusion, from the 41 of Roman gems from Micia examined by us, 18 pieces seem to be manufactured in local gemological resources, respectively in chalcedonies and white or carneolic agates and in jaspers of different shades. In percentages, approximately 44% of gems had been manufactured in raw local materials.

We can also mention that one knows an intalie with Pan god represented on it and which has been found at the Roman settlement of Cincis. We do not know the material on which the image has been incised.

Unfortunately, I haven't had the opportunity to see and examine the gems found in The Museum of Dacian and Roman Civilization in Deva, so that, at this moment, we can declare neither the topographic origin of the materials from which they are manufactured or of other gems from the

Hunedoara district found in other museums in the country or abroad, or even in some private collections.

The quarry of andesites from Brănișca (3 km) is the nearest area to Vețel (Micia) where white chalcedony occur. North of Mureș are situated Sârbi area (10 km), Bacea, Cuieș, Ulieș, Gurasada (up to 11 km), Runcșor, Brădățel, Câmpuri de Sus, Câmpuri de Surduc (28 km), perimeters in which a great variety of chalcedony, agates, opals, and silicified woods appear.

South of Mures, close to Vețel gemological area are situated Dobra area (18 km), Lăpuș (24 km), and Pojoga (36 km). The gemological resources are similar to the north of Mureș.

The fact that, even the administrative capital of the Roman Dacia was Ulpia Traiana Sarmiszegetusa, the literature hasn't pointed out anything from this important site where the Roman archaeological gems would be abundant, remains an enigma.

In conclusion, we consider that the performing of some general gemological studies on the Roman gems found in the museal and private collections would be necessary, to determine more accurately the problem of the autohtone or foreign topographic origin of the raw materials used in their manufacturing, using in this direction as comparative materials the actual collections of gems manufactured of materials from Romania.

A more efficient co-operation among archaeologist, gemologists, and geologists would be necessary in future, to determine the topographic origin of the different geologic materials, used by our ancestors in different pre-historical and historical stages.

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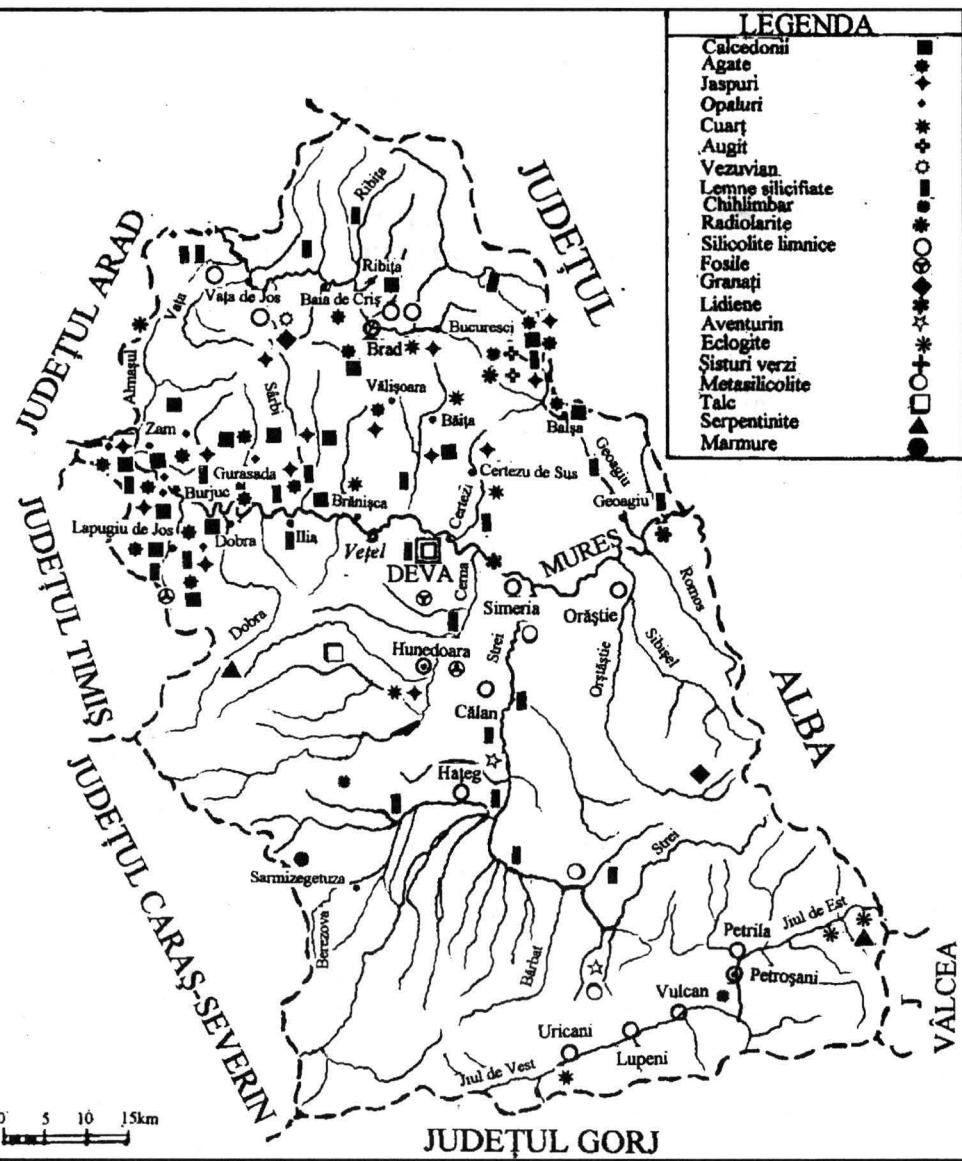


Fig. 1. – The gemological resources in Hunedoara District.



# **THE GEMOLOGICAL RESOURCES OF THE TIMIŞ DISTRICT**

**VIRGIL GHIURCĂ**

*Universitatea „Babeş-Bolyai”, Cluj-Napoca, Catedra de Geologie-Paleontologie,  
Str. M. Kogălniceanu nr. 1, 3400 - Cluj-Napoca*

**DIANA CHIRĂ**

*Universitatea „Babeş-Bolyai”, Cluj-Napoca, Catedra de Mineralogie-Petrometalogenie,  
Str. M. Kogălniceanu nr. 1, 3400 - Cluj-Napoca*

## ***REZUMAT***

Pe baza premitelor favorabile furnizate de repartiția și caracterele formațiunilor geologice, precum și a prospecțiunilor geologice efectuate până în prezent, se face o evaluare a resurselor geologice oferite de aria județului Timiș. Se apreciază potențialul geologic actual al formațiunilor magmatische, sedimentare, metamorfice, cu specificarea mineralelor și rocilor cu calități de gema caracteristice fiecărei unități geologice.

**INTRODUCTION.** Gemology is the science which deals with the study of the noble stones, which have come into the humanity mass attention still in their pre-historical stage, thanks to their bright colours and to their high hardness. However, since the paleolithic and then the neolithic epoch, the human being has begun to carve and later to polish hard stones to create their first lasting, resistant, and efficient tools and weapons. Through the knowing of stones qualities and through the appropriation of manufacturing techniques, the human being had passed step by step to the manufacturing of the first worship objects, talismans, power and property (seals) meaning and which had been finally transformed into ornamental objects.

Gems are usually cristalized minerals, which may be used as ornaments or for the manufacturing of art objects. These minerals are characterized by

aesthetic and physical features such as: colour, brightness, sparkling, transparency, shape, hardness, resistance. Once cut, polished and set, the gems allow preservation of these features. Some substances of organic origin such as coral amber, pearls, ivory, yet are assimilated to the gems.

Owing to the fact that in our literature and in the usually speech, the specific gemological terminology is sometimes obscure, superannuated or ambiguous, we shall do some explanations in connection with terminology. This is especially because they sometimes have, except their gemologic or commercial sense, a legislative one. Because in the public opinion and even in the ancient legislation (still valid) exist opinions and positions which are neither in agreement with the European Community legislation nor with that of the International Gemologic Fora, we shall do the explanations in case of necessity.

First of all, we must mention that the gems, according to the legislation of the European Union and with the regulation of the International Confederation of Jewellers (gold craftsmans), C.I.B.J.O., are divided into the following main categories:

1. Precious stones, which usually include unalterable mineral species, transparent, very hard fusible and which have hardness equal to or greater than 8 in the Mohs scale. Their weight is assessed in carates (one carat is equal to 0,2053 g), they always are being manufactured by facetation methods which rather put their internal sparklings in evidence. In the precious stones category are included only the diamond, ruby, sapphire and emerald. The notion of precious stones refers especially to their high value, their beauty and their rarity.

2. Fine stones. This category includes stones with hardness which varies between 7 and 8, they being much more frequently met in the natural deposits than the precious stones. A great part of them are manufactured by facetation and especially by the chabochone technique. In the fine stones category are included all the other transparent gems, translucent sometimes: aquamarines, topazes, chrysoberyls, tourmalins, amethysts, zircons, garnets etc. The noble opals are also included into this category even if their hardness is between 6 and 6.5. The ancient notion of „semiprecious stones”, a still used expression in commerce, had been abandoned in the actual gemological vocabulary, its utilization being prohibited because of its derogatory shade.

3. Ornamental stones (decorative or for ornamentation). This category includes minerals or mineral aggregates, sometimes even true rocks (obsidian) which have hardness equal to 7, but usually smaller than 7 and which are

used in the manufacturing of some art or ornament objects. They are usually polished in the chabochone technique or used in glyptique; those transparent are facetated. In this category are included transparent, translucid or opaque stones, such as: jade, nephryte, turquoise, peridot, rhodochrosite, dyopside, malachite, sodalite, lapis-lazuli (azure stone) and the different woods, dysthene, serpentine etc. Function of hardness, they are subdivided in hard stones, with hardness between 5 and 7, and soft stones with hardnesses below 5.

## THE GEMOLOGICAL RESOURCES OF THE TIMIŞ DISTRICT

The gemological resources of a region, area or administrative units are conditioned of the existence in that area of some geological formations which were able to generate minerals of gems quality. These formations generating gems (mother rocks) belong as a rule to the three main domains of rocks which compose generally the terrestrial crust. From these, most of generating gems formations belong almost exclusively to the magmatic domain, which provides about 99% from the global world gems production. The remaining of the gemological resources (1%) are generating by the metamorphic and sedimentary domains. If we analyse through by means of this superficial premise the geological area of the Timiş district, we can statistically establish that 92,98% of its surface consists of sedimentary deposits, 5,4% of metamorphic deposits, and only 1,62% amounts to magmatic deposits. From these geological premises follows that the district area presents not too much favorable conditions for the existence of some rich gemological resources. In other words, from the entire district surface of about 8678 kmp, about 8069 kmp amounts to the sedimentary, 469 kmp to the metamorphic, and only about 140 kmp to the magmatic rocks (the latest localized in the Coșteiul de Sus, Nemeșești, Bulza, Poiana Ruscă, Lucăreț and Gătaia areas). If we refer to the total gemological potential of Romania, considered as being of 100% and divided after certain criteria to the 40 districts, a percentage of 1.41 amounts to the Timiş district, placing it in the top of the districts of Romania only on the 19th place. This is only a relative statistical estimation, of course, based on the data of 1985 standards and which may suffer completions based on some future gemological prospections activities.

We shall present in the following the gemological potentials of the three main rock domains of Timiş district.

## I. THE SEDIMENTARY DOMAIN

This domain occurs on the largest surface in the Timis district (92.98%), amounting to it an area of about 8069 kmp. Stratigraphically, the marine sedimentary and brackish deposits belong predominant to the Badenian, Sarmatian, Panonian and Quaternary. The greatest weight amounts to the Panonian and Quaternary deposits. Occurrences of silicified woods may be in connection with the Panonian sands and sandstones, these woods may be found reworked in the deposits of the brooks and rivers which cross these deposits (see Fig. 1).

Occurrences of fossiliferous lacustrine silicolites (with Characee oogoane) are in connection with lacustrine deposits from the Gosi area.

Occurrences of fossiliferous molluscs are in connection with the Badenian deposits from the Coșteiul de Sus - Nemeșeti area, and which through their aesthetic forms and their good preservation state can be used as ornamental objects.

Occurrences of aventurinic quartzites and even varieties of chalcedony, agate and jaspers may be in connection with Pleistocene, Holocene and actual gravels of the Bega and Timiș rivers. Moreover, in the Timiș deposits of the rivers, the beryl, tourmaline and garnets may occur.

## II. THE METAMORPHIC DOMAIN

This domain occupies the western areas of the Poiana Ruscă Mountains and the crystalline island from the south of Buziaș (469 kmp - 5.40%), consisting generally in epimetamorphic crystalline shales with intercalation of dolomites and crystalline limestones. The occurrences of carbonatic yellowish-brownish, fine laminated onix (aragonite) are in connection with these metamorphites; this onix occurs in the right bank of the Bega river, at Luncani, in the place named Cisaca Nimanilor. Here, it constitutes a lens of 100 m long, 60 m broad and 35 m thick. The aragonite constitutes a beautiful ornamental stone from which they may have manufactured art and writing-table objects. It constitutes the greatest-deposit of this kind from our country.

Also in the Luncani region talc, dolomitic limestones and even marbles occur and they may be used in the same purposes.

### III. THE MAGMATIC DOMAIN

Even it occupies a rather small area of about 146 kmp (1.2%) localized in the north-eastern corner of the district, to which a serie of scattered bodies in the western side of the Poiana Ruscă Mountains are added, this magmatic area constitutes so far, the main area with gems minerals occurences. Small basalt massives occure even in the sedimentary deposits area from Lucăreț and Gătaia.

The many minerals from the chryptocristalline quartz family are in connection with the occuring areas of the banatites bodies (aramic eruptions) from the following three areas:

- the area with andezitic eruptive bodies and with the agglomerates of these from the Coșteiu de Sus - Bulza - Groși - Nemeșești area;
- the Pietroasa - Crivia de Sus area;
- the diorite, andezite and riolite bodies area placed to west of the Poiana Ruscă Mountains that is to North of Nădrag (Gladna - Huzești - Drinova area).

From these three areas, only the first one was partly examined under gemological aspect, the other two constituting unexamined areas. In the Bulza locality boundary, on the Bulza, Bolinda, Putori, Ioneasca, Peștiș, Nastan, Ultoni, Fata Mare, La Brazi, Tigănesc valleys and on the Piatra Sârbului, Ciungilor, Gruiu, Cimitirului hills, chalcedonies and monocromatic (translucide-white) agates fragments, coloured jaspers and silicified woods appear. The same gemologic range occurs upstream of Groși, on the Somonita Valley and on its superiör affluents. Also here, a green rock (corneene with epidote) occurs at the confluence with Valea Ciutii and it constitutes an ornamental stone with real aesthetic qualities (colour and brightness).

At Coșteiul de Sus and Nemeșești, on the Ungurului, Sârbului, Caselor, Negrileasca valleys and their collector, The Icului Valley, the same chalcedonies, agates and polichrome jaspers varieties occur.

It is also possible that the bodies from Pietroasa and from the west of The Poiana Ruscă Mountains to be characterized by similar minerals varieties. At Românești, in the Dumbrăvița area, on the Cremenea hill, the common opal occurs, and in the gravels of the brook which comes from Pietroasa, chalcedonies and jaspers may occur.

The bazalte bodies from Lucăreț and Gătaia have a particular situation, that which, except calcite and quartz, sporadic olivine (peridot) of gemologicał importance occurences would be in connection with.

Of course, this work does not obviously exhaust all the gemological possibilities of the Timis district, and because of these reasons we consider that the future research will be able to give emphasis to new and variable raw materials resources of gemological interest. However, the already known resources may constitute the base of some small local artizanal workshops.

Because in the Timiş district and in the neighbouring areas the vestiges of some Roman establishments are found, there wouldn't be out of the question the fact that a part of the Roman gems found in the archaeological sites would be manufactured also from autohtone gemological resources.

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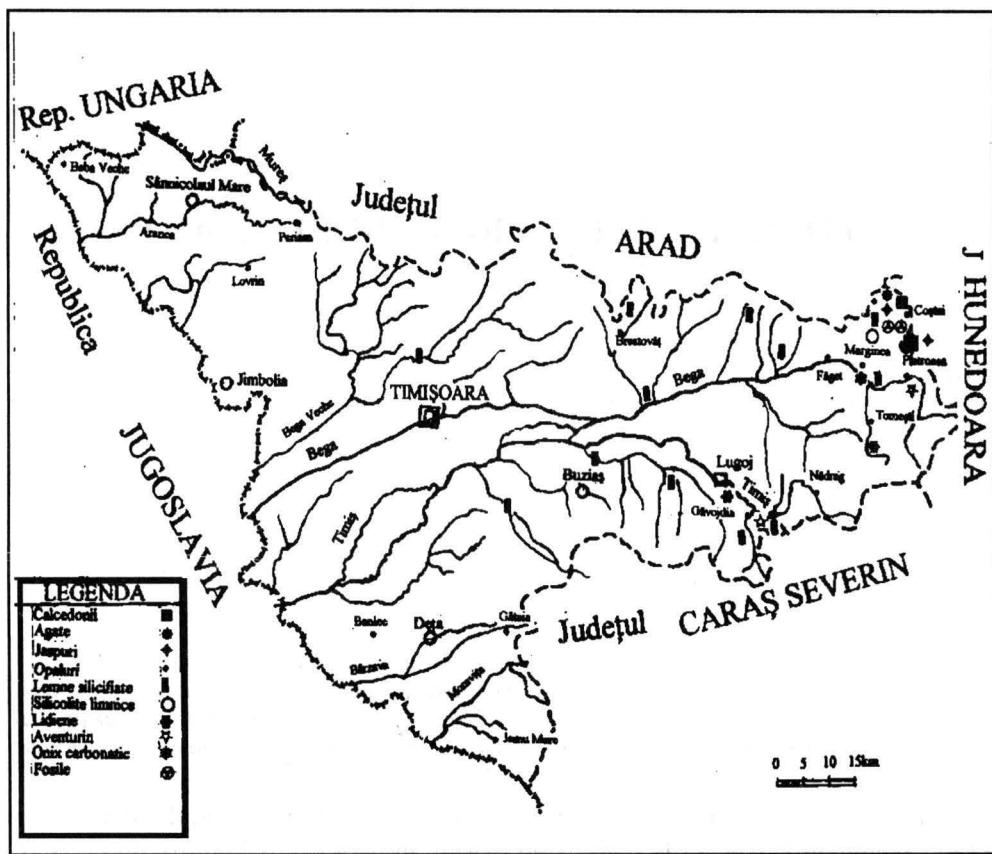
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*Fig.1 – The gemological resources of the Timiș district  
Resursele gemologice ale județului Timiș*



# THE BADENIAN DEPOSITS AT BUITUR

NICOLAE MÉSZÁROS, CARMEN CHIRĂ

*Babeş-Bolyai University, Faculty of Biology  
and Geology, Geology Department, Kogălniceanu  
St. 1, 3400 Cluj-Napoca, Romania.*

## REZUMAT

Fauna de moluște și asociația de nannoplancton din regiunea Buitur indică prezența unor depozite de vârstă Badenian superioară (Kossovian). Acestea sunt cuprinse între depozite cu gipsuri în bază (Wielician) și depozite de vârstă volhyniană în partea terminală a succesiunii. Fauna de la Buituri este de vârstă Badenian inferioară (Moravian).

The deposits of Badenian age from Buitur and their faunistic content have been studied by numerous researchers: Fichtel (1780), Lilienbach (1833), Boué (1833), Hauer (1837), Zikeli (1851), Hoernes (1856), Neugeboren (1860), Stur (1863), Martonfi (1893), Nemes (1888), Koch (1900), Halavats (1902), Zalanyi (1914), Gertruda Moisescu (1955) a.o.

In the Buituri area deposits of Badenian age are outcropping in the upper part of the brook which crosses the village of Băcia; in the Hunedoara Hill, the Miries Top (383 m), the Cărpiniș Hill (399 m) – north from the Buituri village, as well as at the place called Ion's Well (Spring of the Ion's Brook). In all the profiles to be found in this area, the Badenian consists of marly clays, ash – grey sands and sandy marls.

In the Sîncraiu Valley can be mentioned the presence of a block of gypsum in the base of the deposits, covered by coarse micaceous sands, with intercalations of gravel, followed by clays and then again by sands.

A lot of wellknown fossiliferous points, where from rich mollusc assemblages were collected in the past, are unfortunately covered at the

moment. This in the case of the outcrop from Ion's Well where the richest assemblage of bivalves and gasteropodes was collected from.

Further on we intend to present the mollusc assemblage from Buitur, the denomination we use being – as far as possible – adapted to the present synonymy, in accordance with the studies of Strausz (1966), Baluk (1975), Steininger et al. (1978), Svagrovsky (1981), Studencka (1986), Studencka & Studencki (1988), Baluk (1995).

## BIVALVIA

*Nucula nucleus* Linne

*Nuculana (Sacella) fragilis* Chemnitz

*Anadara (Anadara) diluvii* (Lamarck) (= *Arca diluvii* Lamarck)

*Barbatia (Barbatia) barbata* Linne (= *Arca barbata* Lamarck)

*Glycymeris (Glycymeris) deshayesi* (Mayer) (= *Pectunculus pilosus* Hoernes = *Pectunculus (Axinea) deshayesi* Mayer)

*Glycymeris cf. obtusatus* (Partsch) (= *Pectunculus obtusatus* Partsch)

*Megaxinus ef. globulosa* Deshayes (= *Lucina globulosa* Hoernes)

*Megaxinus incrassatus* Duboi (= *Lucina incrassata* Hoernes)

*Lucina (Linga) columbella* Lamarck (= *Lucina columbella* Lamarck)

*Loripes (Loripes) dujardini* Deshayes (= *Lucina dujardini* Hoernes)

*Divaricella (Lucinella) ornata* Agassiz (= *Lucina ornata* Hoernes)

*Tellina (Moerella) donacina* Linne (= *Tellina donacina* Lamarck)

*Glans (Glans) tournoueri* (Mayer)

*Pitar (Callista) chione* Linne

*Cordiopsis gigas* Lamarck

*Venus (Ventricoloidea) burdigalensis* Mayer (= *Venus burdigalensis* Mayer)

*Venus (Ventricoloidea) multilamella* Lamarck

*Venus (Ventricoloidea) cincta* Eichwald

*Circomphalus basteroti* Deshayes (= *Venus basteroti* Hoernes = *Chione (Clausinella) basteroti* Deshayes)

*Lutraria (Lutraria) cf. oblonga* Chemnitz

*Acanthocardia (Acanthocardia) turonica* (Hoernes) (= *Cardium turonicum* Mayer)

*Cardium (Acanthocardia) preechinatum* Hilber

- Cardium hians* Brocchi  
*Cardium* cf. *fragile* Brocchi  
*Trachycardium* (*Trachycardium*) *multicostatum* (Brocchi)  
*Laevicardium* (Discors) *herculeus* Dollfus, Cotter et Gomez  
*Cerastoderma multicostatum* Brocchi (= *Cardium multicostatum* Lamarck)  
*Cardites partschi* (Goldfuss) (= *Cardita partschi* Goldfuss)  
*Megacardita jouanetti* Basterot (= *Cardita jouanetti* Basterot = *Cardita* (*Megacardita*) *jouanetti* Basterot)  
*Glans* (*Glans*) *tournoueri* Mayer (= *Cardita* (*Glans*) *tournoueri* Cossom. & Peyr.)  
*Glossus* (*Glossus*) *hoernesii* (Dall) (= *Isocardia cor* Linne)  
*Panopea* (*Panopea*) *menardi* (Deshayes) (= *Glycymeris*) (*Panopea*) *menardi* (Deshayes)  
*Cubitostrea digitalina* (Dubois) (= *Ostrea digitalina* Dubois)  
*Ostrea* cf. *lamellosa* Brocchi  
*Pecten* (*Oppenheimiopecten*) *aduncus* Eichwald (= *Pecten aduncus* Eichwald)  
*Pecten* (*Flabellipecten*) *besseri* Andrzejowsky (= *Pecten besseri* Hoernes)  
*Pecten* (*Flabellipecten*) *leythajanus* Partsch (= *Pecten leythajanus* Partsch)  
*Chlamys tigrina obsoleta* Sowerby  
*Corbula* (*Corbula*) *carinata* Dujardini  
*Corbula* (*Varicorbula*) *gibba* Olivi  
*Corbula* (*Corbula*) *basteroti* Hoernes  
*Leda nitida* Brocchi  
*Anomia ephippium ornata* Schaffer  
*Anomia ephippium pergibbosa* Sacco  
*Anomia ephippium rugulosostriata* Bronn (= *Antomia costata* Hoernes)  
*Anomia* cf. *rugosa* Schaffer  
*Tapes* (*Callistotapes*) *vetulus* Basterot  
*Chytherea discrepans* Basterot

## ***GASTROPODA***

- Haliotis volhynica* Eichwald  
*Oxystele orientalis* Cossmann & Peyrot (= *Trochus patulus* Dubois)  
*Cerithium vulgatum* Bruguiere  
*Cerithium crenatum* Brocchi

*Cerithium rubiginosum* Eichwald

*Cerithium (Ptychocerithium) bronni* Partsch (= *Cerithium bronni* Hoernes)

*Cerithium (Ptychocerithium) crenatum* Brocchi (*Cerithium crenatum* Brocchi)

*Potamides (Terebralia) bidentatus* Defrance (= *Cerithium bidentatum* Grat.)

*Potamides (Piranella) pictus mitralis* Eichwald (= *Potamides mitralis* Eichw. *Cerithium mitrale* Eichw.)

*Terebralia lignitarum* Eichwald (= *Cerithium lignitarum* Eichwald)

*Turritella (Archimediella) turris* Basterot (= *Turritella turris* Hoernes)

*Turritella (Archimediella) pythagoraica* Hilber

*Turritella (Torculoidella) bicarinata* Eichwald

*Turritella (Torculoidella) subangulata polonica* Friedberg

*Turritella (Torculoidella) subangulata pseudoscalaris* Moisescu

*Turritella tethis* erronea Cossmann (= *Turritella archimedis* Hoernes = *Turritella (Torculoidella) erronea* Cossmann)

*Lemintina arenaria* Sacco (= *Vermetus arenarius* Linne)

*Vermetus* cf. *clathratus* Deshayes

*Natica (Lunatia) catena helicina* Brocchi (= *Natica helicina* Brocchi)

*Natica millepunctata* Lamarck

*Neverita josephinia* Risso (= *Natica josephinia* Hoernes)

*Polinices redemptus* Michelotti (= *Natica redempta* Michelotti)

*Melanopsis* cf. *aquensis* Grateloup

*Crepidula (Crepidula) gibbosa* Defrance

*Sigaretus striatus* Cossmann & Peyrot (= *Sinum striatum* De Serres)

*Aporrhais pespelecani* Linne (= *Chenopus (Aporrhais) pespelicanus* Linne)

*Semicassis (Semicassis) miolaevigata* Sacco (= *Cassis saburon* Eichwald = *Phalium (Cassidea) saburon* Lamarck)

*Phalium (Cassidea) cypraeiformis* Borson

*Ficus (Ficus) condita* Brongniart (= *Pirula (Ficula) condita* Brongniart)

*Ficus geometrus* Borson

*Murex tortueosus* Sowerby

*Typhis fistulosus* Brocchi

*Hexaplex (Phyllonotus) pomiformis* (Eichwald) (= *Murex (Phyllonotus) hoerneši* Eichw.)

*Vitularia lingauabovis* (Basterot) (= *Murex (Vitularia) linguabovis* Basterot)

*Strombus (Strombus) bonellii* Brongnairt (= *Strombus coronatus* Defrance)

*Nassa obliqua* Hilber (= *Buccinum miocenicum* Hoernes)

- Nassa dujardini* Deshayes  
*Nassa korobkowi* Moisescu  
*Nassa restitutiana buiturica* Moisescu  
*Nassa (Tiritia) rosthorni* Partsch (= *Buccinum (Tiritia) rosthorni* Partsch)  
*Nassa (Tiritia) serraticosta* Bronn (= *Nassa (Hima) serraticosta* Bronn)  
*Nassa (Hima) granulare* Borson  
*Nassa (Phrontis) dujardini schoenni* Hoernes & Auinger (= *Buccinum (Niotha) schoenni* Hoernes & Auinger)  
*Buccinum (Niotha) subquadangulare* Michelotti  
*Buccinum coloratum* Eichwald  
*Columbella (Tetrasomella) astensis* Bellardi  
*Columbella (Atilia) fallax* Hoernes & Auinger  
*Voluta (Athleta) ficalina haueri* Hoernes (= *Voluta haueri* Hoernes)  
*Mitra bouei* Hoernes & Auinger  
*Mitra striatula* Brocchi  
*Mitra (Nebularia) scrobiculata* Brocchi  
*Sveltia lyrata* Brocchi  
*Cancellaria suessi* Hoernes  
*Cancellaria (Calcarata) calcarata* Brocchi (= *Cancellaria (Trigonostoma) calcarata* Brocchi)  
*Cancellaria (Sveltia) varicosa dertovaricosa* Sacco (= *Cancellaria (Narona) varicosa* Sacco)  
*Cancellaria westiana* Grateloup  
*Fusus hoessii* Partsch  
*Latirus valenciennesi* (Grateloup) (= *Fusus valenciennesi* Grateloup)  
*Conus (Lithoconus) friedbergi* Moisescu  
*Conus (Chelyconus) enzesfeldensis* Hoernes & Auinger  
*Conus (Chelyconus) sturi* Hoernes  
*Conus (Chelyconus) fuscocingulatus* Bronn (= *Conus (Lithoconus) fuscocingulatus* Bronn)  
*Conus (Chelyconus) miovoeslanensis* Sacco (= *Conus (Chelyconus) ventricosus* Bronn)  
*Conus (Chelyconus) ponderosus* Brocchi (= *Conus (Rhizoconus) ponderosus* Brocchi = *Conus (Lithoconus) ponderosus*)  
*Conus (Conolithus) dujardini* Deshayes (= *Conus (Leptoconus) dujardini* Deshayes = *Conus (Conuspira) dujardini* Deshayes)  
*Conus (Conolithus) dujardini brezinae* Hoernes & Auinger (= *Conus (Leptoconus) brezinae* Hoernes & Auinger = *Conus (Conuspira) brezinae* Hoernes & Auinger)

- Conus (Conuspira) antideluvianus buiturica* Moisescu  
*Surcula reevei* Bellardi (= *Pleurotoma (Surcula) reevei* Bellardi)  
*Surcula reevei buiturica* Moisescu  
*Pleurotoma (Clavatula) olgae* Hoernes  
*Pleurotoma (Clavatula) justinae* Hoernes  
*Pleurotoma (Drillia) angustae* Hoernes  
*Mangilia bujturana* Bottger  
*Terebra (Subula) fuscata* Brocchi (= *Terebra (Acus) fuscata* Brocchi)  
*Terebra fuscata buiturica* Moisescu  
*Terebra bistriata* Grateloup  
*Terebra basteroti* Nyst  
*Terebra neglecta* Michelotti (= *Terebra (Acus) pertusa* Michelotti)  
*Terebra (Acus) hochstetteri* Hoernes  
*Ringicula (Ringicula) auriculata buccinea* Brocchi (= *Ringicula buccinea* Hoernes = *Ringicula auriculata* Menard)  
*Scaphander lignarius* Linne (= *Bulla lignaria* Hoernes)

Certain Echinidae are mentioned from Buitur, such as *Echinolampas hemisphaericus* Lamarck and *Scutella vindobonensis* Laub.

In order to precisely determine the age of the studied deposits from Buituri we also effected several studies on nannoplankton. The following species have been determined:

- Braarudosphaera bigelowii* (Gran et Braarud) Deflandre  
*Coccolithus pelagicus* (Wallich) Schiller  
*Coccolithus miopelagicus* Bukry  
*Coccolithus eopelagicus* (Bramlette & Riedel)  
*Cyclicargolithus floridanus* (Roth & Hay) Bukry  
*Calcidiscus* sp.  
*Discoaster exilis* Martini & Bramlette  
*Discoaster brouweri* Tan emended Bramlette & Riedel  
*Helicosphaera carteri* (Wallich) (Kamptner)  
(= *Helicopontosphaera kamptneri* Hay & Mohler)  
*Helicosphaera wallichi* (Lohmann)  
*Reticulofenestra pseudoumbilicus* (Gartner) Gartner  
*Sphenolithus moriformis* (Broennimann & Stradner) Bramlette & Wilcoxon  
*Sphenolithus abies* Deflandre  
*Syracosphaera histrica* Kamptner

*Triquetrorhabdulus rugosus* Bramlette & Wilcoxon

This assemblage indicates the presence of the NN6 Zone – with *Discoaster exilis*, therefore Upper Badenian age of the deposits from Buituri. There was no trace found of *Sphenolithus heteromorphus*, the index species for NN5 Zone, this being typical for the Lower and Middle Badenian.

Therefore, the gypsum we mentioned previously should belong to the Middle Badenian – Wielician.

Thus, the deposits from Buitur are of Upper Badenian age, while those from Lăpugiu de Sus are of Lower Badenian age.

In the upper part of the profile from Ion's Well we also identified some species of gasteropodes: *Cerithium rubiginosum*, *Potamides bidentatus*, *Melanopsis cf. aquensis*, which indicate a brackish environment, and consequently the transition from Badenian to Sarmatian. N. Mészáros also mentions rare forms of *Discoaster kugleri* included in these deposits, which might indicate the terminal part of Badenian and the base of Volhynian.

Althought the fauna of molluscs does not play essential role in establishing the age of the despositos, the absence of certain species, such as *Ancilla glandiformis*, most frequent in the mollusc assemblage from Lăpugiu de Sus, backs the observation regarding the age of the deposits, based on the study of nannofosils.

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# **SAUROPOD FEEDING: DIFFERENTIATION AND GHOST LINEAGES**

**CORALIA-MARIA JIANU**

*Muzeul Civilizației Dacice și Romane Deva,  
B-dul 1 Decembrie Nr. 39, 2700 Deva, Romania  
and*

**DAVID B. WEISHAMPEL**

*Department of Cell Biology and Anatomy, The Johns Hopkins University,  
School of Medicine, Baltimore, Maryland 21204, U.S.A.*

## **REZUMAT**

Unul dintre cele două mari grupe de dinozauri ierbivori – Sauropoda – este cunoscut în toată lumea începând din Jurasicul Inferior până la sfârșitul Cretacicului, având maxime în Jurasicul Superior, Cretacicul Inferior și Cretacicul Superior.

Combinând informațiile filogenetice cu aspectele funcționale ale hrănirii, acest studiu lărgește aria estimărilor inițiale.

Combinarea filogeniei și cronostratigrafiei se folosește pentru a se detecta prezența așa numitelor “ghost lineages” (strămoși fantomă) și distribuția acestora în cadrul Sauropodelor. Aceștia sunt răspândiți prin tot grupul, dar fac parte integrantă din cladele superioare.

Dacă probăm diversitatea la un interval de 2.5 milioane de ani, observăm un maxim la începutul Jurasicului, urmat de un declin în timpul Jurasicului mediu, apoi cel mai mare maxim la sfârșitul Jurasicului, în timpul căruia diversitatea temporală „a sărit” aproximativ de 7 ori (datorită cladogenezei crescute în cadrul brachiosauridelor, camarasauridelor, titanosauridelor și diplodocoidelor). Apoi, nivelul diversității scade gradat pâna la sfârșitul Mesozoicului, cu un declin final abrupt începând din Campanian până în Maastrichtian.

Optimizarea grupurilor în funcție de tipul de hrănire pe filogenie indică o radiație rapidă în Jurasicului Superior a sauropodelor cu dinții în formă de con comprimat, și de tip “peg-spoon”, nivelele diversității acestor grupuri trofice bazate pe “ghost lineages” par să nu aibă nici o relație cu dinamica diversității printre plantele contemporane.

În cele din urmă, analizele bazate pe “ghost lineages” indică faptul că gradul nostru de cunoaștere este foarte limitat în ceea ce privește evoluția modului de hrănire al sauropodelor.

**INTRODUCTION** Populated by drastically different creatures, the Mesozoic was almost a world of its own. Dinosaurs dominated the terrestrial realm, occupying virtually all ecosystem levels from primary consumers to top predators. Then, 65 million years ago, when an asteroid collision decimated 95% of all life on land and in the sea, all of these food-web associations completely disintegrated. Following this dramatic biotic reshuffling, many of the overarching ecosystem relationships were somehow maintained, to be rebuilt largely from a mammalian perspective.

Many attempts have been made to understand ancient trophic relationships by analogy with the modern world, especially from this mammalian point of view. In particular, investigations of herbivore-plant interactions during the Mesozoic have emphasized the ways in which synapsid and diapsid herbivores mutually related with terrestrial tracheophyte plants. By grouping faunas and floras in terms of the taxa associated with one another or the features that reflect this plant-herbivore interaction (tooth shape, foliage type, etc.), it is then possible to examine these groupings in light of their paleobiogeographic and temporal distributions. Expectations are that these groupings will provide a better understanding of possible coevolutionary patterns (e.g., Bakker 1978, Benton 1984, Tiffney 1986, Farlow 1987, Coe et al. 1987, Wing and Tiffney 1987).

In addition to its devastating climax, the Mesozoic is also particularly important in view of the profound evolutionary radiation of angiosperms beginning in the latter half of the Early Cretaceous and extending through the end of the Period (Doyle and Donoghue 1986, Crane 1989). In view of these changes in the plant realm, not only in diversity, but also in physiognomy and life histories (Crane 1987, Upchurch and Wolfe 1987), contemporary herbivores surely confronted new feeding opportunities and perhaps problems associated with the digestion of these new plants. Consequently, it is important to evaluate changes in taxonomic diversity and feeding systems among contemporary primary consumers of these angiosperms and other plants.

Two great clades of dinosaurs lived in this world of tracheophytes (e.g., angiosperms, "gymnosperms", and "pteridophytes"). One - Ornithischia - has received the greatest interest in studies of the evolution of Mesozoic herbivory, in part because of the diversity and complexity of their chewing apparatus (Weishampel and Norman 1989, Weishampel and Jianu in press). The other great clade - Sauropodomorpha - lacks much of the masticatory sophistication of ornithischians (Dodson 1990a). However, they clearly surpassed the latter in one of the most fundamental of biological properties, that of body size (Farlow 1987). At any time during their long Mesozoic reign, sauropods were always at least an order of magnitude larger than contemporary ornithischians.

Among sauropodomorphs, we focus on sauropods in this paper (fig. 1). These long necked, long-tailed quadrupeds are, for many, the “archetypal” dinosaurs. Beyond that, sauropod diversity, biology, and phylogeny are becoming much better known than ever before in the 150 years of their study. For example, feeding differentiation, once regarded as minimal (Weishampel and Norman 1989), is now known to be fairly great based on differences in dentitions, tooth wear, jaw mechanics, neck biomechanics and browse height, gut size, and occasional presence of gastroliths (Fiorillo 1991, Barrett and Upchurch 1994, Calvo 1994a, b). In addition, phylogeny now comprises a major research effort in sauropod studies (e.g., Upchurch 1995, 1998, Wilson and Sereno 1998), with many longstanding controversies about relationships beginning to be resolved (cf. McIntosh 1990).

In our efforts to better understand sauropods (and other taxa) as dominant among Mesozoic herbivorous vertebrates, we have developed a new approach to diversity estimates. Its aim is to tease apart the relationship between taxonomic and function diversity among these herbivores on the one hand and changes among Mesozoic plants on the other (Weishampel and Jianu in press). Called “Ghost Lineage Analysis”, this approach begins with traditional sources of data (e.g., a temporal census of species-level taxa; Weishampel and Norman 1989). These raw stratigraphic data are then combined with phylogenetic information to yield a stratigraphically-calibrated phylogeny. Although it does not completely correct for the inherent biases of the fossil record, ghost lineage analysis provides additional information about diversity not present in the raw fossil data. Ghost lineage analyses operate on both taxic and functional levels, the former by maintaining the continuity between sibling species and their common ancestor, while the latter by interpreting this continuity in functional (or behavioral) terms via optimization analysis. These two aspects of ghost lineage analysis are discussed following our discussion of sauropods and their groups of feeding.

## SAUROPOD TAXA, DIVERSITY PATTERNS, AND FEEDING GROUPS

Sauropods have long been considered a monophyletic group, but internal relationships have been unclear until recently. Upchurch (1995, 1998) recognized euhelopodids, diplodocoids, camarasaurids, brachiosaurids, and titanosauroids as monophyletic clades, with other taxa interpolated among

them (fig. 2), while Wilson and Sereno (1998), using a smaller sample of taxa, identified three of these clades (diplodocoids, brachiosaurids, titanosaurids); their study however advocated different relationships among them and between them and other taxa (fig. 3). It is not our purpose to assess the relative merits of the Upchurch and Wilson-Sereno studies in what follows. Instead, we will use Upchurch's phylogenetic analyses in our analyses, leaving the Wilson-Sereno cladogram and its diversity implications for another study.

Historically, sauropods have been best known from the Late Jurassic of North America (the famous Morrison fauna of the western United States), but most recently from the Middle and Late Jurassic of eastern Asia and the Cretaceous of South America. Taken as a whole, however, sauropods are known worldwide from the Early Jurassic through the end of the Cretaceous (McIntosh 1990, Weishampel 1990). When sampled through this interval at the species-level, sauropod diversity fluctuates dramatically on a stage-by-stage basis. There is a peak in the Late Jurassic (North American and Chinese sauropods), another less substantial peak in the mid-Cretaceous (South American sauropods), and another just prior to the end of the Cretaceous (dominated by titanosaurid sauropods from Gondwana; data from Weishampel and Norman 1989, with updates).

As the world's largest terrestrial plant-eaters, these quadrupedal herbivores ranged upwards in length to 30 m and must have been formidable plant-eaters (McIntosh 1990, Dodson 1990a). However, beyond their size, sauropods have not been regarded as having particularly complex adaptations for herbivore. Consequently, Weishampel and Norman (1989) characterized the entire clade as gut processors in large part because of their simple teeth, lack of documented tooth wear and the sporadic preservation of gastroliths in sauropods as a whole.

More recent studies have shown that this characterization is much too simple. The dentition consisted of relatively widely spaced, peg-like or spatulate teeth often restricted to the front of the mouth (Calvo 1994a, Barrett and Upchurch 1994). Calvo's (1994a) study represents the most comprehensive work on the cranial anatomy and biomechanics of feeding among sauropods to-date and we focus on his feeding groups in the following. These groups are based on details not only of the skull but also of the dentition (including wear) for all of the major taxonomic groups of sauropods.

Calvo (1994a) groups sauropods into those with peg-like teeth, spoon-like teeth, compressed cone-chisel-like teeth, and chisel-like teeth (another group - indeterminate - will not be considered here). Peg-like teeth (fig.

4), found in such diplodocids as *Diplodocus*, *Dicraeosaurus*, *Apatosaurus*, *Amargasaurus* are long, slender, and slightly curved lingually, restricted to rostral margin of the jaws. Tooth wear and cranial biomechanics indicate that the lower jaw was able to move propalinally (fore-and-aft) to produce modest oral processing (see also Barrett and Upchurch 1994) and that relatively soft plant material was the chief source of food. In contrast, teeth whose crown is appreciably wider than the root, that interlock with each other throughout a relatively long arcade, and that have wear are considered spoon-like (fig. 5). Found in camarasaurids and euhelopids (*sensu* Upchurch 1995, 1998; i.e., species of *Camarasaurus*, *Euhelopus*, and *Aragosaurus*), sauropods with spoon-like teeth are characterized as having a somewhat better ability to chew, both propalinally as well as transversely, than those sauropods with peg-like teeth.

Calvo's group of chisel-toothed sauropods includes species of *Titanosaurus*, *Antarctosaurus*, *Saltasaurus*, *Alamosaurus*, *Nemegtosaurus*, and *Quaesitosaurus*, taxa distributed within Titanosauroidea and Diplodocoidea by Upchurch (1998). These long, thin, and straight teeth are restricted to the rostrum (fig. 6). Ingestion (and perhaps slight oral processing) appears to be limited to orthal (up-and-down) motion of the lower jaw, as indicated by both jaw mechanics and tooth wear. Finally, those sauropods whose tooth crowns are wider than the root (but not so much as in spoon-like teeth), appear to be compressed cones in lingual view, are set in a relatively long arcade but do not interlock are considered to be compressed cone-chisel-like forms by Calvo (fig. 7). Found in species of *Brachiosaurus*, *Bothriospondylus*, and *Astrodon* (brachiosaurids *sensu* Upchurch 1995, 1998), both cranial biomechanics and tooth wear indicate that lower jaw movement was orthal, enabling ingestion but little oral processing of plant food.

## SAUROPOD GHOST LINEAGES AND DIVERSITY PATTERNS

Before evaluating the patterns of the evolution of feeding among sauropods, it is appropriate to provide more details on ghost lineages and their affect on diversity calculations. As indicated previously, ghost lineage analysis combines phylogeny and stratigraphy in a way that identifies contiguity between ancestors and descendant sibling species and thereby better reflects

diversity through time. But what are these ghost lineages? Norell and Novacek (1993) described them as the portions of the history of a taxon for which there is no direct fossil record, but which logically come from the phylogenetic continuity between ancestors and paired descendants at cladogenesis. Ghost lineages (and their durations) can be identified through the stratigraphic calibration of the phylogeny of particular groups of interest (Weishampel 1996, Weishampel and Jianu in press). For example, Figure 8a portrays the stratigraphic distribution and phylogeny of a hypothetical group of extinct organisms. When these two sources of information are combined (fig. 8b), sibling relationships often reveal the presence of missing evolutionary history that comes from the ages of any two sister-taxa. Said another way, the older of the two descendant species fixes the minimal age of the common ancestor and thereby provides evidence that some of the history leading to its younger sister species is missing from the stratigraphic record ("ancestors cannot be younger than descendants"). Thus, species occurrences in the fossil record imply, via their phylogeny, unseen aspects of diversity that are reflected in their ghost lineages. In turn, ghost lineages provide information on cladal diversity beyond that available from raw species counts and help provide a clearer picture of minimal diversity levels.

Ghost lineages are most accurately identified when the phylogeny of the group of interest is well understood and the stratigraphic occurrence of the descendant sibling species is relatively precise. At the very least, both the phylogeny and stratigraphic distribution of sauropods are presently the focus of considerable research and are becoming better understood with further discoveries and analyses. In our analyses, as previously indicated, the species-level cladogram for Sauropoda comes from work by Upchurch (1995, 1998) with interpolation of additional species from McIntosh (1990). Resolution of species on this cladogram is generally unproblematic, as most genera are monospecific. Where multispecific genera are encountered, they are positioned as unresolved sister taxa, sometimes with a starburst effect. Total number of sauropodomorph species on this cladogram is nearly 100, ranging in age from the Early Jurassic (Hettangian) through the end of the Cretaceous (late Maastrichtian; Weishampel 1990). The species-level sauropod cladogram is available from the authors.

These phylogenetic relationships are then calibrated against the earliest occurrence of each species (fig. 9). The resulting ghost lineages are not only scattered throughout the entire sauropod clade, but are also an integral part of all higher taxa.

In order to assess the relationship of ghost lineages to estimates of sauropod diversity, we conducted two sampling efforts. The first sampled

the stratigraphic distribution of actual sauropod species known from the fossil record, while the second sampled their ghost lineages at 2.5 million year intervals from the end of the Cretaceous back through to the earliest occurrence of each clade of sauropods. This 2.5 million year interval was chosen in order to insure that all species as well as their ghost lineages will be sampled in view of Dodson's (1990b) calculation that dinosaur species have an approximately 5 million year duration.

Direct sampling of the fossil record of sauropods provides somewhat similar results to that identified earlier by Weishampel and Norman (1989) a peak in the Late Jurassic, several much less substantial peaks in the Early to mid-Cretaceous, and another just prior to the end of the Cretaceous (fig. 10a). In contrast, when sampling ghost lineages at 2.5 million-year intervals (fig. 10b), a vastly different pattern emerges. There is a small peak at the beginning of the Jurassic, followed by a decline through most of the Middle Jurassic, then two extremely large peaks at the end of the Jurassic, during which time diversity jumps by at least an order of magnitude (driven by increased cladogenesis in brachiosaurids, camarasaurids, titanosauroids, and diplodocoids). Thereafter, diversity levels gradually decline through the end of the Mesozoic, with a final abrupt increase and then decline from the Campanian through the Maastrichtian (driven principally by the diversification and extinction of titanosauroids).

Given these very different patterns of diversity among sauropods, as well as the increased sampling afforded by the identification of ghost lineages, it is clear that raw taxonomic counts are at best a less-than-accurate measure of diversity. At worst, however, they can be truly misleading when used to evaluate evolutionary dynamics based on patterns of diversity. By harnessing phylogenetic contiguity between ancestors and descendant sibling taxa, we have demonstrated that the use of ghost lineages can have a large impact on estimates of diversity well beyond that available directly from the fossil record.

## FEEDING GROUP DIVERSITY PATTERNS AND GHOST LINEAGES

However interesting this assessment of ghosts and taxonomic data may be, it is really the diversity of feeding groups that is ultimately useful in assessing herbivore-plant interactions and/or coevolution. Consequently, we have taken Calvo's (1994a) feeding groups for particular sauropod species

and deduced “ghost feeding groups” from their ghost lineages. These feeding groups, as previously described, include sauropods with peg-like teeth, spoon-like teeth, chisel-like teeth, and compressed cone-chisel-like teeth. The ghost feeding groups were then identified on the basis of optimization analysis. Optimization analysis consists of mapping of features of interest - morphological, behavioral, or ecological - down a cladogram and the optimizing them back up the tree to resolve character ambiguities at particular nodes. For example, in Figure 11, characters (a) and (b) are mapped down this cladogram by pair-wise comparisons of terminal taxa, terminal taxa and nodes, and nodes and nodes. Once the basal node is resolved - as (a) - character ambiguities are resolved (or optimized) back up the tree. In this way, it is clear that character transformation from (a) to (b) occurs prior to the most recent common ancestor of A and B.

In this study, we have used the DELTRAN optimization option of PAUP (Swofford 1985) in order to produce the minimal resolution of feeding on the sauropod tree given the available data. Because of the strictures of DELTRAN and lack of appropriate information from the fossils themselves, unresolved feeding groups are also present, located not surprisingly in many of the basal relationships among the sauropod clades.

Sampling of optimized feeding groups was again at the same 2.5 million years as the ghost lineage analyses described previously. Ghost lineage diversity of these groups is indicated in Figure 12. For the first nearly 40 million years of their evolution, the ways that sauropods fed are unknown from the perspective of the Calvo groups. These unknown feeding styles in fact are often found at relatively high levels almost to the end of the Mesozoic (see below for their % contribution to sauropod feeding diversity). Unfortunate though this situation may be, it is expected that new discoveries as well as new analyses of skull biomechanics, tooth form, and other aspects of feeding in some of the basal members of each of the sauropod clades will reduce this ubiquitous class of unknown feeding styles.

Those groups that are known, however, provide a reasonably good picture of sauropod trophic diversity when optimized as ghosts. The group with the longest duration - sauropods with compressed cone-chisel-like teeth - is also the one that dominates the Late Jurassic, the time of greatest cladal diversity. Twin peaks of diversity, each with as many as 13 species, can be identified approximately 165 to 150 million years ago. Following this acme, there is stepwise decline in diversity for approximately 45 million years, after which this feeding group disappears. Yet even during this decrease, compressed-cone-toothed sauropods are twice to five-times as diverse

as are peg-toothed sauropods, their only contemporaries during the Early Cretaceous.

Sauropods with spoon-like teeth also exhibit a tight bimodal distribution, but at less than 2/3 the level seen in compressed-cone-toothed sauropods, declining between these peaks to an intermediate five species. However, these spoon-toothed sauropods have a much shorter longevity than the aforementioned compressed-cone-toothed forms - 15 million years - although their diversity increase appears to occur in concern with the latter.

Peg-toothed sauropods exhibit an abrupt increase and decrease in diversity (from 0 to 12 species and then back to a single species) over an interval of 7.5 million years. This Late Jurassic peak indicates that peg-toothed sauropods were as diverse as contemporary compressed-cone-toothed forms. Furthermore, this high level of diversity also occurs at a time of maximum sauropod diversity; that is, during the same interval as the second peak in both spoon-toothed and compressed-cone-toothed sauropods. Low-level diversity continues until approximately 135 million years ago, after which this feeding group disappears.

Sauropods with chisel-like teeth constitute the only feeding group that is present at the end of the Cretaceous, separated from all others by at least 20 million years. There is a strong increase in diversity beginning 85 million years ago and culminating in nine species some 78 million years ago. Thereafter, chisel-toothed sauropods exhibit a gradual disappearance over the next 20 or so million years.

In order to reduce the effects of different sample sizes, we have also transformed these data into percentage contributions of feeding groups (fig. 13). Most of the patterns seen in the untransformed feeding ghosts remain the same, although often to a heightened degree. For example, the percentage of unknown feeding groups dominates virtually all of the sampling intervals. Unknown feeding groups comprise a minimum of 0 to 20% during the Late Jurassic and latest Cretaceous, but maximally account for 100% of the diversity for as much as 60 million years (concentrated in the Early and Middle Jurassic and mid-Cretaceous).

From what is known about sauropod feeding, the Late Jurassic begins solely with compressed-cone-toothed forms, but sequentially and immediately thereafter includes spoon-toothed and peg-toothed sauropods through the end of the Period. The percentage of first-mentioned group fluctuates around 40-50% in the Late Jurassic, gradually declining to 0% in the Early Cretaceous, approximately 105 million years ago. In contrast, the latter two contribute from 25% to 35% over this same interval. Finally, 100% of the latest Cretaceous feeding groups are made up of chisel-toothed sauropods.

## DISCUSSION

Because of the phylogenetic continuity of species within clades, it is possible to deduce minimal levels of species diversity - as well as feeding groups - beyond those species physically available to us from the fossil record. Although not fully correcting for the biases of the fossil record, ghost lineages add significant information about diversity not available from raw species. For example, raw species counts from Sauropoda under-represent minimal diversity levels by at best 75% and by as much as 100% for individual intervals of time (fig. 10). Clearly, high levels of diversity are masked by the simple-minded use of raw species data.

Even with the use of ghost-lineages, however, our analyses indicate that the major aspects of the diversification of sauropod feeding are woefully incompletely known. As indicated previously, more than 50% of all feeding groups are unknown throughout the duration of the clade. How the eventual resolution of these unknown groups turns out is also unclear, such that further discoveries could have a great impact on the patterns discussed in this paper (see also Weishampel 1996).

In the meantime, we will examine the diversity patterns at hand that come from our ghost-lineage analysis. In particular, we want to test the hypothesis changes in feeding groups among sauropods, the largest and therefore among the most trophically specialized of all terrestrial herbivores (Farlow 1987), might be expected to reflect shifts in contemporary floras, the most significant of which is the Early Cretaceous origin and radiation of angiosperms. That is, changes in the plant realm selected for or against particular aspects of feeding in sauropods, either in an adaptive or coevolutionary way.

If we regard diversity patterns as a signal for important evolutionary events linking plants and herbivores, then virtually all of the feeding diversification among sauropods took place in the Late Jurassic, well before the major radiation of angiosperms. This pattern exists in both untransformed and percentage analyses (cf. figs. 10, 11). Even the diversity decline of all but the chisel-toothed sauropods took place prior to the angiosperm radiation. The degree to which the Late Jurassic diversification of sauropod feeding was tied to the evolutionary dynamics of gymnospermous or pteridophytic plants is not known, although paleobotanical diversity studies (e.g., Niklas et al. 1980, 1985) have not identified major evolutionary changes in these plant groups at this time.

Like the case of ornithischian dinosaurs (Weishampel and Jianu in press), sauropods appear to have been little affected by changes in

contemporary plants, including the initial radiation of angiosperms. However, because of the coincidence of the diversification of sauropod feeding groups in the Late Jurassic, these patterns clearly need further investigation - from the point of view of both diversity fluctuations and also the ebb and flow of features that relate to feeding on the one hand and the resistance to predation by plants on the other.

## ACKNOWLEDGMENTS

We thank P. M. Barrett, P. Upchurch, D. B. Norman, L. M. Witmer, M. B. Meers, R. E. Heinrich, Z. Csiki, and M. A. Norell for discussions and comments on the ideas contained in this study. At one stage or another, this research was supported by grants from the National Science Foundation (INT-8619987, EAR-8719878, EAR-9004458, SBR-9514784), the National Geographic Society, the National Research Council, and the Dinosaur Society.

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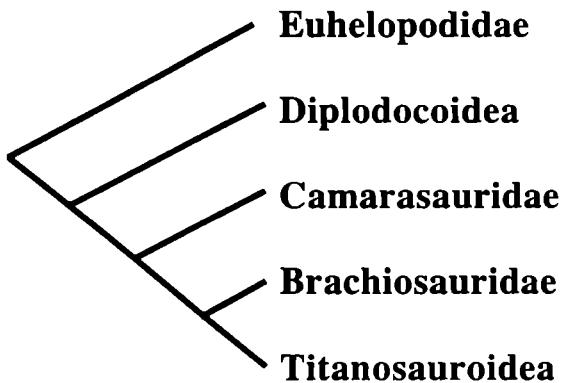
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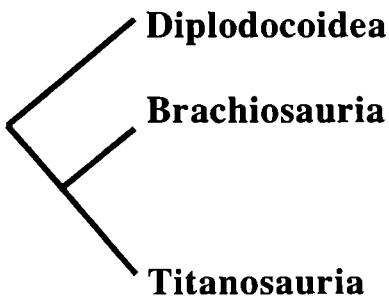
*Figure 1. A restoration of the sauropod *Diplodocus*, by Brian Francak*







*Fig. 2. – Phylogenetic relationships of the major sauropod clades identified by Upchurch (1998)*



*Fig. 3. Phylogenetic relationships of the major sauropod clades identified by Wilson and Sereno (1998).*

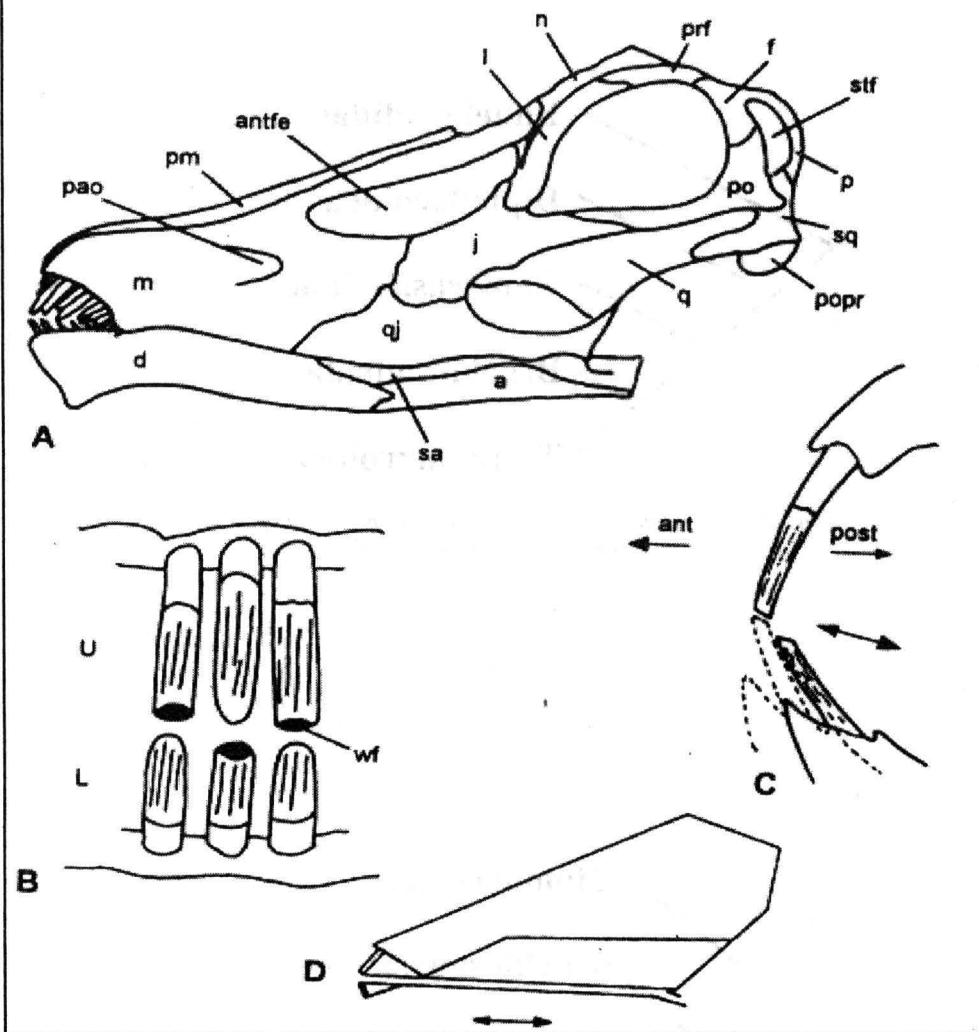


Fig. 4. – Peg-like feeding group. A. Reconstruction of the skull of *Diplodocus* in lateral view. B. Enlargement of premaxillary-dentary teeth in lingual view indicating wear facet position. C. Enlargement of premaxillary-dentary teeth in lateral view to show occlusion and jaw movement of the lower jaw. The double arrow shows the movement of the lower jaw. D. Kinematic abstraction of the propalinal jaw mechanism of peg-toothed sauropods. Abbreviations for Figures 4-7 – a: angular; ant: anterior; antfe: antorbital fenestra; ar: articular; bo: basioccipital; d: dentary; en: external nariss; f: frontal; j: jugal; l: lacrimal; L: lower tooth; m: maxilla; n: nasal; p: parietal; pao: preantorbital opening; pm: premaxilla; po: postorbital; popr: paroccipital process; prf: prefrontal; q: quadrate; qj: quadrate-jugal; sa: surangular; saf: surangular foramen; scr: sclerotic ring; sf: subnarial foramen; sq: squamosal; stf: supratemporal fenestra; U: upper tooth; wf: wear facet. (from Calvo 1994a).

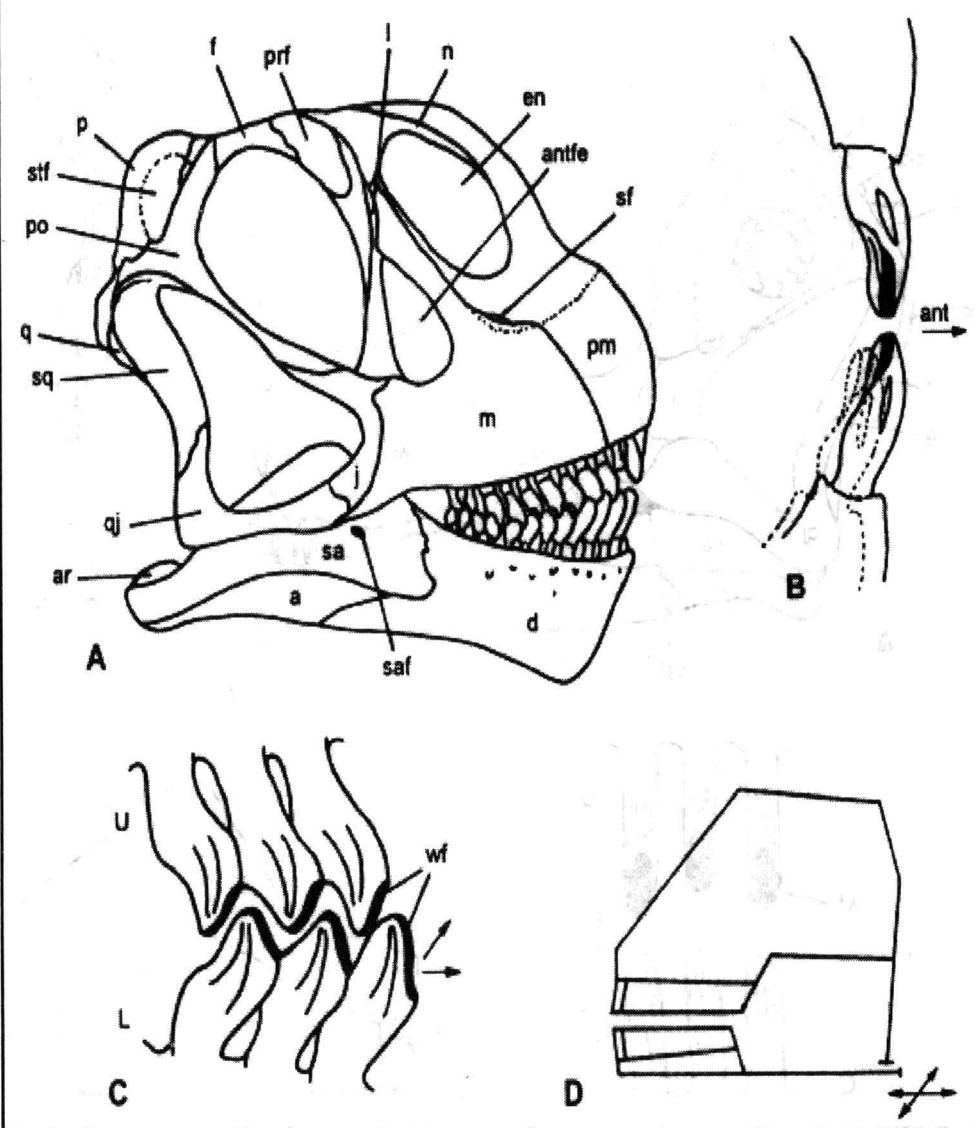


Fig. 5. – Spoon-like feeding group. A. Reconstruction of *Camarasaurus* skull in lateral view. B. Enlargement of premaxillary-dentary teeth in lateral view to show occlusion and jaw movement. C. Enlargement of premaxillary-dentary teeth in lingual view showing wear facet positions. Arrows indicate direction of jaw movement. D. Kinematic abstraction of the isognathic jaw mechanism of spoon-toothed sauropods. Abbreviations as in Figure 4. (from Calvo 1994a).

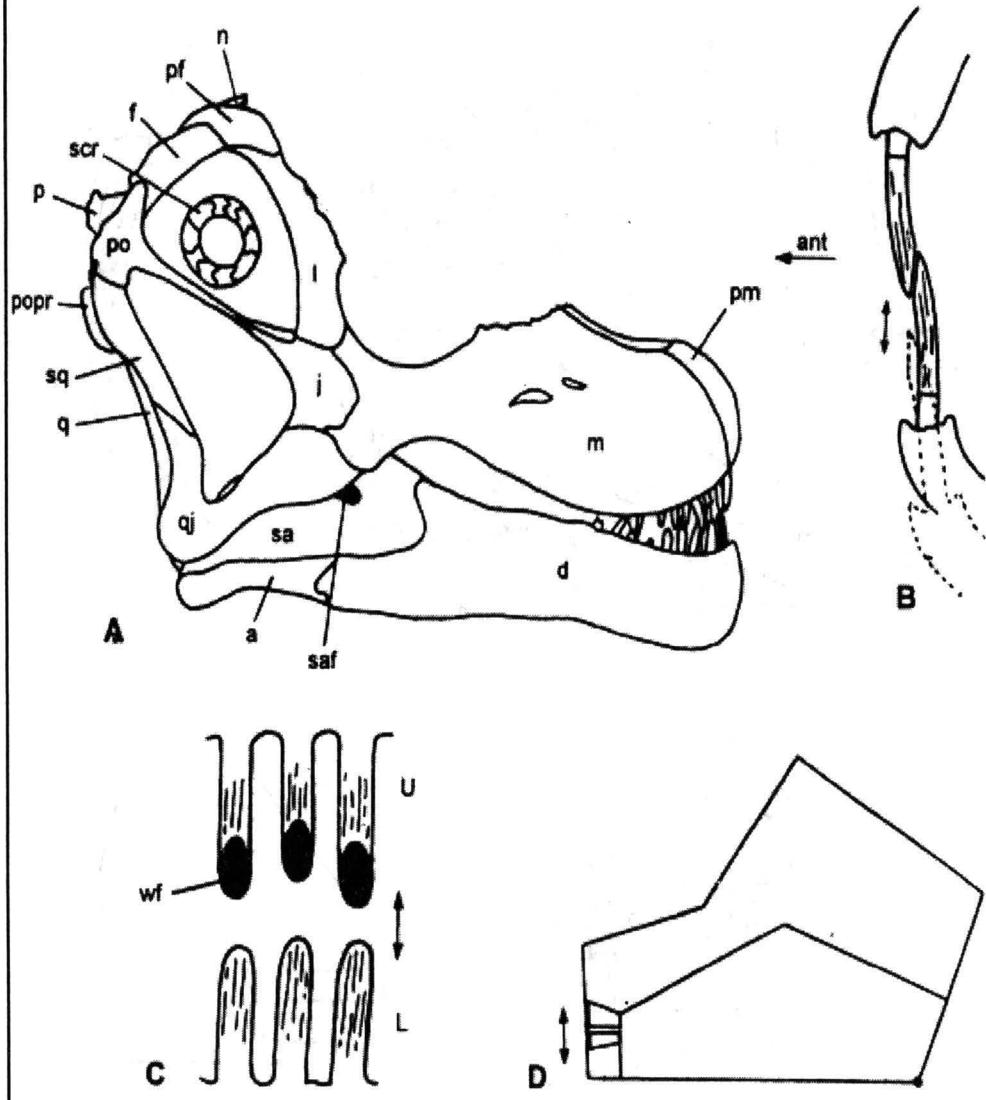


Fig. 6. – Chisel-like feeding group. A. *Nemegtosaurus* skull in lateral view of the skull. B. Enlargement of premaxillary-dentary teeth in lateral view to show occlusion and jaw movement. C. Enlargement of premaxillary-dentary teeth in lingual view showing wear facet positions. D. Kinematic abstraction of the simple hinge jaw mechanism of chisel-toothed sauropods. In (B) and (C), double arrow points out direction of movement. Abbreviations as in Figure 4. (from Calvo 1994a).

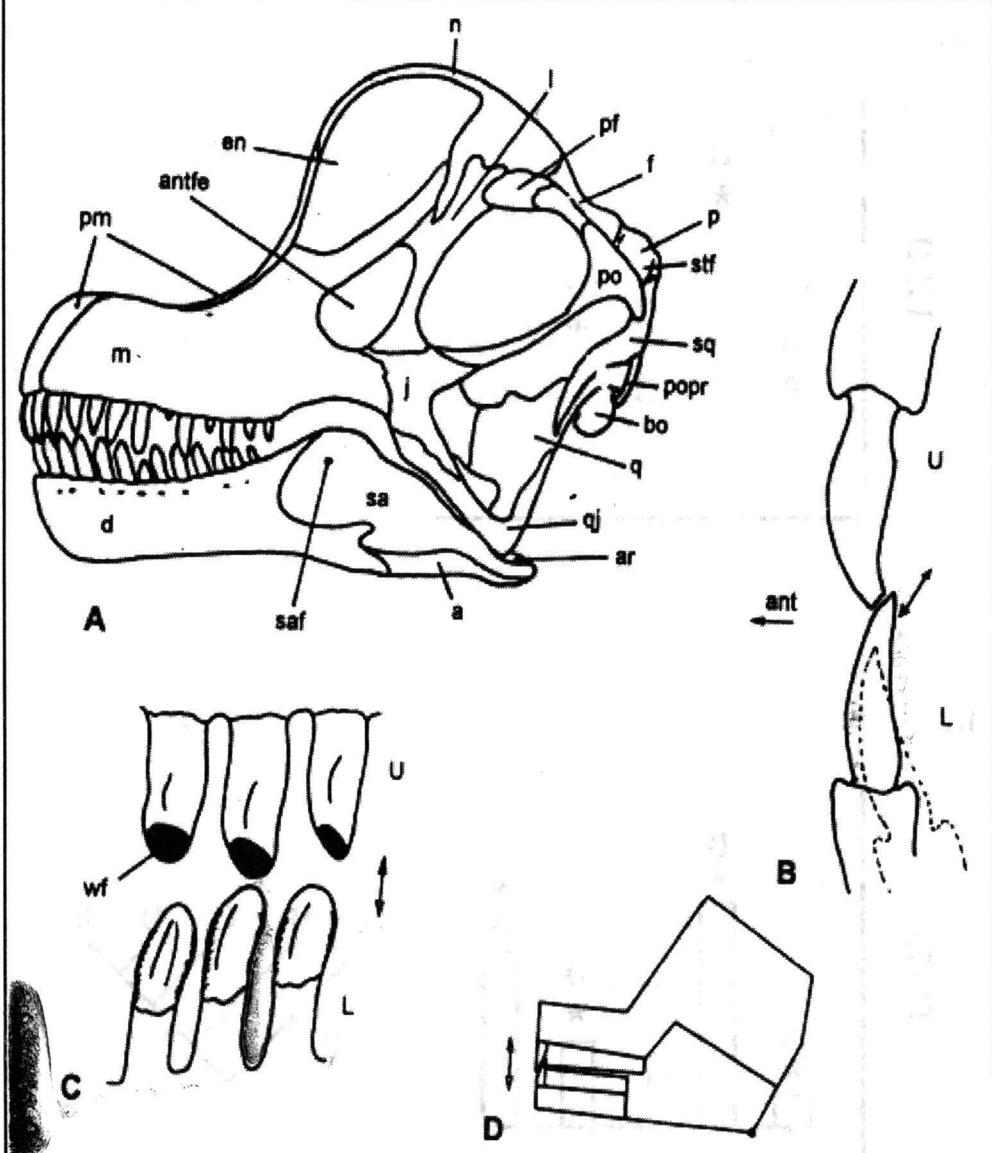
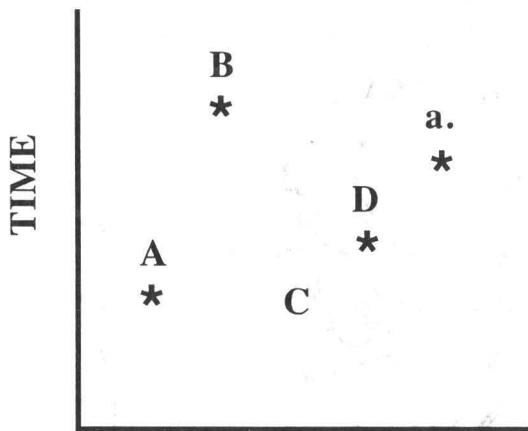


Fig. 7. – Compressed cone-chisel-like feeding group. A. *Brachiosaurus* skull in lateral view. B. Enlargement of premaxillary-dentary teeth in lateral view to show occlusion and jaw movement. C. Enlargement of premaxillary-dentary teeth in lingual view showing wear facet positions. D. Kinematic abstraction of the simple orthal jaw mechanism seen in compressed-cone-toothed sauropods. In (B) and (C), the double arrow indicate direction of jaw movement. Abbreviations as in Figure 4. (from Calvo 1994a.)

a.



a.

\*

D

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C

A

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B

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TIME

b.

TIME

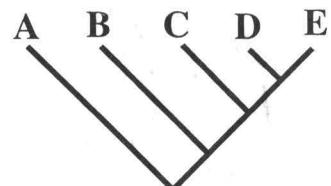
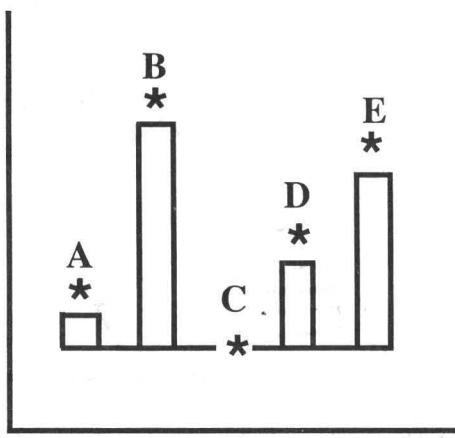


Fig. 8a. – Five hypothetical extinct species plotted against the time of their earliest stratigraphic occurrence. b. The ghost lineages (rectangular boxes) for the same five species. These ghost lineages come from the stratigraphic calibration of the cladogram indicated on the right.



Fig. 9. – Ghost-lineage diagram of Sauropoda.

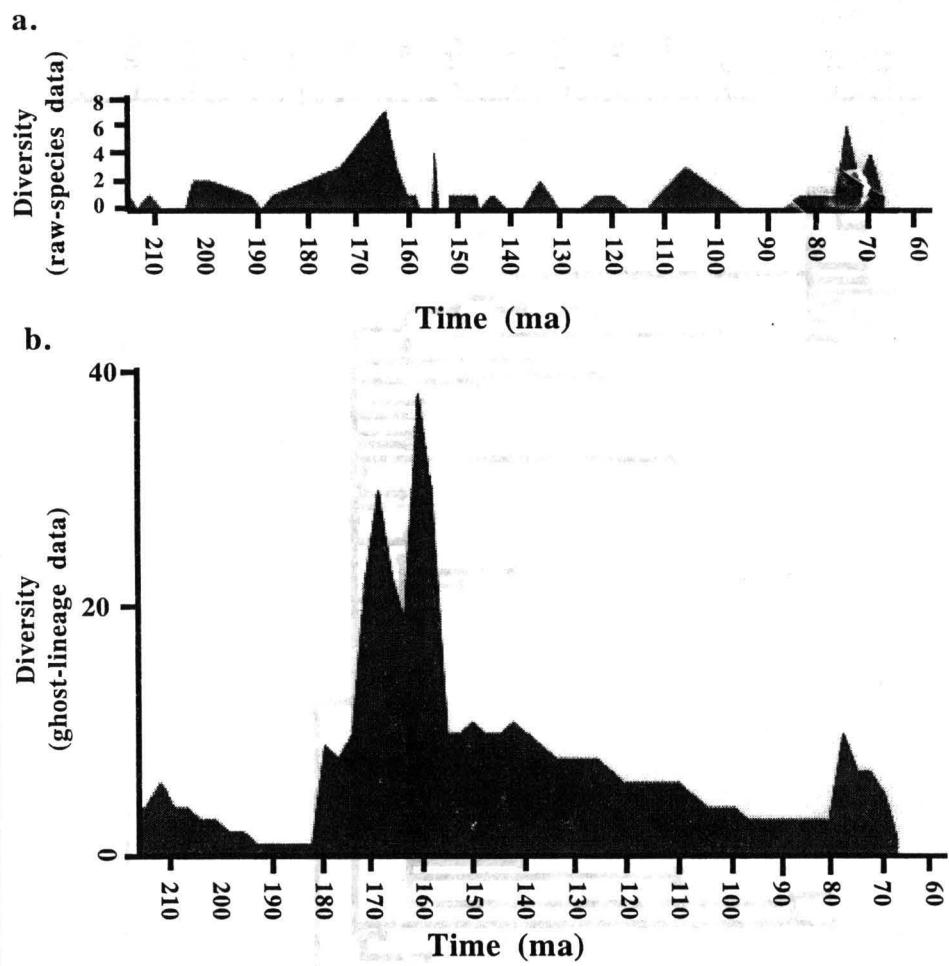
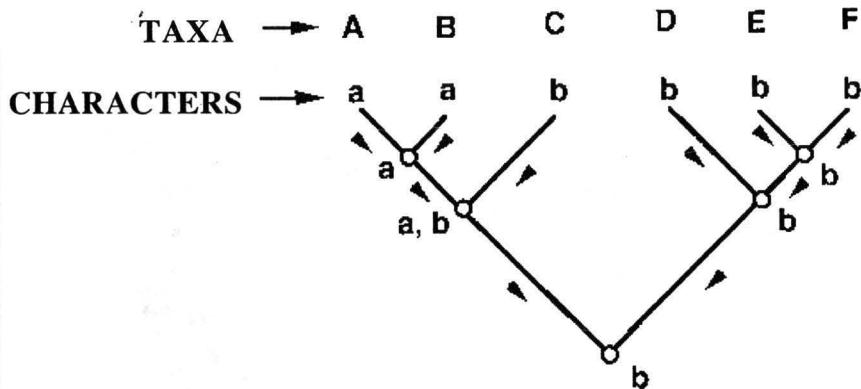


Fig. 10a. – Sauropod diversity based on raw-species data b. Sauropod diversity based on ghost-lineage data.

a.



b.

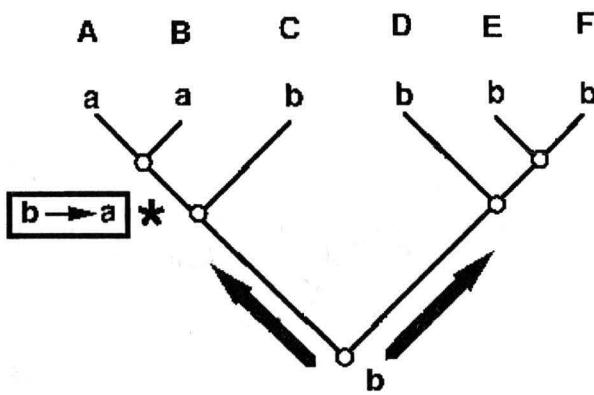


Fig. 17. Optimization analysis of two characters (a,b) onto a cladogram of six species (A-F).

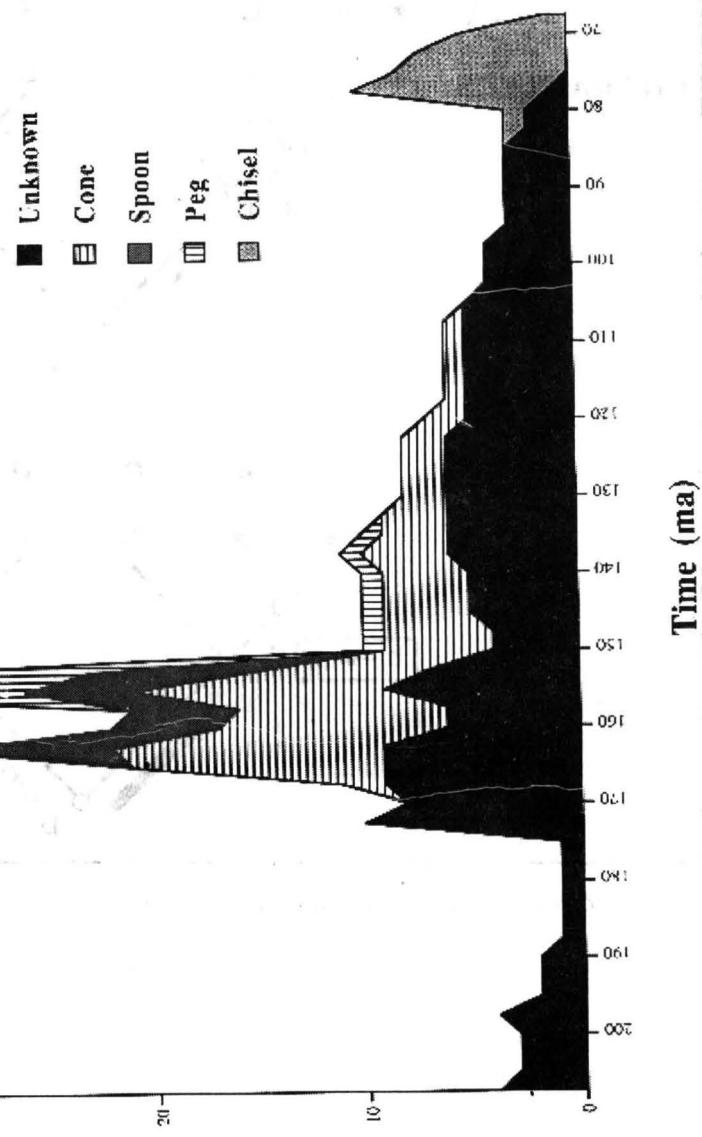
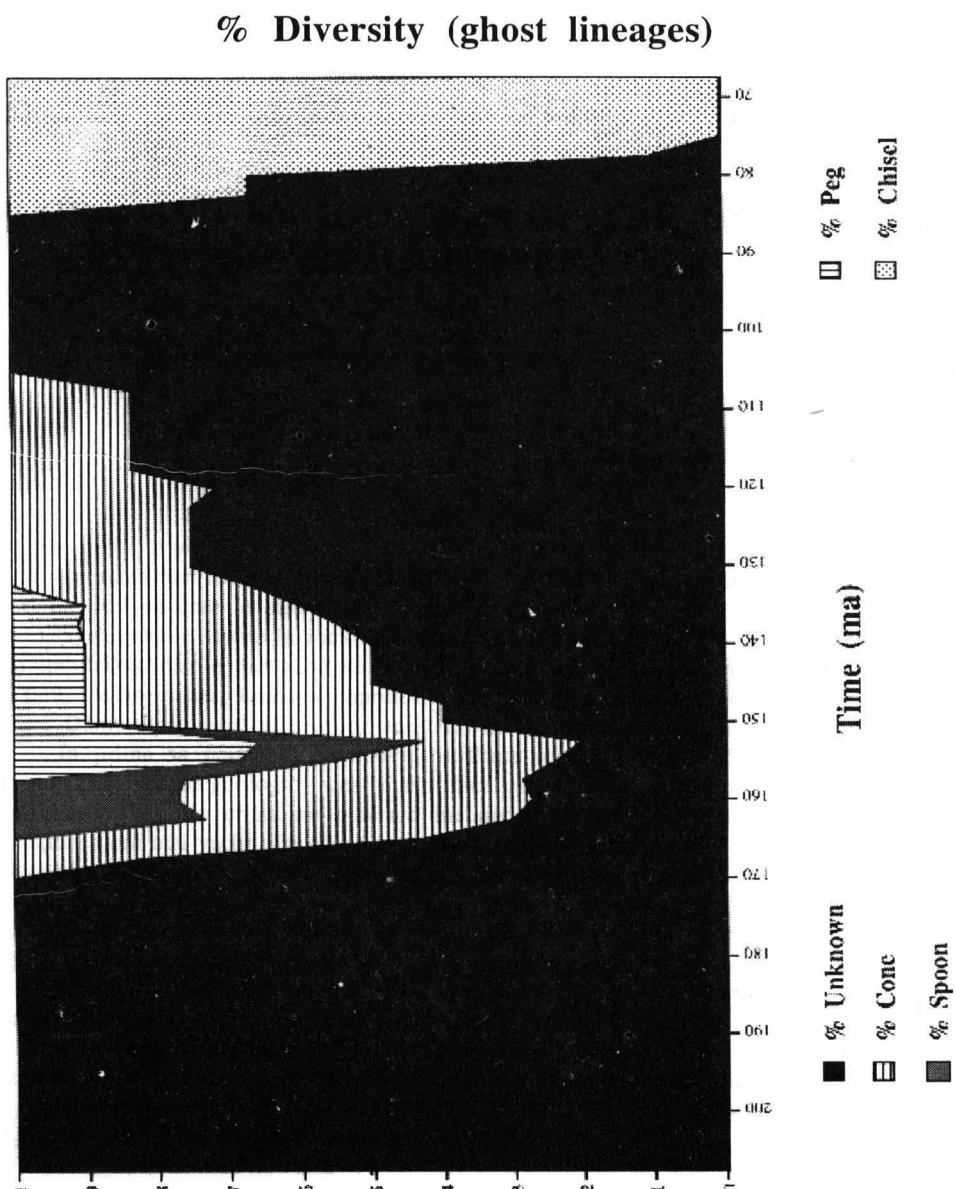
**Diversity (ghost lineages)**

Fig. 12. – Diversity of sauropod feeding groups, based on ghost-lineage analysis.



*Fig. 13. – Diversity of sauropod feeding groups transformed into percentages, based on ghost-lineage analysis.*



# FLORA AND VEGETATION OF THE UPPER BASIN OF DÂMBOVIȚA. COMPARATIVE SURVEY

VALERIU ALEXIU

*Muzeul Județean Argeș*  
*Str. Armand Călinescu 44; 0300 – Pitești*

## REZUMAT

Lucrarea face scurte referiri la locul de obârchie al râului Dâmbovița, la cele două tipuri de chei pe care le străbate în bazinul său superior, de la Gura Vladului și până la Dragoslavele, cheile săpate în rocă de natură acidă (sisturi cristaline: Pecineagu, Petrimanului și Bălțatului) și cheile din zona de calcare, care formează cel mai mare Complex de chei din țară. De asemenea, lucrarea cuprinde o succintă caracterizare a principalelor chei de pe traseul Dâmboviței și al afluenților acesteia, în bazinul său superior.

În prima sa porțiune, Dâmbovița străbate rocile dure ale Masivului Iezer-Păpușa. Din punct de vedere geologic, acest masiv face parte din marele grup cristalin al Carpaților Meridionali. Sisturile cristaline puternic metamorfozate ale seriei de Cumpăna reprezintă formațiunea cea mai veche. Ea ocupă axul unui anticinal, având laturile flancate de succesiunea cristalină a Făgărașului, spre nord și cea de Leaota, pe flancul sudic, aceasta din urmă fiind formațiunea cea mai tânără.

Peste formațiunile cristaline ale Masivului Iezer-Păpușa apare o zonă în care se dispun formațiuni sedimentare de calcare și conglomerate, în care apele Dâmboviței taie sălbaticice chei, la nord și sud de localitatea Podu Dâmboviței. Componența geologică a acestui bazin aparține jurasico-cretacicului. Aceasta este o zonă de prăbușire, în care cristalinul se afundă - dar apare de jur-imprejur, depunându-se calcare lithionice, acoperite de formațiuni conglomeratice și grezoase de vîrstă cretacică. În evoluția cheilor din bazinul Dâmbovița, un rol însemnat l-au jucat procesele carstice, în special cele endocarstice. Carstul acestui bazin cuprinde forme de chei, lapiezuri, doline, peșteri.

Sub aspect floristic, în bazinul superior al Dâmboviței se distinge o evidentă deosebire, privitoare la numărul speciilor vasculare identificate în cele două tipuri de chei. În Cheile Petrimanului, Cheile Bălțatului și Pecineagu, din zona cristalinului, au fost identificați 255 de taxoni, din care 47% sunt strict acidofili, iar 151 dintre aceștia, reprezentând un procent de 59,2%, au fost regăsiți și în cheile de pe substrat calcaros.

Flora Cheilor calcaroase din complexul de Chei al Dâmboviței numără 654 taxoni, din care, un procent însemnat (44,03%) sunt strict calcofili.

În ceea ce privește repartiția formelor biologice, prin studiul calitativ sau/și cantitativ, se constată că în cele două tipuri de chei (cu substrat acid și substrat bazic), ponderea acestora este sensibil egală: hemicriptofitele, 61,18% în zona de șist a cursului superior al Dâmboviței, față de 60,7% în sectorul calcaros. La fel, camefitele reprezintă 5,1% față de 5,2%, geofitele 9,8% față de 10,8%, terofitele 11,76%, respectiv, 11,7%, iar fanerofitele prezente în proporție de 12,6%, comparativ cu 11,2%.

Structura areal-geografică a florei bazinei superioare al Dâmboviței indică o participare, în diferite proporții, a 16 categorii de elemente cu origini florogenice diverse, dintre care, în cheile Petromanului, Cheile Bălțatului și Pecineagu, din zona cristalinului, sunt prezente doar 12 categorii.

Predominante sunt elementele eurasiatice, în ambele tipuri de chei. În zona de șist, ele sunt majoritate față de cea calcaroasă (51,37% față de 37, 62%). Pe fondul acestora s-au interferat, în diferite perioade fitoistorice, elemente europene, circumpolare, central-europene, cosmopolite și un contingent de elemente sudice.

Spre deosebire de zonele de șist străbătute de cursul superior al Dâmboviței, în complexul cheilor de calcar (Cheile Mari, Cheile Mici ale Dâmboviței, Cheile Ghimbavului, Cheile Dâmbovicioarei, Cheile Cheii, Cheile Rudării etc.) se întâlnește o serie de specii floristice interferante sau conservate pe acest teritoriu în diferite perioade fitoistorice: pontice și ponto-panonice, ponto-mediterraneene, submediterraneene, mediterraneene, atlanto-mediterraneene, alpino-carpato-caucaziene, carpatico-endemice.

Studiul ecologic al florei identificate pe cursul superior al Dâmboviței, în raport cu principalii factori: umiditatea, temperatura și reacția solului, subliniază preponderența, în zonele acide, a speciilor mezofile spre mezo-higrofile, micro-mezoterme spre microterme și criofile, respectiv, slab-acid-neutrofile, iar în zonele cu substrat bazic sunt dominate elementele mezofile spre xero-mezofile, moderat-termofile, respectiv, speciile caracteristice pentru condiții neutro-bazifile.

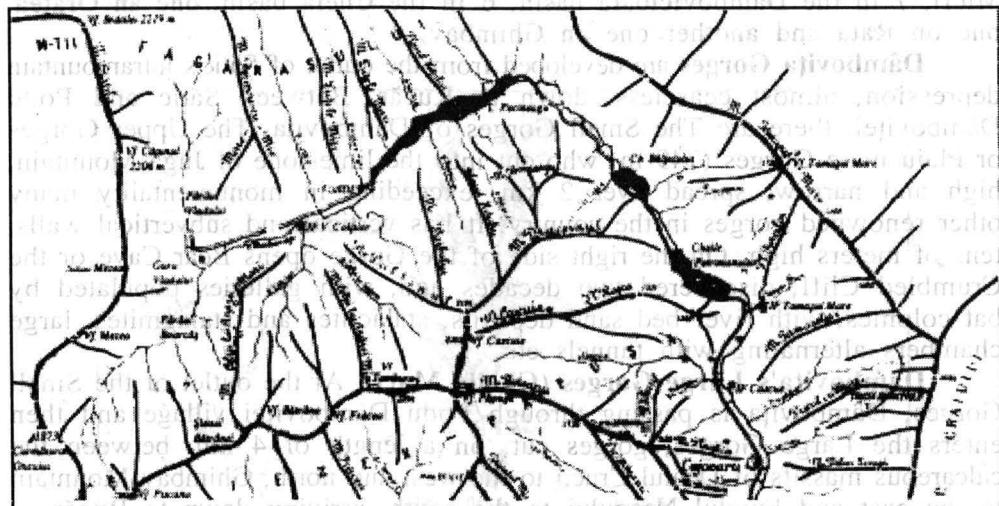
Din totalul care vegetează în zona cercetată, 49,2% sunt diploide în zona de calcar și 41,6% în cea de acid, iar poliploidele sunt preponderente în zona de acid (40,5%) față de cea de calcar (36,9%), aspect explicabil prin existența condițiilor pedoclimatice mai severe. Preponderența populațiilor diploide în teritoriul cu substrat bazic demonstrează vechimea florei respective, fapt ce asigură un potențial genetic favorabil evoluției. Pe acest genofod s-a conservat, alături de un număr de elemente alpigene, un procent ridicat de elemente diploide.

Studiul similarității asociațiilor din teritoriul cercetat, s-a făcut pe baza indicelui de similaritate Jaccard, luându-se în considerare prezența/absența taxonilor identificați în cele 87 relevări, ale celor 11 asociații. În urma obținerii matricei de similaritate rezultă o dendogramă de similaritate, care permite conturarea unor grupe de chei cu caracteristici asemănătoare: a) grupa cheilor de calcar: Cheile Mici, Cheile Mari, Cheile Ghimbavului, Cheile Rudării, Cheile Cheia, Cheile Dâmbovicioarei. b) grupa cheilor formate pe substrat acid: Cheile Petromanului, Cheile Bălțatului și zona Pecineagu; c) grupa de tranziție: Podu Dâmboviței, Sătic, zone depresionare, cu influențe antropicice mai accentuate.

## LOCATION. DESCRIPTION

The source of Dâmbovița river is under the connecting bridge between Făgăraș and Iezer-Păpușa, Mezea-Oticu Ridge, oriented north-south from Brătila Peak (2.279 m) of Făgăraș Massif, to Red Peak (2.469 m) in the Iezer-Păpușa Massif. On the western slope of this crest spring the brooks

which will from Râul Doamnei, while on the eastern slope, from Boarcăș and Vladului brooks, that will be united al Gura Vladului (1.223 m) starts the Dâmbovița river. The river flows, at the beginning, from south-west to north-east, stealing through the precipitous walls of Făgăraș Massif and those of Iezer-Păpușa Massif, in the valleys of whom there are flowing numerous brooks even increasing the flow rate of Dâmbovița. In the recent years, at Pecineagu was built a dam to accumulate the water of Dâmbovița (Pecineagu lake).



*Fig. 1 – The upper course of Dâmbovița (northern slope of Iezer-Păpușa Massif)*

At the Pecineagu dam, Dâmbovița turns at a right angle on a south-east direction, which will be maintained down to Podul Dâmboviței. In this area, the valley is wild and in some places it is very narrow. Between Dracsin valley and Cascue valley, the stream has to pass through very narrow parts of Băltătului Georges and Petrimanului Georges, gorges of crystalline nature, dug in the hard rock of Cumpăna series. Released from the tightness of the georges, the valley broadens up, forming the Decision river meadow (Lunca Hotărârii), and from the few houses from Cojocaru (860 m) down to Săticu de Jos, the river flows through an intramountain depression, located at 810 m above sea level.

As it enters Cheile Mici (Small Gorges), Dâmbovița is flowing though a hydrographical convergence, located at the south-western end of the tectonic-erosive passage Rucăr-Bran. At this point, Dâmbovița receives its most important tributaries of its upper course: from Piatra Craiului it receives Dâmbovicioara, from the passage Oratea and Cheia, from Leaota comes Ghimbav and from Păpușa, Râușoru.

Because of its high uneven portions, compared to the surrounding mountain massif, the region appears as a depressionary gully, to its formation contributing both the tectonic movements and the erosion (Ion Popescu-Argeșel, 1980). Most of these gorges dig their way through calcareous rocks, forming here, both in number and length and branching, the largest gorge complex of the country.

Within the complex there are 18 gorges (even 23 according to Ion Popescu-Argeșel), that is: 2 on the Dâmbovița (Cheile MArî and Cheile Mici), 7 in the Dâmbovicioara basin, 6 in the Cheia basin, one an Oratea, one on Rata and another one on Ghimbav.

**Dâmbovița Gorges** are developed from the outlet of Sătic's intramountain depression, almost ceaseless, down to Rucăr. Between Sătic and Podu Dâmboviței, there are The Small Gorges of Dâmbovița, The Upper Gorges or Plaiu mare Gorges (749 m) who cut into the limestone of Juga Mountain, high and narrow, spread over 2 km, exceeding in monumentality many other renowned gorges in the country. It has vertical and subvertical walls, tens of meters high. On the right side of the Gorge opens Bear Cave or the Crumbled Cliff, discovered two decades ago, with galleries populated by bat colonies, with river bed sand deposits, stalactites and stalagmites, large chambers alternating with tunnels etc.

**Dâmbovița's Large Gorges (Cheile Mari).** At the outlet of the Small Gorges, Dâmbovița is passing through Podu Dâmboviței village and then enters the Large Gorges, gorges cut, on a length of 4 km, between the calcareous massifs of Dealul Crucii to the west and north, Ghimbav Mountain to the east and Fundul Neagului to the south, arriving down to Rucăr.

Close to the entrance to Cheile Mari (Large Gorges), on the left hand side, it opens an impressive passage, narrow and sinuous, wet and dark, on whose bottom steals away the restless stream of Cheia river. It is the Cheia strait, 400 m long, relatively accessible. Except for a small portion in the area of confluence with Ghimbav, the valley is extremely narrow, the river covering entirely the bottom of the Gorge. On almost the entire route, the Large Gorges of Dâmbovița have vertical and subvertical walls, also kettles and numerous springs discharging below the level of the river. After the confluence with Ghimbav, one can see the pattern difference of the two mountain sides. Thus, the right hand mountainside, exposed to the south and, as a result, with higher temperature levels, has a more complex morphology with a more active dynamic generating both a residual microrelief and deluvial detritus. The right mountainside is, for these reasons, more barren than the left-hand one.

**The Gorges of Dâmbovicioara's basin,** They are located along the same river as well as on some of its tributaries. The most important are the following: Brusturet Gorge, Dâmbovicioara Gorge, the gorges of Valea cu Apă, Valea Seaca Pietrelor, Valea Muierii, Valea Peșterii.

**Brusturet Gorge** is developing from the confluence of Valea cu Apă with Valea Seaca Pietrelor, down to Dâmbovicioara village, on a lenght of 5 km. It has some very narrow portions, with many marks of kettle. On the left side of this gorge there is the Dâmbovicioara Cave with a lenght of 300 m and many concretions having odd names.

**Dâmbovicioarei Gorge** extends between Dâmbovicioara and Podu Dâmboviței villages, being 4 km long. It is characterized by narrowness, high calcareous walls. Has many kettles, level gulleys, several debris necks. On its sides one can observe very well the geological structure which shows

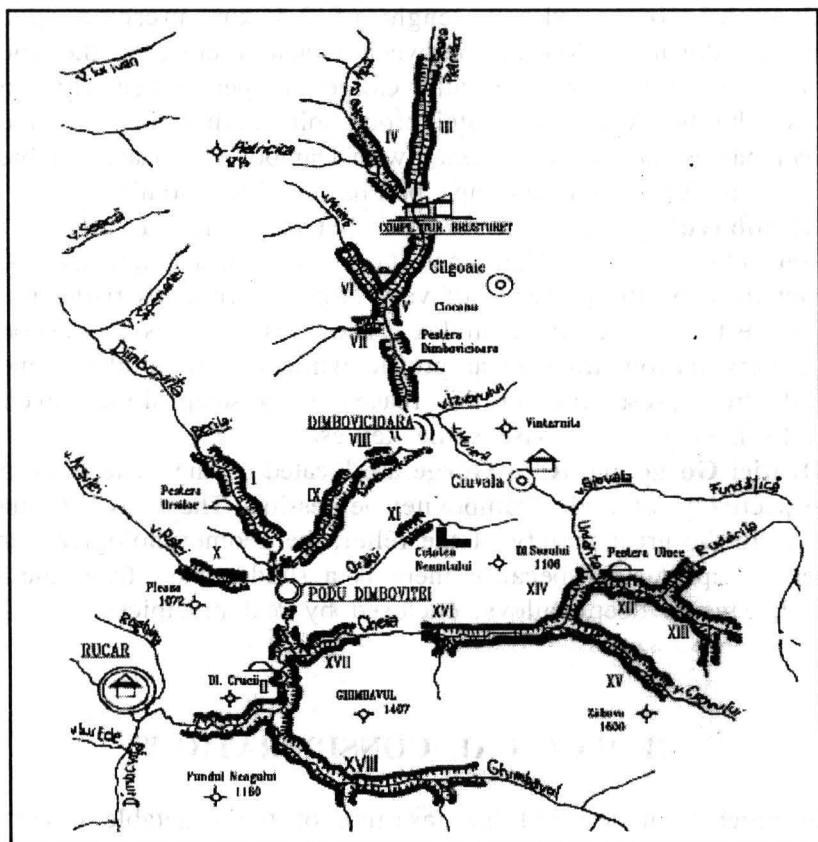


Fig. 2 – The gorge complex of Dâmbovița's upper basin

1. Dâmbovița's Small Gorge; 2. Dâmbovița's Large Gorge; 3. Seaca Pietrelor Valley's Gorge; 4. Valea cu Apă Gorge; 5. Brusturet's Gorge; 6. Valea Muierii's Gorge; 7. Cave's Gorge; 8. Dâmbovicioara's Small Gorges; 9. Dâmbovicioara's Large Gorges; 10. Rata's Gorge; 11. Oratea's Gorge; 12. Rudărīa's Gorge; 15. Crov's Gorges; 17. Cheia's Gorges; 18. Ghimbav's Gorge

as stocks a piles, with different slopes - a proof that the calcareous formations suffered intense tectonic movements.

**The Gorge of Cheia's basin.** They are dug in the calcareous massif within the passage, located to the north of Leaota'crystalline. Out of the six gorge, four are in the upper basin.

**Rudărița Gorge** is 2 km long, while Prepeleacului Gorge is 1,5 km long. Both have vertical walls and a great drop of the thalweg. In the right hand side of Rudărița Gorge there is the Uluce Cave.

**Urdărița Gorge** starts after the confluence of this stream with Rudărița, extending to the confluence with Valea Crovului.

**Crovului Gorge** with a lenght of 2,5 km, presents spectacular escarpments, down to 300 m, bertween Ciucului crest to the south and Zacotelor Crest to the north. Crovului Gorge cuts perpendicularly two faults.

Crovului brook and Urdăriței brook join, giving rise to Cheia river. This river passes, util the confluence with Dâmbovița, an area of barremian calcars and a tithonic calcars, just before the river month.

**Ghimbavului Gorge** is located between the calcareous massifs Ghimbavul (1.407 m) and Vârtoapele (1.434 m), on a length over 4 km. It is characterized by the presence of very large escarpments rising up to 400 m, the largest of the entire complex. Also, this gorge is the deepest one. It has a very narrow transversal profile while the longitudinal one has a very high drop, presenting for this reason many steep slopes, even a few water falls having at the base some kettles.

**Oratiei Gorge and Rata Gorge** are located on the eastern and western side, respectively, of Podu Dâmboviței depression. They have a small size.

Due to the great variety of the relief, the geomorphological landscape is extremely spectacular because there is a sudden pass from the slightly waved plateaus to deep valleys, enclosed by real precipices.

## GEOLOGICAL CONSIDERATIONS

In order to understand the insertion of the vegetable cover on the petrographic underalayer, we would make a brief geological description of Iezer-Păpușa Massif, forming most of Dâmbovița river basing.

From geological point of view, this massif is a part of large crystalline group of the Southern Carpathians. The strongly metamorphosed crystalline schists of Cumpăna series represent the oldest formation. It occupies the

axis of an anticline, having the sides bordered by the crystalline sequence of Făgăraș, to the north and of Leaota to the south, the latter being the youngest formation.

The Cumpăna series forms the largest part of the main ridge of the massif, presenting all the rock complexes with clear metamorphism characters (R. Dimitrescu, 1966).

The lower part of the series is represented by the Cumpăna-Holbav gneiss area, representing a well distinguished individuality, which appears in the massiv through a small anticline „button-hole”, just to the south of Bătrâna Peak and, partially, on the upper course of Dâmbovița. To the north, the Cumpăna-Holbav gneiss are following the northern side of Dâmbovița. The largest part, however, is in the area of Iezer-Şerbota, with a stratigraphic high of about 2.000 m.

The upper part of Cumpăna series which can be followed in the Iezer-Păpușa Massif from the sources of Râul Târgului up to the basin of Bârsa, consists of Voinești-Păpușa area (N. Gherasi, V. Manilici, R. Dimitrescu, 1996). Sidewise it present a strip of ocular gneiss, with quartz schists with biotite. This area outcrops in Leaota Massif (anticline button holes in Băngăleasa, Brătei, Ghimbav Valleys). The stratigraphic heigh of this area is of about 2.500 m.

Most of the secondary ridges are cut from the Leaota series crystalline, corresponding to the green schists facies, represented by mucovite-chloritic schists and chloritic-sericitous schists (N. Gherasi, R. Dimitrescu, 1964; Aurelia Barco and E. Nedelcu, 1974).

This series has a basic amphibolite, with a stratigraphic height of 10 to 15 m, which amphibolite forms an excellent lever mark delimiting the Leaota series from Voinești-Păpușa zone. On top of it there is an about 3.000 m stock made of muscovite-chloritic schists with albite-porphyroblasts and some amphibolite inserts. It is the Lerești-Tămăș area which can be tracked starting from Plaiul Foii (the western side of Piatra Craiului), passing through Dâmbovița valley and the southern side of Păpușa Mountain, up to Văcarea, reappearing to the south of Râul Târgului and on Dâmbovița, between Rucăr and Dragoslavele; from here, to the east it passes to Leaota Massif, forming most of it.

The last part of the Leaota series is represented by Călușu-Tămășel area which forms the axial aprt of a synclinal which can be tracked from Râul Târgului's basin passing through Argeșelu's valley up to Dâmbovița's valley, at Sătic. The development of the component minerals is lower in the schists of Lerești-Tămăș area, this proving a lower degree of metamorphism. The schists of Călușu-Tămășel area, appear also in the Dâmbovicioara passage.

Over the crystalline formations described above, in the south-eastern part of the Iezer-Păpușa Massif, there is a quite important zone having disposed transgressively and discordantly sedimentary formations of calcars and conglomerates in which the water of Dâmbovița is cutting savagely gorges to the north and to the south of Podu Dâmboviței village. The geological componence of this basin is from jurassic-cretaceous, the settling function belonging to a time interval from the middle of jurasic up to the end of the cretaceous. The tectonic distortions of the different nature, amplitude and age creates important disturbances in the initial position of the layers (M. Ilie, 1971). This is a collapse area in which the crystalline sinksint it appears all around. Due to the sinking of the crystalline, the Mesozoic seas invade the area favoring the sedimentation in calcareous, conglomerating and sandstone facies. The tithonic calcars are the hardest rocks and they were covered by conglomerates and sandstone of Cretacic age. After the recess of the Cretacic sea, the hydrographic network settled in these rocks, less resistant. In the Mesozoic, as well as in Neozoic there were several tectonic movements, which were demostrated by the numerous faults and ruptures within the sedimentary formations. Later, the hydrographic network deepens, arriving to the calcar level. This emphasizes the epigenetic nature of the Dâmbovița's basin gorges.

In the evolution of the Dâmbovița's gorges, an important role was played by the carstic processes, in particular the endocrustic ones, the main role being played by the fluvial erosion causing the kettling effect. The carst of this basin includes forms of gorges, lap overs, dolina, caves. It seems that the carsting phenomena reached a maximum of growth around Podu Dâmboviței village where there is a polje depression (I. Popescu-Argeșel, 1980).

## **COMPARATIVE STUDY OF THE FLORA AND VEGETATION OF THE GORGES OF THE UPPER BASSIN OF DÂMBOVIȚA**

Due to complexity of the geological structure, on the background of within the general phytogeographical distribution, there are some environmental

changes of the vegetation caused by the various nature of the petrographic substratum, by the variability of the pedoclimatic conditions by the altitude difference as well as of the zoo-antropic influences, in the vegetation gorges investigated in the upper basin of Dâmbovița, there are substantial changes of the vegetable cover. This paper tried to make a floristic and cenotaxonomic inventory which would offer the premises of some prospecting and evaluations of the different aspects of the vegetation in 2 types of gorges on acid and alkalihne substratum.

a) Form floristic point of view, there is a clear difference of the number of vascular species identified in the two types of gorges. In the Petrișan's, Bălțatu' and Pecineagu's gorges, in the crystalline area, were identified 255 taxons, 47% of which are strictly acidophytic, while 151 of these representing 59,2% we also found in the gorges with calcareous substratum. The 255 taxons are grouped in 62 families, the best represented are: *Asteraceae* (12,54%), *Rosaceae* (6,27%), *Caryophyllaceae*, *Labiatae* and *Ranunculaceae* (5,49%), *Poaceae*, *Brassicaceae* (4,70% each), *Fabaceae* (3,92%) etc.

The flora of the calcareous gorges Complex Of Dâmbovița, in the territories investigated by us, has 645 taxons, with a very high percentage (44,03%) consisting strictly of calcophytes, grouped in 80 families, with the content of: *Asteraceae* (12,1%), *Brassicaceae* (6,15%), *Ranunculaceae* (5,95%), *Lamiaceae* (5,77%), *Caryophyllaceae* (5,02%), *Apiaceae* (4,47%), *Rosaceae* and *Poaceae* (4,46% each) etc.

b) As far as the spreading of the biological forms, by quality and/or quantity survey, it is found that in the two types of gorges (on acidic substratum and alkaline substratum) their extent is considerably equal: hemicryptophytes 61,18% in the schist area of Dâmbovița upper basin, compared to 60,7% in the calcareous area. Likewise, the camephytes represent 5,1% compared to 5,2%, the geophytes 9,8% versus 10,8%, the terrophytes 11,76%, 11,7% respectively while the phanerophytes are 12,6% compared to 11,2%, this percentage representing their coverage in the vegetable cover of the gorges on calcareous substratum. This distribution of the bioforms can be explained by the affiliation of the investigated area to the some phytoclimate: the hemicryptophytic climate characteristic to the nondry temperate regions (Raunkiaer, 1905, 1918 ap. C. Drăgulescu, 1995).

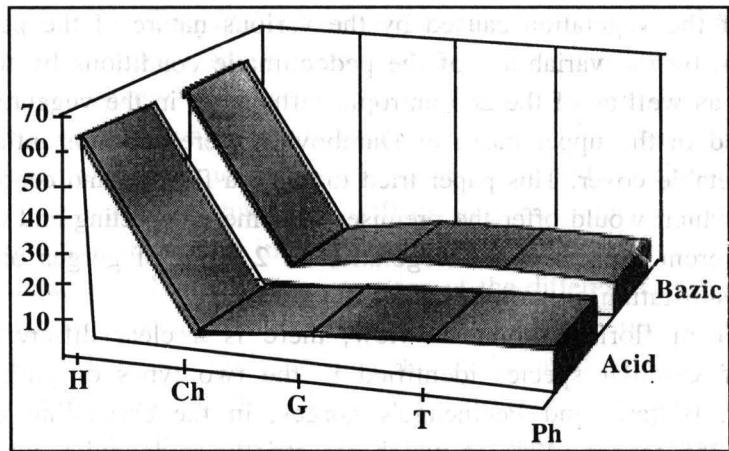


Fig. 3 - Spectrum of biological forms on the upper course of Dâmbovița

c) The analysis of the geoelements. The area-geographical structure of the Dâmbovița's upper basin's flora shows a participation, in different ratios, of 16 classes of elements of various florogenetic origins, from which in the gorges of Petrimanu, Bălțatu and Pecineagu are present only 12 categories.

In both of gorges the Eurasian elements are prevailing. In the schist area these prevail over the calcareous one (51,37% versus 37,62%). On this back-ground there were interferences, in different phytohistorical periods, of European elements, Polarcircle elements, Central-European elements, Cosmopolites and some southern elements.

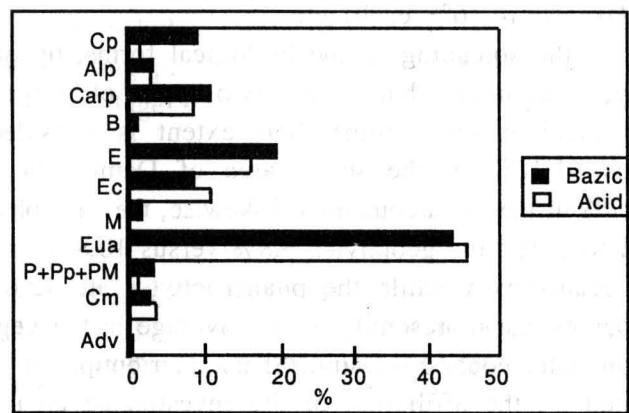


Fig. 4 - The spectrum of the geoelements of the phytocoenoses identified on the upper course of Dâmbovița

In the area with acidic substratum, the prevailing elements are the Eurasian, Polarcircle, Alpine-Carpathian-Balcanic ones, elements which characterize a cooler climate, while the calcareous gorge complex offers favorable conditions for European, Central-European, Pontic, Pontic-panonic and Mediterranean-pontic, Mediterranean, Submediterranean and Altanto-mediterranean, Carpathian-balcanic, Carpathian endemic, elements which emphasize both the relationships with the southern regions and Central-European ones, with the Balcanic-illiric region and the Balcanic-moesic region, Anatolia and the Caucasians, presenting affinities to the Central-European region and reasonable influences towards the balcanic-anatolian region, but also conservative character of the rocky substratum intensified on the calcars.

As a difference from the schist area crossed by the upper course of Dâmbovița, in the calcareous gorge complex (Large Gorges, Small Gorges of Dâmbovița, Ghimbav Gorges, Dâmbovicioara's Gorges, Cheia's Gorges Rudărița's Gorges) one can meet some floristic species interfered a preserved on this territory in different phytohistorical periods: pontic and ponto-panonic – *Inula ensifolia*, *Erysimum odoratum*, *Isatis tinctoria*, *Iris aphylla*, *Glechoma hirsuta*, *Salvia austriaca*, *Glaucium flavum*, *Ranunculus acris* ssp. *strigulosus*; pontic-mediterranean – *Melica nutans*, *Stachys recta*, *Allium flavum*, *Asparagus tenuifolius*, *Ornithogalum orthophyllum*, *Torilis ucranica*; submediterranean – *Rorippa pyrenaica*, *Cnidium silaifolium*; mediterranean *Arabis turrita*, *Primula veris* ssp. *columnae*, *Rhamnus saxatilis* ssp. *tinctorius*, *Galium divaricatum*, *Galium lucidum*; atlantic-mediterranean – *Tamus communis*, *Primula vulgaris*, *Sanicula europaea*; alpine-carpathian-caucasian – *Orobanche flava*; balcanic – *Campanula kladniana*, *Cirsium decussatum*; carpathian-endemic – *Dianthus spiculifolius*, *Thymus comosus*, *Thymus comosus* ssp. *transsilvanicus*, *Salvia transsilvanica*, *Dianthus tenuifolius*, *Gypsophylla petraea*, *Trisetum macrotrichum*, *Silene dubia*, *Campanula carpatica*, *Dentaria glandulosa*, *Dianthus henteri*, *Leucanthemum waldsteinii*, *Centaurea pinnatifida*, *Hesperis nivea*, *Gentiana cruciata* ssp. *phlogifolia*, *Phyteuma tetramerum*, *Viola jooi*, *Ranunculus carpaticus*, *Saxifraga mutata* ssp. *demissa*, *Hepatica transsilvanica*, *Symphytum cordatum*.

d) The environmental survey of the flora identified on the upper course of Dâmbovița, compared to the main factors: humidity, temperature and reaction of the soil, emphasizes the dominance in the acid areas of the mesophytic species towards the meso-hygrophytic, of the micro-mesothermal towards the microthermes and criophytic, respectively, weakly-acidicneutrophic, while in the alkaline substratum areas dominate the mesophytic towards xero-mesophytic elements, moderately-thermophytic, respectively, the characteristic species for neutral-alkiphobic conditions.

e) The study of the diploid and polyploid species distribution. Of the

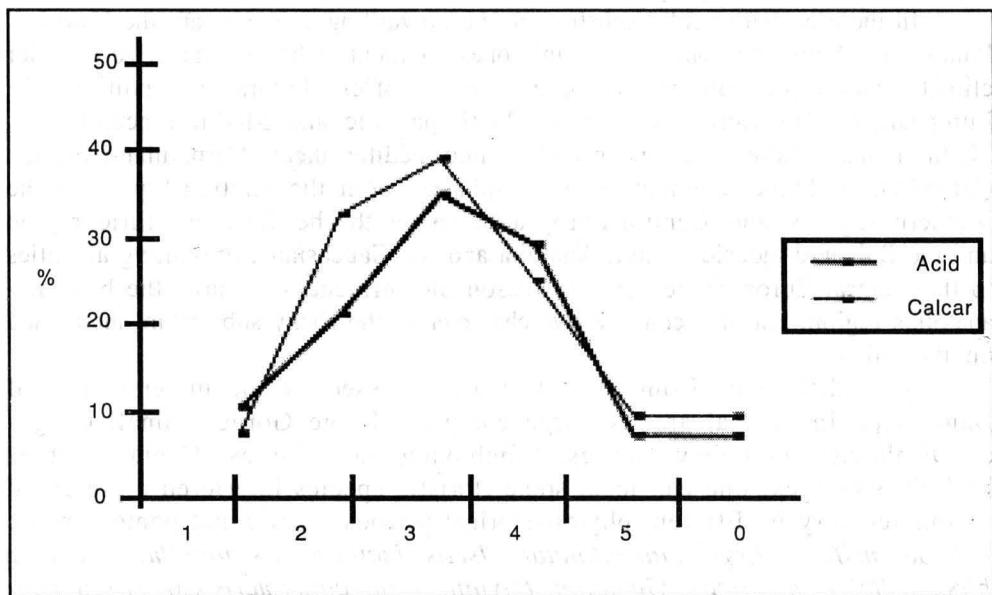


Fig. 5 – The behaviors of identified the cormoflora to U factor.

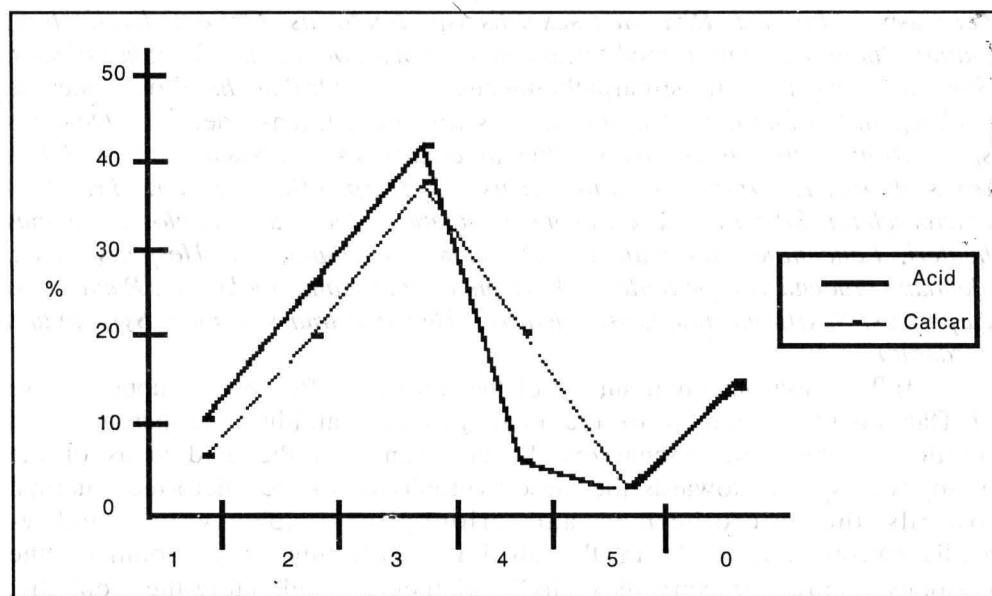


Fig. 6 – The behavior of the identified cormoflora to T factor

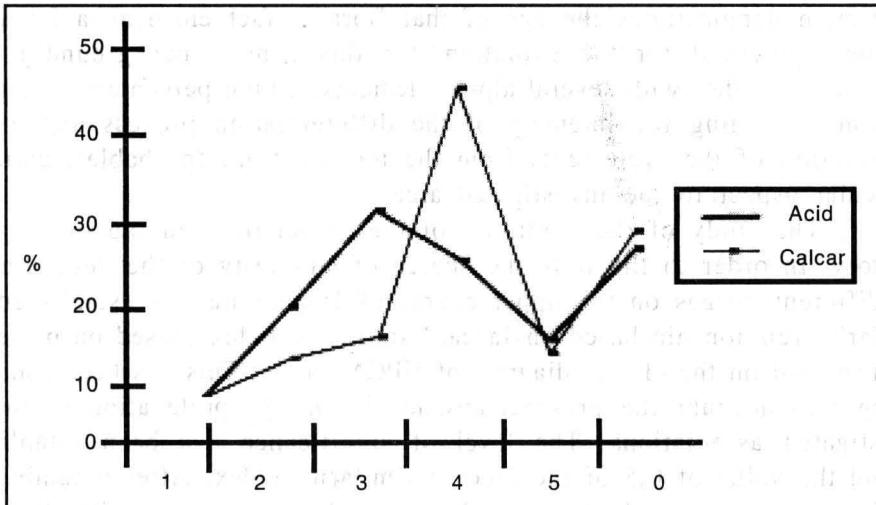


Fig. 7 – The behavior of the identified cormoflora to R factor

total of species vegetating in the investigated area of the upper basin of Dâmbovița, 49,2% are diploids in the calcareous area and 41,6% in the acidic one while the polyploids are prevailing in the acidic zone (40,5%) compared to the calcareous one (36,0%), explainable by the existence of more severe pedoclimatic conditions.

The prevalence of the diploid population in the territory with basic

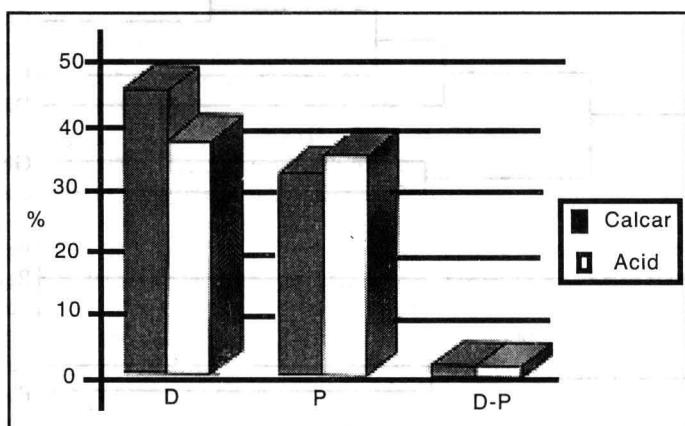


Fig. 8 – The diploid and polyploid species distribution

substratum demonstrates the age of that flora, a fact ensuring a favorable genetical potential for the evolution. On this genetic background it was preserved, together with several alpine elements, a high percentage of diploid elements revealing the intensity of the differentiation process and of the preservation of these elements from the tertiary flora (probable), giving a particular aspect to the investigated area.

f) The study of the similarity of the associations in the investigated territory. In order to illustrate the degree of similarity of the vegetation of the different gorges on the upper course of Dâmbovița, we established the similarity relationship based on Jaccard similarity index (based on presence/absence) and on the cluster diagram of UPGMa type. This has been achieved taking into account the presence/absence in the 87 prelevation of the 11 investigated associations. The level of significance has been established around the value of 0,5 of the Jaccard similarity index. After obtaining the similarity matrix we obtain a similarity dendrogram which will allow the forming of some gorge groups with similar characteristics.

- calcareous gorge group: Large Gorges, Small Gorges, Ghimbav's

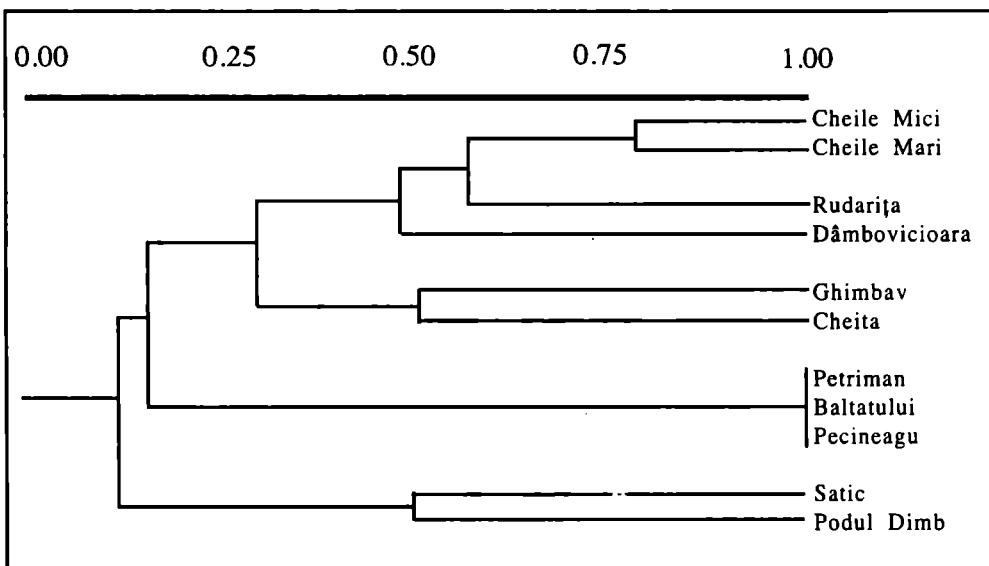


Fig. 9 - Similarity dendrogram of the associations in the upper course of Dâmbovița

Gorges, Rudărița's Gorges, Cheița's Gorges, Dâmbovicioara's Gorges. Within this group it is clearly demonstrated the similarity between the Small Gorges and the Large Gorges, also between Ghimbav's Gorges and Cheița's Gorges;

- acidic substratum gorges: Petriman's Gorges, Bălțatu's Gorges and the adjoining Pecineagu area;

- the transition group: Podu Dâmboviței, Sătic, depressionary areas with more marked antropic influences.

This method verifies perfectly the values of all the phytocenological indexes given above. Knowing the floristic and cenotic structure of this area, using the mathematical calculation and the PC facilities, one can plot the configuration of the vegetable cover depending on different environmental, pedo-climatic, antropo-zoogenic factors, in our case the geological substratum dictating the presence or absence of certain fitotaxons in the different gorges of the upper basin od Dâmbovița.

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# **ENVIRONMENTAL IMPACT ON THE VGETATION OF THE HYDROELECTRIC LAY-OUTS OF VIDRARU, CUMPĂNIȚA, VÂLSAN, OF THE ARGEȘ RIVER UPPER BASIN**

**VALERIU ALEXIU**

*Muzeul județean Argeș  
Str. Armand Călinescu 44; 0300 – Pitești*

## ***REZUMAT***

Dezvoltarea societății umane presupune existența unor infrastructuri capabile să asigure derularea proceselor economice și sociale, infrastructuri care ocupă locul unor biocenoze naturale sau antropizate, producând o serie de modificări în arealul din imediata apropiere, o serie de schimbări ale structurii și dinamicii fitocenozelor respective. De aceea, este necesar studiul de impact ecologic pentru orice proiect de investiții, prin aceasta putându-se evidenția gradul de distrugere și disconfort realizate prin construcția sau amenajarea respectivă, pe de o parte, și stabilirea măsurilor necesare refacerii biocenozelor ce vor fi afectate și reconstrucție ecologică a ecosistemelor în cauză.

Cunoașterea dimensiunilor impactului ecologic, datorat amenajărilor hidroenergetice bazinei superioare al Argeșului, impune fundamentarea măsurilor de protecție a mediului, precum și dezvoltarea monitoringului în aceste zone, optimizare deciziilor privind măsurile de verificare a potențialului hidroenergetic în acord cu necesitatea protecției speciilor de plante rare sau pe cale de dispariție, a ecosistemelor reprezentative din bazinele superioare ale Argeșului.

Biotopul și biocenozele noi formate prin apariția acestor acumulații formează ecosisteme noi, de cele mai multe ori mult diferite de cele inițiale.

Prin amenajarea acestor construcții se modifică regimul de curgere al râurilor, biotopul din reofil (sau lotic) devine lentic. În aceste biotopuri, datorită vitezei de curgere mai redusă, are loc o creștere a sedimentării suspensiilor, deci a apariției unui facies mâlos pe cuvetă, de asemenea, are loc instalarea și dezvoltarea unei biocenoze dominate de speciile stagnofile și cosmopolite (V.Cristea et al., 1996).

Din literatura de specialitate, privitoare la unele determinări ale biomasei planctonice din Lacul Vidraru (G. Vasiliu, 1972), reiese ca apele râului și-au schimbat parametrii

fizico-chimici și structura calitativă și cantitativă a fitoplanctonului. Astfel, au fost studiate temperatura, transparența și culoarea apei, concentrația ionilor de hidrogen, duritatea totală, alcalinitatea, valorile fosfaților, a nitratilor și sulfatilor, care dău caracterul de eutrofizare pronunțată apelor lacului. Cercetarea componentei algale și, în special, a fitoplanctonului, subliniază funcția de producere a substanței organice primare ce revine acestor categorii ca elemente trofice concrete în cadrul lanțurilor care se stabilesc în ecosistem. Fitoplanctonul, de tip stagnofil, alcătuit din specii tipic lacustre, este dominat de *Asterionella formosa*, diatomee colonială, alături de care au mai fost identificate specii ale geniului *Cosmarium* (Conjugata), unele peridinee, flagelate etc. În zonele de influență din imediata apropiere a vărsării afluenților în lac, s-a observat un conținut mai mare de diatomee reobionte, aduse de acești afluenți (*Ceratoneis arcus*, *Cymbella sp.*, *Navicula sp.*, *Achnantes sp.*).

Odată cu apariția acestor amenajări, se impune problema impactului ecologic asupra vegetației. Arealul în discuție cuprinde zonele limitrofe cursurilor de râu, a lacurilor de acumulare, dar și interfluiilor Capra-Buda, respectiv Argeș-Vâlsan. Impactul declanșat de presiunea antropică asupra covorului vegetal a determinat, în unele locuri, modificări profunde. Atât variațiile cu care s-a exercitat presiunea, cât și diferențele acestora în privința sensibilității și vitezei de cicatrizare au avut ca efect determinarea unei mozaicări a covorului vegetal.

Construcțiile hidroenergetice, precum și drumurile de acces construite în lungul lacurilor de acumulare au modificat puternic specificul vegetației, imprimând dezvoltarea buruienișurilor higofile. Local, unele activități antropice au declanșat o eroziune foarte puternică, mai ales în porțiunile cu pantă mai accentuată, pe povârnișuri sculptate în roci friabile. În apropierea localităților se instalează o vegetație nitrofilă sau, de multe ori, s-a procedat la defrișări masive.

În urma unui studiu, privind impactul ecologic în zona de influență a amenajărilor hidroenergetice Vidraru, Cumpenița, Vâlsan, din bazinul superior al Argeșului, au fost identificate 25 de asociații vegetale, aparținând la 13 clase, 14 ordine, 18 alianțe și 5 subalianțe.

Asociațiile aparțin următoarelor tipuri de vegetație: vegetația înaltă din apele și mlaștinile eutrofe; vegetația scundă din băltoace și terenuri măloase; vegetația segetală și ruderală; vegetația de stâncării; vegetația pajiștilor mezofile; vegetația tăieturilor de pădure; vegetația buruienișurilor de munte; vegetația zăvoaielor de foioase și de amestec cu răšinoase; vegetația pădurilor de răšinoase.

Folosind indicele de similaritate Jaccard (bazat pe prezență/absența celor 479 specii identificate în cinci stațiuni: Oești, Cheile Argeșului-Căpățâneni, Cumpăna, Cumpănița, Valea Vâlsanului) se obține o dendrogramă de similaritate, din care se desprinde o grupare a stațiunilor:

- Cumpănița și Cumpăna, situate în depresiunea intramontană, sedimentară a Loviștei; taxonii identificați pe Valea Vâlsanului, care formează cea de a doua grupă, vegeteză pe un substrat alcătuit din argile și marne (eocene), pe un relief cu pante mai domoale, cu soluri mai puțin levigate (depresiunea Corbi-Bradet); cu un grad de similaritate apropiat este cea a Cheilor Argeșului-Căpățâneni, situată în lanțul muntos Ghju-Frunjii, unde domină solurile brune acide montane, formate pe gresii și micașisturi; se detasează printr-o valoare mică a indicelui de similaritate (0,16), Stațiunea Oești, amplasată pe un relief cu pante domoale, caracteristică rocilor argiloase și marnoase, pe care s-au format soluri mai puțin

levigate de tipul solurilor brune, a pseudorendzinelor, a solurilor negre de fâneată (Turcu L. Gh., 1969).

- structura dendrogramei poate fi interpretată și prin gradul de antropizare al stațiunilor Vâlsan și, mai ales, Valea Argeșului la Oești, cu o vegetație mult mai ruderalizată decât a celorlalte stațiuni. De altfel, asociațiile stâncărilor și solurilor scheletice (litosoluri) este întâlnită în chei, la Cumpănița și Cumpăna și, în mai mică măsură, pe Vâlsan predomină vegetația nemorală, iar vegetația segetală și ruderală se dezvoltă în aval de Căpățâneni: Arefu, Corbeni, Onești.

The development of human society involves the existence of some infrastructures capable to provide for the economical and social processes according to the necessities and requirements of that society in a certain stage of its evolution. All these infrastructure take the place of some natural and antropized biocenoses, causing several modifications of the area of their close proximity. Thus, one gets several changes of the structure and dynamics of those fitocenoses. For this reason, as it is stated By Vasile Cristea et col., in 1996, „in the environmental strategy of several countries the environmental impact study is legislated for every investment project”.

By means of this study one can demonstrate the degree of destruction and inconvenience achieved through that lay-out, on one hand being able to establish the necessary actions to rebuild the biocenoses which will be affected and the environmental reconstruction of those ecosystems.

The knowledge of the size of the environmental impact, due to the hydroelectric dam construction of the Argeș river upper basin imposes the substantiation of the environmental protection actions as well as the development of the monitoring in these areas. The data obtained following the researches will facilitate the knowledge of the capability to support the ecosystems and the use of the knowledge in the field of hydroenergetical design and arrangement of the rivers as well as in the field of regenerable and nonregenerable natural resource operation.

As economical, social, scientific effects, the study is considering: the optimization of the decisions on the exploitation of the hyrdroenergetic potential in agreement with the necessity to protect the rare or the threatened plants, the representative ecosystems of the Argeș river upper basin.

The birth of the dam lakes created, most of the times, besides the hydroenergetical problems, problems related to the application of some action to exploit these huge volums of water.

The newly fumed biotop and biocenoses due to these accumulations will from new ecosystems, most of the time different from the initial ones.

In Romania, the Forest Research Institute, the Piscicultural Research Institute, the Game Economy Management and the Biogeographical Station Pângărați of Neamț District initiated a complex of hydrochemical, hydrobiological, fauna, pisciculture research carried out since the flooding of Bicaz accumulation lake, over many years. In the Argeș District, up to this date the phytocenological investigations of the vegetable cover after the hydroenergical arrangement are very few, the existing random data of the literature being totally insufficient to offer a complete picture, particularly of the mountain accumulation lakes as it is the case of the lakes Vidraru, Cumpănița, Vâlsan.

By the arrangement of these dams the target is to accumulate a large volume of water required for the operation of the hydroelectric station, supplying electric power. With these constructions the flowing of the rivers is changed, the biotop of the reophyl (a lotic) becomes lentic.

Due to the decreased flow, in these new biotop there is an increase of the suspension settling, therefore there is a slimy facies on the sink, also there is a settling and development of a biocenosis dominated by stagnophyle and cosmopolite species (V. Cristea et al., 1996).

The literature concerning some determinations of the planktonic biomass of Vidraru lake (G. Vasiliu, 1972), shows that the river water changed its physical parameters as well as the quality and quantity structure of the phytoplankton. Thus, the study included the temperature, the transparency and the color of the water, the hydrogen ion content, the total hardness, the alkalinity, the phosphate, nitrates and sulfates value which give the pronounced eutrophisation character of the water of the lake. The investigation of the algae composition and, in particular, of the phytoplankton, emphasizes the function of producing primary organics pertaining to these categories as concrete trophic elements within the chains established in the ecosystem. The phytoplankton, of stagnophyle type, consisting of typical lacustrine species, is dominated by *Asterionella formosa*, a colonial diatomae, which there were identified other species of the *Cosmarium* (Conjugata) genus, some peridinae, phagelatae etc. In the affluence area in the close proximity of the flow of the tributaries into the lake, it has been observed a higher content of rheobiontic diatomeae, brought by these tributaries (*Ceratoneis arcus*, *Cymbella* sp., *Navicula* sp., *Achnantes* sp.). On the vertical, the

phytoplankton occupies, mainly, the upper horizons of the water, where its development is conditioned by the proper light. The samples taken from the water delivery canal from Oeşti have shown that in the deep water the number of algae is reduced, even when on the surface of the lake one can see a „blooming" of the water (G. Vasiliu, 1972).

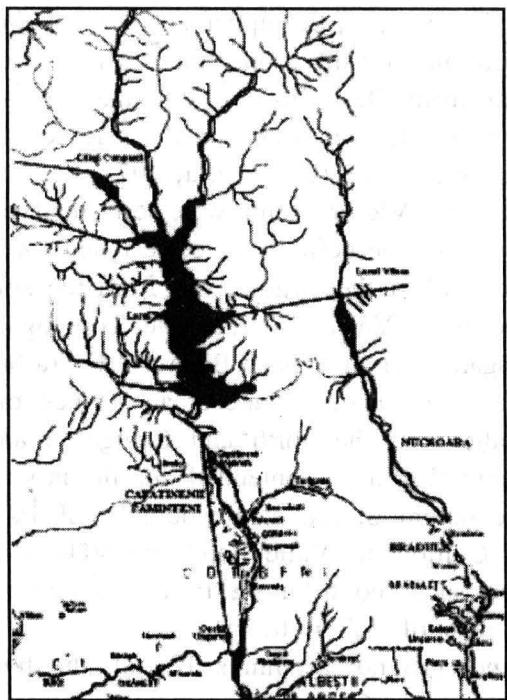
The closing of the Vidraru dam was performed on 15.03.1966. To obtain the necessary hydroenergetic volume, designed for Vidrau (Argeş), it has been intended to collect the Argeş river, from the source to this point, including some feed from Vâlsan, Cernat and Topolog rivers. The Argeş river springs from Făgăraş Massif, though Buda and Capra brooks. Its collection at Vidraru formed an accumulation lake at an altitude of 830 m, between Buda and Capra valleys in the north and Călugăriţa and Lupului in the south. For the accumulation it was intended that the largest depth should be of 155 m while the height of the dam would be of 167 m.

Later, in the Cumpăniţa Valley and the Vâlsan Valley were built other dams, smaller ones, contributing to the achievement of the gross volume of Vidraru lake of 467 mill. m<sup>3</sup>.

Being built underground, at minus 104 m, the hydroelectric station has, with its 4 turbines of 56.500 kW, an installed capacity of about 200 Mw, its annual production of electric power reaching 400 mill. kWh.

With the appearance of these arrangements, there is the problem of the environmental impact on the vegetation. The area in discussion includes the areas around the river banks, of the accumulation lakes but also the inter-rivers Capra-Buda, Argeş-Vâlsan respectively. The impact triggered by the antropic pressure on the vegetable cover determined, in certain places, so deep a change that, often, it becomes difficult to reconstitute the original aspects of the vegetal groups. Both the variations of the intensity of the pressure and their differences of sensitivity and of the rate of healing had as an effect an irelating of the vegetable cover.

The spontaneous vegetation, relatively well kept in a woodland with hayfields and pastures, in the close proximity of the hydroenergetic systems, of the access ways is loosing, to a great extent, its spontaneous character, it is ruderalizing, on some portions of the land showing up some irreversible changes determined by the physical environment changes, by the human activities or by the conditions created by the community of plants itself, reaching even regressive serial evolutions.



*Fig. 1 – Hydroenergetic system of Vidraru*

The territory of our survey is at the south of the strongly metamorphosed crystalline schist of Făgăraş Mountains which are lost, gradually, in a thick layer of conglomerates, deposited in more recent times (Neogen) in the sedimentary basin of Loviștea. To the south of these, the crystalline schist appear again in the mountain range of Ghițu-Frunții-Cozia, the last high compartment of crystalline blocks, and afterwards they are lost without a net boundary in the so called piedmontaneous hills. Due to the various geological, geomorphological, pedological conditions, the vegetation is structured in distinct units. The relationship **rock-soil-vegetation** is striking in the vegetation profiles.

The hydroenergetic systems were built between the 2 mountain ranges, this intramountain depression, on the Argeș, Cumpănița and Vâlsan rivers, works which strongly affected the evolution of the vegetable cover. These systems, as well as the access ways built along the accumulation lake shores strongly affected the specifics of the vegetation, imposing the growth of the hygrophilic weeds.

Locally, some antropic activities triggered a very strong erosion, mainly on the steep slopes, on slopes sculptured in crumbly rocks. In the proximity of human communities there is a nytrophilic vegetation or, very often, it has been carried out a massive clearing.

Following a survey on the environmental impact in the area of influence of Vidraru, Cumpănița Vâlsan hydroenergetic systems, in the upper basing of the Argeș river, there were identified 29 vegetable associations, belonging to 13 classes, 14 orders, 18 alliances and 5 suballiances.

The associations belong to the following types of vegetation:

- tall vegetation of eutrophic waters and swamps;
- short vegetation of the puddles and oozy soils;
- segetal and ruderal vegetation;
- rocky region vegetation;
- mesophilic lawn vegetation;
- woods clearing vegetation;
- mountain weed vegetation;
- river meadow vegetation;
- vegetation of foliage and resinous mixture;
- resinous forest vegetation.

Summary of identified associations:

Tall vegetation of eutrophic waters and swamps

I. PHRAGMITETEA Tx. et Prsg. 1942

**Nasturtio-Glycerietalia** Pign. 1953

**Glycerio-Sparganion** Br. Bl. et Siss. ex Boer 1942

1. *Eleocharietum palustris* (Sennikov 1919) Soó 1933

Short vegetation of puddles and oozy soils

II. ISOETO-NANO-JUNCETEA Br.-Bl. et R. Tx. 1943

**Nano-Cyperetalia** Klika 1935

**Nano-Cyperion flavescentis** W. Koch 1926

2. *Juncetum buffonii* Morariu 1956

Rocky region vegetation

III. ASPLENIETEA TRICHOMANIS (Br.-Bl. in Meyer et Br.-Bl. 1934)

Oberdorfer 1977

**Androsacetalia vandellii** Br.-Bl. in Br.-Bl et Meyer 1934

**Androsacion vandellii** Br.-Bl. in Br.-Bl et Jenny 1926

3. *Asplenio trichomani-Poetum nemoralis* Boşcariu 1971

Mesophilic lawn vegetation

**IV. MOLINIO-ARRHENATHERETEA Tx. 1937****Molinietalia caeruleae** W. Koch 1926**Filipendulo-Petasition** Br.-Bl. 19474. **Petasitetum hybidi** (Dost. 1933) Soó 1940**Agrostion stoloniferae** Soó (1933) 19715. **Agrositio-Deschampsietum caespitosae** Ujh. 1947**Calthion palustris** Tx. 19376. **Scirpetum silvatici** Maloch 1935 em. Schwich. 19447. **Epilobio-Juncetum effusi** Oberdorfer 1957**Arrhenatheretalia** Pawl. 1928**Cynosurion cristati** Br.-Bl. et Tx. 19438. **Agrostio-Festucetum rupicolae (sulcatae)** Csürös-Kaptalan 1964

Woodland clearing vegetation

**V. EPILOBIETEA ANGUSTIFOLII R. Tx. et Prsg. in R. Tx. 1950****Atropetalia Vlieger** 1937**Sambuco-Salicion** Tx. 19509. **Rubetum idaei** Pfeiff. 1936 em. Oberdorfer 1973

Segetal and ruderal vegetation

**VI. BIDENTETEA TRIPARTITAE R. Tx., Lohm. et Prsg. 1956****Bidentetalia tripartitae** Br.-Bl. et R. Tx. 1943**Bidention tripartitae** Nordhagen 1940 em. R. Tx. apud Poli et J. Tx.

1960

10. **Xanthio strumario-Chenopodietum** (Timár 1947) I. Pop 1968**VII. CHENOPODIETEA Br.-Bl. 1951 em. Lohm. et Tx. 1961****Onopordetalia** Br.-Bl. et Tx. 1943 em. Görs 1966**Onopordion acanthii** Br.-Bl. 1926 s. str.11. **Carduetum acanthoidis** (Allorge 1922) Morariu 1939**VIII. ARTEMISIETEA VULGARIS Lohm., Prsg. et Tx. 1950****Artemisieta vulgaris** Lohm. apud R. Tx. 1947**Arction lappae** R. Tx. 1937 em. Sissingh 194612. **Urticetum dioicae** Steffen 1931, Turenschi 196613. **Rumicetum obtusifolii** Br.-Bl. et Tx. 195014. **Tussilaginetum farfarae** Oberdorffer 194915. **Sambucetum ebuli** (Kaiser 1926) Felföldy 1942**IX. GALIO-URTICETEA Passarge 1967 em. Kopecky 1969****Petasito-Chaerophylletalia** Morariu 1967**Petasition officinalis** Sillinger 193316. **Telekio-Petasitetum hybidi** (Morariu 1967) Resm. et Rațiu 1974

Mountain weeds vegetation

**X. BETULO-ADENOSTYLETEA Br.-Bl. et Tx. 1943**

**Adenostyletalia Br.-Bl. 1931**

**Adenostylium alliariae Br.-Bl. 1925**

17. **Cirsio waldsteinii-Heracleetum transsilvanicae Pawl. et Walas 1949**

River meadow vegetation

**XI. SALICETEA PURPUREAE Moor 1958**

**Salicetalia purpureae Moor 1958**

**Salicion elaeagni (Aichinger 1933) Moor 1958**

18. **Hipophaë-Salicetum elaeagni Br.-Bl. et Volk 1940**

19. **Myricarietum germanicae Rübel 1912 em. Jenik 1915**

Foliage and resinous mixture vegetation

**XII. QUERCO-FAGETEA Br.-Bl. et Vlieger 1937**

**Fagetalia silvaticae Pawl. 1928**

**Alno-Padion Knapp 1942 em. Medwecka-Kornas 1957**

**Alnenion glutinosae-incanae (Br.-Bl. 1951) Oberdorfer 1953**

20. **Alnetum glutinosae-incanae Br.-Bl. (1915) 1950**

**Lathyro-Carpinion Boșcaiu 1974**

**Lathyro hallersteinii-Carpinenion (Boșcaiu 1979) Boșcaiu et all. 1982**

21. **Carpino-Fagetum silvaticae Paucă 1941**

**Symphyto-Fagion Vida 1959**

**Symphyto-Fagenion (Vida 1959) Soó 1964**

22. **Pulmorio rubrae-Fagetum (Soó 1964) Fauber 1987**

23. **Leucanthemo waldsteinii-Fagetum (Soó 1964) Fauber 1987**

**Calamagrostio-Fagenion Boșcaiu et all. 1982**

24. **Hieracio rotundati-Fagetum (Vida 1963) Fauber 1987**

Resinous forest vegetation

**XIII. VACCINIO-PICEETEA Br.-Bl. 1939**

**Vaccinio-Piceetalia abietis Br.-Bl. 1939**

**Piceion abietis Pawl. in Pawl. et all. 1928**

**Soldanello majori-Picenion Coldea 1991**

25. **Hieracio rotundati-Piceetum Pawl. et Br.-Bl. 1939**

Using the Jaccard similarity index (based on the presence/absence of the 479 species identified in 5 stations: Oeşti, Cheile Argeşului-Căpătâneni, Cumpăna, Cumpăniţa, Valea Vâlsanului) one can obtain the following similarity dendrogram, leading to the conclusion that:

- the relationship rock-soil-vegetation is illustrated in the group of the 5 stations, as: Cumpănița and Cumpăna, located in the sedimentary intramontain depression of Loviștea; the taxons identified on Vâlsan Valley, forming the second group, lay on a sublayer consisting of clay and marl (Eocene), on a less sloped relief, with less levigated soils (Corbi-Brădet depression); closely similar to this is that of Argeș-Căpățâneni, located in the Ghițu-Frunții mountain range, with prevailing mountain acid brown soils, consisting of the sandstone and mica schist; Oești station is outstanding with a small value of the similarity index (0,16), being located on a mild sloped relief, characteristic for the clay and marl soils, where they were formed less levigated soils of the brown soil types of the pseudorendzines, of the hayfield black soils (Turcu L. Gh., 1969).

- the structure of the dendrogram can be also interpreted by the degree of anthropization of Vâlsan and, in particular, Valea Argeșului at Oești stations, with a much more rudelised vegetation than in the other stations. Actually, the associations of the rocky soils and of the skeletal soils (lithosoils) is met at the keys, at Cumpănița and Cumpăna and, to a lesser degree, on the Vâlsan Valley prevails the nemoral vegetation while the segetal and ruderal vegetation develops upstream of Căpățâneni: Arefu, Corbeni, Oești.

In conclusion, the hydroenergetic systems through their major implications on the modifications of the biocenoses and biotops of the affected areas, impose the necessity of the complex investigations of an

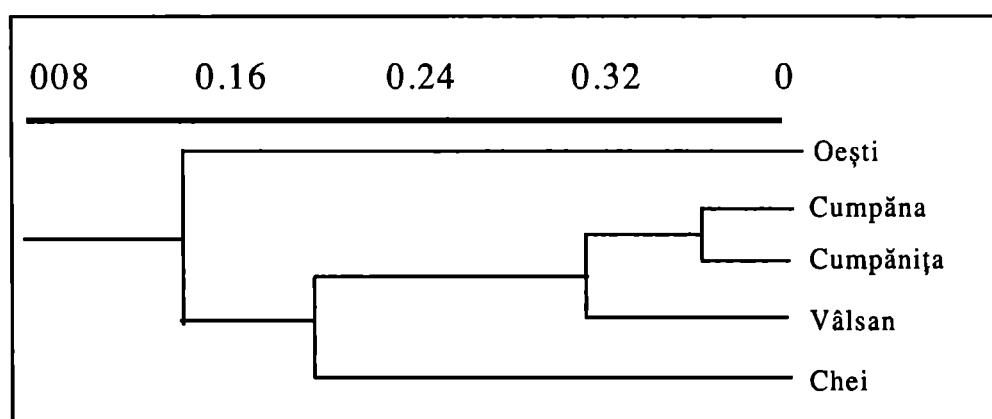


Fig. 2 - Dendrogram of similarity of the associations of the upper course of Argeș

interdisciplinary nature. In the survey of the environmental impact of the hydroenergetical system constructions of the upper basin of the Argeș river were entrained specialist of various fields (flora and vegetation, vertebrate and invertebrate zoology, ecology, sociology, ethnography etc.) according to a unitary and dynamic scientific conception, reflected in a unique prospective for the entire group. Therefore, from *totum pro parte*, the aim is a pluridisciplinary investigation where the disciplines and the interdisciplines involved in the research act in the spirit of a unity, *pars pro toto*.

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# LES ASSOCIATIONS SAXICOLES DES GORGES CALCAREUSES DES MONTS METALLIFERES

MARCELA BALAZS

*Muzeul Civilizației Dacice și Romane Deva,  
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## REZUMAT

În acest articol se analizează 6 asociații vegetale cu 2 subasociații, grupate în 4 alianțe, 4 ordine și 4 clase. Asociațiile sunt analizate și caracterizate din punct de vedere ecologic, corologic și sub aspectul compoziției floristice. Relevetele au fost grupate în tabele fitocenologice.

Pour l'étude du tapis végétal de ce territoire on a utilisé comme unité taxonomique essentielle l'association végétale définie par L'École phytocoenologique central - europeene. Les méthodes de recherche de la végétation sont celles élaborées par J. Braun - Blanquet et adaptées aux particularités de la vegetation du notre pays. Les relevements, les appréciations qualitatives et quantitatives ont été effectuées après les recommandations des auteurs: Al. Borza et N. Boșcaiu (1965). Les associations ont été identifiées avec l'aide des espèces de reconnaissance, des espèces dominantes et différentielles. Pour la dénomination des associations ont été utilisées les indications de syntaxonomie des Notions fondamentales de phytocoenologie (Jean - Marie Géhu, Salvador Rivas - Martinez, 1981) et le Code de Nomenclature phytosociologique (Barkman, Moravec, Rauschert, 1976). Pour la classification des unités coenotiques (coenologiques) ont été utilisées les recommandations sistematiques élaborées par le Centre de phytosociologie Bailleul ( J. M. Géhu, 1992) et Camerino ( F. Pedrotti, 1994).

Dans cet article on analyse 6 associations végétales, avec 2 sousassociations groupées en 4 alliances, 4 ordres et 4 classes. Les associations

sont analysées et caractérisées du point de vue écologique, chorologique, sous l'aspect de la composition floristique. Les relevés effectués ont été groupés dans les tableaux phytocoenologiques. Les surfaces de preuve ont eu des extensions qui ont coïncidé avec les aires minimales qui sont en rapport de conformité aux types de phytocoénoses étudiées, l'étendue étant différente, de 1 - 100 m<sup>2</sup>. Pour chaque relevé, a été notée l'abondance-dominance après l'échelle Braun - Blanquet, tout à coup avec l'enregistrement des taxons. Les tableaux synthétiques (synoptiques) des associations ont été composées après la méthodologie préconisée de Braun - Blanquet et développée par Ellenberg. Dans les tableaux on a été indiquée le numéro du chaque relevé, l'altitude, l'exposition, l'inclinaison) la surface analysée, le recouvrement de la végétation.

La colonisation des roches calcaires, avec des diverses phytocoénoses est un processus assez lent. Sur les cimes rocheuses, sur les parois abruptes des gorges s'installent des plantes chasmophiles. La désagrégation de leur appareil végétatif aussi comme la désagrégation des roches contribuent à la formation des rendzines humiques. Tout-à-coup de l'accumulation du sol s'installe un nombre plus grand des plantes qui forment des associations ouvertes sur les roches. Parmi les associations saxicoles des gorges calcaires des Monts Métallifères nous présentons les suivants:

- CL. ASPLENIETEA RUPESTRIS Br. - Bl. 1934
- ORD. POTENTILLETALIA CAULESCENTIS Br. - Bl. 1926
- ALL. CYSTOPTERIDION (Nordh. 1936) J. L. Rich. 1972
- ASS. SEDO HISPANICI - POETUM NEMORALIS Pop et Hodisan 1985
  
- CL. THLASPIETEA ROTUNDIFOLII Br. - Bl. 1926
- ORD. THLASPIETALIA ROTUNDIFOLII Br. - Bl. 1926
- ALL. STIPION CALAMAGROSTIS Br. - Bl. 1918  
(Achnaterion calamagrostis nom. nov. mut. propos)
- ASS. THYMETUM COMOSI Pop et Hodisan 1963
- ASS. THYMETUM COMOSI Pop et Hodisan 1963 GALIETOSUM ALBI  
(Pop et Hodisan 1964) Coldea 1991
- ASS. THYMETUM COMOSI Pop et Hodisan 1963 TEUCRIETOSUM MONTANI (Csürös 1958) Coldea 1991
  
- CLS. SESLERIETEA ALBICANTIS Br. - Bl. 1948 em Oberd. 1978
- ORD. SESLERIETALIA ALBICANTIS Br. - Bl. 1926

- ALL. SESLERION RIGIDAE Zoly. 1939  
 ASS. ASPERULO CAPITATAE - SESLERIETUM RIGIDAE  
 (Zoly. 1939) Coldea 1991
- CLS. FESTUCO - BROMETEA Br. - Bl. et Tx. 1943  
 ORD. FESTUCETALIA VALESIACAE Br. - Bl. et Tx. 1943  
 ALL. SESLERIO - FESTUCION PALLENTIS Klika 1931  
 ASS. SESELI GRACILE - FESTUCETUM PALLENTIS  
 (Soó 1959) Coldea 1991 .  
 ASS. MELICO - PHLEETUM MONTANI Boșcaiu et al. 1966  
 ASS. THYMO COMOSI - FESTUCETUM RUPICOLAE  
 (Csürös 1959) Pop et Hodisan 1985

L'association Sedo hispanici - Poëtum nemoralis Pop et Hodisan 1985

Cette association a été rencontrée dans les gorges Uibăreşti, les gorges Băcâia et les gorges Mada. Dans les gorges Uibăreşti elle a été identifiée à la base de la côte Bulbuci, sous Dâmbul Înalt, à l'altitude de 575 m, expositon Nord - Nord - Vestique, sur les roches ombragés avec un grande inclinaison. Cette association comprends 23 espèces, en prédominant les hemicryptophytes (65,20 %). Le spectre floristique comprends des éléments euroasiatiques (31,31 %), européennes (21,73%), suivis par des éléments mediterannéenes (9,69 %).

En ce qui concerne les exigences pour l'humidité, les espèces mésophytes sont dominantes et forment une proportion de 52,17%. Les espèces xérophytes réalisent seulement 13,04 % du total. Le pourcentage élevé des mésophytes démontre la quantité relativement élevée des précipitations dans la zone recherchée. Du point de vue des conditions de température, dans cette association prédomine les micromésothermes (65,21%) suivis par les espèces modérées thermophyles (13,04 %). En ce qui concerne l'exigence pour la reaction du sol, on mentionne la prédominance des espèces moins acido-neutrophiles (43,47%).

	0	1 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	0	13,04 %	26,08 %	52,17 %	8,59 %	0
T	8,69 %	0	13,04 %	65,21 %	13,04 %	0
R	21,73 %	0	0	30,43 %	43,47 %	4,34%

No. relevés	Éléments phytogéographiques						U	T	R
L'altitude (m)	575	575	575						
L'exposition	N	N	NV						
L'inclinaison (°)									
Le recouvrement de la végétation	50	60	60						
La surface analysée (m <sup>2</sup> )	25	25	25						
Poa nemoralis	3,4	3	4			Eua	3	3	0
Asarum europaeum	+.1	1	1			Eua	3,5	3	4
Sedum hispanicum	+	+	+			Md	1	3,5	4
Moehringia muscosa	+	+	1			Ec	4	2	4
Cardaminopsis arenosa	+	+	+			Ec	2,5	3	4
Fragaria vesca	+.1	+	1			E(Ct)	2	4	3
Valeriana officinalis	+	+	+			Eua (Md)	4	3	4
Vincentoxicum hirundinaria	+	+	+			E(Md)	2	4	4
Galium album	+.1	1	+			Eua	2,5	2,5	3
Geranium robertianum	+	+	+			Cm	3,5	3	3
Origanum vulgare	+	+	+			Eua (Md)	2,5	3	3
Salvia glutinosa	+	+	+			Eua	3,5	3	4
Campanula persicifolia	+	+	1			Eua (Md)	3	3	0
Digitalis grandiflora	+	1	+			E	3	3	3
Mycelis muralis	+	+	+			Eua (Md)	3	3	0
Senecio ovatus	+	+	+			Eua	3,5	2	3
Asplenium ruta-muraria	1,2	1	1			Circ (bor)	1,5	3	5
Asplenium trichomanes	+.1	1	+			Cm	3	0	4
Cystopteris fragilis	+	+	+			Cm	3,5	0	0
Syringa vulgaris	+	+	+			D-B	1,5	4,5	4,5
Viburnum lantana	+	+	+			Md-Ec	2,5	3	4,5
Carpinus betulus	+	+	+			E	3	3	3
Fagus sylvatica	+	+	+			E	3	3	0

Tableau no. 1

Dans les Gorges Băcâia, cette association a été identifiée sur la côte abrupte du bassin semi-circulaire du Massif Curături, près d'une forêt d'hêtraies, à l'altitude de 450 m, exposition nord - estique. Le degré de recouvrement est de 50 -90%. Les espèces dominantes et caractéristiques pour cette association sont: *Poa nemoralis* var. *coarctata*, *Melica ciliata*, *Sedum hispanicum*, *Arenaria serpyllifolia*, *Erysimum odoratum*, *Galium album*, *Achillea crithmifolia* et *Carduus candicans*. Toutes les espèces caractéristiques de cette coenose sont calcophiles. Le rôle constitutif de l'association est réalisé par les hémicryptophytes (52,5%). Parmi les éléments floristiques dominantes sont celles euroasiatiques (30%) et européennes (20%) influencées en bonne partie par les espèces balkaniques (7,5%), méditerranéennes (5%) et pontiques (5%). En ce qui concerne les exigences pour l'humidité, dominantes sont les espèces xéromésophytes (52,5%) et xérophytes (27,5%). Du point de vue de la température et la réaction du sol, dominantes sont les micromésothermes (47,5%), modérées thermophiles (32,5%) et les espèces moins acide-neutrophiles (47,5%).

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	5 %	27,5 %	52,5 %	10 %	2,5 %	0
T	10 %	0	7,5 %	47,5 %	32,5 %	0
R	27,5 %	0	0	15 %	47,5 %	7,5 %

Tableau no. 2

No. relevés							Éléments phytogéographiques	U	T	R
L'altitude (m)	450	450	450	450	450	450				
L'exposition	N-E	N-E	N-E	N-E	N-E	N-E				
L'inclinaison (°)										
Le recouvrement de la végétation	90	50	80	50	90	90				
La surface analysée (m <sup>2</sup> )	4	4	4	4	4	4				
<b>Facies Erysimum odoratum</b>										
<i>Poa nemoralis</i> v. <i>coarctata</i>	3,5	2,5	3,5	2,4	3,5	4,5	Eua	3	3	0
<i>Melica ciliata</i>	1,1	1,3	+	1,1	+	2,1	Ec-B	1,5	4	4

## LES ASSOCIATIONS SAXICOLES IN MONTS MÉTALLIFÈRS

<i>Festuca rupicola</i> f. <i>rupicola</i>	1.1	+	1.1	+	-	-		<b>Eua (Ct)</b>	1,5	4	4
<i>Phleum montanum</i>	+	+	-	-	2,3	+		<b>Carp-B-Cauc</b>	1,5	4,5	4
<i>Cleistogenes serotina</i>	+	+	+	-	-	-		<b>Eua (Md)</b>	1	3,5	4
<i>Chamaecytisus albus</i>	+	1.1	2.2	-	1.1	+		<b>B-p</b>	1,5	4	3
<i>Trifolium pratense</i>	+	+	+	-	-	-		<b>Eua</b>	3	0	0
<i>Medicago minima</i>	-	-	-	-	1.1	1.2		<b>Eua (Md)</b>	1,5	4	4
<i>Cerastium pumilum</i>	+	+	1.2	-	-	-		<b>E (Md)</b>	2	3	0
<i>Arenaria serpyllifolia</i>	1.3	+	+	+	+	+		<b>Circ (bor)</b>	2	2,5	0
<i>Sagina procumbens</i>	-	-	-	+	+	+		<b>Circ (bor)</b>	4	3	3
<i>Petrorhagia prolifera</i>	+	+	1.1	-	+	+		<b>P-Md</b>	1,5	4	3
<i>Erysimum odoratum</i>	-	-	+	2,5	3,5	2,4		<b>Ec (Md)</b>	2,5	3	4
<i>Fragaria viridis</i>	2,5	1.2	1.1	-	-	-		<b>E (Ct)</b>	2	4	3
<i>Filipendula vulgaris</i>	+	-	+	-	-	-		<b>Eua</b>	2,5	3	0
<i>Potentilla argentea</i>	1.1	+	1.1	-	-	+		<b>Eua</b>	2	4	0
<i>Sanguisorba minor</i>	+	+	+	-	+	-		<b>Eua</b>	2	3,5	4
<i>Sedum hispanicum</i>	1.3	2,2	1.4	1.3	+	1.1		<b>Md</b>	1	3,5	4
<i>Sedum telephium</i> ssp. <i>maximum</i>	-	-	-	+	+	+		<b>Eua (Md)</b>	2	3	0
<i>Euphorbia cyparissias</i>	+	-	+	-	-	+		<b>Eua</b>	2	3	4
<i>Helianthemum</i> <i>hirsutum</i>	+	1.2	+	-	-	-		<b>Ec (Md)</b>	2,5	3	4
<i>Teucrium chamaedrys</i>	2,5	1.2	1.1	2,1	+	-		<b>Md-Ec</b>	2	3,5	4
<i>Teucrium montanum</i>	-	-	+	+	1.1	-		<b>Md-Ec</b>	1	4	5
<i>Acinos alpinus</i> ssp. <i>majoranifolius</i>	-	-	-	+	+	+		<b>Ec (alp)</b>	3	0	5
<i>Stachys recta</i>	+	+	-	-	-	-		<b>P-Md</b>	2	4	4,5
<i>Odontites verna</i> ssp. <i>verotina</i>	+	-	+	-	-	-		<b>Eua</b>	3	3	0
<i>Verbascum lychnitis</i>	+	-	+	+	+	+		<b>E</b>	1	3	4
<i>Galium album</i>	+	-	-	+	+	-		<b>Eua</b>	2,5	2,5	3
<i>Asperula purpurea</i>	2,3	1.1	1.2	-	+	-		<b>Md</b>	2	4	4
<i>Achillea crithmifolia</i>	1,3	+	1.3	+	1.1	+		<b>B-p</b>	2,5	4	0
<i>Carduus candicans</i>	+	+	+	1.1	+	+		<b>B-p</b>	2	3	5
<i>Centaurea biebersteinii</i> ssp. <i>biebersteinii</i>	+	-	+	-	-	-		<b>E(Ct)</b>	3	3	3
<i>Hieracium pilosella</i>	+	-	+	-	-	-		<b>E(Md)</b>	2,5	0	0
<i>Jurinea mollis</i> ssp. <i>transsilvanica</i>	+	+	1.2	-	-	-		<b>P-B</b>	1	4,5	4
<i>Bromus commutatus</i>	-	-	-	-	+	-		<b>E</b>	0	3	0
<i>Ranunculus bulbosus</i>	+	-	-	-	-	-		<b>E</b>	2	3	3
<i>Buglossoides arvensis</i>	-	-	+	-	-	-		<b>E(Ct)</b>	0	0	4
<i>Dianthus petraeus</i> ssp. <i>petraeus</i>	-	-	-	+	-	-		<b>Carp (end)</b>	2	3,5	4
<i>Cardaminopsis arenosa</i>	-	-	+	-	-	-		<b>Ec</b>	2,5	3	4
<i>Viola joöi</i>	-	-	-	-	-	-		<b>D (end)</b>	2,5	2,5	4,5

Dans les Gorges Mada, l'association a été identifiée sur le Massif Cetățeaua, sur le versant sudique et nord-estique, en réalisant une recouvrement entre 50 % - 90 %. Les espèces dominantes sont les mêmes comme celles des Gorges Băcăiei. Le rôle constitutif de l'association Sedo hispanici - Poëtum nemoralis Pop et Hodisan 1985 est décompli par les hémicryptophytes (50 %), complétées par les therophytes. Ici, sont dominantes les éléments euroasiatiques (35,29 %), influencées par les espèces mediteranéennes (17,64%), balkano - pontiques (5,88 %). Les espèces thermophiles réalisent un pourcentage de 29,41 %, les micromésothermes (55,88 %), les espèces faible acide-neutrophile (38,23 %) et celles neutro-basophile 4,70 %.

	0	1-1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	0	29,41 %	58,82 %	8,82 %	2,94 %	0
T	5,88 %	0	5,88 %	55,88 %	32,35 %	0
R	23,52 %	0	0	23,52 %	38,23 %	14,70%

Fig. no. 3

No. relevés						Éléments phytogéographiques	U	T	R
L'altitude (m)	640	640	600						
L'exposition	S	N	N-E						
L'inclinaison (°)	50	60	50				.		
Le recouvrement de la végétation	90	70	50						
La surface analysée (m²)	10	10	10						
Erysimum odoratum	1,1	1	+			Ec (Md)	2,5	3	4
Poa nemoralis v. coarctata	1	1,2	+			Eua	3	3	0
Carduus candicans	1	+	+			B-p	2	3	5
Achillea crithmifolia	+	1	+			B-p	2,5	4	0
Verbascum lychnitis	+	1,1	1			E	1	3	4
Orobanche alba	1	+	+			Eua (Md)	1,5	4,5	0
Thymus pulegioides	+	+	+			Ec	2,5	4	4
Salvia verticillata	1,1	+	-			Eua (Md)	2	4	0
Fragaria viridis	1	1	+			E (Ct)	2	4	3
Orobanche gracilis	+	+	+			Md-Ec	2,5	4,5	0
Galium album	1	1	+			Eua	2,5	2,5	3

<i>Genista tinctoria</i>	+	+	+			Eua	2,5	3	2
<i>Teucrium montanum</i>	1	-	+			Md-Ec	1	4	5
<i>Acinos alpinus</i> ssp. <i>majoranifolius</i>	+	+	-			Ec	3	0	5
<i>Arenaria serpyllifolia</i>	+	+	+			Circ (bor)	2	2,5	0
<i>Medicago minima</i>	1	+	+			Eua (Md)	1,5	4	4
<i>Sedum hispanicum</i>	2,5	3,4	2,5			Md	1	3,5	4
<i>Sedum telephium</i> ssp. <i>maximum</i>	1,1	+	+			Eua (Md)	2	3	0
<i>Sagina procumbens</i>	+	+	-			Circ (bor)	4	3	3
<i>Melica ciliata</i>	1	+	+			Ec-B	1,5	4	3
<i>Fraxinus ornus</i>	+	-	-			Md	1,5	3,5	5
<i>Crataegus monogyna</i>	+	+	+			E	2,5	3	3
<i>Viburnum lantana</i>	+	+	+			Md-Ec	2,5	3	4,5
<i>Berberis vulgaris</i>	+	+	+			E	2	3	4
<i>Prunus spinosa</i>	+	+	+			Eua	2	3,5	3
<i>A s p l e n i u m</i> trichomanes	+	+	+			Cm	3	0	4
<i>Asplenium ruta-muraria</i>	+	+	+			Circ (bor)	1,5	3	5
<i>Festuca rupicola</i>	1	+	+			Eua (Ct)	1,5	4	4
<i>Salvia pratensis</i>	+	+	+			E (Md)	2,5	3	4,5
<i>Nepeta nuda</i> ssp. <i>pannonica</i>	+	+	-			Eua (Ct)	2	3	0
<i>Echium vulgare</i>	+	+	+			Eua	2	3	4
<i>Cruciata levipes</i>	+	-	-			Eua	2,5	3	3
<i>Veronica austriaca</i> ssp. <i>crinita</i>	+	1	-			Ec	1,5	4	4,5
<i>Teucrium chamaedrys</i>	+	+	+			Md-Ec	2	3,5	4

Tableau no. 3

L'association **Thymetum comosi** Pop et Hodisan 1963, pousse dans les Gorges Crăciunești à l'altitude de 300 - 350 m, exposition Nordique, dans les Gorges Uibărești à 600 - 700 m exposition Sud - Sud - Vestique, sur des moraines semifixés et dans les Gorges Bulzești, à l'altitude de 500 - 520 m, exposition Nord - Estique.

Dans les Gorges Crăciunești, l'association comprend à coté de hémicryptophytes (62,85 %), aussi de therophytes (14,28 %) et géophytes (5,71 %). Sur les roches calcareuses avec un degré plus grand d'inclinaison, parmi les buissons de *Sesleria rigida*, hautes de cca. 30 cm, poussent des arbustes de *Fraxinus ornus* et *Juglans regia*. En ce qui concerne le spectre

floristique on constate le grand nombre des éléments thermophiles (51,42%). Les éléments euroasiatiques et européennes font 37,14 % du total des espèces. Les xéromésophytes et xérophytes participent dans cette association avec une proportion de 57,14 %, respectivement 22,85 %. Les espèces moderées thermophiles réalisent 28,57 %.

	0	1 – 1,5	2 – 2,5	3 – 3,5	4 – 4,5	5
U	0	22,85 %	57,14 %	17,14 %	2,85 %	0
T	2,85 %	0	8,57 %	57,14 %	28,57 %	2,85 %
R	8,57 %	0	0	11,42 %	51,42 %	28,57 %

Fig. no. 4

No. relevés	1	2	3	Éléments phytogéographiques	U	T	R
L'altitude (m)	300	320	350				
L'exposition	N	N	N				
L'inclinaison (°)	40	60	70				
Le recouvrement de la végétation	70	60	70				
La surface analysée (m²)	100	100	100				
Sesleria rigida	4	3	3	D – B	2,5	2	4,5
Festuca valesiaca	1	+	-	Ec	1,5	4	4
Piphtatherum virescens	+	+	-	Md	2	3,5	4,5
Phleum montanum	+	+	+	B	1,5	4,5	4
Poa nemoralis	+	+	-	Cp	3	3	0
Achillea collina	+	-	+	Eua	2	3	3
Achillea crithmifolia	+	1	-	B	2,5	4	0
Allium flavum	+	+	-	Md	1,5	4	4
Campanula sibirica	+	+	-	Eua	2,5	4	4
Cardaminopsis arenosa	+	-	+	Ec	2,5	3	4
Centaurea atropurpurea	+	-	+	D – B	2	3	5
Vincetoxicum hirundinaria	+	+	-	E (Md)	2	4	4
Dianthus carthusianorum	+	+	+	E	2	5	5
Dianthus petraeus ssp. petraeus	1	-	-	Carp (end)	2	3,5	4
Digitalis grandiflora	+	+	+	E	3	3	3
Galium album	+	-	-	Eua	2,5	2,5	3
Helianthemum hirsutum	+	-	-	Ec – Md	2,5	3	4

<i>Hepatica nobilis</i>	+	+	+			E	3	3	4
<i>Isatis tinctoria v. praecox</i>	+	+	+			Md (P)	2	3,5	4
<i>Minuartia setacea ssp. banatica</i>	+	-	-			P-p-B	1,5	0	4
<i>Nepeta cataria</i>	+	-	+			Eua (Md)	3	3	4
<i>Potentilla cinerea</i>	+	-	1			E (Ct)	2	3,5	4,5
<i>Potentilla thuringiaca</i>	+	+	+			Ec	2	3	3
<i>Primula veris ssp. columnae</i>	+	+	-			Md	3	2	5
<i>Sedum hispanicum</i>	+	-	+			Md	1	3,5	4
<i>Seseli elatum ssp. osseum</i>	+	-	+			p-D	1,5	4	4
<i>Stachys recta</i>	+	+	+			P-Md	2	4	4,5
<i>Teucrium chamaedrys</i>	+	1	-			Md-Ec	2	3,5	4
<i>Teucrium montanum</i>	+	-	+			Md-Ec	1	4	5
<i>Thlaspi perfoliatum</i>	+	+	+			Eua	2,5	3,5	4,5
<i>Thymus comosus</i>	1	-	1			Carp (end)	2	3,5	5
<i>Valeriana officinalis</i>	+	+	+			Eua (Md)	4	3	4
<i>Viola tricolor ssp. subalpina</i>	+	+	-			Eua	2,5	3	0
<i>Juglans regia</i>	-	+	-			Carp-Anat	3	4	4
<i>Fraxinus ornus</i>	+	+	-			Md	1,5	3,5	5

Tableau no. 4

Dans les Gorges Uibărești, cette association qui comprend 42 espèces, près de l'espèce dominante, végétent, avec une fréquence élevée les espèces: *Festuca pallens ssp. pallens*, *Galium album*, *Acinos arvensis*. La phytocoenose est dominée par les hémicryptophytes (45,23 %), suivis par les therophytes (19,04 %). En ensemble, l'association est dominée par les espèces euroasiatiques (35,31 %), européenne (19,04 %), suivi par celle méditerranéennes (7,14 %). Les espèces xérophytes réalisent une proportion de 26,19 %, celle micromésothermes 57,14 % et celle faible acide-neutrophiles 57,14 %.

	0	1-1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	2,38 %	26,19 %	59,52 %	9,52 %	0	0
T	7,14 %	0	11,90 %	57,14 %	19,04 %	2,38 %
R	16,66 %	0	2,38 %	11,90 %	57,14 %	9,52 %

Fig. no. 5

No. relevés	1	2	3	4	Éléments phytogéographiques	U	T	R
L'altitude (m)	650	650	600	700				
L'exposition	S	S	S-V	S-V				
L'inclinaison (°)	25	30	35	30				
Le recouvrement de la végétation	70	85	80	80				
La surface analysée (m²)	16	16	12	12				
Thymus comosus	3,4	4	3,4	3	Carp (end)	2	3,5	4,5
Festuca pallens ssp. pallens	+	1,2	+	+	Carp -B	1,5	4	4,5
Carex divulsa	+	+	-	+	Eua	2,5	3	0
Arenaria serpyllifolia	+	+	-	-	Circ (bor)	2	2,5	0
Arabis hirsuta	-	+	+	+	Circ (bor)	1,5	3	4
Cardaminopsis arenosa	+	-	+	+	Ec	2,5	3	4
Euphorbia cyparissias	+	+	-	+	Eua	2	3	4
Erysimum odoratum	+	+	-	-	Ec (Md)	2,5	3	4
Fragaria vesca	2	1,2	+	1	Eua	3	2,5	0
Potentilla argentea	+	+	-	+	Eua	2	4	2
Sanguisorba minor	+	+	-	-	Eua	2	3,5	4
Sedum hispanicum	+	+	+	+	Md	1	3,5	4
Galium album	1	1	1,2	1,2	Eua	2,5	2,5	3
Helianthemum canum	+	-	-	+	Atl-Md	2	4	5
Hypericum perforatum	+	-	+	-	Eua	3	3	0
Acinos arvensis	+,1	+	-	-	E (Md)	1,5	3,5	4
Stachys recta	-	-	+	+	P-Md	2	4	4,5
Teucrium chamaedrys	1	1,2	2	+	Md-Ec	2	3,5	4
Verbascum lychnitis	+	+	-	-	E	1	3	4
Scabiosa ochroleuca	+	+	-	-	Eua (Ct)	2	4	4
Viola joói	-	+	+	-	D (end)	2,5	2,5	4,5
Achillea setacea	+	+	-	-	Eua (Ct)	2	3	5
Centaurea biebersteinii ssp. biebersteinii	-	+	+	-	E (Ct)	3	3	3
Hieracium pilosella	-	+	+	+	E (Md)	2,5	0	0
Ornithogalum umbellatum	-	+	-	+	Md-Ec	0	3,5	4
Asplenium ruta-muraria	+	+	1,2	1	Circ (bor)	1,5	3	5
Asplenium trichomanes	1	1,2	1	1	Cm	3	0	4
Fraxinus ornus	+	-	+	+	E	1,5	3,5	5
Crataegus monogyna	+	+	-	-	E	2,5	3	3

Rosa canina	-	+	+	-			E	2	3	3
Syringa vulgaris	+	+	-	+			D-B	1,5	4,5	4,5
Elymus hispidus ssp. hispidus	-	+	-	-			Eua	2	4,5	4
Dorycnium pentaphyl- lum ssp. herbaceum	1	-	-	-			Ec-Md	2	5	4
Ranunculus bulbosus	-	+	-	-			E	2	3	3
Potentilla recta	-	+	-	-			Eua (Ct)	1,5	3,5	4
Sedum telephium ssp. maximum	+	-	-	-			Eua (Md)	2	3	0
Ajuga genevensis	-	-	-	+			Eua (Ct)	2,5	3	4
Cephalaria uralensis	-	+	-	-			P-p	1,5	4	4,5
Veronica arvensis	-	-	+	+			Eua	2,5	3	3
Allium senescens ssp. montanum	+	-	-	-			Eua (Ct)	1,5	3,5	4
Gymnocarpium robertianum	-	-	+	-			Circ (bor)	3	2,5	4,5
Juniperus communis	-	+	-	-			Circ (bor)	2	0	0

Tableau no. 5

À l'entrée des Gorges Bulzești, sur le versant gauche avec l'exposition Nord-Vestique on trouve des phytocoénoses pionnières de *Thymus comosus*. Elles végétent sur un sol brun, riche en sable et gravier. À la base, ces phytocoénoses sont entourées par la Vallée de Bulzești et dans la partie supérieure par *Pinus sylvestris*. Dans la composition de cette association ont été identifiées 25 espèces. Parmi les espèces plus fréquentes on mentionne: *Teucrium chamaedrys*, *Viola joóoi*, *Galium album*. Dans cette phytocoénose le charmaephite *Thymus comosus* est dominante, près de lequel végétent aussi hémicryptophytes (48 %) et therophytes (40 %). Le spectre floristique comprend des éléments euroasiatiques (28 %), central - européennes (12 %), méditerranéennes (8 %) et endémiques (8 %). Les espèces xéromésophytes réalisent 56 % et celles modérément thermophiles 12 %.

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	0	20 %	56 %	24 %	0	0
T	12 %	0	24 %	52 %	12 %	0
R	20 %	0	4 %	16 %	56 %	4 %

Fig. no. 6

No. relevés	1	2	Éléments phytogéographiques	U	T	R	
L'altitude (m)	500	520					
L'exposition	NE	NE					
L'inclinaison (°)	25	25					
Le recouvrement de la végétation	50	70					
La surface analysée (m²)	250	250					
<i>Thymus comosus</i>	3	3		End	2	3,5	4,5
<i>Festuca pallens</i> ssp. <i>pallens</i>	-	+		Ec	1,5	4	4,5
<i>Sesleria rigida</i>	-	+		DB	2,5	2	4,5
<i>Asplenium ruta-muraria</i>	1	1		Circ (bor)	1,5	3	5
<i>Asplenium trichomanes</i>	-	+		Circ (bor)	3	0	4
<i>Gymnocarpium disjunctum</i>	-	+		Circ (bor)	3	2,5	2
<i>Arenaria serpyllifolia</i>	+	-		Circ (bor)	2	2,5	0
<i>Arabis hirsuta</i>	+	+		Circ (bor)	1,5	3	4
<i>Cardaminopsis arenosa</i>	+	+		Ec	2,5	3	4
<i>Erigeron acer</i>	-	+		Circ (bor)	2,5	3	0
<i>Erysimum odoratum</i>	+	+		Ec (Md)	2,5	3	4
<i>Fragaria vesca</i>	+	+		Eua	3	2,5	0
<i>Fumaria officinalis</i>	+	+		Eua (Md)	3	0	3,5
<i>Galium album</i>	+	1		Eua	2,5	2,5	3
<i>Geranium robertianum</i>	-	+		Cm	3,5	3	3
<i>Geranium rotundifolium</i>	+	-		Eua (Md)	2	3,5	4
<i>Hieracium pilosella</i>	+	+		E (Md)	2,5	0	0
<i>Hypericum perforatum</i>	+	+		Eua	3	3	0
<i>Sedum hispanicum</i>	+	+		Md	1	3,5	4
<i>Stachys recta</i>	+	+		P-Md	2	4,5	4,5
<i>Taraxacum erythrospermum</i>	+	+		Eua (Md)	2	4	4,5
<i>Teucrium chamaedrys</i>	+	1		Md-Ec	2	3,5	4
<i>Verbascum lychnitis</i>	-	+		E	1	3	4
<i>Veronica arvensis</i>	+	-		Eua	2,5	3	3
<i>Viola joöi</i>	1	1,2		D (end)	2,5	2,5	4,5

Tableau no. 6

L'association **Thymetum comosi Pop et Hodisan 1963 subass. galietosum albi (Pop et Hodisan 1964) Coldea 1991** se forment sur des moraines mobiles ou semifixés. Elle a été rencontrée dans les Gorges Uibăreşti, à l'altitude entre 500 - 650 m, exposition Sudique, Vestique et Sud - Vestique. Les pantes ont une inclination entre 30 - 40°. Les coenoses sont relativement bien liées, avec une recouvrement générale de 70 - 90 %. La composition floristique est hétérogène grâce au stade primaire de la colonisation de la végétation sur ces terrains. Comme une particularité, on signale le grand nombre des espèces de Poaceae qui contribuent à rester en friche de lieux et indique la direction d'évolution. Dominantes sont dans cette association, qui comprend 45 espèces, les hémicryptophytes (55,55 %), suivies par les therophytes (22 %). En ce qui concerne les éléments géographiques, on constate la prédominance des éléments euroasiatiques (37,77 %), suivies par celles central-européennes (11 %), ponto-méditerranéenne (8,88 %) et carpato-balkaniques (6,66 %).

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	0	24,44 %	62,22 %	13,33 %	0	0
T	6,66 %	0	0 %	62,33 %	24,44 %	6,66
R	17,77 %	0	2,22 %	17,77 %	57,77 %	4,44 %

Fig. no. 7

No. relevés	1	2	3	4	5	6	Éléments phytogéographiques	U	T	R
L'altitude (m)	600	550	600	500	650	600				
L'exposition	S	V	V	S-V	S-V	S-V				
L'inclinaison (°)	35	40	40	35	30	25				
Le recouvrement de la végétation	70	70	60	60	70	90				
La surface analysée (m <sup>2</sup> )	25	25	25	25	25	25				
Galium album	2	3	3	2,3	3,4	3	Eua	2,5	2,5	3
Melica ciliata f. flavescens	1	+	+	+	+1	-	Ec-B	1,5	4	4
Festuca pallens ssp. pallens	+	+	+	-	-	+	Carp-B	1,5	4	4,5

<i>Helictotrichon decorum</i>	-	-	-	+	+	-		Carp (end)	2,5	3,5	4,5
<i>Poa nemoralis</i>	+	+	+	-	-	-	Eua	3	3	0	
<i>Carex divulsa</i>	-	+	-	+	-	+	Eua	2,5	3	0	
<i>Coronilla varia</i>	-	+	-	+	-	-	Ec-Md	2	3	4	
<i>Dorycnium pentaphyllum</i> ssp. <i>herbaceum</i>	+	-	+	-	+	+	Ec-Md	2	5	4	
<i>Medicago lupulina</i>	+	-	+	-	-	-	Eua	2,5	3	4	
<i>Dianthus carthusianorum</i>	-	+	+	+	-	-	E	2	5	5	
<i>Minuartia setacea</i> ssp. <i>banatica</i>	-	-	+	-	-	+	P-p-B	1,5	0	4	
<i>Euphorbia cyparissias</i>	-	+	-	+	+	-	Eua	2	3	4	
<i>Aconitum anthora</i>	+	+	-	+	-	-	E (Ct)	2	3	0	
<i>Cardaminopsis arenosa</i>	+	+	-	+	+	-	Ec	2	3,5	4	
<i>Erysimum odoratum</i>	+	-	+	+	+	+	Ec (Md)	2,5	3	4	
<i>Alyssum alyssoides</i>	+	-	+	+	-	-	E (Ct)	1	3	0	
<i>Hypericum perforatum</i>	+	+	-	-	+	-	Eua	3	3	0	
<i>Sedum hispanicum</i>	-	-	+	-	+	+	Md	1	3,5	4	
<i>Fragaria viridis</i>	-	+	+	-	+	2	E (Ct)	2	4	3	
<i>Cnidium silaifolium</i>	-	+	+	+	-	-	Md	3	3,5	4,5	
<i>Daucus carota</i>	-	-	-	-	+	+	Eua (Md)	2,5	3	0	
<i>Verbascum lychnitis</i>	-	+	+	-	+	+	E	1	3	4	
<i>Acinos arvensis</i>	+	-	+	+	-	-	E (Md)	1,5	3,5	4	
<i>Origanum vulgare</i>	+	+	-	+	1,2	+	Eua (Md)	2,5	3	3	
<i>Salvia verticillata</i>	1	1	+	+	1,2	+	Eua (Md)	2	4	0	
<i>Teucrium chamaedrys</i>	-	+	-	-	1	1	Md (Ec)	2	3,5	4	
<i>Teucrium montanum</i>	+	+	-	+	-	-	Md-Ec	1	4	5	
<i>Thymus comosus</i>	-	-	+	+	+	-	Carp (end)	2	3,5	4,5	
<i>Stachys recta</i>	+	+	-	-	+	-	P-Md	2	4	4,5	
<i>Cephalaria uralensis</i>	-	-	-	+	+	+	P-p	1,5	4	4,5	
<i>Campanula sibirica</i>	-	+	+	-	-	-	Eua (Ct)	2,5	4	4	
<i>Erigeron acer</i>	-	-	-	-	+	+	Circ (bor)	2,5	3	0	
<i>Inula ensifolia</i>	+	+	-	+	-	-	P-p	1,5	3,5	4	
<i>Crataegus monogyna</i>	+	+	-	-	+	-	E	2,5	3	3	
<i>Rosa canina</i>	-	+	+	+	+	-	E	2	3	3	
<i>Syringa vulgaris</i>	+	-	+	-	+	+	D-B	1,5	4,5	4,5	
<i>Brachypodium sylvaticum</i>	-	-	-	-	+	-	Eua (Md)	3	3	4	
<i>Vicia cracca</i>	-	-	-	-	-	+	Eua	3	0	3	
<i>Cerastium arvense</i>	-	-	-	-	+	-	Circ (bor)	2,5	0	3,5	
<i>Ranunculus bulbosus</i>	-	-	-	-	-	+	E	2	3	3	
<i>Geum urbanum</i>	-	-	+	-	-	-	Eua (Md)	3	3	4	
<i>Sanguisorba minor</i>	-	+	-	-	-	-	Eua	2	3,5	4	
<i>Potentilla argentea</i>	-	-	-	-	-	+	Eua	2	4	2	
<i>Echium vulgare</i>	-	+	-	-	-	-	Eua	2	3	4	
<i>Taraxacum erythrospermum</i>	-	-	-	+	-	-	Eua (Md)	2	4	4,5	

Tableau no. 7

L'association **Thymetum comosi Pop et Hodisan 1963** subass. **teucrietosum montani** (Csürös 1958) Coldea 1991 a été identifié dans les Gorges Crăciunești, sur les pentes avec une exposition ouestique et sud - ouestique. Les coenoses de cette association se développent, pour la plus part, dans les lieux avec des moraines mobiles de la base des roches calcareuses et sur les terrains pierreux des environs des grottes. Elles sont bien raillées, ayant un recouvrement de 60 - 70 %. L'association a 51 espèces, parmi lesquelles prédominantes sont les hémicryptophytes (56,86 %), suivies par therophytes. L'analyse des éléments géographiques montre une proportion élevée de celles d'origine euroasiatique (27,45 %), sudique (27,45 %), suivies par celles central - européennes (13,72 %).

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	0	33,33 %	56,86 %	7,84 %	0	0
T	7,84 %	0	11,76 %	41,17 %	33,33 %	3,92 %
R	19,60 %	0	0 %	11,76 %	56,86 %	9,80 %

Fig. no. 8

No. relevés	1	2	3	4	Éléments phytogéographiques	U	T	R
L'altitude (m)	450	500	300	555				
L'exposition	V	V	S	SV				
L'inclinaison (°)	20	25	25	35				
Le recouvrement de la végétation	60	70	70	30				
La surface analysée (m <sup>2</sup> )	10	10	10	10				
Galium album	3.4	+	-	-	Eua	2,5	2,5	3
Teucrium charnaedrys	+	3	2.3	+	Md-Ec	2	3,5	4
Teucrium montanum	1	1	+	+	Md-Ec	1	4	5
Seseli elatum ssp. osseum	1	+	-	+	p-D	1,5	4	4
Sanguisorba minor	+	-	+	-	Eua	2	3,5	4
Stachys recta	+	+	+	-	P-Md	2	4	4,5
Viola tricolor ssp. subalpina	+	+	-	+	Eua	2,5	3	0
Scrophularia heterophylla ssp. laciniata	+	-	-	+	Carp-B	2	2,5	0

<i>Orlaya grandiflora</i>	-	1	+	+			Md-Ec	2	3,5	4
<i>Verbascum phlomoides</i>	-	+	+	-			E	2,5	3,5	4
<i>Geranium robertianum</i>	-	1	+	-			Eua (Md)	2	3,5	4
<i>Geranium columbinum</i>	-	+	+	-			Eua	2	3,5	4
<i>Campanula sibirica</i>	-	+	+	-			Eua (Ct)	2,5	4	4
<i>Fragaria vesca</i>	-	+	+	-			Eua	3	2,5	0
<i>Alyssum alyssoides</i>	-	+	+	-			E (Ct)	1	3	0
<i>Jurinea mollis</i> ssp. <i>transsilvanica</i>	-	+	+	-			D-B	1	4,5	4
<i>Salvia verticillata</i>	-	+	+	-			Eua (Md)	2	4	0
<i>Isatis tinctoria</i> ssp. <i>praecox</i>	-	+	+	-			Md (P)	2	3,5	4
<i>Xeranthemum annuum</i>	-	+	1	-			P-Md	1,5	4	3
<i>Centaurea atropurpurea</i>	-	+	+	+			D-B	2	3	5
<i>Centaurea bieberste- inii</i> ssp. <i>biebersteinii</i>	-	+	+	+			E	3	3	3
<i>Allium flavum</i>	-	+	+	-			P-Md	1,5	4	4
<i>Genista tinctoria</i> ssp. <i>ovata</i>	-	+	+	-			Atl-Carp-B	2,5	3	3
<i>Chamaespartium sagittale</i>	-	-	+	+			Atl-Md-Ec	3	3	3
<i>Stipa pennata</i> ssp. <i>pennata</i>	-	+	+	1,2			Eua (Md)	1,5	4	4
<i>Sesleria rigida</i>	-	+	+	1			Carp-B	2,5	2	4,5
<i>Phleum montanum</i>	-	+	+	+			Carp-B-Cauc	1,5	4,5	4
<i>Koeleria pyramidata</i>	-	-	+	+			Circ (bor)	2	4	5
<i>Festuca valesiaca</i>	-	-	+	+			Eua (Ct)	1,5	4	4
<i>Cleistogene serotina</i>	-	-	+	+			Eua (Md)	1	3,5	4
<i>Piptatherum virescens</i>	-	-	+	+			Md	2	3,5	4,5
<i>Melica ciliata</i>	-	-	+	+			Ec-B	1,5	4	4
<i>Dorycnium pentaphy- llum</i> ssp. <i>herbaceum</i>	-	-	2	-			Ec-Md	2	5	4
<i>Sedum hispanicum</i>	-	-	+	+			Md	1	3,5	4
<i>Thymus pulegioides</i>	-	-	+	+			Ec	2,5	3	3
<i>Hieracium pilosella</i>	-	-	+	+			E (Md)	2,5	0	0
<i>Veronica austriaca</i> ssp. <i>teucrium</i>	-	-	+	+			Ec	1,5	4	4,5
<i>Carex caryophyllea</i>	-	-	+	+			Eua (Md)	2	2,5	0
<i>Scleranthus annuus</i>	-	-	+	+			Eua	2	3	2
<i>Arenaria serpyllifolia</i>	-	-	+	+			Circ (bor)	2	2,5	0
<i>Achillea crithmifolia</i>	-	-	+	+			B-p	2,5	4	0
<i>Minuartia setacea</i> ssp. <i>banatica</i>	-	-	+	+			P-p-B	1,5	0	4
<i>Dianthus petraeus</i> ssp. <i>petraeus</i>	-	-	+	+			Carp (end)	2	3,5	4

<i>Acinos alpinus</i> ssp. <i>majoranifolius</i>	-	-	+	+			<i>Ec</i>	3	0	5
<i>Cardaminopsis arenosa</i>	-	-	+	+			<i>Ec</i>	2,5	3	4
<i>Lembotropis nigricans</i>	-	-	-	+			<i>Ec</i>	2,5	3	0
<i>Vincetoxicum</i>	-	-	-	+			<i>E (Md)</i>	2	4	4
<i>hirundinaria</i>										
<i>Dictamnus albus</i>	-	-	-	+			<i>Eua (Md)</i>	1,5	4,5	4,5
<i>Asplenium</i>	-	-	-	+			<i>Circ (bor)</i>	3	0	4
<i>trichomanes</i>										
<i>Asplenium ruta-muraria</i>	-	-	-	+			<i>Circ (bor)</i>	1,5	3	5
<i>Asplenium ceterach</i>	-	-	-	1			<i>Atl-Md</i>	1,5	5	4,5

Tableau no. 8

**L'association *Asperulo capitatae - Seslerietum rigidae* (Zoly. 1939)**

**Coldea 1991** a été rencontrée dans les Gorges de Bulzești, sur les versants rocheux, à l'altitude de 760 - 810 m, dans les Gorges Cibului à 665 m, dans les Gorges Ardeu à l'altitude de 725 - 760 m et dans les Gorges Mada à l'altitude de 690 - 700 m.

Dans les Gorges Bulzești, les phytocoénoses de *Sesleria rigida* se trouvent sur les murs calcaires avec une inclination de 30 - 60°, exposition ouestique et nord-ouestique, en commencement de la base vers le sommet, dans le voisinage d'une forêt de hêtre. À côté de *Sesleria rigida*, on rencontre fréquent *Carex digitata*, *Saxifraga paniculata*, *Thymus pulegioides* et *Thymus comosus*. Parmi les formes biologiques predominent les hémicryptophytes (61,53 %). Les espèces thermophiles réalisent une proportion de 25 %. L'altitude en sus de 800 m est reflétée par l'élément montagneux (11,53 %).

	0	1-1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	0	11,53 %	38,46 %	42,30 %	7,69 %	0
T	7,69 %	0	26,92 %	50 %	15 %	0
R	15,38 %	0	0 %	26,92 %	53,84 %	3,84 %

Fig. no. 9

No. relevés	1	2	3	4	Éléments phytogéographiques	U	T	R
L'altitude (m)	760	800	810	810				
L'exposition	V	V	NV	NV				
L'inclinaison (°)	50	60	40	30				
Le recouvrement de la végétation	90	70	50	40				
La surface analysée (m²)	100	100	100	100				
<i>Sesleria rigida</i>	4	3	2	3	Carp-B	2,5	2	4,5
<i>Poa nemoralis</i>	1	+	-	-	Eua	3	3	0
<i>Carex divulsa</i>	+	-	+	-	Eua	2,5	3	0
<i>Carex digitata</i>	+	+	+	-	E	3	3	3
<i>Cnidium silaifolium</i>	+	-	1	-	Md	3	3,5	4,5
<i>Vincetoxicum hirundinaria</i>	+	+	+	+	E(Md)	2	4	4
<i>Dianthus petraeus</i> ssp. <i>petraeus</i>	+	1	+	+	Carp (end)	2	3,5	4
<i>Digitalis grandiflora</i>	+	-	+	-	E	3	3	3
<i>Doronicum columnae</i>	+	-	+	-	Alp-B-Carp	3,5	2	3,5
<i>Galium album</i>	+	+	-	-	Eua	2,5	2,5	3
<i>Hypericum perforatum</i>	+	-	+	-	Eua	3	3	0
<i>Laserpitium latifolium</i>	+	-	+	-	E	0	0	4
<i>Primula veris</i> ssp. <i>columnae</i>	+	+	-	-	Md	3	2	5
<i>Saxifraga paniculata</i>	+	+	-	+	Eua	1,5	1,5	4,5
<i>Seseli gracile</i>	+	-	+	+	D	2	4	4,5
<i>Seseli rigidum</i>	-	+	-	+	D-B	1,5	4,5	4,5
<i>Silene italica</i> v. <i>nemoralis</i>	+	-	-	+	Alp-Carp-B	3	0	3
<i>Thymus pulegioides</i>	+	+	1	-	Ec	2,5	3	3
<i>Thymus comosus</i>	-	+	+	+	Carp (end)	2	3,5	4,5
<i>Verbascum lanatum</i> v. <i>hinkei</i>	+	+	-	+	D-B	3	2	3
<i>Polypodium vulgare</i>	+	-	-	+	Circ (bor)	3,5	3	4
<i>Selaginella helvetica</i>	+	-	+	-	Eua	4	3,5	4,5
<i>Chamaecytisus hirsutus</i>	+	-	+	-	Ec (Md)	2	3,5	4
<i>Sorbus aria</i>	+	-	-	+	Eua (Md)	2,5	3	4
<i>Syringa vulgaris</i>	+	+	-	-	D-B	1,5	4,5	4,5
<i>Spirea chamaedryfolia</i>	+	-	+	-	Eua	3	2,5	0

Tableau no. 9

Dans les Gorges de Cib, cette association végète sur les roches calcareuses de Piatra Cibului, en occupant des superficies relativement petits, avec un degré de recouvrement de 40 - 80 %. L'association est composée par 19 espèces. Prédominantes sont les hémicryptophytes (73%) suivies par les chamaephytes et thérophytes. Du point de vue floristique, les éléments central - européennes (26%) et euroasiatiques (15 %) sont prédominantes. Les éléments sudiques forment une proportion de 20,29% du total des espèces. Les espèces xérophytes réalisent un pourcentage de 36,84 %, les micromésothermes 47,36% et les espèces moins acide - neutrophiles 68,42 %.

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	5,26 %	36,84 %	47,36 %	5,26 %	5,26 %	0
T	5,26 %	0	15,78 %	46,36 %	31,57 %	0
R	5,26 %	0	0	10,52 %	68,42 %	15,78 %

Fig. no. 10

No. relevés	1	2	Éléments phytogéographiques	U	T	R
L'altitude (m)	665	600				
L'exposition	NV	NV				
L'inclinaison (°)	50	50				
Le recouvrement de la végétation	40	80				
La surface analysée (m <sup>2</sup> )	25	25				
Sesleria rigida	3	4	Carp-B	2,5	2	4,5
Festuca rupicola	+	+	Eua (Ct)	1,5	4	4
Melica ciliata	+	+.1	Ec-B	1,5	4	4
Koeleria pyramidata	+	+	Circ (bor)	2	4	5
Phleum montanum	+	+	Carp-B-Cauc	1,5	4,5	4
Cardaminopsis arenosa	+	+	Ec	2,5	3	4
Isatis tinctoria	+	+	P-p	1,5	3,5	4
Erysimum odoratum	+	+	Ec (Md)	2,5	3	4
Moehringia muscosa	+	+	Ec	4	2	4
Sedum acre	+	+	Eua	0	3	3
Sedum hispanicum	1,2	2	Md	1	3,5	4
Galium album	1	1	Eua	2,5	2,5	3

<i>Helianthemum nummularium</i>	+	+						Ec (Md)	2	3	4
<i>Vincetoxicum hirundinaria</i>	+	+						E (Md)	2	4	4
<i>Teucrium chamaedrys</i>	+	+						Md-Ec	2	3,5	4
<i>Linaria angustissima</i>	+	+						Md	1	3,5	5
<i>Achillea crithmifolia</i>	+	+						B-p	2,5	4	0
<i>Asplenium ruta - muraria</i>	+	+						Circ (bor)	1,5	3	5
<i>Asplenium trichomanes</i>	+	+				•		Circ (bor)	3	0	4

Tableau no. 10

Dans les Gorges Ardeu, cette association est rencontrée sur les versants nord - ouestiques, avec un grand degré d'inclinaison 40 - 75°, en réalisant un recouvrement de 50 - 75%. Dans ces zones les éléments xérophyles, avec des préférences pour la lumière, la chaleur et les roches chalereuses, sont dispersées. L'association comprend 31 espèces, dominantes étant les hémicryptophytes. En ce qui concerne les éléments géographiques, dominantes sont les éléments sudiques et endémiques (32,25%), suivies par celles euroasiatiques (19,35%). Les espèces xérophyles réalisent 27,27%, celles modérées thermophiles 36%, et celles neutro - basiphiles 36%.

*	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	0	27,27 %	51,51 %	15,15 %	6,06 %	0
T	9,09 %	0	15,15 %	36,36 %	36,36 %	3,03 %
R	9,09 %	0	0	12,12 %	42,42 %	36,36 %

Fig. no. 11

No. relevés	1	2	3	Éléments phytogéographiques	U	T	R
L'altitude (m)	725	760	750				
L'exposition	N	NV	N				
L'inclinaison (°)	50	40	75				
Le recouvrement de la végétation	70	75	50				
La surface analysée (m²)	100	25	100				

## LES ASSOCIATIONS SAXICOLES IN MONTS MÉTALLIFÈRES

Ch. ass.								
Sesleria rigida	4.5	4.5	3.5			Carp-B	2,5	2
<b>Seslerion et Seslerietalia rigidae</b>								
Helictotrichon decorum	+	+	1.3			Carp (end)	2,5	5
Saxifraga paniculata	+.3	+	+			Eua	1,5	1,5
Jurinea mollis ssp. transsilvanica	+	-	+			D-B	1	4,5
Thymus comosus	1,5	2,5	-			Carp (end)	2	3,5
Helianthemum canum	+	+.3	+			Atl-Med	2	4
Seseli rigidum	+	+.2	+			D-B	1,5	4,5
Seseli gracile	+	-	+			D	2	4
Dianthus petraeus ssp. petraeus	-	+	1,5			Carp (end)	2	3,5
Viola joói	+	-	-			D	2,5	2,5
Moehringia muscosa	+	-	-			Ec	4	2
<b>Stipio-Festucetalia pallentis (s.l.)</b>								
Stipa pennata ssp. eriocaulis	+	-	+			Eua (Md)	1,5	4
Phleum montanum	-	-	+			B	1,5	4,5
Erysimum odoratum	+	+	-			Ec (Md)	2,5	3
Teucrium montanum	+	-	+			Md-Ec	1	4
Potentilla cinerea	-	-	+			E (Ct)	2	3,5
<b>Insoțitoare:</b>								
Silene otites	+	+	-			Eua (Ct)	1,5	4
Galium mollugo	1,3	1,5	+			Eua	3	0
Teucrium chamaedrys	+.5	-	-			Md-Ec	2	3,5
Minuartia setacea ssp. banatica	+	+	-			P-p-B	1,5	0
Anthyllis vulneraria ssp. polyphylla	+	+.3	-			P-p	2	3
Digitalis grandiflora	+	-	-			E	3	3
Asplenium trichomanes	+	+	+.5			Circ (bor)	3	0
Asplenium ruta - muraria	-	+	.4			Circ (bor)	1,5	3
Stachys recta	-	+	-			P-Md	2	4
Sedum telephium ssp. maximum	-	+	-	,		Eua (Ct)	2	3
Campanula sibirica	-	+	+			Eua	2,5	4
Cystopteris fragilis	-	+	-			Circ (bor)	3,5	0
Vincetoxicum hirundinaria	-	+	-			E (Md)	2	4
Allium carinatum ssp. pulchellum	-	-	+			Ec-B	2	3,5
Koeleria pyramidalis	+	-	-			Circ (bor)	2	4

Tableau no. 11

Dans les Gorges de Mada l'association a été rencontrée sur les versants avec une inclination de 50 - 60 %. L'association comprend 32 espèces. Parmi les bioformes, dominantes sont les hémicryptophytes (84,37%). Dans le spectre floristique prédominantes sont les éléments euroasiatiques (31,25%), suivies par les éléments sudiques (28,13%). Les autres éléments géographiques sont représentées par des proportions de 9,37 à 3,12%. Les espèces xérophytes réalisent une participation de 34,37%, celles moderées thermophiles et thermophiles sont représentées par une proportion de 12% - 37,5%.

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	0	34,37 %	40,62 %	18,75 %	6,25 %	0
T	15,62 %	0	12,49 %	31,25 %	37,5 %	3,12 %
R	9,37 %	0	0	9,37 %	50 %	31,25 %

Fig. no. 12

No. relevés	1	2	Éléments phytogéographiques	U	T	R
L'altitude (m)	690	700				
L'exposition	N	NE				
L'inclinaison (°)	50	60				
Le recouvrement de la végétation	60	50				
La surface analysée (m²)	25	100				
<b>Ch. ass.</b>						
<i>Sesleria rigida</i>	4,5	3,5	Carp-B	2,5	2	5
<i>Seslerion et Seslerietalia rigidae</i>						
<i>Helictotrichon decorum</i>	-	1,5	Carp (end)	2,5	5	3,5
<i>Saxifraga paniculata</i>	+	-	Eua	1,5	1,5	5
<i>Jurinea mollis</i> ssp. <i>transsilvanica</i>	+2	+	D-B	1	4,5	4
<i>Thymus comosus</i>	1,3	+	Carp (end)	2	3,5	5
<i>Helianthemum canum</i>	+	-	Alt-Md	2	4	5
<i>Seseli rigidum</i>	+	+	D-B	1,5	4,5	5

<i>Dianthus petraeus</i>	+.3	+.5				Carp (end)	2	3,5	4
ssp. <i>petraeus</i>									
<i>Viola joöi</i>	+	-				D	2,5	2,5	5
<i>Moehringia muscosa</i>	+	+				Ec	4	2	4
<i>Stipio-Festucetalia pallentis</i> (s.l.)									
<i>Stipa pennata</i> ssp. <i>eriocaulis</i>	-	+				Eus (Md)	1,5	4	4
<i>Phleum montanum</i>	1,2	-				B	1,5	4,5	4
<i>Erysimum odoratum</i>	-	+				Ec (Md)	2,5	3	4
<i>Teucrium montanum</i>	-	+				Md-Ec	1	4	5
<i>Potentilla cinerea</i>	+	-				E (Ct)	2	3,5	5
<b>Însoțitoare:</b>									
<i>Silene otites</i>	+	+				Eua (Ct)	1,5	4	4,5
<i>Galium mollugo</i>	+.5	+				Eua	3	0	3
<i>Teucrium chamaedrys</i>	+	-				Md-Ec	2	3,5	4
<i>Minuartia setacea</i> ssp. <i>banatica</i>	-	+				P-p-B	1,5	0	4
<i>Digitalis grandiflora</i>	-	+				E	3	3	3
<i>Asplenium trichomanes</i>	-	+				Circ (bor)	3	0	4
<i>Stachys recta</i>	+	-				P-Md	2	4	4,5
<i>Sedum telephium</i> ssp. <i>maximum</i>	-	+				Eua (Ct)	2	3	0
<i>Campanula sibirica</i>	+	+				Eua	2,5	4	4
<i>Valeriana officinalis</i>	+	+				Eua (Md)	4	3	4
<i>Cystopteris fragilis</i>	-	+				Circ (bor)	3,5	0	0
<i>Vincetoxicum hirundinaria</i>	-	+				E (Md)	2	4	4
<i>Poa nemoralis</i>	-	1,5				Eua	3	3	0
<i>Melica ciliata</i>	-	+				Ec-B	1,5	4	4
<i>Festuca rupicola</i>	-	+				Eua (Ct)	1,5	4	4
<i>Isatis tinctoria</i>	-	+				P-p	1,5	3,5	4
<i>Seseli libanotis</i>	-	+				Eua (Ct)	3	0	4

Tableau no. 12

L'association **Seseli gracile - Festucetum pallentis** (Soó 1959) Coldea 1991, a été analysée dans les sommets Vârful Custura et Pietriceaua à 640 m altitude, dans la zone Godinești, et dans les Gorges Uibărești et Ribicioara. Dans la zone de Godinești, l'association comprend 47 espèces. Prédominantes sont les hémicryptophytes (44,68 %) suivies par thérophytes (25,53 %). Le

spectre floristique comprend les éléments euroasiatiques (40,42 %), européennes (14,89%) et méditerranéennes (14,89%). En ce qui concerne l'humidité, dominantes sont les espèces xéromésophytes (55,19%), suivies par les xérophytes (27,65 %). Du point de vue des conditions de température, dans cette association sont prédominantes les micro-mésothermes (55,31%). En ce qui concerne l'exigence pour la réaction du sol, dominantes sont les espèces moins acide-neutrophiles (59,57 %).

	0	1 – 1,5	2 – 2,5	3 – 3,5	4 – 4,5	5
U	4,25	27,65 %	53,19 %	14,89 %	0	0
T	17,02 %	0	0 %	55,31 %	27,65 %	0
R	8,51 %	0	0	23,39 %	59,57 %	8,51 %

Fig. no. 13

No. relevés	1	2	3	4	Éléments phytogéographiques	U	T	R
L'altitude (m)	640	640	640					
L'exposition	SE	SV	SV					
L'inclinaison (°)	30	30	30					
Le recouvrement de la végétation	60	60	50					
La surface analysée (m <sup>2</sup> )	25	25	25					
Festuca pallens ssp. pallens	+	2	1		Carp-B	1,5	4	4,5
Elymus hispidus	+	+	+		Eua (Ct-Md)	2	4,5	4
Melica ciliata	+	+	+		Ec-B	1,5	4	4
Cleistogenes serotina	+	1	1		Eua (Md)	1	3,5	4
Bromus sterilis	+	+	+		Eua (Md)	2	4	4
Urtica dioica	+	+	1		Cm	3	3	4
Polycnemum majus	+	1	+		Eua (Md)	1,5	4,5	4
Scleranthus perennis	+	+	+		Eua	3	0	3
Petrohragia prolifera	+	+	+		P-Md	1,5	4	3
Euphorbia cyparissias	+	+	+		Eua	2	3	4
Chelidonium majus	+	+	1		Eua	3	3	4
Alyssum alyssoides	2	3	3		E (Ct)	1	3	0
Sedum acre	1	1	1		Eua	0	3	3
Sedum hispanicum	1	1	1		Md	1	3,5	4

<i>Fragaria viridis</i>	+	+	+.1			E (Ct)	2	4	3
<i>Potentilla cinerea</i>	1	1	1			E (Ct)	2	3,5	4,5
<i>Potentilla argentea</i>	+	+	+			Eua	2	4	2
<i>Sanguisorba minor</i>	+	+	1			Eua	2	3,5	4
<i>Medicago minima</i>	+	+	1			Eua (Md)	1,5	4	4
<i>Erodium cicutarium</i>	+	+	+			Cm	2,5	0	0
<i>Orlaya grandiflora</i>	+	+	1			Md-Ec	2	3,5	4
<i>Verbascum thapsus</i>	+	+	+			Eua	2,5	0	4
<i>Verbascum phlomoides</i>	+	+	+			E	2,5	3,5	4
<i>Veronica arvensis</i>	+	+	+			Eua	2,5	3	3
<i>Veronica spicata</i>	+	+	+			Eua	2,5	4	4
<i>Origanum vulgare</i>	+	+	-			Eua (Md)	2,5	3	3
<i>Acinos alpinus</i> ssp. <i>majoranifolius</i>	+	1	+			Ec (alp)	3	0	5
<i>Stachys recta</i>	+	+	+			P-Md	2	4	4,5
<i>Teucrium chamaedrys</i>	+	+	+			Md-Ec	2	3,5	4
<i>Thymus pulegioides</i>	+	+	-			Ec	2,5	3	3
<i>Plantago lanceolata</i>	+	+	+			Eua	0	0	0
<i>Vincetoxicum hirundinaria</i>	+	+	+			E (Md)	2	4	4
<i>Asperula cynanchica</i>	+	+	-			P-Md	2	3,5	4
<i>Cruciata pedemontana</i>	+	+	-			Md	2	3,5	4
<i>Achillea millefolium</i>	+	+	+			Eua	3	0	0
<i>Carduus candicans</i>	+	+	+			B-p	2	3	5
<i>Chondrilla juncea</i>	+	+	-			Eua (Ct)	1,5	3,5	4
<i>Centaurea apiculata</i> ssp. <i>spinulosa</i>	+	+	+			Eua (Md)	2,5	0	4
<i>Allium flavum</i>	+	+	-			P-Md	1,5	4	4
<i>Asplenium trichomanes</i>	+	+	+			Circ (bor)	3	0	4
<i>Asplenium ruta-muraria</i>	+	+	+			Circ (bor)	1,5	3	5
<i>Acer campestris</i>	-	+	+			E	2,5	3	3
<i>Cornus sanguinea</i>	+	-	+			Ec	3	3	4
<i>Crataegus monogyna</i>	-	+	+			E	2,5	3	3
<i>Fraxinus ornus</i>	+	-	+			Md	1,5	3,5	5
<i>Quercus cerris</i>	-	+	+			Md	2	3,5	3
<i>Rosa rubiginosa</i>	+	-	+			Md	2	3,5	4,5

Tableau no. 13

Dans les Gorges Uibărești cette association se rencontre sur les roches abruptes, ensoleillées, avec l'exposition sud, sud-estique, sud-ouestique, sur des moraines bien liés et, plusieurs fois, parmi les buissons de *Syringa vulgaris* et *Fraxinus ornus*. Le degré de recouvrement est de 60 - 80%. La composition floristique de la phytocoenose est hétérogène et comprend 52 espèces. Les espèces installées sur les moraines et celles saxicoles se disputent la primauté en fonction du degré du développement du sol et des autres facteurs écologiques. En plus de l'espèce édificatrice, on signale les espèces *Galium album*, *Fragaria vesca*, *Teucrium chamaedrys*, *Thymus comosus*, *Asplenium ruta-muraria* avec l'abondance-dominante élevée. L'analyse des éléments géographiques montre un pourcentage plus élevé pour les éléments euroasiatiques (44,23%), suivies par celles sudiques (13,46%) et endémiques (3,84%). Parmi les bioformes prédominantes sont les hémicryptophytes (51,92%). Les thérophytes participent seulement avec 17,30% à l'édification du tapis végétal. Les espèces xéromésophytes réalisent 48,07% et celles xérophytes 23,07%. Les espèces micromésothermes réalisent 65,38% et les espèces moins acide-neutrophiles 51,92%.

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	5,76 %	23,07 %	48,07 %	17,30 %	3,84 %	0
T	11,53 %	0	7,69 %	65,38 %	13,46 %	0
R	19,23 %	0	0	21,15 %	51,92 %	5,76 %

Fig. no. 14

No. relevés	1	2	3	4	5	Éléments phytogéographiques	U	T	R
L'altitude (m)	600	550	700	600	650				
L'exposition	S-E	S-V	S-V	S-E	S				
L'inclinaison (°)	30	35	40	15	25				
Le recouvrement de la végétation	60	80	80	85	60				
La surface analysée (m <sup>2</sup> )	25	25	25	25	25				
Festuca pallens ssp. pallens	3	3,4	3,4	3	3	Carp-B	1,5	4	4,5
Festuca rupicola	-	+	+	+	+	Eua (Ct)	1,5	4	4
Melica ciliata	-	+	+	-	-	Ec-B	1,5	4	4

## LES ASSOCIATIONS SAXICOLES IN MONTS MÉTALLIFÈRES

<i>Carex divulsa</i>	-	+	+	+	-	Eua	2,5	3	0
<i>Coronilla varia</i>	+	+	-	-	-	Ec-Md	2	3	4
<i>Astragalus glycyphyllos</i>	-	+	+	-	-	Eua	3	3	4
<i>Euphorbia cyparissias</i>	+	+	+	+	+	Eua	2	3	4
<i>Ranunculus bulbosus</i>	-	-	+	+	-	E	2	3	3
<i>Moehringia muscosa</i>	+	+	-	-	-	Ec	4	2	4
<i>Cardaminopsis arenosa</i>	-	-	+	+	+	Ec	2,5	3	4
<i>Erysimum odoratum</i>	+	-	-	+	-	Ec (Md)	2,5	3	4
<i>Galium album</i>	1	+	1	1,2	1	Eua	2,5	2,5	3
<i>Sedum hispanicum</i>	+	-	+	+	+	Md	1	3,5	4
<i>Sedum telephium ssp. maximum</i>	-	-	+	+	-	Eua (Md)	2	3	0
<i>Fragaria vesca</i>	+	+	1	1,2	+	Eua	3	2,5	0
<i>Potentilla argentea</i>	+	-	+	+	-	Eua	2	4	2
<i>Vincetoxicum hirundinaria</i>	-	-	+	+	-	E (Md)	2	4	4
<i>Hypericum perforatum</i>	-	-	+	+	-	Eua	3	3	0
<i>Helianthemum hirsutum</i>	+	+	-	-	-	Ec-Md	2,5	3	4
<i>Myosotis laxa ssp. caespitosa</i>	+	+	-	-	-	Circ (bor)	4,5	0	0
<i>Verbascum lychnitis</i>	-	+	+	-	-	E	1	3	4
<i>Acinos arvensis</i>	+	-	+	+	-	E (Md)	1,5	3,5	4
<i>Teucrium chamaedrys</i>	-	+	1	1,2	+	Md-Ec	2	3,5	4
<i>Thymus comosus</i>	1	+.1	1,2	1	+	Carp (end)	3	2,5	0
<i>Pedicularis comosa ssp. campestris</i>	-	-	+	+	-	Ec	2	3,5	4,5
<i>Plantago lanceolata</i>	+	-	-	+	-	Eua	0	0	0
<i>Veronica chamaedrys</i>	-	-	+	-	+	Eua	3	0	0
<i>Achillea setacea</i>	+	-	-	+	+	Eua (Ct)	2	3	5
<i>Centaurea biebersteinii ssp. biebersteinii</i>	-	-	+	+	-	E	3	3	3
<i>Hieracium pilosella</i>	+	+	-	-	-	E (Md)	2,5	0	0
<i>Allium senescens ssp. montanum</i>	-	+	-	+	-	Eua (Ct)	1,5	3,5	4
<i>Asplenium ruta - muraria</i>	+	-	1	1	+	Circ (bor)	1,5	3	5
<i>Asplenium trichomanes</i>	+	+	1	-	-	Circ (bor)	3	0	4
<i>Crataegus monogyna</i>	-	+	+	-	+	E	2,5	3	3
<i>Rhamnus catharticus</i>	+	-	+	-	+	Eua	2	3	4

<i>Fraxinus ornus</i>	-	-	+	-	+		Md	1,5	3,5	5
<i>Syringa vulgaris</i>	+	+	+	-	+		D-B	1,5	4,5	4,5
<i>Vicia cracca</i>	-	-	-	+	-		Eua	3	0	3
<i>Potentilla recta</i>	+	-	-	-	-		Eua (Ct)	1,5	3,5	4
<i>Sanguisorba minor</i>	-	-	-	-	+		Eua	2	3,5	4
<i>Geranium rotundifolium</i>	+	-	-	-	-		Eua (Md)	2	3,5	4
<i>Echium vulgare</i>	-	-	-	+	-		Eua	2	3	4
<i>Ajuga genevensis</i>	-	+	-	-	-		Eua (Ct)	2,5	3	4
<i>Polygala vulgaris</i>	-	-	-	+	-		Eua	3	3	3
<i>Origanum vulgare</i>	-	+	-	-	-		Eua (Md)	2,5	3	3
<i>Cephalaria uralensis</i>	-	-	+	-	-		P-p	1,5	4	4,5
<i>Ornithogalum umbellatum</i>	-	-	+	-	-		Md-Ec	0	3,5	4
<i>Juniperus communis</i>	+	-	-	-	-		Circ (bor)	2	0	0
<i>Carpinus betulus</i>	-	-	+	-	-		E	3	3	3
<i>Quercus cerris</i>	-	+	-	-	-		Md	2	3,5	3
<i>Prunus spinosa</i>	-	+	-	-	-		Eua	2	3,5	3
<i>Rosa canina</i>	-	-	-	-	+		E	2	3	3

Tableau no. 14

Cette association a été rencontrée aussi dans les Gorges Ribicioara à 600 m altitude, parmi les buissons de *Syringa vulgaris* et *Fraxinus ornus*, sur des petits surfaces (25 - 50 m<sup>2</sup>), avec une exposition sudique et sud-ouestique. Le degré de recouvrement est de 70%. Dominantes sont les hémicryptophytes (70%). Les therophytes réalisent seulement un pourcentage de 20% tant que les éléments sudiques réalisent 15%. En ce qui concerne l'humidité, dominantes sont les espèces xérophytes (40%) suivies par xéromésophytes (25%). En ce qui concerne l'exigence pour la température, dominantes sont les espèces micromésothermes (45%), suivies par celles moderé-thermophiles (35%).

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	5 %	40 %	25 %	30 %	0	0
T	20 %	0	0	45 %	35 %	0
R	0	0	0	20 %	80 %	0

Fig. no. 15

No. relevés	1	2	Éléments phytogéographiques	U	T	R
L'altitude (m)	600	600				
L'exposition	S	SV				
L'inclinaison ( $^{\circ}$ )	25	25				
Le recouvrement de la végétation	70	80				
La surface analysée ( $m^2$ )	10	10				
Festuca pallens ssp. pallens	3,2	3	Carp-B	1,5	4	4,5
Festuca valesiaca	+.	1	Eua (Ct)	1,5	4	4
Melica ciliata	+	1	Ec-B	1,5	4	4
Dianthus petraeus ssp. petraeus	+	+	Carp (end)	2	3,5	4
Petrorhagia prolifera	+	+	P-Md	1,5	4	3
Silene italica v. nemoralis	+	+	Alp-Carp-B	3	0	3
Cardaminopsis arenosa	+	+	Ec	2,5	3	4
Sedum hispanicum	+	+	Md	1	3,5	4
Saxifraga paniculata	+	+	Eua	1,5	1,5	4,5
Fragaria viridis	+	+	E (Ct)	2	4	3
Vincetoxicum hirundinaria	+	+	E (Md)	2	4	4
Seseli rigidum	+	+	D-B	1,5	4,5	4,5
Peucedanum austriacum	+	+	Ec	2,5	3	4
Cnidium silaifolium	+	+	Md	3	3,5	4,5
Seseli libanotis	+	+	Eua (Ct)	3	0	4
Laserpitium latifolium	+	+	E	0	0	4
Digitalis grandiflora	+	+	E	3	3	3
Isatis tinctoria	+	+	P-p	1,5	3,5	4
Polypodium vulgare	+	+	Circ (bor)	3,5	3	4
Asplenium trichomanes	+	+	Circ (bor)	3	0	4

Tableau. no. 15

L'association Melico - Phleetum montani Boșcaiu et al. 1966 a été rencontrée dans les Gorges Ardeu et Mada. Les coenoses saxicoles de cette

association occupent des grands surfaces sur les versants fort ensoleillés des roches calcareuses des Gorges Ardeu, à l'altitude de 730 - 780 m. Les sols sur lesquels elles végétent sont des rendzines bruns en alternance avec des roches. Cette particularité edaphique et aussi les propriétés morphologiques des espèces qui édifient l'association (*Phleum montanum* et *Melica ciliata*) empêchent la réalisation d'un bon caillage du tapis végétal. Dans la composition de cette association qui comprend 51 espèces, prédominantes sont les hémicryptophytes (65,95%), suivies, à une grande différence, par les thérophytes (17,02%) et chamaephytes (12,76%). Les géophytes réalisent seulement 4,25% du total des espèces de l'association. Parmi les éléments géographiques dominantes sont celles sudiques (31,81%), suivies par les éléments euroasiatiques (31,15%). Les éléments endémiques réalisent 6,38%. Les espèces xéromésophytes réalisent un pourcentage de 54,90% et celle xérophytes, 39,21%.

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	1,96 %	39,21 %	54,90 %	3,92 %	0	0
T	1,96 %	0	3,92 %	52,49 %	37,25 %	3,92 %
R	13,72 %	0	1,96 %	9,80 %	64,70 %	9,80 %

Fig. no. 16

No. relevés	1	2	3	Éléments phytogéographiques			U	T	R
L'altitude (m)	730	750	780						
L'exposition	S	S	S						
L'inclinaison (°)	35	20	30						
Le recouvrement de la végétation	50	75	60						
La surface analysée (m <sup>2</sup> )	100	100	100						
Ch. ass.									
<i>Phleum montanum</i>	1,5	3,5	2,5				B	1,5	4,5
<i>Melica ciliata</i>	1,5	2,5	2,5				Ec-B	1,5	4
<i>Thymio comosif-</i> <i>Festucion sulcate et</i> <i>Stipio-Festucetalia</i> <i>pallentis</i>									
<i>Stipa pennata</i> ssp. <i>eriocaulis</i>	+3	+2	.+4				Eua (°t)	1,5	4

## LES ASSOCIATIONS SAXICOLES IN MONTS MÉTALLIFÈRES

<i>Festuca rupicola</i>	2,5	1,5	2,5			Eua (Ct)	1,5	4	4
<i>Thymus comosus</i>	+	-	+,3			Carp (end)	2	3,5	4,5
<i>Sedum hispanicum</i>	+,4	+	+,3			Md	1	3,5	4
<i>Orlaya grandiflora</i>	+,3	1,5	+,5			Md-Ec	2	3,5	4
<i>Jurinea mollis</i> ssp. <i>transsilvanica</i>	+	+	+			D-B	1	4,5	4
<i>Dictamnus albus</i>	+	+	-			Eua (Md)	1,5	4,5	4,5
<i>Erysimum odoratum</i>	-	+,4	+			Ec (Md)	2,5	3	4
<i>Carduus candicanis</i>	-	+	+			B-p	2	3	5
<i>Teucrium montanum</i>	-	-	+,3			Md-Ec	1	4	5
<i>Hypericum rochelii</i>	-	-	+			B	1,5	4	4
<i>Piptatherum virescens</i>	-	-	+,3			Md	2	3,5	4,5
<b>Festuco-Brometea</b>									
<i>Arenaria serpyllifolia</i>	+	+	+2			Circ (bor)	2	2,5	0
<i>Acinos arvensis</i>	+	-	-			E (Md)	1,5	3,5	4
<i>Dianthus carthusianorum</i>	+	+	+			E	2	5	5
<i>Teucrium chamaedrys</i>	+	1,5	+,4			Md-Ec	2	3,5	4
<i>Euphorbia cyparissias</i>	+	+	+			Eua	2	3	4
<i>Asperula cynanchica</i>	-	+	+			P-Md	2	3,5	4
<b>Festucetalia valesiacae</b>									
<i>Achillea setacea</i>	+,3	+	+			Eua (Ct)	2	3	5
<i>Campanula sibirica</i>	+	+	+			Eua (Ct)	2,5	4	4
<i>Elymus hispidus</i>	+	+	1			Eua (Ct)	2	4,5	4
<i>Scabiosa ochroleuca</i>	+	-	-			Eua (Ct)	2	4	4
<i>Athemis tinctoria</i>	-	+	-			Eua	1,5	3	3
<i>Stachys recta</i>	-	+	-			P-Md	2	4	4,5
<b>Seslerietalia rigidae</b>			-						
<i>Seseli rigidum</i>	+	-	+			D-B	1,5	4,5	4,5
<i>Sempervivum marmoreum</i>	+	-	-			Carp-B	1,5	2,5	2,5
<i>Dianthus petraeus</i> ssp. <i>petraeus</i>	+	-	-			Carp (end)	2	3,5	4
<i>Helictotrichon decorum</i>	-	-	+			Carp (end)	2,5	3,5	4,5
<i>Seseli gracile</i>	-	+	+			D	2	4	4,5
<i>Helianthemum nummularium</i>	+	+	+			Ec-Md	2	3	4
<b>Însoțitoare:</b>									
<i>Asplenium ruta-muraria</i>	1,4	-	+			Circ (bor)	1,5	3	5
<i>Galium mollugo</i>	1,3	1,5	+			Eua	3	0	3
<i>Silene otites</i>	+	+	+,3			Eua (Ct)	1,5	4	4,5

<i>Hypericum perforatum</i>	+	-	-			Eua	3	3	0
<i>Verbascum lychnitis</i>	+	-	-			E	1	3	4
<i>Crupina vulgaris</i>	-	+	+			P-Md	2	3,5	0
<i>Arabis glabra</i>	-	+	-			Circ (bor)	2	3	3
<i>Echium vulgare</i>	-	-	+			Eua	2	3	4
<i>Sedum acre</i>	+	-	-			Eua	0	3	3
<i>Isatis tinctoria</i>	1	-	-			P-p	1,5	3,5	4
<i>Vincetoxicum hirundinaria</i>	-	-	+			E (Md)	2	4	4
<i>Brachypodium pinnatum</i>	-	-	+			Eua (Md)	2,5	4	4
<i>Lembotropis nigricans</i>	-	-	+			Ec	2,5	3	0

Tableau. no. 16

Dans les Gorges Mada cette association qui comprend 44 espèces se développe à l'altitude de 700 m sur les versants avec l'exposition sud-sud-estique, en réalisant un recouvrement de 50 - 60 %. Dominantes sont les hémicryptophytes (63,63%) mais les therophytes réalisent seulement 20,45 %. Dans le spectre floristique prédominent les espèces sudiques et endémiques qui réalisent un pourcentage de 34,09 %, suivies par les espèces euroasiatiques (29,54 %). En ce qui concerne l'exigence pour l'humidité, la température et la réaction du sol, dans cette association dominantes sont les espèces xéromésophytes (58,33 %), modérément-thermophiles (37,5%) et les espèces moins acide-neutrophiles (68,75 %).

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	0	37,5 %	58,33 %	4,16 %	0	0
T	2,08 %	0	4,16 %	52,08 %	37,5 %	4,16 %
R	14,58 %	0	0	9,33 %	68,75 %	10,41 %

Fig. no. 17

No. relevés	1	2	3	Éléments phytogéographiques			U	T	R
L'altitude (m)	700	700	700						
L'exposition	SE	S	S						
L'inclinaison (°)	35	25	25						
Le recouvrement de la végétation	60	50	50						

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La surface analysée (m <sup>2</sup> )	100	100	100							
Ch. ass.										
Phleum montanum	2.5	1.5	1			B		1.5	4.5	4
Melica ciliata	1.5	1.3	1			Ec-B		1.5	4	4
<b>Thymio comosifestucation sulcate et Stipio-Festucetalia pallentis</b>										
<i>Stipa pennata</i> ssp. <i>eriocaulis</i>	1.5	+.3	1.5			Eua (Ct)		1.5	4	4
<i>Festuca rupicola</i>	2.5	2.5	1.5			Eua (Ct)		1.5	4	4
<i>Thymus comosus</i>	-	+.2	1			Carp (end)		2	3.5	4.5
<i>Sedum hispanicum</i>	+	+	+			Md		1	3.5	4
<i>Orlaya grandiflora</i>	+	+	+			Md-Ec		2	3.5	4
<i>Jurinea mollis</i> ssp. <i>transsilvanica</i>	-	+	+			D-B		1	4.5	4
<i>Dictamnus albus</i>	-	+	+			Eua (Md)		1.5	4.5	4.5
<i>Erysimum odoratum</i>	+	+	+			Ec (Md)		2.5	3	4
<i>Carduus candicanis</i>	-	+	+			B-p		2	3	5
<i>Teucrium montanum</i>	1.5	-	+			Md-Ec		1	4	5
<i>Hypericum rochelii</i>	+	-	+			B		1.5	4	4
<i>Potentilla cinerea</i>	-	1.3	1			E (Ct)		2	3.5	4.5
<i>Piptatherum virescens</i>	-	+	+			Md		2	3.5	4.5
<b>Festuco-Brometea</b>										
<i>Arenaria serpyllifolia</i>	+	+.3	+			Circ (bor)		2	2.5	0
<i>Acinos arvensis</i>	+	+	+			E (Md)		1.5	3.5	4
<i>Dianthus carthusianorum</i>	-	+	+			E		2	5	5
<i>Teucrium chamaedrys</i>	+	+	+			Md-Ec		2	3.5	4
<i>Euphorbia cyparissias</i>	-	+	+			Eua		2	3	4
<i>Asperula cynanchica</i>	-	+	+			P-Md		2	3.5	4
<i>Poa compressa</i>	-	+	+			Circ (bor)		1.5	3	0
<b>Festucetalia valesiacae</b>										
<i>Achillea setacea</i>	+	+.5	+			Eua (Ct)		2	3	5
<i>Campanula sibirica</i>	+	+	+			Eua (Ct)		2.5	4	4
<i>Elymus hispidus</i>	+	-	+			Eua (Ct)		2	4.5	4
<i>Scabiosa ochroleuca</i>	+	-	+			Eua (Ct)		2	4	4
<i>Stachys recta</i>	-	+	+			P-Md		2	4	4.5
<i>Sempervivum marmoreum</i>	-	+	+			Carp-B		1.5	2.5	2.5
<i>Dianthus petraeus</i> ssp. <i>petraeus</i>	-	+	+			Carp (end)		2	3.5	4

<i>Helictotrichon decorum</i>	-	+	+				Carp (end)	2,5	3,5	4,5
<i>Seseli gracile</i>	+	-	+				D	2	4	4,5
<i>Helianthemum nummularium</i>	+	+	+				Ec-Md	2	3	4
<b>Însoțitoare:</b>										
<i>Asplenium ruta-muraria</i>	-	+	+				Circ (bor)	1,5	3	5
<i>Galium mollugo</i>	1,5	+	+				Eua	3	0	3
<i>Silene otites</i>	-	+	+				Eua (Ct)	1,5	4	4,5
<i>Hypericum perforatum</i>	+	-	+				Eua	3	3	0
<i>Verbascum lychnitis</i>	+	-	+				E	1	3	4
<i>Crupina vulgaris</i>	+	-	+				P-Md	2	3,5	0
<i>Arabis glabra</i>	+	+	+				Circ (bor)	2	3	3
<i>Echium vulgare</i>	+	-	+				Eua	2	3	4
<i>Achillea chrymifolia</i>	+	-	+				B-p	2,5	4	0
<i>Dichanthium ischaemum</i>	+	-	+				Eua (Md)	1,5	5	3
<i>Lepidium campestre</i>	+	-	+				E (Md)	2,5	3	0
<i>Anchusa barrelieri</i>	-	+	+				P-Md	1,5	4	4

Tableau. no. 17

**L'association Thymo comosi - Festucetum rupicolae (Csürös 1959)**  
**Pop et Hodişan 1985** a été rencontrée dans les Gorges Cib, les Gorges Ardeu, les Gorges Mada et les Gorges Ribicioara.

Dans les Gorges Cib, cette association a été identifiée sur le sommet Ceret (Vârful Ceret), Piatra Mijlocie et Piatra Corbului, à l'altitude de 665 m, où elles forment des prés, plus ou moins étendues. Sur les terrains avec l'exposition estique et nord-ouestique, les prés présentent un caractère mésophytique et sur celles avec l'exposition sudique, un prononcé caractère xérophytique.

Dans la composition de cette association qui comprend 83 espèces, participent effectivement les hémicryptophytes (67,46 %). Sur les terrains fort ensoleillés se distinguent, particulièrement les therophytes (20,48 %). Les chamaephytes participent avec une proportion de 7,22 %, suivies par les géophytes (4,80 %). Le spectre floristique de cette association relève une dominance des éléments euroasiatique (48,19 %), suivies par celle européenne (19,27 %) tant que les éléments sadiques réalisent seulement 4,80 %.

En ce qui concerne les exigences pour l'humidité, les espèces xéromésophytes réalisent 48,19 % et celles xérophytes 9,63%. En ce qui

concerne la température et la réaction du sol, dans cette association sont dominantes les micromésothermes (46,98 %) et les espèces moins acide-neutrophiles (34,93 %).

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	8,43 %	9,63 %	48,19 %	30,12 %	3,61 %	0
T	26,50 %	0	8,43 %	46,98 %	15,66 %	2,40 %
R	38,55 %	0	4,81 %	18,07 %	34,93 %	3,61 %

Fig. no. 18

No. relevés	1	2	3	4	5	6	7	Éléments phytogéographiques	U	T	R
L'altitude (m)	650	650	650	656	660	665	665				
L'exposition	E	E	E	NV	NV	S	S				
L'inclinaison (°)	40	30	30	40	30	40	40				
Le recouvrement de la végétation	100	80	100	100	60	90	80				
La surface analysée (m²)	4	4	4	4	9	9	9				
Festuca rupicola f. rupicola	4.5	3.5	4.5	3.4	2.4	2.4	1.2	Eua (Ct)	1.5	4	4
Festuca pratensis	1.4	+	-	1.3	1.4	-	-	Eua	3,5	0	0
Lolium perenne	1.3	1.3	+	-	1.1	1.2	1.3	Eua (Md)	2,5	4	4,5
Poa pratensis	+	+	+	+	+	+	-	Circ (bor)	3	0	0
Anthoxanthum odoratum	1.2	+	+	1.5	-	-	-	Eua	0	0	0
Dactylis glomerata	+	+	-	+	-	-	-	Eua (Md)	3	0	4
Phleum montanum	+	+	+	-	+	+	-	Carp-B-Cauc	1,5	4,5	4
Cynosurus cristatus	+	1.1	-	1.1	1.3	-	-	E	3	3	3
Bromus hordaceus	+	+	1.3	-	2.5	+	7.1	Eua	0	3	0
Briza media	+	1.4	+	1.3	-	-	-	Eua	0	3	0
Koeleria pyramidalis	+	-	+	-	+	3.3	3.5	Circ (bor)	2	4	5
Carex pallescens	+	+	-	-	-	+	-	Circ (bor)	3,5	3	3
Carex spicata	-	-	-	-	-	+	+	Eua (Md)	0	3	0
Luzula campestris	+	+	+	1.3	+	+	-	E (Md)	3	0	3
Trifolium pratense	+	1.3	1.2	2.4	1.3	+	+	Eua	3	0	0
Trifolium aureum	+	-	+	+	-	+	-	Eua (Ct)	2,5	2	4
Trifolium pannonicum	+	-	+	+	-	+	-	P-Md	2	3	0

<i>Trifolium repens</i>	-	-	+	-	+	-	-	Eua	3,5	0	0
<i>Lotus corniculatus</i>	+	1,2	1,1	+	1,1	1,3	1,1	Eua	2,5	0	0
<i>Coronilla varia</i>	+	+	+	+	+	-	-	Ec-Md	2	3	4
<i>Chamaespartium sagittale</i>	+	1,3	1,1	+	+	+	-	Alt-Md-Ec	3	3	3
<i>Medicago falcata</i>	1,1	-	+	+	2,4	-	-	Eua (Md)	2	3	5
<i>Medicago lupulina</i>	-	-	1,1	-	+	1,2	7,1	Eua	2,5	3	4
<i>Dorycnium pentaphyllum</i> ssp. <i>herbaceum</i>	-	-	+	-	-	+	+	Ec-Md	2	5	4
<i>Rumex acetosa</i>	+	-	+	-	+	-	-	Eua (Cm)	3	0	0
<i>Dianthus carthusianorum</i>	+	+	+	-	-	+	+	E	2	5	5
<i>Arenaria serpyllifolia</i>	+	+	+	-	-	+	+	Circ (bor)	2	2,5	0
<i>Scleranthus annuus</i>	1,3	+	+	-	-	+	1,1	Eua	2	3	2
<i>Stellaria graminea</i>	+	-	+	+	-	-	-	Eua (Md)	2,5	2	3
<i>Cerastium holosteoides</i>	+	+	1,1	-	+	-	-	Cm	3	0	0
<i>Ranunculus bulbosus</i>	+	+	+	+	+	-	-	E	2	3	3
<i>Erysimum odoratum</i>	+	-	+	-	-	+	+	Ec (Md)	2,5	3	4
<i>Lepidium campestre</i>	+	+	+	-	-	-	-	E (Md)	2,5	3	0
<i>Alyssum alyssoides</i>	-	+	+	+	-	+	+	E (Ct)	1	3	0
<i>Potentilla argentea</i>	+	+	+	-	+	+	-	Eua	2	4	2
<i>Sanguisorba minor</i>	+	+	1,2	-	-	1,3	1,1	Eua	2	3,5	4
<i>Filipendula vulgaris</i>	+	+	+	+	-	-	-	Eua	2,5	3	0
<i>Linum catharticum</i>	+	+	-	+	-	-	1,1	E (Md)	3	2	4
<i>Polygala vulgaris</i>	+	+	1,1	+	-	1,2	+	Eua	3	3	3
<i>Euphorbia cyparissias</i>	-	-	+	+	-	+	+	Eua	2	3	4
<i>Erodium cicutarium</i>	+	+	+	-	-	-	-	Cm	2,5	0	0
<i>Geranium columbinum</i>	+	+	+	-	+	-	-	Eua	2	3,5	4
<i>Hypericum tetrapterum</i>	+	-	-	+	-	-	-	E (Md)	4	3	4
<i>Helianthemum hirsutum</i>	+	-	-	+	-	-	-	Ec-Md	2,5	3	4
<i>Orlaya grandiflora</i>	-	-	+	-	+	1,1	1,3	Md-Ec	2	3,5	4
<i>Echium vulgare</i>	+	+	+	-	+	+	+	Eua	2	3	4
<i>Thymus glabrescens</i> ssp. <i>glabrescens</i>	1,3	1,3	1,4	-	+	+	+	P-p	2	4	0
<i>Teucrium chamaedrys</i>	1,3	+	1,3	-	+	+	-	Md-Ec	2	3,5	4
<i>Prunella vulgaris</i>	+	+	+	+	+	-	-	Circ (bor)	3	3	0
<i>Ajuga genevensis</i>	+	+	-	-	-	+	+	Eua (Ct)	2,5	3	4
<i>Salvia pratensis</i>	-	-	+	+	+	-	-	E (Md)	2,5	3	4,5
<i>Rhinanthus rumelicus</i>	+	2,5	+	2,3	+	-	-	D-B-Anat	3	4	0
<i>Verbascum lychnitis</i>	+	-	+	+	-	+	-	E	1	3	4
<i>Veronica arvensis</i>	-	-	+	+	+	-	-	Eua	2,5	3	3
<i>Veronica austriaca</i> ssp. <i>jacquinii</i>	+	+	1,3	-	+	+	+	Ec	2	4	4

## LES ASSOCIATIONS SAXICOLES IN MONTS MÉTALLIFÈRES

<i>Plantago lanceolata</i>	2,4	1,5	2,5	1,3	1,3	2,4	2,2	Eua	ü	0	0
<i>Plantago media</i>	+	-	+	+	-	+	+	Eua	2,5	0	4,5
<i>Plantago major</i>	-	-	-	+	-	+	+	Eua	3	0	0
<i>Cruciata laevipes</i>	+	-	-	+	-	-	-	Eua	2,5	3	3
<i>Cruciata glabra</i>	+	-	+	-	-	-	+	Eua	3	2	2
<i>Galium verum</i>	+	+	+	-	-	-	-	Eua	2,5	2,5	0
<i>Campanula patula</i>	+	+	-	+	+	-	-	E	3	2,5	3
<i>Achillea millefolium</i>	+	-	+	+	+	-	+	Eua	3	0	0
<i>Leucanthemum vulgare</i>	-	+	1,1	1,3	-	1,3	+	Eua	3	0	0
<i>Hieracium lactucella</i>	-	-	+	+	-	+	+	E	3	0	3
<i>Hieracium pilosella</i>	+	+	+	-	+	+	+	E (Md)	2,5	0	0
<i>Poa compressa</i>	-	-	-	-	+	-	-	E	1,5	3	0
<i>Agrostis stolonifera</i>	-	-	-	-	-	+	-	Circ (bor)	4	0	0
<i>Agrostis capillaris</i>	+	-	-	-	-	-	-	Circ (bor)	0	0	0
<i>Ranunculus acris</i>	-	+	-	-	-	-	-	Eua (Md)	3,5	0	0
<i>Nepeta nuda</i> ssp. <i>pannonica</i>	-	-	+	-	-	-	-	Eua (Ct)	2	3	0
<i>Fragaria viridis</i>	-	-	-	+	-	-	-	E (Ct)	2	4	3
<i>Sedum acre</i>	+	-	-	-	-	-	-	Eua	0	3	3
<i>Arabidopsis thaliana</i>	-	-	-	-	+	-	-	Eua (Md)	2	3	3
<i>Vincetoxicum hirundinaria</i>	-	+	-	-	-	-	-	E (Md)	2	4	4
<i>Helianthemum nummularium</i>	-	-	+	-	-	-	-	Ec-Md	2	3	4
<i>Ferulago sylvatica</i>	-	-	-	+	-	-	-	D-B	3	3	2
<i>Carum carvi</i>	-	-	-	-	+	-	-	Eua	3,5	3	3
<i>Seseli elatum</i> ssp. <i>osseum</i>	-	-	-	-	-	+	-	p-D	1,5	4	4
<i>Veronica austriaca</i> ssp. <i>crinita</i>	-	+	-	-	-	-	-	Ec	1,5	4	4,5
<i>Veronica austriaca</i> ssp. <i>teucrium</i>	-	-	+	-	-	-	-	Ec	1,5	4	4,5
<i>Gymnadenia conopsea</i>	-	+	-	-	-	-	-	Eua	4	0	4,5
<i>Pteridium aquilinum</i>	-	-	-	-	-	-	-	Cm	3	3	0

Tableau no. 18

Dans les Gorges Ardeu, l'association Thymo comosi - Festucetum rupicolae (Csürös 1959) Pop et Hodişan 1985 est largement répandue tout le long des rivières aussi comme sur les pentes arides. Au bord des vallées, où l'humidité du sol est plus accentuée, l'association a un forte caractère

mésophytique. 68 espèces (un nombre relativement élevé) entrent dans la composition de cette association. Le spectre biologique de cette association montre une prédominance catégorique des hémicryptophytes (50%), qui sont suivies par les therophytes (23,52%). L'élément prépondérant de cette association est celui euroasiatique (38,23%). Les éléments méditerranéens réalisent 10,29%, pontiques 7,35% et balkaniques, seulement 2,94%. Aussi comme dans les Gorges Cib, dans les Gorges Ardeu, les espèces xéromésophytes sont dominantes (52,94%). Les espèces micromésothermes réalisent 55,88%. En ce qui concerne la réaction du sol, dominantes sont les espèces moins acide-neutrophiles (42,64%).

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	2,94 %	14,70 %	52,94 %	27,94 %	1,47 %	0
T	16,17 %	0	5,88 %	55,88 %	20,58 %	1,47 %
R	27,94 %	0	0	23,52 %	42,64 %	5,88 %

Fig. no. 19

No. relevés	1	2	3	4	Éléments phytogéographiques	U	T	R
L'altitude (m)	570	600	540	540				
L'exposition	S	S	S	S				
L'inclinaison (°)	25	30	30	25				
Le recouvrement de la végétation	50	70	70	70				
La surface analysée (m²)	100	100	100	100				
Festuca rupicola	3,5	3,4	3,5	3,5	Eua (Ct)	1,5	4	4
Festuca valesiaca	1,2	1,1	+	1	Eua (Ct)	1,5	4	4
Cynosurus cristatus	1,2	1,1	+	+	E	3	3	3
Poa pratensis	1,3	1,1	-	+	Circ (bor)	3	0	0
Bromus commutatus	1,1	+	+	+	E	0	3	0
Phleum montanum	-	+	+	+	Carp-B-Cauc	1,5	4,5	4
Carex distans	+	+	-	+	E	4	3	4
Luzula campestris	+	+	+	+	E (Md)	3	0	3
Trifolium pratense	2,5	2,4	1,3	1,1	Eua	3	0	0
Trifolium aureum	1,1	1,2	-	1	Eua (Ct)	2,5	2	4
Trifolium repens	+3	+4	+	1	Eua	3,5	0	0
Lotus corniculatus	1,3	1,4	+	+	Eua	2,5	0	0

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<i>Lembotropis nigricans</i>	+	+	+	+			Ec	2,5	3	0
<i>Chamaecytisus albus</i>	-	-	+	+			B-p	1,5	4	3
<i>Vicia pannonica</i>	+	+	-	+			P-Md	2,5	3,5	4
<i>Medicago lupulina</i>	1,2	1,3	1,3	1			Eua	2,5	3	4
<i>Medicago minima</i>	-	-	+	+			Eua (Md)	1,5	4	4
<i>Genista tinctoria</i> ssp. <i>ovata</i>	-	-	+	+			Alp-Carp-B	2,5	3	3
<i>Rumex acetosa</i>	1,1	+	-	+			Eua (Cm)	3	0	0
<i>Dianthus carthusianorum</i>	1,2	+	+	+			E	2	5	5
<i>Ranunculus bulbosus</i>	+	+	-	+			E	2	3	3
<i>Thalictrum minus</i>	-	-	+	+			Eua (Ct)	2	4	4
<i>Alyssum alyssoides</i>	-	-	+	+			E (Ct)	1	3	0
<i>Erysimum odoratum</i>	-	-	1,1	1			Ec (Md)	2,5	3	4
<i>Filipendula vulgaris</i>	2,3	2,4	+	+			Eua	2,5	3	0
<i>Fragaria viridis</i>	+	+	+	+			E (Ct)	2	4	3
<i>Potentilla recta</i>	-	-	1,2	1			Eua (Ct)	1,5	3,5	4
<i>Potentilla reptans</i>	+	+	-	+			Cm	3,5	0	4
<i>Sanguisorba minor</i>	+	+	+	+			Eua	2	3,5	4
<i>Linum catharticum</i>	+	+	-	+			E (Md)	3	2	4
<i>Euphorbia cyparissias</i>	+	+	-	+			Eua	2	3	4
<i>Helianthemum hirsutum</i>	-	-	+.3	1			Ec-Md	2,5	3	4
<i>Carum carvi</i>	1,3	1,1	-	+			Eua	3,5	3	3
<i>Orlaya grandiflora</i>	-	-	1,3	1			Md-Ec	2	3,5	4
<i>Selinum carvifolia</i>	-	-	1,4	1			Eua	3,5	3	3
<i>Echium vulgare</i>	-	-	+	+			Eua	2	3	4
<i>Myosotis arvensis</i>	-	-	+	+			Eua	3	3	0
<i>Myosotis ramosissima</i>	+	+	-	+			E	2	3,5	4
<i>Stachys officinalis</i>	+	+	-	+			Eua (Md)	3	3	0
<i>Prunella vulgaris</i>	1,1	1	+	+			Circ (bor)	3	3	0
<i>Salvia pratensis</i>	+	+	+.3	+			E (Md)	2,5	3	4,5
<i>Stachys germanica</i>	+	-	+	+			P-Md	2	4	4
<i>Teucrium chamaedrys</i>	-	-	+	+			Md-Ec	2	3,5	4
<i>Thymus pulegioides</i>	+	+	-	+			Ec	2,5	3	3
<i>Thymus glabrescens</i>	-	-	1,1	1			P-p	2	4	0
<i>Rhinanthus angustifolius</i>	1,4	1,3	+	+			Eua	2	4	0
<i>Verbascum lychnitis</i>	-	-	+	+			E	1	3	4
<i>Veronica arvensis</i>	+	+	-	+			Eua	2,5	3	3
<i>Veronica austriaca</i> ssp. <i>jacquinii</i>	+	+	1,3	1			Ec	2	4	4

<i>Plantago lanceolata</i>	1.3	1.4	-	+			Eua	0	0	0
<i>Plantago media</i>	+	+	+	+			Eua	2,5	0	4,5
<i>Galium glaucum</i>	-	-	+	+			P-Md	2	4	4
<i>Asperula purpurea</i>	-	+	1.1	+			Md	2	4	4
<i>Galium verum</i>	1.2	1.1	-	+			Eua	2,5	2,5	0
<i>Campanula patula</i>	1.1	+.3	-	1			E	3	2,5	3
<i>Achillea crithmifolia</i>	-	-	1.3	1			B-p	2,5	4	0
<i>Leucanthemum vulgare</i>	2.4	2.5	2.4	1			Eua	3	0	0
<i>Crepis praemorsa</i>	+	+	+	+			Eua (Ct)	2	3,5	5
<i>Hieracium lactucella</i>	+	+	-	+			E	3	0	3
<i>Tragopogon pratensis</i> ssp. <i>orientalis</i>	+	+	-	+			Eua	3	3	4
<i>Colchicum autumnale</i>	+	+	+	-			E-Md	3,5	3	4
<i>Muscari comosum</i>	+	+	-	+			Md-Ec	1,5	3,5	0
<i>Crataegus monogyna</i>	-	-	1.1	1			E	2,5	3	3
<i>Fraxinus ornus</i>	-	-	1.2	+			Md	1,5	3,5	5
<i>Cornus mas</i>	-	-	+	+			P-Md-Ec	2	3,5	4
<i>Quercus pubescens</i>	-	-	1.1	1			Md	1,5	4	5
<i>Quercus cerris</i>	-	-	1	1			Md	2	3,5	3
<i>Acer campestre</i>	+	-	+	+			E	2,5	3	3
<i>Euonymus europaeus</i>	+	-	+	+			E	3	3	3

Tableau no. 19

Sur la pente nordique des Gorges Mada se trouve un pré étendu. L'analyse de la répartition phytogéographique de l'association **Thymo comosi - Festucetum rupicolae** (Csürös 1959) Pop et Hodisan 1985, formée par 74 espèces, montre la dominance des éléments euroasiatiques 44,59%, près de lesquelles on trouve un pourcentage assez élevé des éléments sudiques (méditerranéennes et balkaniques) 20,26 %, parmi lesquelles des espèces comme *Orlaya grandiflora*, *Achillea crithmifolia* et *Rhinanthus rumelicus* impriment un coloris spécifique. Parmi les formes biologiques, dominantes sont les hémicryptophytes (60,81%). Dans le voisinage de ce pré, sur la pente abrupte, calcaireuse, pousse *Festuca rubra* qui n'édifie dans cette région, moins favorable, une association.

En ce qui concerne les exigences pour l'humidité, dominantes sont les espèces xéro-mésophytes (64,86%). Du point de vue de la condition de température, dans cette association prédominent les micromésothermes (52,70%), suivies par les espèces modérée-thermophiles (31,08%). En ce qui concerne l'exigence pour la réaction du sol, dominantes sont les espèces moins acide-neutrophiles (45,94%)

LES ASSOCIATIONS SAXICOLES IN MONTS MÉTALLIFÈRES

	0	1 - 1,5	2 - 2,5	3 - 3,5	4 - 4,5	5
U	1,35 %	14,86 %	64,86 %	16,21 %	1,35 %	0
T	8,10 %	0	4,05 %	52,70 %	31,08 %	2,70 %
R	26,67 %	0	2,70 %	16,21 %	45,94 %	8,10 %

Fig. no. 20

No. relevés	1	2	3	Éléments phytogéographiques	U	T	R
L'altitude (m)	625	600	600				
L'exposition	N	N	N				
L'inclinaison (°)	45	40	40				
Le recouvrement de la végétation	50	60	50				
La surface analysée (m <sup>2</sup> )	25	25	25				
Festuca rupicola	3	3	2	Eua (Ct)	1,5	4	4
Festuca valesiaca	1	2	1	Eua (Ct)	1,5	4	4
Poa compressa	+	1	+	E	1,5	3	0
Stipa pulcherrima	+	1	+	Eua (Md)	1	4	5
Phleum montanum	+	1	+	Carp B-Cauc	1,5	4,5	4
Koeleria pyramidata	+	1	+	Circ (bor)	2	4	5
Anthyllis vulneraria ssp. polyphylla	+	1	+	P-p	2	3	4,5
Chamaecytisus albus	1	2	1	P-p-B	1,5	4	3
Medicago sativa ssp. falcata	1	+	1	Eua (Md)	2	3	5
Medicago lupulina	1	1	1	Eua	2,5	3	4
Lotus corniculatus	+	1	+	Eua	2,5	0	0
Coronilla varia	+	1	+	Ec (Md)	2	3	4
Trifolium arvense	+	1	1	Eua (Md)	1,5	3	4
Trifolium ochroleucum	2	3	1	Md-Ec	2	3	3
Trifolium pratense	1	1	+	Eua	3	0	0
Trifolium campestre	+	1	+	E	3	3	0
Astragalus onobrychis	1	1	1	Eua (Ct)	1,5	3,5	5
Dorycnium pentaphyllum ssp. herbaceum	+	1	+.1	Ec-Md	2	5	4

<i>Rhinanthus rumelicus</i>	2	3	1			D-B-Anat	3	4	0
<i>Melampyrum arvense</i>	2	2	1			E (Ct)	2	3,5	4,5
<i>Euphrasia stricta</i>	+	1	+			Ec	4	3	0
<i>Veronica spicata</i>	+	1	1			Eua	1	4	4
<i>Veronica austriaca</i> ssp. <i>jacquinii</i>	+	+	+			Ec	2	4	4
<i>Linum tenuifolium</i>	1	1	+.1			P-Md-Ec	2	4	5
<i>Linum flavum</i>	+	1	1			P-p-B	2	4	4
<i>Linum catharticum</i>	+	1	+			E (Md)	3	2	4
<i>Polygala major</i>	2	2	1			P-Md	2	3	4,5
<i>Cerastium glomeratum</i>	+	1	1			Cm	2,5	3	0
<i>Dianthus carthusianorum</i>	+	1	+			E	2	5	5
<i>Salvia verticillata</i>	+	1	+			Eua (Md)	2	4	0
<i>Prunella laciniata</i>	1	2	1			Md-Ec	2,5	3,5	3
<i>Teucrium chamaedrys</i>	1	1	1			Md-Ec	2	3,5	4
<i>Thymus glabrescens</i>	+	1	+.1			P-p	2	4	0
<i>Galium verum</i>	1	3	1			Eua	2,5	2,5	0
<i>Asperula cynanchica</i>	+	2	1			P-Md	2	3,5	4
<i>Euphorbia cyparissias</i>	+	1	1			Eua	2	3	4
<i>Bupleurum affine</i>	+	+	+			P-p-B	2	3,5	4
<i>Orlaya grandiflora</i>	2	3	1			Md-Ec	2	3,5	4
<i>Scabiosa ochroleuca</i>	+	1	+			Eua (Ct)	2	4	4
<i>Erodium cicutarium</i>	+	+	+			Cm	2,5	0	0
<i>Plantago lanceolata</i>	1	3	1			Eua	0	0	0
<i>Filipendula vulgaris</i>	1	1	+			Eua	2,5	3	0
<i>Sanguisorba minor</i>	1	1	+			Eua	2	3,5	4
<i>Fragaria viridis</i>	1	2	1			E (Ct)	2	4	3
<i>Potentilla recta</i>	+	+	+			Eua (Ct)	1,5	3,5	4
<i>Helianthemum hirsutum</i>	+	1	+			Ec-Md	2,5	3	4
<i>Orchis ustulata</i>	+	+	+			E	2,5	3	0
<i>Leucanthemum vulgare</i>	2	2	1			Eua	3	0	0
<i>Achillea pannonica</i>	+	1	+			E (Ct)	2	4	3,5
<i>Achillea crithmifolia</i>	1	1	+			B-p	2,5	4	0
<i>Senecio jacobaea</i>	+	1	+			Eua	2,5	3	3
<i>Centaurea biebersteinii</i> ssp. <i>biebersteinii</i>	+	+	+			E	3	3	3
<i>Campanula sibirica</i>	+	1	1			Eua (Ct)	2,5	4	4
<i>Luzula campestris</i>	+	-	+			E (Md)	3	0	3
<i>Gentiana cruciata</i>	-	+	+			Eua (Md)	3	3	4

<i>Dianthus armeria</i>	-	-	+			E	2	3	3
<i>Stellaria graminea</i>	+	+	-			Eua (Md)	2,5	2	3
<i>Vincetoxicum hirundinaria</i>	+	+	+			E (Md)	2	4	4
<i>Lepidium campestre</i>	+	+	+			E (Md)	2,5	3	0
<i>Asperula purpurea</i>	-	+	-	-		Md	2	4	4
<i>Myosotis arvensis</i>	+	-	+			Eua	3	3	0
<i>Echium vulgare</i>	+	+	+			Eua	2	3	4
<i>Valerianella rimosa</i>	-	+	+			Ec-Md	3	4	4
<i>Hypericum perforatum</i>	+	+	+			Eua	3	3	0
<i>Agrimonia eupatoria</i>	+	+	+			Eua	2,5	3	4
<i>Potentilla argentea</i>	+	-	+			Eua	2	4	2
<i>Acinos arvensis</i>	-	+	+			E (Md)	1,5	3,5	4
<i>Stachys germanica</i>	+	+	+			Eua (Md)	2	4	4
<i>Origanum vulgare</i>	+	+	+			Eua (Md)	2,5	3	3
<i>Vicia hirsuta</i>	+	+	-			Eua (Md)	2,5	3,5	4
<i>Chamaespantium sagittale</i>	+	+	+			Atl-Md-Ec	3	3	3
<i>Genista tinctoria</i>	+	+	+			Eua	2,5	3	2
<i>Lathyrus nissolia</i>	-	+	+			Atl-Md	2	3,5	3
<i>Tragopogon pratensis</i> ssp. <i>orientalis</i>	+	+	+			Eua	3	3	4

Tableau no. 20

Dans les Gorges Ribicioara, cette association s'installe sur les pantes ombrages, avec une inclination modérée. Elle comprend seulement 36 espèces. Dans sa composition, prédominantes sont les hémicryptophytes (69,44%), tant que les espèces thérophytes (19,44%) et chamaephytes (8,33%) sont peu nombreuses. Parmi les éléments floristiques, dominantes sont les éléments euroasiatiques (55,55%) et celles sudiques (19,44%).

En ce qui concerne les exigences pour l'humidité, dominantes sont les espèces mésophytes (41,66%). Ce pourcentage élevé nous montre la quantité relativement élevée des précipitations dans la zone recherchée. Du point de vue des conditions de température, dans l'association prédominent les micromésothermes (36,11%), suivies par les espèces modérément thermophiles (16,66%). En ce qui concerne l'exigence pour la réaction du sol, les espèces moins acide-neutrophiles sont dominantes (19,44%), suivies par celles neutro-basiphiles (8,33%).

	0	1 – 1,5	2 – 2,5	3 – 3,5	4 – 4,5	5
U	8,33 %	2,77 %	41,66 %	41,66 %	5,55 %	0
T	30,55 %	0	11,11 %	36,11 %	16,66 %	5,55 %
R	47,22 %	0	8,33 %	19,44 %	22,22 %	2,77 %

Fig. no. 21

No. relevés	1	2	2	Éléments phytogéographiques	U	T	R
L'altitude (m)	645	620	620				
L'exposition	S	S	S				
L'inclinaison (°)	20	25	25				
Le recouvrement de la végétation	50	50	50				
La surface analysée (m²)	25	25	25				
Festuca valesiaca	2,5	2,5	1	Eua (Ct)	1,5	4	4
Agrostis capillaris	3,5	2,5	2	Circ (bor)	0	0	0
Anthoxanthum odoratum	2,5	2,5	1	Eua	0	0	0
Cynosurus cristatus	1,4	2	1,4	Eua	3	3	3
Festuca rubra	+,5	1	+	Circ (bor)	3	0	0
Dorycnium pentaphyllum ssp. herbaceum	+	1	+	Ec-Md	2	5	4
Camaespartium sagittale	1	+	+	Alt-Md-Ec	3	3	3
Lotus corniculatus	1	+	+	Eua	2,5	0	0
Ononis arvensis	+	+	+	Eua (Ct)	3	4	0
Trifolium campestre	+	1,1	1	E	3	3	0
Trifolium aureum	+	+	+	Eua (Ct)	2,5	2	4
Trifolium pratense	+	+	+	Eua	3	0	0
Trifolium repens	+	1,1	+	Eua	3,5	0	0
Achillea millefolium	+	+	+	Eua	3	0	0
Agrimonia eupatoria	+	+	1,1	Eua	2,5	3	4
Centaurea erythrea	+	+	+	Eua	3	3	2
Leucanthemum vulgare	+	+	1,2	Eua	3	0	0
Dianthus carthusianorum	+	+	1,1	E	2	5	5
Euphrasia stricta	+	+	+	E (Ct)	4	3	0
Fragaria viridis	1,1	+	+	E (Ct)	2	4	3

<i>Galium verum</i>	+	+	+			Eua	2,5	2,5	0
<i>Plantago lanceolata</i>	1,1	+	+			Eua	0	0	0
<i>Plantago media</i>	+	+	+			Eua	2,5	0	4,5
<i>Polygala vulgaris</i>	+	+	+			Eua	3	3	3
<i>Potentilla argentea</i>	1	+	+			Eua	2	4	2
<i>Prunella vulgaris</i>	+	+	+			Circ (bor)	3	3	0
<i>Rhinanthus rumelicus</i>	1,5	+	+			D-B-Anat	3	4	0
<i>Erigeron annuus</i>	+	+	+			Adv	4	0	4
<i>Thymus pulegioides</i>	+	+	1			Ec	2,5	3	3
<i>Rosa gallica</i>	+	+	+			Md	2	4	4
<i>Poa pratensis</i>	+	+	+			Circ (bor)	3	0	0
<i>Daucus carota</i>	+	+	+			Eua (Md)	2,5	3	0
<i>Hypericum perforatum</i>	+	+	+			Eua	3	3	0
<i>Melampyrum arvense</i>	+	+	+			E (Ct)	2	3,5	4,5
<i>Prunella laciniata</i>	+	+	+			Md-Ec	2,5	3,5	3
<i>Stellaria graminea</i>	+	+	+			Eua (Md)	2,5	2	3

Tableau no. 21

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# **INDICATORS OF BIODIVERSITY FOR NATURAL FORESTS**

*Stelian RADU  
Corina COANDĂ  
I.C.A.S. - Stațiunea Simeria*

## ***REZUMAT***

Biodiversitatea este o noțiune globală care cuprinde ansamblul formelor de viață de pe Terra. Omniprezentă, ea se referă la gene, la speciile animale și vegetale, la ecosistemele și peisajele planetei, înglobând astfel toate nivelele de organizare a lumii vii. Orice analiză a biodiversității trebuie să țină seama și să precizeze: nivelul la care se referă (intraspecific, specific, ecosistem sau peisagistic), teritoriul analizat și data când ea se realizează.

După definirea diversității genetice, specifice și ecosistemice se prezintă o serie de indicatori ai acestei biodiversități proprii pădurilor României (în general) și pădurilor naturale din unele Parcuri Naționale (Tabelul nr. 1). Se insistă asupra indicatorilor specifici pădurilor naturale adoptați în diferite țări în urma conferințelor internaționale de la Rio de Janeiro (1992), Helsinki (1993) și Geneva (1994) și se selecteză o serie de indicatori pentru condițiile din țara noastră.

The biodiversity (or the biological diversity) is an aggregate notion, not only with scientific significance, but also with social and economic contents. Generally speaking it include all living forms of the Earth, the component parts of an tremendous interdependent system and describe just the expression of this life variety. Everywhere present, it refers to genes, to the animal and vegetal species, to the ecosystems and landscapes of the planet, including thus all levels of the life organisation, from genes to biosphere.

Taken into the most common sense, the biodiversity is measured by the total number of the living beings (plants, animals, mushrooms, microorganisms) including in the ensamble of terrestrial and aquatic ecosystems of the planet (so called abundance or total richness). However, it the dominance

must be taken in view also, determined by the numerical predominance of one populations or of the few species, in the interior of the same community.

Due to the complexity, dynamics and mobility of life forms, any analysis of biodiversity should take into consideration and to specify, the following:

- the level of reference: infraspecific (genetic), specific, ecosystemic or landscapic;

- the analysed space (area): tree, microsite, site, parcel, production unit, forest district, forest massif, region, country a.s.o.;

- the time, that is the date when this analysis is performed.

In the forest ecosystems, the genetic diversity includ such categories as individual, population, ecotype, provenance and can be expressed by occurrence and number of populations, ecotypes, biotypes, varietes, forms and phenotypes – extant in the frame of species, in the whole its area, or on a delimited area.

The species diversity of forest is mainly determined by the stand composition, structure and developmental phases. It can be evaluated by the number of species (populations), or by the number of individuals for each species.

The ecosystems diversity is conditioned by the richness of flora and fauna and by the space variability of life environment. It can be expressed by the number of ecosystems types or by the number of species related to a definite, standard area (1,4 or 16 km<sup>2</sup>).

Characterised by a large space extention, perennity, complexity and stability, the forest ecosystems include specific extremely diversified biocenosis, make up by populations of tree, shrubs, lianas, herbs, mosses, lichens, mushrooms, mammals, birds, amphibians, reptiles, insects, worms, bacterias and other microorganisms (actinomycetes, protozoa). Really, the multitude and diversity of ecological niches offered with generosity by forests to others different categories of living beings is extremely amazing.

The forests of Romania fully illustrates this high diversity. They are make up by 58 native tree species, 118 shrub species, and 1075 herb species (37% of whole flora) and are differentiated into more then 300 natural forests types, in 150 forest ecosystems types, located in some hundreds site types. They show an outstanding variety of compositions, structures, developmental phases and forest landscape types. In these forests take refuge 33 mammal species (32% of total country's number) more than 250 bird species (67% of country's avifauna), 15 reptile species (50%), 16 amphibian species (80%), and 21 fresh water fish species in the mountains rivers (Beldie 1979; Giurgiu, 1995; Bănărescu, 1994; Radu, 1995).

In forest ecosystems and in associated to these areas biotops (clearings, streams, marches, stone a.o.) are located many threatened and rare plant species: 14 relicts and 32 endemic and subendemic species, respectively 40% from the list established by Dihoru and Pârvu, 1989. The woodland area shelter the majority of strictly protected plants, declared or not as „nature monuments”, as well as a great number of monumental trees (century-old and./or with record sizes). These specimens have an particularly dendrological, historical, landscape, dendrochronological and memorial values.

The great frequency of natural forest in Romania is completed by their high genetic and by monumentality of some exceptional stands (by Norway Spruce, Silver Fir, Sessile Oak and Beech), well known and certified by European scientists. To these stands must be added the last large quasivirgin (primary) forest still conserved in Romanian Carpathian Mts.; such woods are almost extinct in Central Europe and replaced by man-made forests. According to the experts of Council of Europe (Strasbourg, 1987) the natural and ancient forest mean a part of European patrimony, due to their natural, scientific, aesthetic, cultural and instructive values. These forests have fundamental ecological roles and shelter an original flora and wildlife very rich in threatened species.

In the addition to such diversity indices as Simpson's and Shannon Weaver index – widely used in ecology, a lot of special indices for biodiversity for forest ecosystems were elaborated and suggested during the last decade.

After the UN Conference on Environment and Development, Rio de Janeiro, June 1992, and the recommendation for conservation of natural forests and biological biodiversity, which were adopted at this conference, a lot of countries started to elaborate criterions and indicators for biodiversity conservation as a main link of sustainable development.

The criterions used in the sustainable management of forests correspond to some major concern of forests policy and direct the managers in adopting the suitable decisions, while the indicators give us the opportunity to estimate the results of our interventions in forest and to monitor the changes of forests state.

The overall list of sustainable management indicators for forests include, as a component part, the biodiversity indicators for the respective forest.

The meeting of forest experts in Geneva (1994) adopted 6 criterions and 27 quantitative indicators which allow to estimate the forest sustained management. It was agreed that each country need to complete these indicators, according to their essential features and necessities. A number of 5 indicators refer to the forest biodiversity.

An analyses of adopted in France and Canada biodiversity indicators, or selected by Giurgiu give us the possibility to retain the following more important indicators:

– for forest ecosystems: the number of species per unit area or for an certain habitat; the number or percent of endemic, rare or threatened species, related to the total number of species; the number of species with evidently decreasing populations; the volume of dead wood (dead or dying trees, standing or fallen) per ha;

– at the country's or region's level, among the main biodiversity indicators it is necessary to retain the followings: the percent of protected areas, and the proportion of protected ecosystems and species in these areas; the proportion of natural and quasivirgin forest; the percent of mixed unevenaged and many layers stands; the proportion of natural regeneration and of intensive silvicultural systems; the degree of territorial forest fragmentation; the density of access roads and others indicators.

In the case of scientific researches, the biodiversity assessment needs combined – team work of silviculturists assisted by botanists, zoologists, ornithologists and other specialists, having done the forests ecosystems complexity.

In the frame of the sustained management plants, the biodiversity assessment and monitoring at mentioned territorial level (plot, management units, forest district) can be done by forest engineers, after an special training course.

Studying biodiversity in natural forests of some National Park in this country we used also the following indicators: the number of trees and shrubs species; the number of endemic taxa; the number of protected plants and animals; the threatened and vulnerable species of plants, mammals, fishes, birds, reptiles and amphibians; the occurrence of relevant landscapes elements or of characteristic biotops; the number of protected plants and animals; the threatened and vulnerable species of plants, mammals, fishes, birds, reptiles and amphibians; the occurrence of relevant landscapes elements or the characteristic biotops; the number of forest types, sites and ecosystems.

The indicators of forest biodiversity in 7 National Parks are shown in the table 1.

These indicators allow to make an partial hierarchy of studied National Parks but only in the frame of each indicators, due to the fact that as concerning the biodiversity, the landscape value and the occurrence of specific habitats, each National Parks mean an complex singleness, with suitable personality conferred by specific individual, unrepeatable and incomparable features.

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# SOME INDICATORS OF BIODIVERSITY OF NATURAL FORESTS IN 7 NATIONAL PARKS

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Indicators	At the level of		National Parks						
	Romania	Forest ecosystems of Romania	Retezat	Domogled V.Cernei	Apuseni	Călimani	Rodna	Ch. Caraș Semenic	Ch. Nerei-Beușnița
1. Total number of wooden sp.	176	176	58	106	83	69	73	127	132
of which: trees	58	58	27	46	36	32	30	43	51
shrubs	118	118	31	60	47	37	43	84	81
2. Glaciar relicts (nr.of sp.)	29+14	10+4	0	0	0	1	7	1	0
3. Number of endemic taxa %	128	32	24(+39)	18	16	15	45	7	10
4. Number of superior plants sp.	3450	1251	1602	1119	*	*	1123	500	694
5. Protected plants(sp.)	25	23	15	9	6	7	13	7	22
6. Endangered (E) and vulnerable (V) plant sp.	*	60	13	14	10	5	12	13	16
7. Mammals (sp.)	102	33	>26	*	*	*	*	*	*
of which: endangered, vulnerable and rare	*	19	9	8	3	7	9	7	11
8. Birds (sp.)	375	250	82	49	49	135	*	70	140
of which: E+V+R	*	29	15	22	8	17	21	19	24
9. Reptiles+Amphibians	30+20	15+16	*	*	*	*	*	*	*
of which: E+V+R	*	28	10	17	10	9	9	22	21
10. Site types (nr.)	*	367	19	39	6	11	23	7	9
11. Forest types (nr.)	282	282	26	41	8	10	20	8	7
12. Ground vegetation types (nr.)	0	50	11	7	9	5	12	7	9

Legend: \* = incomplete data; 0 = missing data  
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# THE ECOLOGICAL STUDY OF THE CHILOPODS (CHILOPODA) POPULATIONS FROM FĂGET- COLIBAȘI FOREST, ARGEȘ COUNTY

RADU GAVA  
Muzeul Județean Argeș  
Str. Armand Călinescu 4, 0300 – Pitești

## REZUMAT

În lucrare se analizează calitativ și cantitativ fauna de chiolopode din pădurea Făget-Colibași, județul Argeș. Pădurea Făget-Colibași este o pădure de fag situată în sudul Carpaților Meridionali, în bazinul mijlociu al râului Argeș. Lunar, timp de trei ani, am colectat probe de litieră și sol de unde, cu ajutorul aparatului Tulgren, am triat fauna. Chilopodele sunt reprezentate prin 18 specii care aparțin la trei ordine, cinci familii (Lithobiidae, Schenididae, Mecistocephalidae, Geophylidae, Criptopidae) și opt genuri. Geofilomorfele alcătuiesc grupul cel mai divers (opt specii) iar scolopendromorfele grupul cel mai abundant. În lucrare se prezintă detaliat raporturile cantitative dintre speciile identificate și se evidențiază importanța și rolul fiecărei specii în biocenoză.

Chilopods can be seen everywhere where there is a certain humidity. The most and diverse aspects populate the litter and the soil of the leafy forests being an important part of the bieafic communities. In this work the goal is to follow the qualitative and quantitative, static and dynamic structure of the chilopods from a beech tree forest.

## THE MATERIAL AND THE METHOD

Făget-Colibași forest is situated in the middle basin of the Argeș River, in the northwest part of Pitești at a height of 350 meters. It is a beech tree forest, typical of the inferior boundary of the beech forest spreading, which trickles into the oak graves tier.

The dominant species *Fagus silvatica* is accompanied by sporadic examples of *Quercus petrea*. The bush canopy is formed of beech tree brushwood. The grassy layer is dominated by *Carex pilosa* and this is just a little developed. The litter layer is permanent and it has varied thickness

because of the unlinear microrelief, which favors agglomeration of the leaves in the concave sections and their disappearance in the convex portions.

The soil is a typical erodisoil with a homogeneous sand-clay structure on the entire profile. The reaction is temperately acid ( $\text{pH}=5.06$ ) and the quantity of organic substance ( $C_t$ ) varies from 1.50 to 1.80. The airohydric regime is good because of the sand-clay structure, which ensures a good permeability, and the existent slope provides the drainage of the surface water. The relative humidity of the soil reaches a monthly average of 34% and varies relatively little because of the good permeability of the soil and the reduced evaporation due to the thick litter layer and the compact canopy.

Regarding the climate, the researched area is part of the hill continental climate region (the Dfbx province). The yearly average temperature is 9.5 centigrades and the yearly average of the rainfall quantity is 685 milimeters. The mow layer generally lasts 60 to 80 days (Barco & Nedelcu, 1974). The climate chart reported to the Peguy grid emphasizes that December, January, February and March are „cold and wet” and the rest of the months are temperate, a fact emphasized also by the ombrothermic diagram. While comparing the climate of the 3 years of study with the one established on the basis of the average data from the last 60 years, we find that in the first two years the differences are obvious in the sense that the first year is „colder and wetter”, and the second is warmer and more unproductive. In the last year the climate is more homogeneous, very similar to the general climate of the area.

The working station, having an area of 10.000 square meters was fixed on an irregular mountainside, with concave and bulging sectors, with western exposure and an eight grades slope. In nature the chilopods present such a distribution which approximates thea theoretical model of the binomial negative distribution (Gava, 1990). The gatherings of material lasted for three years (1972-1974). We picked up 6 probe units monthly from February to November inclusively. This number was tested by using the corresponding formula for the model of the binomial negative disbution ( $N=1/D^2 (1/X+1/k)$ ) which ensured a precision of the estimated parameters with an error of less than 20%, an error which is usually admitted in ecological research. From the point of view of the dimension of the body, the chilopods belong to the macrofauna according to the classification made by Van der Drift (1951) and Dunger (1962), this being the reason for which the surface of the probe units was  $625 \text{ cm}^2 (1/16 \text{ m}^2)$ . Specialized literature (Hutha, 1972,

Geoffroy, 1979) appreciates that the size of these samples units is satisfactory and responds to the exigencies imposed by such researches at the same time large enough to enable one to avoid the so-called „curb-effect" which occurs in case the size of the drawings is small by comparison with the size of the organisms. The samples included the canopy of leaves and the soil down to the depth of 10 cm. They were collected only during the day to avoid the modifications, which appear in distribution because of the movements produced during the night. In order to avoid the so-called „collector's error" the drawings were always made by the author. The samples were extracted at random. the studied area was marked out in 400 square having the side of 5 m. These were noted after the model of chessboard and by drawing lots, two times (it was the letter on the first drawing and the number on the second one.) We decided the plates were we had to pick up those six specimen units. The emplacement of the frame was done at a distance at 30-40 cm. from the trunks of the trees or from fallen and decaying ones. We avoided the little steep slopes without a litter or the places covered with moss or bushes of graminee bushes. The canopy of leaves was sorted out in laboratory with the help of the Tullgren funnels and the soil was sorted right there by eye. All the material was preserved in 70° alcohol.

## RESULTS AND DISCUSSIONS.

During the period of study we picked up analyzed 180 samples units of which we separated and determined a numer of 1601 individuals, which belong to three orders of those four orders known in Romania, 5 families (Lithobiidae, Schendilidae, Mecistocephalidae, Geophilidae, Criptopidae), 9 genus and 18 species (Table1).

From a biogeographical point of view most of the species in this area have a great European extent. So, theree of them are Holarctic, two – Palearctic, four – European three – Alpine-Carpathian, two – Mediterranean, two – Southeast European and one *Lithobius burzenlandicus* – endemical in the Carpathians. The scolopendramorphs represented by thirteen species form the group with the greatest specific variety. These analyses are related to the others made by other research workers in similar studies in foliated forests in the Temperate Zone of Europe (Table 2).

TABLE I - Identified species, numerical plenty and yearly average density (ind/m<sup>2</sup>) of chilopods of Făget forest

TAXONOMICAL UNITY	Numerical plenty				Numerical density				The geographical distribution
	Y* I	Y* II	Y* III	Total	Y* I	Y* II	Y* III	The averagee	
Class CHILOPODA	594	455	552	1601	158,39	121,53	147,20	142,37	
Order LITHOBIOMORPHA	170	78	59	307	45,33	20,80	15,73	27,28	
<i>Lithobius mutabilis</i>	27	11	5	43	7,20	2,93	1,33	3,82	Southeast European
<i>Lithobius muticus</i>	1	-	3	4	0,26	-	0,80	0,36	European
<i>Lithobius burzenlandicus</i>	142	67	51	260	37,86	17,86	13,60	23,10	Endemical-carpathians
Order GEOPHIOMORPHA	171	155	231	557	45,60	41,33	48,80	45,24	
<i>Schendyla nemorensis</i>	1	-	1	2	0,26	-	0,26	0,17	European
<i>Schendyla zonalis</i>	1	-	-	1	0,26	-	-	0,08	Mediterranean
<i>Brachyschendyla montana</i>	14	4	12	30	3,73	1,06	14,30	6,36	Alpine-Carpathian
<i>Brachysciendyla</i> sp.	6	12	53	71	1,60	3,20	14,30	6,36	-
<i>Dicellophilus carniolensis</i>	43	41	46	130	11,46	10,93	12,26	11,55	Holarctic
<i>Clinopodes flavidus</i>	1	2	2	5	0,26	0,53	0,53	0,44	Holarctic
<i>Clinopodes linearis</i>	1	8	8	17	0,26	2,13	2,13	1,50	Paleartic
<i>Clinopodes abbreviatus</i>	54	50	44	148	14,40	13,33	11,73	13,15	Southeast European
<i>Necrophloeophagus longicornis</i>	31	17	9	57	8,26	4,53	2,40	5,06	Holarctic
<i>Geophilus elctricus</i>	-	2	-	2	-	0,53	-	0,17	European
<i>Geophilus insculptus</i>	11	7	14	32	2,93	1,86	3,73	2,86	European
<i>Strigamia engadina</i>	4	9	29	42	1,06	2,40	7,73	3,73	Alpine-Carpathian
<i>Strigamia transylvanica</i>	4	3	13	20	1,06	0,80	3,46	1,77	Alpine-Carpathian
Order SCOLOPENDROMORPHA	253	222	262	737	67,46	59,20	69,86	65,50	
<i>Cryptops parisi</i>	1	-	2	3	0,26	-	0,53	0,26	European
<i>Cryptops hortensis</i>	252	222	260	734	67,20	59,20	69,33	65,26	Palearctic

\*Y = Year

I have also estimated the dimensions of chilopods population by numerical density, which I have expressed by the number of the individuals on square meter ( $\text{ind}/\text{m}^2$ ). I have calculated the medium density every month in a series of six units of test. With the help of these medium monthly densities I came to the annual medium densities and then to the medium density on the whole period of study. In these three years of study, the density of chilopods altered from  $158.39 \text{ ind}/\text{m}^2$  (in the first year) to  $147 \text{ m}^2$  (in the last year of study). These observations are comparable to the observations made by other research workers in similar studies upon the chilopods in beech forests in the temperate zone of Europe (Albert, 1977, Germany –  $73 \text{ ind}/\text{m}^2$ ; Bornebush, 1930, Denmark –  $69.0 \text{ ind}/\text{m}^2$ ; Drift J. van der, 1951, Holland –  $187.0 \text{ ind}/\text{m}^2$ ). Among all the big taxonomically units which from the chilopods group of this biohope, the scolopendromorphs have had the greatest density of population ( $65.50 \text{ ind}/\text{m}^2$ ). They are followed by the geophilomorphes ( $45.24 \text{ ind}/\text{m}^2$ ) and by the lithobiomorphes ( $27.28 \text{ ind}/\text{m}^2$ ) (Table 1). Among the species with a high numerical density we name here the *Cryptops hortensis* (from the scolopendromorphs) with a density of  $65.26 \text{ ind}/\text{m}^2$ , the *Clinopodes abbreviatus* –  $13.5 \text{ ind}/\text{m}^2$  and *Lithobius burzenlandicus* –  $23.10 \text{ ind}/\text{m}^2$  (from the geophilomorphs) and the *Dicellophilus carniolensis* –  $11.55 \text{ ind}/\text{m}^2$  (from the lithobiomorphs). Among the species with a low annual medium density (lower than  $1 \text{ ind}/\text{m}^2$ ) we can mention *Lithobius muticus*, *Schendyla nemorensis*, *Geophilus electricus* and *Cryptops parisii* (Table 1).

TABLE-2 The number of identified chilopods species in different european forest

Kind of forest	Country	Number of species	Authors
Different deciduous trees	Poland	21	Folkmanova și Lang, 1960
Oak	France	13	Geoffroy, 1979
Coniferous trees and beeches	Poland	5	Jawlowski, 1949
Coniferous trees and beeches	Romania	7	Matic și Strugen, 1984
Beech	Romania	13	Matic și Hodoroga, 1985
Evergreen oak	Romania	12	Gava, 1990
Beech	Romania	18	<i>This work</i>

In order to point out the importance and the role of each species in the studied biocenosis, I established the quantitative and qualitative rapport between the identified species in the studied space. In Table 3 there are presented: the relative numerical plenty, the domination, the frequency, the constance and the index of ecological value.

The numerical plenty expresses the degree of participation of every species or group of species to the constitution of structural nets of biocenosis. It represents an important index in estimating the role of different groups or of every species in biocenosis. If we look at the forces of different superspecific taxonomical units comparatively, we see that the scolopendromorphs represent over 46.00% from the forces, they are followed by geophilomorphs – 34,79% and by lithobiomorphs – 19.17% Concerning the numerical importance of every species there are also great differencies. Thus, the species: *Cryptops hortensis* (63.3%), *Lithobius burzenlandicus* (16.2%) and *Clinopodes abbreviatus* (9.2%) hold, as it results almost 90% from total identified forces, while the species *Clinopodes flavidus*, *Lithobius muticus*, *Cryptops parisi*, *Schendyla nemorensis*, *Geophilus electricus* and *Schendyla zonalis* hold together under 1%.

TABLE 3 – THE RELATIVE ABUNDANCE, THE DOMINATION, THE FREQUENCY, THE CONSTANCY, AND THE INDEX OF ECOLOGICAL SIGNIFICANCE OF THE SPECIES OF CHILOPODS IN FĂGET FOREST

THE SPECIES	Relat. abun. %	Domination	F* %	Constancy*				The index of ecological value (W)
				Ac	A	C	E	
<i>Cryptops hortensis</i>	63,3	Dominant	83,3	-	-	-	+	38,2
<i>Lithobius burzenlandicus</i>	16,2	Accompanying	51,1	-	-	+	-	13,1
<i>Clinopodes abbreviatus</i>	9,2	Accompanying	44,4	-	+	-	-	4,1
<i>Dicelophillus carniolensis</i>	8,1	Accompanying	44,4	-	+	-	-	3,6
<i>Brachyschendyla sp.</i>	4,4		20,0	+	-	-	-	0,8
<i>Necrophoepagus longicornis</i>	3,5		19,4	+	-	-	-	0,9
<i>Lithobius mutabilis</i>	2,6		15,5	+	-	-	-	0,4
<i>Strigamia engadina</i>	2,6		17,2	+	-	-	-	0,4
<i>Geophilus insculptus</i>	2,0		16,1	+	-	-	-	0,3
<i>Brachyschendyla montana</i>	1,8		11,1	+	-	-	-	0,2
<i>Strigamia transylvanica</i>	1,2		8,3	+	-	-	-	0,1
<i>Clinopodes linearis</i>	1,0		6,6	+	-	-	-	0,07
<i>Clinopodes flavidus</i>	0,3		2,7	+	-	-	-	0,008
<i>Lithobius muticus</i>	0,2		1,6	+	-	-	-	0,004
<i>Cryptops parisi</i>	0,1		1,6	+	-	-	-	0,003
<i>Schendyla nemorensis</i>	0,1		1,1	+	-	-	-	0,001
<i>Geophilus electricus</i>	0,1		1,1	+	-	-	-	0,001
<i>Schendyla zonalis</i>	0,06		0,5	+	-	-	-	0,0003

\* F = frequency; Ac = casual species; A = accessories; C = constants; E = euconstants;

The numerical domination of species represents an ecological index, which reveals the extant rapports between the species of a certain biotope. Its calculation is usually made by taking into account the relative plenty. It is influenced by the number of the individuals and of extant species. Among the 18 species, present in this biotope, we meet one dominant species (*Cryptops hortensis*) and three accompanying species (*Lithobius burzenlandicus*, *Clinopodes abbreviatus* and *Dicelophillus carniolensis*).

**Frequency** is an index of the biocenosis level, which contributes together with other structural parameters to the characterization, and the description of the number, giving us a full image of the percentage in time or space – of every species in the overall picture of the relations established between these species. It is influenced by the richness and the spatial distribution of every species. Generally speaking the species with a relatively great abundance show high values of the frequency index, an observation also confirmed in our case. It can be noticed that the same species *Cryptops hortensis* registers the highest frequency – 83,3%. The rest of the species have frequencies with fluctuating values, which can reach the 0,5%, and this fact indicates only the presence of the species among the 180 units of testing (Table 3).

**Constancy** is an index, which depends on the frequency, and this index emphasized the percentage in time of the species as part of the relations they belong to. Depending on the Tischler frequency percentage (1955) the species can be grouped in casual species ( $F = 0,1\text{-}25\%$ ) accessories ( $F = 25,1\text{-}50\%$ ) constants ( $F=50,1\text{-}75\%$ ), euconstants ( $F=75,1\text{-}100\%$ ). On the basis of the presented dates in the table 3 it comes out that *Cryptops hortensis* belongs to the euconstant species *Lithobius burzenlandicus* to the constant *Clinopodes abbreviatus* and *Dicelophillus carniolensis* belongs to the accessories and the remaining species belongs to the casual category (Table 3).

**The index of ecological value (W)** mirrors more precisely the position of the species in the biocenosi. It represents the relation between frequency ( $F$ ) and abundance ( $A$ ) and it is calculated with the following formula:  $W = FxA/100$ . Taking into account the value of this index the species can be grouped into the following categories: casual ( $W = \text{under } 0,1\%$ ), accessory ( $W = 0,1\text{-}5\%$ ), characteristic ( $W = \text{over } 5\%$ ). It can be noticed that two species are dominant: nine accessories and seven casual (Table 3).

**The numerical evolution.** The myriad populations are characterized by a permanent change of the numerical structures, determined on the one hand by the internal factors of the populations and on the other hand by the external factors. There is a close and permanent connection between

those two categories of factors and the force of the change of numerical relations. The numerical evolution of myriapods during a year is marked in general by the appearance of two periods of maximum plenty: spring and autumn. The début and the lenght of those periods vary sometimes very much depending on the area examined and on the change of climatic conditions in time (Weidemann, 1972). There are cases when the populations plenty vary very little during a year. In such cases the maximum values are reached during summer when new generations appear in the populations, and the minimum values during winter when the development of the populations stagnates (Albert, 1977). The estimation and the interpretation of density fluctuations in the case of these organisms is much complicated by the vertical and horizontal migrations which some species do for wintering or for reproduction. The annual variation of the density curve is determined in general by the numerical evolution of the dominant group, and inside it by the dominant species. In our case the annual curve of evolution of the numerical abundance of the chilopods is determined by a great number of species – *Cryptops hortensis*, *Lithobius burzenlandicus*, *Clinopodes abbreviatus*, *Brachyschendyla* sp., *Necrophloeophagus longicornis*, *Dicelophillus carniolensis* all present here in great number. This specific variety causes the two maximums to decrease. This one can see that the monthly numerical density increases suddenly beginning in spring when it reaches maximum values in March (216 ind/m<sup>2</sup>, the third year of study) and it keeps so with some variations at a high level until late autumn when it begins to decrease (Fig.1). When interpreting this kind of evolution we should take into account both the great variety of the present populations and the environmental conditions which here vary relatively little.

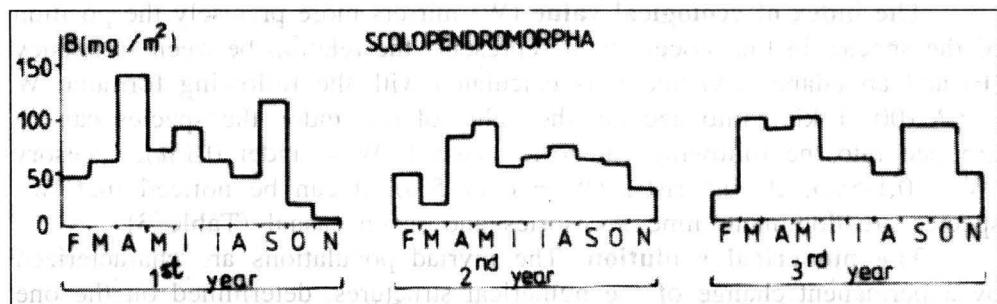


Fig.1 – The evolution of the monthly average density (ind/m<sup>2</sup>) of the Chilopods in Făget Forest

The biomass accumulated by a species or by a group of species at a certain moment expresses more precisely their ecological role and their importance in the activity of transfer of the substance and energy as part of an ecosystem. Both the estimation of the quantity of biomass and its evaluation in time were done only for the order scolopendromorphs and for lithobiomorphs, starting from the knowledge of the numerical density of each species. As the post-embryonic development of most of the species is not very well known, and so the classification of the individuals according to the development stages, can not be made, we grouped same species into many classes, according to their size. For each class, we established an average individual weight, which was multiplied by the number of the individuals belonging to that class and in this way we found out the biomass at a certain moment. I expressed the biomass through mg dry substance on  $m^2$ . Drying was made in the thermostat-boiler at  $95^\circ C$  for 72 hours. The weighing was done with an electronic weight indicator, its precision being  $1/10$  mg. We found out that the annual average biomass of the scolopendromorphs is  $62.33/mg$  dry substance per  $m^2$ , and that of the lithobiomorphs is  $18.11/mg$  dry substance per  $m^2$ .

Following the monthly evolution of the biomass of the scolopendromorphs over a year, we can notice that in spring and in autumn, the values are higher, and in summers they are lower. The values in the spring are higher than those in the autumn. In the last year of study, in the spring months, the biomass was over  $90mg/m^2$ , it lowered in the first part of the summer to  $55 mg/m^2$ , reaching the minimal value in August ( $38.2 mg/m^2$ ), and it grew again in the autumn to  $86 mg/m^2$  (Fig. 2).

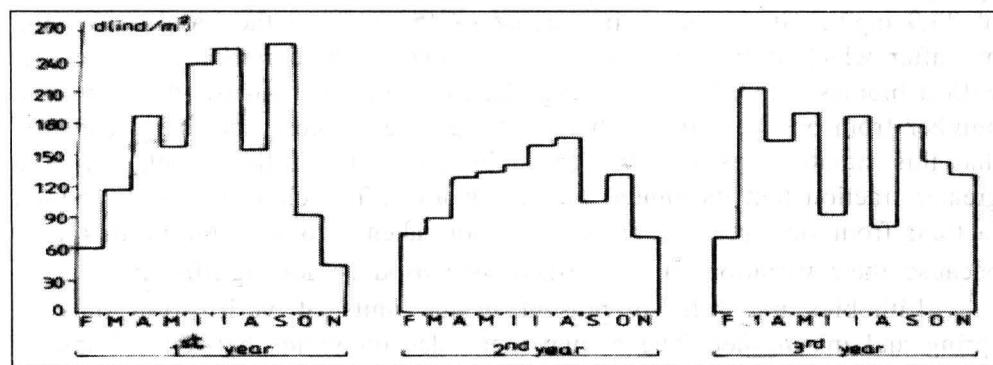


Fig.2 - The evolution of the monthly average biomass (mg. dry substance /  $m^2$ ) of the scolopendromorphs.

The evolution of the numerical density and of the biomass is characteristic for every species.

The **lithobiomorphs** are represented by three species: *Lithobius mutabilis*, *Lithobius muticus*, and *Lithobius burzenlandicus*. The researches regarding the postembryonic development of the Lithobiidae (Andersen, 1976, 1978, Jolly, 1966) emphasized the idea that their biological cycle takes place in thirtees stages and the period of development from the egg to the reproductive adult is variable depending on the species and even on the geographic area. Thus, in the temperate zones it lasts three years (Lewis, 1965) and sometimes it reaches 5-6 years (Wignarajah and Phillipson, 1977 quoted after Geoffroy, 1979). The researches have also proved that the period of reproduction and depositing of the eggs takes place during the whole year. In such conditions we find a large number of generations in the biothop, which grow simultaneously, therefore in each unit of verification we find individuals of various ages, the most numerous being the immature individuls.

*Lithobius (M) burzenlandicus* is present in the survey every month. In the case of this species one also notices a lowering of the annual mean density in the three years of study. Thus, from 37.8 ind/m<sup>2</sup> in the first year it decreases to 17.8 ind/m<sup>2</sup> in the second year and it reaches 13.6 ind/m<sup>2</sup> in the third year, and the mean biomass decreases from 18.8 mg/m<sup>2</sup>, in the first year, to 5.9 mg/m<sup>2</sup> in the third year. The maximum density is reached at the end of the spring and the beginning of the summer. Then, a lowering follows at the end of the summer and a new increasing value in autumn. For instance, in the first year of studies the numerical density increases in spring and it reaches maximum value in June (64 ind/m<sup>2</sup>), with a biomass of 33,9 mg/m<sup>2</sup>, it decreases in August to 45,3/m<sup>2</sup> and the biomass 39 mg/m<sup>2</sup>, after which it increases again and it reaches 66,6 ind/m<sup>2</sup> in September with a biomass of 35,7 mg/m<sup>2</sup> (Fig. 3). In conection with the decreasing in number from one year to another as it the case of these specis we consider that this situation results from the subtracting out of the population of a greater fraction that its annual increasing level. The change of the medium factors, from one year to another, is not taken into account in this case because their variation in the respective period is not significant.

*Lithobius mutabilis* is present in the units of verification only in spring and in summer. The annual mean density varies between 7.2 ind/m<sup>2</sup>

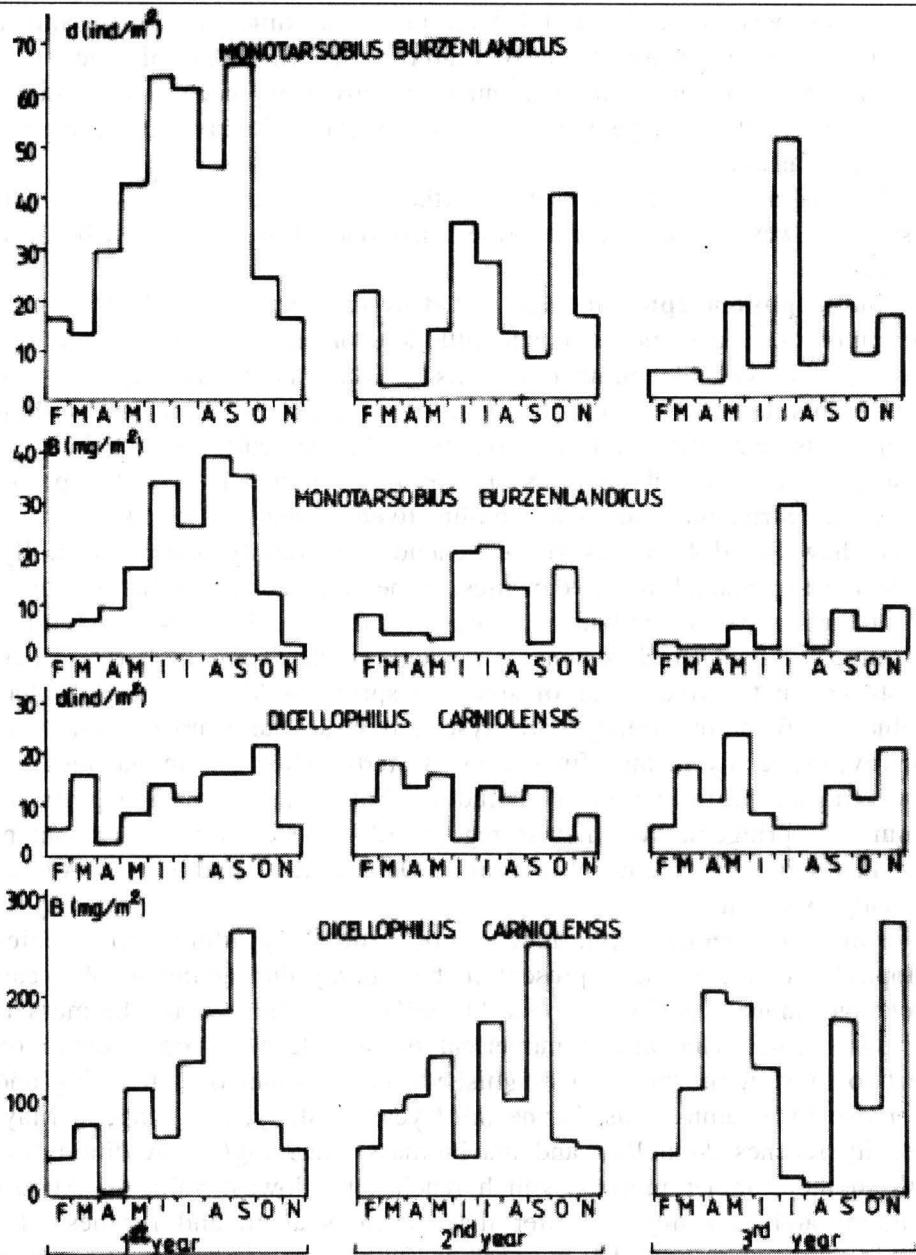


Fig. 3 – The evolution of the monthly numerical density ( $\text{ind}/\text{m}^2$ ) and of the biomass ( $\text{mg. dry substance}/\text{m}^2$ ) of some species of chilopods in Făget forest

(in the second year of study) and 1.3 ind/m<sup>2</sup> (in the third year). The annual mean biomass also decreases from 10 mg/m<sup>2</sup> in the first year of study to 2 mg/m<sup>2</sup> in the third year. The maximum density was reached in summer (13.3 ind/m<sup>2</sup>), in the first year of study. The highest biomass, 20.12 mg/m<sup>2</sup>, was reached in June.

The medium annual densities of *Lithobius muticus* are very low. The highest value was of 0.8 ind/m<sup>2</sup>, in the third year of study, with a biomass of 2.5 mg/m<sup>2</sup>.

The **geophilomorphs** are represented by thirteen species. In their case the postembryonic development is still little known. In our country conditions females spawn variable number of eggs in May and at the beginning of June (Dărăbanțu 1973). The nestlings are formed in June-July. Their development is epimorphic, the larva looks, just like the adult. The development cycle some species lasts three years or even more (Lewis 1971). The species of the genus *Strigamia* and *Dicellophilus* lived 7 years in captivity.

We have found 4 species in the Schendylidae family which, generally, have decreasing annual mean densities. *Schendyla zonalis* turns up quite rarely in the survey. *Schendyla nemorensis* turns up only in May having a density of 2.6 ind/m<sup>2</sup>. *Brachyschendyla montana* reaches some higher densities. For instance, in the final Year of study in spring in May the density had the value of 16 ind/m<sup>2</sup>. Finally, *Brachyschendyla* sp. turns up constantly in the survey, especially in the final Year of study, when the annual medium density reached the value of 14.1 ind/m<sup>2</sup>. This year, a more significant maximum in spring, in March, was registered in the density's development (40 ind/m<sup>2</sup>) and a lower one in autumn in October (21.3 ind/m<sup>2</sup>). In August the density was null.

From the Mecistocephalidae family the only identified species *Dicellophylus carniolensis*, is present in the survey during the whole year. The average annual density is about 11 ind/m<sup>2</sup> and the average biomass is about 100 mg/m<sup>2</sup>. The annual numerical density develops on a curve on which two maximums can be distinguished, an important one in spring and a lower one in autumn. Thus, in the third year of study, in spring, in May, the density reaches 24 ind/m<sup>2</sup> and the biomass 192.9 mg/m<sup>2</sup>. A diminution follows in the summer months, which reaches the lowest value in August (5.3 ind/m<sup>2</sup> and 11.7 mg/m<sup>2</sup>), after that develops again and reaches 21.3 ind/m<sup>2</sup> in November and the biomass is 270.6 mg/m<sup>2</sup>. The mature type appeared in the survey only in spring and autumn (Fig.3).

The species of the Geophilidae family are the largest group. The *Clinopodes* genus is represented by three species. *Clinopodes flavidus* is

present in the test units only in certain months. The average annual density does not exceed 0.5 ind/m<sup>2</sup> in any of the years of study. *Clinopodes abbreviatus* appears in the survey month. The average annual density is about 12 ind/m<sup>2</sup>. In the monthly variation of the numerical density, in a year time, three maximums can be distinguished, two of them being important, one in spring and the other in summer and a lowest one in autumn, in November. Referring to the first year of study, the density rose in spring, reaching in April 18.6 ind/m<sup>2</sup>, diminished in May to 8 ind/m<sup>2</sup>. It rose in summer and reached in July the highest annual value of 37.3 ind/m<sup>2</sup>, a diminishing to 2.6 ind/m<sup>2</sup> followed in autumn, in October, and a new rising to 10.6 ind/m<sup>2</sup> in November. *Clinopodes linearis* appears in all the three years of study but only in spring and autumn. The average medium densities are 2.1 ind/m<sup>2</sup>.

*Necrophloeophagus longicornis*, is another geophilidius, which appears in surreys only in certain months. The monthly densities do not exceed 16 ind/m<sup>2</sup>. *Geophilus electricus* appears sporadically only in certain months and it has monthly densities under 2.6 ind/m<sup>2</sup>. *Geophilus insculptus* appears especially in spring months and in autumn with densities, which do not exceed 8 ind/m<sup>2</sup>.

The last two species of *Geophilidae* belong to the *Strigamia* genus.

*Strigamia engadina* appears in surreys only in some months of the year. The monthly densities in the first two years do not exceed 8 ind/m<sup>2</sup>. In the last in summer in July they get to 24 ind/m<sup>2</sup>.

*Strigamia transsylvanica* is in the testing units only in some months with densities, which do not exceed 8 ind/m<sup>2</sup>. As in the case of the preceding species their number is greater in the last of the last part of the third year of study. The maximal values (10.6 ind/m<sup>2</sup>) were reached also in July. It is possible for the hatching of the eggs to take in this month too.

**Scolopendromorphs** are to be found in two species. Their post-embryonic development is less known. If for the tropical species there are some data regarding their post-embryonic development which seems to be annual (Lewis, 1969), for the European species these data are missing.

*Cryptops parisi* appears by accident only in two testing units.

*Cryptops croaticus* gest to very big densities. The annual average densities varied between 60 ind/m<sup>2</sup> (the second year of study) and 70 ind/m<sup>2</sup> (the last year of study), and the biomass between 55.5 and 65.5 mg/m<sup>2</sup> in the same period. The monthly numerical density develops a maximum in spring in April and May and one in autumn, in september.

For example, in the last year of study, the maximum value (117.3 ind/m<sup>2</sup>) was reached in March and was maintained at such a high value (over 85



# DATA CONCERNING THE MACROLEPIDOPTERA FAUNA FROM THE MURES RIVER'S COULOIR (HUNEDOARA COUNTY, ROMANIA)

SILVIA BURNAZ

Muzeul Civilizației Dacice și Romane Deva,  
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## REZUMAT

Autorul prezintă lista faunistică a speciilor de macrolepidoptere colectate între anii 1991-1995, în principalele tipuri de ecosisteme din culoarul râului Mureş (sectorul Deva-Zam, judeţul Hunedoara).

Analiza distribuției geografice și a habitatelor preferențiale pentru cele 213 specii de macrolepidoptere relevă predominanța speciilor euroasiatice (93,42%) legate de prezența pădurilor de luncă (sălcete, plopișuri, arinișuri colinare, cărpинete, etc), pajiștilor higrofile și mezohigrofile din lunca râului, bălțiilor și terenurilor mlăștinoase. Între elementele caracteristice pădurilor de luncă colinare se menționează: *Poecilocampa populi* L., *Phyllodesma tremulifolia* Hb., *Tethea ocularis* L., *Catocala elocata* Esp., *Catocala electa* Esp., *Nymphalis polychloros* L., etc.

În sectoarele colinar-montane dintre localitățile Deva și Zam (județul Hunedoara) au fost colectate o serie de specii caracteristice quercineelor: *Pyramidcampa perflua* Fabr., *Minucia lunaris* Den. & Sch., *Boarmia viertlii* Boh.

Pajiștile higrofile sunt habitate caracteristice pentru *Lycaena dispar rutila* Wrmbg., *Lycaena virgaureae* L., *Arsilonche albovenosa* Guen., *Celaena leucostigma* Hb. În pajiștile cu caracter mezohigrofil de la Zam au fost colectate numeroase exemplari aparținând speciei *Euphydryas aurinia* Rott.

Între speciile cu efective populационale reduse în zona cercetată se menționează: *Eriogaster catax* L., *Gastropacha populifolia* Esp., *Naenia typica* L., *Symira nervosa* Den. & Sch., *Pyramidcampa perflua* Fabr.

The sector of the Mureş River from the Hunedoara County (Romania), situated at the interference zone between Apuseni Mountains, in the North, and Poiana Ruscă Mountains, in the South, is developed in a broad tectonic couloir, which contains some important epigenetic sectors, cutted in crystalline rocks, granites and gneisses. A lot of basins, among which the most important are Ilia and Deva-Simeria basins, accompanied by large terraces and separated by neogene eruptive formations, are inserted between the principal sectors. (UJVARI, 1972).

The levels of the Mureş River's Couloir terraces, belonging to lower Pleistocene and upper Pleistocene, have different altitudes, from 5-6 m to 110-120 m. (OANCEA et al., 1987).

The meadow of the Mureş River has three distinct longitudinal portions: the lower floodable meadow; the upper unfloodable meadow, with a great extension in all the couloir of Mureş River; the meadow situated under the terraces, with a particular morphology (glacis and depressionary zones, with swamps or temporary excesses of humidity). (VULCU, 1971).

The soils are very varied, depending on relief, geological substratum and bioclimatical conditions. In the Mureş River's meadow, the alluvial, chernozem and brown soils are prevalents.

In the upper terraces and the side of mountains, the chernozem, brown soils, rendzina and pseudo-rendzina soils are prevalents.

The Mureş River's Couloir is integrated in the hilocky climatic region, with moderate winters concerning the thermic regime and cool summers with a well-balanced pluviometrical regime. The mean value of the annual temperature is oscillating about 10° C. The regime of the atmosperical rain falls has a mean annual value of 600-650 mm (OANCEA et al. 1987).

The study of the Macrolepidoptera fauna from the Mureş River's Couloir was accomplished in 1991-1995, in the most important ecosystems of the zone Deva-Zam.

1. *The meadow forests*, representing a complex of phytocoenoses: Ass. Stellarionemori-Alnetum glutinosae (Kastn. 38) Lohm 57; Ass. Fraxino oxycarpae-Ulmetum Mitt. et al., 73; Ass. Querco robori Carpinetum Soó & Pocs. (DONITA et al., 1992).

2. *The willow and popular forest* (Ass Salicetum albae-fragilis Issl. 26 em Soó 57) (DONITA et al., 1992).

3. *The hygrophilous grassland* (Ass. Agrostetum stoloniferae Ujv. 41 (BOSCAIU et al., 1972; DONITA et al., 1992).

4. *The mesophyloous and meso-hygrophilous grasslands* (Ass. Festucetum pratensis Soó, 1928, 1936; Ass. Trifolio repenti-Lolietum Kripp. 67; Ass.

Agropyretum repentis Burd. et al, 56) (BOSCAIU et al., 1972; DONITA et al., 1992).

5. *The pool and swamps phytocoenoses* (Ass. Scirpo-Phragmitetum Koch 26; Ass. Thyphetum angustifoliae-latifoliae (Eggl 33 Schmale 39). (BOSCAIU et al., 1972).

The faunistic list, including 213 species which were identified in the principal ecosystems of the Mureş River's Couloir, is presented (Table 1).

The systematic arrangement of the species is based on the latest systematic and taxonomic conceptions (POPESCU-GORJ, 1987; RÁKOSY, 1996).

The presence of the species in the principal ecosystems, their geographical spreading are mentioned.

*TABLE 1.: THE DISTRIBUTION OF THE MACROLEPIDOPTERA SPECIES FROM THE MUREŞ RIVER'S COULOIR IN THE PRINCIPAL ECOSYSTEMS AND THE GEOGRAPHICAL SPREADING*

**Legend:** Ecosystem types: 1 = The meadow forests; 2 = The willow and poplar forests; 3 = The hygrophilous grasslands; 4 = The mesophylous and meso-hygrophilous grasslands; 5 = Pools and swapms

Geographical spreading: Eua=Euroasiatic; Am = Atlanto-mediterranean; Pm = Ponto-mediterranean; Wam = Westasiatic-mediterranean; Hol=Holarctic; Str = Subtropical; E = European

FAMILIES; SPECIES	1	2	3	4	5	GS
<b>LASICAMPIDAE</b>						
Poecilocampa populi L.	+	+				Eua
Trichiura crataegi creataeigi L.	+					Eua
Eriogaster catax L.	+					Eua
Malacosoma neustria neustria L.	+					Eua
Phyllodesma tremulifolia Hb.	+	+				Eua
Macrothylacia rubi rubi L.	+					Eua
Gastropacha populifolia Esp.	+	+				Eua
<b>ATTACIDAE</b>						
Aglia tau tau L.	+					Eua
<b>DREPANIDAE</b>						
Falcaria lacertinaria L.	+					Eua
Drepana falcataria L.	+					Eua
Sabra harpagula Esp.	+					Eua

## MACROLEPIDOPTERS FROM THE MURES RIVER'S COULOIR

FAMILIES; SPECIES	1	2	3	4	5	GS
<i>Cilix glaucatus glaucatus</i> Scop.	+					Eua
<b>THYATIRIDAE</b>						
<i>Thyatira batis</i> L.	+					Eua
<i>Habrosyne pyritooides</i> Hufn.	+					Eua
<i>Thetea ocularis ocularis</i> L.	+	+				Eua
<i>Thetea or or</i> Den. & Sch.	+	+				Eua
<i>Tetheella fluctuosa</i> Hb.	+	+				Eua
<i>Ochropacha duplaris</i> L.	+					Eua
<b>GEOMETRIDAE</b>						
<i>Archiearis notha</i> Hb.	+					Eua
<i>Alsophila aescularia</i> Den. & Sch.	+					Eua
<i>Chlorissa pulmentaria</i> Guen.	+					Eua
<i>Cyclophora annulata</i> Schulze	+					Eua
<i>Cyclophora porata</i> L.	+					Eua
<i>Cyclophora linearia</i> Hb.	+					Eua
<i>Timandra griseata</i> W. Pet.	+			+		Eua
<i>Scopula immorata</i> L.				+		Eua
<i>Scopula rubiginata</i> Hufn.				+		Eua
<i>Idaea aversata aversata</i> L.				+		Eua
<i>Lythria purpuraria</i> L.				+		Eua
<i>Phyalapteryx virgata</i> Hufn.	+			+		Eua
<i>Scotopteryx luridata</i> Hufn.	+			+		Eua
<i>Xanthorhoe ferrugata</i> Cl.	+					Eua
<i>Xanthorhoe fluctuata</i> L.	+			+		Eua
<i>Camptogramma bilineatum</i> L.				+		Eua
<i>Mesoleuca albicillata</i> L.	+			+		Eua
<i>Cosmorrhoe ocellata</i> L.	+			+		Eua
<i>Horisme vitalbata</i> Den. & Sch.	+					Eua
<i>Operophtera brumata</i> L.	+					Eua
<i>Lithostege farinata</i> Hufn.	-					Eua
<i>Lobophora halterata</i> Hufn.	+	+				Eua
<i>Trichopteryx carpinata</i> Brkh.	+					Eua
<i>Lomaspilis marginata</i> L.	+	+				Eua
<i>Semiothisa notata</i> L.	+	+				Eua
<i>Semiothisa alternaria</i> Hb.	+	+				Eua
<i>Plagodis pulveraria</i> L.	+	+				Eua
<i>Opistographis luteolata</i> L.	+					Eua
<i>Pseudopanthera macularia</i> L.				+		Eua
<i>Therapis flavicaria</i> Den. & Sch.	+					Eua
<i>Selenia dentaria</i> Fabr.	+					Eua
<i>Selenia lunaria</i> Hb.	+					Eua
<i>Selenia tetralunaria</i> Hufn.	+					Eua
<i>Crocallis elinguaria</i> L.	+					Eua
<i>Artiora evonymaria</i> Den. & Sch.	+					Eua

FAMILIES SPECIES	1	2	3	4	5	GS
<i>Ourapteryx sambucaria</i> L.	+					Eua
<i>Colotois pennaria</i> L.	+					Eua
<i>Angerona prunaria</i> L.	+					Eua
<i>Lycia hirtaria hirtaria</i> Cl.	+					Eua
<i>Biston betularius betularius</i> L.	+					Eua
<i>Agriopsis aurantiaria</i> Hb.	+					Eua
<i>Peribatodes umbraria</i> Hb.	+					Eua
<i>Cleora cinctaria cinctaria</i> Den. & Sch.						Eua
<i>Boarmia roboraria</i> Den & Sch.	+					Eua
<i>Boarmia viertlii</i> Boh.	+					Eua
<i>Serraca punctinalis</i> Scop.	+					Eua
<i>Ascotis selenaria</i> Den & Sch.	+					Eua
<i>Ectropis crepuscularia</i> Den & Sch.						Eua
<i>Ematurga atomaria atomaria</i> L.	+			+		Eua
<i>Lomographa temerata</i> Den & Sch.						Eua
<i>Siona lineata</i> Scop.				+		Eua
<b>SPHINGIDAE</b>					+	
<i>Agrius convolvuli</i> L.					+	Eua
<i>Laothoe populi</i> L.	+					Eua
<i>Smerinthus ocellatus</i> L.	+		+			Eua
<i>Macroglossum stellatarum</i> L.	+		+			Eua
<i>Deilephila elpenor</i> L.	+					Eua
<i>Deilephila porcellus</i> L.	+					Eua
<b>NOTODONTIDAE</b>						
<i>Cerura vinula vinula</i> L.	+					Eua
<i>Cerura erminea</i> Esp.	+			+		Eua
<i>Furcula furcula forficula</i> Fisch.	+		+			Eua
<i>Dicranura ulmi ulmi</i> Den. & Sch.	+		+			Eua
<i>Spatialia argentina</i> Den. & Sch.	+					Eua
<i>Notodonta dromedarius</i> L.	+				+	Eua
<i>Notodonta torva torva</i> Hb.	+					Eua
<i>Tritophia tritophus</i> Den. & Sch.	+					Eua
<i>Pheosia gnoma</i> Fabr.	+			+		Eua
<i>Pheosia tremula</i> Cl.	+			+		Eua
<i>Pterostoma palpinum</i> Cl.	+					Eua
<i>Eligmodonta ziczac ziczac</i> L.	+					Eua
<i>Closteria curtula</i> L.	+					Eua
<i>Closteria anastosis</i> L.	+			+		Eua
<i>Closteria pigra</i> Hufn.	+			+		Eua
<b>LYMANTRIIDAE</b>						
<i>Laelia coenosa coenosa</i> Hb.	+					Eua
<i>Leucoma salicis</i> L.	+			+		Eua
<i>Arctornis l-nigrum</i> O.F. Mull.	+			+		Eua

## MACROLEPIDOPTERS FROM THE MURES RIVER'S COULOIR

FAMILIES; SPECIES	1	2	3	4	5	GS
<b>ARCTIIDAE</b>						
<i>Atolmis rubricollis</i> L.	+					Eua
<i>Lithosia quadra</i> L.	+					Eua
<i>Arctia villica villica</i> L.	+					Eua
<i>Diacrisia sannio sannio</i> L.	+					Eua
<i>Phragmatobia fuliginosa</i> L.	+					Eua
<i>Callimorpha quadripunctaria</i> P.	+					Eua
<i>Callimorpha dominula</i> L.	+					Eua
<b>NOCTUIDAE</b>		+				
<i>Idia calvaria</i> Den. & Sch.	+					Wam
<i>Macrochilo cribrumalis</i> Hb.	+					Eua
<i>Herminia tarsipennalis</i> Tr.	+					Eua
<i>Polypogon tentacularia</i> L.	+					Eua
<i>Rivula sericealis</i> Scop.	+					Eua
<i>Colobochyla salicalis</i> Den. & Sch.	+					Eua
<i>Hypena proboscidalis</i> L.	+					Eua
<i>Hypena rostralis</i> L.	+					Eua
<i>Catocala nupta nupta</i> L.	+	+				Eua
<i>Catocala elocata elocata</i> Esp.	+	+				Wam
<i>Catocala fulminea</i> Scop.	+					Eua
<i>Minucia lunaris</i> Den. & Sch.	+					Wam
<i>Lygephila craccae</i> Den. & Sch.	+					Eua
<i>Aedia funesta</i> funesta Esp.	+					Wam
<i>Euclidia glyphica</i> <i>glyphica</i> L.	+					Eua
<i>Meganola albula</i> Den. & Sch.	+					Eua
<i>Nola cucullatella</i> L.	+					Eua
<i>Nycteola revayana</i> Scop.	+					Wam
<i>Earias chlorana</i> L.	+	+				Eua
<i>Bena prasinana</i> L.	+					Wam
<i>Colocasia coryli</i> <i>coryli</i> L.	+					Eua
<i>Acronicta megacephala</i> Den. & Sch.	+					Eua
<i>Acronicta leporina</i> <i>leporina</i> L.	+					Eua
<i>Simyra nervosa</i> Den. & Sch.	+					Eua
<i>Arsilonche albovenosa</i> Guen.			+	+		Eua
<i>Emmelia trabealis</i> Scop.			+	+		Eua
<i>Deltode bankiana</i> Fabr.				+		Eua
<i>Diachrysia chrysitis</i> L.				+		Eua
<i>Autographa gamma</i> <i>gamma</i> L.				+		Eua
<i>Abrostola triplasia</i> L.	+			+		Eua
<i>Cucullia umbratica</i> L.	+					Eua
<i>Amphipyra perflua</i> Fabr.	+					Eua
<i>Pyrrhia umbra</i> L.	+			+		Eua
<i>Paradrina clavipalpis</i> Scop.				+		Eua
<i>Rusina ferruginea</i> Esp.	+					Eua

FAMILIES; SPECIES	1	2	3	4	5	GS
<i>Thapophila matura</i> Hufn.	+					Wam
<i>Euplexia lucipara</i> <i>lucipara</i> L.	+					Eua
<i>Phlogophora meticulosa</i> L.	+					Warn
<i>Ipimorpha retusa</i> <i>retusa</i> L.	+					Eua
<i>Mesogona acetoselae</i> Hb.	+					Eua
<i>Cosmia trapezina</i> Den. & Sch.	+					Wam
<i>Xanthia togata</i> <i>togata</i> Esp.	+					Hol
<i>Xanthia gilvago</i> Den. & Sch.	+					Eua
<i>Agrochola circellaris</i> Hufn.	+					Eua
<i>Lithophane ornitopus</i> Hufn.	+					Eua
<i>Allophyes oxyacantheae</i> L.	+					Wam
<i>Oligia strigilis</i> <i>strigilis</i> L.	+			+		Eua
<i>Mesapamea secalis</i> L.	+			+		Eua
<i>Rhizedra lutosa</i> Hb.					+	Eua
<i>Calamia tridens</i> Hufn.	+					Eua
<i>Nonagria typhae</i> Th.					+	Eua
<i>Celaena leucostigma</i> Hb.	+			+	+	Eua
<i>Discestra trifoli</i> Hufn.	+			+		Eua
<i>Lacanobia oleracea</i> L.				+		Eua
<i>Melanchna persicariae</i> L.				+		Eua
<i>Mamestra brassicae</i> <i>brassicae</i> L.				+		Eua
<i>Mythimna turca</i> <i>turca</i> L.	+			+		Eua
<i>Mythimna pallens</i> <i>pallens</i> L.				+		Eua
<i>Mythimna l-album</i> <i>l-album</i> L.				+		Eua
<i>Tholera decimalis</i> Poda	+			+		Eua
<i>Ochropleura plecta</i> <i>plecta</i> L.	+			+		Eua
<i>Noctua pronuba</i> <i>pronuba</i> L.	+			+		Eua
<i>Noctua fimbriata</i> Schr.	+			+		Wam
<i>Xestia c-nigrum</i> <i>c-nigrum</i> L.	+	+	+	+		Eua
<i>Naenia typica</i> L.	+					Eua
<i>Agrotis segetum</i> <i>segetum</i> Den. & Sch.	+			+		Eua
<b>HESPERIIDAE</b>						
<i>Thymelicus sylvestris</i> Poda	+			+		Eua
<i>Hesperia comma</i> <i>comma</i> L.				+		Eua
<i>Ochlodes venatus</i> <i>faunus</i> Tur.				+		Eua
<i>Erynnis tages</i> <i>tages</i> L.				+		Eua
<i>Pyrgus malvae</i> <i>malvae</i> L.				+		Eua
<b>RIODINIDAE</b>						
<i>Hamearis lucina</i> <i>lucina</i> L.						E
<b>LYCAENIDAE</b>						
<i>Lycaena dispar</i> <i>rutila</i> Wernbg.		+	+			Eua
<i>Lycaena virgaureae</i> <i>virgaureae</i> L.		+	+			Eua
<i>Lycaena alciphron</i> <i>alciphron</i> Rott.		+	+			Eua

FAMILIES; SPECIES	1	2	3	4	5	GS
<i>Everes argiades</i> Pall.				+		Eua
<i>Celastrina argiolus argiolus</i> L.				+		Eua
<i>Scoliantides orion orion</i> Pall.				+		Eua
<i>Plebejus argus argus</i> L.				+		Eua
<i>Polyommatus icarus icarus</i> Rot.				+		Eua
<b>SATYRIDAE</b>						
<i>Satyrus dryas drymeia</i> Fhrst.	+					Eua
<i>Maniola jurtina jurtina</i> L.				+		Eua
<i>Aphantopus hyperanthus</i> L.				+		Eua
<i>Coenonympha pamphilus</i> L.				+		Eua
<i>Coenonympha arcania arcania</i> L.				+		Eua
<i>Coenonympha glycerion</i> Brkh.	+			+		Eua
<i>Melanargia galathea scolis</i> Fr.				+		Eua
<b>NYMPHALIDAE</b>						
<i>Clossiana selene selene</i> Den. & Sch.				+		Eua
<i>Clossiana euphrosyne</i> L.				+		Eua
<i>Clossiana dia dia</i> L.				+		Eua
<i>Argynnis paphia paphia</i> L.				+		Eua
<i>Nymphalis polychloros</i> L.	+					Eua
<i>Nymphalis antiopa</i> L.	+					Eua
<i>Polygonia c-album</i> L.	+			+		Eua
<i>Vanessa atalanta atalanta</i> L.	+			+		Eua
<i>Inchis io io</i> L.	+			+		Eua
<i>Aglais urticae urticae</i> L.	+			+		Eua
<i>Araschnia levana levana</i> L.	+			+		Eua
<i>Neptis sappho aceris</i> Lep.	+			+		Eua
<i>Euphydryas aurinia aurinia</i> Rott.				+		Eua
<i>Melitaea didyma didyma</i> Esp.				+		Eua
<i>Melitaea cinxia cinxia</i> L.				+		Eua
<i>Melitaea phoebe</i> Den. & Sch.				+		Eua
<i>Melitaea athalia athalia</i> Rott.				+		Eua
<b>PIERIDAE</b>						
<i>Leptidea sinapis sinapis</i> L.				+		Eua
<i>Aporia crataegi crataegi</i> L.				+		Eua
<i>Pieris rapae rapae</i> L.				+		Eua
<i>Pieris napi meridionalis</i> Heyne				+		Pm
<i>Pontia daplidice daplidice</i> L.				+		Eua
<i>Colias hyale hyale</i> L.				+		Eua
<i>Colias crocea crocea</i> Geoffr.				+		Eua
<i>Gonepteryx rhamni meridionalis</i> Rob.				+		Eua

## CONCLUSIONS

The examination of the systematic list of the species identified in the ecosystems of the Mures River's Couloir from the Hunedoara County emphasizes the predominance of the euroasiatic elements (93,42%) attached by the meadow complex forests: *Aglia tau* L., *Drepana falcataria* L., *Crocallis elinguaria* L., *Colocasia coryli coryli* L., *Poecilocampa populi* L., *Phyllodesma tremulifolia* Hb., *Tethea ocularis ocularis* L., *Laothoe populi* L., *Cerura vinula vinula* L., *Pheosia tremula* Cl., *Clostera curtula* L. *Catocala nupta nupta* L., *Catocala elocata elocata* Esp., *Nymphalis polychloros polychloros* L., etc.

In the hillocky – mountain zone, from Zam and Brănișca a lot of species are typical from the oak forests (*Quercus*): *Amphipyra perflua* Fabr., *Minucia lunaris* Den. & Sch., *Nycteola revayana* Scop., *Cyclophora porata* L., *Boarmia viertlii* Boh.

The hygrophilous and meso-hygrophilous grasslands are typical habitats for: *Lycaena dispar rutila* Wrnb., *Lycaena virgaureae virgaureae* L., *Arsilonche albovenosa* Guen., *Celaena leucostigma* Hb., *Euphydryas aurinia aurinia* Rott.

In the pool and swamps ecosystems we identified *Nonagria typhae* Th. and *Rhizedra lutosa* Hb.

Between the most rarely species we mentioned: *Eriogaster catax* L., *Gastropacha populifolia* Esp., *Boarmia viertlii* Boh., *Pheosia tremula* Cl., *Minucia lunaris* Den. & Sch., *Simyra nervosa* Den. & Sch., *Amphipyra perflua* Fabr., *Xanthia gilvago* Den. & Sch., *Calamia tridens* Hufn., *Naenia typica* L.

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# **MACROLEPIDOPTERA SPECIES FROM PONORICI-CICLOVINA KARSTIC REGION (Şureanu Mountains, Romania)**

**SILVIA BURNAZ**

*Muzeul Civilizaţiei Dacice şi Romane Deva  
Str. 1. Decembrie, nr. 39, Deva*

## **REZUMAT**

Pe baza cercetărilor efectuate între anii 1990-1996, asupra faunei de macrolepidoptere din zona carstică Ponorici-Ciclovina (Munții Șureanu) se prezintă lista sistematică a speciilor înregistrate precum și considerațiile de ordin ecologic și zoogeografic.

Lista sistematică cuprinde 448 specii colectate în ecosistemele naturale cele mai reprezentative ale zonei cercetate.

Câteva specii considerate rare sau cu apariții sporadice în fauna României sunt semnalate: *Rhyparia purpurata* L., *Polymixis rufocincta* Geyer, *Xestia ashworthi candelarum* Stdgr., *Ochropleura musiva* Hb., *Opigena polygona* D&S, *Euxoa distinguenda* Led., *Naenia typica* L., etc.

The karstic Ponorici-Ciclovina region is situated in the western part of Șureanu Mountains (Southern Carpathians) and crossed by Luncani Valley (affluent of Strei River Basin) (Hunedoara County, Romania).

The absolute altitude is in Dealul Arsului (Hill Arsului): 920 m.

The middle annual temperature is: 9,5°C.

The average of precipitations is: 850 mm.

The geological composition consists in almost exclusively Mesozoic calcareous deposits, having a repercussion on soils (rendzina soil) and vegetation.

The region is dominated by forests constituted of phytocoenoses from Phyllitidi-Fagetum Vida (1959) 1963 association. The montane rocky region is dominated by Asplenio-Cystopteridetum fragilis Oberd (1939) 1949 and Melico-Pheletum montani Boșcăiu et al. 1966, mesophylous and

mesoxerothermophylous associations. The lawns edified by *Thymo comosifestucetum rupicolae* (Csuros 1959) Pop & Hodisan 1995 are spreaded over the hills between 640-700 m altitude. In the running water meadows of Luncani river there are forests of *Alnetum glutinoso-incanae* Br. – Bl. (1915) 1930 association.

As a result of lepidopterofaunistical investigations during 1990-1996 in Ponorici-Ciclovina karstic region there were identified 448 species of Macrolepidoptera. Preliminary studies were published by the author in 1986-1987, 1993.

The classification and scientifical nomenclature of the Macrolepidoptera species, used in the elaboration of the faunistical list is after POPESCU-GORJ (1987) and RAKOSY (1991, 1995, 1996). (Tab. 1)

**TAB. 1. – FAUNISTICAL LIST, FLYING PERIOD, GEOGRAPHICAL DISTRIBUTION, ECOLOGICAL EXIGENCES AND LARVAL FOOD, OF THE MACROLEPIDOPTERA SPECIES – PONORICI-CICLOVINA (ŞUREANU MOUNTAINS)**

Family Taxon	F.P. *	G.D.	E.E.	L.F.
<b>LASILOCAMPIDAE</b>				
<i>Poecilocampa populi</i> L.	15.10 - 3.11	Eua	M	D
<i>Trichiura crataegi</i> L.	22.09 - 1.10	Eua	Mt	D;A
<i>Malacosoma neustria</i> L.	22.06 - 1.08	Eua	M	D
<i>Macrothylacia rubi</i> L.	1.06 - 15.07	Eua	M	A
<i>Gastropacha quercifolia</i> L.	18.06 - 15.08	Eua	M	D
<i>Gastropacha populifolia</i> Esp.	1620.08.1992	Eua	Mh	D
<b>ATTACIDAE</b>				
<i>Eudia pavonia</i> L.	15.04 - 22.05	Eua	M	A
<i>Aglia tau</i> L.	15.05 - 23.06	Eua	M	D
<b>DREPANIDAE</b>				
<i>Drepana cultraria</i> Fabr.	16, 1♀ 20.07.1990	Eua	M	D
<i>Drepana falcataria</i> L.	18.05 - 14.08	Eua	M	D
<i>Sabra harpagula</i> Esp.	10.05 - 17.08	Eua	Mh	D
<i>Cilix glaucatus</i> Scop.	10.05 - 3.06; 10.07 - 15.08	Eua	Mt	A

Family	Taxon	F.P. *	G.D.	E.E.	L.F.
<b>THYATIRIDAE</b>					
	<i>Thyatira batis</i> L.	19.05 - 15.08	Eua	Mh	A
	<i>Habrosyne pyritoides</i> Hfn.	3.06 - 25.08	Eua	M	A
	<i>Tethea ocularis</i> L.	16 20.04.1994	Eua	Mh	D
	<i>Tethea or</i> or D.&S.	11.05 - 22.06	Eua	Mh	D
	<i>Tetheella fluctuosa</i> Hb.	25.06 - 15.07	Eua	Mh	D
	<i>Ochropacha duplaris</i> L.	366, 2♀ 11-13.07.1993	Eua	Mh	D
<b>GEOMETRIDAE</b>					
	<i>Alsophila aescularia</i> D.&S.	30.03 - 13.04	Eua	M	D
	<i>Aplasta ononaria</i> Fssly	666, 2♀ 25-29.05.1995	Wam	Xt	A
	<i>Pseudoterpnna pruinata</i> Hfn.	6.06 - 5.08	Eua	Xt	P
	<i>Geometra papilionaria</i> L.	3.07 - 5.08	Eua	M	P
	<i>Thetidia smaragdaria</i> Fabr.	12.06 - 25.07	Wam	Mxt	P
	<i>Hemithea aestivaria</i> Hb.	10.06 - 20.07	Eua	M	P
	<i>Chlorissa viridata</i> L.	20.05 - 3.07	Eua	Mt	P
	<i>Chlorissa pulmentaria</i> Gn.	366 14-15.07-1994	Eua	Xt	D; P
	<i>Thalera fimbrialis</i> Scop.	20.06-23.08	Eua	Mt	P
	<i>Hemistola chrysoprasaria</i> Esp.	16 14.07.1993; 16, 1♀ 20.08.1996	Eua	Mt	A
	<i>Jodis lactearia</i> L.	24.06 - 28.07	Eua	M	D
	<i>Cyclophora punctaria</i> L.	13.05 - 4.07; 22.07 - 11.09	Wam	Mt	D
	<i>Cyclophora annulata</i> Schl.	20.05 - 28.08	Eua	M	D
	<i>Cyclophora albipunctata</i> Hfn.	10.05 - 15.06	Eua	Mt	P
	<i>Cyclophora linearia</i> Hb.	10.05 - 18.06; 11-22.08	Eua	M	D
	<i>Timandra griseata</i> W.Pet.	20.05 - 15.06; 8.07 - 19.09	Eua	Mt	P
	<i>Scopula immorata</i> L.	15.06 - 25.08	Eua	Mt	P
	<i>Scopula nigropunctata</i> Hfn.	29.06 - 15.07	Eua	Xt	P
	<i>Scopula ornata</i> Scop.	20.05 - 10.06; 25.07 - 19.08	Eua	Mt	P
	<i>Scopula rubiginata</i> Hfn.	166, 2♀ 14-15.07.1995	Eua	Mxt	P

Family	Taxon	F.P. *	G.D.	E.E.	L.F.
Scopula	marginepunctata Gze.	3.06-10.07, 3.08-19.09	Wam	Mxt	P
Scopula	flaccidaria Zell.	299 4.08.1992	Eua	Xt	P
Idaea	ochrata Scop.	10.06-25.08	Eua	Mxt	P;G
Idaea	vulpinaria H.S.	266 3.08.1993	Eua	Mt	X
Idaea	biselata Haw.	10. 06-3.08	Vam	Mht	P;X
Idaea	trigeminata Haw.	2 ♂♂ 22. 06. 1995	Eua	Xt	P
Idaea	degeneraria Hb.	4 ♂♂, 1 ♀ 20.-21. 06.1994	Eua	Mt	P
Idaea	aversata L.	11.06-5.09	Eua	Mt	X
Idaea	straminata Brkh.	1 ♂ 14.07.1995; 3 ♂♂ 22.07.1996	Eua	Mh	P
Rhodostrophia	vibicaria Cl.	3. 06-22.08	Eua	Xt	P
Phyalapteryx	virgata Hfn.	1 ♀ 14.07.1996	Eua	M	P
Scotopteryx	moeniata Scop.	15.07-18.08	E. Was.	Mxt	P
Scotopteryx	bipunctaria D. & S	10.07-5.08	Eua	Xt	P
Scotopteryx	chenopodiata L.	19.07-13.09	Eua	M	P
Scotopteryx	luridata Hfn.	10.04-5.07 24.07-30.08	Hol	Mh	P
Xanthorhoe	biriviata Br.	3.05-30.06; 13.07-27.08	Eua	M	P
Xanthorhoe	ferrugata Cl.	3.05-9.09	Eua	M	P
Xanthorhoe	montanata D. & S.	13.05-28.07	Eua	M	P
Xanthorhoe	fluctuata L.	1.04-15.06; 30.06-15.09	Eua	M	P
Catarhoe	cuculata Hfn.	15.06-23.07	Eua	Mt	P
Epirhoe	tristata L.	28.05-30.06 14.07-22.08	Eua	Mt	P
Epirrhoe	alternata O.F. Müll.	21.07-10.09	Eua	Mht	P
Costaconvexa					
polygrammata Brkh.		15.05-11.09	Eua	M	P
Camptogramma	bilineatum L.	11.06-3.08	Eua	M	P
Anticlea	badiata D. & S.	24.04-19.05	Eua	M	A
Mesoleuca	albicillata L.	25.05-30.07	Eua	M	A
Pelurga	comitata L.	20.07-10.09	Eua	M	P
Cosmorhoe	ocellata L.	25.05-29.06 17.07-13.09	Eua	Mh	D
Ecliptopera	silacea D.&S.	20.04-30.09	Eua	Mh	P
Ecliptopera	capitata H.S.	19.07-1.09	Eua	Mh	P

Family Taxon	F.P. *	G.D.	E.E.	L.F.
<i>Chloroclysta siterata</i> Hfn.	1 ♂ 24.04.1992 4 ♂♂ ,1 ♀ 15- 17.09.1994	Eua	M	P
<i>Plemyria rubiginata</i> D.&S.	10.07-1.08	Eua	Mht	P
<i>Eustroma reticulatum</i> D.&S.	12.07-22.08	Eua	Mh	P
<i>Electrophaes corylata</i> Thnbg.	12.05-30.06	Eua	Mh	D
<i>Colostygia pectinataria</i> Kn.	3.06-17.07	Eua	M	P
<i>Horisme vitalbata</i> D.&S.	3.06-22.07	Eua	Mt	A
<i>Horisme tersata</i> D.&S.	26♂ 13.07.1994	Eua	Mt	A
<i>Melanthis procellata</i> D.&S.	25.05-3.07; 29.07-3.09	Eua	M	A
<i>Triphosa sabaudiata</i> Dup.	3♂♂ 29-30.07.1992	Eua	Xt	A
<i>Triphosa dubitata</i> L.	7.07-20.08; 13.06.1996	Eua	Xt	A
<i>Philereme transversata</i> Hfn.	16.07-3.08	Eua	M	A
<i>Euphyia frustata</i> Tr.	3 ♂♂ 20.07.1993	Eua	M	P
<i>Euphyia scripturata</i> Hb.	15.06.-20.07	E	Mx	P
<i>Operophtera brummata</i> L.	3.10-20.11	Eua	M	D
<i>Perizoma alchemillatum</i> L.	15.05-24.08	Eua	M	P
<i>Perizoma albulatum</i> D.&S.	20.05-11.08	Eua	M	P
<i>Perizoma parallelolineatum</i> Retz.	2 ♂♂ ,3♀♀ 3-5. 09.1994	Eua	Mh	P
<i>Eupithecia linariata</i> Fabr.	2 ♂♂ 3.07.1994	E.Was	M	P
<i>Eupithecia centaureata</i> D.&S.	15.05-3.07; 25.07-3.09	Eua	M	P
<i>Chloroclystis rectangulata</i> L.	3.06-25.07	Eua	M	P
<i>Aplocera plagiata</i> L.	10.05-29.06; 27.07-3.09	Eua	Mx	P
<i>Aplocera praeformata</i> Hb.	14.06-26.07	Eua	M	P
<i>Lithostege farinata</i> Hfn.	27.05-15.07	E. Was	Mx	P
<i>Asthena albulata</i> Hfn.	10.05-3.08	Eua	M	D
<i>Minoa murinata</i> Scop.	1♂ 2.07.1996	Eua	M	P
<i>Abraxas grossulariata</i> L.	20.07-22.08	Eua	M	A
<i>Calospylos sylvatus</i> Scop.	15.06-20.07	Eua	M	D
<i>Lomaspilis marginata</i> L.	10.05-15.06; 29.06-10.08	Eua	M	D
<i>Ligdia adustata</i> D.&S.	14.05-28.06	Eua	M	A
<i>Semiothisa alternaria</i> Hb.	29.04-27.07	Eua	M	D
<i>Semiothisa clathrata</i> L.	15.05-26.06; 29.07-19.08	Eua	M	P

Family Taxon	F.P. *	G.D.	E.E.	L.F.
<i>Semiothisa glarearia</i> D.&S.	1 ♂, 1♀ 17.07.1993 1 ♂ 20.07.1994	Eua	Mt	P
<i>Petrophora chlorosata</i> Scop.	3 ♂♂ 29.05.1994; 2.06.1995	Eua	M	F
<i>Plagodis dolabraria</i> L.	2 ♂♂, 1♀ 10-12 06.1992	Eua	M	D
<i>Opistograpta luteolata</i> L.	28.05-10.07; 20.07-3.08	Eua	M	D
<i>Epione repandaria</i> Hfn.	15.06-13.09	Eua	Mh	D
<i>Pseudopanthera macularia</i> L.	20.04-29.06	Eua	M	P
<i>Ennomos autumnarius</i> Wrbnbg.	28.08-17.09	Eua	M	D
<i>Ennomos fuscantarius</i> Stph.	10.08-13.10	Eua	M	D
<i>Ennomos alniarius</i> L.	26♂ 28-29.07.1995; 16 30.07.1996	Eua	M	D
<i>Selenia dentaria</i> Fabr.	30.04-10.05;	Eua	M	D
<i>Selenia tetralunaria</i> Hufn.	20.04-25.05 25.07-3.08	Eua	M	D
<i>Selenia lunularia</i> Hb.	20.05-7.08	Eua	M	D
<i>Odontopera bidentata</i> Cl.	14.05-25.07	Eua	M	D
<i>Artiora evonymaria</i> D.&S.	15.08-10.09	Eua	M	A
<i>Crocallis elinguaria</i> L.	15.07-21.08	Eua	M	D
<i>Ourapteryx sambucaria</i> L.	10.06-15.08	Eua	M	A
<i>Colotois pennaria</i> L.	20.09-3.11	Eua	M	D
<i>Angerona prunaria</i> L.	15.06-27.08	Eua	M	D;A
<i>Apocheima hispidarium</i> D.&S.	1 ♀ 18.03.1993	Eua	M	D
<i>Biston betularius</i> L.	21.05-3.09	Eua	M	D
<i>Biston stratarius</i> Hfn.	2 ♂♂ 20.04.1994	Eua	M	D
<i>Agriopsis leucophaea</i> D.&S.	31.03-3.04	Eua	M	D
<i>Erannis defoliaria</i> L.	20.10-13.11	Eua	M	D
<i>Peribatodes rhomboidarius</i> D.&S.	10.06-3.08	Eua	M	D
<i>Cleora cinctaria</i> D.&S.	24.04-27.05	Eua	M	D
<i>Alcis repandatus</i> L.	30.06-15.08	Eua	M	D
<i>Alcis maculatus bastelbergeri</i> Hrsch.	20.07-17.08	Eua	Mh	D
<i>Serraca punctinalis</i> Scop.	3 ♂♂ 10.07.1994	Eua	M	D
<i>Ascotis selenaria</i> D.&S.	20.05-15.08	Eua	M	D
<i>Ectropis crepuscularia</i> D.&S.	29.04-3.06; 22.06-15.08	Eua	M	D

Family Taxon	F.P. *	G.D.	E.E.	L.F.
<i>Ematurga atomaria</i> L.	20.04-3.07; 2.08-3.09	Eua	M	P
<i>Cabera pusaria</i> L.	20.05-15.08	Eua	M	D
<i>Lomographa temerata</i> D.&S.	27.07-15.06	Eua	M	D
<i>Gnophos pullatus</i> D & S.	2 ♂♂ 27.06.1995	Eua	Xt	P
<i>Siona lineata</i> Scop.	12.06-24.07	Eua	M	P
<i>Perconia strigillaria</i> Hb.	10.06-3.07	Eua	Mt	P
<b>SPHINGIDAE</b>				
<i>Agrius convolvuli</i> L.	7.08-4.09	Str.	Mt	P
<i>Mimas tiliae</i> L.	20.06-9.08	Eua	Mh	D
<i>Laothoe populi</i> L.	15.06-30.07	Eua	Mh	D
<i>Hemaris fuciformis</i> L.	4 ♂♂ 6-8.06.1995	Eua	M	P
<i>Macroglossum stellatarum</i> L.	25.05-3.09	Eua	Mt	P
<i>Hyles euphorbiae</i> L.	27.05-15.08	Eua	M	P
<i>Deilephila elpenor</i> L.	27.05-15.08	Eua	M	P
<i>Deilephila porcellus</i> L.	3.06-24.08	Eua	M	P
<b>NOTODONTIDAE</b>				
<i>Phalera bucephala</i> L.	12.06-22.08	Eua	M	D
<i>Cerura vinula</i> L.	1 ♀ 8.08.1993	Eua	Mh	D
<i>Furcula furcula</i> forficula F.v.W.	27.05-10.07	Eua	Mh	D
<i>Furcula bifida</i> Br.	2 ♀♂ 20.07.1992	Eua	Mh	D
<i>Stauropus fagi</i> L.	15.05-10.08	Eua	M	D
<i>Dicranura ulmi</i> D.&S.	6 ♂♂ , 1 ♀ 15-18.05.1995	Eua	Mh	D
<i>Spatialia argentina</i> D.&s.	12.06-21.08	Eua	M	D
<i>Notodonta dromedarius</i> L.	27.05-21.08	Eua	Mh	D
<i>Tritophia tritophus</i> D.&S.	20.07-17.08	Eua	M	D
<i>Drymonia dodonaea</i> D.&S.	27.05-18.07	Eua	Mh	D
<i>Drymonia ruficornis</i> Hfn.	25.05-16.06	Eua	M	D
<i>Drymonia melagona</i> Brkh.	1 ♂♂ 3.07.1996	Eua	M	Dq
<i>Pheosia gnoma</i> Fabr.	17.07-10.08	Eua	M	D
<i>Pterostoma palpinum</i> Cl.	10.05-1.06 3-5.08	Eua	M	D
<i>Ptilodon capucina</i> L.	25.05-27.05	Eua	M	D
<i>Ptilodontella cucullina</i> D.&S.	3 ♂♂ 19-20.06.1993 1 ♂ 12.07.1996	Eua	M	D

Family	Taxon	F.P. *	G.D.	E.E.	L.F.
Eligmodonta	zic zac L.	27.04-13.06; 10-18.08	Eua	Mh	D
Clostera	pigra Hfn.	29.07-28.08		Mh	D
Clostera	curtula L.	24.04-12.05	Eua Eua	Mh	D
<b>LYMANTRIIDAE</b>					
Elkneria	pudibunda L.	5.05-9.06		M	D
Euproctis	chrysorrhoea L.	16.05-5.06	Eua	M	D
Leucoma	salicis L.	15.06-20.08	Eua	Mh	D
Arctornis	l-nigrum O.F. Müll.	16.06-3.08	Eua	M	D
Lymantria	dispar L.	19.07-9.08	Eua Eua	M	D
<b>ARCTIIDAE</b>					
Setina	irrorella L.	13.07-3.08		Mt	L
Miltochrysta	miniata Frst.	5.07-9.08	Eua	M	L
Atolmis	rubricollis L.	21.05-25.07	Eua	M	L
Cybosia	mesomella L.	666 299 20-22 07.1994	Eua Eua	Ht	L
Eilema	sororcolum Hfn.	15.05-24.06	Eua	Mh	L
Eilema	complanum L.	3-19.07	E.Was	Mt	L
Eilema	lurideolum Znkn.	5-26.07	Eua	Mt	L
Eilema	deplanum Esp.	3.07-18.08	Eua	M	L
Lithosia	quadra L.	11.07-24.08	Eua	M	A;P
Arctica	caja L.	13.07-25.08	Eua	M	P
Arctia	villica L.	11.06-28.07	E.Was.	Mt	P
Diacrisia	sannio L.	10.06-15.07	Eua	M	P
Rhyparia	purpurata L.	266 21.07.1994 366 29.06.1995	Eua Eua	Mt	P
Spilosoma	lubricipeda L.			M	P
Spilosoma	luteum Hfn.	25.05-11.07	Eua	M	P
Diaphora	mendica Cl.	27.05-11.07	Eua	Mh	P
Phragmatobia	fuliginosa L.	2 66 25.05.1992	Eua	M	P
Phragmatobia	caesarea Gze.	11.07-14.08	Eua	Mt	P
Callimorpha	quadripunctaria Poda	15.05-11.06	Eua	Mt	P
Callimorpha	dominula L.	22.07-16.08 15.07-3.08	Eua E.Was.	Mt	P
<b>CTENUCHIDAE</b>					
Syntomis	phegea danieli O.	11.06-15.07	Eua	Mt	P

Family	Taxon	F.P. *	G.D.	E.E.	L.F.
Dysauxes	ancilla L.	3 ♂♂ 28.07.1995	Eua	Xt	L;M
<b>NOCTUIDAE</b>					
Idia	calvaria D.&S.	15.06-3.09	Wam	Mh	X
Herminia	tarsicrinialis Kn.	3.06-10.07; 20.08-15.09	Eua	M	X
Quaramia	grisealis D.&S.	3 ♂♂ 15.06.1995	Eua	M	D
Polypogon	tentacularia L.	5.06-28.07; 10-15.09	Eua	Mh	P
Zanlognatha	lunalis Scop.	15.06-10.07	Eua	Xt	X
Rivula	sericealis Scop.	25.05-27.07; 15.08-3.09	Eua	Mh	P;G
Hypena	proboscidalis L.	15.05-27.07; 10.08-15.09	Eua	Mh	P
Hypena	rostralis L.	27.04-18.06	Eua	M	P
Phytometra	viridaria Cl.	2 ♂♂ 9.07-1995	Eua	Mt	P
Scoliopteryx	libatrix L.	28.07-30.09	Hol	M	D
Catocala	fraxini L.	22.07-15.09	Eua	Mh	D
Catocala	nupta L.	15.07-20.09	Eua	M	D
Catocala	fulminea Scop.	22.06-27.08	Eua	Mt	D;A
Lygephila	viciae Hb.	15.06-27.08; 11.08-20.09	Eua	Mt	P
Lygephila	craccae D.&S.	3.06-15.07; 10.08-25.09	Eua	Xt	P
Aedia	funesta Esp.	28.05-15.07	Vam	Mt	P
Tyta	luctuosa D.&S.	10.08-15.09	Eua	Xt	P
Calistege	mi Cl.	3.05-15.07 10.08-18.09	Eua	Xt	P
Euclidia	glyphica L.	27.04-20.06 15.07-15.09	Eua	Mxt	P
Laspeyria	flexula D.&S.	15.06-3.08	Eua	M	L
Eutelia	adulatrix Hb.	3♂♂ ,1♀ 15-17; 07.1995	Vam	Xt	A
Nola	cucullatella L.	11.06-20.07	Eua	Mx	A
Nycteola	revayana Scop.	3♂♂ 30.04.1994	Vam	Mh	Dq
Bena	prasinana L.	14.07-15.08	Vam	Mt	D
Pseudoips	fagana Fabr.	28.06-3.09	Eua	M	D
Colocasia	coryli L.	19.05-15.06; 11.07-21.08	Eua	M	D

Family Taxon	F.P. *	G.D.	E.E.	L.F.
<i>Diloba caeruleocephala</i> L.	3.09-25.10	Eua	M	D
<i>Moma alpium</i> Osb.	2 ♂♂ 20.06.1995	Eua	Mt	Dq
<i>Acronicta tridens</i> D.&S.	27.04-11.06; 20.07-3.09	Eua	Mt	D
<i>Acronicta aceris</i> L.	13.05-30.07	Wam	Mh	D
<i>Acronicta leporina</i> L.	15.05-10.09	Eua	Mh	D
<i>Acronicta alni</i> L.	27.05-15.08	Eua	M	D
<i>Acronicta megacephala</i> D.&S.	20.05-5.07	Eua	Mh	D
<i>Acronica strigosa</i> D.&S.	2.00 3.08.1994	Eua	M	A;D
<i>Acronicta rumicis</i> L.	25.04-13.06; 2 ♂♂ 07-15.09	Eua	M	D
<i>Craniophora ligustri</i> D.&S.	27.04-12.06 3.07-15.09	Eua	M	A
<i>Cryphia fraudatricula</i> Hb.	11.06-15.08	Wam	Xt	L
<i>Emmelia trabealis</i> Scop.	15.06-24.08	Eua	Mt	P
<i>Acontia lucida</i> Hfn.	15.07-13.08	Eua	T	P
<i>Pseudeustrotia candidula</i> D.&S.	30.05-3.07	Eua	Mh	P
<i>Euchalcia modestoides</i> Poole	3.06-28.08	Eua	Mh	P
<i>Diachrysia chrysitis</i> L.	20.05-22.09	Eua	M	P
<i>Diachrysia chryson</i> Esp.	15.06-11.08	Eua	Mh	P
<i>Macdunnoughia confusa</i> Stph.	29.05-3.09	Eua	M	P
<i>Plusia festucae</i> L.	2 ♂♂ 27.07.1994	Eua	Hg	P
<i>Autographa gamma</i> L.	25.05-5.10	Eua	M	P
<i>Autographa pulchrina</i> Haw.	10.06-15.08	Eua	M	P
<i>Autographa bractea</i> D.&S.	2 ♂♂ 3.07.1992	Eua	Mh	P
<i>Abrostola triplasia</i> L.	17.05-20.07; 5.08-3.09	Eua	M	P
<i>Abrostola asclepiadis</i> D.&S.	10.06-19.08	Wam	Mt	P
<i>Cucullia umbratica</i> L.	15.05-3.09	Eua	M	P
<i>Shargacucullia thapsiphaga</i> Tr.	4 ♂♂ 1 ♀ 16-20.07.1995	Wam	Xt	P
<i>Calophasia lunula</i> Hfn.	27.07-15.08	Hol	Xt	P
<i>Asteroscopus sphinx</i> Hfn.	20.05-27.07	Eua	M	D
<i>Brachionycha nubeculosa</i> Esp.	3 ♂♂ 27.04.1994	Eurosib.	M	D
<i>Pyramidcampia pyramidea</i> L.	11.06-15.09	Eua	M	D
<i>Pyramidcampia berbera</i> swenssoni Fltch.	27.07-3.10	Wam	M	D
<i>Pyramidcampia perflua</i> Fabr.	3 ♂♂ 14.07.1992 1 ♂ ,1 ♀ 20.07.1994	Eua	Mh	D
<i>Adamphipyra livida</i> D.&S	2 ♂♂ 15.08.1994	Eua	Mth	P

Family	Taxon	F.P. *	G.D.	E.E.	L.F.
<i>Heliothis viriplaca</i> Hfn.		11.06-5.08	Eua	T	P
<i>Pyrrhia umbra</i> Hfn.		30.05-13.09	Hol	Mt	P
<i>Panemeria tenebrata</i> Scop.		15.05-21.06	Pm	Mh	P
<i>Caradrina morpheus</i> Hfn.		30.05-5.08	Eua	Mh	P
<i>Paradrina clavipalpis</i> Scop.		30.05-15.09	Eua	Mt	P
<i>Hoplodrina respersa</i> D.&S.		11.06-3.09	Wam	Mt	P
<i>Hoplodrina ambigua</i> D.&S.		3.06-13.07	Wam	Mt	P
<i>Dypterygia scabriuscula</i> L.		10.06-25.08	E.Was	Mh	P
<i>Rusina ferruginea</i> Esp.		16.07-15.09	Eua	M	P
<i>Mormo maura</i> L.		16, 1 $\varphi$ 30.06.1993 16 3.08.1994	Wam	Mh	P
<i>Polyphaenis sericata</i> Esp.		466, 3 $\varphi$ 15-20.07.1993	Wam	Xt	P
<i>Thalpophila matura</i> Hfn.		15.08-20.09	Wam	M	R
<i>Trachea atriplicis</i> L.		16.06-10.09	Eua	M	P
<i>Euplexia lucipara</i> L.		31.05-15.08	Eua	Mh	P
<i>Phlogophora meticulosa</i> L.		28.08-15.10	Wam	M	P
<i>Phlogophora scita</i> Hb.		27.06-3.09	Wam	Mh	P
<i>Auchmis detersa</i> Esp.		266 27.06.1994	Wam	Xt	A
<i>Callopistria juventina</i> Stool		266, 1 $\varphi$ 20.07.1993; 366, 1 $\varphi$ 3.08.1995	Eua	Mxt	F
<i>Eucarta amethystina</i> Hb.		13.07-10.08	Eua	T-Hg	P
<i>Enargia paleacea</i> Esp.		366 13.09.1994	Eua	Mh	D
<i>Mesogona oxalina</i> Hb.		15.08-10.10	Eua	Mh	D
<i>Cosmia pyralina</i> D.&S.		10.06-29.07	Eua	Mh	D
<i>Cosmia trapezina</i> L.		15.06-10.09	Wam	M	D
<i>Atethmia centrago</i> Haw.		266 15.09.1944.	Wam	T	D
<i>Xanthia togata</i> Esp.		4.09-20.10	Hol	M	D
<i>Xanthia aurago</i> D.&S.		30.08-20.10	Eua	M	D
<i>Xanthia icterita</i> Hfn.		266 3.09.1993	Eua	Mh	D
<i>Xanthia gilvago</i> D.&S.		25.09-25.10	Wam	Mh	D
<i>Xanthia ocellaris</i> Brkh.		27.08-15.10	Wam	Mh	D
<i>Agrochola lychnidis</i> D.&S.		1 $\varphi$ 25.09.1994	Wam	M	D
<i>Agrochola circellaris</i> Hfn.		5.05-11.11	Eua	M	D
<i>Agrochola nitida</i> D.&S.		3.09-13.10	A.P.	M	A;P
<i>Agrocholo litura</i> L.		28.08-15.10	Wam	Mh	A;P
<i>Eupsilia transversa</i> Hfn.		14.09-27.04	Wam	M	D
<i>Conistra vaccinii</i> L.		10.10-15.05	Eua	M	D
<i>Conistra rubiginosa</i> Scop.		15.09-27.04	Wam	M	A;D
<i>Conistra rubiginea</i> D.&S.		3.04-27.05	Wam	M	A;D

Family Taxon	F.P. *	G.D.	E.E.	L.F.
<i>Conistra erytrocephala</i> D.&S.	30.10-10.05	Wam	Mt	D
<i>Episema glaucina</i> Esp.	266, 1 ♀ 27-28.09.1994	Wam	Xt	P
<i>Lithophane ornitopus</i> Hfn.	18.09-17.05	Eua	M	D
<i>Xylena exoleta</i> L.	1♀ 5.05.1994	Eua	M	D
<i>Allophyes oxyacanthae</i> L.	28.09-25.10	Wam	Mxt	A;D
<i>Dichonia convergens</i> D.&S.	1♂ 13.10.1994	Wam	Xt	Dq
<i>Ammoconia caecimacula</i> D.&S.	366 3.10.1993	Eua	Mt	P
<i>Polymixis rufocincta</i> Geyer	16 3.10.1994; 16, 1 ♀ 27.09.1995	Wam	Xt	P
<i>Blepharita satula</i> D.&S.	11.07-3.10	Eua	Mh	P;A
<i>Apamea monoglypha</i> Hfn.	22.06-13.09	Eua	M	R
<i>Apamea characterea</i> D.&S.	1 ♂ 22.06.1994	Eua	M	R
<i>Apamea anceps</i> D.&S.	25.05-18.07	Eua	M	G
<i>Apamea sordens</i> Hfn.	18.05-22.07	Eua	M	G
<i>Apamea scolopacina</i> Esp.	22.06-3.09	Eua	M	G
<i>Oligia strigilis</i> L.	17.05-29.07	Eua	M	G
<i>Mesapamea secalis</i> L.	22.06-5.09	Eua	M	G
<i>Calamia tridens</i> Hfn	22.06-15.09	Eua	T-Mh	P;G
<i>Charanycha trigrammica</i> Hfn.	3.06-28.08	Wam	M	P;G
<i>Lacanobia w-latinum</i> Hfn.	15.05-3.07	Eua	M	P
<i>Lacanobia oleracea</i> L.	21.05-28.07; 10.08-3.09	Eua	M	P
<i>Lacanobia contigua</i> D.&S.	18.05-27.06; 11.07-28.08	Eua	M	P
<i>Hecatera bicolorata</i> Hfn.	2 ♂♂ 23.07.1993; 4 ♂♂, 1 ♀ 3-5.08.1994	Eua	Mt	P
<i>Hadena compta</i> D.&S.	27.06-15.08	Eua	Mxt	P
<i>Hadena albimacula</i> Brkh.	3 ♂♂, 1 ♀ 15.-16.08.1993	Eua	Mxt	P
<i>Hadena luteago</i> D.&S.	4 ♂♂, 27.06.1994 5-7.07.1995	Wam	Mxt	P
<i>Hadena perplexa</i> D.&S.	2 ♂♂ 27.06.1994	Eua	Xt	P
<i>Aneda rivularis</i> Fabr.	15.05-18.08	Eua	M	P
<i>Sideridis lampra</i> Schaw.	2 ♂♂ 29.06.1994; 3 ♂♂ 5-6.07.1995	Wam	Xt	P
<i>Heliophobus reticulata</i> Gze.	25.05-22.07	Eua	Mxt	P
<i>Melanchra persicariae</i> L.	20.05-15.08	Eua	Mh	P
<i>Mamestra brassicae</i> L.	22.05-20.08	Eua	M	P
<i>Polia nebulosa</i> Hfn.	27.05-25.08	Eua	M	D;P

Family	Taxon	F.P. *	G.D.	E.E.	L.F.
<i>Mythimna turca</i> L.		3.06-15.07; 10.08-2.10	Eua	Mh	G
<i>Mythimna conigera</i> D.&S.		10.06-16.08	Eua	M	G
<i>Mythimna albipuncta</i> D.&S.		18.05-25.07 11.08-15.09	Wam	M	G
<i>Mythimna vitellina</i> Hb.		11.-06-29.07; 10.08-3.10.	Wam	Xt	G
<i>Mythimna 1-album</i> L.		21.05-27.07; 11.08-27.09	Eua	M	G
<i>Orthosia incerta</i> Hfn.		30.03-10.05	Eua	M	D
<i>Orthosia gothica</i> L.		22.04-27.05	Eua	M	D
<i>Orthosia cruda</i> D.&S.		4.04-27.04	Wam	M	Dq
<i>Orthosia miniosa</i> D.&S.		15.04-9.05	Eua	M	Dq
<i>Orthosia cerasi</i> Fabr.		14.04-28.04	Eua	M	D
<i>Orthosia gracilis</i> D.&S.		13.04-5.05	Eua	M	P;A
<i>Orthosia munda</i> D.&S.		15-28.04	Eua	M	D
<i>Egira conspicillaris</i> L.		30.04-25.05	Wam	M	P
<i>Neuronia decimalis</i> Poda		28.08-15.09	Eua	M	R
<i>Pachetra sagittigera</i> Hfn.		3.06-27.07	Eua	M	P
<i>Axylia putris</i> L.		15.06-24.08	Eua	M	G;P
<i>Ochropleura musiva</i> Hb.		2 ♂, 1 ♀ 24-25.07.1994	Eua	Xt	P
<i>Ochropleura plecta</i> L.		28.04-22.06; 3.07-25.09	Hol	M	P
<i>Diarsia mendica</i> Fabr.		15.06-18.07	Hol	Mh	P
<i>Diarsia brunnea</i> D.&S.		11.06-5.08	Hol	Mh	P
<i>Noctua pronuba</i> L.		2.06-27.09	Eua	M	P
<i>Noctua interposita</i> Hb.		1 ♂ 27.07.1995	Med.-As.	M	P
<i>Noctura fimbriata</i> Schrb.		16.06-14.09	Wam	M	P
<i>Noctua janthina</i> D.&S.		7.07-28.08	Med.As.	Mt	P
<i>Epilecta linogrisea</i> D.&S.		1 ♂ 18.07.1994	Med.Was	Xt	P
<i>Lycophotia porphyrea</i> D.&S.		1 ♂, 1 ♀ 14.07.1993	Am	Mt	E
<i>Chersotis multangula</i> Hb.		2 ♀ 13.07.1993	Wam	Xt	P
<i>Opigena polygona</i> D.&S.		1 ♂ 14.07.1993	Eua	M	P
<i>Eugrapha sigma</i> D.&S.		22.06-15.08	Eua	M	P
<i>Eugnorisma depuncta</i> L.		4 ♂ 3-5.09.1993	Eua	M	P
<i>Xestia c-nigrum</i> L.		4.05-25.06; 3.08-15.10	Kosm	M	P

Family Taxon	F.P. *	G.D.	E.E.	L.F.
Xestia ditrapezium D.&S.	11.06-22.08	Eua	M	P
Xestia triangulum Hfn.	2.06-18.08	Eua	M	P
Xestia ashworthi candelarium Stdgr.	2 ♂ 16.07.1994	Eua	Xm	P
Cerastis rubricosa D&S.	23.04-3.06	Eua	M	P
Naenia typica L.	1 ♂ 14.08.1995	Eua	M	A
Anaplectoides prasina D.&S.	13.07-3.08	Hol	M	R
Euxoa obelisca D.&S.	15.06-13.09	Eua	Mxt	P
Euxoa tritici L.	28.07-10.08	Eua	M	R
Euxoa nigricans L.	25.07-17.09	Eua	M	R
Euxoa distinguenda Led.	1 ♂ 3.09.1995	Eua	Xt	R
Euxoa aquilina D.&S.	28.06-18.09	Eua	Mxt	R
Agrotis cinerea D.&S.	2 ♂ 9.07.1995	Eua	M	R
Agrotis segetum D.&S.	11.06-5.07; 13.09-10.10	Eua	M	R
Agrotis exclamationis L.	11.05-30.07; 7.08-14.09	Pal	M	R
Agrotis ipsilon Hfn.	12.06-25.07; 19.08-23.10	Kosm	M	R
Agrotis crassa Hb.	1 ♂, 1 ♀ 22.07.1995	Med.As	Xt	R

**HESPERIIDAE**

Carterocephalus palaemon Pall.	25.05-26.06	Eua	Mh	P
Thymelicus sylvestris Poda	3.07-11.08	Eua	M	G
Hesperia comma L.	15.06-3.08	Eua	M	G
Ochlodes venatus faunis Tr.	27.05-3.08	Eua	M	G
Erynnis tages L.	5.05-11.06	Eua	M	G;P
Carcharodus alceae Esp.	2 ♂ 27.06.1995	E.Was	Xt	A
Pyrgus malvae L.	3.05-11.07	Eua	M	P

**RIODINIDAE**

Hamearis lucina L.	11.05-12.06	E	M	P
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**LYCAENIDAE**

Satyrium Walbum	15.06-14.07	Eua	M	D
Fixsenia pruni L.	1 ♂ 25.07.1995	Eua	M	A
Callophrys rubi virgatus Vrty.	15.05-11.06	Eua	M	P

Family	Taxon	F.P. *	G.D.	E.E.	L.F.
<i>Lycaena phlaeas</i> L.		20.05-3.07	Hol	M	P
<i>Heodes virgaureae</i> L.		15.06-3.08	Eua	Mh	P
<i>Cupido minimus</i> Fssly.		15.05-28.06	Eua	M	P
<i>Everes argiades</i> Pall.		11.05-28.06	Eua	Mxt	P
<i>Celastrina argiolus</i> L.		11.05-9.06; 22.07-11.08	Eua	M	P
<i>Scoliantides orion</i> Pall.		20.05-19.06; 18.07-3.08	Eua	Xt	P
<i>Glaucopsyche alexis</i> Poda		11.05-21.06	Eua	Mxt	P
<i>Maculinea alcon</i> D.&S.		22.06-11.07	E.Was	Xt	P
<i>Maculinea arion</i> L.		25.06-22.07	Eua	Xt	P
<i>Plebejus argus</i> L.		11.06-28.07	Eua	Mt	P
<i>Plebejus argyronomon</i> Brgstr.		22.06-18.07	Eua	M	P
<i>Aricia agestis</i> D.&S.		25.05-27.06	Eua	Mt	P
<i>Cyaniris semiargus</i> Rott.		11.06-27.07	Eua	M	P
<i>Polyommatus daphnis</i> D.&S.		22.07-3.08	E.Was	Xt	P
<i>Polyommatus coridon</i> Poda.		22.06-13.08	E.Was	Xt	P
<i>Polyommatus bellargus</i> Rott.		15.05-11.06; 22.08-11.09	E.Was	Mt	P
<i>Polyommatus icarus</i> Rott.		11.05-11.09	Eua	M	P
<b>SATYRIDAE</b>					
<i>Hipparchia fagi</i> Scop.		11.07-28.08	E.Was	M	G
<i>Hipparchia semele</i> L.		11-29.07	E.Was	Mt	G
<i>Satyrus circe pannonica</i> Frhst.		15-28.07	E.Was	M	G
<i>Satyrus dryas drymeia</i> Frhst.		22.07-15.08	Eua	M	G
<i>Maniola jurtina</i> L.		15.05-28.08	Eua	M	G
<i>Aphantopus hyperanthus</i> L.		11.06-3.08	Eua	M	G
<i>Coenonympha pamphilus</i> L.		17.05-3.09	Eua	M	G
<i>Coenonympha arcania</i>		25.05-22.08	Eua	M	G
<i>Coenonympha glycerion</i> Brkh.		11.06.-18.07	Eua	M	G
<i>Pararge aegeria tircis</i> Btl.		11.05-27.06; 2-28.08	Eua	M	G
<i>Pararge megera megera</i> L.		22.05-27.06; 3-28.08	Eua	M	G
<i>Pararge maera maera</i> L.		15.05-29.08			
<i>Melanargia galathea scolis</i> Frhst.		20.06-11.08	E.Was	M	G
<i>Erebia ligea carthusianorum</i> Frhst		27.06-11.08	Eua	M	G
<i>Erebia aethiops aethiops</i> Fsp.		11.07-29.08	Eua	M	G

Family Taxon	F.P. *	G.D.	E.E.	L.F.
<b>NYMPHALIDAE</b>				
<i>Clossiana selene</i> D.&S.	15.05-22.06 11.07-3.09	Hol	M	P
<i>Clossiana euphrosyne</i> L.	18.05-11.06	Eua	M	P
<i>Clossiana dia</i> L.	12.05-19.09	Eurosib.	M	P
<i>Argynnис daphne</i> D.&S.	11-26.07	Eua	M	P
<i>Argynnис hecate</i> D&S.	266, 3 ♀♀ 22-24.06-1995	E.Was	M	P
<i>Argynnис lathonia</i> L.	18.05-13.09	Eua	M	P
<i>Argynnис aglaja</i> L.	11.06-25.07	Eua	M	P
<i>Argynnис adippe</i> D.&S.	11.06-25.07	Eua	M	P
<i>Argynnис niobe</i> L.	12.06-29.07	Eua	M	P
<i>Argynnис paphia</i> L.	11.06-25.08	Eua	M	P
<i>Nymphalis polychloros</i> L.	3.07-11.08	Eua	M	P
<i>Nymphalis antiopa</i> L.	15.07-18.08	Hol	M	P
<i>Polygonia c-album</i> L.	25.05-27.06; 18-28.08	Eua	M	P
<i>Vanessa atalanta</i> L.	11.07-9.09	Hol	M	P
<i>Vanessa cardui</i> L.	15.06-3.09	Hol	M	P
<i>Inachis io</i> L.	11.07-13.09	Pal	M	P
<i>Aglais urticae</i> L.	11.07-28.08	Kosm	M	P
<i>Araschnia levana</i> L.	14.05-27.05; 11.07-23.08	Eua	Mh	P
<i>Neptis rivularis</i> Scop.	19.06-25.06	Eua	M	P
<i>Neptis sappho aceris</i> Lep.	27.05-3.06	Eua	M	P
<i>Apatura iris</i> L.	22.06-11.08	Eua	M	D
<i>Apatura ilia</i> D.&S.	22.06-3.08	Eua	M	D
<i>Melitaea didyma</i> Esp.	19.05-13.08	Eua	M	P
<i>Melitaea cinxia</i> L.	19.05-28.07	Eua	Mt	P
<i>Melitaea phoebe</i> D.&S.	15.05-18.08	Eua	M	P
<i>Melitaea trivia</i> D.&S.	366 22.07.1994 466, 2 ♀♀ 17-18. 07.1996	Eua	M	P
<i>Melitaea athalia</i> Rott.	11.05-19.09	Eua	M	P
<i>Melitaea aurelia</i> Nick.	266, 1 ♀ 2.07.1994; 1♀ 11.07.1995	Eua	M	P

Family Taxon	F.P. *	G.D.	E.E.	L.F.
<b>PAPILIONIDAE</b>				
<i>Papilio machaon</i> L.	25.05-28.07	Eua	M	P
<i>Iphiclides podalirius</i> Scop.	15.06-25.08	Eua	M	P
<i>Parnassius mnemosyne</i> distincta Br.-Eisn.	11-24.06	E	Mh	P
<b>PIERIDAE</b>				
<i>Leptidea sinapis</i> L.	18.05-3.09	Pal	M	P
<i>Pieris brassicae</i> L.	11.05-23.08	Pal	M	P
<i>Pieris rapae</i> L.	11.05-23.09	Hol	M	P
<i>Pieris napi meridionalis</i> Heyne	15.05-23.09	Hol	M	P
<i>Anthocharis cardamines</i> meridionalis Vrty.	15.05-1.06	Eua	M	P
<i>Colias hyale</i> L.	12.05-13.09	Eua	M	P
<i>Colias myrmidone</i> Esp.	12.06-3.09	E.Was	M	P
<i>Gonepteryx rhamni</i> meridionalis Vrty.	12.06-3.09	Pal	M	A

\* LEGEND

FP: FLYING PERIOD (The first and the last data of the capture)

GD: GEOGRAPHICAL DISTRIBUTION

Eua = Euroasiatic; Hol = Holarctic; Wam = Westasiatic-mediterranean

Am = Atlanto-mediterranean; Med. - As = Mediterranean-Asiatic;

E. Was = European-Westasiatic; Eurosib = Eurosiberian; Pal = Palearctic;

E = European; Kosm = Kosmopolite

EE = ECOLOGICAL EXIGENCES

M = Mesophylous species; Mh = Mesohygrophylos; Mt = Mesotermophylous; Mth = Mesothermohygrophylos; Mht = Mesohydrothermophylous; Mx = Mesoxerophylous; Xt = Xerothermophylous

LF = LARVAL FOOD

D = Defoliators species; Dq = Defoliators species with preference for Quercus sp.; Q = Quercus species consumers; P = Herbaceous plants consumers; A = Arboret consumers; L = Lichens consumers R = Roots consumers; X = Saprophague; F = Ferns consumers (after RÁKOSY 1992, 1995, 1996)

## RESULTS

The researches undergone in the Karstic Ponorici-Ciclovina Region ended with counting of 448 species of Macrolepidoptera. The biggest number of species belongs to: NOCTUIDAE (175 species; 39,06%), GEOMETRIDAE (117 species; 26,12%) and RHOPALOCERA & GRYPOCERA (83 species; 18,53%). (Tab. 2).

TAB. 2 THE STRUCTURE OF MACROLEPIDOPTERA FAMILIES

Families	No. species	%
NOCTUIDAE	175	39,06
GEOMETRIDAE	117	26,12
NOTODONTIDAE	19	4,24
ARCTIIDAE	20	4,46
RHOPALOCERA & GRYPOCERA	83	18,53
Other families	34	7,59
	448	100,00%

Zoogeographical analysis reflects the dominance of euroasiatic elements (76,56%), followed by westasiatic-mediterranean (9,82%), european-westasiatic (4,46%) and holarctic elements (3,79%). Fig. 1)

On the basis of ecological peculiarities the Macrolepidoptera species were included in 14 ecological categories (RÁKOSY, 1992, 1995, 1996). The global structure of the ecological exigences reflects the dominance of the mesophylous species (56,25%), followed by meso-hygrophyloous species (14,29%), mesothermophylous (11,83%) and mesoxerothermophylous species (3,79%). The xerothermophylous and thermophylous species represent 8,48% and 1,12% from all the analised material. (Fig. 2)

The global analysis of larval food reflects the preponderence of the herbaceous plants consumers (49,11%), followed by defoliators (26,56%), arboret consumers (7,81%) and graminaceous plants consumers (6,70%). (Fig.3).

Some species considered rarities or sporadicalness in Romanian fauna were founded in Ponorici-Ciclovina Karstic Region: *Rhyparia purpurata* L., *Pyramidcampa perflua* Fabr., *Polyphaenis sericata* Esp., *Auchmis detersa* Esp., *Callopistria juventina* St., *Enargia paleacea* Esp., *Episema glaucina* Esp., *Polymixis rufocincta* Geyer, *Sideridis lampra* Schaw., *Ochropleura musiva* Hb., *Noctua interposita* Hb., *Chersotis multangula* Hb., *Opigena polygona* D. & S., *Xestia ashworthi candelarum* Stdgr., *Naenia typica* L., *Euxoa distinguenda* Led., *Colias myrmidone* Esp.

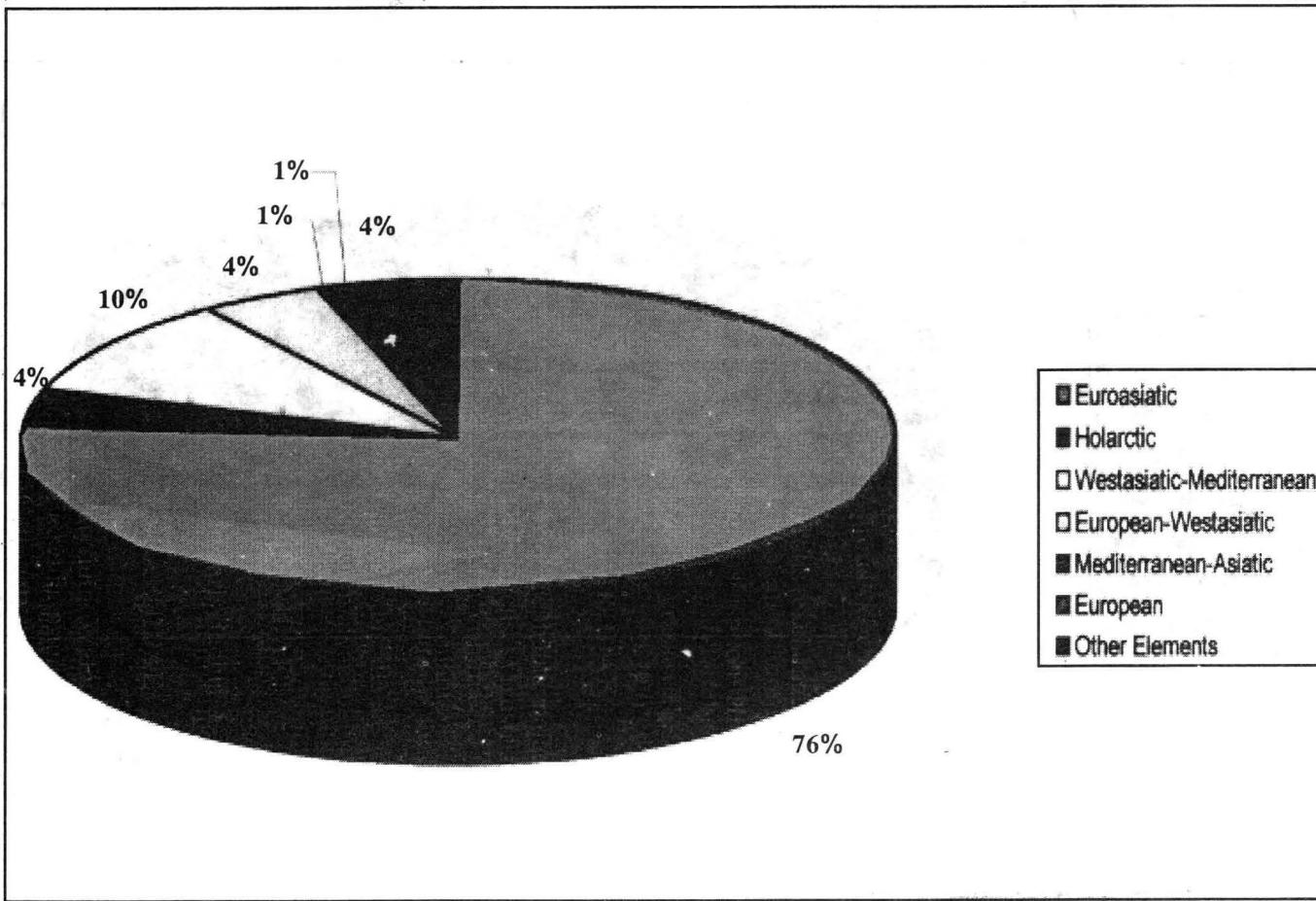


Fig. 1 – Macrolepidoptera Species of Ponorici-Ciclovina Karstic Region; Geographical Distribution  
[www.mncal.ro](http://www.mncal.ro) / [www.cimec.ro](http://www.cimec.ro)

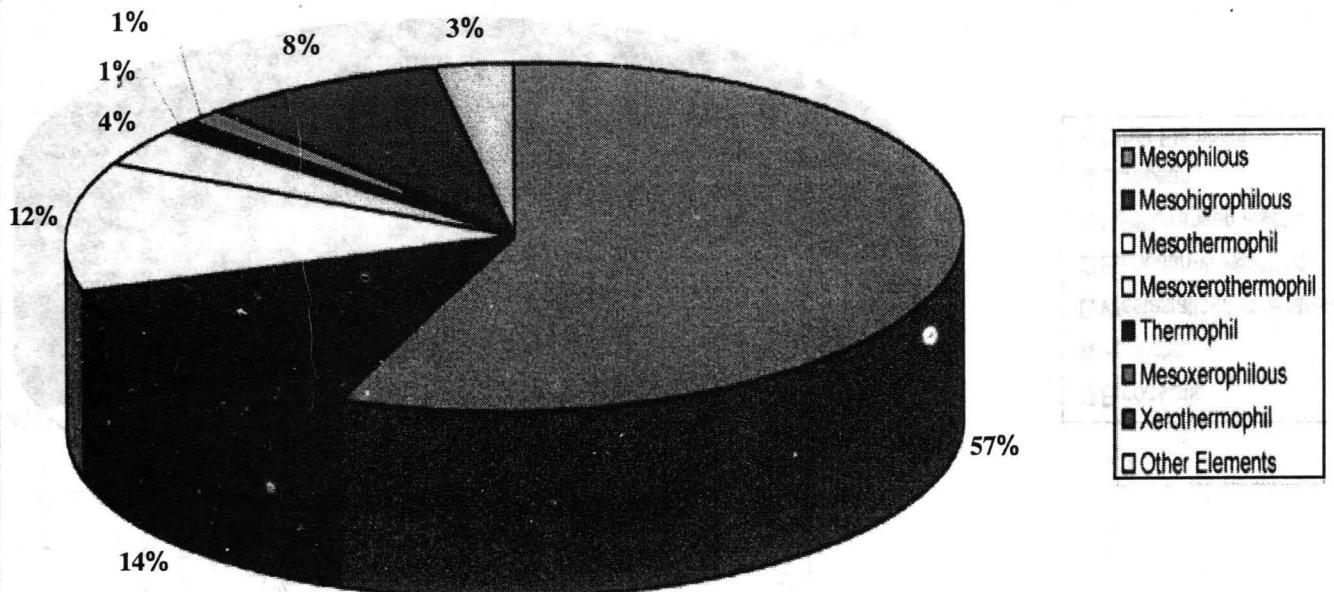


Fig. 2 – Macrolepidoptera Species of Ponorici-Ciclovina Karstic Region; Ecological Exigences  
www.mcdr.ro / www.cimec.ro

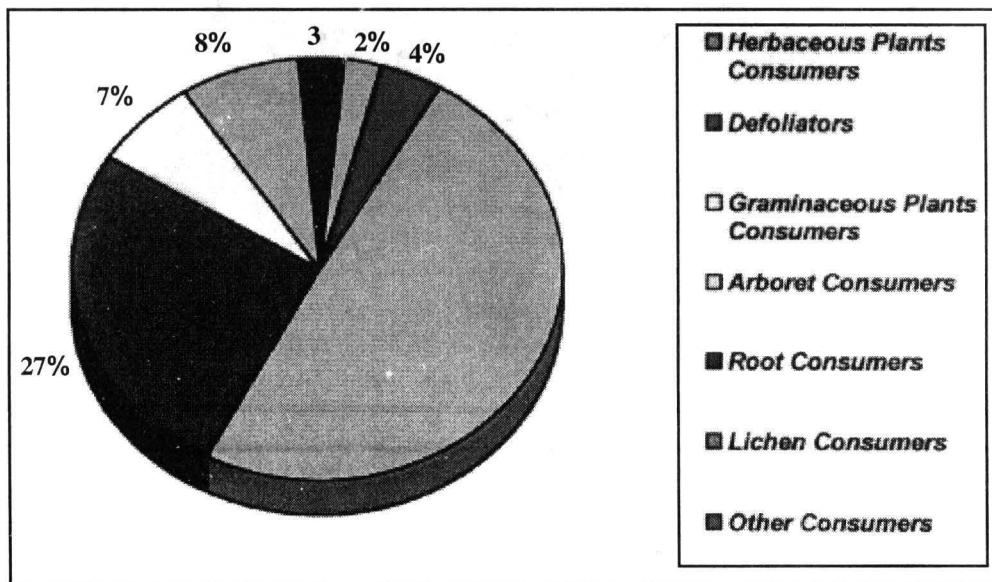


Fig. 3 – Macrolepidoptera Species of Ponorici-Ciclovina Karstic Region; Larval food

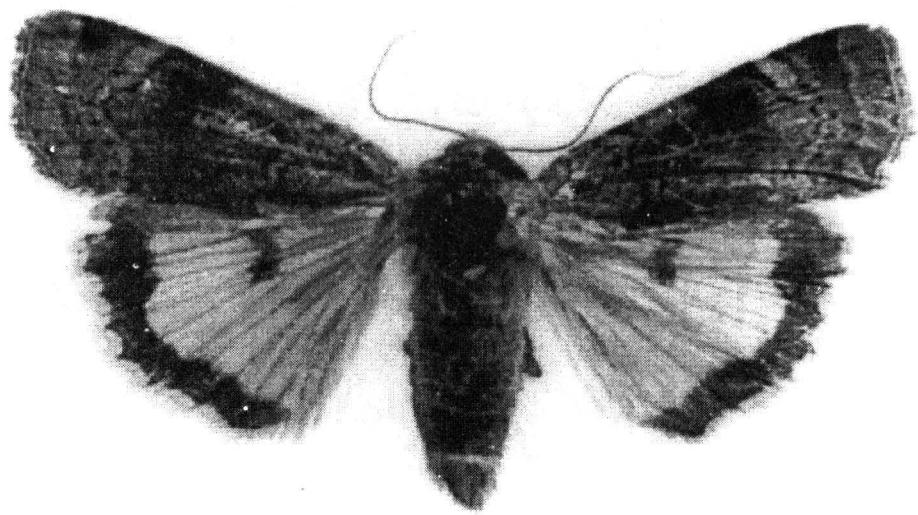
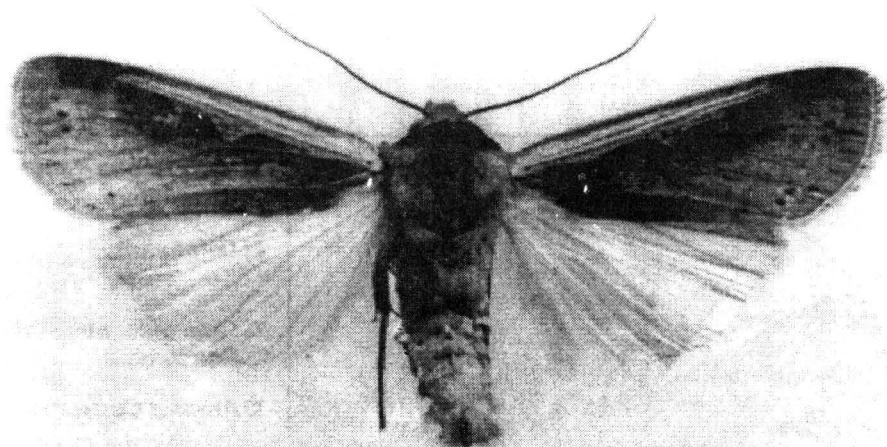


Planche I – 1. *Ochropleura musiva* Hb: 1 ♂ 24.07.1994  
2. *Noctua interposita* Hb: 1 ♂ 27.07.1995

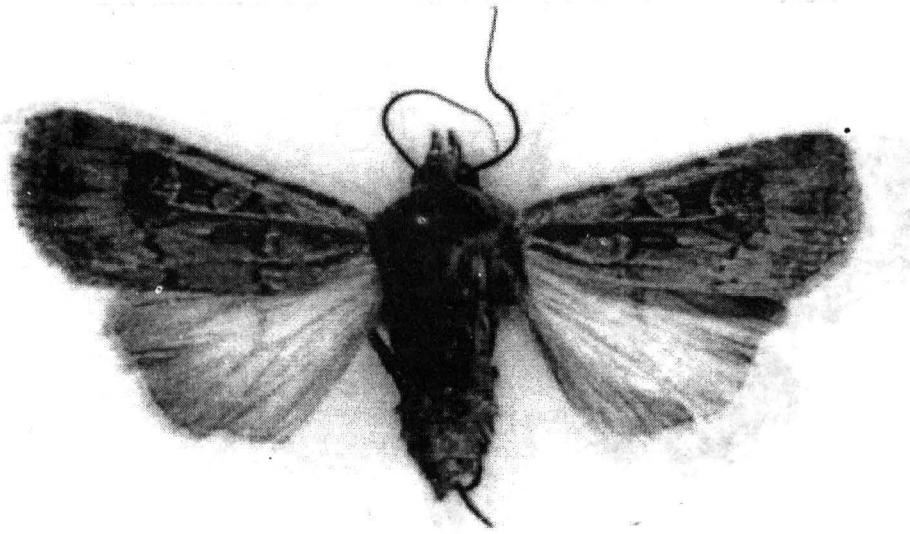
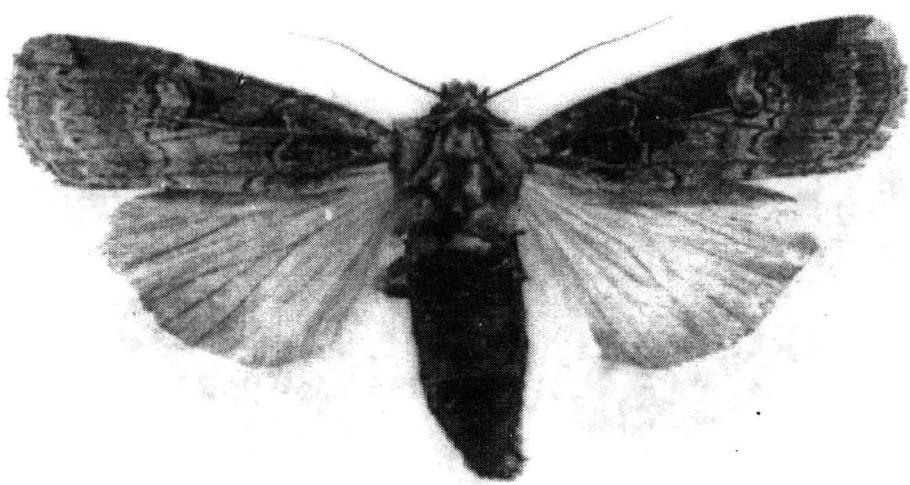


Planche II - 1. *Opigena polygona* D & S: 1 ♂ 14.07.1993

2. *Euxoa distinguenda* Led. 1 ♂ 3.09.1995

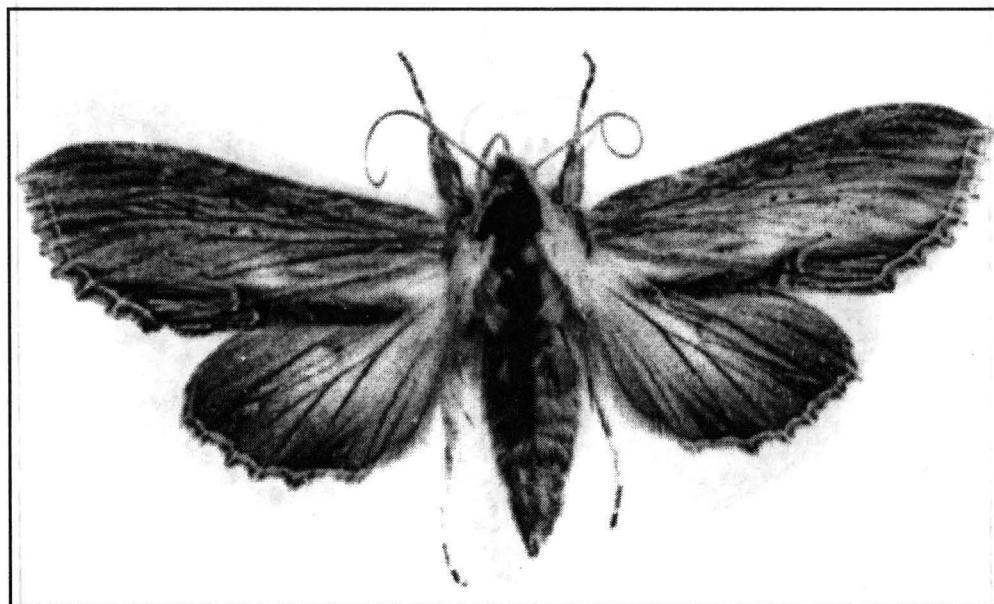
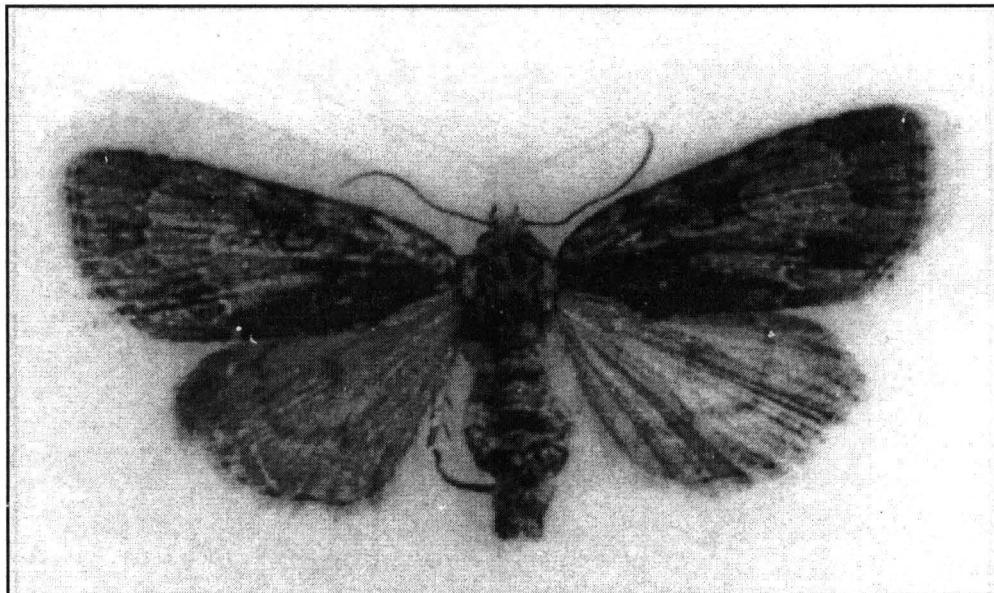


Planche III – 1. *Acronicta strigosa* D & S 1 ♂ 3.08.1994  
2. *Shargacucullia thapsiphaga*, Tr. 1 ♂ 20.07.1995

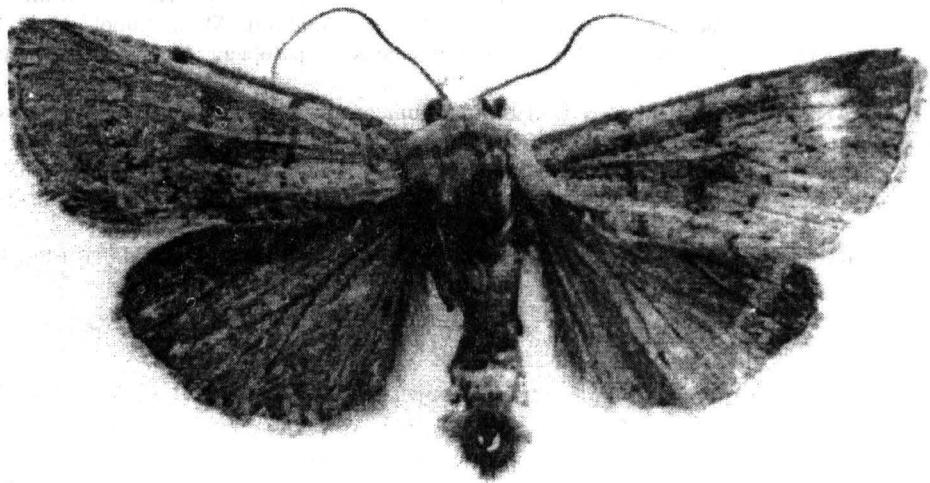
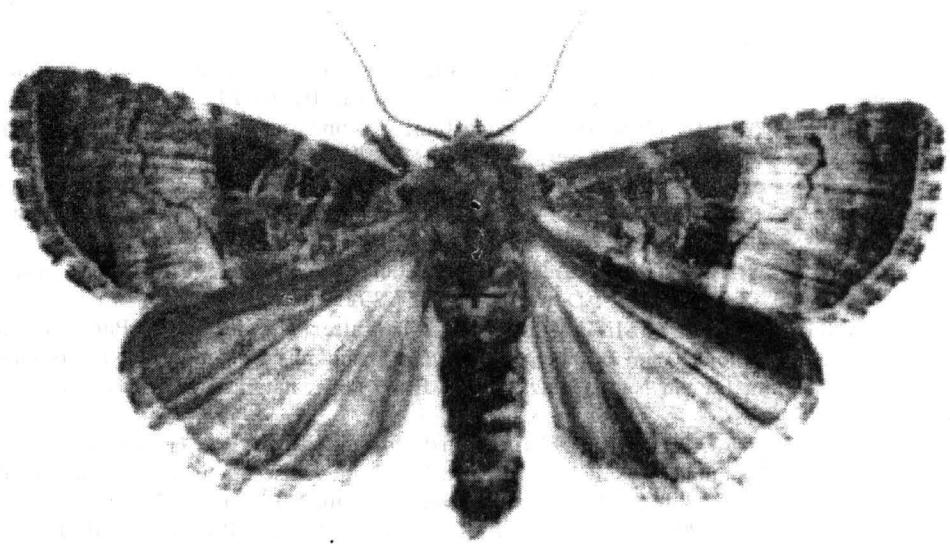


Planche IV – 1. *Eucarta amethystina* Hb: 1 ♂ 3.08.1995  
2. *Xestia ashworthi candalarum* Stdgr. 1 ♂ 16.07.1994

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# **DES CONTRIBUTIONS À LA CONNAISSANCE DE LA FAUNE ICHTIOLOGIQUE DE LA RIVIÈRE STREI ( LE DÉPARTEMENT DE HUNEDOARA, ROUMANIE)**

**SEBASTIAN DOMNARIU**

*Muzeul Civilizației Dacice și Romane Deva,  
Str. 1 Decembrie nr. 39. 2700 Deva*

## **REZUMAT**

Lucrarea prezintă rezultatele cercetărilor ihtiologice efectuate pe valea Streiului, în ecosistemele acvatice din sectorul inferior al râului. Au fost cercetate șase stațiuni: Subcetate, Călan Simeria, Nălați, Păclișa și Ostrov. Ultimele trei stațiuni cercetate se află în zona lacurilor artificiale, rezultat al construcțiilor hidroenergetice efectuate după anul 1980. În urma cercetărilor au fost colectate 215 exemplare aparținând la 33 specii și 7 familii. Se prezintă lista sistematică a speciilor însotită de menționarea stațiunilor cercetate și date ecologice privind preferința față de biotop și locul de reproducere.

Se menționează modificarea structurii rețelei hidrografice și regimului de curgere al râului în zona lacurilor artificiale cu repercușiuni asupra spectrului ihtiofaunistic.

La rivière de Strei ( $L=89$  km;  $S=1970$  km<sup>2</sup>) est l'un des plus importants affluents de la rivière de Mureş, qui traverse le département de Hunedoara.

La source de la rivière de Strei est dans les Monts Sureanu (Les Carpates Meridionales), où se forme par la confluence de trois ruisseaux: Cald, Rovinei et Gruișoara.

Au long de la vallée de Strei on distingue trois secteurs: le secteur supérieur - entre la source et la localité Baru; le secteur moyen - entre les localités Baru et Subcetate; le secteur inférieur situé entre la localité Subcetate et l'embouchure dans la rivière de Mureş.

Après le passage d'un défilé épigénétique à Subcetate, la rivière de Strei a une direction générale vers Nord jusqu'à l'embouchure dans la rivière de Mureş. Dans ce secteur inférieur, la vallée de Strei a été profondément modifiée par les constructions hydro-électriques effectuées après 1980, dans les localités: Nălaţi, Păclişa et Ostrov. On mentionne les modifications de la structure du réseau hydrographique et du régime de l'écoulement de la rivière.

Les recherches ichtyologiques ont été effectuées, pendant les années 1996-1998, en six stations situées au long de la vallée: Subcetate, Călan, Simeria, Nălaţi, Păclişa et Ostrov. Les premières stations sont situées dans la zone pas modifiée par les constructions hydro-électriques. Les suivants stations recherchées sont des lacs artificiels formées après les constructions hydro-électriques.

Le matériel ichtyofaunistique collecté par nous est représenté par 215 exemplaires qui appartiennent au 3 espèces et 7 familles. Le matériel a été préparé, conservé et déterminé dans le laboratoire du Musée de Deva (le département de Hunedoara).

On présente la liste systématique des espèces identifiées, élaborée en conformité avec la nomenclature et la classification scientifique actuelle. (Tableau 1). La liste systématique est accompagnée par des dates écologiques concernant la préférence pour le biotope et le lieu de la reproduction.

**TABLEAU 1 - LA LISTE SYSTÉMATIQUE, LES STATIONS RECHERCHÉES ET LES DATES ÉCOLOGIQUE  
DES ESPÈCES SIGNALÉES DANS LA RIVIÈRE DE STREI.**

Famille <i>Espèces</i>	Subcetate	Călan	Simeria	Nălaţi	Păclişa	Ostrov	Exigences écologiques
<b>SALMONIDAE</b>							
Salmo trutta fario (Regan 1914)	+	-	-	-	-	-	Lithophile
Salmo gairdneri irideus Gibbons 1855	-	-	-	+		+	Lithophile
<b>THYMALLIDAE</b>							
Thymallus thymallus (Linnaeus 1758)	+	-	-	-	-	-	Lithophile
<b>UMBRIDAE</b>							
Umbra krameri Walbaum 1792	-	-	-	-	-	-	Phytophile

<b>ESOCIDAE</b>							
<i>Esox lucius</i> Linnaeus 1758	-	+	+	-	-	-	Phytophile
<b>CYPRINIDAE</b>							
<i>Rutilus rutilus</i> <i>carpathorossicus</i> Vladykov 1930	-	-	-	-	-	-	Phytophile
<i>Leuciscus cephalus</i> (Linnaeus 1758)	+	+	+	+	+	+	Rheophile, lithophile
<i>Leuciscus idus</i> (Linnaeus 1758)	-	-	-	-	+	-	Phytophile
<i>Phoxinus phoxinus</i> (Linnaeus 1758)	+	-	-	+	+	+	Lithophile
<i>Tinca tinca</i> (Linnaeus 1758)	-	-	-	-	+	-	Phytophile
<i>Scardinius erythrophthalmus</i> (Linnaeus 1758)	-	-	-	+	-	-	Phytophile
<i>Aspius aspius</i> (Linnaeus 1758)	+	-	-	-	-	-	Phytophile
<i>Alburnus alburnus</i> (Linnaeus 1758)	+	+	+	+	+	+	Phyto- lithophile
<i>Alburnoides bipunctatus</i> (Block 1782)	+	+	+	+	+	+	Lithophile
<i>Blicca bjorkna</i> (Linnaeus 1758)	-	+	+	-	-	-	Phytophile
<i>Abramis brama</i> (Pavlov 1956)	-	-	+	-	-	-	Phyto- lithophile
<i>Vimba vimba carinata</i> (Pallas 1811)	-	+	+	-	-	-	Lithophile
<i>Chondrostoma nasus</i> (Linnaeus 1758)	+	+	+	-	-	-	Lithophile
<i>Rhodeus sericeus amarus</i> (Bloch 1782)	-	-	-	+	-	-	Phytophile
<i>Gobio gobio</i> (Valenciennes 1844)	+	+	+	+	+	+	Phyto- lithophile
<i>Pseudorasbora parva</i> (Schlegel 1842)	+	+	+	+	+	+	Phytophile

<i>Barbus barbus</i> (Linnaeus 1758)	+	+	+	+	-	-	Lithophile
<i>Barbus meridionalis</i> Heckel 1847)	+	-	-	+	+	-	Lithophile
<i>Cyprinus caprio</i> (Linnaeus 1758)	-	-	-	+	+	-	Phytophile
<i>Carassius auratus</i> (Bloch 1782)	-	-	+	+	+	+	Phytophile
<b>COBITIDAE</b>							
<i>Noemacheilus barbatulus</i> (Linnaeus 1758)	+	-	-	+	+	+	Lithophile
<i>Misgurnus fossilis</i> (Linnaeus 1758)	-	-	+	-	-	-	Phytophile
<i>Cobitis elongata</i> (Henckel & Kner 1858)	+	+	+	+	+	+	Lithophile
<b>SILURIDAE</b>							
<i>Silurus glanis</i> (Linnaeus 1758)	-	-	+	-	-	-	Phytophile
<b>ICTALURIDAE</b>							
<i>Ictalurus melas</i> (Rafinesque 1820)	+	-	-	-	-	-	Phytophile
<b>CENTRARCHIDAE</b>							
<i>Lepomis gibbosus</i> (Linnaeus 1758)	-	-	+	-	-	-	Phytophile
<b>PERCIDAE</b>							
<i>Perca fluviatilis</i> (Linnaeus 1758)	-	-	+	-	-	-	Phytophile
<i>Stizostedion volgense</i> (Gmelin 1788)	-	-	+	-	-	-	Phyto-lithophile

## CONCLUSIONS

La composition de la faune ichtiologique de la rivière de Strei a souffert beaucoup de modifications grâce aux constructions hydro-électriques qui occupent une grande surface dans le secteur inférieur de la valée. Seulement dans quelques zones comme: Subcetate, Călan et Simeria, le cours de la rivière est naturel avec des écosystèmes pas modifiés du point

de vue anthropique. Dans ces stations, l'ichtyofaune est tipique pour les cours des rivières collinaires du bassin du Strei. On mentionne les espèces: *Leuciscus cephalus*, *Barbus meridionalis* et *Condrostoma nasus*. Ces espèces ont une fréquence et une abondance relativement grande. Par la création des lacs artificiels, le spectre faunistique a été modifié à Nălați, Păclișa et Ostrov, dans le sens de l'apparition des espèces pas caractéristiques pour la vallée inférieure de Strei, comme: *Cyprinus carpio*, *Carassius auratus*, *Pseudorasbora parva*, *Ictalurus melas* et *Lepomis gibbosus*, espèces introduites par colonisation. On mentionne la grande abondance des individus de l'espèce *Alburnus alburnus* dans les lacs artificiels mentionnées.

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