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The Upper and Middle Olt River Basin

Editors
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Preface

The *"Transylvanian Review of Systematical and Ecological Research"* is a new scientific publication, edited with the aim to improve the biological and environmental knowledge. It will be focused mainly on biosystematics, ecology and related sciences, like environmental monitoring, human impact, biogeography, taxonomy and others.

This first tome was established in order to present the results of the research team involved in a project of biodiversity and human impact assessment on the upper and middle Olt River Basin. Some of the enclosed papers are based on the long-time work of several scientists. Another part of the results offered in this work were obtained during an expedition organised by the "Lucian Blaga" University, Faculty of Sciences, Department of Ecology and Environmental Protection, and by the NGO Ecotur Sibiu, in October 1999, in the frame of a Project funded by the Global Environmental Fund/ United Nations Development Program, through the Regional Environment Centre REC - Romania. This project was focused mainly on the assessment of the human impact on the wetlands from the upper and middle Olt River, and on the popularisation of the results. It is evident that scientific information has first to be gained and handled, afterwards this can be spread by means of mass media and popularisation works. In order to accomplish this task, it was written a volume, in Romanian language, which presents the results of the field investigation in an accessible manner. The scientific works are published in this review, which is not to be regarded as a part of the former mentioned Project.

Anyhow this work was necessary because no updated knowledge were available for the main part of the systematical groups of the Olt River Basin and its present-day ecological state. Some few studies accomplished in the past decades were focused mainly on a few taxa and some sectors from the middle river's course. In order to obtain a whole image of the river's communities and of the human impact effects, the project organisers tried to gather a group of scientists and young biologists, which studied the Olt River along its course. This river was researched starting with the first polluted sector in its upper course, and ending with the lower part of the middle course. The research period, its length, the team composition and size were linked to the available budget and time resources, the organisers trying to find a common denominator between them. It should be clear that this work is by far not finished; it has to be regarded only as a beginning of a research.

Although just a part of the papers are based on the expedition from October 1998, in order to help the understanding of these works and the sampling points' location, we show below a schematical representation of the studied area, the position and the codes used for each station.

The editors will continue the series of this review, according to the gaining of more scientific information on the specified goals.

Acknowledgements

The editors wish to express their gratitude to all the staff involved in the research project, and to those who helped in any manner their work. Special regards to the Directors of the National Company "Romanian Waters" branches from Sfântu Gheorghe and Sibiu, namely Ms. Maria Stoica and Mr. Petru Maxim, and to the Director of the Environmental Protection Agency in Sibiu, Mr. Adrian Georgescu, who helped constantly the project. We wish to thank to the members from the NGO Ecotur, and among them especially to Ms. Marina Bogdan and Ms. Liliana Furdui, who have supported us during the whole period.

The Editors

THE CARPATHIANS OROGRAPHIC BARRAGE ROLE FOR THE AIR MASSES CROSSING THE UPPER AND MIDDLE COURSE OF THE OLT RIVER

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RÉSUMÉ

La zone située entre la source et la sortie de la défilé Turnu Roşu – Cozia est caracterisée par un climat moderat-continental, avec des influences et particularités determinées par la position des principales formes du relief situé dans la route des masses d'air, par l'altitude, par l'expositions des versants, par le type de la vegetation. À cause des amenagements du cours superieur et moyenne du l'Olt, le paysage géografique a souffrit forts transformations. Les lacs d'accumulation avec leur rol termoregulateure, ont determiné l'instalation d'un microclimat specifique, lequel influences sont remarqués surtout dans l'apparition des associations des plants termophiles et higrophiles.

Keywords: climate, Carpathians' influence.

GENERAL CONSIDERATIONS

The climate of a region represents, according to "The Dictionary of Meteorology and Climatology", the pluriannual regime of weather conditions, characterizing a place or a certain region, being determined by the solar radiation, the character of the active surface and the general atmospheric circulation. Therefore, the climate is characterized by certain stability and it is one of the components which define a certain geographical area.

The zone situated between the Olt River springs and its emergence from the Turnu Roşu – Cozia passage have a moderate-continental climate, with influences and particularities generated by the position of the main relief forms on the trajectory of the air masses circulation, the relief altitude and exposition of the slopes, the type of vegetation that covers the soil surface and, not least, by its latitude extension. Due to the hydropower facilities on the upper and middle course of the Olt River, the geographical landscape has suffered great modifications. The retention lakes, with thermoregulatory role, have determined the installation of a typical microclimate, whose influences are more visible in the appearance of some thermophylous and hygrophilous vegetal associations.

The Romanian landscape is defined by the concentric arrangement of the South-Eastern Carpathians that, due to their position, altitude and massiveness obviously influence all the components of the environment. The relief also determines the climatic conditions, reflected in the variation of all the other components of the natural environment and especially in the presence of the succession of the geographical landscape, from the steppe-like one, in the lower zones, to the alpine floor. The altitude variation of the vegetation floors between the slopes with northern exposure and those with a Southern exposure, of almost 200 m, is the consequence of the relief orientation and reflects its variety. The concentric arrangement of the major relief levels is also reflected in the extension of the Carpathians influence, way beyond the mountain space. It is noteworthy the influence over the regime of the river's flow with all the succession of aspects that derive from this.

The geographic position of the upper and middle course of the Olt River determine the period and intensity of the solar radiation, which changes during the year. The temperate zone benefits of a moderate radiation regime, with considerable regional differences. At the latitudinal limits of the analysed sector, the fascicle of Solar beams covers an interval of maximum 1^0 38' latitude and the annual variation of the incidence angle, which generates an increase of the day length from winter to summer solstice, generates a corresponding zoning of climatic processes and, subsequently, of the landscape. The moderate regime of the solar radiation exerts a special influence upon all physical and biotic processes at the active surface.

Referring to the atmospheric circulation, the territory between the Olt River springs and its emergence from the Turnu Roşu - Cozia passage is situated at the interference zone of the Western wetter air masses with the Eastern dry continental ones, determining the general character of the climate as being a temperate – continental one, a transition between the Eastern excessive – continental climate and the moderate – continental one from the middle of the continent.

The Carpathians, due to their orientation, play a barrage role for the air masses. The Oriental and Meridional Carpathians are obstacles for the Eastern anticyclone (continental) circulation and the cyclone (oceanic) one. As a result, the wetter masses of sea air determine a more moderate climate regime in the Eastern and South - Eastern part of the Transylvanian Plateau, after the escalation of the Western Carpathians peaks. On the other hand, the greater frequency of the continental anticyclones, with tentacular penetration into the zone and low vertical development, determine in the contact hilldowns on the internal flank of the Orientals great thermal amplitudes, reduced air humidity, low cloudiness, reduced rainfall and a greater frequency of the hoar and frosts, which are more extended in time. All these highlight the Carpathians role as a climatic barrier.

Similar to the annual cycle of the Solar radiation that presents contrasts between summer and winter, the land and water surfaces act differently towards the absorption and radiation of thermal energy. The land stores the heat quickly and yields it just as fast, while the water has a thermo-regularization role, yielding the slowly stored caloric energy in a slow way. Therefore, the thermal contrasts are lower near the Olt River and the power reservoirs, comparatively to the surfaces without large water mirrors.

Due to the differentiate heating and yielding of the caloric energy of the water and land, there are generated air movements, imposed by the pressure differences.

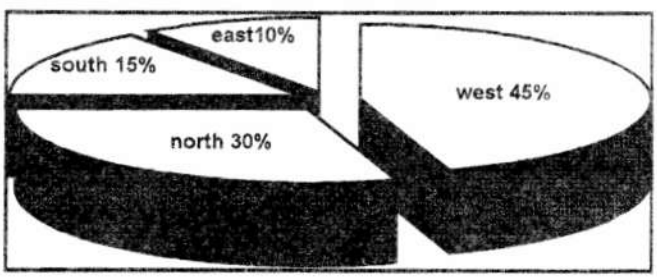

Fig. 1. *Types of atmospheric circulation in the investigated region*

Analysing the types of atmospheric circulation which determine the modification of the weather aspect in the investigated region, it is ascertained the

great frequency of the Western and adjacent circulation, which represents 45 % of all cases, being the prevalent element in the atmospheric transformations that take place over the land. The shape of the Carpathic arch, oriented with the span to the West, the massiveness and the fragmentation degree determine the concentration of the air current lines in the Intracarpathian sector of the Curvature just like in a "funnel". On the Extracarpathian slopes of the Curvature area, foehn-like processes take place, while the Western slopes, "in the wind" ones, are rich in rainfall. (**Fig. 2**).

Due to their particular position and to their concave form towards the movement direction of the Western air masses, the Curvature Carpathians have the most favourable conditions for the forced ascent of the wet and cold air to the interior slopes and the discharge into the Carpathic space of the air with modified properties, i.e. dry and heated. The limits of this discharge are marked by the 500 mm isohyet, indicator of the evaporation and evapo-transpiration humidity, of the water deficit in the soil and of the dryness degree.

The Western and North-Western air crosses parallel summits: Perşani Mts., Baraolt Mts., Bodoc Mts., oriented from North - North-West to South - South-East and perpendicular to the air masses movement line. After escalating the Bârsei Mts., the air masses outrun the Western slopes of Vrancei and Siriului Mts. and descend on the Eastern side. The Oriental Carpathians, due to their position (perpendicular to the air movement line) and their massiveness and altitude, induce significant transformations to the circulation of the Western sector air. The Meridional Carpathians .also represent a barrage element because they hinder the air discharge over the ridge.

The Western circulation is present both in the hot and cold period of the year, being able to last for several days. The situations with Western circulation determine mild winters, during which prevail the rain falls. In summer, the Western circulation determines a great variability in the weather aspect and an increased degree of instability, especially in the Northern part of the zone.

The polar circulation represents approx. 30 % of all cases, being generated by the movement of the cold air masses with the general orientation from North-West to South-East. This type of circulation carries to the Centre and the South-East of the Transylvanian Plateau wet air masses from polar latitudes, determining the decrease of air temperature and the increase of the cloudiness as well as shower rainfall. This type of circulation generates the spring-summer and autumn cooling, and in wintertime determines very low temperatures. The North - North-West and North - North-East circulation meets the Carpathic obstacle that, through its shape and massiveness, forces the cold air masses moving from North to South to avoid it, thus the anticyclone sends two cold Pericarpathian penetrations: one towards the Moldavian Plateau, closed to the Oriental Carpathians and the second one towards the Pannonian Depression. The first lobe rounds the Oriental and Curvature Carpathians; the air masses from the Extracarpathian sector moving from North to South over Moldavia closely adhere to the mountain flank. At the end of the obstacle, a Westward deviation is produced, the cold air masses quickly invading the most of the Romanian Plain.

This atmospheric process takes place this way: in the first stage, between the two main barometric forms it has to be a quasistationary front, expressed through a large contact area of air masses, which follows the big Carpathic arch till the Vrancea Curvature, the Meridional Carpathians and the Transylvanian Plateau remaining in the warm sector of the quasistationary front.

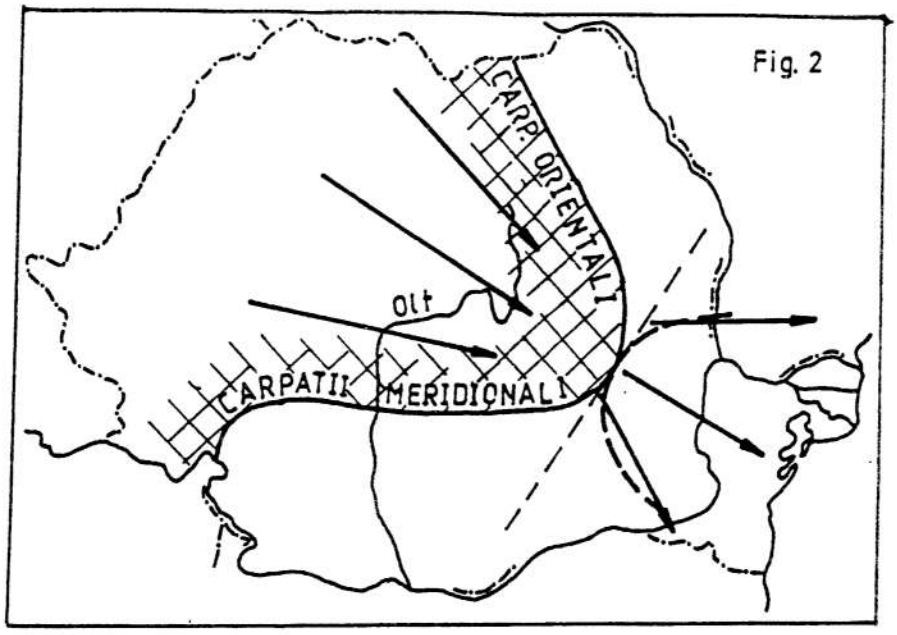
Fig. 2
CARP. ORIENTALI
Olt
CARPATII MERIDIONALI

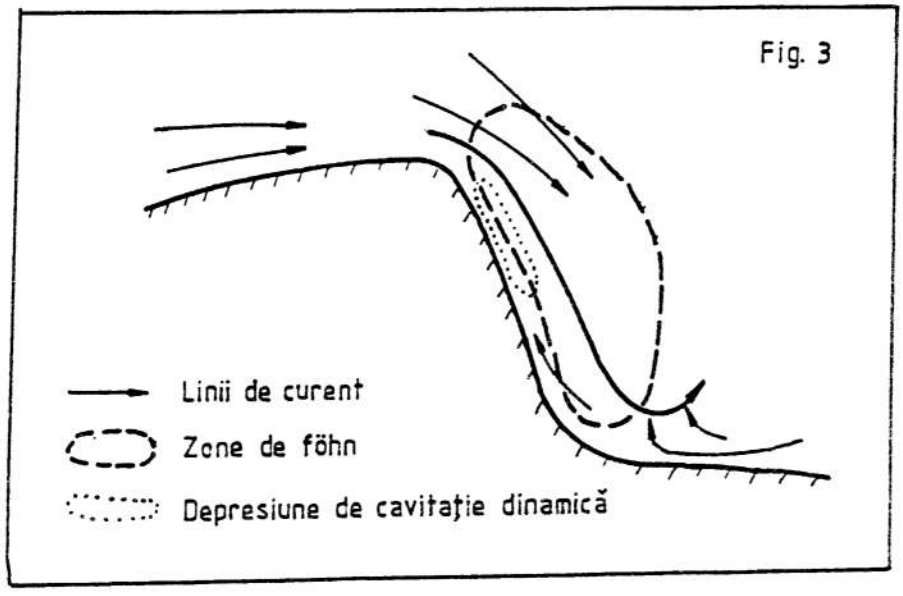
Fig. 3
Linii de curent
Zone de föhn
Depresiune de cavitaţie dinamică

If, because of general synoptic causes, the anticyclone masses from the North of Carpathian Mountains begins a North-South movement, the cold and dense air masses cannot escalate the mountain range and then they avoid it Pericarpathic. Specific to this moment of the Carpathic cyclogenesis is that the East – Pericarpathic lobe infiltrated over Moldavia, with a great energy, represents the cold anticyclone penetration that displaces the hot air from the shelter zone. The East - Pericarpathic lobe is the most intense from barometric point of view, the fastest advancing towards South and also the coldest, being followed, with a delay, by the West – Pericarpathic lobe, less colder, with lower barometric values and implicitly with a more reduced advancement speed.

Over the Transylvanian Plateau the lowest pressure values are always preserved, even if generally the pressure increases in all the other regions. It does not matter how much the pressure grows and it is to be identified a barometric isolation, a small Transylvanian "cyclone eye". The Carpathic orographic cyclogenesis remains an atmospheric process specific for the Romanian territory, dominated by the Carpathians.

The tropical circulation represents only 15 % of all cases and provides the heat excess transport from the tropical regions to the North. These seldom occur over the analysed region because, on the South-West direction, the tropical air should outrun the peaks of the Meridional Carpathians, where they would adiabatic cool. A weak penetration of hot air manages to sneak through Turnu-Roşu – Cozia passage. From South-East, the air easily outruns the Curvature Carpathians and becomes a warm or even hot air, poor in rainfall. In the cold period of the year, the transport of warm air determines the appearance of mild winters and contributes to the drop of heavy rainfall. In summertime, the transport of hot air from South-East determines fine and warm/dry weather and the transport of sea air from South-West determines unstable weather, with shower rainfall, accompanied by lightning discharges.

The blocking circulation is installed when the Centre and South-East of the Transylvanian Plateau find themselves in a high pressure field, which determines during summer a fine weather, dry and warm, with a clear sky. In winter, it prevails the cloudy and wet weather, the rainfall being quantitatively insignificant.

Each of these types has several variants, depending on the position and the intensity of the main barometric systems that generate them: cyclones and anticyclones. Over all these, it is manifested the barrage influence of the Carpathians range, which alters the evolution of the atmospheric processes, changes the directions of the air masses, deforms the fronts and produces differences in the weather aspect.

In case of the West and North-West circulation, on the exposed slopes takes place an increase of the nebulosity accompanied by abundant rainfalls, while on the sheltered, "under the wind" slopes, foehnal processes take place.

From the analysis of the repartition of the medium annual quantities of liquid and solid rainfalls, it results that the greatest values are registered in the mountain region (1000 – 1500 mm/year). Depending on the altitude of the relief and the exposure of the Carpathians ranges to the admission of sea or continental air, there are registered differences with 100 - 200 mm more on the Western and Northern slopes than on the Eastern and Southern ones. As a result of the Carpathians orographic barrage role, the rainfall are unevenly distributed on their sides: richer on the North-West exposed slopes, under oceanic influence and more reduced in the South-Eastern half, situated under the influence of the continental air. It is noteworthy the decrease of the rainfall quantity from West to East, where the degree of continentalism increases.

A specific note presents the rainfall decrease, due to catabatic causes, to less than 600 mm/year in Giurgeu and Ciuc Hilldowns, where are also manifested strong thermal inversions, especially in the cold season, "the Romanian cold pole" switching between Joseni and Miercurea Ciuc.

The exposure of the internal Curvature slopes, with long summits that close the intramontane Braşov Depression, generates differences in the structure and the association of the bio-pedo-climatical factors. There are noteworthy the thermal inversions, frequent in Braşov Depression, defining the geographical discontinuity aspect, similar to the one of Ciuc Depression. For example, in January 1942 in Bod, the medium temperature was $-12\ ^0C$, in Braşov $-10\ ^0C$ and on the Omu Peak only $-2,5\ ^0C$. More different are the absolute minimal values, which can be, in the higher zone $-27,5^0C$ and in the depression $-38,5\ ^0C$. The explanation of this situation is the prevalence of the barometric maximum, which directs cold continental air masses from North-East, which stand by in the depression depending on the relief configuration. To these is added the presence of the snow stratum, which, by albedo, substantially contributes to the temperature decrease. Thermal inversions have the greatest frequency in winter, in January being registered 11,8 such days; in spring and summer there are very few, which directly influences the caloric potential of the active surface. In Târgu-Secuiesc depression pass, the number of thermal inversions is higher because of the big thermal contrasts, which are conditioned by barometric maximums caused by the North - North-East and East circulation. In Bârsei Depression, these contrasts are diminished by the influence of the West and North-West air masses.

At the base of the Făgăraş abrupt there appear frequently temperature inversions, especially in the Făgăraş Depression. The descendant circulation of the air masses, of foehn type, is to be felt especially in the Northern half of the depression where the temperature is a bit higher and the humidity is lower. The Northern exposure of the Făgăraş ridge preserves for a longer time both the snow stratum and the lower temperatures. At its base, the rainfalls have values between 700 and 800 mm yearly.

The range, the exposure and the different albedo of the rocks as well as the active surface altered by the great presence of forests determines in the Northern sector of the Cindrel Mts. annual averages of $4,5\ ^0C$, unlike the depression compartments from the base - Sibiu, Apold and Sălişte Hilldowns that benefit by the foehn type catabatic winds - where these values rise above $7\ ^0C$. In the zones of Cibin river springs and its tributaries, the snow stratum lasts between 150 and 200 days yearly. This, together with the annual rainfalls that varies between 900 and 1300 mm, explain the high value of the average specific flow, the great density of the hydrographic network and the high debit.

The shelter offered by the slopes of Olt's transversal axis determines a local circulation of the air masses. The climatic conditions confirm small vegetation inversions downstream the confluence with the Lotru River, where the valley has a width reduced to less than 100 m between the slopes. Topoclimatic particularities are specific to the Southern area, at Cozia the annual temperature average being 9^0C, the temperature average in January being $-1\ ^0C$ to $-2\ ^0C$ and in July $23\ ^0C$. The average quantity of rainfall reaches 750 mm/year.

The position and orientation of the Carpathic arch towards the air masses circulation, grants the analysed space specific characteristics, expressed by the values of air temperature, rainfall and wind regime.

MATERIALS AND METHODS

To characterise the climate regime it was used the data bank of the zonal weather network, that also sends data world-wide, i.e. the Miercurea-Ciuc, Sfântu-Gheorghe, Braşov, Făgăraş, Sibiu and Păltiniş weather stations. These data allowed us to update the values of the climatic parameters shown by the multiannual averages calculated for the last thirty years, this being possible because of the uninterrupted row of observations performed during this period and kept within the weather stations archives. Since 1995, at the Sibiu weather station it is worked out the "Climate" message program, which contains monthly data reported to the normal averages calculated for the 1961-1990 period. This type of message allows comparing normal values with the deviations from normal. It is calculated the square average duration.

The data were completed with those existing in the weather year-books and in the Climatologic Atlas of Romania.

RESULTS AND DISCUSSION

The climatologic researches are quite difficult because of the reduced number and unevenness of the weather stations in Carpathians. The activity of the mountain weather stations is relatively recent (usually 30-40 years). The mountain weather stations are not distributed uniformly and not always in the most representative places. Important for this study are the stations Bucin, the station Lăcăuţi, situated right on Lăcăuţi Peak, at 1777 m, and the relatively recent founded stations Cheia and Penteleu, all in Carpathians Curvature. In the Meridional Carpathians the weather stations are grouped either in the West, or in the East of the Meridionals, Făgăraş Massive being, except for Bâlea-Lac station, uncovered. To this are added the weather stations Poiana Braşov, Postăvaru, Păltiniş, Voineasa, Obârşia Lotrului and Cozia. Thus arranged, these weather stations register the effects of the general atmospheric circulation in different ways. There can be separated three main circulation directions that determine the weather status:

- the oceanic circulation, Western and North-Western, influencing directly the Western and North-Western slopes of the Oriental Carpathians, where the rainfall are abundant;
- the Eastern and North-Eastern circulation, with continental masses, poor in humidity, influencing the Eastern slopes of the Orientals;
- the Southern and South-Eastern circulation, which is sensed more seldom, is materialised in warm air masses, with Mediterranean influences.

The differences given by the sun brightness period and by the slope degree of exposure highlight characteristics with local importance.

The regime of the air temperature from the interior of the Carpathic arch is different to that of the Extracarpathic zones. In the hilldowns situated at different heights, in valleys and saddles, a differentiated thermal regime is installed. This aspect is emphasised by the repartition of the annual isotherms, completed with diverse thermal limits: the average date of the disappearance of the daily average temperature $\leq 0\ ^0C$, the average length of the daily average temperatures $/0\ ^0C$, the interval of days with daily average temperatures $> 5\ ^0C$, $>10\ ^0C$, the average frequency of frosty days, when the minimum temperature is $\leq 0\ ^0C$, the average frequency of the summer days characterised by maximum temperatures $/25^0$ C and that of the tropical days, when the maximum temperature is $/30\ ^0C$.

The wind is strongly influenced by the major relief forms. During the Carpathic range crossing, the atmospheric streams suffer ample value deformations,

depending on the slopes, on the height and succession of the mountain massifs, on the distance and altitude difference between the most prominent summits.

On the slopes under the wind, the transversal streams get foehn characteristics (**Fig. 3**).

The spatial variation of the relative humidity under the circumstances of Western and North-Western sector winds emphasise the transformations in the wet air masses at the escalation of the mountain massifs. The humidity load carried by the air masses from the ocean is kept in the area situated in front of the mountain barrage.

By altitude, extension and orientation towards the main advection directions of air masses, the relief is a factor influencing the rainfall quantity and type. The way the rainfall quantity varies from the West to the East of the Carpathic space, highlights the barrage role of the mountain range. The solid rainfall regime expresses the combination of the altitude effects with the exposure of the slopes towards the atmospheric circulation. The zone exposed to the blizzard highlights the separating wall role of the Carpathic arch.

CONCLUSIONS

An important role in the diversification of the climatic elements has the relief. The Moldo-Transylvanian and Curvature Carpathians, and also the Făgăraş and Cindrel Mountains, through their orientation, form a barrage that lends substantial changes in the air masses movement.

The Oriental and Meridional Carpathians represent an important barrage in the cyclone circulation from West, North-West and partially from South-West that brings wet air, determining a moderate regime in the Transylvanian Plateau. The anticyclones, having a reduced vertical development, flow near the mountain frame or are standing by in front of the Carpathians and determine high temperature variations and decrease of the atmospheric humidity and nebulosity, and also of the rainfall. The frequency and intensity of the hoar, frosts, blizzards and prolonged droughts is higher in the Extracarpathic sector than in the Intracarpathic one. All these highlight the climatic barrier role played by the Carpathians.

The analysis of the meteorological elements characterising the state of weather in the zone of the upper and middle course of Olt River, from October the 4th till October the 10th, 1998

GENERAL CONSIDERATIONS

The weather represents the state of continuous change of the atmosphere. The weather, at a certain moment, is characterised by the totality of the meteorological elements values and for a longer period of time, by the successive variation of these elements or by their average during that period.

Beginning from this definition, presented by the Dictionary of Meteorology and Climatology, we have characterised the state of the weather in each point of observation from the upper and middle course of Olt River, made both on site and based on the data provided by the Weather Forecast Centre in Sibiu, which collects and processes all the meteorological data from the stations in the subject area for this analysis: Sibiu, Braşov, Harghita and Covasna Counties.

MATERIALS AND METHODS

The data provided by the psychrometrical observations performed on site, in the points of interest for gathering the flora and fauna samples were completed with the

meteorological data measured at the 13 weather stations in the area: Miercurea Ciuc, Agnita, Târgu Secuiesc, Baraolt, Făgăraş, Sfântu Gheorghe, Întorsura Buzăului, Păltiniş, Sibiu, Lăcăuţi, Boiţa, Bâlea-Lac and Braşov.

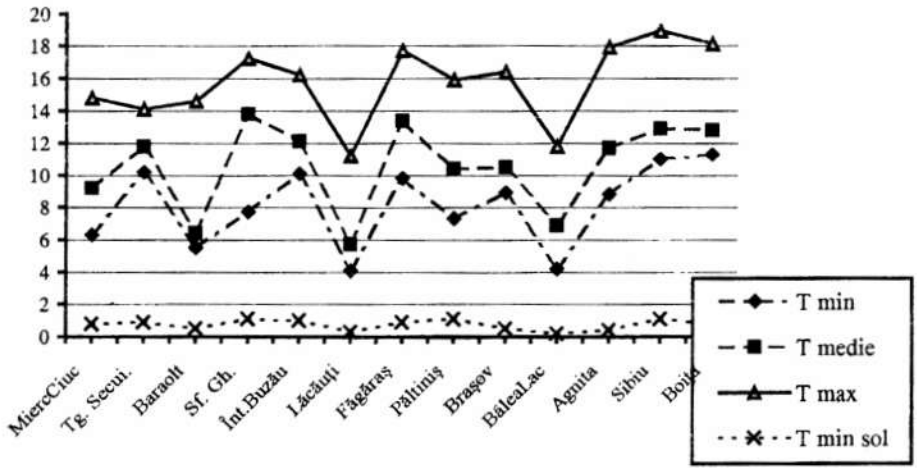

Fig. 4. *Meteorological data measured at the 13 weather stations in the area: Miercurea Ciuc, Agnita, Târgu Secuiesc, Baraolt, Făgăraş, Sfântu Gheorghe, Întorsura Buzăului, Păltiniş, Sibiu, Lăcăuţi, Boiţa, Bâlea-Lac and Braşov.*

Even if not all the weather stations are situated on the upper and middle course of Olt River, we have considered that for a precise and complex characterisation of the state of weather it is necessary the comparison of the data registered both at the stations situated on plateaus and at those in the mountain. The meteorological data consisted in values of the main parameters that characterise the state of weather: the atmospheric pressure, the air and soil temperature, the air humidity, the wind, the nebulosity, completed with the characterisation of the meteorological phenomena: fog, foggy air, rain – referring only to the phenomena registered in the investigated area and in the period of time that we are referring to.

RESULTS AND DISCUSSION

Considering the characteristics of the zonal climate, based on the processed data, it can be considered that, during the whole investigated period, the weather was fine and warm for that period of the year. The average, maximum and minimum temperatures at the 13 weather stations, shown in the graphics below, present high values. Only the minimum values registered on soil surface have been lower, but normal for that period of the year.

The favourable weather conditions were visible on the background of an intense Eastern sector air circulation, especially in the first part of the investigation, when the wind reached values of 8 m/s. On October the 7th 1998, at the weather stations Târgu Secuiesc, Baraolt, Miercurea Ciuc, Sfântu Gheorghe, Braşov and Făgăraş, have been registered 8 m/s in the afternoon, the wind having high values in this area until the next morning. On October the 8th after 9 o'clock, the wind direction switched and until the end of the analysed period, the wind have blown from South,

South - South-East, or South -South-West with speeds exceeding 8 m/s: 9 m/s at Târgu Secuiesc, 9 m/s at Sfântu Gheorghe, 14 m/s at Sibiu and 28 m/s at Boiţa.

In the conditions of the warm and dry air advection from the Southern and Eastern sector, the air temperature reached values of over 20 ^{0}C, 20,4 ^{0}C at Sfântu Gheorghe, 20,8 ^{0}C at Făgăraş, 20,5 ^{0}C at Braşov and 21,8 ^{0}C at Sibiu. The temperature values have been maintained high during the whole analysed period. The minimum air temperatures have not registered in any day negative values, this being valid for the soil too, though in this case the values have been much lower.

The high values of the air temperature were due to a strong sunstroke, the degree of sky covering with clouds being small – 2/10, 3/10 in the first half of the period, then gradually increasing to 5/10, 7/10 and even 10/10 to the end of the period. Even if in some days the sky was cloudy, the type of clouds (Ci, Cs, Cc high clouds, with the base at over 2500 m), allowed an intense sun radiation. Only to the end of the period, in the area of the samples collecting station in Bogata-Măieruş was registered a shower rain and fog towards Făgăraş.

CONCLUSIONS

The analysed period was characterised by a fine and warm weather, with a big stability of the barometric fields. Towards the end of the period, the weather became unstable, the appearance of the clouds with vertical development generating short shower rains. The wind intensification has continued for several days, but being from Southern and Eastern sector in the first part of the analysed period, they generated high air temperatures, low humidity and limited the rain occurrence. The change of the air masses direction of circulation from the Western sector towards the end of the period determined the air humidity increase and allowed the installation of favourable conditions for rainfall appearance.

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THE HYDROPHILOUS AND HYGROPHILOUS FLORA AND VEGETATION FROM THE UPPER AND MIDDLE OLT RIVER VALLEY

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ZUSAMMENFASSUNG

In der Arbeit sind die hydrophile und hygrophile Kormophyten und die Gesselschaften auf dem oberen und mittleren Kurs des Altes aufgezählt, bzw. 396 Arten und 105 Pflanzengesselschaften. Die beiden Konspekten sind aufgrund der Bibliographie erarbeitet und aufgrund der Forschungen des Verfasser. Für jede Art wird nicht nur die Chorologie, sondern auch die tutologische Kategorie (die rote Liste) angegeben. Es werden die natürlichen Reservaten erwähnt aus der Altau und Altterasse und man schlägt neue natürliche Schutzgebiete vor.

Keywords: aquatic, paludal, flora, red list, vegetation, protected area, Olt River

The botanical researches in the upper and middle Olt medow evidence a high vegetal diversity, even more pronounced than the diversity of other Transylvanian rivers. The cormophytic flora includes 396 hydrophilous, hygrophilous and meso-hygrophilous species, and the vegetation 105 aquatic and paludal associations. This richness is the consequence of the existence of swampy areas in Ciuc Depression (Mădăraş, Racu, Miercurea-Ciuc, Sâncrăieni, Sântimbru, Sânsimion, Vrabia, Tuşnad), Bârsa Depression (Prejmer, Hărman, Stupini, Bod, Feldioara) and Făgăraş Depression (Comana de Jos, Mândra, Arpaşul de Jos, Avrig), and of Olt puddles, pools and branches in Sântion-Luncă, Arini, Aita Mare, Micloşoara, Apaţa, Ormeniş, Augustin, Bradu, Turnu Roşu).

For the conservation of a part of this diversity there were declared some protected areas like Borsaros-Sâncrăieni Swamp (1,0 ha), the birch forest from Reci (259,1 ha), Hărman Swamp (8,0 ha), Stupini Swamp (6,0 ha), Mohoş-Tuşnad Bogs (240 ha), Prejmer Swamp (252,0 ha), Bogăţii-Bogata Forest (85,0 ha). We can observe that in the upper course of the Olt River the protected areas are insufficient and in the middle course are absent. I propose the preservation of marshes and branches from Sânsimion (Datcara Swamp and Stuf Swamp), the Olt sector between Apaţa and Augustin and the marshes from Avrig.

The main rare plants are represented by *Acorellus pannonicus* (Prejmer, Hărman), *Acorus calamus* (Comana de Jos, Făgăraş, Bradu), *Allium angulosum* (Bod, Vadu-Roşu), *Angelica palustris* (Sânsimion, Miercurea-Ciuc, Arpaşul de Jos), *Armeria barcensis* (Prejmer, Hărman), **endemit to Bârsa District,** *Betula humilis* (Sâncrăieni, Sânsimion,Vrabia, Tuşnad-Sat, Tuşnadu-Nou, **the last is the southest locality of its areal**), *Betula nana* (Sâncrăieni, **the southest limit of its areal),** *Calla palustris* (Miercurea-Ciuc, Prejmer, Avrig), *Calamagrostis neglecta* (Mădăraş, Miercurea-Ciuc, Tuşnadu-Nou, Hărman, **the last locality is the southest European point**), *Carex contigua* (Vrabia), *Cladium mariscus* (Prejmer, Stupini, Hărman, Avrig), *Cnidium dubium* (Mădăraş, Vrabia, Miercurea-Ciuc, Tuşnadu-Nou Reci, **the last locality is at the south limit of its areal**), *Drosera anglica* (Sâncrăieni, Prejmer, Stupini, Hărman, **at the south limit of its areal**), *Dryopteris thelypteris* (Vrabia,

Avrig), *Elatine hexandra* (Sâmbăta de Jos), *Euonymus nana* (Sâncrăieni, Miercurea-Ciuc, Tuşnad-Sat), *Fritillaria meleagris* (Vrabia, Sântimbru, Sânsimion, Miercurea-Ciuc, Tuşnadu-Nou, Hărman, Bod, Vadu-Roşu), *Groenlandia densa* (Prejmer), *Hippuris vulgaris* (Prejmer, Rotbav, Arini), *Hottonia palustris* (Rotbav, Făgăraş, Olteţ), *Isolepis setacea* (Reci, Prejmer), *Isolepis supina* (Reci, Prejmer, Hărman), *Lemna gibba* (Bradu), *Liparis loeselii* (Stupini, Hărman), *Narcissus angustifolius* (Sântimbru, Arpaşul de Jos, Cârţa), *Nuphar luteum* (Sântimbru, Tuşnad, Bod, Arini, Micloşoara), *Nymphaea alba* (Apaţa, Augustin), *Pedicularis sceptrum-carolinum* (Hărman), **the southest point of its areal,** *Plantago maritima* (Sărata), *Primula farinosa* (Vrabia, Sâncrăieni, Tuşnadu-Nou, Prejmer, Stupini, Hărman, **in Bârsa District at the south limit of its areal**), *Ranunculus rionii* (Bradu), *Salvinia natans* (Apaţa, Augustin), *Saxifraga hirculus* (Vrabia, Sâncrăieni, Tuşnadu-Nou, **the last locality is the south limit of its areal**), *Saxifraga mutata* (Stupini, **the single locality in which the plant grows in Romania**), *Schoenus ferrugineus* (Sântimbru, Sânsimion, Prejmer, **the last locality is the southest point of its areal**), *Schoenus nigricans* (Prejmer, Stupini, Hărman), *Scheuchzeria palustris* (Avrig, **the lowest altitude in Romania**), *Scirpus radicans* (Prejmer, Bradu), *Sesleria uliginosa* (Prejmer, Stupini, Hărman, Bod, **the single localities in which the plant grows in Romania**), *Spiraea salicifolia* (Racu, Vrabia, Miercurea-Ciuc, Tuşnadu-Nou), *Stellaria longifolia* (Sâncrăieni, Tuşnad), *Stratiotes aloides* (Sântion-Luncă, Măeruş, Rotbav, Apaţa, Bradu), *Swertia perennis* (Sânsimion, Prejmer, Stupini, Hărman), *Trapa natans* (Racoşul de Jos, Bradu), *Typha laxmanni* (Sâmbăta de Jos), *Utricularia bremii* (Hărman), *Valisneria spiralis* (Tuşnad-Băi), *Veronica longifolia* (Sântimbru, Sânsimion, Bod, Rotbav, Vadu-Roşu), *Veronica catenata* (Prejmer, Ormeniş), *Viola epipsila* (Sânsimion, Vrabia, **the south limit of its areal**), *Viola uliginosa* (Viştea de Jos).

The vegetation of the upper and middle Olt River was researched only on certain areas. I. Gergely, Fl. Raţiu and Al. Kovacs (7-9, 15, 27-33) studied the swamps of Ciuc Depression and I. Morariu, P. Ularu and H. Heltmann (16-18, 46) the swamps of Bârsa District. P. Ularu (42-46) also researched the vegetation from the Olt meadow in the segment of the Perşani Mountains, and I. Şerbănescu (38-40) the vegetation of Făgăraş Depression. Before our studies, from Transylvanian Olt meadow there were published 70 aquatic and paludal associations. In our geobotanical investigations, made in 1976-1977, 1984-1986, 1988, 1998, we found the majority of the vegetal associations which were mentioned by the quoted authors and we identified other 35 associations with hydrophilous, hygrophilous and meso-hygrophilous character. Among the very rare vegetal associations we note: *Stratiotetum aloidis* (Măeruş, Rotbav, Apaţa), *Hottonietum palustris* (Rotbav, Olteţ), *Nymphaeetum albo-luteae* (Micloşoara, Arini, Augustin), *Typhaetum laxmanni* (Sâmbăta de Jos), *Calamagrostetum canescentis* (Sântimbru, Sânsimion, Miercurea-Ciuc, Tuşnadu-Nou, Vrabia), *Caricetum appropinquatae* (Sântimbru, Vrabia), *Cladietum marisci* (Prejmer, Stupini, Hărman), *Comaro-Caricetum lasiocarpae* (Arpaşul de Jos), *Caricetum buxbaumii* (Arpaşul de Jos), *Calamagrostetum neglectae* (Miercurea-Ciuc), *Seslerietum uliginosae* (Tuşnadu-Nou, Prejmer), *Eleocharitetum quinqueflorae* (Dridif, Arpaşul de Jos), *Orchido-Schoenetum nigricantis* (Prejmer, Stupini, Hărman), *Caricetum buekii* (Beclean).

The species are alphabetically ordered and the vegetal associations are presented – with rare exceptions - after L. Mucina et all. (10,19-20) and A. Borhidi (2).

Abbreviations

Red list: Ex- Extinct, **E-** Endangered, **V-** Vulnerable, **R-** Rare, **I-** Indeterminate, **K-** Insufficiently known, **nt-** not threatened. **Herbaria:** HD- M.I. Doltu Herbarium, HF- M. Fuss Herbarium, HIP- I. Pop Herbarium, HK- J. Kisch Herbarium, HSB- Erika Schneider-Binder Herbarium, HU- K. Ungar Herbarium (the herbaria are in the Natural History Museum of Sibiu).

FLORA

nt- *Acer negundo L.*: Arini, Făgăraş, Avrig (!)
E- *Achillea asplenifolia* Vent.: Hărman (13,16), Prejmer (17), **V-** *A. ptarmica L.*: Mădăraş (6), Hărman (5,!), Viştea de Jos (40), Arpaşu de Jos (!), Scorei (5, 57,), Avrig (40,!)
E- *Acorellus pannonicus* (Jacq.) Palla : Hărman, Prejmer (5)
E- *Acorus calamus* L.: Comana de Jos, Făgăraş (5), Bradu (5,50)
nt- *Adoxa moschatellina* L.: Bălan (!), Tuşnad, Racoşu de Jos (5)
nt- *Aegopodium podagraria* L. : Frequent
nt- *Agrostis canina L.* : Mădăraş (6), Ucea de Jos, Viştea de Jos, Scorei, Avrig (40), *var. hybrida*: Mândra (5), *f. varians*: Tuşnad (5), **nt-** *A. stolonifera L.*: Frequent
I- *Alisma gramineum* Lej.: Tuşnad (5), **R-** *A. lanceolatum* With.: Mădăraş, Racu (6), Miercurea Ciuc (8), **nt-** *A. plantago-aquatica* L.: Fercventă,
nt- *Allium angulosum* L.: Sânsimion (23), Rotbav, Vadu-Roşu (45), Hărman (12,!), Bod (5,23), Părău (40)
nt- *Alnus glutinosa* (L.) Gaertn.: Frequent, **nt-** *A. incana* Moench.: Bălan, Sâncrăieni (!), Vrabia (33) *f. parvifolia* Rgl.: Sâncrăieni, Tuşnad (5)
nt- *Alopecurus aequalis* Sobol.: Racu, Mădăraş (6), Rotbav (45), Şercaia, Mândra (40), Făgăraş (!), **nt-** *A. geniculatus* L.: Vrabia, Tuşnad-Sat (33), Avrig (47), **nt-** *A. pratensis* L.: Frequent
E- *Angelica palustris* (Besser) Hoffm.: Sânsimion (23), Miercurea Ciuc (5,23), Arpaşu de Jos (5), **nt-** *A. silvestris* L.: Frequent, f. *macrodonta*: Siculeni (5)
Ex- *Apium repens* (Jacq.) Lag.:Miercurea Ciuc (5)
R- *Armeria. barcensis* Simk.: Hărman (16, 23, 46,!), Prejmer (17,23), Stupini (23).
K- *Aruncus dioicus* Fernald: Tuşnad (5)
nt- *Aster lanceolatus* Willd.: Sântion-Luncă, Arini, Sâmbăta de Jos, Avrig, Bradu (!), **K-** *A. x salignus* Willd.: Prejmer (17), **R-** *A. tripolium* L.: Sărata, Avrig (40)
E- *Betula humilis* Schrank: Tuşnad-Sat, Tuşnadu Nou, Sânsimion (23), Vrabia (23,33), Sâncrăieni (5,23,!), **R-** *B. pubescens* Ehrh.: Sânsimion, Vrabia, Tuşnadu Nou (23), Tuşnad-Sat, Avrig (5,23), Sâncrăieni (5,23,!), Miercurea-Ciuc, Arpaşu de Jos (5), var. *carpatica*: Sâncrăieni, Tuşnad (5), f. *glabra*: Sâncrăieni, Tuşnad (5), f. *ovalis*: Arpaşu de Jos, Avrig (53), f. *rhomboidalis*: Arpaşu de Jos (53), Avrig (23), **I-** *B. x hybrida* Bechst.: Sânsimion, Vrabia (23), Sâncrăieni, Tuşnad (5), **I-** *B. x warnstorfii* C.K. Schneider: Vrabia (23), **I-** *B. x zimpelii* Junge: Sâncrăieni (23)
nt- *Berula erecta* (Huds.) Coville: Hărman (16), Aita Mare (!), Arpaşu de Jos, Bradu (57), Avrig (!)
nt- *Bidens cernua* L.: Mădăraş (6), Vrabia (33), Aita Mare, Bradu (!), **nt-** *B. tripartita* L.: Frequent
R- *Blysmus compressus* (L.) Panzer: Racu (6), Bălan, Sândominic, Ciceu, Tuşnad, Bixad (5), Sânsimion, Sâncrăieni (23)
nt- *Bolboschoenus maritimus* (L.) Palla: Săcădate, Bradu (HF), Avrig (!)
nt- *Butomus umbellatus* L.: Rotbav, Vadu Roşu (45,!), Feldioara (42), Arini (!), Olteţ (40), Avrig, Bradu (50), Săcădate (HF)
R- *Calamagrostis canescens* (Weber) Roth: Mădăraş, Racu (6), Miercurea-Ciuc (8,!), Sântimbru, Sânsimion (9), Vrabia, Tuşnadu Nou (33), Tuşnad-Sat (5,33), **R-** *C. neglecta* (Ehrh.) Beauv.: Mădăraş (6,8,!), Miercurea-Ciuc (8),- Tuşnadu Nou (5,15), **nt-** *C. pseudophragmites* (Haller fil.) Koeler: Sântion-Luncă, Reci, Pasul Turnu Roşu (!), Bradu (50)
E- *Calla palustris* L.: Prejmer (17), Avrig (5,50,57)
nt- *Callitriche cophocarpa* Sendtner: Frequent, *f. terricola* Soo: Tuşnad (5), f. *limnicola* Soo: Tuşnad (5), **I-** *C. hamulata* Kutz: Sâncrăieni (5), **R-** *C. palustris* L.:Sântimbru (5,9), Tuşnad (5), Hărman (16), Avrig (23), Bradu (HD), f. *stellata*: Prejmer (17), f. *angustifolia*: Prejmer (17), **I-** *C. stagnalis* Scop.: Tuşnad (5)
nt- *Caltha palustris* L. ssp. *laeta* (Schott, Nym. et Kotschy) Hegi: Frequent
nt- *Calystegia sepium* L.: Frequent

nt- *Cardamine amara* L.: Sântimbru (9), Bălan, Sândominic, Tuşnad (5), Hărman (5,16,!), Prejmer (5,17), Rotbav, Măieruş (45), **nt-** *C. pratensis L.*: Frequent, ssp. *matthioli* (Moretti) Arc.: Mădăraş (6), Bradu (HD)

nt- *Carex acutiformis* Ehrh.: Frequent, f. *spadicea*: Bradu (50), **R-** *C. appropinquata* Schumacher: Racu, Mădăraş (6), Sântimbru (9), Sânsimion (5,9,23), Vrabia, Tuşnad-Sat (33), Tuşnadu Nou (15), Sâncrăieni (5), Prejmer, Avrig (5,23), Beclean (40), **I-** *C. bohemica* Schreber: Racoşu de Jos (5), **nt-** *C. brizoides* L.: Sâmbăta de Jos, Arpaşu de Jos, Avrig (5), f. *subheterostachya* A. et G.: Viştea de Jos, Sâmbăta de Jos (5), **R-** *C. bueckii* Wimmer: Prejmer (17), Bod, Porumbacu de Jos (5), Beclean (5,40), Bradu (57,HD), Avrig (HD), **R-** *C. buxbaumii* Wahlenb.: Racu, Mădăraş (6), Sântimbru, Bixad, Sâmbăta de Jos (5), Hărman, (16,23), Prejmer (17,23), Beclean, Arpaşu de Jos (40), Viştea de Jos (5,40), **R-** *C. caespitosa* L.: Sântimbru, Mândra (5), Sâncrăieni (5,23), Rotbav, Vadu Roşu (45), Viştea de Jos (40), Bradu (HK), **nt-** *C. canescens* L.: Racu (6), Mădăraş (6,8,!), Vrabia (23,33), Tuşnadu Nou (5,15,33), Beclean, Mândra (40), Arpaşu de Jos, Avrig (5), **R-** *C. davalliana* Sm.: Racu (8), Mădăraş (23,!), Sântimbru, Sânsimion (9), Miercurea-Ciuc (5,8,23), Tuşnadu Nou (15), Hărman (5,16,23,!), Prejmer (5,17), Stupini (5,23), Şercaia, Mândra (5), **R-** *C. diandra* Schrank: Racu, Mădăraş (6), Vrabia (23,33), Sânsimion (5,33), Miercurea-Ciuc (8), Tuşnad-Sat (33), Tuşnadu Nou (5,15,23), Jigodin (23), Sâncrăieni (5,23), Beclean, Viştea de Jos, Arpaşu de Jos (40), **R-** *C. dioica* L.: Racu (6,8), Vrabia (33), Tuşnadu Nou (15), Tuşnad-Băi, Olteţ (5), Sâncrăieni (5,23), **nt-** *C. distans* L.: Frequent, **R-** *C. disticha* Hudson: Racu, Mădăraş (6), Sântimbru (9), Miercurea-Ciuc (8), Tuşnad-Sat (33), Vrabia (23,33), Augustin (42), Rotbav (44,45), Părău (44), Racoşu de Jos, Făgăraş (5), **R-** *C. elata* All.: Viştea de Jos, Arpaşu de Jos (40), Bradu (HF), **nt-** *C. elongata* L.: Sânsimion, Avrig (5,23,!), Tuşnad, Racoşu de Jos, Şercaia, Mândra, Beclean, Arpaşu de Jos (5), **nt-** *C. flava* L.: Frequent, var. *alsatica*: Racu (6), f. *patula*: Arpaşu de Jos (5, 56), **nt-** *C. gracilis* Curt.: Frequent, var. *personata*: Sâncrăieni (5), var. *strictifolia*: Avrig (HD), **nt-** *C. hirta* L.: Frequent, **I-** *C. hordeistichos* Vill.: Hărman (5), **R-** *C. hostiana* DC.: Sântimbru (9), Vrabia, Tuşnadu Nou (23), Hărman (16,23), Prejmer (17), Stupini (23), **R-** *C. lasiocarpa* Ehrh.: Sânsimion, Hărman (5), Arpaşu de Jos (HD,HIP), Avrig (5,23), **R-** *C. lepidocarpa* Tausch.: Bălan, Sântimbru, Miercurea-Ciuc, Hărman, Mândra, Avrig (5), Vrabia (5,23,33), Sânsimion, Tuşnad-Sat, Comana de Jos (5,23), Tuşnadu Nou (15,23), Stupini (23), Prejmer (5,17), Beclean, Sâmbăta de Jos, Arpaşu de Jos (40), **nt-** *C. leporina* L.: Frequent, **R-** *C. limosa* L.: Vrabia (33), Jigodin (23), Sâncrăieni (5,23), Avrig (5), Bradu (57), **K-** *C. melanostachya* Bieb.: Bradu (HF), **nt-** *C. nigra* (L.) Rchb.: Frequent, ssp. *juncella* Fries: Viştea de Jos (5), var. *recta*: Bixad (5), var. *curvata*: Sâncrăieni (5), **I-** *C. oederi* Retz: Sântimbru (5,9), Miercurea-Ciuc (5,8), Sânsimion, Sâmbăta de Jos, Dridif, Viştea de Jos (5), **K-** *C. otrubae* Podp.: Vrabia (33), Miercurea-Ciuc, Arpaşu de Jos (5), **nt-** *C. pallescens* L.: Frequent, **nt-** *C. panicea* L.: Frequent, **R-** *C. paniculata* L.: Bălan, Sânsimion (5),Vrabia (23,33), Tuşnad-Sat, Prejmer, Hărman (5,23), Avrig (23), f. *simplex*: Bălan, Sândominic (5), **V-** *C. pauciflora* Lightf.: Siculeni (5), **nt-** *C. pseudocyperus* L.: Siculeni, Hărman, Arpaşu de Jos (5), Prejmer (13,17), Apaţa (42), Măieruş (45), Şercaia (5,40), Avrig (5,23), Bradu (5,57,HF), **nt-** *C. riparia* Curt.: Frequent, **nt-** *C. rostrata* Stokes: Frequent, var. *laevirostris*: Arpaşu de Jos)56,57), **I-** *C. x schatzii* Kneucker: Sânsimion, Miercurea-Ciuc (5), **nt-** *C. stellulata* Good.: Frequent, **K-** *C. x tetrastachya* Trauntst.: Sânsimion (5,23), Arpaşu de Jos, Avrig (5), **nt-** *C. vesicaria* L.: Frequent, **nt-** *C. vulpina* L.: Frequent

R- *Catabrosa aquatica* (L.) Beauv.: Ormeniş (42)

V- *Centaurium littorale* (D. Turner) Gilmour ssp. *uliginosum* (W. et K.) Melderis: Prejmer (5), **R-** *C. pulchellum* (Swartz) Druce: Hărman (5,16), Prejmer (17), Augustin (42,!), Rotbav (45), Perşani, Arpaşu de Jos (5), var. *simplicissimum*: Prejmer (17), f. *emarginatum*: Hărman (5)

nt- *Ceratophyllum demersum* L.:Sântion-Luncă, Arini, Aita Mare, Micloşoara, Augustin, Avrig (!), Bradu (5,57,!), Săcădate (57), ssp. *platycanthum*: Bradu (49), Săcădate (56), f. *polyacanthum* Schur: Bradu (5), **R-** *C. submersum* L.: Ormeniş (42), Bradu (5)

nt- *Chrysosplenium alternifolium* L.: Bălan (!), Bradu (5,50), Turnu Roşu (HD)

nt- *Cicuta virosa* L.: Mădăraş (6), Sântimbru (9), Vrabia (33), Tuşnad-Sat, Sânsimion (3,33), Sâncrăieni , Avrig (5,23), Apaţa (42), Măieruş (45), Beclean (40)

nt- *Cirsium canum* (L.) All.: Sântimbru, Sânsimion (9), Vrabia (33), Miercurea-Ciuc (8), Sâncrăieni (23,!), Prejmer (17), Rotbav, Vadu Roşu (45), Beclean, Olteţ (40), Bradu (50), **I-** *C. x erucagineum* DC.: Sândominic (5), **I-** *C. helenioides* (L.) Hill.: Sântimbru (5), **K-** *C. oleraceum* (L.) Scop.: Sântimbru (9), Prejmer (17), **R-** *C. palustre* (L.) Scop.: Racu (6), Sânsimion (9), Vrabia (33), Ormeniş (42,!), Mândra, Beclean, Viştea de Jos, Arpaşu de Jos (40), **nt-** *C. rivulare* (Jacq.) All.: Racu , Mădăraş (6,8), Sântimbru, Sânsimion (9,11), Sândominic (!), Vrabia , Tuşnad-Sat (33), Tuşnadu Nou (15), Hărman (16,!9, Prejmer (17), Stupini (23), Vadu Roşu (45), **I-** *C. x subalpinum* Gaud.: Topliţa-Ciuc (5), **R-** *C. x tataricum* (L.) All.: Bălan-Sândominic, Sânsimion, Bradu (5)

R- *Cladium mariscus* (L.) Pohl: Hărman (5,23,46,!), Prejmer (17), Stupini (46), Avrig (5)

V- *Cnidium dubium* (Schkuhr) Thell.: Mădăraş (6,23), Vrabia, Tuşnad-Sat (23,33), Miercurea-Ciuc (8), Sânsimion, Tuşnadu Nou (23)
R- *Comarum palustre* L.: Racu (6), Mădăraş (6,8,23), Vrabia, Sânsimion (23,33), Miercurea-Ciuc (8), Sâncrăieni , Comana de Jos, Avrig (23), Tuşnad-Sat (33), Tuşnadu Nou (15,23), Hărman (46), Făgăraş (5), Arpaşu de Jos (40,57), Bradu (57)
nt- *Crepis paludosa* (L.) Moench.: Sântimbru, Sânsimion (9), Vrabia (33), Prejmer (17), Vadu Roşu (45), Beclean (40)
K- *Cuscuta lupuliformis* Krocker: Arpaşu de Jos, Cârţa (!)
nt- *Cyperus flavescens L.* Hărman , Viştea de Jos, Cârţa (5), Prejmer (17), Sărata (50,!), Avrig, Bradu (HF,!) **nt-** C. *fuscus* L.: Prejmer (5,17), Racoşu de Jos (5), Bradu (HF), var. *virescens:* Perşani (5)
R- *Dactylorhiza incarnata* (L.) Soo: Sântimbru, Sânsimion (9), Vrabia (33), Tuşnad-Sat (5,33), Tuşnadu Nou (15), Chichiş, Făgăraş (5), Sâncrăieni (5,23), Hărman (5,16,!), Prejmer (17), Rotbav, Vadu Roşu (45), Scorei, Bradu (HU), Avrig (HD), var. *extensa* Hartm.: Prejmer (13), f. *macrophylla* Schur: Făgăraş (5), **R-** *D. maculata* (L.) Soo: Avrig (23,50), Bradu (50), ssp. *transsilvanica* (Schur) Soo: Bradu (5), **R-** D. *majalis* (Rchb.) P.F. Hunt et Summerh.: Prejmer (13)
nt- *Deschampsia caespitosa* (L.) Beauv.: Frequent, var. *parviflora*: Sântimbru (5), f. *aurea*: Miercurea-Ciuc (5)
R- *Dianthus superbus* L.: Sânsimion (23,33), Vrabia, Stupini (23), Sâncrăieni (5,23), Hărman (!)
V- *Drosera anglica* Huds.: Sâncrăieni (5,23), Hărman (5,16,23), Prejmer (17), Stupini (23), **R-** *D. rotundifolia* L.: Tuşnad (5), Viştea de Jos (40), Arpaşu de Jos (5,40,!), Cârţa (5), Avrig (23)
R- *Dryopteris cristata* (L.) A. Gray: Sânsimion (23), Vrabia, Tuşnadu Nou (5, 23), **R-** *D. thelipteris* (L.) A. Gray: Sânsimion , Tuşnadu Nou (23), Vrabia (33), Tuşnad-Băi, Arpaşu de Jos, Bradu (5), Prejmer (17)
nt- *Echinocystis lobata* (Michx) Torrey et Gray: Sântion-Luncă, Bixad, Arini, Sâmbăta de Jos, Arpaşu de Jos, Avrig, Şebeş-Olt (!), Bod (13), Ormeniş (42), Boiţa, Turnu Roşu (55,!)
E- *Elatine hexandra* (Lapierre) DC.: Sâmbăta de Jos (5)
R- *Eleocharis acicularis* (L.) Roem. et Schult.: Hărman, Prejmer, Arpaşu de Jos (5), Avrig (5,23), **R-** *E. carniolica* Koch: Sâncrăieni, Prejmer (5), Arpaşu de Jos (40), **R-** *E. ovata* (Roth) Roem. et Schult.: Hărman-Prejmer, Viştea de Jos (5), Arpaşu de Jos (50,56), Avrig (5,50), Bradu (57), **nt-** *E. palustris* (L.) Roem. et Schult.: Frequent, f. *filiculmis:* Arpaşu de Jos (56), f. *minor*: Bradu (HF), **I-** *E. parvula* (Roem. et Schult.) Link.: Mândra (40), **R-** *E. quinqueflora* (Hartm.) O. Schwarz: Racu (6), Sândominic (5), Hărman (5,16), Dridif, Arpaşu de Jos (40), **V-** *E. uniglumis* (Link) Schult.: Sâncrăieni (23), Tuşnad-Sat (5,23)
R- *Elodea canadensis* L.: Arini (!)
nt- *Epilobium hirsutum* L.: Vrabia (33), Prejmer (23), Ormeniş, Vadu Roşu (42), Bradu, Boiţa, Turnu Roşu (50), **R-** *E. lamyi* F.W. Schultz: Sândominic (!), Feldiora (12), **R-** *E. obscurum* Schreb.: Bixad, Prejmer (5), **nt-** *E. palustre* L.: Frequent, f. *glandulosum*: Prejmer (17), f. *latifolium*: Sâncrăieni (5), **R-** *E. parviflorum* Schreb.: Prejmer (17), Augustin (42,!), Avrig, Bradu (HF), **R-** *E. roseum* Schreb.: Bălan (5), Apaţa (!)
R- *Epipactis palustris* (L.) Crantz: Sântimbru (9), Sânsimion, Prejmer (5), Tuşnadu Nou (15), Tuşnad-Sat (23), Sâncrăieni (5,23,!), Hărman (5,16,23), Stupini (5,23), Avrig (23), Bradu (5,57)
nt- *Equisetum fluviatile* L.:Frequent, **R-** *E. hyemale* L.: Bradu, Boiţa (5), Turnu Roşu (!), **nt-** *E. palustre* L.: Frequent, **nt-** *E. telmateia* Ehrh.: Mădăraş (6,!), Tuşnadu Nou (33), Hoghiz (5), Avrig, Turnu Roşu (!), Bradu (HF), **nt-** *E. sylvaticum* L.: Bălan, Tuşnad-Băi, Racoşu de Jos, Hoghiz (5), Bradu (5,57), Avrig, Săcădate (!), **V-** *E. variegatum* Schleich.: Hărman, Prejmer (12)
nt- *Eriophorum angustifolium* Honckeny: Bălan (!), Racu, Mădăraş (6), Tuşnad-Sat (23,33), Tuşnadu Nou (15,23), Sâncrăieni, Avrig (23), Hărman (16,46), Prejmer (17), **R-** *E. gracile* Koch: Tuşnad, Arpaşu de Jos, Avrig (5), **nt-** *E. latifolium* Hoppe: Frequent, **R-** *E. vaginatum* L.: Miercurea-Ciuc, Avrig (23)
nt- *Eupatorium cannabinum* L.: Frequent
K- *Euphorbia palustris* L.: Bradu (5)
K- *Euphrasia hirtella* Jord. ?Hărman (5,16), **V-** *E. kerneri* Wettst.: Hărman (5,16)
V- *Evonymus nana* Bieb.: Miercurea-Ciuc, Tuşnad-Sat (23), Sâncrăieni (!)
nt- *Festuca pratensis* L.: Frequent
nt- *Filipendula ulmaria* (L.) Maxim: Frequent, ssp. *denudata* (J. et C. Presl.) Hayek: Prejmer (5), ssp. *nivea* (Wallr.) Hayek: Sâncrăieni (23)
nt- *Frangula alnus* Miller: Frequent
V- *Fritillaria meleagris* L.: Mădăraş, Jigodin (23), Sântimbru, Sânsimion (9), Vrabia (33), Miercurea-Ciuc (5,8), Tuşnadu Nou (5,15), Hărman (5,16,17), Bod (5,17,23), Vadu Roşu (17)
nt- *Galega officinalis* L.: Bradu (57), Turnu Roşu (!)

nt- *Galium boreale* L.: Racu, Mădăraş (6,!), Sântimbru (9,11), Sânsimion, Stupini, Bod, Hărman (23), Tuşnadu Nou (15), Miercurea-Ciuc, Ciceu (5), Prejmer (17,23), var. *pseudorubioides* Schur: Hărman (13), **nt-** *G. palustre* L.: Frequent, **R-** *G. rubioides* L.: Hărman (13), Vadu Roşu (45), Bradu (5), **nt-** *G. uliginosum* L.: Frequent

R- *Gentiana pneumonanthe* L.: Hărman (5,!), Prejmer (17), Sebeş-Olt (!)

nt- *Geranium palustre* L.: Racu (6), Vrabia (33), Sânsimion, Tuşnadu Nou, Prejmer, Bod, Feldioara (23), Sâncrăieni, Tuşnad-Sat (5,23), Scorei, Avrig (57), Bradu (5, 57), f. *obtusatum*: Hărman (12)

K- *Geum x intermedium* Ehrh.:Tuşnad, Racoşu de Jos (5), **nt-** *G. rivale* L.: Racu, Mădăraş (6), Sântimbru (9), Miercurea-Ciuc (5,8), Hărman (5), Prejmer (17)

R- *Gladiolus imbricatus* L.: Bradu, Boiţa (48,57)

nt- *Glyceria fluitans* (L.) R.Br.: Frequent, **nt-** *G. maxima* (Hartm.) Holmberg: Frequent, f. *vivipara*: Racu (6), **nt-** *G. plicata* (Fries) Fries: Racu, Mădăraş (6), Tuşnad-Sat (33), Feldioara (42), Comana de Jos (44), Avrig (!), Bradu (HF)

nt- *Gratiola officinalis* L.: Apaţa, Ormeniş (42,!), Părău (44), Avrig, Turnu Roşu (!), var. *angustifolia*: Săcădate (5)

E- *Groenlandia densa* (L.) Fourr.: Prejmer (5)

nt- *Helianthus decapetalus* L.: Sântion-Luncă, Reci, Bixad, Arini, Comana de Jos, Sâmbăta de Jos, Avrig, Bradu, Podu Olt (!)

V- *Hippuris vulgaris* L.: Prejmer (5,17), Arini (!), Rotbav (45)

nt- *Holcus lanatus* L.: Frequent

V- *Hottonia palustris* L.: Bod-Apaţa (46), Rotbav (44,45), Făgăraş (5), Olteţ (40), Bradu (HF)

R- *Hydrocharis morsus-ranae* L.: Reci, Arini, Aita Mare (!), Apaţa, Ormeniş, Augustin (42), Ariujd (17), Rotbav, Vadu Roşu (45), Avrig (5,23), Racoviţa (HK)

nt- *Hypericum humifusum* L.: Scorei (40), Arpaşu de Jos (5,23,56), Mârşa (!), Turnu Roşu (5,567), **nt-** *H. quadrangulum* L.: Hărman (5), Prejmer (17), Viştea de Jos (40), Avrig (!), Bradu (5,57)

nt- *mpatiens glandulifera* Royle: Stupini, Bod (12), Bixad, Arini, Făgăraş, Mândra, Sâmbăta de Jos, Ucea de Jos, Arpaşu de Jos,, Avrig, Bradu, Turnu Roşu (!), **nt-** *I. noli-tangere* L.: Prejmer (17), Arpaşu de Jos (!)

R- *Inula helenium* L.: Tuşnad, Hărman, Prejmer, Săcădate (5), Bradu (5,!)

nt- *Iris pseudacorus* L.: Tuşnad-Sat (33), Prejmer (17), Ormeniş, Apaţa, Vadu Roşu (42,45), Augustin (42,!), Arini, Turnu Roşu (!), Rotbav, Măieruş (45), Beclean, Olteţ, Mândra, Arpaşu de Jos, Scorei, Racoviţa (40), Avrig (23,40,50,!), Bradu (50,!), **R-** *I. sibirica* L.: Mădăraş (6), Prejmer (12,17), Bod (5), Bradu (5,50)

R- *Isolepis setacea* (L.) R.Br.: Hărman (16), Prejmer (5,17), **I-** *I. supina* (L.) R. Br.: Hărman-Prejmer (5)

K- *Juncus acutiflorus* Ehrh.: Bradu (5), **nt-** *J. articulatus* L.: Frequent, **R-** *J. atratus* Krocker: Mădăraş (6), Miercurea-Ciuc, Ciceu (5), Bradu (5,50), **nt-** *J. bufonius* L.: Feldioara (42), Avrig, Bradu (50,HF), **nt-** *J. conglomeratus* L.: Frequent, **nt-** *J. compressus* Jacq.: Racu (6), Sântimbru (9), Vrabia (33), Tuşnad, Ciceu), Feldioara (42), Vadu Roşu (45), Avrig, Bradu (5,50), Podu Olt (HSB), **nt-** *J. effusus* L.: Frequent, var. *compactus* Lej. et Court.: Sâncrăieni (5), Avrig (!), **R-** *J. gerardi* Lois: Racu, Mădăraş (6), Hărman (16), Rotbav (45), Feldioara (42), Mândra, Olteţ, Sărata, Avrig (40), **nt-** *J. inflexus* L.: Hărman (16), Rotbav (45,!), Turnu Roşu (!), **K-** *J. x royeri* Fournier: Ciceu (5), **K-** *J. tanageia* Ehrh.: Podu Olt (5), **R-** *J. thomassii* Ten.: Bălan, Sândominic, Sâncrăieni, Tuşnad, Bixad (5), Arpaşu de Jos, Bradu (5,57)

nt- *Lathyrus palustris* L.: Racu, Mădăraş (6), Sânsimion, Sântimbru (9), Vrabia (23,33), Simioneşti (5), Tuşnad-Sat (5,23,33), Tuşnadu Nou (15,33), Miercurea-Ciuc (8), Sâncrăieni (23), Rotbav, Vadu Roşu (45)

R- *Leersia oryzoides* (L.) Swartz: Comana de Jos (44), Şercaia, Viştea de Jos, Porumbacu de Jos, Avrig, Racoviţa (40), Scorei (57)

I- *Lemna gibba* L.: Olteni (5), Bradu (5,57), **nt-** *L. minor* L.: Frequent, **nt-** *L. trisulca* L.: Sântion-Luncă, Turnu Roşu (!), Ormeniş, Apaţa, Feldioara (42), Rotbav, Vadu Roşu (45), Bradu (HF)

R- *Ligularia sibirica* (L.) Cass.: Sânsimion (9,23), Vrabia (33), Ciceu, Bixad, Simioneşti (5), Miercurea-Ciuc-Topliţa Ciuc (5,23), Tuşnad-Sat (23), Tuşnadu Nou, Sâncrăieni (5,23), Tuşnad-Băi (23), Hărman (5,16,23,46), Prejmer (5,17), Stupini (5,23), f. *arenosa*: Sânsimion, Vrabia, Tuşnadu Nou, Tuşnad-Sat, Tuşnad-Băi, Hărman, Stupini (23), Sâncrăieni (5,23), f. *pubicaulis*: Tuşnad, Hărman (5)

R- *Limosella aquatica* L.: Aita Mare, Cârţa (5), Podu Olt (!)

R- *Lindernia procumbens* (Krocker) Philcox: Prejmer (5), Porumbacu de Jos, Scorei, Avrig (5,57), Cârţa (57)

nt- *Lychnis flos-cuculi* L.: Frequent, f. albiflora: Bradu (HF)

I- *Lycopodium inundatum* L.: Tuşnad (5)
nt- *Lycopus europaeus* L.: Frequent, f. elatior : Sâncrăieni (5), **R-** *L. exaltatus* L.: Prejmer (17)
nt- *Lysimachia nummularia* L.: Frequent, **R-** *L. thyrsiflora* L.: Racu (6), Mădăraş (6,8), Sântimbru (9), Sânsimion (9,23), Vrabia (33), Tuşnad-Sat (5,33), Tuşnadu Nou (15), Tuşnad-Băi (23), Miercurea-Ciuc, Ciceu-Topliţa, Bixad, Făgăraş (5), Sâncrăieni (5,23), Bod-Apaţa (46), Comana de Jos (44), Beclean (5,40), Arpaşu de Jos (40), Avrig (5,23), **nt-** *L. vulgaris* L.: Frequent, f. *paludosa*: Tuşnad-Băi, Prejmer (5)
R- *Lythrum hyssopifolia* L.: Racoşu de Jos, Avrig (5), **nt-** *L. salicaria* L.: Frequent, var. *intermedium* : Hărman (12), f. *glabrescens*: Avrig (HD), Bradu (HF)
R- *Malaxis monophyllos* (L.) Swartz: Bălan (5)
nt- *Matteuccia struthiopteris* (L.) Tod.: Bălan (!), Tuşnad-Băi (5), Bradu (50)
nt- *Mentha aquatica* L.: Frequent, **nt-** *M. arvensis* L.: Sâncrăieni (23,!), Prejmer (17), Ormeniş, Augustin, Feldioara, Vadu Roşu (42), Rotbav (44,45), ssp. *austriaca* (Jacq.) Briq.: Sâncrăieni (23), var. *hostii*: Sâncrăieni (23), **R-** *M. x dumetorum* Schultes: Prejmer (17), **I-** *M. laciniosa* Schur var. *diespasmena*: Avrig (5), **nt-** *M. longifolia* L.: Frequent, var. *hapalophylla*: Sf. Gheorghe (5), var. *weinerniana*: Hărman (5), var. *leioneura:* Turnu Roşu (5), **nt-** *M. pulegium* L.: Sântimbru (9), Augustin (42), Beclean, Viştea de Jos (40), Comana de Jos, Făgăraş, Turnu Roşu (!), **I-** *M. spicata* L.: Hărman (16)
R- *Menyanthes trifoliata* L.: Racu (6), Sântimbru (9), Sânsimion (5,9,23), Vrabia (23,33), Tuşnadu Nou (15), Ciceu, Siculeni (5), Sâncrăieni (5,23,!), Hărman (5,16), Stupini, Veneţia de Jos (23), Beclean, Mândra, Viştea de Jos, Racoviţa (40), Arpaşu de Jos (5,40), Avrig (5,23,40,57), Bradu (5,57)
nt- *Molinia coerulea* (L.) Moench.: Racu (6,8), Sântimbru (9,11), Sânsimion (9,23), Vrabia (23,33), Tuşnadu Nou, Tuşnad-Sat, Bod, Comana de Jos (23), Sâncrăieni (23,!), Hărman (16,23,46), Prejmer (17,23,46), Stupini (23,46), Viştea de Jos, Olteţ, Scorei (40), Arpaşu de Jos (40,!), Cârţa, Sebeş-Olt (!), Avrig (23,40), ssp. *littoralis:* Bradu (HF)
I- *Myosotis caespitosa* C.F. Schultz: Beclean, Viştea de Jos, Arpaşu de Jos, Scorei (40), **nt-** *M. scorpioides* L.: Frequent, var. *memor* Kitt.: Topliţa-Ciuc, Miercurea-Ciuc, Ciceu, Sâncrăieni (5), f. *laxiflora:* Turnu Roşu (5)
K- *Myosurus minimus* L.: Racoşu de Jos (5)
nt- *Myricaria germanica* (L.) Desv.: Săndominic (5), Arpaşu de Jos (40,!), Avrig, Bradu (HF)
nt- *Myriophyllum spicatum* L.: Sânsimion, Prejmer (5), Sântion-Luncă, Reci, Mândra, Sebeş-Olt (!), Augustin (42,44,!), Scorei (57), Avrig (HS), Bradu (5,57), **nt-** *M. verticillatum* L.:Sântimbru (5,9), Tuşnad, Sâncrăieni (5), Arini, Aita Mare (!), Scorei (57), Avrig (5,57), Bradu (57,HF)
V- *Narcissus angustifolius* Curt.: Sântimbru, Ciceu, Sâncraiu (5), Arpaşu de Jos (!)
I- *Nasturtium officinale* R. Br.: Prejmer (5)
R- *Nuphar lutea* (L.) Sibth. et Sm.: Sântimbtu, Tuşnad-Băi, Bod (5), Prejmer-hărman (17), Arini (!)
E- *Nymphaea alba* L.: Augustin (42,44), Apaţa (5)
nt- *Oenanthe aquatica* (L.) Poiret: Racu (6), Sântimbru, Sânsimion (9), Vrabia, Tuşnad-Sat (33), Ormeniş, Apaţa, Feldioara (42), Rotbav, Măieruş (45), Vadu Roşu (42,45), Mândra, Şercaia, Porumbacu de Jos (40), Avrig (23,!), Bradu (50,HF), **R-** *O. banatica* Heuff.: Sântimbru (9), Sânsimion (5,9), Miercurea-Ciuc, Tuşnad, Sâncrăieni (5), **R-** *O. silaifolia* Bieb.: Vrabia, Tuşnadu Nou (33), Avrig (23)
K- *Ophioglossum vulgatum* L.: Hoghiz (5)
R- *Orchis laxiflora* Lam.: Racu (6), Vrabia (33), Hărman (13,16), Prejmer (17), Mândra, Beclean, Viştea de Jos, Olteţ (40), Arpaşu de Jos (23,40), Scorei (40,HF), Porumbacu de Jos, Avrig (HD), Bradu (57,HF), Turnu Roşu (!)
nt- *Parnassia palustris* L.: Racu (8), Sântimbru (9), Vrabia (23,33), Tuşnad-Sat (33), Tuşnadu Nou (15,23), Hărman (16,23,!), Prejmer (17), Stupini, Feldioara (23)
R- *Parthenocissus inserta* (A. Kern.) K. Fritsch: Augustin (!)
nt- *Pedicularis palustris* L.: Racu, Mădăraş (6), Sântimbru (9), Sânsimion , Tuşnad-Sat (23,33), Tuşnadu Nou (15,23,33), Vrabia (33), Sâncrăieni , Hărman, Veneţia de Jos (23), Sândominic (5), Prejmer (5,23), Vadu Roşu (45), Comana de Jos (23,44), Beclean, Olteţ (40), **V-** *P. sceptrum-carolinum* L.: Hărman (5,16,23,46), Prejmer (17)
nt- *Peplis portula* L.: Sântimbru, Cârţa (5), Scorei (!), Avrig (5,23,57)
nt- *Petasites albus* (L.) P. Gaertn.: Bălan (!), **nt-** *P. hybridus* (L.) P. Gaertn.: Frequent
R- *Peucedanum palustre* (L.) Moench.: Sânsimion, Avrig (5,23), Sâncrăieni (5,23,!), Tuşnad-Sat, Tuşnadu Nou, Bod, Comana de Jos (23), Hărman (16), Arpaşu de Jos (5)
nt- *Phalaris arundinacea* L.: Frequent
nt- *Phragmites australis* (Cav.) Trin. et Steudel: Frequent
R- *Pinguicula vulgaris* L.: Sântimbru (9,11), Hărman (5,16,23), Prejmer (17,23), Stupini (23)

R- *Plantago maritima* L.: Sărata (40)
nt- *Poa palustris* L.: Racu (6), Mădăraş (6,8,!), Sânsimion, Sântimbru (9), Vrabia, Tuşnad-Sat (33), Miercurea-Ciuc (8,!), Tuşnadu Nou (15,33), Hărman (16), Rotbav, Vadu Roşu (45), Bradu (HU), Podu Olt (HSB), var. *fertilis*: Turnu Roşu (57), f. *baumgarteniana*: Săcădate (52), **nt-** *P. trivialis* L.: Frequent
R- *Polemonium caeruleum* L.: Vrabia (23,33), Sânsimion, Tuşnadu Nou (23), Tuşnad-Sat (5,23), Miercurea-Ciuc (5)
nt- *Polygonum amphibium* L.: Racu (6), Mădăraş (6,8), Sântimbru (9), Miercurea-Ciuc (8), Prejmer (17), Ormeniş, Apaţa (42), Augustin (42,44), Rotbav, Măieruş (45), Vadu Roşu (42,45), Feldioara (42), Şercaia (40), Bradu (50), Sebeş-Olt (!), f. *terrestre*: Racu (6) **nt-** *P. bistorta* L. Racu, Mădăraş (6,!), Sântimbru, Sânsimion (9), Sândominic (!), Vrabia (23,33), Miercurea-Ciuc, Făgăraş (5), Sâncrăieni (23,!), Feldioara (23), Avrig (23,40), Bradu (5,57), **nt-** *P. cuspidatum* Sieb. et Zucc.: Bălan, Miercurea-Ciuc, Făgăraş, Avrig, Podu Olt, Turnu Roşu (!), **nt-** *P. hydropiper* L.: Frequent, **nt-** *P. lapathifolium* L.: Mândra, Beclean (40), Făgăraş, Scorei, Podu Olt (!), Viştea de Jos (5), Avrig (HF), Bradu (50), var. *nodosum*: Bradu (50), **K-** *P. minus* Huds.: Tuşnad, Feldioara, Făgăraş (5), Turnu Roşu (!), **nt-** *P. mite* Schrank: Sântimbru (9), Ormeniş (42,!), Bradu (5), Turnu Roşu (!), **nt-** *P. persicaria* L.: Frequent
nt- *Populus alba* L. : Hoghiz (5), Bradu (5,50), Turnu Roşu (!), **nt-** *P. nigra* L.: Avrig, Bradu (!)
I- *Potamogeton acutifolius* Link: Tuşnad (5), **Ex-** *P. coloratus* Hornem: Sândominic (5), **nt-** *P. crispus* L. Sântimbru (9), Bixad, Reci, Sebeş-Olt (!), Săcădate, Bradu (57,HF), **I-** *P. gramineus* L.: Sâmbăta de Jos (5), **R-** *P. lucens* L.: Augustin, Apaţa, Ormeniş (42), **nt-** *P. natans* L.: Sântimbru (5,9), Sânsimion, Prejmer (5), Hărman (16), Arpaşu de Jos, Avrig (23), Bradu (5,57), f. *amphibius*: Bradu (5), **nt-** *P. nodosus* Poiret: Augustin, Avrig, Bradu (!), **I-** *P. pectinatus* L. Bradu (57,HF), **nt-** *P. pusillus* L.: Sândominic (5), Bixad, Mândra (!), Hărman (16), Avrig (5,!), Bradu (57,HF), var. *tenuissimus*: Avrig (5,57), f. *acuminatus:* Sândominic (5), f. *elongatus*: Hărman (5), **R-** *P. trichoides* Cham. et Schlecht.: Vrabia (23), Augustin (42)
nt- *Potentilla anserina* L.: Frequent, **nt-** *P. reptans* L.: Frequent, **nt-** *P. supina* L.: Hărman (12), Făgăraş, Turnu Roşu (!)
R- *Primula farinosa* L.: Vrabia (33), Tuşnadu Nou (15,23), Hărman (5,16,23,46,!), Prejmer (5,17,23), Stupini (5,23), f. *albiflora* Pax: Hărman (5)
nt- *Prunus padus* L.: Tuşnadu Nou (5,23), Hărman, Racoşu de Jos, Bradu (5)
R- *Puccinellia distans* (L.) Parl.: Sărata (40), Bradu (50)
nt- *Pulicaria dysenterica* (L.) Bernh.: Prejmer, Hărman, Scorei (5), **nt-** *P. vulgaris* Gaertn.: Sâncrăieni (5,!)
nt- *Ranunculus acris* L.: Frequent, f. *latisectus*: Bradu (HD), **K-** *R. aquatilis* L.: Avrig (56), **nt-** *R. flammula* L.: Frequent, ssp. *reptans*: Racoşu de Jos (5), f. *tenuifolius* Wallr.: Bălan, Racoşu de Jos (5), **K-** *R. fluitans* Lam.: Sâncrăieni (5), **R-** *R. lingua* L.: Racu (6), Vrabia (33), Tuşnadu Nou (15), Rotbav (45), Vadu Roşu (42), Hărman (5),Beclean, Olteş, Arpaşu de Jos (40), Avrig (5,57), **nt-** *R. repens* L.: Frequent, **R-** *R. rionii* Lagger: Bradu (5,57), Sebeş-Olt (!), **nt-** *R. sceleratus* L.:Reci, Sf. Gheorghe, Făgăraş (!), Beclean (40), Avrig (23,!), Bradu (50, HF), **nt-** *R. strigulosus* Schur: Frequent, **nt-** *R. trichophyllus* Chaix: Miercurea-Ciuc, Bradu (5), Hărman (12), Prejmer (17), Vadu Roşu, Feldioara (42)
R- *Ribes nigrum* L. Sânsimion (9,23), Vrabia, Tuşnadu Nou (23), Prejmer (17)
nt- *Rorippa amphibia* (L.) Bess.: Prejmer (17), Ormeniş, Apaţa (42,45), Rotbav (45), **nt-** *R. austriaca* (Crantz) Bess.: Tuşnad, Sâncrăieni, Hărman (5), Ormeniş, Feldioara (42), Robav (45), Bradu (50), **nt-** *R. palustris* (L.) Bess.: Sândominic-Bălan, Hărman, Făgăraş (5), Măieruş, Vadu Roşu (45), Porumbacu de Jos (5,57), Bradu (57), **nt-** *R. sylvestris* (L.) Bess.: Mădăraş (6), Vrabia, Tuşnadu Nou (33), Ormeniş, Feldioara (42), Rotbav (45),Porumbacu de Jos (40,!), Avrig, Podu Olt, Turnu Roşu (!), Bradu (50)
nt- *Rudbeckia laciniata* L.: Viştea de Jos, Arpaşu de Jos, Bradu (5), Avrig (5,!), Turnu Roşu (!)
R- *Rumex aquaticus* L.: Sânsimion (5), Săcădate (56), Avrig (HD), Bradu (50), **nt-** *R. hydrolapathum* Huds.: Sânsimion, Racoşu de Jos, Făgăraş, Săcădate (5), Prejmer (5,17), Aita Mare (!), Ormeniş, Feldioara, Augustin (42), Apaţa, Vadu Roşu (42,45), Rotbav, Măieruş (45), **R-** *R. maritimus* L.: Sâncrăieni (5), Măieruş-Apaţa (45), Săcădate, Bradu (HF), **R-** *R. palustris* Sm.: Ormeniş (42), Olteţ (40), Bradu (5,57), Sebeş-Olt (!)
R- *Sagittaria sagittifolia* L.: Tuşnad (5), Augustin (42,!), Arini, Micloşoara (!), Avrig, Bradu (5,HF,!), f. *heterophylla* (Schreb.) Bolle: Bod (13), f. *vallisnerifolia:* Tuşnad (5)Ariujd (17),
nt- *Salix alba* L.: Frequent, **K-** *S. x alopecuroides* Tausch: Bradu (5), **R-** *S. aurita* L.: Tuşnad-Sat (5,23), Avrig (23), **K-** *S. x capreola* Kern.: Stupini (23), **nt-** *S. cinerea* L.: Frequent, **R-** *S. x cuspidata* F. Schultz: Sâncrăieni, Bod (5), **R-** *S. eleagnos* Scop.: Hărman-Prejmer (17), **nt-** *S. fragilis* L.:

Frequent, **K-** *S. x multinervis* Doll.: Sânsimion (23), **R-** *S. pentandra* L.: Vrabia, Tuşnadu Nou, Miercurea-Ciuc, Feldioara (23), Tuşnad-Sat (5,33), Sânsimion, Sâncrăieni (5,23), Hărman-Prejmer (17), **nt-** *S. purpurea* L.: Frequent, **nt-** *S. rosmarinifolia* L.: Mădăraş, Tuşnadu Nou, Stupini (23), Sântimbru (9), Vrabia (23,33), Sânsimion, Tuşnad-Sat, Avrig (5,23), Miercurea-Ciuc, Racoşu de Jos (5), Sâncrăieni (5,23,!), Prejmer (17,23), Hărman (23,!), Sâmbăta de Jos (40), Arpaşu de Jos (40,57,!), Bradu (56), Pasul Turnu Roşu (5,56), **nt-** *S. triandra* L.: Frequent, **nt-** *S. viminalis* L.: Mădăraş (23,!), Vrabia (23), Miercurea-Ciuc, Feldioara, Racoşu de Jos (5), Tuşnadu Nou (5,15), Prejmer (17), Aita Mare, Arini, Avrig (!), Bradu, Sebeşu de Jos, Turnu Roşu (5,57,!)

R- *Salvinia natans* L.: Apaţa (!), Augustin (42,!)

nt- *Sanguisorba officinalis* L.: Frequent

E- *Saxifraga hirculus* L.: Vrabia, Tuşnadu Nou (23), Sâncrăieni (5,23), f. *major*: Sâncrăieni (5), **E-** *S. mutata* L.: Stupini (35)

R- *Scheuchzeria palustris* L.: Avrig (5,23,51), f. minor: Avrig (5,51)

nt- *Schoenoplectus lacustris* (L.) Palla: Ormeniş, Apaţa (42), Augustin (42,44,!), Arini (!), Şercaia (40), Avrig (57,!), Bradu (57), **R-** *S. mucronatus* (L.) Palla: Hărman, Prejmer, Arpaşu de Jos (5), **R-** *S. tabernaemontani* (C.C. Gmel.) Palla: Hărman, Prejmer, Racoşu de Jos (5)

E- *Schoenus ferrugineus* L.: Sântimbru (9,11), **R-** *S. nigricans* L.:Hărman (5,16,23,46,!), Prejmer (5,16,46), Stupini (46)

R- *Scirpus radicans* Schkuhr: Prejmer (5), Bradu (56,57,HF), **nt-** *S. sylvaticus* L.: Frequent, f. compactus (Klinggr.) Nyar.: Hărman (13)

R- *Scorzonera humilis* L.: Prejmer (17), f. latifrons: Prejmer (12)

nt- *Scrophularia umbrosa* Dum.: Mădăraş (!), Sânsimion, Tuşnad-Sat (23), Prejmer (17), Bradu (57)

nt- *Scutellaria galericulata* L.: Frequent, **nt-** *S. hastifolia* L.: Hărman (12), Făgăraş (5), Bradu (5,!), Avrig, Sebeş-Olt (!)

R- *Selinum carvifolia* (L.) L.: Tuşnadu Nou (15,23), Sâncrăieni (23,!)

R- *Senecio aquaticus* Hill. ssp. *barbaraefolius* (Wimm. et Grab.) Walters: Sântimbru (9), Vrabia (33), Sândominic (!), Miercurea-Ciuc (8), Tuşnadu Nou (15), Prejmer (5), var. *pinnatifidus*: Tuşnad-Băi (5), var. *rosulatus*: Tuşnad-Băi (5), **nt-** *S. fluviatilis* Wallr.: Bălan, Sândominic, Racu, Tuşnad, Bod, Prejmer, Feldioara (5), Sâncrăieni (5,!), Micloşoara, Mândra (!), Avrig, Bradu (5,56,!), **nt-** *S. paludosus* L.: Sântimbru (9), Sânsimion (5,9,23), Tuşnadu Nou, Bod (23), Sâncrăieni, Hărman, Olteţ (5), Prejmer (5,17), Avrig (5,56), Bradu (56), var. *tomentosus:* Prejmer (5,17), var. *glabratus*: Avrig (5,56), **I-** *S. paluster* (L.) DC.: Prejmer, Bod (5)

nt- *Serratula tinctoria* L.: Frequent, var. *lancifolia*: Hărman, Prejmer, Viştea de Jos (5), f. *palustris*: Siculeni (5), **E-** *S. wolffii* Andrae: Ormeniş (42)

V- *Sesleria uliginosa* Opiz: Tuşnadu Nou (15), Hărman (5,16,23,!), Prejmer (5,17,23), Stupini (5,23), Bod (5), f. *subscabrida* Simk.: Hărman, Bod (5)

nt- *Sium latifolium* L.: Augustin (42,!), Ormeniş, Feldioara, Vadu Roşu (42), Măieruş, Rotbav (45), Viştea de Jos (40), Sâmbăta de Jos (!), **R-** *S. sisarum* L.: Olteţ (40)

nt- *Solanum dulcamara* L.: Frequent

nt- *Solidago canadensis* L.: Avrig, Bradu (5,56,!), Sebeş-Olt (!), **R-** *S. gigantea* Aiton: Avrig, Bradu (5)

K- *Sonchus palustris* L.: Hărman (5)

nt- *Sparganium emersum* Rehm.: Tuşnad-Băi, Hărman, Arpaşu de Jos (5), Arini (!), Bradu (5,50), **nt-** *S. erectum* L.: Prejmer (17), Ormeniş (42,!), Beclean, Olteţ, Arpaşu de Jos (40), Avrig (23,40,!), Bradu (50), Turnu Roşu (!), ssp. *neglectum* (Beeb.) Schinz et Thell.: Mădăraş (6), Augustin, Apaţa-Ormeniş (42), Rotbav (45), Comana de Jos (44,!), ssp. *microcarpum* (Neum.) Dom.: Bod-Apaţa (46), f. *simpliciforme* Nyar.: Hărman (13), **E-** *S. minimum* Wallr.: Avrig (23)

V- *Spiraea salicifolia* L.:Mădăraş, Vrabia, Miercurea-Ciuc, Tuşnadu Nou (23)

nt- *Spirodella polyrhiza* (L.) Schleich.: Sântion-Luncă (!), Ormeniş, Apaţa, Feldioara (42), Bradu (57)

nt- *Stachys officinalis* (L.) Trev.: Frequent, var. *serotina*: Sândominic (5), **nt-** *S. palustris* L.: Racu (6), Sânsimion, Bod (23), Sântimbru (9), Miercurea-Ciuc (8), Ormeniş (42), Augustin, Vadu Roşu (42,!), Măieruş-Apaţa (45), Şercaia (40), Bradu (50), Avrig (!)

nt- *Stellaria aquatica* (L.) Scop.:Mădăraş (6), Sânsimion (9), Prejmer (17), Bradu (5,57), **R-** *S. palustris* Ehrh.: Racu (6), Mădăraş (6,8), Sânsimion (9), Miercurea-Ciuc (8), Vrabia, Tuşnad-Sat, (33), Tuşnadu Nou (15,33), var. *laxmanni*: Sâncrăieni (23)

R- *Stratiotes aloides* L.: Sântion-Luncă , Bradu (5), Bod-Apaţa (46), Măieruş-Apaţa, Rotbav (45), Scorei (56)

nt- *Succisa pratensis* L.: Frequent, f. *glabrata:* Bradu (50,HF)

R- *Swetia perennis* L.: Sânsimion (23), Hărman (5,17,23), Stupini (5,23)

nt- *Symphytum officinale* L.: Frequent, ssp. *uliginosum* (A. Kern.) Nym.: Sf. Gheorghe (5)

K- *Taraxacum palustre* (Lyons) Symons: Hărman, Prejmer (5)
nt- *Telekia speciosa* (Schreb.) Baumg.: Bradu,Turnu Roşu (HF)
K- *Teucrium scordium* L.: Bod (5)
nt-*Thalictrum lucidum* L.: Frequent, var. *stenophyllum*: Prejmer (5,17), var. *heterophyllum:* Tuşnad (5)
R- *Trapa natans* L.: Ariujd (17), Racoşu de Jos (5), Bradu (5,57)
nt- *Trifolium hybridum* L. Frequent, **nt-** *T. repens* L.: Frequent, **R-** *T. spadiceum* L.: Mădăraş (23), Tuşnadu Nou (5,23)
nt- *Triglochin maritima* L.: Racu (6,8), Sântimbru (9), Sânsimion (23), Vrabia (23,33), Miercurea-Ciuc (8), Ciceu, Prejmer (5), Tuşnad-Sat (33), Tuşnadu Nou, Sâncrăieni (5,23), Hărman (5,16), Măndra, Sărata, Avrig (40), **nt-** *T. palustris* L.: Mădăraş-Racu (6), Sântimbru (9), Vrabia, Bod (23), Sâncrăieni (23,!), Ciceu, Tuşnad, Hărman, Stupini, Perşani (5), Prejmer (5,17,23)
R- *Trollius europaeus* L.: Vrabia (23,33), Tuşnadu Nou (5,23), Miercurea-Ciuc, Hărman (5), Prejmer (17)
nt- *Typha angustifolia* L.: Frequent, **nt-** *T. latifolia* L.: Frequent, **R-** *T. laxmanni* Lepechin: Sâmbăta de Jos (!), **R-** *T. schuttleworthii* Koch et Sonder: Bod-Apaţa (46), Racoşu de Jos (5)
V- *Utricularia bremii* Heer: Hărman (5,16), **V-** *U. minor* L.: Hărman (5,23), Arpaşu de Jos (5,56), Avrig (HD), **nt-** *U. vulgaris* L.:Simioneşti, Hărman, Feldioara (5), Augustin (42,44), Rotbav, Vadu Roşu (45,!), Olteţ (40), Bradu (5,57), Turnu Roşu (!)
nt- *Valleriana officinalis* L.: Frequent, ssp. *collina* (Wallr.) Nym.: Bradu, Turnu Roşu (5), var. *media* Koch: Hărman (13), **R-** V. *simplicifolia* (Rchb.) Kabath: Racu (6), Mădăraş (6,23), Sântimbru (5,9,11), Sânsimion (9,23), Vrabia, Tuşnad-Sat (23,33), Miercurea-Ciuc (8), Tuşnadu Nou (15,23), Sâncrăieni (23,!), Stupini (46)
K- *Vallisneria spiralis* L.: Tuşnad-Băi (5)
nt- *Veratrum album* L. Frequent, ssp. *lobelianum* Bernh.) Rchb.: Prejmer (17)
K- *Veronica anagallioides* Guss.: Arpaşu de Jos (5), **nt-** *V. anagallis-aquatica* L. Racu (6), Sântimbru (9), Arpaşu de Jos (40), Avrig (!), Bradu (50,!), f. *glandulosa* Schur: Arpaşu de Jos (5,56), f. *tenerrima*: Bălan (5), Bradu (HF), **nt-** *V. beccabunga* L. Frequent, var. *limosa* : Bradu (5,50), f. *alpina* Ten: Bălan-Sândominic (5), **R-** *V. catenata* Pennell.: Prejmer (17), Ormeniş (42), **R-** *V. longifolia* L.: Sântimbru (9), Sânsimion (9,23), Bod (23), Rotbav (45), Vadu Roşu (42), **nt-** *V. scutellata* L.: Racu (6), Vrabia, Tuşnad-Sat (33), Miercurea-Ciuc, Ciceu (5), Hărman (16), Prejmer (5,17), Rotbav, Vadu Roşu (45), Arpaşu de Jos (40,!), Avrig (23), Bradu (5,57), Turnu Roşu (!)
R- *Viola elatior* Fries: Hărman-Prejmer (17), **V-** *V. epipsila* Ledeb.: Sânsimion (9,23), Vrabia (33), **R-** *V. persicifolia* Schreb.: Vrabia (33), Prejmer-Hărman (17), **K-** *V. uliginosa* Bess.: Viştea de Jos (40)
E- *Zanichellia palustris* L. var. *aculeata*: Avrig (56,57)

VEGETATION

LEMNETEA de Bolos et Masclans 1955
LEMNETALIA de Bolos et Masclans 1955
Lemnion minoris de Bolos et Masclans 1955
1. *Lemnetum minoris* Oberd. ex T. Muller et Gors 1960
Mădăraş, Sântimbru, Sântion-Luncă, Reci, Sfântu-Gheorghe, Arini, Ormeniş, Vadu-Roşu, Şercaia, Făgăraş, Ucea de Jos, Viştea de Jos, Arpaşul de Jos, Cârţa, Porumbacul de Jos, Avrig, Bradu, Racoviţa, Podu-Olt, Turnu-Roşu (!)
2. *Lemnetum trisulcae* Knapp et Stoffers 1962
Sântion-Luncă, Ormeniş, Rotbav (!)
3. *Lemno- Spirodeletum polyrrhizae* Koch 1954
Sântion-Luncă, Rotbav (!)
UTRICULARIETALIA MINORIS Den Hartog et Segal 1964
Utricularion vulgaris Passarge 1964
4. *Lemno- Utricularietum vulgaris* Soo (1928)1947
Sântimbru (9), Augustin, Rotbav, Hoghiz, Comana de Jos (43,44), Micloşoara, Turnu Roşu (!), Arpaşul de Jos(39)
- *lemnetosum trisulcae* (Karpati 1963) Soo 1964
Augustin, Comana de Jos, Turnu-Roşu (!)
HIDROCHARIETALIA Rubel 1933
Hydrocharition Rubel 1933
5. *Hydrocharitetum morsus- ranae* van Langendonck 1935
Augustin (!), Apaţa, Măeruş, Rotbav (43,44,!)

6. *Stratiotetum aloidis* Nowinski 1930
Apaţa, Măeruş, Rotbav (43,44)
- *salviniosum natantis* Ularu 1972
Apaţa (43)
7. *Ceratophylleto- Hydrocharitetum* I. Pop 1962
Arini, Aita-Mare, Augustin (!)
8. *Ceratophylletum demersi* Hild 1956
Sântion-Luncă, Arini, Sâmbăta de Jos, Avrig, Bradu, Sebeş-Olt (!)

POTAMETEA R. Tx. et Preising 1942
POTAMETALIA Koch 1926
Ranunculion fluviatilis Neuhausl 1959
9. *Ranunculo trichophylli- Callitrichetum cophocarpae* (Soo 1927) Pocs in Pocs et al. 1958
Reci, Mândra,Făgăraş, Arpaşul de Jos, Racoviţa, Turnu-Roşu (!)
Potamion pectinati (Koch 1926) Gors 1977
10. *Hottonietum palustris* Tx. 1937
Rotbav (43,44), Olteţ (38)
11. *Potametum lucentis* Hueck 1931
Augustin (42), Apaţa, Ormeniş, Comana de Jos (43,44)
12. *Myriophyllo- Potametum lucentis* Soo 1934
Sîntimbru (9), Aita-Mare, Mândra (!)
13. *Potametum nodosi* (Soo 1960) Segal 1964
Augustin, Avrig (!)
14. *Elodeetum canadensis* Eggler 1933
Arini (!)
15. *Potametum crispi* Soo 1927
Bixad, Reci (!)
16. *Potametum pussili* Soo 1927
Mândra (!), Arpaşul de Jos (39)
Nymphaeion albae Oberd. 1957
17. *Nymphaeetum albo- luteae* Nowiski 1928
- *nymphaeetosum* Karpati 1963
Micloşoara (42), Augustin (42,43,44,!)
- *nupharetosum* Soo 1957
Arini (!)
- *vallisnerietosum Borza* 1963 n.n.
Tuşnad-Băi (3,35)

PHRAGMITETEA R. Tx. et Preising 1942
PHRAGMITETALIA Koch 1926
Phragmition Koch 1926
18. *Phragmitetum australis* Soo 1927 em. Schmale 1939
Sântimbru, Sânsimion (9), Vrabia (33), Mădăraş, Reci (!), Prejmer, Hărman (46,!), Ormeniş, Vadu-Roşu, Feldioara (42,!), Viştea de Jos (40), Făgăraş, Mândra, Sâmbăta de Jos, Arpaşul de Jos, Cârţa, Porumbacul de Jos, Scorei, Racoviţa, Avrig, Bradu, Turnu-Roşu (!)
- *bolboschoenetosum* Ubrizsy 1961
Depresiunea Ciuc (29)
19. *Schoenoplectetum lacustris* Chouard 1924
Apaţa, Ormeniş, Cuciulata (42,43,44), Aita-Mare (!)
- *iridosum pseudacori* Ularu 1972
Ormeniş (!)
- *glyceriosum maximae* Ularu 1972
Apaţa (!)
20. *Typhaetum angustifoliae* Pignatti 1943
Mădăraş (6), Depr. Ciuc (29), Reci (!), Vadu-Roşu, Ormeniş, Feldioara (42), Augustin, Rotbav, Sâmbăta de Jos, Avrig (!)
21. *Typhaetum latifoliae* G. Lang 1973
Mădăraş (6.!), Sântimbru, Sânsimion (9), Tuşnadul Nou (15), Reci, Aita- Mare, Arini (!), Apaţa, Rotbav (43), Sâmbăta de Jos, Arpaşul de Jos, Scorei, Avrig, Racoviţa, Turnu-Roşu (!)
22. *Typhaetum laxmanni* (Ubrizsy 1961) Nedelcu 1968
Sâmbăta de Jos (!)

23. *Glycerietum maximae* Hueck 1931
    Mădăraş, Racu (6), Sântimbru, Sânsimion (9), Vrabia (33), Tuşnadul Nou (15), Măeruş (45), Ormeniş, Augustin, Feldioara (42,!), Apaţa, Rotbav, Vadu-Roşu (43,44), Comana de Jos (43,!), Făgăraş (!), Beclean, Şercaia (40), Mândra, Olteţ, Arpaşul de Jos, Avrig (40,!), Racoviţa, Turnu-Roşu (!)
24. *Equisetetum fluviatilis* Steffen 1931
    Mădăraş, Racu, Avrămeşti (6), Sâncrăieni (!), Vrabia , Tuşnad-Sat (33), Apaţa, Rotbav (43,44), Comana de Jos (43,44,!), Beclean, Olteţ (40)

NASTURTIO – GLYCERIETALIA Pignatti 1953

Glycerio – Sparganion Br.-Bl. et Sissingh 1942

25. *Glycerietum plicatae* Kulczynski 1928
    Mădăraş, Racu (6), Avrig (!)
    - *catabrosetosum* Soo 1957
    Sântimbru (9)
26. *Glycerietum fluitantis* Eggler 1933
    Comana de Jos (44), Beclean, Dridif (40), Arpaşul de Jos (40,!), Avrig, Racoviţa (!)
27. *Leersietum oryzoidis* Krause in R. Tx. 1955 em. Passarge 1957
    Avrig, Racoviţa (40)
28. *Veronicetum beccabungae* Philippi 1973
    Bălan (!)

OENANTHETALIA AQUATICAE Hejny in Kopecky et Hejny 1965

Oenanthion aquaticae Hejny ex Neuhausl 1959

29. *Sagittario – Sparganietum* R.Tx. 1953
    Arini, Micloşoara, Avrig (!)
30. *Alismato – Eleocharitetum* M. Kovacs et Mathe 1967
    Augustin, Mândra (!)
31. *Eleocharitetum palustris* Ubrizsy 1948
    Mădăraş, Racu (6), Bălan, Reci (!), Ormeniş, Apaţa (43,44), Augustin, Feldioara (42,!), Făgăraş, Mândra, Sâmbăta de Jos, Porumbacul de Jos, Avrig, Racoviţa (!)
32. *Oenantho aquaticae – Rorippetum amphibiae* Lohmeyer 1950
    Ormeniş, Feldioara (42), Porumbacul de Jos (40,!), Avrig, Racoviţa (!)

Magnocaricion elatae Koch 1926

Caricenion rostratae (Bal.-Tul. 1963) Oberd. et al. 1967

33. *Calamagrostetum canescentis* Simon 1960
    Depr. Ciuc (6,29), Sântimbru, Sânsimion (9), Miercurea-Ciuc (8), Tuşnadul Nou (15), Vrabia (33)
34. *Caricetum appropinquatae* (Koch 1926) Tx. 1947
    Depr. Ciuc (29), Sântimbru (9), Vrabia (33)
35. *Caricetum rostratae* Rubel 1912
    Bălan, Mădăraş (!), Racu (6), Depr. Ciuc (29), Vrabia (33), Hărman (16), Rotbav, Vadu-Roşu, Făgăraş (!), Beclean (40), Viştea de Jos, Arpaşul de Jos (40,!), Sâmbăta de Jos, Porumbacul de Jos (!)
36. *Cladietum marisci* Zobrist 1935
    Hărman (16,46,!), Stupini, Prejmer (46)
37. *Comaro – Caricetum lasiocarpae* Bal.-Tul. et Hubl 1985
    Arpaşul de Jos (40)
38. *Caricetum buxbaumii* Issler 1932
    Depr. Ciuc (6), Arpaşul de Jos (40)
39. *Carici – Menyanthetum* Soo (1938)1955
    Racu (6), Beclean, Viştea de Jos, Arpaşul de Jos (40)
40. *Caricetum diandrae* Jonas 1932 em. Oberd. 1957
    Racu (6), Depr. Ciuc (29), Tuşnadul Nou (15), Vrabia, Sânsimion (33)

Caricenion gracilis (Neuhausl 1959) Oberd. et al. 1967

41. *Caricetum gracilis* Almquist 1929
    Mădăraş, Racu (6), Sâncrăieni, Reci (!), Tuşnad-Sat, Vrabia (33), Apaţa, Rotbav, Vadu-Roşu (43,44), Veneţia de Jos (43,44,!), Măeruş (45,!), Ormeniş (!), Beclean, Olteţ (40), Mândra, Arpaşul de Jos (41,!), Avrig, Turnu-Roşu (!)
- *caricetosum ripariae* Ularu 1972
    Ormeniş (!)

42. *Caricetum vesicariae* Chouard 1924
Mădăraş, Racu (6,8), Depr. Ciuc (29), Vrabia (33), Tuşnadul Nou (15,33), Beclean, Olteţ (40)
43. *Phalaridetum arundinaceae* Libbert 1931
Racu (6), Sântimbru, Sânsimion (9), Vrabia, Tuşnad (33), Sântion-Luncă (!), Depr. Ciuc (29), Ormeniş, Rotbav, Vadu-Roşu (42), Feldioara - Şercaia (43,45), Veneţia de Jos (40), Şercaia, Făgăraş (!)
44. *Caricetum distichae* Steffen 1931
Depr. Ciuc (6,29), Sântimbru (9), Miercurea-Ciuc (8), Tuşnad-Sat (33), Rotbav, Părău, Veneţia de Jos (43,44,45)
45. *Caricetum vulpinae* Soo 1927
Racu (6), Depr. Ciuc (29), Vrabia (33), Rotbav (45), Vadu-Roşu, Făgăraş (!), Veneţia de Jos, Beclean, Mândra, Olteţ, Sâmbăta de Jos (40)
46. *Caricetum acutiformis* Eggler 1933
Stupini, Hărman, Prejmer (46)
47. *Caricetum ripariae* Soo 1928
Mădăraş, Racu, Avrămeşti (6), Sântimbru (9), Miercurea-Ciuc (8), Vrabia, Tuşnad-Sat, Tuşnadul Nou (33), Arini, Ormeniş, Augustin, Făgăraş (!), Beclean (40)
48. *Iridetum pseudacori* Eggler 1933
Turnu-Roşu (!)
49. *Calamagrostetum pseudophragmitis* Beldie 1967, Kopecky 1968
Arpaşul de Jos (!)

SCHEUCHZERIO – CARICETEA NIGRAE R. Tx. 1937

CARICETALIA NIGRAE Koch 1926 em. Br.-Bl. 1949

Calamagrostidion neglectae Tengwal 1920

50. *Calamagrostetum neglectae* Tengwal 1920
Miercurea-Ciuc (8)

Caricion nigrae Koch 1926 em. Klika 1934

51. *Caricetum nigrae* Braun 1915
Mădăraş, Racu (6), Depr. Ciuc (29), Sântimbru, Sânsimion (9), Miercurea-Ciuc (8), Vrabia, Tuşnad-Sat, Tuşnadul-Nou (33), Beclean, Mândra, Dridif (40), Viştea de Jos, Arpaşul de Jos (40,!), Cârţa, Porumbacul de Jos (!)

- *calamagrostetosum neglectae* Coldea 1981
Tuşnadul Nou (15)
- *seslerietosum uliginosae* Kovacs et Gergely 1979
Tuşnadul Nou (15)
- *caricetosum rostratae* Kovacs et Gergely 1979
Tuşnadul Nou (15)

52. *Carici stellulatae – Sphagnetum* (Balazs 1942) Soo 1955
Viştea de Jos, Olteţ (40), Arpaşul de Jos (40,!)

CARICETALIA DAVALLIANAE Br.-Bl. 1949

Caricion davallianae Klika 1934

53. *Caricetumn davallianae* Dutoit 1924
Depr. Ciuc (29), Miercurea-Ciuc (8), Tuşnadul Nou (15), Hărman (16,46) , Prejmer , Stupini (46)

- *molinietosum coeruleae* (Morariu 1967) Coldea 1977
Sântimbru (9), Hărman (18,35)
- *seslerietosum uliginosae* Kovacs et Gergely 1979
Tuşnadul Nou (15)

54. *Seslerietum uliginosae* (Palmgren 1916) Soo 1941
Tuşnadul Nou (15), Prejmer (17)
55. *Eriophoretum angustifoliae* Morariu 1964
Bălan (!), Hărman (16)
56. *Eleocharitetum quinqueflorae* Ludi 1921
Dridif, Arpaşul de Jos (40)
57. *Carici flavae – Eriophoretum latifolii* Soo 1944
Mădăraş,Racu (6),Viştea de Jos,Sâmbăta de Jos (40),Arpaşul de Jos.Avrig(!)
58. *Caricetum paniceae* Sabardina 1957
Beclean, Olteţ, Dridif, Sâmbăta de Jos, Arpaşul de Jos (40)

59. *Orchido – Schoenetum nigricantis* Oberd. 1957
Stupini (46), Hărman (23)
- *armerietosum barcensis* Morariu 1964
Prejmer (46), Hărman (16,46,!)

LITORELLETEA R. Tx. 1947
LITORELLETALIA Koch ex R. Tx. 1937
Eleocharition acicularis Pietsch 1967
60. *Ranunculo flammulae – Gratioletum officinalis* Borhidi et Juhasz 1985
Scorei (40), Racoviţa, Turnu-Roşu (!)

ISOETO – NANOJUNCETEA Br.-Bl. et R. Tx. ex Westhoff et al. 1946
NANOCYPERETALIA Klika 1935
Nanocyperion flavescentis Koch ex Libbert 1932
61. *Cyperetum flavescentis* Koch ex Aichinger 1933
Cârţa, Sărata, Scorei, Avrig (!)
62. *Juncetum bufonii* Felfoldy 1942
Sâmbăta de Jos (40), Ucea de Jos, Avrig (!)
63. *Eleocharitetum carniolicae* Şerbănescu 1953
Cârţişoara, Arpaşul de Jos (40)

PUCCINELLIO – SALICORNIETEA Ţopa 1939
PUCCINELLIETALIA Soo 1947 em. Vicherek 1973
Puccinellion limosae (Soo 1933) Klika et Vloch 1937
64. *Plantaginetum maritimae* Rapaics 1927
Sărata (40)
Puccinellion peisonis (Wendelbg. 1943) Soo 1957
65. *Puccinellietum distantis* Soo 1937
Sărata, Avrig (40)
SCORZONERO – JUNCETALIA GERARDI Vicherek 1973
Scorzonero – Juncion gerardi (Wendelbg. 1943) Vicherek 1973
66. *Juncetum gerardi* (Warming 1906) Nordh. 1923
Mândra, Sărata, Avrig (40)
67. *Caricetum distantis* Rapaics 1927
Şercaia (25), Sărata (!)

MOLINIO – ARRHENATHERETEA R. Tx. 1937 em. R. Tx. 1970
MOLINIETALIA COERULEAE Koch 1926
Molinion coeruleae Koch 1926
68. *Molinietum coeruleae* (Allorge 1922) Koch 1926
Sântimbru - Sânsimion (9)
- *schoenetosum ferruginei* Bal.-Tul. et Hubl 1985
Sântimbru - Sânsimion (9), Sântimbru (11)
- *caricetosum hostianae* Koch 1926
Sântimbru - Sânsimion (9)
- *caricetosum oederi* Gergely et al. 1988
Sântimbru - Sânsimion (9)
- *galietosum boreali* Schluter 1955
Sântimbru - Sânsimion (9)
- *brizetosum mediae* Gergely et al. 1988
Sântimbru - Sânsimion (9)
69. *Junco - Molinietum coeruleae* Preissing in R. Tx. et Preissing ex. Klapp 1954
Depr. Ciuc (6), Prejmer, Stupini (46), Hărman (46,!), Depr.Făgăraş (40), Cârţa, Arpaşul de Jos, Sebeş-Olt (!)
- *nardetosum strictae* (Jonas 1933) Kovacs 1956
Viştea de Jos, Olteţ (40), Cârţa (40,!), Arpaşul de Jos (!)
- *narcissosum stellaris* (Şerbănescu 1960) Sanda et Popescu 1991
Arpaşul de Jos (!)
70. *Molinio- Salicetum rosmarinifoliae* Magyar ex Soo 1933
Sâncrăieni (!)

Calthion R. Tx. 1937 em. Bal.-Tul. 1978
Calthenion
71. *Scirpetum sylvatici* Ralski 1931
Bălan (!), Mădăraş (6,!), Reci (!), Beclean, Viştea de Jos, Scorei (40)

72. *Calthaetum laetae* V. Krajina 1933
Bălan, Sândominic, Arpaşul de Jos (!)
- *eriophorosum angustifoliae* Resmeriţă 1969
Bălan (!)
73. *Holcetum lanati* Issler 1936 em. Passarge 1964
Beclean, Olteţ (40), Porumbacul de Jos, Avrig (40,!), Racoviţa, Podul-Olt, Turnu-Roşu (!)
- *trifoliosum dubii* Şerbănescu 1964
Beclean, Arpaşul de Jos, Scorei, Avrig (40)
Filipendulenion (Lohmeyer in Oberd. et al. 1967) Bal.-Tul. 1978
74. *Filipendulo – Geranietum palustris* Koch 1926
Depr. Ciuc (6,29), Mădăraş (!)
75. *Cirsio rivulari- Filipenduletum ulmariae* Gergely et al. 1988
Sântimbru, Sânsimion (9)
- *poetosum palustris* Gergely et al. 1988
Sânsimion (9)
76. *Caricetum buekii* Şerbănescu 1964, Kopecky et Hejny 1965
Beclean (40)
Agrostion stoloniferae Soo 1943
77. *Agrostetum caninae* Harg. 1942
Depr.Ciuc (6,29), Veneţia, Şercaia, Viştea de Jos, Olteţ (40), Ucea de Jos (!), Arpaşul de Jos, Sărata, Cârţişoara, Cârţa, Scorei, Porumbacul de Jos, Avrig, Racoviţa (40)
78. *Agrostetum stoloniferae* Ujvarosi 1941
Bălan, Sândominic, Mădăraş, Miercurea-Ciuc, Sâncrăieni, Bixad, Sfântu-Gheorghe, Reci, Sântion- Luncă, Chichiş, Bod, Araci, Arini (!),Rotbav, Măcruş, Apaţa (45,!), Aita-Mare, Ormeniş, Augustin, Racoş, Hoghiz,
Cuciulata, Comana de Jos (!), Mândra (40,!), Făgăraş, Beclean, Voila,
Sâmbăta de Jos, Viştea de Jos, Ucea de Jos, Arpaşul de Jos, Cârţa, Colun (!),
Sărata, Avrig (40,!), Racoviţa, Sebeş-Olt, Podu-Olt,Turnu-Roşu (!)
79. *Agrostio – Deschampsietum caespitosae* (Soo 1928) Ujvarosi 1947
Depr.-Ciuc (6,29), Sântimbru (!), Depr. Făgăraş (40), Beclean,Arpaşul de Jos, Cârţa, Scorei (!)
80. *Alopecuretum pratensis* Regel 1925
Depr. Ciuc (29), Sântimbru, Sânsimion (9), Bălan, Mădăraş, Reci (!)
81 *Festucetum pratensis* Soo 1938
Rotbav, Vadu-Roşu (45), Arpaşul de Jos, Avrig (!)
82. *Ranunculo strigulosi – Equisetetum palustris* Gh. Popescu 1975
Bălan (!), Mândra, Beclean, Viştea de Jos (40)
83. *Poetum trivialis* Soo 1940
Sânsimion (!), Beclean (40)
POTENTILLO – POLYGONETALIA R. Tx. 1947
Potentillion anserinae R. Tx. 1947
Potentillenion anserinae
84. *Potentilletum anserinae* Felfoldy 1942
Miercurea-Ciuc, Sfântu-Gheorghe, Chichiş, Mândra, Făgăraş, Ucea de Jos, Cârţa, Avrig, Sebeş-Olt (!)
85. *Ranunculetum repentis* Knapp ex. Oberd. 1957
Bălan, Miercurea-Ciuc, Bod, Comana de Jos, Făgăraş, Avrig (!)
Juncenion effusi Westhoff et Van Leeuwen ex Hejny et al. 1979
86. *Juncetum effusi* Soo (1931) 1949
Bălan, Miercurea-Ciuc, Comana de Jos, Mândra, Făgăraş, Beclean, Sâmbăta de Jos, Cârţa, Avrig, Podu-Olt, Turnu- Roşu (!)
87. *Junco inflexi – Menthetum longifoliae* Lohmeyer 1953
Avrig, Turnu-Roşu (!)
GALIO – URTICETEA Passarge ex Kopecky 1969
CALYSTEGIETALIA SEPIUM R. Tx. 1950
Senecion fluviatilis R. Tx. 1950
88. *Senecionetum fluviatilis* Th. Muller ex Straka in Mucina 1993
Micloşoara, Mândra (!)
89. *Calystegio – Eupatorietum cannabini* Gors 1974
Arpaşul de Jos, Cârţa (!)

90. *Astero – Rubetum caesii* I. Karp. 1962
Sâncrăieni, Arini, Comana de Jos, Mândra (!)
91. *Helianthetum decapetali* Morariu 1967
Comana de Jos, Sâmbăta de Jos (!)
92. *Impatienti – Calystegietum* (Gondola 1965) Soo 1971
Arini, Mândra,Făgăraş, Sâmbăta de Jos, Ucea de Jos, Arpaşul de Jos, Avrig (!)
93. *Rudbeckio – Solidaginetum* R. Tx. et Raabe 1950 em. Soo 1961
Avrig, Turnu-Roşu (!)
94. *Polygonetum cuspidati* Tx. et Raabe 1950
Bălan, Miercurea-Ciuc, Făgăraş (!)

PETASITO – CHAEROPHYLLETALIA Morariu 1967
Petasition officinalis Sillinger 1933
95. *Aegopodio- Petasitetum* R. Tx. 1947
Turnu-Roşu (!)

BIDENTETEA TRIPARTITI R. Tx. et al. in R. Tx. 1950
BIDENTETALIA TRIPARTITI Br.-Bl. et R. Tx. ex Klika et Hadac 1944
Bidention tripartiti Nordhagen 1940 em. R. Tx. in Poli et J. Tx. 1960
96. *Bidenti- Polygonetum hydropiperis* Lohmeyer in R. Tx. 1950
Miercurea-Ciuc, Sfântu-Gheorghe, Comana de Jos, Mândra, Făgăraş, Sâmbăta de Jos, Cârţa, Avrig, Turnu-Roşu (!)
97. *Bidentetum cernui* Kobendza 1948
Sâmbăta de Jos, Cârţa (!)
98. *Rumici – Alopecuretum geniculati* Tx. (1937) 1950
Mădăraş, Racu (6), Depresiunea Ciuc (29)
99. *Rumici- Alopecuretum aequalis* Cîrţu 1972
Mândra (40)

SALICETEA PURPUREAE Moor 1958
SALICETALIA PURPUREAE Moor 1958
Salicion albae Soo 1930 em. Th. Muller et Gors 1958
100. *Salicetum albae – fragilis* Issler 1926 em. Soo 1957
Depr. Ciuc (29), Sântion-Luncă, Rotbav, Mândra, Sâmbăta de Jos, Ucea de Jos, Viştea de Jos, Arpaşul de Jos, Cârţa, Scorei, Avrig, Racoviţa, Podu-Olt, Turnu-Roşu (!)
- *phragmitetosum* Th. Muller et Gors 1958
Făgăraş, Sâmbăta de Jos, Viştea de Jos, Arpaşul de Jos, Cârţa, Avrig, Racoviţa (!)
- *cornetosum sanguineae* (Wendelbg.-Zelinka 1952) Karpati 1958
Viştea de Jos, Arpaşul de Jos, Avrig (!)
- *rubosum caesii* (Doniţă et al. 1966)
Făgăraş, Sâmbăta de Jos, Colun, Arpaşul de Jos, Porumbacul de Jos, Avrig, Sebeş-Olt (!)
- *echinocystosum* Drg. 1995
Avrig, Podu-Olt, Sebeş-Olt, Turnu-Roşu
Salicion triandrae Th. Muller et Gors 1958
101. *Salicetum triandrae* Malcuit ex Noirfalise in Lebrun et al. 1955
Bălan, Mădăraş, Reci, Făgăraş, Săcădate, Avrig (!)
- *salicetosum viminalis* Soo 1958
Mădăraş, Făgăraş, Săcădate, Avrig, Sebeş-Olt (!)
- *rubosum caesii* Pazmany 1961
Săcădate, Sebeş-Olt (!)
102. *Saponario – Salicetum purpureae* (br.-Bl. 1930) Tschou 1946
Mădăraş, Sântion-Luncă, Miercurea-Ciuc, Sfântu-Gheorghe, Micloşoara, Feldioara, Comana de Jos, Făgăraş, Sâmbăta de Jos, Arpaşul de Jos, Scorei, Porumbacul de Jos, Avrig (!)

ALNETEA GLUTINOSAE Br.-Bl. et Tx. ex Westhoff et al. 1946
SALICETALIA AURITAE Doing 1962
Salicion cinereae Th. Muller et Gors 1958
103. *Salicetum cinereae* Zolyomi 1931
Depr. Ciuc (29), Miercurea-Ciuc, (8), Mădăraş, Sâncrăieni, Bod, Comana de Jos, Arpaşul de Jos (!)

QUERCO – FAGETEA Br.-Bl. et Vlieger in Vlieger 1937
FAGETALIA Pawlowski in Pawlowski et al. 1928
Alnion incanae Pawlowski in Pawlowski et al. 1928
Alnenion glutinoso – incanae Oberd. 1953

104. *Alnetum incanae* Ludi 1921
Depr. Ciuc (29)
105. *Stellario nemorum – Alnetum glutinosae* Lohmeyer 1957
Turnu-Roşu (!)

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BIODIVERSITY OF ALGAE OF THE UPPER AND MIDDLE COURSE OF THE OLT RIVER

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REZUMAT

Lucrarea prezintă compoziţia floristică a comunităţilor algale din cursul superior şi mijlociu al râului Olt, caracterizat printr-o diversitate algală mare, constituită din 426 de taxoni aparţinând la şapte divizii: Cyanophyta, Chrysophyta, Bacillariophyta, Chlorophyta, Dinophyta, Euglenophyta şi Rhodophyta.

Diatomeele domină în cadrul comunităţilor. Nu au fost găsite diferenţe marcante între compoziţiile specifice ale comunităţile algale planctonice şi cele bentonice. Elementele dominante sunt formele cosmopolite sau ubicviste, sau cele care preferă ape cu concentraţii mari sau moderate ale substanţelor anorganice. Unele dintre acestea indică un nivel critic sau chiar mai mare de saprobitate.

Compoziţia comunităţilor ilustrează existenţa eutrofizării şi a poluării, chiar şi în cazul cursului superior al râului, cu tendinţe crescânde spre aval. Multe dintre speciile colectate nu au fost până în prezent identificate în România, altele fiind rare în flora acestei ţări.

Keywords: biodiversity, algae, Olt River, human impact.

INTRODUCTION

Algological investigations carried out on the Olt River are less numerous. The first ones, as part of an international collaboration of a complex limnological study of the Danube, concerned the lower course of the Olt and its confluence with the Danube (Buşniţă, Brezeanu & Prunescu-Arion, 1961; Popescu-Marinescu et al., 1980). Important qualitative and quantitative phytoplankton data were also published by Popescu-Marinescu & Elian-Tălău (1980) and Prunescu-Arion (1980) concerning the middle course of the Olt River.

Other watercourses of Transylvania recently investigated for their algal diversity and human impact are the Someşu Mic (Rasiga, Péterfi & Momeu, 1992; Rasiga, Momeu & Péterfi, 1995/96; Rasiga, Péterfi & Momeu, 1996), Someşul Mare (Rasiga, Péterfi & Momeu, in press), Someşul (Rasiga, Momeu & Péterfi, in press) and Crişul Repede Rivers (Momeu, Rasiga & Péterfi, in press).

MATERIALS AND METHODS

The upper and middle courses of the Olt River were sampled during October 1998. The plankton samples were collected with plankton net No. 25 by filtering about 20 l of water. The benthos (epilithic, epipelic and epipsammic communities) was sampled using scraping, suction and detaching methods. The epiphytic community was studied in a stand located between Avrig and Boiţa, near the village Racoviţa (**Q11/12**, see **Table 1**).

The samples were fixed in the field with 4% formaldehyde and investigated with NpFk and Interfako (C. Zeiss, Jena) optical microscopes.

RESULTS AND DISCUSSION

In the upper and middle course of the Olt River there have been identified 426 taxa, belonging to the following divisions: *Cyanophyta* – 38, *Chrysophyta* – 5, *Bacillariophyta* – 275, *Chlorophyta* – *Chlorophyceae* – 62, *Chlorophyta* – *Conjugatophyceae* – 10, *Dinophyta* – 5, *Euglenophyta* – 30 and *Rhodophyta* –1 (**Table 1** and **Fig. 1**).

The communities are dominated by diatoms in all the investigated stands, excepting the plankton at the uppermost part of the dam reservoir, upstream Avrig (**Q10/3**), where they are almost equal in number (57 taxa) with the other groups together (49 taxa). As a matter of fact, the dominance of diatoms seems to be characteristic for the Olt, not only in its upper and middle course, a fact already mentioned by Popescu-Marinescu & Elian-Tălău (1980) and Prunescu-Arion (1980), but also in the lowest one (Popescu-Marinescu et al., 1980).

The total number of algae identified in the plankton was 347, varying between 74 and 154 according to sampling sites (**Table 1**). The communities from the uppermost part of the reservoir (**Q 10/3**) and close to the dam (**Q10/2**) exhibit higher diversity than those of its channel (**Q 10/1**). The greatest species number (152-154) was identified in the last two sampling sites, namely in those located downstream its confluence with the Cibin River (**Q 12** and **Q 13**). In benthic communities the number of taxa varies between 44 and 191, showing a total of 333. The lowest number of algae was observed at Sândominic (**Q 1**), the highest near Racoviţa (**Q 11/12**), where the number of green algae was maximum (55) too.

Bacillariophyta. The composition of diatom communities, both planktonic and benthic, appears qualitatively and quantitatively rather uniform in all studied stands. They exhibit a relatively high species diversity. The number of species living in the plankton is almost equal with those occurring in benthic habitats (235 and 239, respectively). 119 species were common for both floating and benthic communities (72,4%), while 76 were found only in plankton (38 taxa) or in benthos (38 taxa). Most of these differential species are solitary, occurring in 1-2 sampling sites; most probably have been washed into the Olt. According to their ecological preferences they are characteristic for mountain habitat types. One should note the relative scarcity of the characteristic plankton diatoms. The potamoplankton of the Olt River is far less developed in the investigated sectors than its benthic diatom communities. The influence of the tributaries in the upper, montane part of the Olt River was quite evident, clearly reflected in the composition of the communities in which appeared various elements which belong to different terrestrial or aquatic habitat types of the surrounding areas (*Achnanthes bioretii, A. laevis, A. nodosa, A. subatomoides, Caloneis schummaniana, Cymbella aspera, C. cesatii, C. cymbiformis, C. falaisensis, C. mesiana, Diatoma anceps, Diploneis oblongella, Eunotia diodon, E. flexuosa, E. formica, E. hexaglyphis, E. muscicola* v. *tridentula, Fragilaria bicapitata, Frustulia rhomboides, Gomphonema gracile, Navicula contenta, N. gallica* v. *perpusilla, N. hambergii, N. laevissima, N. indifferens, N. reinhardtii, N. tenelloides, Nitzschia hantzschiana, Pinnularia appendiculata, P. lata, P. stomatophora* etc).

The communities consist of species which occurred constantly or almost constantly in the investigated sampling sites. Most of them are known as highly tolerant (eurytopic) and cosmopolitan (*Achnanthes lanceolata, A. minutissima, Amphora lybica, A. pediculus, Cocconeis pediculus, C. placentula, C. affinis, C. minuta, C. silesiaca, D. vulgare, Fragilaria capucina, Gomphonema olivaceum, G. parvulum, Gyrosigma acuminatum, Melosira varians, Navicula cryptocephala,*

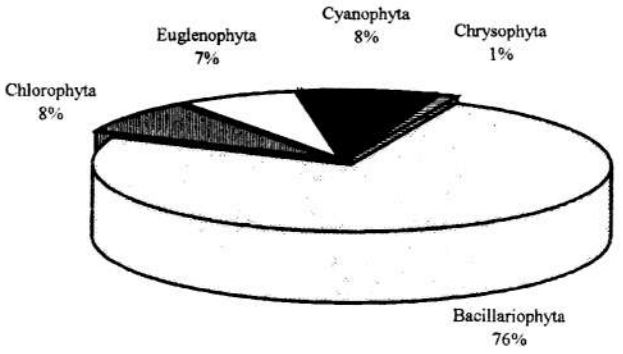

Fig. 1. *Contribution of the main algal groups to specific composition of plankton communities in the Olt River*

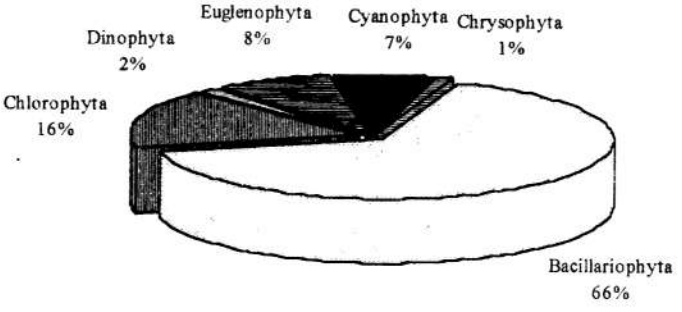

Fig. 2. *Contribution of the main algal groups to specific composition of benthic communities in* the *Olt River*

N. lanceolata, Nitzschia linearis, N. amphibia). Others are characteristic for waters with high or moderate mineral content (brackish or saline waters): *Caloneis amphisbaena, C. silicula, Diatoma moniliformis, Cymatopleura solea, Cymbella cistula, C. helvetica, Gyrosigma scalproides, Navicula capitata, N. capitatoradiata, N. pupula, N. tripunctata, N. trivialis, Nitzschia constricta, N. dissipata, N. hungarica, N. sigmoidea, N. umbonata, Surirella brebissonii, S. linearis, S. ovalis, Rhoicosphaenia abbreviata*). Some of the allready mentioned species and several others tolerate or grow rather well in waters with massive organic loading (at critical saprobity level or even higher): *Navicula subminuscula, N. veneta, N. viridula,*

Nitzschia inconspicua, N. palea, N paleacea, or in eutrophic waters (*Aulacoseira granulata, A. ambigua, Cyclotella meneghiniana, Cymbella tumidula, Nitzschia vermicularis, Surirella angusta, S. minuta, S. splendida*).

By the contrary, the number of catarobic species was very low (*Cymbella naviculiformis, Diatoma mesodon, Fragilaria arcus, Gomphonema angustum, G. clavatum, Meridion circulare, Navicula cryptotenella*).

The composition of diatom communities clearly shows that the Olt River in these sectors is massively eutrophic and polluted. These phenomena are less marked in the first sector of the upper course (Sândominic – **Q 1**), where the number of benthic diatoms was the lowest, and the community consisted of 44 widely distributed and clean water forms and very few eutrophic and polluted water ones. In the next downstream stand (**Q 2** – Sâncrăieni) there was an evident change in community composition (up to 106 taxa), indicating the start of eutrophication. It is very interesting to follow downstream, stand by stand, the floristic enrichment of diatom communities ("in jumps"), especially at the level of benthic ones. The next sector in which the same tendency was very evident is situated between stands Q 4 and Q 5 (upstream and downstream Sf. Gheorghe). Most of the species added to the original flora in this section, from ecological point of view show identical preferences (preferentially eutrophic conditions, with high mineral content): *Amphora ovalis, Cyclotella atomus, Cyclostephanos dubius, Cymbella caespitosa, Gyrosigma parkerii, G. spencerii, Navicula erifuga, N. halophila, N. menisculus, N. pygmaea, N. slesvicensis, Nitzschia acicularis, N. angustatula, N. calida, N. dubia, N. intermedia, N. littoralis, N. sigma, N. sinuata* v. *tabellaria, N. thermaloides*.

In the sector situated between **Q 5** and **Q 8** (downstream Sf. Gheorghe and upstream Făgăraş) on one hand, and between **Q 8** and **Q 9** (upstream and downstream Făgăraş) on the other, could also be detected a diversification of communities of benthic diatoms by the appearance of other forms of the same ecological categories (*Aulacoseira italica, Cyclostephanos invisitatus, Navicula schroeterii, Nitzschia clausii, N. filiformis, N. geitlerii, N. lorenziana, N. nana, N. parvula, Stephanodiscus hantzschii*).

It should be mentioned that the qualitative and quantitative composition of diatom communities of the dam reservoir upstream Avrig did not differ from those of the river.

Other algal groups. According to our findings the next and more important groups are the green algae (Chlorophyta) with 73 and the euglenoid flagellates (Euglenophyta) with 30 species. The species belonging to the other groups like chrysophytes and dinophytes are quite few (5). The floating communities as a whole, exhibits a higher biodiversity (118 taxa) comparatively with the benthos consisting of 88 taxa only.

As concerning the diversity of different stands, the highest was detected in benthos of **Q 11- Q 12** (55 species). The other high value samples were plankton samples (**Q 10/3** - 49 taxa, **Q 10/2** and **Q 11** - 42 taxa, and **Q 13**). In every group, besides the common species occurring in both plankton and benthos, there are also typical plankton forms (euplankton) and typical benthic forms. The identified dinophytes are all plankton forms.

Common blue-greens for both community types were *Anabaena solitaria, Aphanothece chlatrata, Oscillatoria amoena, O. limosa* and *Spirulina major*. Planktonic cyanophytes are *Chroococcus limneticus, Gomphosphaeria aponina, Microcystis aeruginosa, Oscillatoria lacustris* etc.; benthic forms are *Lyngbya*

kuetzingii, Merismopedia elegans, Oscillatoria sancta, O. simplicissima, Phormidium tenue etc.

The same thing is true for the other groups too (see **Table 1**), except dinophytes, all floating forms. The only red alga (*Rhodochorton*) is benthic.

The upper course of the Olt is characterised by a few rheophil, xeno- and oligosaprobic species, which usually inhabit clear and cool, montane waters: *Hydrurus foetidus, Oscillatoria terebriformis, O. siplicissima, Ulothrix temiissima* and *U. zonata* which are lacking in the middle course. The middle course of the river is characterised by the occurrence of many eutrophic, β-mesosaprobic, or even β-α - mesosaprobic species (*Oscillatoria limosa, Hofmania lauterbornii, Monoraphidium contortum, Trachelomonas armata* etc.). Of course, the dominants are indifferent, cosmopolitan species distributed in a wide range of habitat conditions, like *Gomphosphaeria aponina, Spirulina major, Eudorina elegans, Pandorina morum, Ceratium hirundinella, Peridinium cinctum, Trachelomonas volvocina* etc.

The influence of human activity can be traced in both upper and middle course of the Olt River based on algal community structure. Sometimes the water reached β-α -, α - or even polysaprobic levels, which is clearly indicated by the presence of *Oscillatoria chalybaea, Chlamydomonas reinhardtii, Monoraphidium griffithii, Euglena texta, E. viridis, Lepocinclis ovum* etc.

It is worth mentioning that almost all the identified green algae (55 taxa) occur in the dam reservoir (49 species). Many of them are washed into the river, together with some forms belonging to other groups, and therefore are often found in downstream communities. Most of these algae are meso-eutrophic plankton elements (*Botryococcus braunii, Carteria abiscoensis, C. globosa, C. multifilis, C. vulgaris, Chlamydomonas reinhardtii, C. passiva, Coenococcus planctonicus, Coenochloris pyrenoidosa, Crucigenia apiculata, C. tetrapeda, Dictyosphaerium pulchellum, Eudorina elegans, Hofmania lauterbornii, Monoraphidium irregularis, Nephroselmis angulata, Pandorina morum, P. boryanum, P. duplex, Scenedesmus acuminatus, S. acutus, S. opoliensis, S. quadricauda, S. spinosus, Closterium limneticum, Staurastrum paradoxum, S. tetracerum* etc (*Chlorophyta*); *Ceratium hirundinella, Peridinium aciculiferum, P. cinctum (Dinophyta); Lepocinclis ovum, Trachelomonas lacustris, T. oblonga, T. verrucosa, Strombomonas caudata, S. gibberosa, S. verrucosa (Euglenophyta)*. The highest species numbers of the Olt downstream the dam reservoir (**Q 11, Q 12** and **Q 13**) are due to these species.

Many of the identified algae in the upper and middle course of the Olt River have not yet been recorded in Romania: *Aulacoseira muzzanensis* (Meister) Krammer, *Melosira lineata* (Dillwyn) Agardh, *Cyclotella iris* Brun et Heribaud, *C. bodanica* Grunow, *Navicula meniscus* Schumann, *N. phyllepta* Kuetzing, *N. clementioides* Hustedt, *N. pseudonivalis* Bock, *N .indifferens* Hust., *Diploneis smithii* v. *dilatata* (Peragallo) Terry, *Gyrosigma parkerii* (Harrison) Elmore, *Stephanodiscus niagarae* Ehrenberg, *S. neoastraea* Hakansson, *S. alpinus* Hust., *S. medius* Hakanss., *Thalassiosira visurgis* . Hust., *Amphora thumensis* (A. Mayer) Cleve-Euler, *Gomphonema insigne* Gregory, *Rhopalodia rupestris* (W. Smith) Krammer, *Mastogloia elliptica* Thwites, *Navicula bacilloides* Hust.(Bacillariophyta), genous *Rhodochorton (Rhodophyta)*. There have been identified several rare species like *Aulacoseira ambigua, Cyclotella distinguenda, Navicula laevissima, Diploneis interrupta, Cymbella cesatii, C. delicatula, Amphora coffeaeformis, A. normanii, Nitzschia littoralis, N. intermedia, Caloneis schumanniana, C. permagna, Navicula kotschyi, Stauroneis kriegerii, Cymbella mesiana, Caloneis undulata, Cymbella proxima, C. cymbiformis v. nonpunctata, Cyclotella ocellata, Navicula tenelloides, N.*

striolata, N. hambergii, N. schroeterii, Nitzschia brevissima (Bacillariophyta); Hofmania lauterbornii, Nephroselmis angulata, Monoraphidium braunii (Chlorophyta); Dinobryon stipitatum (Chrysophyta).

CONCLUSIONS

The upper and middle course of the Olt River are characterised by high species diversity.

In both plankton and benthos the dominants are diatoms; there are no marked qualitative differences between the plankton and benthic communities.

As concerning other algal groups there are qualitative differences between plankton and benthos communities, due to the occurrence of some characteristic species, particularly in the case of water reservoir.

The phytoplankton of the dam reservoir markedly influences the downstream community structures of the Olt River.

The algal communities consist mostly of cosmopolitan and omnipresent forms, as well as species preferring high or moderate mineral content. Many of them tolerate high saprobity levels too. There are also present, of course less constantly, rheophil, clear water or terrestrial forms, which came from the surrounding areas or tributaries.

Community structures indicate the presence of eutrophication-pollution, slight in the upper course of the Olt, but showing increasing tendency downstream sectors.

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Table 1. *List of algal species in the upper and middle course of the Olt River*

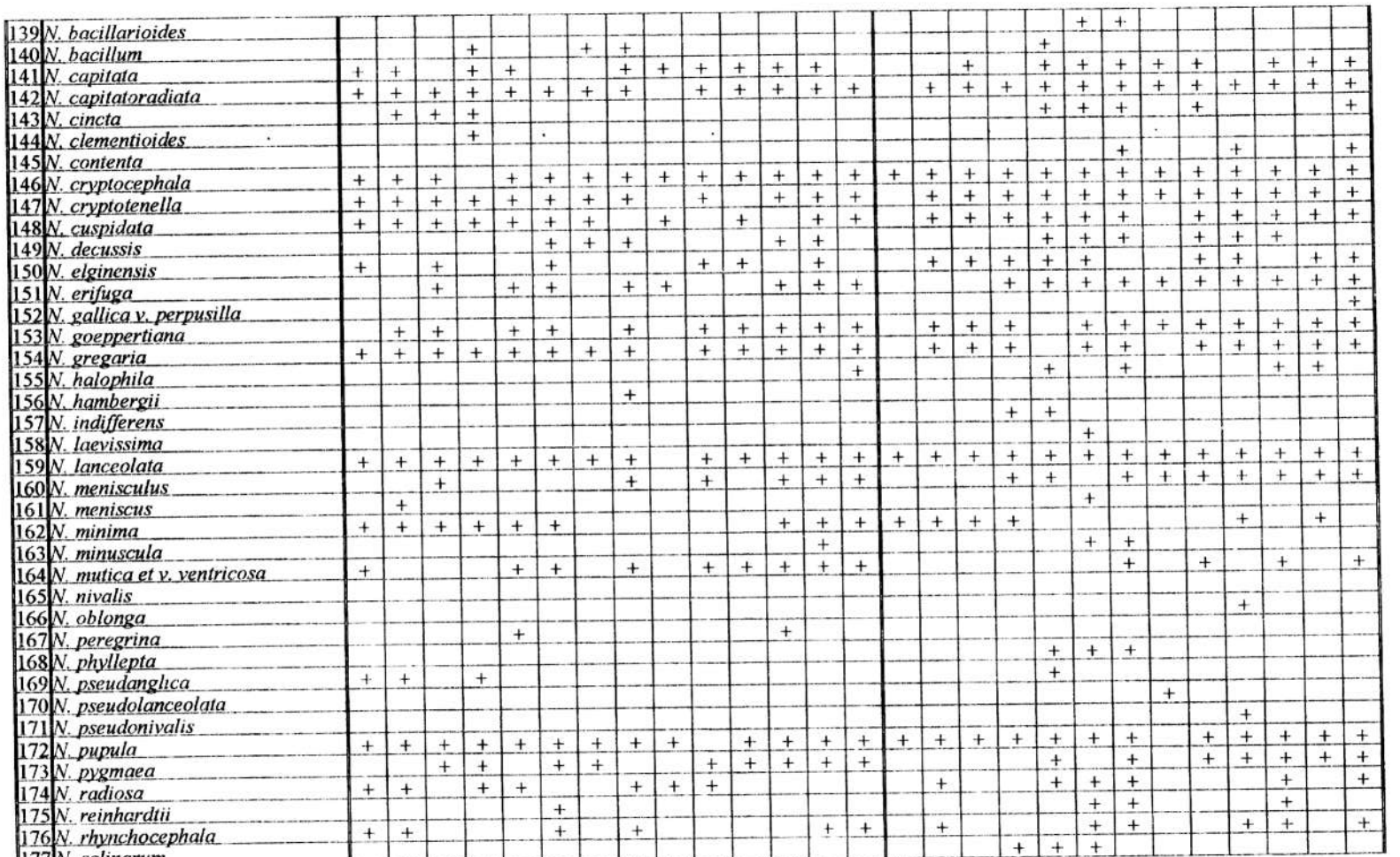
No.	Taxa	Phytoplankton													Periphyton												
		Q_2	Q_3	Q_4	Q_5	Q_6	Q_7	Q_8	Q_9	$Q_{10/1}$	$Q_{10/2}$	$Q_{10/3}$	Q_{11}	Q_{12}	Q_{13}	Q_1	Q_2	Q_3	Q_4	Q_5	Q_8	Q_9	$Q_{10/2}$	$Q_{10/3}$	Q_{11}	$Q_{11/12}$	Q_{12}	Q_{13}
	Cyanophyta																											
1.	*Anabaena aequalis*										+																	
2.	*A. circinalis*											+																
3.	*A. flos-aquae*									+																		
4.	*A. oscillatorioides*																									+		
5.	*A. solitaria*											+										+						
6.	*A. variabilis*										+																	
7.	*Aphanothece chlatrata*	+	+	+	+	+	+							+			+											
8.	*Chroococcus limneticus*												+															
9.	*Coelosphaerium küetzingianum*										+																	
10.	*Gomphosphaeria aponina*								+		+	+	+															
11.	*G. compacta*																											
12.	*Lyngbia kuetzingii*															+								+				
13.	*L. kossinskajae*	+	+	+	+		+									+												
14.	*Merismopedia elegans*																							+		+		
15.	*M. glauca*																			+								
16.	*Microcystis aeruginosa*										+		+	+														
17.	*Oscillatoria amoena*					+	+		+				+								+			+		+		
18.	*O. amphibia*			+	+							+	+			+		+		+	+			+	+	+	+	+
19.	*O. animalis*																									+		
20.	*O. boryana*							+				+									+	+		+				
21.	*O. brevis*																					+			+		+	+
22.	*O. chalybaea*													+														
23.	*O. formosa*																					+				+		
24.	*O. irrigua*										+													+	+	+		
25.	*O. lacustris*											+	+															
26.	*O. limosa*								+															+	+	+		
27.	*O. mougeotii*																	+										
28.	*O. planctonica*							+				+	+															
29.	*O. rubescens*								+		+	+			+										+			

30.	*O. sancta*																					+						
31.	*O. simplicissima*																				+							
32.	*O. tenuis*																					+				+		
33.	*O. terebriformis*																				+	+						
34.	*Phormidium ambiguum*																									+		
35.	*P. corium*																							+		+		
36.	*P. tenue*																							+				
37.	*Spirulina major*									+			+	+					+		+		+		+			
38.	*Snowella rosea*													+											+			
	Chrysophyta																		+									
1.	*Chrysococcus rufescens*																								+			
2.	*Dinobryon divergens*																											
3.	*D. stipitatum*																							+				
4.	*Hydrurus foetidus*														+	+												
	Bacillariophyta																											
1.	*Achnanthes bioretii*						+	+					+								+							
2.	*A. hungarica*		+											+														
3.	*A. laevis*																				+							
4.	*A. lanceolata*	+	+	+		+	+		+	+	+		+	+	+		+	+	+	+	+	+	+		+	+	+	+
5.	*A. minutissima*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+
6.	*A. nodosa*																								+			
7.	*A. subatomoides*																+				+							
8.	*Actinocyclus normanii*		+																									
9.	*Amphipleura pellucida*	+				+	+		+				+			+			+	+	+							+
10.	*Amphora libyca*	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+
11.	*A. montana*						+	+	+								+		+	+	+		+	+	+	+	+	
12.	*A. ovalis*			+	+		+			+	+	+	+	+					+	+		+	+	+	+		+	
13.	*A. pediculus*	+	+	+	+	+	+			+		+	+	+		+	+	+	+	+	+	+		+	+	+	+	
14.	*A. veneta*													+														
15.	*Anomoeoneis sphaerophora*												+							+			+		+	+		
16.	*A. vitrea*							+						+														
17.	*Asterionella formosa*			+	+	+		+	+		+	+	+	+	+									+		+		+
18.	*Aulacoseira alpigena*			+											+													
19.	*A. ambigua*	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+					+	+		+	+	+
20.	*A. granulata*	+	+	+	+	+	+							+	+		+	+	+	+			+	+				+
21.	*A. italica v. angustata*	+	+				+		+		+	+	+	+	+											+		+
22.	*A. muzzanensis*				+							+																
23.	*A. subarctica*					+			+		+	+																
24.	*Bacillaria paradoxa*												+															

25.	*Caloneis amphisbaena*		+	+	+	+	+	+		+		+												+	+		+	+	+
26.	*C. bacillum*		+			+	+			+	+			+	+		+	+		+								+	+
27.	*C. molaris*																														
28.	*C. permagna*														+									+	+				+		
29.	*C. schumanniana*				+															+											
30.	*C. silicula*	+			+	+		+			+			+	+	+	+			+	+	+	+	+	+	+	+	+	+	+
31.	*C. tenuis*													+																	
32.	*Campylodiscus hibernicus*	+	+	+			+	+									+		+												
33.	*Cocconeis neodiminuta*													+																	
34.	*C. pediculus*	+	+	+		+	+	+	+	+	+	+	+	+	+		+	+	+					+	+		+	+	+		
35.	*C. placentula*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+				+	+		+	+	+		
36.	*Cyclostephanos dubius*					+														+							+				
37.	*C. invisitatus*											+	+	+													+				
38.	*Cyclotella atomus*			+	+	+	+		+			+	+	+						+							+				
39.	*C. bodanica*	+				+																									
40.	*C. comensis*	+	+	+													+	+			+										
41.	*C. distinguenda*	+															+	+									+				
42.	*C. iris*	+	+			+	+	+									+	+	+		+										
43.	*C. meneghiniana*	+	+	+	+	+	+	+	+	+	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+
44.	*C. ocellata*			+			+																				+			+	
45.	*C. pseudostelligera*													+													+			+	
46.	*C. radiosa*	+				+	+	+	+								+														
47.	*Cymatopleura elliptica*				+	+	+					+	+	+				+						+	+	+	+			+	
48.	*C. solea*	+	+	+	+	+		+	+		+	+	+	+				+	+	+	+	+	+	+	+	+	+	+	+	+	
49.	*Cymbella affinis*	+	+	+		+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
50.	*C. amphicephala*	+				+	+		+			+	+							+	+	+					+	+	+		
51.	*C. aspera*	+			+																										
52.	*C. caespitosa*	+					+				+		+	+	+					+			+		+		+	+	+		
53.	*C. cesatii*					+																									
54.	*C. cistula*	+	+							+			+		+		+	+	+	+	+		+					+	+		
55.	*C. cuspidata*																					+			+						
56.	*C. cymbiformis et v. nonpunctata*	+																													
57.	*C. ehrenbergii*	+			+							+		+	+		+			+											
58.	*C. falaisensis*					+																									
59.	*C. gracilis*								+					+																	
60.	*C. helvetica*	+	+	+		+	+	+	+				+	+		+	+	+	+		+	+									
61.	*C. lanceolata*	+	+	+		+	+	+						+						+	+										
62.	*C. mesiana*																			+											
63.	*C. microcephala*						+								+						+			+							+

64.	*C. minuta*	+	+	+		+	+	+	+						+	+	+	+	+		+	+		+	+		+	+		+	+
65.	*C. naviculiformis*			+		+			+						+	+	+		+		+	+			+	+	+	+			
66.	*C. prostrata*	+		+							+		+				+				+		+		+	+	+				
67.	*C. silesiaca*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
68.	*C. sinuata*	+	+	+		+	+	+	+		+	+	+	+	+	+	+	+	+		+	+	+	+		+	+	+	+	+	+
69.	*C. tumida*	+		+				+	+		+		+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
70.	*C. turgidula*													+							+		+	+	+	+					+
71.	*Denticula elegans*																														+
72.	*D. kützingii*						+														+										
73.	*D. tenuis*					+	+													+				+							
74.	*Diatoma anceps*			+											+	+								+							
75.	*D. mesodon*	+	+	+		+	+	+	+				+	+	+	+	+	+	+		+	+		+	+	+	+	+	+	+	+
76.	*D. moniliformis*		+	+	+	+	+	+	+			+	+	+			+	+	+			+		+	+	+				+
77.	*D. tenuis*																				+										
78.	*D. vulgaris*	+	+	+		+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
79.	*Diatomella balfouriana*								+																						
80.	*Diploneis elliptica*			+										+							+	+									
81.	*D. interrupta*																				+										
82.	*D. oblongella*		+	+											+	+															
83.	*D. oculata*			+										+						+		+				+				+	
84.	*D. ovalis*																														+
85.	*D. smithii v. dilatata*																														
86.	*Elierbeckia arenaria*	+															+	+	+												
87.	*Entomoneis paludosa v subsalina*							+																							
88.	*Epithemia adnata*	+	+		+	+	+								+		+	+	+	+	+	+					+	+			
89.	*E. argus*					+																									
90.	*E. sorex*	+			+	+												+	+	+											
91.	*E. turgida*	+		+	+	+									+		+														
92.	*Eunotia bilunaris*		+	+										+			+		+		+	+				+	+			
93.	*E. diodon*			+																											
94.	*E. exigua*													+				+													
95.	*E. flexuosa*													+																	
96.	*E. formica*						+																								
97.	*E. hexaglyphis*	+																													
98.	*E. minor*	+	+						+					+			+			+	+	+		+				+	+	
99.	*E. muscicola v. tridentula*																				+							+			
100	*E. pectinalis*														+											+		+			
101	*E. praerupta*																+				+	+	+	+	+	+	+	+	+		
102	*Fragilaria arcus*	+	+	+	+	+	+	+	+		+	+	+	+	+				+		+	+	+	+	+	+	+	+	+	+	+

103	*F. bicapitata*																						+						
104	*F. biceps*		+																										
105	*F. brevistriata*													+								+							
106	*F. capucina v. distans*																				+								
	F. c. v. gracilis								+					+															
	F. c. v. mesolepta													+															
	F. c. v. vaucheriae	+	+	+	+	+	+		+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
107	*F. construens*	+	+	+		+		+		+			+	+			+	+	+	+	+	+	+		+	+	+	+	+
108	*F. crotonensis*														+								+						
109	*F. dilatata*						+								+				+										
110	*F. leptostauron*																					+							
111	*F. parasitica*								+																+				
112	*F. pinnata*	+	+	+	+	+	+			+			+	+	+		+		+	+	+				+	+	+	+	+
113	*F. tenera*													+															
114	*F. ulna et v. acus*	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+
115	*Frustulia rhomboides*			+																									
116	*F. vulgaris*	+	+	+		+	+	+	+				+	+	+		+	+	+		+	+	+	+	+	+	+	+	+
117	*Gomphonema acuminatum*		+						+						+				+	+		+			+	+	+	+	
118	*G. angustatum*	+	+	+				+	+	+	+			+	+		+	+	+		+	+						+	
119	*G. angustum*	+	+	+		+	+	+			+	+	+	+	+		+	+	+	+	+	+	+		+	+	+	+	+
120	*G. augur*											+													+	+			
121	*G. clavatum*	+							+						+			+	+	+		+	+			+	+	+	
122	*G. gracile*													+						+		+	+						+
123	*G. insigne*													+								+	+						
124	*G. olivaceum*		+	+		+	+	+	+		+		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+
125	*G. parvulum*	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+
126	*G. tergestinum*			+		+																+	+						
127	*G. truncatum*	+	+		+				+	+				+	+		+			+			+	+	+	+	+	+	+
128	*Gyrosigma acuminatum*	+	+	+	+	+	+		+	+	+	+	+	+	+			+	+	+	+	+	+	+	+		+	+	
129	*G. attenuatum*		+			+												+				+		+					
130	*G. nodiferum*			+				+					+		+								+				+	+	
131	*G. parkerii*								+		+	+		+	+						+		+	+	+	+	+	+	+
132	*G. scalproides*		+	+		+	+	+	+		+		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+
133	*G. spencerii*				+		+		+				+	+					+	+		+		+	+	+	+	+	+
134	*Hantzschia amphioxys*	+	+	+		+		+						+			+	+	+	+	+	+				+	+	+	
135	*Melosira lineata*		+	+																									
136	*M. varians*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
137	*Meridion circulare*	+	+	+		+	+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
138	*Navicula accomoda*					+	+		+					+			+				+	+		+					+


139 N. bacillarioides
140 N. bacillum
141 N. capitata
142 N. capitatoradiata
143 N. cincta
144 N. clementioides
145 N. contenta
146 N. cryptocephala
147 N. cryptotenella
148 N. cuspidata
149 N. decussis
150 N. elginensis
151 N. erifuga
152 N. gallica v. perpusilla
153 N. goeppertiana
154 N. gregaria
155 N. halophila
156 N. hambergii
157 N. indifferens
158 N. laevissima
159 N. lanceolata
160 N. menisculus
161 N. meniscus
162 N. minima
163 N. minuscula
164 N. mutica et v. ventricosa
165 N. nivalis
166 N. oblonga
167 N. peregrina
168 N. phyllepta
169 N. pseudanglica
170 N. pseudolanceolata
171 N. pseudonivalis
172 N. pupula
173 N. pygmaea
174 N. radiosa
175 N. reinhardtii
176 N. rhynchocephala
177 N. salinarum

178	*N. schröeterii*							+			+	+	+	+			+				+	+	+			+	+	+
179	*N. slesvicensis*	+					+		+	+	+		+	+	+		+			+	+	+	+	+	+	+		+
180	*N. splendicula*																				+								
181	*N. subhamulata*	+	+			+												+	+	+							+		
182	*N. subminuscula*		+	+	+	+	+	+	+		+	+	+	+	+		+	+	+		+	+		+	+	+	+	+	
183	*N. tenelloides*		+			·	·											·+	·											
184	*N. tripunctata*	+	+	+		+	+	+					+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+
185	*N. trivialis*	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+		+	+	+	+	+	+	+	+	+	+
186	*N. veneta*					+					+		+				+	+		+		+	+	+	+	+	+	+
187	*N. viridula*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
188	*Neidium affine*																+					+							
189	*N. ampliatum*	+	+											+					+	+	+	+		+	+	+		+
190	*N. bisulcatum*					+																+							
191	*N. dubium*				+															+	+				+	+		+
192	*Nitzschia acicularis*							+	+		+	+	+	+						+	+	+		+	+	+	+	+
193	*N. amphibia*		+	+							+	+	+		+			+	+	+	+	+	+	+	+	+	+	+
194	*N. angustata*				+		+													+				+			+	
195	*N. angustatula*																			+								
196	*N. brevissima*								+						+		+				+	+			+		+	
197	*N. calida*		+	+	+	+		+			+	+	+	+	+				+	+	+	+	+	+	+	+	+	+
198	*N. capitellata*	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
199	*N. clausii*																					+		+		+	+	
200	*N. communis*						+											+								+		+
201	*N. constricta*		+	+	+	+		+	+		+		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+
202	*N. debilis*																			+								
203	*N. dissipata*	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
204	*N. dubia*			+		+	+	+						+	+			+	+		+				+	+	+	+
205	*N. filiformis*			+							+											+				+	+	+
206	*N. fonticola*			+							+		+		+			+	+	+		+	+	+	+	+	+	+
207	*N. frustulum*	+		+		+	+	+	+				+	+	+	+	+	+				+	+			+	+	
208	*N. geitlerii*																					+		+				
209	*N. gracilis*											+								+			+					
210	*N. hantzschiana*			+																							+	
211	*N. heufleriana*	+	+	+					+					+			+	+	+			+			+			
212	*N. hungarica*	+		+	+	+	+	+	+				+	+	+			+	+	+	+	+	+	+	+	+	+	+
213	*N. inconspicua*			+		+	+				+	+	+	+	+			+		+	+	+	+			+	+	+
214	*N. intermedia*			+		+		+	+				+	+	+						+	+		+	+	+	+	+
215	*N. levidensis*																			+							+	
216	*N. linearis et v. subtilis*	+	+	+	+	+	+	+	+		+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

217	*N. littoralis*				+									+						+	+	+			+	+	+			
218	*N. lorenziana*											+										+			+		+			
219	*N. microcephala*													+												+				
220	*N. nana*												+		+						+				+		+			+
221	*N. ovalis*																						+			+				
222	*N. palea*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
223	*N. paleacea*			+	+	+	+	+			+	+	+	+	+		+	+		+	+	+	+	+	+		+	+	+	+
224	*N. parvula*																					+	+							
225	*N. pellucida*																+													
226	*N. pseudofonticola*																			+						+				
227	*N. recta*		+	+	+	+	+			+			+		+					+	+	+	+	+	+		+	+	+
228	*N. reversa*										+	+														+				
229	*N. sigma*			+	+	+			+					+	+						+		+		+	+	+	+	+
230	*N. sigmoidea*	+		+	+	+	+	+	+	+		+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+
231	*N. sinuata et v. tabellaria*						+			+	+				+					+				+	+		+			
232	*N. sociabilis*													+	+		+		+			+								
233	*N. thermaloides*																			+					+		+			
234	*N. umbonata*	+	+	+	+	+		+			+		+	+			+			+					+	+	+			
235	*N. vermicularis*	+	+	+		+	+		+			+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+
236	*Pinnularia appendiculata*	+																												
237	*P. borealis*	+	+				+	+						+			+	+	+		+	+					+		
238	*P. braunii*																													
239	*P. cardinalicus*																	+												
240	*P. gibba*							+	+														+				+			
241	*P. ignobilis*			+																										
242	*P. interrupta*	+		+										+		+	+	+				+					+	+		
243	*P. lata*	+																												
244	*P. microstauron*		+	+									+	+	+		+	+	+	+	+	+					+	+		
245	*P. stomatophora*		+																											
246	*P. subcapitata*	+		+					+						+	+							+							
247	*P. viridis*	+	+	+	+	+		+					+	+	+		+	+	+		+	+			+	+	+	+	+	+
248	*Pleurosira laevis*														+															
249	*Rhoicosphaenia abbreviata*	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+		+	+	+			+	+	+	+	+	+	+
250	*Rhopalodia brebissonii*		+																											
251	*R. gibba*	+	+	+		+											+	+	+	+		+								+
252	*R. rupestris*	+																												
253	*Stauroneis anceps*		+		+										+			+	+	+		+					+	+	+
254	*S. phoenicenteron*			+										+			+					+				+	+			
255	*S. smithii*																	+				+								

256	*Stephanodiscus alpinus*					+	+	+	+					+	+		+			+	+	+			+	+		+
257	*S. hantzschii*						+		+		+		+	+	+			+			+	+		+	+	+	+	+
258	*S. medius*					+	+	+	+					+	+			+			+	+		+	+	+	+	+
259	*S. neoastraea*																				+							
260	*S. niagarae*						+		+												+							
261	*Surirella angusta*	+	+	+		+	+	+	+				+	+	+		+	+	+	+	+	+	+	+	+	+	+	+
262	*S. biseriata v. constricta*	+																										
263	*S. brebissoni*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
264	*S. capronii*	+																										
265	*S. elegans*	+																										
266	*S. linearis*	+		+	+	+	+	+						+			+	+	+	+	+	+		+	+		+	+
267	*S. minuta*	+	+	+	+	+	+	+	+	+	+		+	+		+	+	+	+	+	+	+	+	+	+	+	+	+
268	*S. ovalis*			+			+							+			+	+	+	+	+	+		+	+	+	+	+
269	*S. splendida*	+	+	+	+		+	+	+			+	+	+	+			+	+	+	+	+	+	+	+	+	+	+
270	*Tabellaria fenestrata*	+							+								+					+						
271	*T. flocculosa*			+	+										+		+	+				+	+	+		+		+
272	*Thalassiosira visurgis*	+	+																									
273	*T. weissflogii*		+	+									+	+	+			+	+							+	+	+	+
	Chlorophyta-Chlorophyceae																											
1.	*Actinastrum hantzschii*										+																	
2.	*Ankistrodesmus bibraianus*									+																		
3.	*A. gracilis*														+											+		
4.	*Botryococcus braunii*							+				+	+		+													
5.	*Carteria abiscoensis*											+																
6.	*C. globosa*											+			+													
7.	*C. multifilis*											+	+															
8.	*C. vulgaris*											+	+															
9.	*Chaetophora elegans*																	+	+				+					
10.	*Chlamydomonas reinhardtii*											+			+													
11.	*C. passiva*											+																
12.	*Chlosteriopsis acicularis*								+			+																
13.	*Coelastrum sphaericum*											+																
14.	*Coenococcus planctonicus*										+	+																
15.	*Coenochloris pyrenoidosa*										+		+	+														
16.	*Crucigenia apiculata*											+																
17.	*C. tetrapedia*													+														
18.	*Dictyosphaerium pulchellum*										+		+	+	+													
19.	*D. tetrachotomum*												+															
20.	*Eudorina elegans*									+	+		+	+	+											+		

21.	*Hofmania lauterbornii*										+	+	+													+			
22.	*Keratococcus caudatus*																									+			
23.	*Kirchneriella obesa*									+																+			
24.	*K. subcapitata*																									+			
25.	*Lagerheimia ciliata*											+																	
26.	*Micractinium pusillum*									+		+																	
27.	*Monoraphidium arcuatum*										+			+															
28.	*M. braunii*																									+			
29.	*M. contortum*											+	+	+									+		+		+			
30.	*M. griffithii*											+		+															
31.	*M. irregularis*										+	+	+																
32.	*M. minutum*																									+			
33.	*M. pusillum*																									+			
34.	*Nephroselmis angulata*										+																		
35.	*Oocystis lacustris*									+																			
36.	*Pandorina morum*								+	+		+	+	+										+		+			
37.	*Pediastrum biradiatum*							+		+	+	+		+															
38.	*P. boryanum*								+	+	+		+	+															
39.	*P. duplex*									+	+	+	+	+										+					
40.	*P. simplex*							+		+																			
41.	*P. tetras*																												
42.	*Scenedesmus acuminatus*									+		+	+													+			
43.	*S. acutus*								+	+	+	+	+	+										+		+			
44.	*S. ecornis*									+																+			
45.	*S. granulatus*										+																		
46.	*S. intermedius*									+	+																		
47.	*S. opoliensis*							+		+	+	+	+	+												+			
48.	*S. quadricauda*							+		+	+	+	+	+										+	+	+			
49.	*S. spinosus*				+			+	+	+	+	+		+						+				+	+	+	+	+	
50.	*Sphaerocystis schroeterii*									+																			
51.	*Stichococcus bacillaris*														+				+	+						+			
52.	*S. minor*														+				+	+						+			
53.	*Stigeoclonium longipillum*																		+										
54.	*S. subsecundum*														+														
55.	*Tetraedron caudatum*							+																					
56.	*T. hastatum*																												
57.	*T. incus*								+		+								+										
58.	*T. regulare*											+																	
59.	*T. trigonum*																									+			

60.	*Tetrastrum glabrum*					+									+													
61.	*Ulothrix tenuissima*																+											
62.	*U. zonata*															+	+											
63.	*Uronema confervicolum*																							+	+		+	+
	Chlorophyta-Conjugatophyceae																											
1.	*Closterium acerosum*								+			+			+							+		+		+		
2.	*C. limneticum*							+				+	+												+			+
3.	*C. litorale*																											
4.	*C. moniliferum*										+	+														+	+	+
5.	*C. venus*																									+		
6.	*Cosmarium subtumidum*																							+	+	+		
7.	*Staurastrum lunatum*											+																
8.	*S. orbiculare*												+													+	+	+
9.	*S. paradoxum*													+														
10.	*S. tetracerum*										+		+															
	Dinophyta																											
1.	*Ceratium hirundinella*					+		+		+	+	+																
2.	*Gloenodinium uliginosum*																											
3.	*Peridinium aciculiferum*									+	+	+		+														
4.	*P. cinctum*					+				+				+														
5.	*P. umbonatum*					+																						
	Euglenophyta																											
1.	*Euglena acus*					+			+			+	+															
2.	*E. deses*																				+					+		
3.	*E. ehrenbergii*														+											+		
4.	*E. oxyuris*												+								+							
5.	*E. pisciformis*																				+					+		
6.	*E. polymorpha*																				+							
7.	*E. spirogyra*					+			+						+						+					+		
8.	*E. splendens*																									+		
9.	*E. stellata*							+													+							
10.	*E. texta*							+		+		+			+							+				+		
11.	*E. viridis*														+						+					+		
12.	*Lepocinclis ovum*											+			+						+					+		
13.	*Phacus brevicaudatus*														+													
14.	*P. longicauda*							+	+		+		+	+	+													
15.	*P. orbicularis*												+	+	+											+		
16.	*P. pleuronectes*														+											+		

17.	*P. pyrum*												+	+													
18.	*P. tortus*																								+		
19.	*P. triqueter*												+														
20.	*Trachelomonas armata*										+														+		
21.	*T. hispida*												+	+											+		
22.	*T. intermedia*							.	.											.	.				+		
23.	*T. lacustris*										+		+														
24.	*T. oblonga*											+		+								+			+		
25.	*T. planctonica*							+			+	+															
26.	*T. verrucosa*											+			+										+		
27.	*T. volvocina*					+	+	+	+	+	+	+			+					+				+	+	+	+
28.	*Strombomonas caudata*										+																
29.	*S. gibberosa*										+	+	+												+		
30.	*S. verrucosa*										+	+													+		
	Rhodophyta																										
1.	*Rhodochorton sp.*															+	+	+									
	Total	102	104	115	74	113	106	87	103	56	114	106	137	154	152	44	106	103	94	130	154	162	86	128	111	191	126	138

ALGAL COMMUNITIES OF THE CIBIN RIVER AND OF WETLANDS SITUATED ON THE UPPER AND MIDDLE COURSE OF THE OLT RIVER

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REZUMAT

Diversitatea relativ mare a algelor din râul Cibin (197 taxoni) şi din unele zone umede din bazinul râului Olt (322 de taxoni) se datorează, mai ales, prezenţei unui mare număr de diatomee (Bacillariophyta), ca şi prezenţei a numeroase alge verzi (Chlorophyta), albastre-verzi (Cyanophyta) şi flagelate euglenoide (Euglenophyta). Elementele cosmopolite domină în cadrul comunităţilor, dispunând de largi valenţe ecologice (ubicviste) sau preferând concentraţii medii sau mari ale nutrienţilor. Compoziţia comunităţilor (planctonice, bentonice) indică o eutrofizare evidentă, precum şi un stress la poluarea organică (grad critic de saprobitate).

Keywords: algal diversity, Olt River tributaries, wetlands.

INTRODUCTION

The algal flora of the Olt River was poorly documented (Buşniţă, Brezeanu, Prunescu-Arion, 1961; Popescu-Marinescu, Elian-Tălău, 1980; Popescu-Marinescu et al., 1980). Recent investigations carried out on the upper and middle course of the river revealed a high diversity of floating and benthic communities (Rasiga *et al.*, in press). The Olt's tributaries (including the Cibin River) and wetlands have not yet been investigated.

MATERIALS AND METHODS

Planktonic and benthic communities were sampled in selected stands, as well as in two supplementary ones from an oxbow lake of the Olt near Augustin (**T 5/1**) and the Sâmbăta rivulet (**T 7/8**). The Cibin River and the mentioned wetlands from the Olt River Valley were sampled during October 1998. The plankton samples were collected with No. 25 plankton net by filtering about 20 l of water. The benthos of the riverbed (epilithic, epipelic and epipsammic communities) was sampled by using adequate methods (scraping, suction, detaching).

RESULTS AND DISCUSSION

A. Algae from the Cibin River and Gura Râului Dam Reservoir.

There have been identified 197 algae in the Cibin River Basin; they belong to the following divisions: *Cyanophyta* – 11, *Chrysophyta* – 2, *Xanthophyta* – 3, *Bacillariophyta* – 138, *Chlorophyta* – *Chlorophyceae* – 21, *Chlorophyta* – *Conjugatophyceae* – 1, *Euglenophyta* – 21 (see **Table 1, Fig. 1**). The highest number of algal species (109) occurred downstream Mohu (**R 8**), the lowest in the Gura Râului dam reservoir (13). The number of species identified in other localities varied between 42 and 62 (**Table 1**).

Bacillariophyta. Diatoms exhibited the same tendency of variation as the whole group of algae (see above). Community compositions were similar with those occurring in the Olt River (Rasiga *et al.* in press), 90,6% of the taxa being common.

However, the Cibin River appeared less uniform and the number of species in all sampling sites was much reduced. Most of the occurred diatoms are indifferent, or have wide ecological tolerance (*Achnanthes lanceolata, A. minutissima, Cocconeis placentula, Cymbella minuta, C. silesiaca, C. sinuata, Fragilaria capucina, Gomphonema parvulum, Hantzschia amphioxys, Melosira varians, Navicula cryptocephala, N. lanceolata*). By the contrary, some are frequently found in clean, mountain waters (*Diatoma mesodon, Fragilaria arcus, F. pinnata,*

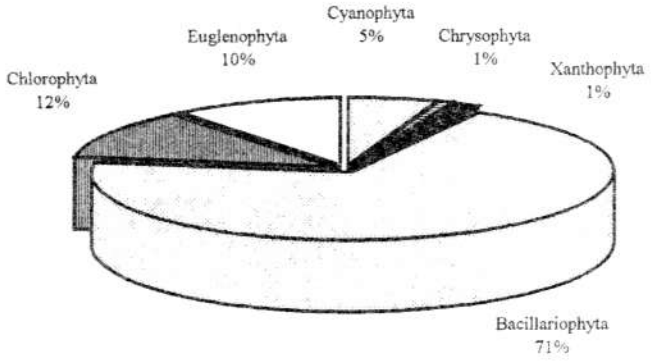

Fig. 1. *The percentage distribution of the main algal divisions in the flora of the Cibin River.*

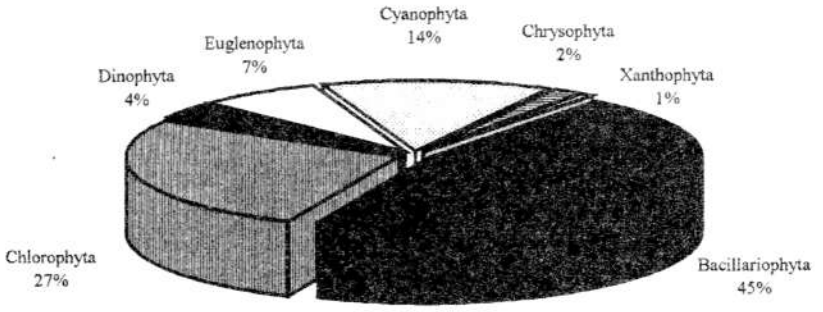

Fig. 2. *The percentage distribution of the main algal groups in the flora of the Olt River wetlands.*

Gomphonema angustum, G. clavatum). In the same time there were observed evident qualitative differences between the communities occurring in the tributaries of the upper sector of the Cibin River and those inhabiting the lower course of the river. As such, the communities of the Râul Mic (**R 3/1**) and Râul Mare (**R 3/2**) mostly consist of some eurytopic elements (mentioned before), mixed up with oligotrophic, clean water forms or that washed into the rivulets from other aquatic and terrestrial habitats of the surrounding area (*Achnanthes bioretii, A. oblongella, A. subatomoides, Aulacoseira alpigena, A. distans, Cymbella cymbiformis v. nonpunctata, C. falaisensis, C. gracilis, C. naviculiformis, Diatoma anceps, Eunotia, Fragilaria virescens, Frustulia rhomboides, Navicula angusta, N. tenelloides, Nitzschia hantzschiana* and *Pinnularia* species). Upstream Sibiu (**R 6, R 7, R 8**) such elements disappear and the communities become dominated by species that prefer higher mineral content and tolerate organic loading (*Achnanthes hungarica, Amphora veneta, Asterionella formosa, Cyclotella atomus, C. meneghiniana, Fragilaria crotonensis, Gyrosigma scalproides, Navicula capitatoradiata, N. cincta, N. cuspidata, N. erifuga, N. goeppertiana, N. gregaria, N. halophila, N. pupula, N. pygmaea, N. subminuscula, N. trivialis, N. veneta, N. viridula, Nitzschia acicularis, N. capitellata, N. communis, N. constricta, N. dubia, N. frustulum, N. hungarica, N. inconspicua, N. palea, N. sigmoidea, N. umbonata, Rhoicosphaenia abbreviata*).

As concerning the Gura Râului dam reservoir and the river below, the diatom species are less numerous.

The diatom populations were poorly developed in the floating community ("plankton") of the Cibin River and the same is true for the benthos of its main tributaries (Râul Mare and Râul Mic).

In the Cibin River upstream Sibiu, the most abundant forms were *Achnanthes minutissima* (ubiquitous diatom, distributed mostly in clean waters), *Fragilaria arcus, Diatoma mesodon* and *Gomphonema angustum* (prefer oligotrophic, oligosaprobic habitats) and *Cymbella sinuata* (aerophil element). In the floating community upstream Sibiu (**R 6**), there were relative frequent some of the more tolerant elements (eutrophic, saprobic): *Navicula viridula, N. trivialis, Nitzschia palea, Achnanthes hungarica, Fragilaria dilatata, Gomphonema parvulum* etc.

In the lake phytoplankton, very poor indeed, only *Asterionella formosa* (euplankter) appeared with somewhat higher frequency.

Other algal groups. The green algae (Chlorophyta) and euglenoid flagellates (Euglenophyta) were less numerous (22 and 21 taxa). The blue-greens (Cyanophyta) were more reduced (11 species). Other groups are even less important (**Table 1, Fig. 1**).

The floating communities contained more species than the benthic ones. There were marked differences between the upper course of the Cibin River and that downstream Sibiu, as concerning both, species diversity and community structure. In stands, located downstream Sibiu (**R 7**) there were detected 42 species (total number of identified species 58), while upstream the city only 3-6 species occurred in each stand.

In the communities from the upper course of the Cibin River (dominated by diatoms) there live some rheophil, oligotrophic, benthic greens and chrysophytes: *Hydrurus foetidus, Ulothrix tenuissima* and *U. zonata*.

Changes in habitat condition determined by industrial effluents and urban sewage increased the species diversity of phytoplankton communities of the Cibin River downstream Sibiu (42 taxa). There are 22 euglenoid flagellates and several cyanophytes, xanthophytes and green algae that occurred exclusively in these sites.

From ecological point of view most of the species prefer eutrophic habitats, with moderate or high mineral content (e.g. *Microcystis aeruginosa, Oscillatoria brevis, Phormidium tenue, Crucigenia terapedia, Pediastrum boryanum, Sphaerocystis schroeteri, Euglena, Phacus* and *Trachelomonas* species). There were also present many indicators of critical saprobic levels (β-α, α- or even polysaprobic), especially downstream Sibiu (R 7): *Oscillatoria chalybaea, Ophyocytium cochleare, O. parvulum, Euglena pisciformis, E. texta, Lepocinclis ovum* etc. Certainly, there were equally important the cosmopolitan, ubiquitous elements (*Dinobryon sertularia, Eudorina elegans, Pandorina morum, Trachelomonas volvocina* etc.).

B. **Algal communities of the Olt River basin wetlands and tributaries.**

The algal floras of wetlands (oxbow lakes, old riverbeds [**T 1, T 4, T 5, T 5/1, T 8, T 9**], swamps [**T 2**]) and the Olt River small tributaries (**T 6/1, T 6/2, T 7-8**) are outstandingly diverse (322 species). They belong to the following divisions: *Cyanophyta* – 29, *Chrysophyta* – 4, *Xanthophyta* – 2, *Bacillariophyta* – 202, *Chlorophyta-Chlorophyceae* – 45, *Chlorophyceae-Conjugatophyceae* –15, *Dinophyta* – 8, *Cryptophyta* –1, *Euglenophyta* – 16 (See **Table 1, Fig. 2**).

The highest number of species (100 taxa) was detected in the oxbow lake near Aita Mare (**T 4**), in the other places their number varied between 47 and 85.

Bacillariophyta. All these communities were dominated by diatoms (**Fig. 2**), the highest numbers of species (65 taxa) was detected in periphyton communities of the old riverbeds near Racoviţa (**T 8**) and Augustin (**T 5/1**, 62 taxa), the lowest in the benthic communities of the Măieruş rivulet (**T 6/1**; 20 taxa) and in the oxbow lakes of Râul Negru at Sântionlunca (**T 1**; 30 taxa). 89% of the species are common with those occurring in the Olt River.

The phytoplankton of oxbow lakes was scarce, with low diversity. Most of them are widely distributed species, but clean water forms (*Navicula cryptotenella*), standing water forms (*Navicula radiosa*), or those preferring eutrophic conditions (*Nitzschia palea*) and higher mineral content are not lacking. The common feature of the species occurring in these stands is their preference for standing or slowly running waters. Many of them are littoral forms (epiphytic or epipelic) which prefer moderate mineral content (*Epithemia adnata, E. sorex, E. turgida, Cymbella affinis, Amphipleura pellucida, Rhoicosphaenia abbreviata, Rhopalodia gibba*). On the other hand there were those preferring high mineral loading, but moderate saprobic levels (*Cymbella cistula, Cyclotella meneghiniana, Amphora veneta, Nitzschia gracilis, N. dissipata*). Species tolerating massive organic loading are few. Many of the species detected in the oxbow lake near Racoviţa (**T 8**) are halophil, preferring brackish or freshwater with massive mineral loading (*Amphora coffeaeformis, Caloneis permagna, Mastogloia elliptica, M. smithii, Denticula subtilis, Entomoneis palludosa v. subsalina, Navicula slesvicensis, N. salinarum, N. phyllepta, N. halophila, N. pseudolanceolata, Nitzschia umbonata, N. littoralis, N. intermedia, N. nana, N. reversa, Surirella ovalis*). The dominant species was *Navicula nana*, a cosmopolitan one, frequent in brackish coastal waters, which tolerate variable osmotic pressures.

As concerning the rivulets, the benthic communities of Măieruş (**T 6/1**) and Bogata (**T 6/2**) showed a reduced number of individuals. More frequent were the clean water forms (*Gomphonema angustum*), which tolerate moderate loading of minerals (*Navicula tripunctata, Cymbella helvetica*) and the widely distribute ones. In the Bogata rivulet there were also detected several species that tolerate high mineral content (*Nitzschia dissipata, Navicula tripunctata, Gyrosigma attenuatum, Nitzschia sigmoidea, N. thermaloides* etc). The Sâmbăta rivulet (**T 7/8**) was characterised by

the presence of periphytic communities dominated by widely distributed species (*Achnanthes minutissima, Cymbella sinuata, C. silesiaca, C. minuta, Fragilaria capucina, Navicula cryptocephala, Gomphonema parvulum*).

The phytoplankton of the Hărman-Prejmer swamp (**T 2**) exhibited very poor diatom populations. The most frequent forms were the ubiquitous ones (*Amphora pediculus, Achnanthes minutissima*), members of the benthic communities washed into the plankton and preferring higher mineral content (*Cymbella lanceolata, Amphora ovalis, Gyrosigma attenuatum*), together with some plankters (*Fragilaria construens*).

Other algal groups. Generally speaking, the plankton samples exhibited higher species diversity than the benthic ones. They originated in the benthic habitats of the Olt and of the Râul Negru rivers. The green algae are present with 60 species (half of the total number of species others than diatoms) (**Table 1, Fig. 2**). The conjugatophyceae are present in the wetlands with 15 species, much more numerous than in the Olt and Cibin rivers. Some of them are eutrophic (*Closterium limneticum, Cl. moniliferum, Cosmarium subtumidum*), others prefer eu-mesotrophic habitats (*Staurastrum crenulatum, S. forficulatum, S. lunatum, S. orbiculare*).

The next more important groups were the blue-greens (29 taxa) and the euglenoid flagellates (16 taxa). The highest diversity was detected in sample **T 4**, collected in one of the old riverbeds of Râul Negru near Sântionlunca (54 species). Somewhat similar diversities were detected in other wetland samples. The lowest species diversities were observed in the benthos of the Olt small tributaries and in the Hărman-Prejmer swamp.

Some of the greens were found exclusively in benthos (*Lyngbya kuetzingii, Phormidium frigidum*), others seem to be plankters (*Coelosphaerium kuetzingianum, Gomphosphaeria naegeliana, Microcystis aeruginosa, and Nodularia spumigena*). *Spirulina major* appeared in both plankton and benthos.

Dominants are the cosmopolitan and ubiquitous forms like *Spirulina major, Chrysococcus rufescens, Synura petersenii, Eudorina elegans, Pandorina morum, Cosmarium subtumidum, Ceratium hirundinella, Peridinium umbonatum* etc. Widespread eutrophic species form equally rich populations in wetland habitats (*Merismopedia elegans, Microcystis aeruginosa, Uroglena volvox, Coelastrum sphaericum* and species of *Monoraphidium, Scenedesmus, Pediastrum, Euglena, Phacus* and *Trachelomonas*). Some of the species are more or less of terrestrial origin (*Stichococcus bacillaris, S. minor, Coccomixa lacustris*).

Human impact caused the eutrophication of wetland habitats, reflected by the frequency of saprobic indicators (*Oscillatoria chalybaea, O. formosa, O. princeps, O. tenuis, Closterium venus, Monoraphidium griffithii, Euglena texta, Lepocinclis ovum* and others).

CONCLUSIONS

- Algal diversity exhibits an increasing tendency in the Cibin River from its upper course towards its middle and lower ones. These changes are due to the increasing frequency of eutrophic and saprobic elements.
- The general eutrophication process of the river is doubled by the marked urban and industrial pollution stress caused by the city of Sibiu.
- The wetland area of the Olt River basin exhibit an outstanding algal diversity due to the variability of its habitats: oxbow lakes, old riverbed, swamps, clean water rivulets etc.

- Compositions of algal communities in the investigated wetland stands exhibit the strong influence of human activities.

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Tab. 1. *List of algal species in the Cibin River and in the wetlands of the Olt River drainage basin*

No.	Taxa	Cibin							Wetlands										
		$R_{3/1}$	$R_{3/2}$	$R_{3/4}$	R_4	R_6	R_7	R_8	T_1	T_2	T_3	T_4	T_5	$T_{5/1}$	$T_{6/1}$	$T_{6/2}$	$T_{7/8}$	T_8	T_9
	Cyanophyta																		
1.	*Anabaena circinalis*												+						
2.	*A. ellipsoideus*													+					
3.	*A. oscillatorioides*																		+
4.	*A. variabilis*											+	+	+					
5.	*Aphanothece chlatrata*						+												
6.	*Coelosphaerium kuetzingianum*											+	+						
7.	*Cylindrospermum stagnale*											+							
8.	*Gomphosphaeria aponina*								+			+							
9.	*G. compacta*						+						+	+					
10.	*G. naegeliana*											+							
11.	*Lyngbia kuetzingii*	+			+										+	+			
12.	*L. limnetica*														+	+			
13.	*Merismopedia elegans*								+	+	+								+
14.	*Microcystis aeruginosa*					+	+					+							
15.	*M. viridis*											+							
16.	*Nodularia spumigena*											+							
17.	*Oscillatoria amphibia*		+		+			+	+		+								+
18.	*O. boryana*							+						+					
19.	*O. brevis*						+												
20.	*O. chalybaea*						+					+							
21.	*O. formosa*											+	+						
22.	*O. irrigua*											+		+					
23.	*O. lacustris*																		+
24.	*O. planctonica*						+					+	+	+					+
25.	*O. princeps*											+							
26.	*O. simplicissima*											+							
27.	*O. tenuis*											+							

28.	*Phormidium ambiguum*												+	+				+	+
29.	*P. autumnale*						+								+	+		+	+
30.	*P. corium*														+	+			
31.	*P. frigidum*																		
32.	*P. tenue*	+	+					+											
33.	*Spirulina major*											+			+	+		+	+
	Chrysophyta																		
1.	*Chrysococcus rufescens*											+							
2.	*Dinobryon divergens*								+		+	+		+					
3.	*D. sertularia*						+												
4.	*Hydrurus foetidus*	+	+		+														
5.	*Synura petersenii*								+										
6.	*Uroglena volvox*								+		+								
	Bacillariophyta																		
1.	*Achnanthes bioretii*	+			+	+													
2.	*A. clevei*									+									
3.	*A. flexella*									+									
4.	*A. hungarica*						+		+		+		+					+	+
5.	*A. laevis*				+														
6.	*A. lanceolata*	+	+	+	+	+	+	+		+	+	+			+	+	+	+	+
7.	*A. minutissima*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
8.	*A. oblongella*	+	+														+		
9.	*A. subatomoides*	+	+															+	
10.	*Amphipleura pellucida*									+	+	+	+	+					
11.	*Amphora coff...*																	+	
12.	*A. lybica*									+	+	+	+			+		+	
13.	*A. montana*					+		+			+	+				+			
14.	*A. muzzanensis*													+					
15.	*A. normanii*									+									
16.	*A. ovalis*									+		+		+	+	+			
17.	*A. pediculus*	+				+		+	+	+	+	+	+	+	+	+		+	
18.	*A. thumensis*									+									
19.	*A. veneta*						+		+		+		+					+	
20.	*Anomoeoneis vitraea*				+														
21.	*Asterionella formosa*			+		+	+	+										+	
22.	*Aulacoseira alpigena*	+				+													
23.	*A. ambigua*											+	+					+	+
24.	*A. distans*	+																	
25.	*A. granulata et f. curvata*								+	+	+		+	+		+			

26.	*A. italica*							+												
	A. i. v. angustissima											+		+						
27.	*Caloneis bacillum*				+					+		+				+				
28.	*C. molaris*							+												
29.	*C. permagna*																		+	
30.	*C. silicula*							+			+					+			+	
31.	*C. tenuis*										+									
32.	*C. undulata*									+										
33.	*Campylodiscus hibernicus*									+										
34.	*Cocconeis neodiminuta*									+										
35.	*C. pediculus*							+	+		+		+	+		+		+	+	+
36.	*C. placentula*	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+		
37.	*Cyclotella atomus*					+		+											+	
38.	*C. distinguenda*									+										
39.	*C. meneghiniana*					+	+		+		+	+							+	+
40.	*C. radiosa*												+						+	
41.	*Cymatopleura elliptica*							+		+						+			+	
42.	*C. solea*							+	+		+	+		+		+			+	
43.	*Cymbella affinis*				+		+		+	+	+	+	+		+	+	+			+
44.	*C. amphicephala*							+		+										
45.	*C. caespitosa*										+	+		+						
46.	*C. cistula*				+		+		+		+	+	+	+					+	+
47.	*C. cuspidata*																	+		
48.	*C. cymbiformis*										+	+	+							
	C. c. et v. nonpunctata		+																	
49.	*C. delicatula*									+										
50.	*C. ehrenbergii*											+								
51.	*C. falaisensis*	+																		
52.	*C. gracilis*	+	+			+														
53.	*C. helvetica*								+									+		
54.	*C. lanceolata*								+	+		+	+	+						
55.	*C. microcephala*									+		+								
56.	*C. minuta*	+	+		+	+	+	+									+	+		
57.	*C. naviculiformis*	+																+		
58.	*C. proxima*								+		+									
59.	*C. silesiaca*	+	+	+	+	+		+			+	+	+	+	+			+		+
60.	*C. sinuata*	+	+		+	+	+	+		+					+	+		+		+
61.	*C. tumida*										+							+	+	
62.	*Denticula kützingii*				+		+			+						+				

63.	*D. subtilis*																		+	
64.	*D. tenuis*													+						
65.	*Diatoma anceps*		+																	
66.	*D. mesodon*	+	+	+	+		+	+												
67.	*D. moniliformis*							+												
68.	*D. tenuis*										+									
69.	*D. vulgaris*												+				+	+	+	
70.	*Diploneis aculata*													+						
71.	*D. elliptica*				+					+										
72.	*D. oblongella*											+					+			
73.	*Entomoneis paludosa v subsalina*																		+	
74.	*Epithemia adnata*	+					+		+		+	+	+	+					+	+
75.	*E. argus*									+										
76.	*E. sorex*								+		+	+	+	+					+	
77.	*E. turgida*						+		+		+	+	+	+						+
78.	*Eunotia bilunaris*	+	+			+	+					+								+
79.	*E. crista-galli*					+														
80.	*E. diodon*																			+
81.	*E. exigua*	+	+																	
82.	*E. flexuosa*						+												+	
83.	*E. formica*																			
84.	*E. implicata*						+													
85.	*E. incisa*	+																		
86.	*E. intermedia*																			+
87.	*E. minor*	+	+		+		+										+			+
88.	*E. muscicola v. tridentula*	+																		
89.	*E. praerupta*	+																		
90.	*E. sudetica*											+								
91.	*E. s... v. tetraodon*		+																	
92.	*Fragilaria arcus*	+	+		+	+	+	+						+				+	+	
93.	*F. bicapitata*					+														
94.	*F. biceps*						+			+										
95.	*F. brevistriata*									+										
96.	*F. capucina et v. gracilis*									+								+		+
	F. c. et v. mesolepta						+	+	+		+			+						
	F. c. et v. vaucheriae	+	+		+	+	+		+		+	+	+	+			+	+	+	
97.	*F. construens*		+						+	+	+	+						+		+
98.	*F. crotonensis*				+		+		+		+							+		
99.	*F. delicatissima*		+																	

100	*F. dilatata*						+					+		+					
101	*F. fasciculata*									+								+	
102	*F. leptostauron*									+									
103	*F. pinnata*	+	+			+	+	+		+	+							+	
104	*F. ulna*				+	+	+	+											
	F. u. et v. acus								+	+	+	+	+	+	+		+	+	+
105	*F. virescens*	+	+																
106	*Frustulia rhomboides*		+																
107	*F. vulgaris*	+	+			+				+		+	+		+	+	+		
108	*Gomphonema acuminatum*	+	+		+		+		+				+	+			+		+
109	*G. angustatum*	+	+		+	+	+			+	+			+				+	
110	*G. angustum*	+	+		+	+		+		+			+		+	+	+		+
111	*G. angum*									+		+							
112	*G. clavatum*	+	+			+	+	+	+	+	+		+						
113	*G. gracile*	+					+					+		+			+	+	+
114	*G. olivaceum*	+													+	+			
115	*G. parvulum*	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
116	*G. tergestinum*							+							+	+			
117	*G. truncatum*				+		+		+		+	+	+	+	+		+	+	+
118	*Gyrosigma acuminatum*							+		+	+	+	+	+		+		+	
119	*G. attenuatum*									+						+			
120	*G. nodiferum*																		+
121	*G. parkerii*											+	+						
122	*G. scalproides*							+	+				+			+			
123	*G. spencerii*											+		+				+	
124	*Hantzschia amphioxys*	+	+		+	+		+		+				+		+	+		
125	*Mastogloia elliptica*								+									+	
126	*M. smithii ...*	+																+	
127	*Melosira varians*		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
128	*Meridion circulare*	+	+		+	+				+					+	+	+			
129	*Navicula accomoda*																	+	
130	*N. angusta*	+	+																
131	*N. bacillum*								+					+					
132	*N. capitata*										+	+				+		+	
133	*N. capitatoradiata*					+	+	+	+		+	+		+					
134	*N. ... caterna*															+			
135	*N. cincta*							+		+	+								
136	*N. contenta*							+											
137	*N. cryptocephala*	+	+	+			+	+	+	+	+	+	+	+			+		+

138	*N. cryptotenella*					+	+		+	+	+	+	+	+	+	+		+	+
139	*N. cuspidata*				+		+	+			+		+					+	
140	*N. decussis*					+			+										
141	*N. elginensis*					+		+									+		+
142	*N. erifuga*						+						+					+	+
143	*N. goeppertiana*					+	+	+											
144	*N. gregaria*					+		+								+	+	+	+
145	*N. halophila*						+											+	
146	*N. kotschyi*									+									
147	*N. lanceolata*	+	+		+	+	+	+	+		+		+					+	+
148	*N. libonensis*					+							+						
149	*N. menisculus*								+			+	+		+	+		+	
150	*N. minima*	+	+			+		+		+	+	+	+		+				+
151	*N. minuscula*	+																	
152	*N. mutica*							+											
	N. m. et v. ventricosa									+			+			+			
153	*N. oblonga*								+										
154	*N. p... lepta*																	+	
155	*N. pseudolanceolata*																	+	
156	*N. pupula*					+	+	+		+				+	+	+		+	
157	*N. pygmaea*							+			+							+	+
158	*N. radiosa*				+		+		+	+	+	+	+	+	+	+	+	+	
159	*N. rhynchocephala*	+				+				+							+	+	
160	*N. salinarum*																	+	
161	*N. schröeterii*											+							
162	*N. slesvice...*																	+	
163	*N. strialata*									+									
164	*N. sub...*									+				+		+			
165	*N. subminuscula*					+		+			+							+	
166	*N. tenelloides*	+				+													
167	*N. tripunctata*							+		+		+		+	+	+		+	
168	*N. trivialis*					+	+	+	+		+	+	+	+		+			
169	*N. veneta*					+		+				+	+					+	
170	*N. viridula*					+	+	+	+				+	+		+			+
171	*Neidium ... pliatum*								+		+								
172	*N. ... odeformes*									+						+			
173	*N. dubium*															+			
174	*Nitzschia acicularis*					+				+						+			+
175	*N. amphibia*						+			+		+	+	+				+	

176	*N. angustata*									+		+							
177	*N. angustatula*											+				+			
178	*N. calida*													+				+	
179	*N. capitellata*						+	+			+		+	+					
180	*N. clausii*												+						
181	*N. communis*					+		+											
182	*N. constricta*							+				+				+		+	
183	*N. dippelii*															+			
184	*N. dissipata*	+						+		+	+	+	+	+		+	+	+	
185	*N. dubia*							+								+			
186	*N. filiformis*															+			
187	*N. fonticola*					+		+	+			+							
188	*N. frustulum*				+		+	+			+	+	+				+		+
189	*N. gracilis*											+	+						+
190	*N. heufleriana*														+	+			
191	*N. hantzschiana*	+	+			+													
192	*N. hungarica*					+		+	+		+	+	+					+	+
193	*N. inconspicua*				+		+	+										+	+
194	*N. intermedia*																	+	
195	*N. linearis*					+		+		+	+	+	+	+	+	+	+	+	+
196	*N. littoralis*																	+	
197	*N. microcephala*																	+	
198	*N. nana*																	+	
199	*N. palea*	+			+	+	+	+	+	+	+		+	+	+	+	+	+	+
200	*N. paleacea*	+									+	+		+			+	+	+
201	*N. recta*									+	+	+	+	+		+		+	
202	*N. reversa*																	+	
203	*N. sigmoidea*							+		+		+		+		+		+	
204	*N. sinuata*									+									
	N. s. et v. tabellaria				+														
205	*N. sociabilis*															+			
206	*N. thermaloides*														+	+			
207	*N. umbonata*							+										+	
208	*N. vermicularis*											+				+			
209	*Pinnularia borealis*	+							+							+	+		
210	*P. braunii*													+					
211	*P. gibba*							+								+			
212	*P. microstauron*	+																	
213	*P. obscura*	+						+											

214	*P. subcapitata*		+																
215	*P. viridis*	+	+			+	+			+		+		+				+	+
216	*Rhoicosphaenia abbreviata*					+	+		+	+	+	+	+	+			+		+
217	*Rhopaloida gibba*										+	+	+	+				+	+
218	*Stauroneis anceps*				+								+						+
219	*S. kriegenii*																	+	
220	*S. phoenicenteron*										+		+						+
221	*S. smithii*									+					+				
222	*Stephanodiscus alpinus*												+	+					
223	*S. hantzschii*								+	+									
224	*S. medius*												+	+					
225	*S. neoastraea*												+						
226	*Surirella angusta*	+				+		+			+			+		+		+	
227	*S. brèbissonii*		+			+		+						+	+	+			
228	*S. linearis*										+					+			
229	*S. minuta*															+			
230	*S. ovalis*																	+	
231	*S. spiralis*															+			
232	*S. splendida*	+										+		+		+			+
233	*S. tenera*							+											
234	*Tabellaria fenestrata*													+			+		
235	*T. flocculosa*						+							+			+		
236	*Thalassiosira weissflagii*				+														
	Xanthophyta																		
1.	*Goniochloris mutica*						+						+						
2.	*Ophiocytium cochleare*						+						+						
	O. parvulum						+												
	Chlorophyta-Chlorophyceae																		
1.	*Ankistrodesmus bibraianus*													+					+
2.	*A. gracilis*																		+
3.	*Botryococcus braunii*								+			+	+						
4.	*Characiochloris characioides*			+															
5.	*Coccomyxa lacustris*											+							
6.	*Coelastrum sphaericum*					+						+							
7.	*Coenococcus planctonicus*					+													
8.	*Coenochloris pyrenoidosa*								+		+			+					
9.	*Crucigenia apiculata*								+										
10.	*C. fenestrata*											+							
11.	*C. tetrapedia*						+					+							

12.	*Dictyosphaerium pulchellum*											+									
13.	*Eudorina cylindrica*											+									
14.	*E. elegans*						+		+	+	+	+	+	+							
15.	*Gonium pectorale*						+														
16.	*Hofmania lauterbornii*													+							
17.	*Keratococcus caudatus*																			+	+
18.	*Kirchneriella irregularis*								+		+										
19.	*K. obesa*																			+	+
20.	*Micractinium pusillum*			+																	
21.	*Monoraphidium arcuatum*											+									
22.	*M. braunii*																				+
23.	*M. contortum*									+		+		+							
24.	*M. convolutum*									+											
25.	*M. griffithii*								+		+										
26.	*M. minutum*																				+
27.	*M. pusillum*																				+
28.	*Nephroselmis angulata*						+														
29.	*Oocystis lacustris*			+										+							
30.	*Pandorina morum*			+			+		+	+	+	+	+	+							
31.	*Pediastrum angulosum*								+												
32.	*P. boryanum*							+	+		+	+									
33.	*P. duplex*							+	+		+										
34.	*Polyblepharides singularis*						+														
35.	*Scenedesmus acuminatus*																			+	+
36.	*S. acutus*																			+	+
37.	*S. arcuatus*											+									
38.	*S. opoliensis*																			+	+
39.	*S. quadricauda*																			+	+
40.	*S. spinosus*													+							
41.	*Sorastrum spinulosum*								+			+									
42.	*Sphaerocystis schroeterii*			+		+	+		+												
43.	*Stichococcus bacillaris*							+	+							+	+				
44.	*S. minor*								+							+	+				
45.	*Stigeoclonium longipillum*				+																
46.	*S. subsecundum*															+	+	+			
47.	*Tetraedron caudatum*					+															
48.	*T. hastatum*													+							
49.	*T. minimum*						+		+	+											
50.	*T. trigonum*																			+	+

51.	*Tetrastrum glabrum*						+												
52.	*T. triangulare*					+													
53.	*Ulothrix tenuissima*		+		+												+		
54.	*U. zonata*				+														
55.	*Uronema confervicolum*														+	+	+		
56.	*Volvox aureus*			+									+	+					
	Chlorophyta-Conjugatophyceae																		
1.	*Closterium aciculare*								+			+							
2.	*C. capillare*											+							
3.	*C. dianae*											+							
4.	*C. limneticum*								+	+	+								
5.	*C. moniliferum*								+			+	+						
6.	*C. venus*																+		
7.	*Cosmarium angulosum*								+		+								
8.	*C. subtumidum*								+			+					+		
9.	*Mougeotia parvula*						+		+		+	+							
10.	*Pleurotaenium trabecula*											+					+		
11.	*Staurastrum crenulatum*								+			+							
12.	*S. forficulatum*								+		+						+		
13.	*S. lunatum*								+		+	+		+					
14.	*S. orbiculare*										+						+		
15.	*S. polymorphum*								+								+		
	Dinophyta																		
1.	*Ceratium cornutum*												+						
2.	*C. hirundinella*								+			+	+						
3.	*Peridinium aciculiferum*													+					
4.	*P. bipes*													+					
5.	*P. borgei*								+										
6.	*P. cinctum*											+	+	+					
7.	*P. elpatiewskyi*												+						
8.	*P. umbonatum*								+	+	+		+	+					
	Cryptophyta																		
1.	*Cryptomonas marssonii*								+										
	Euglenophyta																		
1.	*Colacium cyclopicola*								+			+							
2.	*C. simplex*											+							
3.	*Euglena acus*						+					+							
4.	*E. deses*						+						+						

5.	*E. gracilis*						+					+	+						
6.	*E. oblonga*						+												
7.	*E. oxyuris*						+												
8.	*E. pisciformis*						+												+
9.	*E. polymorpha*						+												
10.	*E. proxima*						+												
11.	*E. stellata*						+												
12.	*E. texta*						+	+					+	+					
13.	*E. viridis*						+												
14.	*Lepocinclis ovum*						+					+	+						
15.	*Phacus acuminatus*						+												
16.	*P. aenigmaticus*						+												
17.	*P. brevicaudatus*						+												
18.	*P. longicauda*											+		+					
19.	*P. orbicularis*						+					+							
20.	*P. pusillus*						+												
21.	*P. pyrum*						+												
22.	*P. triqueter*						+												
23.	*Trachelomonas armata*											+							
24.	*T. hispida*												+						
25.	*T. lacustris*													+					
26.	*T. planctonica*						+					+							
27.	*T. superba*											+							
28.	*T. volvocina*						+					+		+					
	Total	58	44	13	42	62	96	75	66	53	55	110	66	29	62	76	61	89	51

CONTRIBUTIONS TO THE KNOWLEDGE OF THE ZOOPLANKTON FROM THE OLT RIVER

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RÉSUMÉ

Le travail est basé sur 18 echantillons quantitatives de zooplancton prelevés au long du rivière Olt entre Sândominic et Călineşti et egalement au long de deux de ses affluents (Cibin et Măieruş) en octobre 1998.

On a identifié 25 éspèces holoplanctonognes appartenant aux Rotifères, Cladocères et Copèpodes. Cinques d'eux (*Trichocerca elongata* - Rotatoria, *Pleuroxus trigonellus* et *Deroperus angustatus* - Cladocera, *Eucyclops macrurus macrurus* et *Mesociclops leuckarti* - Copepoda) ont été trouvés pour la première fois dans le potamoplancton des rivières de Roumanie.

La présence des localités au bord de la rivière peut influencer la structure qualitative du zooplancton, soit augmentant la biodiversité par des effluents richers en matière organogne, soit en inhibant le developpement du zooplancton par des égouts toxiques.

Keywords: fresh-water zooplankton, the Olt River.

INTRODUCTION

Along the time, only several papers were concerning with the zooplankton from the Romanian rivers, the majority of them being published thirty years ago (Brezeanu, Marinescu-Popescu, 1994, Brezeanu et al., 1968, Buşniţă et al., 1961a, 1961 b, Motaş, Anghelescu, 1994, Popescu et al., 1962, Prunescu-Arion, 1968, Prunescu-Arion, Elian, 1962, Prunescu-Arion, Baltac, 1967, Rogoz, 1972).

More recently, a detailed examination of the zooplankton from the Mureş River and the Criş Rivers is given in Katalin Zsuga's papers (1995, 1997,a,b), and the ecological conditions from the Mureş River are illustrated in Sárkány-Kiss, Hamar and Sîrbu's contribution (1997).

Recent zooplankton studies were performed on some tributaries of the Olt River, in the Făgăraş - Avrig area, in 1989 (Victora Tatole, Elena Prunescu-Arion, 1992), but exactly in the Olt River they are missing.

A quite detailed ecological survey of the upper and middle Olt River (including some of its affluents and dead branches, as well as the Avrig Reservoir) was carried out in October 1998, the present paper being based on the zooplankton samples collected during the field trip.

MATERIALS AND METHODS

Quantitative samples were obtained in October 1998, by filtering 100 l water through a silk net with mesh size of 90 μm in the upper and middle sector of the Olt River (**Fig.1**). The samples were preserved directly on the field with 40% formaldehide solution to reach a 4% final concentrations.

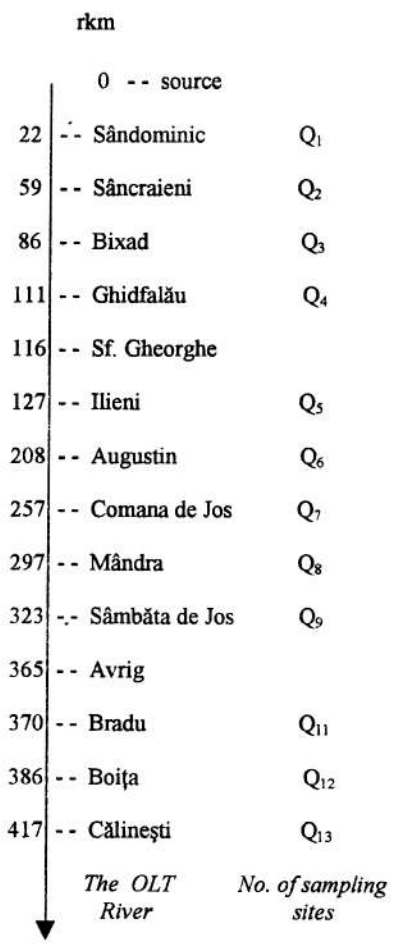

Fig. 1. *The schematic longitudinal section of the Olt River. Distance of the sampling stations from the source in river kilometres (rkm) is indicated at the left side.*

This paper is based on the samples collected only from the flowing water of the upper and middle Olt River, Cibin River and Măieruş Brook.

The samples were examined at an MSB-stereomicroscope and an IOR-MC_3 type microscope. The quantitative data are presented as number of individuals (ex.) and biomass (wet weight) in mg per cubic metre (m^{-3}).

For the species identification we used mainly the identification guides written by Damian-Georgescu (1963, 1966), Negrea (1983) and Rudescu (1960), books published by the Romanian Academy in the series "Romanian Fauna" – cyclopida, calanoida, cladocera and rotatoria, supplemented by other well known international books (Dussart, Defaye, 1995, Harding, Smith, 1974, Kiefer, 1960, Nogrady et al., 1993).

RESULTS AND DISCUSSION

A number of 25 holoplanktonic species belonging to Rotatoria, Cladocera, Copepoda (Calanoida and Cyclopida) were identified in the studied zone (**Table 1**).

Tabel 1.

The zooplankton organisms from the Olt River, Cibin River and Măieruş Brook

No.	SPECIES	Olt River	Cibin River	Măieruş Brook	OBSERVATIONS
	Phyl. TROCHELMINTHES **Class ROTATORIA** **Order PLOIMA**				
1	*Brachionus diversicornis v. homoceros* Wierzejski 1891	*			
2	*Keratella cochlearis v. tecta* Gosse 1851	*			Dmx=10 ex. • m^{-3}, Q_5 and Q_{12}
3	*Keratella quadrata* O.F. Müller 1786		*		
4	*Trichocerca elongata* Gosse 1886		*		
5	*Trichocerca similis* Wierzejski 1893	*			
6	*Asplanchna sp.* Gosse 1850	*	*		
7	*Polyarthra vulgaris* Carlin 1943	*			
	Phyl. ARTHROPODA **Class CRUSTACEA** **Order CLADOCERA**				
8	*Simocephalus vetulus* O.F. Müller 1776	*			Dmx=60 ex. • m^{-3}, Q_5
9	*Ceriodaphnia pulchella* Şars 1862	*	*		Dmx=50 ex. • m^{-3}, R_4
10	*Bosmina longirostris* O.F. Müller 1785	*			Dmx=100 ex. • m^{-3}, Q_5
11	*Pleuroxus aduncus aduncus* Jurine 1820	*			
12	*Pleuroxus trigonellus* O.F. Müller 1785		*		
13	*Disparalona rostrata* Koch 1841	*	*		Dmx=20 ex. • m^{-3}, R_9
14	*Chydorus sphaericus* O.F. Müller 1776	*	*		Dmx=720 ex. • m^{-3}, Q_5
15	*Acroperus angustatus* Sars 1864		*		
16	*Graptoleberis testudinaria* Fischer 1848	*			Dmx=30 ex. • m^{-3}, Q_6
	Order COPEPODA - CALANOIDA				
17	*Eudiaptomus gracilis* Sars 1863	*			Dmx=180 ex. • m^{-3}, Q_6
18	*Eurytemora velox* Lilljeborg 1853	*		*	
	Order COPEPODA - CYCLOPOIDA				

19	*Macrocyclops albidus* Jurine 1820	*	*		
20	*Eucyclops serrulatus serrulatus* Fischer 1851	*	*		Dmx=320 ex. • m^{-3}, Q_5
21	*Eucyclops macrurus macrurus* Sars 1863	*			
22	*Paracyclops fimbriatus* Fischer 1853		*		Dmx=50 ex. • m^{-3},
23	*Acanthocyclops viridis* Jurine 1820	*			
24	*Mesocyclops leuckarti* Claus 1857	*			
25	*Mesocyclops crassus* Fischer 1853	*	*		Dmx=190 ex. • m^{-3}, R_9
	Total number of taxa:	**20**	**12**	**1**	

The Olt River, between Sândominic (Q_1) and Călineşti (Q_{13}) (**Fig.1**) can be divided into four different sectors according to main ecological conditions:

The first sector is situated in the most upper course (Q_1- Q_4) (**Fig.1**) characterised by fast running, clean and cold water, with 8.2 mg O_2 • l^{-1}, gravel substratum (lotic sector), and less disturbed by human activities. Only three species were found here: *Asplanchna sp.*, *Chioarus sphaericus* and *Acanthocyclops viridis*, especially as copepodite forms (**Fig.1**, Q_1). The mean value of the total density (11 ex. • m^{-3}) and biomass (0.054 mg • m^{-3}) are very low.

The Rotatoria and the cyclopid Copepoda have a facultative predacious feeding and *Chydorus sphaericus* consumes organic debris including afferent bacterial aggregates (Nogrady et al., 1993, Zinevici, Teodorescu, 1991).

The second sector is situated downstream Sf. Gheorghe to Augustin (Q_6); the conditions are similar to the previous one, but here the water calmly flows over sandy-muddy (Q_5) or gravel (Q_6) riverbed (lentic sector).

In this sector, the number of species (15) was the highest recorded during our investigation.

The qualitative composition is quite different in these two stations, only *Chydorus sphaericus* is common (**Fig. 2**, Q_5 and Q_6). At Augustin, there are six Cladocera and six Copepoda, the most abundant being *Eudiaptomus gracilis* (**Table 1**, **Fig.2**, Q_6).

The Rotatoria are euplanktonic (Prunescu-Arion, 1968, Rudescu, 1960) and beside the particles of organic matter and bacterial aggregates, they are filtering also planktonic alga. *Simocephalus vetulus* and *Ceriodaphnia pulchella* are considered as efficient filter-feeding (Zinevici, Teodorescu, 1991). *Eudiaptomus gracilis* and *Eucyclops serrulatus* are described as primary consumers eating algae, and *Macrocyclops albidus* is mainly omnivorous feeding on algae and even Rotatoria (Dussart, Defaye, 1995, Kiefer, 1960).

The zooplankton mean density (785 ex. • m^{-3}) and biomass (11.594 mg • m^{-3}) are the highest in the studied Olt River sector. More important are the Cladocera and especially *Chydorus sphaericus* (375 ex. • m^{-3} and 3.375 mg • m^{-3}), *Simocephalus vetulus* (3.000 mg • m^{-3}) followed by Copepoda (305 ex. • m^{-3} and 4.048 mg • m^{-3}).

The third sector of the Olt River is in the vicinity of the industrial Făgăraş town; here three sampling sites were analysed (Q_7 and Q_8 upstream Făgăraş and Q_9 downstream) (**Fig.1**). The river is large, quite deep (1m), the oxygen content of the water is high (5.6-7.7 mg O_2 • l^{-1} and it flows slowly over muddy riverbed.

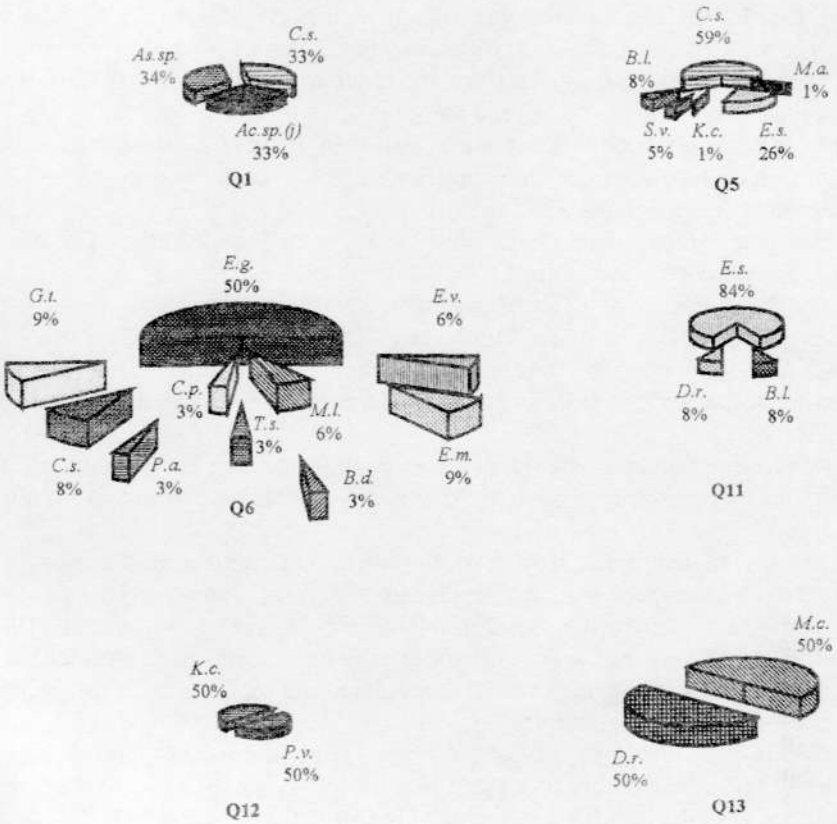

Fig. 2. *The qualitative composition of the zooplankton from some sections of the Olt River.*

Q_1 Săndominic
Ac.sp.(j)=Acanthocyclops sp. (juv)
As.sp.=Asplanchna sp.
C.s.=Chydorus sphaericus
Q_5 Iliemi
B.l.=Bosmina longirostris
C.s.=Chydorus sphaericus
E.s.=Eucyclops serrulatus
K.c.=Keratella cochlearis var. tecta
M.a.=Macrocyclops albidus
S.v.=Simocephalus vetulus
Q_6 Avgustin
B.d.=Brachionus diversicornis
C.p.=Ceriodaphnia pulchella
C.s.=Chydorus sphaericus
E.g.=Eudiaptomus gracilis
E.m.=Eucyclops macrourus
E.v.=Eurytemora velox
G.t.=Graptoleberis testudinaria
M.l.=Mesocyclops leuckarti
P.a.=Pleuroxus aduncus
T.s.=Trichocerca similis
Q_{11} downstream Avrig
B.l.=Bosmina longirostris
D.r.=Disparalona rostrata
E.s.=Eucyclops serrulatus
Q_{12} downstream Boita
K.c.=Keratella cochlearis var. tecta
P.v.=Polyarthra vulgaris
Q_{13} downstream Călinești
D.r.=Disparalona rostrata
M.c.=Mesocyclops crassus

Even if the conditions seem to be favourable for the development of a rich potamoplankton, in our samples the zooplankton was totally missing, due probable to the high water turbidity and pollution.

The fourth sector is situated downstream Avrig (Q_{11}-Q_{13}) (**Fig.1**). The Olt River is large, the water velocity is slow, the oxygen content is remarkable high (7.2 mg $O_2 \cdot l^{-1}$), the riverbed is sandy, but there are zones with gravel (downstream Boița – Q_{12}). The bank is quite high (1.5 m) and steep.

Only 2-3 zooplankton species were identified, mostly Crustaceans, except downstream Boița (Q_{13}), but all of them, in a few number (mean density – 49 ex. $\cdot m^{-3}$ having a biomass of 0.416 mg $\cdot m^{-3}$).

In Măieruş Brook were found only 20 ex. $\cdot m^{-3}$ copepodites IV and V belonging to *Eurytemora velox* (**Tab. 1**).

In the head stream of Cibin River, where the water is clean, with 7.4-8.2 mg $O_2 \cdot l^{-1}$, warmer than that of the Olt River (12 – 13 °C) and its velocity is high (lotic zone), in each sampling site (R_1- R_8) the zooplanktonic fauna is poor, represented by some Rotatoria, Cladocera and Copepoda (**Fig. 3**, sampling stations R_3, R_6 and R_8).

Downstream Tălmaciu, the qualitative composition is rich (9 species), the cyclopid Copepoda representing more as 70% of the zooplankton from this sampling site (**Fig. 3, R_9**).

According to the mean values of the density, dominant and eudominant species are *Asplanchna sp.*, *Eucyclops serrulatus serrulatus*, *Paracyclops fimbriatus* (with a predominant carnivorous nutrition) (Dussart, Defaye, 1995, Kiefer, 1960, Norgady et al., 1993), and *Ceriodaphnia pulchella*, *Chydorus sphaericus* and *Mesocyclops crassus*, the last one could be considered the representative taxa for the Cibin River zooplanktonic community.

Even if in the Cibin River *Paracyclops fimbriatus* and *Acanthocyclops viridis* live in clean water, they are able to support also critical conditions as in Dâmbovnic River, submitted at high pollution aggression (Teodorescu, Zinevici, 1992).

Referring to the qualitative composition of the zooplankton from the upper and middle Olt sectors and its two mentioned tributaries, it is important to notice that in comparison with the literature, 17 species were found in different Romanian rivers in the similar ecological conditions.

Two species (*Disparalona rostrata* and *Mesocyclops crrasus*) are common for Olt and Cibin River and *Euritemora velox* was found in the Olt River and Măieruş Brook.

Eucyclops macrurus macrurus and *Mesocyclops leuckarti* from the Olt River and *Trichocerca elongata*, *Pleuroxus trigonellus* and *Acroperus angustatus* from Cibin River are recorded for the first time in the potamoplankton from Romanian rivers.

EVALUATION OF RESULTS

Based on the study of 18 quantitative samples from the upper and middle course of the Olt River, Cibin River and Măieruş Brook, performed in October 1998, a number of 25 holoplanktonic species were identified.

Their participation at the qualitative structure of the zooplanktonic community is different according to some ecological conditions:

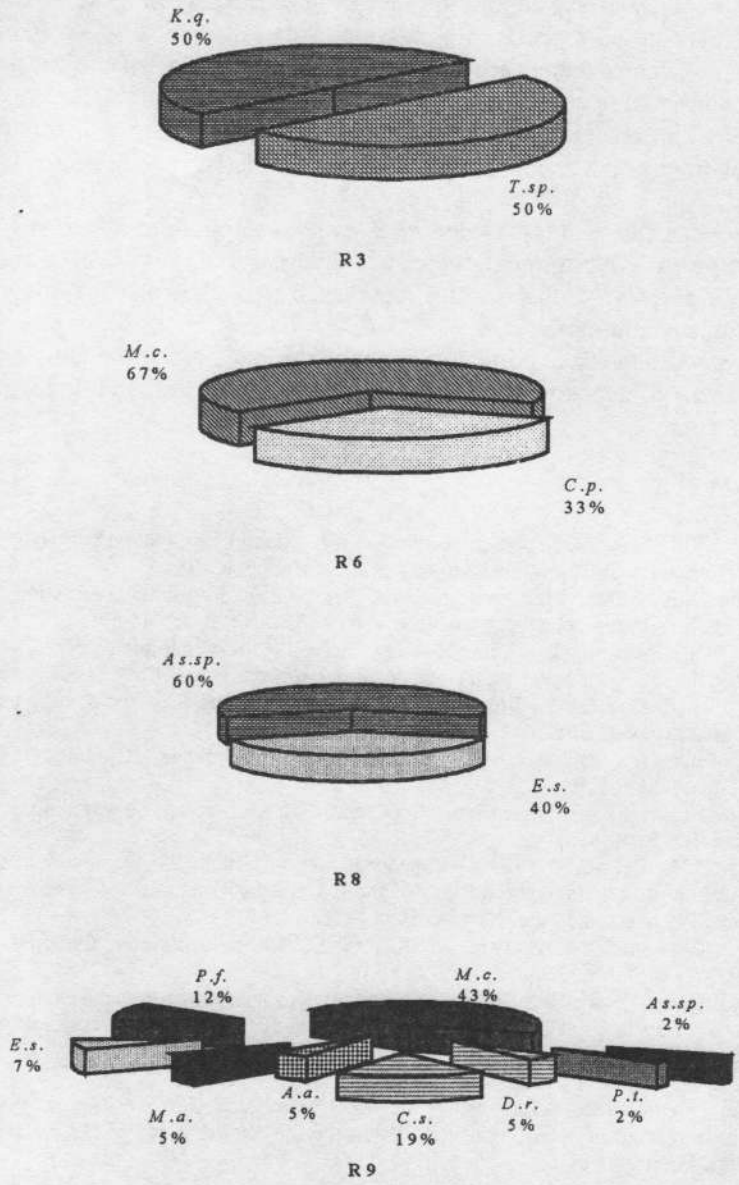

Fig. 3. *The qualitative composition of the zooplankton from some sections of the Cibin River.*

R_3 downstream Râul Mare junction
K.q.=Keratella quadrata
T.sp.=Trichocerca sp.
R_6 upstream Sibiu
C.p.=Ceriodaphnia pulchella
R_8 downstream Mohu
As.sp.=Asplanchna sp.
M.c.=Mesocyclops crassus
E.s.=Eucyclops serrulatus
R_9 downstream Tălmaciu
P.f.=Paracyclops fimbriatus
M.c.=Mesocyclops crassus
A.a.=Acroperus angustatus
M.a.=Macrocyclops albidus
C.s.=Chydorus sphaericus
D.r.=Disparalona rostrata
P.t.=Pleuroxus trigonellus
As.sp.=Asplanchna sp.
E.s.=Eucyclops serrulatus

• only a few number of species (1-3 species) in all lotic zones; higher biodiversity in those sectors which are downstream a locality (Sf. Gheorghe and Tălmaciu for instance) where the river becomes richer in organic debries and even in nutrients, and in consequence the number of filter-feeding organisms is greater;

• an accentuate turbidity associated with pollutant effluents could be an explanation for the zooplankton scarcity in the Făgăraş sector of the Olt River.

Five species, namely *Trichocerca elongata*-Rotatoria, *Pleuroxus trigonellus* and *Deroperus angustatus*-Cladocera, *Eucyclops macrurus macrurus* and *Mesociclops leuckarti*-Copepoda are recorded for the first time in Romanian rivers zooplanktonic communities.

It would be very important to continue the study along the Olt River, from its source to the confluence with the Danube, and to repeat the sampling expeditions in each season.

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TENDENCIES OF THE TAXONOMIC DYNAMICS OF THE AQUATIC INVERTEBRATE FAUNA FROM MIDDLE OLT RIVER SECTION

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REZUMAT

Pe baza unui bogat material, ce saturează în date cele două coordonate, spaţiul şi timpul, este analizată evoluţia biodiversităţii faunei de nevertebrate acvatice în două tronsoane ale Oltului Mijlociu: Făgăraş - Avrig şi Cornetu - Râmnicu Vâlcea. Se iau în considerare surse care au condus la creşterea presiunii antropice (cu precădere amenajările hidroenergetice) şi implicit se fac referiri la nivelul de manifestare al impactului acesteia în zonă. Se constată că în sectorul Făgăraş - Avrig structura faunei de nevertebrate acvatice este mult diferită de cea stabilită în urmă cu 10 ani; comunităţile bentale ale lacurilor de acumulare, Voila, Viştea, Scoreiu şi Avrig, se află într-o etapă de tranziţie, în plin proces de constituire. În sectorul Cornetu - Râmnicu Vâlcea se constată că: în subzona Cornetu - Turnu la nivelul comunităţilor faunei de nevertebrate acvatice se înregistrează o creştere a componentelor populaţionale comparativ cu anul 1977, în timp ce în tronsonul Turnu - Râmnicu Vâlcea are loc o scădere drastică a taxonilor faţă de aspectul structural stabilit în trecut (1973).

INTRODUCTION

The Olt River, one of the largest Romanian rivers, represents an ecosystem that is very exposed to anthropic pressure. In its valley have been developed human settlements, have been built industrial plants and above all there have been constructed 31 hydropower harnessing. Over time, all these factors have contributed to environment depreciation.

To approach correctly, exactly and especially efficiently the complex problematic rose by an impact estimation all the studies must be done in a holistic manner. Therefore, it ought to be analysed the entire Olt Valley in order to identify and to catalogue all the impact sources and their nature, it ought to be estimated the ecological impact alongside with economic and social profit. The results may ground the ecological, preservative and conservative restoration strategy for this area.

The data we present are referring to two of the Middle Olt sectors: Făgăraş-Avrig and respectively Cornetu-Râmnicu Vâlcea (**Map 1**.).

We mention that these sectors are hydropower harnessed.

The Făgăraş-Avrig sector.

Regarding the invertebrates fauna of this sector there had been done studies in 1986-88 period and recently, in 1998.

The first mentioned ones were focused on aquatic fauna cataloguing both in the Olt River and its tributaries, in the area that was going to be harnessed. This way, we equally establish the control data that permit, over time, a correct estimation of the hydropower harnessing impact, and, on the other hand, to differentially appreciate the biodiversity potential (in this case faunistic) of the Olt River and its tributaries. At the

same time, it can be advanced some hypothesis regarding the harnessed river-tributary interrelation.

The data we present and analyse comparatively with the pre-existent ones were sampled in September 1998. We have selected only the data referring to benthic communities. The sampling was made in the following dam lakes shore: Voila, Vişlea, Scoreiu, Avrig. On this data basis we establish the structural configurations of benthic compartment for each lake, by calculating relative abundance of this structural components, of whose graphic expression is given in **Plate I (Figs. 1 - 4)**.

The mentioned dam lakes show a sum of structural similarities and differences. From a qualitative point of view the diversity decreases from upstream to downstream: Voila, Vişlea, Scoreiu, Avrig. Regarding the relative abundance values there can be observed that Voila and Vişlea dam lakes have many structural similarities, namely: the best represented are the chironomids (63.52 % in Voila, 47.10% in Vişlea) followed in order by oligochets (14.11% in Voila and 14.94% in Vişlea); the trichopters have identical values; the differences consist of the big number of copepods (14.94%) and hirudinee, in Vişlea and respectively gastropods (8.23%) in Voila.

The dam lake Scoreiu is poorer represented. The surprise is the exaggerate number of heteropters, represented as well by the high number of species (**Tab. 1**). There are present populations typically for the benthic compartment: oligochets (13.39%), chironomids (9.67%) and nematods (8.18%).

The Avrig dam lake situation, though we consider it as an exception, we still present it because it is a state of fact.

A more detailed structural presentation is given in **Table 1**, and in **Fig. 5** we give the invertebrates taxa ratio and that of the identified commune species from the given sector. As it can be observed the biggest number of species is present in Voila dam lake, followed at equal distance by Vişlea and Scoreiu dam lakes. Concerning the commune species ratio, the highest value was found in the case of Vişlea dam lake, closely followed by Voila and then by Scoreiu.

With the limitation imposed by the fact that the recent data comes only from a single sampling expedition, we can affirm that the aquatic invertebrates fauna in the area of newly constructed dam lakes from Făgăraş-Avrig sector is highly poorer comparatively with the fauna from Olt drainage area, in the same sector, 10 years ago (Tatole & Prunescu-Arion, 1992).

After about 9 years since the lakes inundation, we can say that:

- at the level of benthic communities can be found enough constitutive elements;
- the typically benthic elements are dominant being represented mainly by chironomids, oligochets, nematods and gastropods populations;
- there are present constantly typically lentic elements (i.e.: copepods);
- there still are rheophilous representatives (i.e.: trichopters, some of the chironomids);
- the typically rheophilous components have disappeared: gamarids, plecopters, ephemeropters, simuliids, many chironomids;
- the "residual fauna" populations sizes have grown;

On these basis, we can conclude that Voila, Vişlea, Scoreiu and Avrig dam lakes are in a transition stage, the biocoenosis being under a constitutive process.

The Cornetu-Râmnicu Vâlcea sector.

Regarding this second sector that we propose to analyse, our data are from several years, namely: 1973, 1977, 1983-85, 1997. These studies have been done, mainly, in the aim to estimate the hydropower harnessings impact on the environment.

The appreciation of present biotic component structure is based on the data obtained from two sampling expeditions that took place in 1997, concerning the following four subsections of the given sector: Cornetu-Gura Lotrului, Gura Lotrului-Turnu, Turnu-Călimăneşti, Călimăneşti-Râmnicu Vâlcea. The sampling have been done differentially by substrate nature (stone bed, muddy-sandy bed, bioderm), by water flow, stream, still waters, isolated water bodies, etc.

We resort to comparative presentation of invertebrates fauna structure because for this Olt sector we have previous data for its hydropower harnessing. However, in 1997, deliberately, we established a testing graphic according to which the sampling was made in the same stations that we studied before.

In **Plate II (Figs. 6 - 9)** we give the expression of the relative abundance dynamics of the invertebrates groups found into the four sectors of Olt River. There can be observed the following similarities:

- in all the four sectors, in both 1973 and 1977 sampling data were dominant, without exception, the oligochets, chironomids, nematods;
- the recent data demonstrate a higher diversity of rheophilous forms (ephemeropters, trichopters, amphipods, simuliids, and some chironomids) mainly for the first two sections.

Each section presents distinctive particularly features.

Very suggestive are also the two faunistic inventories realised in the same place, but in different time moments (**Tab. 2**).

To appreciate, at a higher level of accuracy, the evolution of invertebrates fauna biodiversity from the given area we have estimated both the taxa ratio on a spatio-temporal scale, and, at the same time, the commune species ratio (Fig. no. 10) (Tatole, 1985). There can be observed that:

- the taxa number grows in the first and second subsections (66.67% and 64.52% comparatively to 33.33% and respectively 35.52%) and decreases drastically in the other two (24.14% and 20.59% comparatively to 75.86% and respectively 79.41%);
- the commune taxa number remains relatively low (between 24.24-8.82%) in all the four subsections and includes the representatives of the groups that prove the highest ecological plasticity level (oligochets and chironomids);
- there have disappeared many of the rheophilous species populations, especially in Turnu-Râmnicu Vâlcea section where had been started both a lakes silting process and an advanced pollution process due to industrial sources.

Excepting the influence of upstream pollution sources (Făgăraş, Victoria) and considering the auto-cleaning process effect combined with tributaries contribution we can conclude that in the first and second subsections there is present a tendency of maintaining an optimum biodiversity level characteristic for a river ecosystem.

This situation can be a consequence of Olt riverbed configuration of this area, where due to dam lakes narrowness and accentuated slope, assuring constantly a higher water flow. In these lakes the lotic biotope modifies itself, in the sense that from a relatively deep river and with a more or less stony substrata, it becomes a deep

"river", with a slow stream, in which the muddy-sandy substrata is dominant. In these conditions the survival of recently identified rheophilous species is possible.

In conclusion, we specify again, as we did it as well in other occasions, that the main conditions for maintaining the lotic biocoenosis are: the debt, that means the water flow and stream, and the substrate nature.

At the same time, it is confirmed that the Olt River, in spite of the advanced pollution of some of its sectors, proves ecological recover capabilities in the areas where the auto-cleaning processes together with the tributaries matter, energy and information contribution can prevail.

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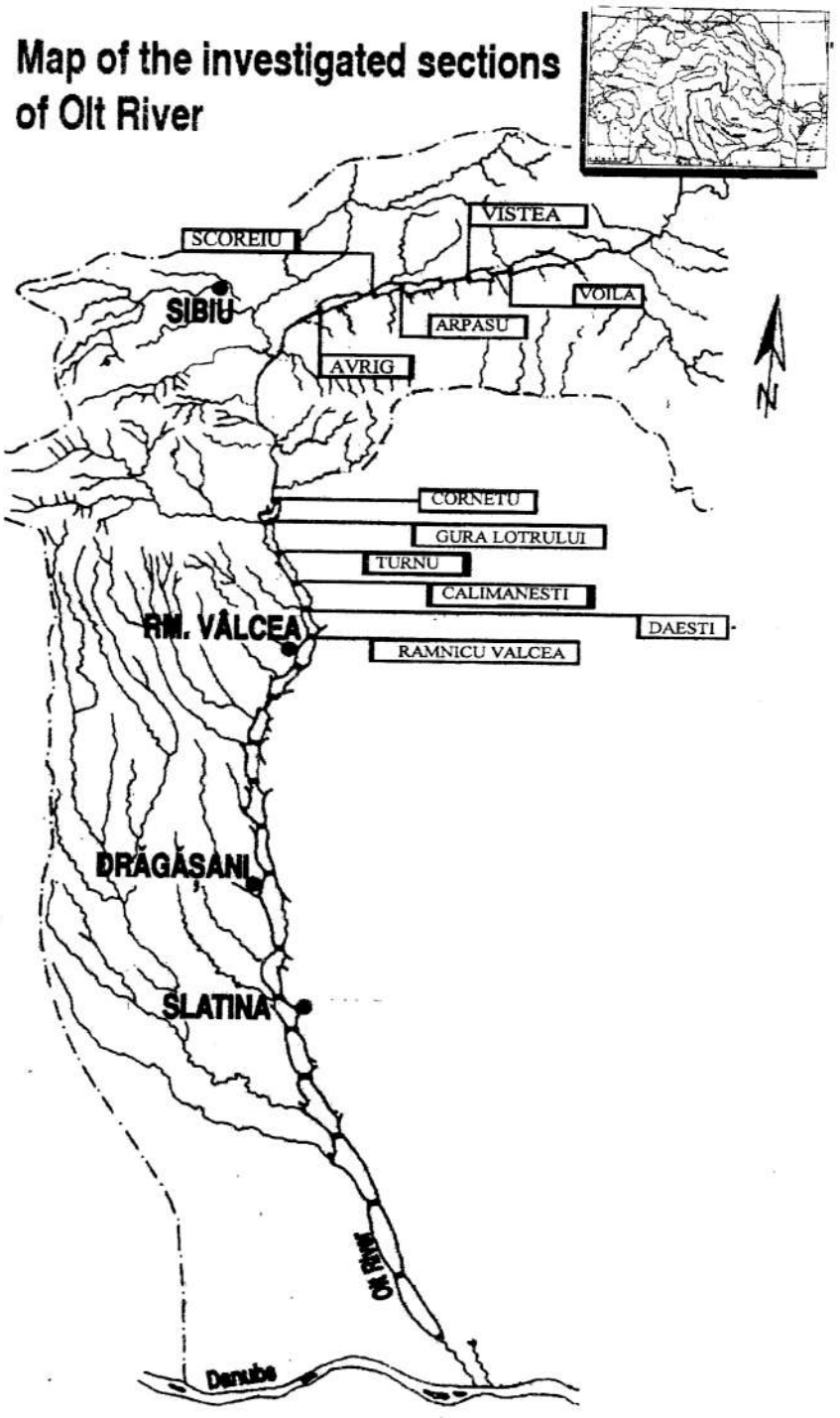

Map of the investigated sections of Olt River
VISTEA
SCOREIU
SIBIU
VOILA
ARPASU
AVRIG
N
CORNETU
GURA LOTRULUI
TURNU
CALIMANESTI
DAESTI
RM. VÂLCEA
RAMNICU VALCEA
DRĂGĂȘANI
SLATINA
Olt River
Danube

Tab. 1.

Station	Voila		Vistea		Scoreiu		Avrig	
Taxa	1988	1998	1988	1998	1988	1998	1988	1998
1	2		3		4		5	
Bryozoa-statoblaste								+
Nematoda								
Gordius aquaticus		+	+	+		+		
Oligochaeta								
Lymnodrilus hoffmeisteri	+	+	+		+	+	+	
L. udekemianus					+		+	
Nais breischeri	+		+		+			
N. communis		+		+		+	+	
N. pseudoptusa	+		+		+			
N. simplex	+							
N. variabilis	+							
Tubifex tubifex	+	+	+	+	+	+	+	
Hirudinea								
Erpobdella octoculata	+	+	+	+			+	
E. monostriata	+							
Piscicola geometra			+					
Lamelibranchiata								
Anodonta sp.		+						
Gasteropoda								
Ancylus fluviatilis			+		+			
Anisus spirorbis		+						
Gyraulus albus		+						
Lymnea stagnalis		+		+		+		
Radix ovata		+	+	+				
Radix peregra	+	+		+		+		
Isopoda								
Asellus aquaticus					+		+	
Copepoda								
Acanthocyclops bicuspidatus		+		+				
Cyclops furcifer furcifer			+		+			
Eucyclops serrulatus		+			+	+		
Merocyclops crassus					+			
Paracyclops fimbriatus		+	+	+				
Amphipoda								
Gammarus balcanicus	+		+					
Hydracarina								
Piona notata		+						
Sperchon glandulosus			+		+			
Collembola								
Isotoma viridis								
Plecoptera								
Leuctra sp.			+					
Perlodes sp.			+					
Ephemeroptera								
Baëtis baëtis	+		+				+	
Ephemerella ignita			+					
Caënis macrura	+		+		+			
Cloën dipterum			+					
Chitonophora sp.			+					
Heptagenia flava	+						+	
Potamantus lutens								

1	2		3		4		5	
Trichoptera								
Hidropsiche angustipennis			+					
Limnophilus sp		+		+				
Stenophylax sp		+						
Rhiacophilla septentrionis			+					
Coleoptera								
Driops ernesti			+					
Colymbetis sp.	+							
Helmis mangei			+					
Hydroporus sp.						+		
Heteroptera								
Coryxa punctata						+		
Nepa cinerea						+		
Micronecta poweri						+		
Plea minutissima						+		
Simuliidae								
Simulium reptans			+					
Chironomidae								
Ablabesmya monilis		+		+				
Clinotanypus pinguis		+						
Tanypus villipennis					+		+	
Thienemannimyia lentiginosa					+			
Procladius choreus	+	+	+	+		+		
Rheopelopia ornata				+				
Cladotanytarsus mancus		+						
Paratanytarsus lauterborni	+				+			
Rheotanytarsus exiguus	+		+		+		+	
R. nigricauda			+				+	
Chironomus plumosus		+		+		+		+
Cryptocladopelma viridula		+		+				
Glyptotendipes gripekoveni						+		
Polypedillum convictum		+		+		+		
Cricotopus algarum				+		+		
C. bicinctus		+		+				
Eukiefferiella brevicalcar			+		+			
E. claripennis	+							
Nanocladius bicolor	+		+				+	
Orthocladius saxicola		+						
Smittia aterima							+	

Tab. 2.

Station	Cornetu-Gura Lotrului		Gura Lotrului-Turnu		Turnu-Călimănești		Călimănești - Rm. Vâlcea	
Taxa	1977	1997	1977	1997	1973	1997	1973	1997
1	2		3		4		5	
Protozooa								
Tintinopsis lacustris							+	
Vorticella sp.							+	
Coelenterata								
Hydra sp.		+						
Rotatoria								
Brachionus calcyflorus					+			
f. spinosus				+				
B. unciolaris				+			+	
Keratella cochlearis				+	+		+	
K. quadrata				+			+	
K. valgo f. heterospina				+	+		+	
Polyathra euriptela							+	
Nematoda	+			+	+	+	+	+
Oligochaeta								
Enchytraeus sp.					+			
Fridericia sp.					+		+	
Ilyodrilus templetoni					+			
Limnodrilus claparedeianus					+			
L. hoffmeisteri	+	+	+		+	+	+	+
L. udekemianus					+			
L.sp.		+			+			
Nais clinguis	+	+			+	+	+	
N.communis		+			+	+	+	+
N. pardalis	+				+	+		
N. simplex					+			
Octolasium lacteum					+			
Ophidonsis serpentina					+			
Potamothrix hammoniensis					+			
Stylaria lacustris					+			
Tubifex ignatus					+	+		
T. tubifex			+		+	+		+
Hirudinea								
Erpobdellà monostriata					+			
E. octoculata	+	+	+	+	+	+	+	+
Gasteropoda								
Ancylus fluviatilis		+						
Radix ovata					+		+	
R. peregra			+	+	+		+	
Valvata piscinalis							+	
Cladocera								
Bosmina longirostris					+		+	
Ceriodaphnia pulchella					+		+	
Daphnia galeata					+		+	
Copepoda								
Acanthocyclops vernalis	+	+	+		+	+	+	
Eucyclops serrulatus			+		+		+	
Paracyclops fimbriatus					+		+	
Isopoda								
Asellus aquaticus		+		+				

1	2		3		4		5	
Amphipoda								
Gammarus balcanicus		+		+	+	+		
Colembolla	+	+						
Efemeroptera								
Baetis sp.	+	+		+	+			
Caenis sp.		+				+		
Ecdionurus sp.	+			+				
Ephemerella sp.		+						
Ordella sp.			+					
Plecoptera								
Leuctra sp.		+	+	+				
Trichoptera						+		
Hydropsiche contubernalis	+	+	+	+	+		+	
Simuliidae								
Simulium reptans		+						
Chironomidae								
Chironomus plumosus					+	+		+
Cricotopus algarum	+			+				
C. bicinctus				+			+	
C.silvestris					+			
Cryptochironomus conjugens					+			
C. defectus					+	+		+
C. pararostratus					+			
Eukiefferiella brevicalcar	+	+		+	+		+	
Diamesa bohemani		+		+			+	
D. insignipes		+					+	
Glyptotendipes gripekoveni					+			
Nanocladius bicolor		+						
Prodiamesa olivaceea					+			
Pseudodiamesa nivosa	+	+						
Rheotanytarsus nigricauda	+		+	+				
Tanytarsus gregarius		+		+	+	+		
T. lauterborni	+		+		+			

Plate I a. *Relative abundance of invertebrate aquatic fauna in the Făgăraş - Avrig sector*

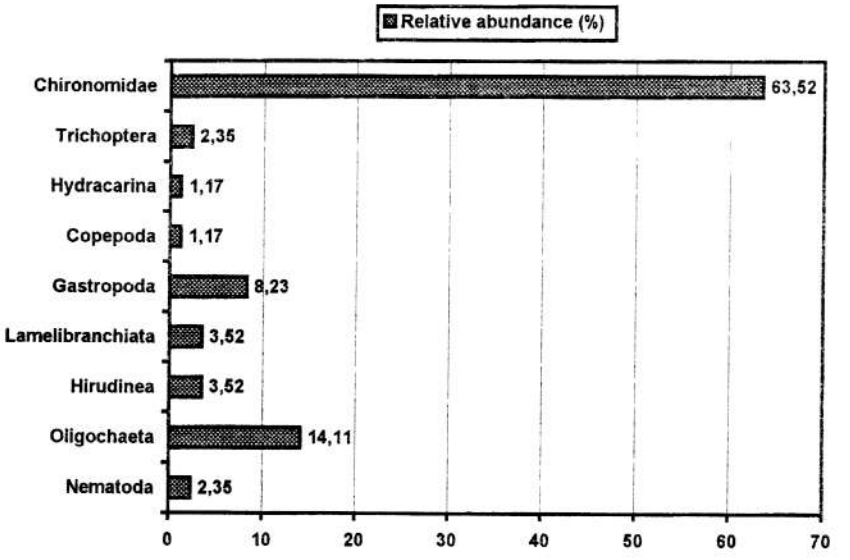


Fig. 1. *Voila dam lake*

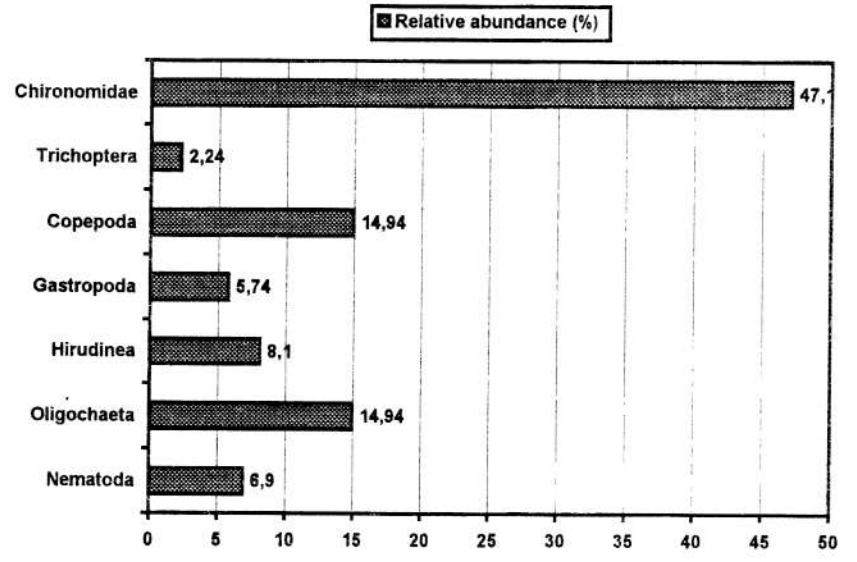


Fig. 2. *Vişlea dam lake*

Plate I b. *Relative abundance of invertebrate aquatic fauna in the Făgăraş - Avrig sector*

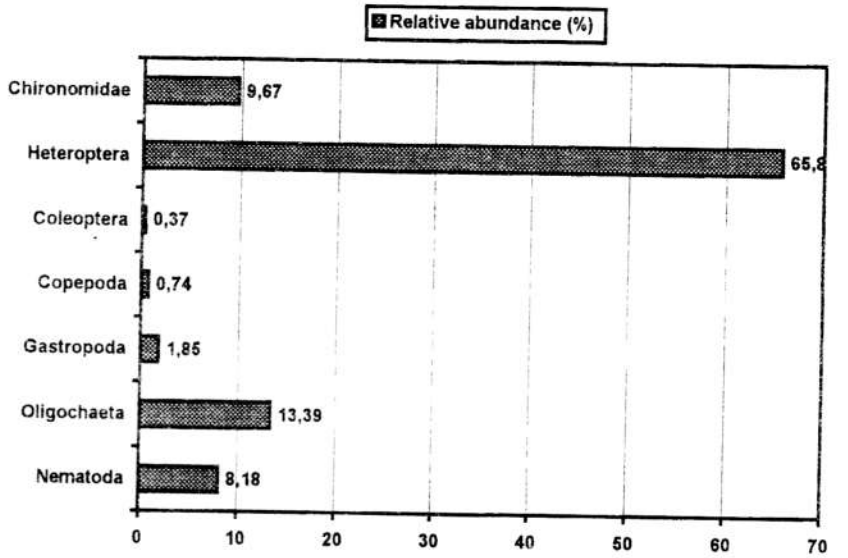


Fig. 3. *Scoreiu dam lake*

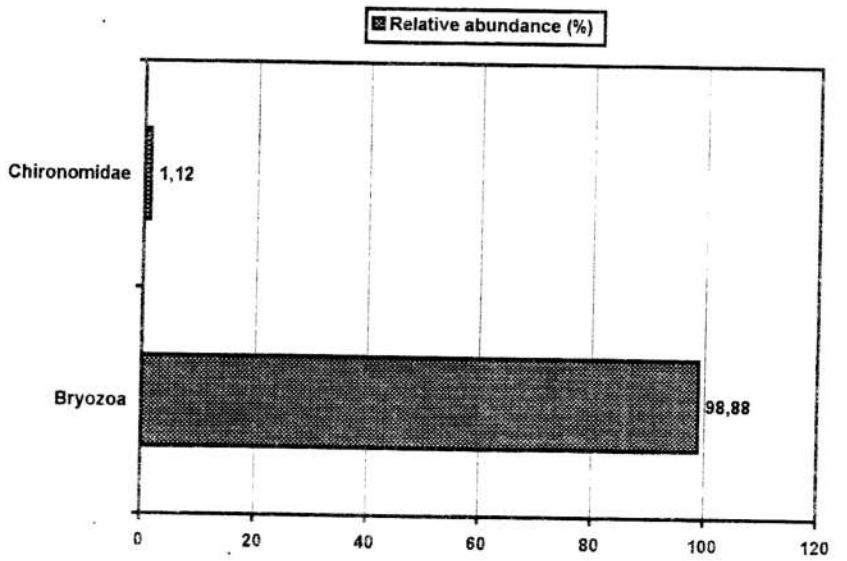


Fig. 4. *Avrig dam lake*

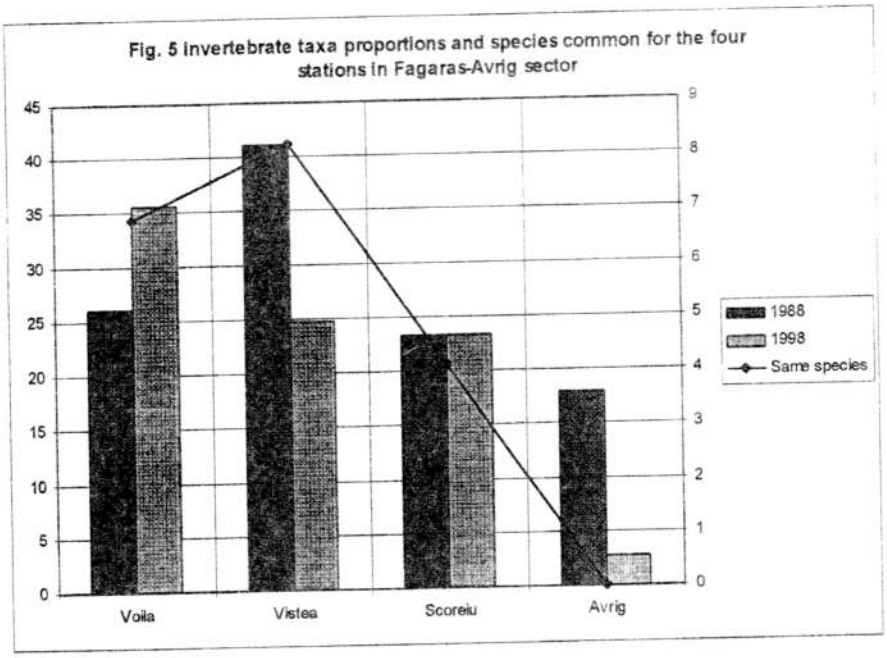


Fig. 5 Invertebrate taxa proportions and species common for the four stations in Fagaras-Avrig sector

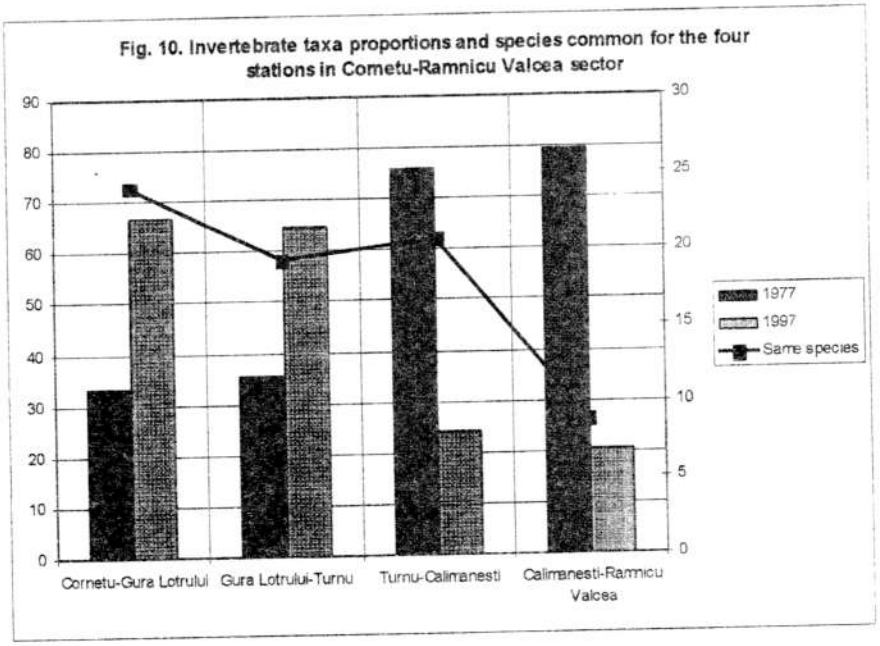
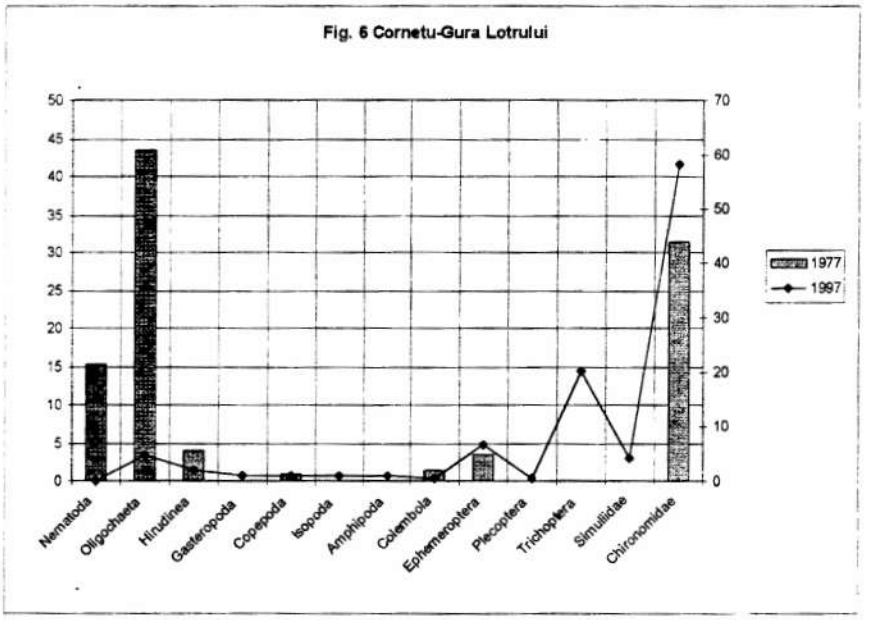


Fig. 10. Invertebrate taxa proportions and species common for the four stations in Cornetu-Ramnicu Valcea sector



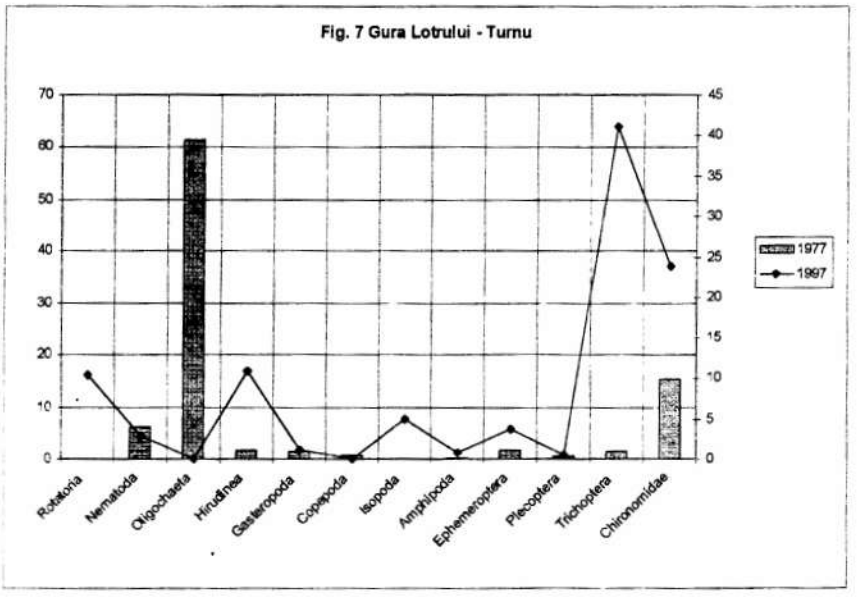
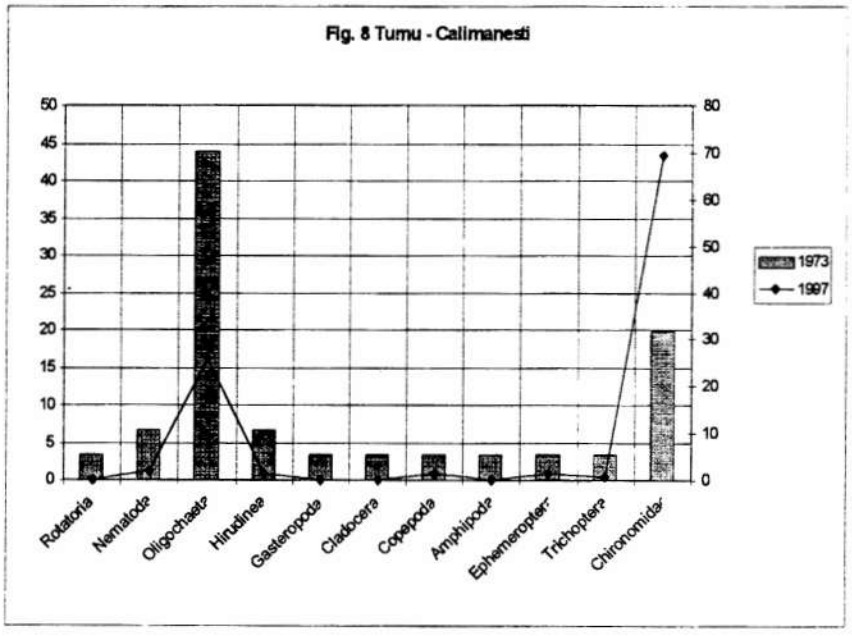


Plate II a. *Dynamics of the relative abundance of aquatic invertebrates from Cornetu-Ramnicu*



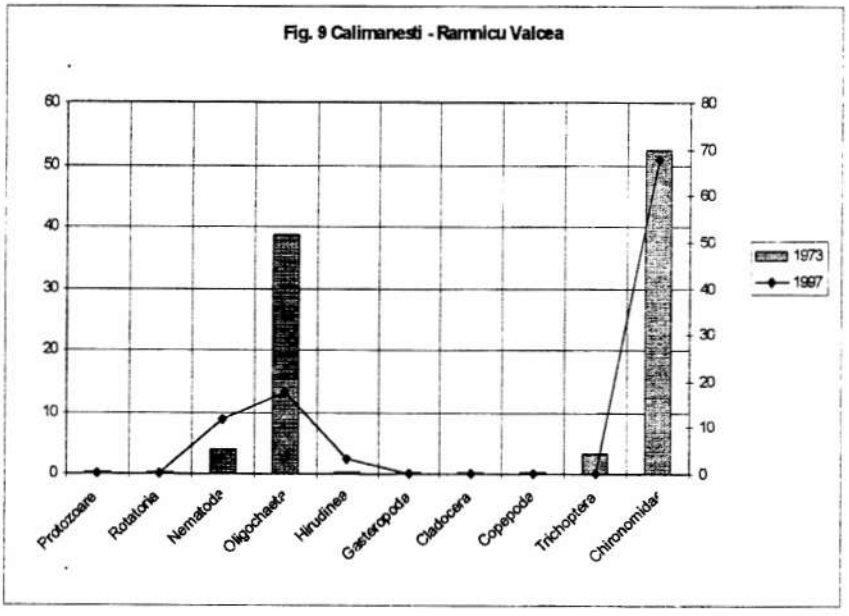


Plate II b. *Dynamics of the relative abundance of aquatic invertebrates from Cornetu-Ramnicu*

SOME ASPECTS CONCERNING THE BENTHAL FAUNA IN THE UPPER AND MIDDLE OLT RIVER BASIN

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RÉSUMÉ

Dans cette ouvrage sont présentées quelques dates concernant la fauna de benthos de la rivière Olt. Cet étude qualitatif et quantitatif a été realisée par l' analyse de 28 de preuves qui ont été collectées en octobre 1998, du long le cours supérieur et dans le moyen du Olt et aussi, ont été prélevées dans la rivière Cibin et dans les bras morts du Olt.

Les résultats mettent en évidence une différence claire de la composition faunistique. Dans les zones avec les eaux polluées sont présentés moins groupes d' organismes (Oligochaeta, Nematoda et Chironomidae) qui sont formes cosmopolites, pendant que dans les bras morts la diversité est plus grande, parce que ces eaux sont isolées et ici existent les conditions d'équilibre de l'écosystemes.

Keywords: benthal, pollution, phytophilous fauna, Olt River Basin.

INTRODUCTION

Benthal fauna is a very important component of aquatic ecosystems, both through its abundance and its variety of species. Zoobenthal organisms can indicate best where the ecosystem is the subject of some modifications and especially the pollution level of the concerned basin.

The attempts to see the pollution level of the Olt River, have also considered the performance of some observations concerning the benthal fauna. Even though, there are no previous studies which allow a comparison of the data. Our results can show the fauna composition and offer some clues concerning the pollution and its proportion in certain sectors of the upper and middle course of the Olt River.

MATERIALS AND METHODS

28 samples collected from 0,5 to 4m deep were analysed for these studies. For the qualitative study was used Băcescu type dredge (of 50-cm length and 30-cm width, with a nylon net of 50-cm length).

Sedimentary samples were collected with a bottom Surber sampler, with a drifting net: Conservation was made in 4% formaldehyde.

Each sample was washed through a metal screen of 0,1-mm pore mesh size. The biological material has been identified to species or genera and then counted. The individuals have been preserved in a 70% alcohol solution and glycerine.

RESULTS AND DISCUSSION

In the analysed samples were found organisms belonging to 20 taxonomic groups, whose frequency varies as following: oligochaets and dipters (Chironomidae) have the highest percentage (98%). Trichoptera larvae, Amphipoda and Ostracoda crustaceans, Gastropoda have a frequency between 50-75%.

The other identified groups do not exceed a percentage of 50%, as it can be seen in **Figure 1**.

The results of this benthal fauna studies show clear differences and a division into zones: the upstream course from Sândominic to Ilieni, the middle zone Făgăraş-Călineşti and the afferent wet zones of the marshes and pools of the dead branches.

Thus, along the upstream course from Sândominic to Ilieni the characteristic

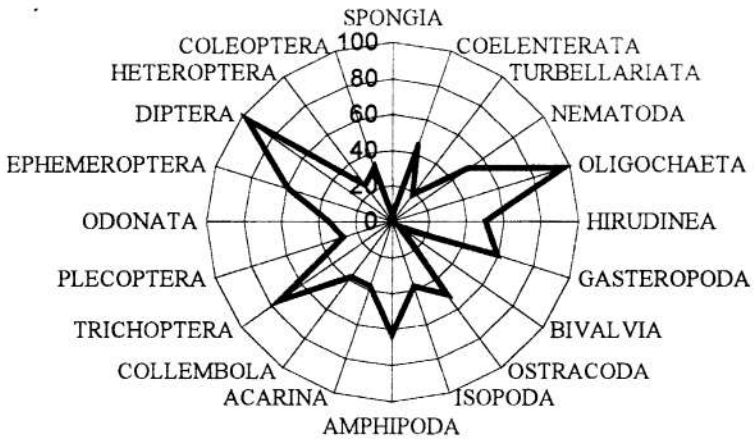

Fig. 1. *The frequency (%) of important organism groups*

zoobenthal forms are represented by the Oligochaets, Nematodes followed by the Chironomidae larvae.

The Trichoptera and Ephemeroptera larvae (genera *Baetis* and *Cloeon*) join these groups, represented by a great number of individuals up to several hundreds or thousands.

The Hirudinea, Gastropoda and Crustacea were represented in a low number of individuals, only in few samples. From the last group there are only a few species such as: *Asellus aquaticus* (Isopoda), *Rivulogammarus balcanicus dacicus* and *Corophium curvispinum* (Amphipoda) and Ostracoda species, that have been described as a part of the phytophilous associations.

These crustaceans and especially *Asellus aquaticus*, *Corophium curvispinum* and also Ostracoda species are cosmopolitan forms. *Corophium curvispinum* was found in Ilieni, in only one single sample, into a specific biotope with sandy and silty bottom.

Rivulogammarus balcanicus dacicus is the only species that prefers clean and oxygenate waters. However its presence has been noticed only in still water sectors, under clean stones and sand.

The high number of the Oligochaeta and Chironomidae larvae shows a high organic matter concentration in the water. However, the bottom of these stations is silty or, in some cases, the silt creates a substantial layer on the surface of the stones.

Another characteristic stream zone is between Făgăraş and Călineşti, where the Oligochaeta and Chironomidae are dominant, too. In a small number of individuals yet with a greater variety compared to the situation from other stations, were found Hirudinea in the dam lake from Avrig. This can be noticed where the stony bottom and the plants from the shore are on the surface with a brown layer of detritus. Also, here larvae of *Naucoris cimicoides* (Heteroptera) are dominant.

In the leaking channel of the dam, where the water is cleaner, among the plants and under the stones there have been found crustaceans, trichopters, ephemeropters, and simuliids. Among crustaceans, the amphipod species found *Rivulogammarus balcanicus montanus* is a rheophyle form which can be considered an indicator of the clear and well oxygenate waters, due to its ecological features.

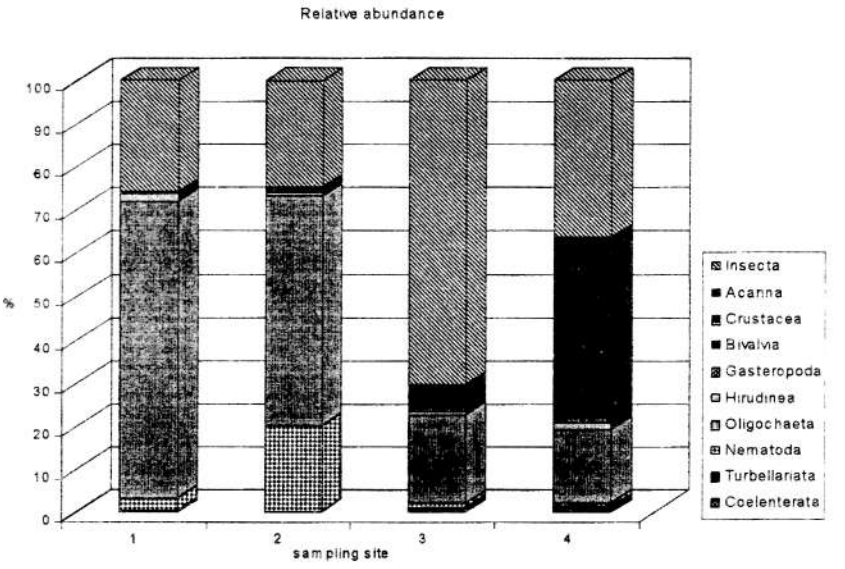

Fig. 2. *The relative abundance of organisms on sampling site*
1.Sândominic–Ilieni; 2. Făgăraş-Călineşti; 3.Cibin; 4. Puddles and dead branches

The largest variety of species and especially of the phytophyllous type has been noticed in the studied dead branches (**Figure 2**). This variety and the numerical proportion between different groups of organisms show an evident balance of these ecosystems. Here, the dominants are Ephemeropters, Trichopteres larvae and also, are present the Odonata, Collembola, larvae and even Coleoptera and Heteroptera adults. Among crustaceans, in a large number there are: *Asellus aquaticus* (Isopoda), *Rivulogammarus balcanicus dacicus* (Amphipoda). In the Hărman Marshes or in the dead branch at Aita Mare, are also Ostracodes of type *Ilyocypris*, *Eucypris* and *Cyclocypris*.

The gastropods are found in a small number of samples and they belong to the common species: *Planorbarius corneus*, *Lymnaea stagnalis*, *Physa fontinalis*, *Physa acuta*, *Radix ovata* and *Gyraulus albus*. We can add to them: *Anisus septemgyratus*, *Hippeutis complanatus*, *Succinea putris* and others, in the samples from the dead-branch at Turnu Roşu.

Another investigated area was the Cibin River. On the upstream, more exactly at the confluence between Râul Mare River and Râul Mic River, the benthal community is characterised by a small number of species and also, of individuals, the predominant ones being the Plecoptera larvae followed by those of Chironomidae.

Near Sibiu the most important groups are Oligochaeta, Nematoda and Chironomidae larvae. The same groups but with a different frequency order can be

met near the confluence point of Cibin and Olt Rivers, too. The great number of Chironomidae and Oligochaeta shows a high concentration of organic suspensions, That can be explained by the influence of the wastewater discharges coming from Sibiu town.

Studying benthal fauna of the Olt River some conclusion can be drawn:

- The benthic communities from the upper and middle Olt River course are showing, by their structural modifications, the pronounced anthropic impact. In Sândominic - Ilieni and Făgăraş - Călineşti sectors the dominant groups are Oligochaeta and Chironomidae.

Thesę groups are considered to be ecological indicators of the polluted water with a high concentration of organic substances.

Their presence in the benthal communities is explained by the fact that these organisms are endowed with physiological mechanisms that allow their survival in conditions of hypoxia.

Due to the fact that they are among the few that can live in such conditions, they play an important role in the energy transfer in the ecosystems that are modified or affected by the pollution.

- A similar aspect has been noticed on the Cibin River, downstream Sibiu, aspect that refers to the dominance in the benthal associations of two categories of organisms with a potential of surviving in limited conditions. This fact is a result of the influence of the urbanised zone.

- There are puddles of the dead branches and marshes from Hărman that remain lightly modified. Their isolation from the proper course of the Olt River protect them by the direct and indirect sources of pollution that affect the previous presented zones.

This became very clear after the analysis of the benthal fauna from these waters, especially of the phytophylous one.

This study has shown an evident balance between the groups of organisms from the associations, the numerical and specific variety being a characteristic of this kind of the ecosystems.

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Tab. 1. *Distribution of organisms in each sampling station*

Sampling stations: ***Q1*** *– Sandominic,* ***Q2*** *– Sancrăieni,* ***Q3*** *- Bixad,* ***Q4*** *– Sf. Gheorghe,* ***Q5*** *– Ilieni,* ***Q9*** *– Sâmbăta de Jos,* ***Q10*** *– Avrig (dam lake),* ***Q11*** *Avrig (downstream),* ***Q12*** *– Boiţa,* ***Q13*** *– Călineşti,* ***T1*** *– Sântionlunca,* ***T2*** *– Hărman,* ***T3*** *– Arini,* ***T4*** *– Aita Mare,* ***T5*** *Micloşoara,* ***T6*** *– Rotbav,* ***T9*** *– Turnu Roşu,* ***T8*** *– Racoviţ;* ***R (3/1, 3/2, 3/3, 4, 6, 8, 9)*** *– Cibin River*

Taxon	R3 /1	R3 /2	R3 /3	R4	R6	R8	R9	T8	T9	Q1 3	Q1 2	Q1 1	Q10 /1	Q10 /2	Q10 /3	Q9	T6/ 2	T5	T4	T3	T6/ 1	T2	T1	Q5	Q4	Q3	Q2	Q1
Spongia																												
Spongilla lacustris									+																			
Coelenterata																												
Hydra vulgaris							+			+	+	+	+	+	+	+	+		+	+			+	+			+	
Turbellariata																						+				+		
Dendrocoelum lacteum															+													
Euplanaria lugubris				+													+		+									
Nematoda	+		+		+		+	+		+	+	+					+			+	+	+	+	+		+		+
Oligochaeta	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Hirudinea							+				+		+							+			+	+			+	
Hirudo medicinalis							+				+	+															+	
Glossiphonia complanata									+					+														
Haemopis sanguisuga															+													
Piscicola geometra														+												+		
Batrachobdelida sp.														+		+											+	
Erpobdella sp.														+				+	+							+		
Gasteropoda											+										+	+		+		+		
Planorbarius corneus																						+	+					
Lymnaea stagnalis																											+	
Radix peregra														+								+						
Radix ovata																				+								
Ancylus fluviatilis														+				+							+			

Physa fontinalis							+								+														
Physa acuta												+																	
Gyraulus albus																		+		+			+						
Anisus septemgyratus								+																					
Hippeutis complanatus								+																					
Succinea putris								+																					
Bivalvia																													
Pisidium amnicum								+															+						
Crustacea																													
Ostracoda												+	+	+			+	+	+	+	+	+			+	+	+		
Ilyocypris decipiens														+								+							
Eucypris zenkeri																						+							
Eucypris lutaria																						+							
Cyclocypris ovum																						+							
Cypridopsis aculeata												+																	
Candona pratensis																+													
Limnocypris sp.															+														
Hungarocypris sp.																		+	+										
Isopoda																													
Asellus aquaticus												+	+			+		+		+		+	+	+				+	
Amphipoda																													
Rivulogammarus balcanicus dac.		+													+	+	+				+	+				+			
R. balcanicus montanus													+																
Corophium curvispinum																									+				
Acarina							+	+										+	+	+	+		+	+				+	+
Insecta																													
Collembola					+		+	+	+		+		+		+			+	+									+	+
Trichoptera	+	+	+	+	+		+			+	+	+	+	+				+	+	+	+	+	+	+	+	+	+	+	
Plecoptera	+	+	+	+														+			+	+			+				
Odonata								+	+				+						+	+	+			+	+			+	

Ephemeroptera								+										+											
Baetis sp.	+			+			+						+						+	+		+	+		+		+		
Cloeon sp.													+						+	+	+			+				+	
Ecdyonurus sp.		+																+				+							
Centroptilum sp.								+																					
Paraleptophlebia sp.																		+							+	+			
Ephemera sp.																		+											
Heptogenia sp.				+																									
Caenis sp.																		+			+			+					
Diptera			+															+	+			+	+		+		+	+	+
Ceratopogonidae									+		+		+						+	+	+			+				+	
Chironomidae	+	+	+	+	+	+	+	+	+	++	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Simuliidae											+		+														+	+	
Culicidae									+												+			+					
Tipulidae													+																
Tabanidae															+														
Heteroptera																						+							
Ranatra linearis																			+										
Corixa sp.															+									+					
Plea sp.																								+					
Notonecta glauca								+																					
Hydrometra sp.								+																					
Naucoris cimicoides													+	+															
Coleoptera																		+			+	+			+			+	
Hydrophilidae																								+					
Haliplidae																			+				+						
Dryopidae																						+							
Dytiscus marginalis																			+										
Hydraena sp.																													+

DATA CONCERNING THE BENTHIC COMMUNITIES OF THE CIBIN RIVER (OLT RIVER BASIN)

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RÉSUMÉ

Le récit fait une description de la structure des comunautés bentoniques de la rivière Cibin en corrélation avec les conditions du biotope (le type de soustrat, la vitesse d'écuolement de l'eau, les caractéristiques fizique-chimique de l'eau).

Les donées se basent sur des échantillons quntitatives de benthos collectés les mois de jullet, octobre et novembre 1998, contenant 11 stations situées au centre de la rivière Cibin. À l'etablisement des points de prelevement on a tenu compte de la spécificité du biotope, les principales confluences, la présence des travaux hidrotechniques et des sources de pollution. Plusieurs échantillons ont été prélévé, en chaque point, pour surprendre la diversité des habitats spécifiques.

Les principales groupes des macroinvertebrates trouvées dans le benthos de la rivière Cibin sont: oligocheta, hirudinea, crustaceea, ephemeroptera, odonata, chironomidae, trichoptera, plecoptera.

Les abondances relatives des differantes groupes de macroinvertebrees bentoniques varient dans des différants secteurs de la rivière. Dans le secteur de la riviere avec soustrat litologique, grand vitesse d'écoulement et d'eau propre, prédominantes sont les larves d'insectes (trichoptera, ephemeroptera, plecoptera, chironomidae). Sur le tronson Orlat - Talmaciu, où le soustrat est formé du grasier, de sable, du limon et l'eau présente une echarge organique, dominantes sont les oligochetes. Les chironomides developent des populations stables dans tous les secteurs de la rivière analisées.

Keywords: benthic communities, hydrobiology, Cibin River

INTRODUCTION

The Cibin River Basin is situated almost in the middle of Romania (between 45° 10' and 46° 20' northern latitude and between 23° 41' and 24° 59' eastern longitude) in the south – west part of Transylvania Depression. This river basin represents a scarcely investigated zone, respecting the benthic macroinvertebrate communities (A. Roşu, 1980).

The Cibin River is interesting concerning ecological research because there are many types of biotopes. This river has its sources in the glacial lakes of Cindrel Mountains (1920 m altitude), having a length of 78 km and flows into the Olt River, being one of the main tributaries of it. Its catchment area has a surface of 2210 km^2 (I. Ujvári, 1972). In this work we aim to offer a description of the structure of the benthic macroinvertebrate communities concerning the biotopes conditions (the type of substratum, water velocity, physical and chemical properties of the water).

MATERIALS AND METHODS

The samples were collected in the months of July, October and November 1998. The river was researched along its course, and there were chosen nine sampling stations (**R1** to **R9**, **Fig. 1**) according to: the specific of biotopes, the main confluences and the human impact on the river sections (hydrotechnical works, pollution sources).

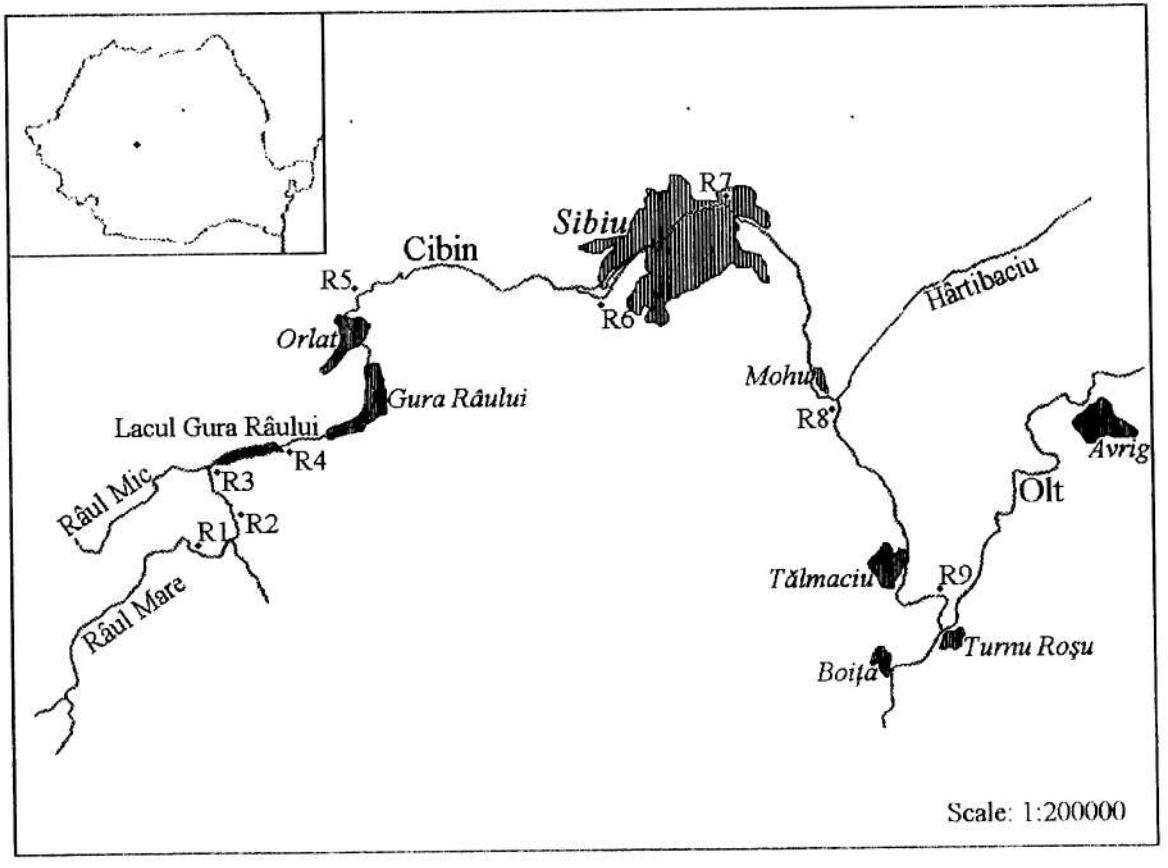


Fig. 1: Sampling area.

From each station we have collected samples from many places in order to analyse each specific habitat: zones with stony substratum and high velocity of water-flow, zones with sandy or silty substratum and slowly water flow.

The quantitative samples were taken with a bottom Surber sampler , which cover an area of 887 cm^2. The samples were preserved in 4% formalyne. The biological material were sorted and there were counted the individuals belonging to the main groups of benthic macroinvertebrates (oligochaeta, hirudinea, crustacean, ephemeroptera, odonata, chironomidae, trichoptera, plecoptera). After the sorting of the biological material, it was preserved in alcohol 70%.

For the description of the structure of benthic communities we have used, for each macroinvertebrate group, the relative abundance - **A**, frequency - **F** and index of ecological significance - **W** = (A x F)/100.

For the description of the biotopes conditions we analysed the following physical and chemical characteristics of the water, like as: temperature, pH, total suspensions (**Susp**.), total hardness (**TH**) , dissolved oxygen (**DO**), BOD_5, COD-Mn, chloride, sulphate, NH_4, NH_3, NO_2, NO_3, PO_4. Also we considered the type of substratum and water velocity.

RESULTS AND DISCUSSION

Table 1 shows the values of the main physical and chemical parameters of the water (in July, October and November) for each analysed river section.

Tab. 1. *The main physical and chemical characteristics of the water in each sampling station*

Parame-ters		Sampling stations								
		R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**
T°C	VII	11	12	14	16	17	19	16	19	20
	X	10.5	10.5	9	10.5	11.5	14	10.5	10.5	8
	XI	1	1.5	3	2	3	6	6	7	7.5
pH	VII	6.8	6.5	6.5	6.6	6.8	7.1	6.8	7.2	7.2
	X	7.5	6.8	6.5	6.6	6.7	6.9	7.2	7.9	7.1
	XI	7.0	6.7	7.1	6.5	7.0	7.2	7.5	7.5	7.3
Susp.	X	59	85	59	61	52	54	90	93	76
(mg/l)	XI	78	69	57	52	51	122	134	110	93
TH	X	2.24	3.92	2.24	2.24	2.80	4.48	8.20	8.40	7.84
(°G)	XI	1.68	2.24	3.36	2.80	2.80	5.60	8.40	8.40	7.84
DO	VII	6.20	8.10	6.60	6.10	7.0	5.50	6.10	3.70	3.20
(mg/l)	X	7.0	8.50	10.70	9.57	10.40	9.25	8.20	8.60	8.16
	XI	12.0	10.71	10.74	11.64	11.60	11.52	10.44	9.20	9.32
BOD_5	X	2.22	7.70	1.90	2.02	4.74	3.40	3.43	3.60	18.0
(mg/l)	XI	2.02	7.62	1.70	2.43	4.65	4.13	4.12	4.10	17.2
CODMn	X	4.0	8.80	4.0	4.0	-	7.20	-	8.80	32.0
(mg/l)	XI	3.88	20.2	3.10	6.21	7.0	6.21	7.76	-	-
Cl^-	X	17.80	14.20	21.30	28.40	21.30	21.30	-	35.50	56.80
(mg/l)	XI	17.75	24.85	24.85	21.30	24.85	24.85	28.40	-	-
SO_4^{2-}	X	5.5	10.40	4.9	6.0	-	1.5	-	14.13	33.2
(mg/l)	XI	7.5	6.67	4.4	10.27	10.9	20.0	28.0	-	-
Ca	X	8.0	6.0	8.0	8.16	-	24.0	-	44.0	48.0
(mg/l)	XI	12.0	12.0	16.0	0	16.0	28.0	48.0	-	-
Mg	X	4.8	13.38	4.90	4.9	-	4.9	-	9.7	4.9
(mg/l)	XI	2.3	2.43	4.86	2.43	2.43	7.3	3.65	-	-
HCO_3	X	30.5	36.6	18.3	18.3	-	30.5	-	158.8	73.2
(mg/l)	XI	18.3	42.7	48.8	42.7	36.6	97.6	1.22	-	-

NH_4	X	0.23	0.133	0	0	-	0	-	0.51	1.10
(mg/l)	XI	0.047	0.03	0.16	0.47	0.15	0.6	1.27	-	-
NO_2	X	0.04	0.03	0.01	0.013	-	0.08	-	0.27	0.31
(mg/l)	XI	0.06	0.02	0	0.011	0.027	0.2	0.017	-	-
NO_3	X	0	0.104	1.60	1.76	-	5.60	-	1.53	2.10
(mg/l)	XI	0.207	0.26	0.59	0.985	1.11	1.01	1.17	-	-
PO_4	X	0.088	0.88	0.04	0.04	-	0.09	-	0.094	0.21
(mg/l)	XI	0.0	0.0	0.067	0.034	0.04	0.101	0.148	-	-

Table 2 shows the density (number of individuals/ m^2) of each benthic macroinvertebrate group on each sampling station in July, October and November 1998.

Tab. 2 *The density (number of individuals/ m^2) from each benthic macroinvertebrate group of the Cibin River in July, October and November 1998.*
Note. The others include: planarian, crustacean, molluscs, and coleopteran larvae.

sampling stations		systematic groups							
		oligochaeta	hirudinea	chironomidae	trichoptera	plecoptera	ephemeroptera	odonata	others
R1	VII	23	0	113	11	45	11	0	56
	X	0	0	609	101	45	56	0	101
	XI	11	0	350	56	147	68	0	158
R2	VII	45	0	282	45	79	68	0	45
	X	327	0	34	440	79	45	0	101
	XI	101	0	45	767	68	23	0	56
R3	VII	135	0	79	23	34	45	0	56
	X	56	0	11	0	45	0	0	0
	XI	11	0	23	113	68	23	23	11
R4	VII	56	0	5017	45	135	395	0	79
	X	11	0	23	0	23	45	0	23
	XI	34	0	34	0	0	0	23	0
R5	VII	11	0	135	11	11	0	11	0
	X	-	-	-	-	-	-	-	-
	XI	-	-	-	-	-	-	-	-
R6	VII	271	0	147	0	0	45	0	45
	X	183	0	113	0	0	23	0	0
	XI	164	0	79	0	0	0	0	0
R7	VII	958	0	237	0	0	0	0	56
	X	826	0	124	0	0	0	0	0
	XI	733	0	101	0	0	0	11	0
R8	VII	1466	0	214	11	0	11	0	45
	X	27	0	316	23	11	0	0	68
	XI	1573	0	304	45	0	0	0	0
R9	VII	147	90	124	34	0	0	0	11
	X	2210	259	3393	113	0	0	0	316
	XI	913	214	1962	135	0	0	0	0

R1 is placed at 20 km downstream the glacial lake Iezerul Mare (in Cindrel Mountains); maximum breadth 7m; maximum depth 0.50 m; the substratum is stony (boulders, gravel, cobble); fast flowing, cold and clear water and high content of dissolved oxygen.

The benthic community is formed by rheophilic species, insect larvae being prevalent and numerous: chironomids (54.69%), plecopterans (12.09%), trichopterans (8.57%, *Brachycentridae, Goeridae, Sericostomatidae*), ephemeropterans (6.37%); there are also oligochaetes.

The dynamic of benthic community of this river sector for the months of July, October and November 1998 is represented in **Fig. 2**.

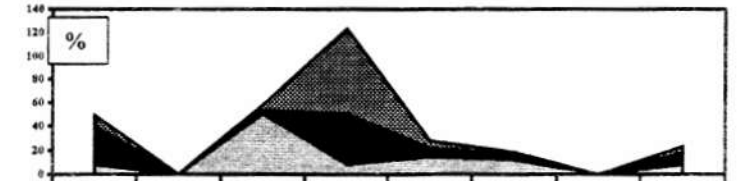
	Oligochaeta	Hirudinea	Chironomidae	Trichoptera	Plecoptera	Ephemer	Odonata	Others
XI	1,36	0	44,3	7,08	18,6	8,6	0	20
X	0	0	66,77	11,07	4,93	6,14	0	11,07
VII	8,88	0	43,62	4,24	17,37	4,24	0	21,62

Fig. 2. *The monthly dynamics of the relative abundance of benthic community in R1 sampling station.*

R2 is placed at 24 km downstream the Iezărul Mare Lake, in the Cheile Cibinului (Cibin Gorge); maximum breadth 4m; the depth is between 0.30m and 1.20m; the substratum is formed by cobble, boulders and gravel in the middle of the riverbed, and it becomes coarse sandy towards the river banks; fast flowing and clear water and high content of dissolved oxygen.

Within this sector benthic fauna is rich: trichopterans (47.24%, *Hydroptilidae, Brachycentridae, Goeridae*), oligochaetes (17.84%), chironomids (13.62%), plecopterans (8.52%), ephemeropterans (5.13%), gammarid crustaceans.

Fig. 3 shows the dynamic in time (relative abundance distribution) of benthic community in R2 sampling station.



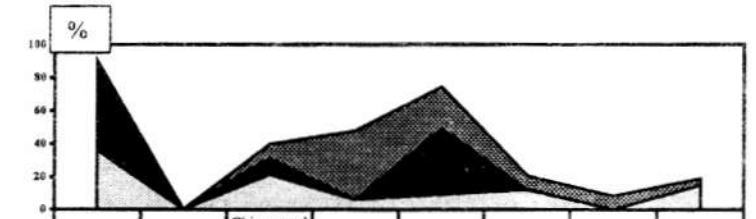
	Oligochaeta	Hirudinea	Chironomidae	Trichoptera	Plecoptera	Ephemer	Odonata	Others
XI	9,52	0	4,24	72,35	6,41	2,16	0	5,28
X	31,87	0	3,31	42,88	7,69	4,38	0	9,84
VII	7,97	0	50	7,97	14	12,05	0	7,97

Fig. 3. *The monthly dynamics of the relative abundance of benthic community in R2 sampling station.*

R3 is placed before Gura Râului dam lake; the river is 8 – 9m wide; the depth is between 0.40m and 1.50m; the water is less rapid; the riverbed contains cobble and gravel; in the slow flowing zones sandy sediments exist.

In this sector the benthic community is composed by oligochaetes (26.71%), plecopterans (19.44%), trichopterans (17.98%, *Hydroptilidae*), chironomids (14.94%), ephemeropterans (8.99%), odonata (3.04%), Ancylus fluviatilis.

The dynamic of benthic community of this river sector for the months of July, October and November 1998 is represented in **Fig. 4**.



	Oligochaeta	Hirudinea	Chironomidae	Trichoptera	Plecoptera	Ephemer	Odonata	Others
XI	4,04	0	8,45	41,54	25	8,45	8,45	4,04
X	50	0	9,82	0	40,17	0	0	0
VII	36,29	0	21,23	6,18	9,13	12,09	0	15,05

Fig. 4. *The monthly dynamics of the relative abundance of benthic community in R3 sampling station.*

R4 is situated downstream the Gura Râului dam lake, the riverbed is affected by the hydrotechnical works; maximum breadth 4 m; maximum depth 0.30m; the substratum is formed by smaller boulders covered with periphyton; fast flowing water.

The benthic community is dominated by chironomids (85.37%). There are also ephemeropterans (7.40%), plecopterans (2.65%), oligochaetes (1.69%), trichopterans (*Rhyacophilidae, Hydroptilidae*), odonates.

The dynamic of benthic community of this river sector for the months of July, October and November 1998 is represented in **Fig. 5**.

	Oligochaeta	Hirudinea	Chironomidae	Trichoptera	Plecoptera	Ephemer	Odonata	Others
XI	37,36	0	37,36	0	0	0	25,27	0
X	8,8	0	18,4	0	18,4	36	0	18,4
VII	0,97	0	87,6	0,78	2,35	6,89	0	1,37

Fig. 5. *The monthly dynamics of the relative abundance of benthic community in R4 sampling station.*

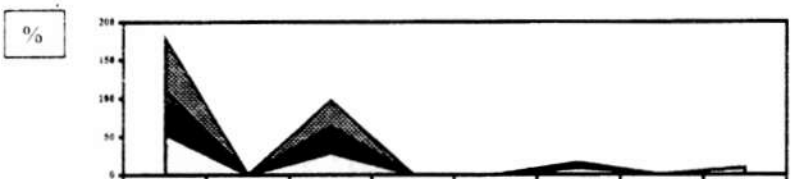
R5 is placed downstream the Orlat village; because of the substratum exploitation the riverbed is very degraded; the river bank is steep; maximum breadth 23m; the depth is between 0.3m and 0.7m; the substratum is formed by gravel. In this sector, the river collects residual water which contains organic matter caused by zootechnical farms and textile industry.

Chironomids (75.41%) and many trichopterans, plecopterans, odonata, oligochaetes form the benthic community. In our samples ephemeropterans are absent.

R6 is placed before the town of Sibiu; the river is 20m wide; the depth is between 0.20m and 0.50m; the substratum is formed by coarse sand, gravel in the middle of the riverbed, and it becomes silty towards the river banks; the banks are straightened and the right bank is dammed. The water is less rapid.

This sector has a low diversity of benthic fauna, represented especially by oligochaetes (57.75%) and chironomids (31.68%). There are also ephemeropterans.

The dynamic of benthic community of this river sector for the months of July, October and November 1998 is represented in **Fig.6**.



	Oligochaeta	Hirudinea	Chironomidae	Trichoptera	Plecoptera	Ephemer	Odonata	Others
XI	67,48	0	32,52	0	0	0	0	0
X	57,36	0	35,42	0	0	7,21	0	0
VII	53,34	0	28,93	0	0	8,85	0	8,85

Fig. 6. *The monthly dynamics of the relative abundance of benthic community in R6 sampling station.*

R7 is situated downstream Sibiu; the river is 15-17m wide; the depth is between 0.20m and 0.80m; in the bank zone the riverbed is covered with muddy sediments, in the middle it contains coarse sand and gravel; the banks are straightened.

The prevalent groups of benthic fauna are oligochaetes (82.62%) and chironomids (15,52%). Those groups develop populations with numerous individuals.

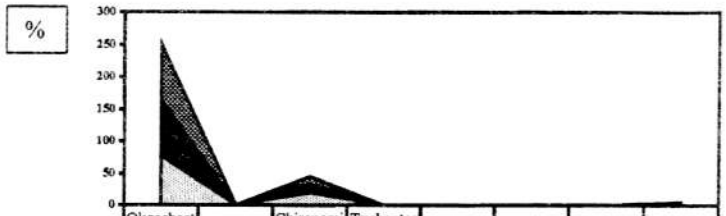
The dynamic of benthic community of this river sector for the months of July, October and November 1998 is represented in **Fig. 7**.

R8 is situated downstream the place where the Cibin River collect residual water from Sibiu town (after being filtered by the cleaning plant of residual water - which doesn't work at normal parameters); the river is 16-18m wide; the depth is between 0.30m and 1.2m; in the middle, the riverbed contains coarse sand and smaller boulders, in the bank zone it is covered by a thick layer of black silt rich in organic matter (the H_2S which comes from the intensive bacterial activity is obviously). The surface of the mud layer has apparently an intense red colour because of the very dense population of *Tubifex tubifex*.

Oligochaetes (74.52%) and chironomids (20.27%, especially *Chironomus plumosus*), dominate the benthic community. Beside these, we have found some trichopterans belonging to the *Hydropsychidae* family, which are resistant on rich organic matter water. The dynamic of benthic community of this river sector for the months of July, October and November 1998 is represented in **Fig. 8**.

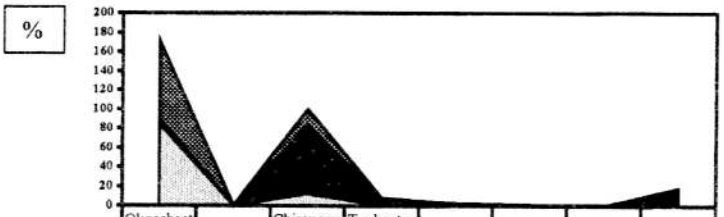
R9 is placed at 3 km before the confluence of the Cibin River with the Olt River, downstream Tălmaciu; the breath of the river is 35 – 40m; the depth is between 0.25 and 1m; the riverbed contains smaller boulders, gravel and sand; the flow is slow.

The benthic community is dominated by chironomids (55.22%) and oligochaetes (32.96%) followed by hirudinea (5.67%), trichopterans (2.84%, Hydropsychidae) and crustaceans.



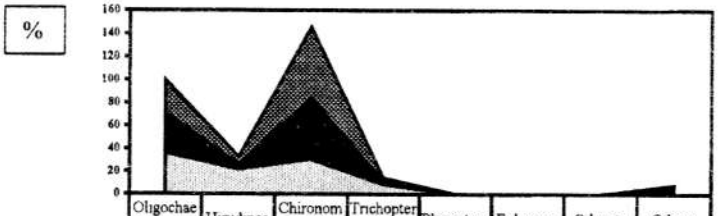
	Oligochaeta	Hirudinea	Chironomidae	Trichoptera	Plecoptera	Ephemer	Odonata	Others
XI	86,74	0	11,95	0	0	0	1,3	0
X	86,94	0	13,06	0	0	0	0	0
VII	76,57	0	18,94	0	0	0	0	4,47

Fig. 7. *The monthly dynamics of the relative abundance of benthic community in R7 sampling station.*



	Oligochaeta	Hirudinea	Chironomidae	Trichoptera	Plecoptera	Ephemer	Odonata	Others
XI	81,84	0	15,81	2,34	0	0	0	0
X	6,06	0	71,01	5,16	2,47	0	0	15,28
VII	83,91	0	12,24	0,62	0	0,62	0	2,57

Fig. 8. *The monthly dynamics of the relative abundance of benthic community in R8 sampling station.*



	Oligochaeta	Hirudinea	Chironomidae	Trichoptera	Plecoptera	Ephemer	Odonata	Others
XI	28,31	6,63	60,85	4,18	0	0	0	0
X	35,12	4,11	53,93	1,79	0	0	0	5,02
VII	36,2	22,16	30,54	8,37	0	0	0	2,7

Fig. 9. *The monthly dynamics of the relative abundance of benthic community in R9 sampling station.*

Table 3 shows the relative abundance, the frequency and ecological significance index of the benthic macroinvertebrate groups, both on each sampling station (A, F, W) and for the whole river (Ag, Fg).

Tab. 3 *Relative abundance, frequency and index of ecological significance of main benthic macroinvertebrate groups from Cibin River.*

Sampling stations		Systematic groups							
		oligochaeta	hirudinea	chironomidae	trichoptera	plecoptera	ephemeroptera	odonata	others
R1	A%	1.73	-	54.69	8.57	12.09	6.37	-	16.07
	F%	66.66	-	100	100	100	100	-	100
	W%	1.15	-	54.69	8.57	12.09	6.37	-	16.07
R2	A%	17.84	-	13.62	47.24	8.52	5.13	-	7.62
	F%	100	-	100	100	100	100		100
	W%	17.84	-	13.62	47.24	8.52	5.13	-	7.62
R3	A%	26.71	-	14.94	17.98	19.44	8.99	3.04	8.86
	F%	100	-	100	66.66	100	66.66	33.33	66.66
	W%	26.71	-	14.94	11.98	19.44	5.99	1.01	5.90
R4	A%	1.69	-	85.37	0.75	2.65	7.40	0.38	1.76
	F%	100	-	100	33.33	66.66	66.66	33.33	66.66
	W%	1.69	-	85.37	0.24	1.76	4.93	0.12	1.17
R5	A%	6.14	-	75.41	6.14	6.14	-	6.14	-
R6	A%	57.75	-	31.68	-	-	6.35	-	4.20
	F%	100	-	100	-	-	66.66	-	33.33
	W%	57.75	-	31.68	-	-	4.23	-	1.40
R7	A%	82.62	-	15.52	-	-	-	-	1.83
	F%	100	-	100	-	-	-	-	33.33
	W%	82.62	-	15.52	-	-	-	-	0.61
R8	A%	74.52	-	20.27	1.92	0.26	0.26	-	2.74
	F%	100	-	100	100	33.33	33.33	-	66.66
	W%	74.52	-	20.27	1.92	0.08	0.08	-	1.83
R9	A%	32.96	5.67	55.22	2.84	-	-	-	3.29
	F%	100	100	100	100	-	-	-	66.66
	W%	32.96	5.67	55.22	2.84	-	-	-	2.19
Ag%		34.47	1.89	46.78	6.65	2.66	2.89	0.22	4.44
Fg%		92	12	100	64	52	52	16	68

In the river sectors with stony substratum, high velocity and clean water, larvae of insects (trichoptera, ephemeroptera, plecoptera) are prevalent, while on the middle and upper course of the river prevalent are the oligochaetes. Chironomids larvae develop stable populations in all the analysed sectors.

The variation of the benthic communities structure, along the rivers course, is showed in terms of values of ecological significance index (W%), in **Fig. 10**.

In the Cibin River, generally we can distinguish three types of substratum: stony, sandy and silty, displaying a characteristic structure of benthic communities.

On the stony substratum we found the greatest diversity of the benthic fauna (see **Fig. 11**). This community is dominated by insects larvae (88.74%): chironomids, trichopterans, ephemeropterans, plecopterans; there are also oligochaetes, planarian and *Ancylus fluviatilis*.

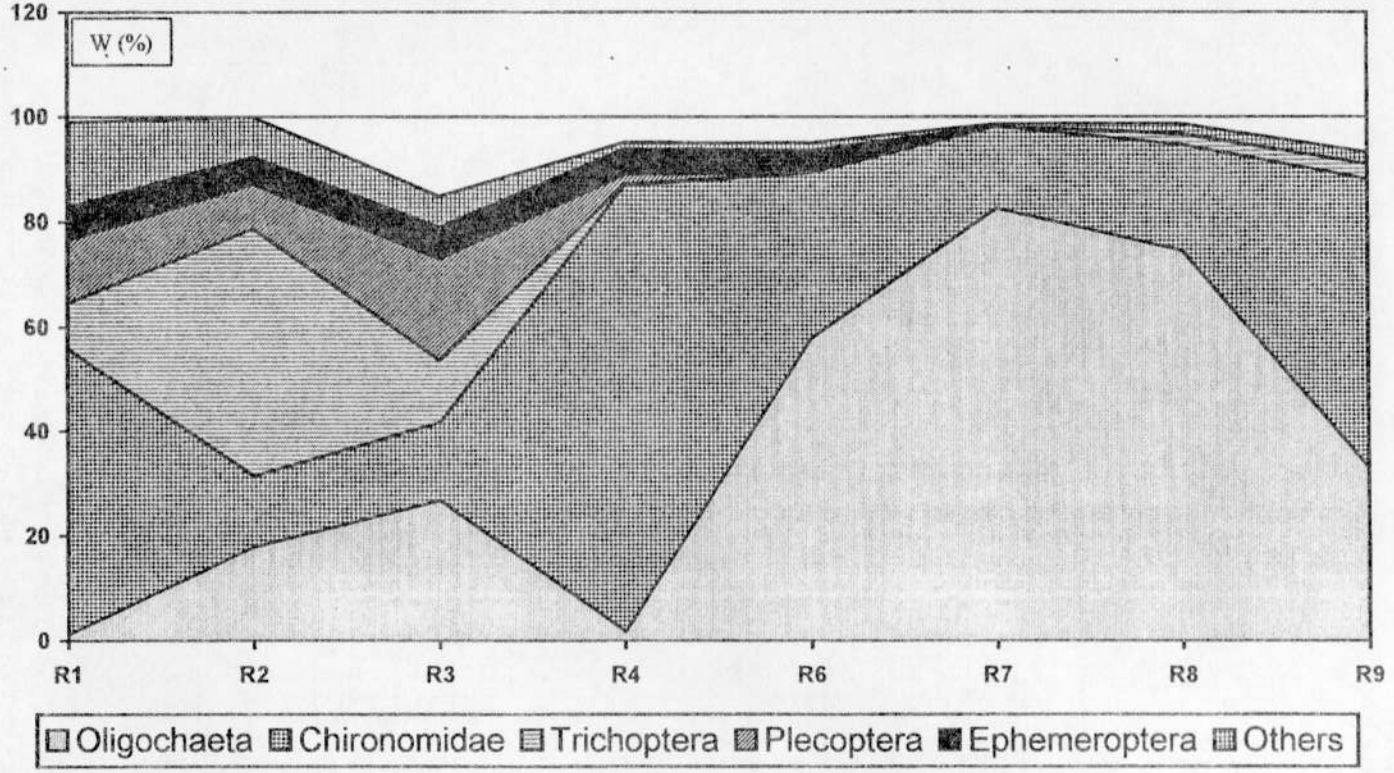


Fig. 10. *The variation of the ecological significance index of the main groups of benthic macroinvertebrates, along the Cibin River course.*

On the sandy bottom oligochaetes are prevalent (44.66%), next to chironomids, trichopterans, plecopterans, ephemeropterans and hirudinea (**Fig.12**).

The benthic fauna on the silty substratum is formed by oligochaetes (56.19%), chironomids (35.86%) and in small proportions by trichopterans and hirudinea (**Fig. 13**)

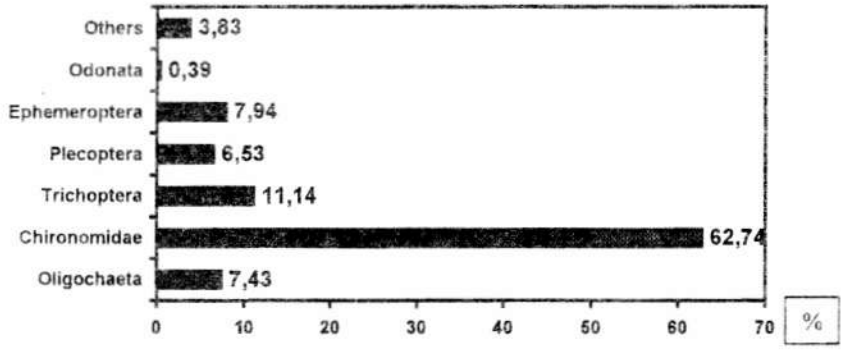


Fig. 11 *The structure of benthic community on the stony substratum.*

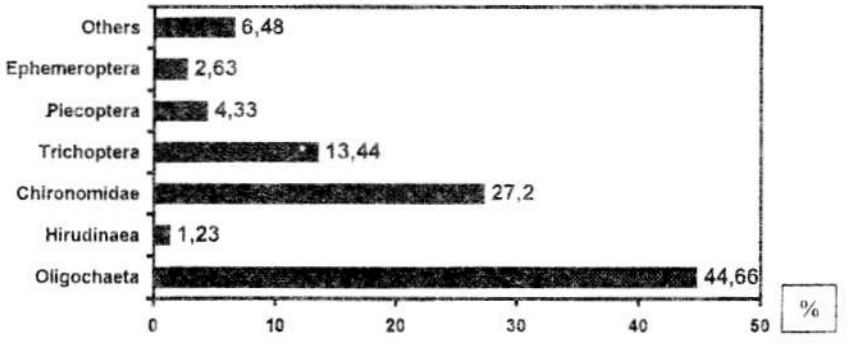


Fig. 12 *The structure of benthic community on the coars sandy substratum.*

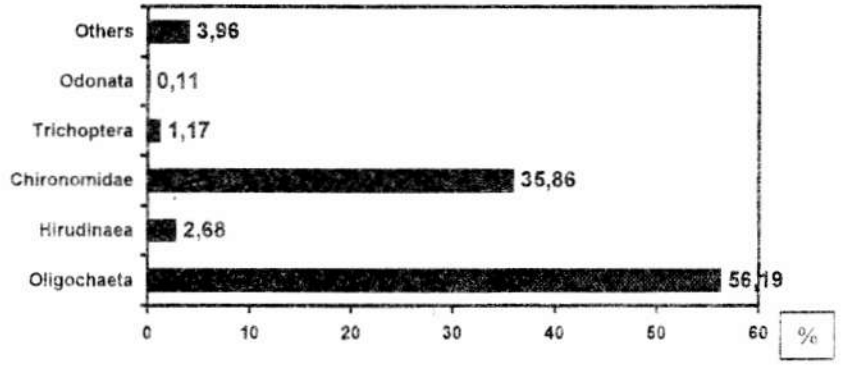


Fig. 13 *The structure of benthic community on the silty substratum.*

CONCLUSIONS

On the bases of the benthic communities, the Cibin River can be divided in the following ecological zones (**Fig. 10**):

- between **R1** and **R3** the course has montanous characteristics, the river shelters a rich rheophilic macroinvertebrate benthic fauna, showed by a balanced structure regarding the chironomids, trichopterans, ephemeropterans, plecopterans, oligochaetes and others; the modifications which occur in the structure of these communities are due to the physical environmental factors (we cannot assume a significant human impact);
- the sector **R3 - R4** is characterised by the presence of the Gura Râului dam lake; downstream the dam the benthic community structure is severe modified, namely the oligochaetes, trichopterans and plecopterans are evidently decreasing, the ephemeropterans remain relatively constant and the chironomids become the evidently dominant group;
- between **R4** and **R8** there is the most affected sector by human impact (housework and industrial wastewater discharges, hydrotechnical works, ballast excavation, draining of the flood area); inside the benthic community the oligochaetes become more and more prevailing; the chironomids are decreasing as far as **R7** (downstream Sibiu) and afterwards they show a significant increasing because of the switch of the component species (there appear more tolerant species like *Chironomus plumosus*), the other groups paying less or no importance;
- from **R7** as far as the Cibin River flows into the Olt River, the ecological state of the river improves significantly: the oligochaetes are evidently decreasing, the chironomids become dominant inside the benthic community and other groups, like hirudinea, trichopterans, crustaceans and snails (i.e. *Physa acuta*), reappear in the riverbed.

Although the situation slightly improves in the last sector of its course, the Cibin River, except the mountainous zone, remains a polluted and degraded flowing water.

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CONTRIBUTIONS TO THE KNOWLEDGE OF THE FRESHWATER MOLLUSKFAUNA FROM THE UPPER AND MIDDLE OLT RIVER BASIN

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ZUSAMMENFASSUNG:

Die vorliegende Arbeit bringt einige Beiträge zur Kenntniss der Süsswassermolluskenfauna aus der Oberen und Mittleren Flussbasin des Altes, um ihren heutigen Zustand zu bestimmen. In die Erforschte Gegend wurden bisher 50 Arten von aquatische Mollusken identifiziert, davon 45 Arten wurden in voriger Jahrhundert und 41 Arten in den letzten Jahre gefunden. Es werden die Heutige Diversität dieser Gruppe und die Ursachen der Modifizierungen diskutiert.

Keywords: malacology, freshwater molluskfauna, Olt River, wetlands, biodiversity

INTRODUCTION

The Olt River, one of the main flowing waters from Romania, has its sources in the Hăşmaş Mountains (Eastern Carpathians) and, after an itinerary of 699 km, it flows into the Danube. The surface of its hydrographic basin is about 24010 km^2. The Olt River passes through all main relief types, namely: mountains, hills, plateaux, depressions and plains, intercepting various geomorphologic conditions and climatic zones. Along the flow it gathers 564 tributaries, which have altogether a total length of 8465 km. In the past decades a very various and intensely human impact upon the river environment and its communities was recorded along the river course. Only a few studies were carried out in the past century, in order to assess the biodiversity and, by these means, the human impact on different sectors of the river. Concerning the freshwater mollusks species, this paper tries to establish a general, updated image and to point out the effects of the anthropic impact.

The freshwater mollusks are relatively easy to be used in a biomonitoring system, because they are responding in a short time and in a very specific manner to the changes in the environmental conditions. These invertebrates from the Olt River Valley were very well studied in the 19th century but scarcely in this one. The authors' aim is to update the knowledge about the present status of this group, the species from the upper and middle Olt River Basin, to show the changes which have occurred in the past century, to identify the river sectors affected by the human impact and to find out the zones which still shelter a higher biodiversity.

The first more comprehensive list of autochthonous mollusk species was published in 1843 by Michael Bielz. Among the naturalists from the Transylvanian Society for Natural Sciences in Sibiu, which was founded in the middle of the past century, we highlight Albert E. Bielz, as one of the most remarkable malacologists of that time. This German naturalist has published his first malacological paper in 1853, in the Journal edited by the mentioned Society (see references), which was followed by several articles so that until 1862 he had identified 125 mollusk species (among them 45 aquatic and paludal) in Transylvania. He published the first monography

regarding the malacofauna from this territory in 1862, followed by a second edition in 1867. In this paper he described not only the identified species and their sampling points, but also their preferences regarding the habitats, data about the shell variability, related to environmental conditions, having thus a pronounced ecological character. Another great malacologist, who also dealt with the species from the Olt River Basin, was Mauritius von Kimakowicz, from the same Society located in Sibiu, but he was focused mainly on terrestrial snails rather than on freshwater species, having in this respect only a few contributions (e.g. the paper published in 1885). Other contributions to the knowledge of the freshwater molluskfauna from the Olt River Valley were provided by S. Clessin (1887), C.F. Jikeli (1878), M. Rotarides (1930), L. Spós (1942) and by Al.V. Grossu (1962, 1986, 1987, 1993 a and b). Most of these authors have quoted the species and the sampling points, as they were mentioned by A.E. Bielz, without verifying if the species still live in the specified habitats and sites.

In recent decades the river environment was drastically affected by pollution and hydrotechnical works, both producing severe changes in the mollusk communities. Some species became extinct, endangered or vulnerable, others (the more resistant pulmonates) became dominant within the communities. Despite this fact, according to the present-day knowledge, we highlight that the Olt River Basin shelters the highest diversity of freshwater mollusks species among the rivers in Transylvania, because of the existence of several wetlands, that were by chance not destroyed yet and in which remnant communities have found a refugee.

All the results presented in this paper have to be regarded as preliminary data; in order to establish a definitive list with all the aquatic and paludal mollusk species from the Olt River Basin, and the current status of their populations, a lot of other habitats and zones must be investigated in the future.

MATERIALS AND METHODS

In the years of 1996 and 1997 some of the authors have done several field researches in different zones and types of habitats, in order to sample and to investigate the freshwater malacofauna from the upper and middle Olt River Basin and in 1998 they took part in an expedition which has followed the main part of the river course in the specified zone. Besides, they gathered the references from the past 150 years which deal with this subject, in order to assess the changes in this fauna. During the 1998 expedition 21 sampling stations were selected along the river valley and several others on the main tributaries, such as Cibin and Râul Negru. The stations were selected in order to investigate the main types of aquatic or paludal habitats, namely: the riverbed, the banks, flood areas, springs, dead branches, lakes, fishponds, permanent or temporal pools, marshes etc, entirely about 120 sites (checked out in the past three years).

We used qualitative sampling techniques. The mollusks were hand-collected, or they were sampled using a bottom Surber, Ekman Bodengreifer, a bottom dredge or a sieve.

In order to display our results in a synthetic manner (**Tab. 1**) we used the following abbreviations:

- **Ar** - relative abundance of the species in the upper and middle Olt River Basin, having the following categories: **C** - common species, **rC** - relatively common, **R** - rare and **vR** - very rare species in the researched area;
- **LR** - the red list proposed for the molluskfauna from the upper and middle Olt River Valley includes: **Ex** - extinct species in the investigated zone; **Ex?** - not

found in recent years, probably extinct; **E** - endangered species; **V** - vulnerable; **I** - insufficiently known status in the researched area;

- **Bgf** - the biogeographic elements are codified as follows: **Hol** - Holarctic, **Pal** - Palearctic, **Eua** - Eurasian, **EW** - European-west-Asian; **Eur** - European, **D** - Danubian, **Mw** - Mediterranean -west - European, **Cos** - cosmopolite.

Other references about the presence of the listed species in certain places from the Olt River Valley are codified by: **B** - A.E. Bielz (1853 - 1867), **K** - M.v. Kimakowicz (1885), **G** - Al.V. Grossu (1962, 1986, 1993 a,b).

In **Tab. 1.** the absence of the species from the sampling station is shown by an empty cell, and the presence in different types of habitats is codified as follows: + - species sampled from the riverbed, **w** - flood area, **b** - pools, **L** - lakes, ponds or fish-ponds, **A** - dead branches invaded by hydro- and/or hygrophilous vegetation, **a** - riverbed of a tributary of the Olt River in the vicinity of the sampling station.

The sampling stations are codified as follows: (on the Olt River course, we are using the names of the nearest locality) **Q3** - Bixad, **Q4** - upstream Sfântu Gheorghe, **Q5** - Ilieni, **Q6** - Augustin, **Q7** - Comăna de Jos, **Q8** - Mândra, **Q9** - Sâmbăta de Jos, **Q10** - dam lake at Avrig, **Q11** - downstream Avrig, **Q12** - downstream Boiţa, **Q13** - downstream Călineşti; (sampling stations in different wetlands from the basin) **T1** - dead branches at Sântionlunca (Râul Negru tributary), **T2** - marshes at Hărman and Prejmer, dead branches at **T3** - Arini, **T4** - Aita Mare, **T5** - Micloşoara, **T6** - fish-ponds at Rotbav, **T7** - rivulets and pools in the Bogata Forest protected natural area, **T8** - dead branch at Racoviţa and **T9** at Turnu Roşu. The list of the identified species from the Cibin River Valley is given on three sectors, namely: **Cs** - the upper basin, **Cm** - the middle and **Ci** - the lower part of the valley. The sampling stations **Q1** - Sândominic and **Q2** - Sâncrăieni are not present in the table, because no living species of freshwater mollusks have been found in the riverbed.

The identification and systhematical framing of the mollusks were done according to A.E. Ellis (1978), P. Glöer (1987) and of Al. V. Grossu (1962, 1986, 1987, 1993 a, b).

RESULTS AND DISCUSSION

In the past century the naturalists from the Transylvanian Society for Natural Sciences in Sibiu, mainly A.E. Bielz, have identified in the upper and middle Olt River Basin 45 species of freshwater and paludal mollusks. Between 1996 and 1998 the authors have found 39 living species. A total of 50 species were collected or quoted in this region; among them 36 species of gastropods and 14 of bivalves. The results are synthetically presented in **Tab. 1**, in which one can see the list of all species mentioned or found in the upper and middle basin, the sampling stations, relative abundance in this region, the red list, biogeographical categories and some other references on the former range of the species, codified (abbreviated) as it was explained in the upper chapter. All the results and interpretations given below are made with respect to the present-day status of the knowledge regarding this group of organisms from the Olt River Valley; it is highly likely that in the future, by gaining more information, some of them are going to be changed. We consider that three species are extinct from this basin, namely *Theodoxus transversalis* C. Pfeiffer, 1828, *Valvata cristata* O.F Müller, 1774 and *Pseudanodonta complanata* Rossmässler, 1835. Four species were not found in the past 4 years and are probably extinct (in the sector enclosed between Bălan and Călineşti): *Valvata piscinalis* O.F. Müller, 1774, *Lithoglyphus naticoides* C.Pfeiffer, 1828, *Bithynia leachi* Sheppard, 1823 and *Anisus*

vortex Linnaeus, 1758. Other four species were not found, but it is possible (even probable) that they survive in different habitats: *Unio pictorum* Linnaeus, 1758, *Pisidium milium* Held, 1836, *Pisidium nitidum* Jenyns, 1832, *Pisidium personatum* Malm, 1855. Besides them, two new species were found in the Transylvanian fauna by the authors, namely *Ferrissia wautieri* Miroli, 1960 (in the Şopa fish-ponds, near Sibiu, Cibin River Basin; found by I. Sîrbu in 1998) and *Anisus vorticulus* Troschel, 1852 (in a dead-branch of the Olt River, near Turnu Roşu village).

By these results we highlight that despite the pollution and degradation of long sectors of the Olt River and its main tributaries, the basin shelters the richest freshwater molluskfauna from all the main river valleys from Transylvania, that is because of the habitats' diversity and the presence of some refuges (like dead branches) which shelter remnant communities since the time when the human impact was low or even absent. That is why some abundant species in the past century became very rare, according to the distribution of such patches, their former range has split and they are surviving in this basin through metapopulations. Regarding the species richness of this group, the ranking of the main rivers from Transylvania is presented in **Fig. 1**.

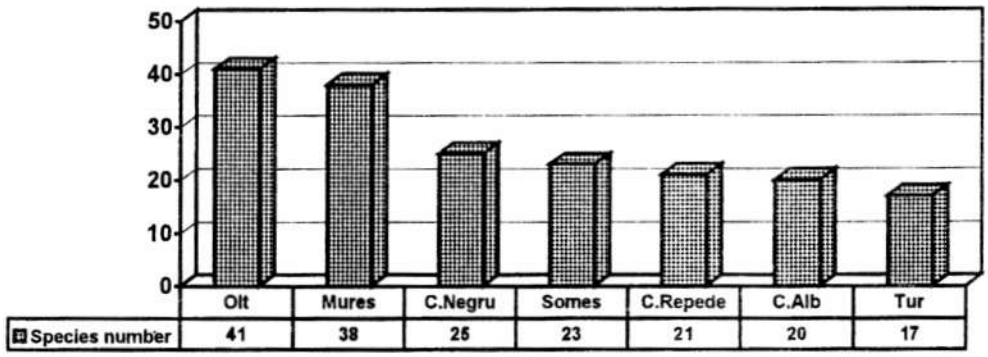

Fig. 1. *Number of the present-day living freshwater mollusk species from the main river basins from Transylvania*

The Olt River Basin, with 39 species is ranked before the Mureş River Basin, in which 38 present-day living species are quoted (A. Sárkány-Kiss, 1995). Although we consider 41 species to be present in the upper and middle Olt River Basin, because two species of Pisiidae have been reported, namely *Pisidium milium* and *P. nitidum*, in the glacial lakes from the Făgăraş Mountains (Grossu, 1962) and that are unlikely to have disappeared in the last 30 years from this zone, while these alpine waters have not suffered because of human impact. Besides the Olt and the Mureş rivers, the other main rivers from Transylvania are sorted as follows: Crişul Negru (with 25 species; A. Sárkány-Kiss et al., 1997), Someş Rivers (23 species; A. Sárkány-Kiss, I. Sîrbu, K. Bába, 1999), Crişul Repede and Crişul Alb (21 and 20 species; A. Sárkány-Kiss et al., 1997) and the Tur River (17 species; A. Sárkány-Kiss and I. Sîrbu, 1999).

Tab. 1. ***Synthetic table with the identified frshwater mollusk species from the upper and middle Olt River Basin***

The sampling stations, types of habitats, relative abundance, Red List category, biogeographical element and other quotations, are codified as described in text about

No.	Species	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	T1	T2	T3	T4	T5	T6	T7	T8	T9	Cs	Cm	Ci	Ar	LR	Bgf	Bibl
1	*Theodoxus transversalis* C.Pfeiffer, 1828	Bielz (1867)- (4 sampling points) Olt River at Cârţa, Sebeşu de Jos, Turnu Roşu. Not recovered.																							-	Ex	D	B
2	*Viviparus viviparus* Linnaeus, 1758	2 recent quotations in some wetlands from Reci and Sântionlunca (Molnar Lidia; Z. Csata, in. verbis)																							vR	I	EW	B,K
3	*Valvata cristata* O.F.Müller, 1774	Bielz (1867)- wetlands in Braşov and Sibiu counties (3 quotations). Not found since the past century.																							-	Ex	Pal	B
4	*Valvata piscinalis* O.F.Müller, 1774	Bielz (1867)-Cibin, Ruscior, wetlands at Avrig. Not recovered in the researched area.																							-	Ex?	Eur	B
5	*Lithoglyphus naticoides* C.Pfeiffer, 1828	Bielz (1867) 1 sampling point in the Turnu Roşu Defile. Not recovered.																							-	Ex?	Eur	B
6	*Bithynia tentaculata* Linnaeus, 1758	1 single recent sampling (Armean Danina in. verbis) from Hârtibaciu tributary (Cibin River Basin).																							vR	I	EW	B,K
7	*Bithynia leachi* Sheppard, 1823	Bielz (1867) - wetlands in Braşov county (3 quotations). Not recovered.																							-	Ex?	Pal	B,K
8	*Physa fontinalis* Linnaeus, 1758						b																		R	V	Eur	B,K
9	*Physa acuta* Draparnaud, 1805			+					w+	+	+	+											+b	+b	C		Mw	
10	*Aplexa hypnorum* Linnaeus, 1758								b										b				Lb		R		Hol	B,K
11	*Lymnaea stagnalis* (Linnaeus, 1758)			L	A			b	bw			b	A		A	A	A				A		L	L	C		Hol	B,K
12	*Stagnicola palustris* (O.F.Müller, 1774)					ba	b		bw	+		b		w	A	A		L				wb	wb	wb	C		Hol	B,K
13	*Stagnicola corvus* Gmelin, 1788												A		A								L		rC		Eur	B,K
14	*Radix auricularia* (Linnaeus, 1758)			+	A			b	w+	+		+b	A		A	A	A	L					L		C		Pal	B,K
15	*Radix ovata* (Draparnaud, 1805)																						L		R		Pal	K
16	*Radix peregra* (O.F.Müller, 1774)					a		a														+b	L		C		Pal	B,K
17	*Galba truncatula* (O.F.Müller, 1774)		+b	+	+	ba	b	b	w	+		+b	A	w	A	A	A	L		A	A		+b	+b	C		Hol	B,K
18	*Ancylus fluviatilis* O.F.Müller, 1774		+										A									+	+		C		Eur	B,K
19	*Acroloxus lacustris* (Linnaeus, 1758)														A		A				A				R		Eur	B,K
20	*Ferrissia wautieri* Miroli, 1960																						L		vR	V	Eur	
21	*Planorbis planorbis* (Linnaeus, 1758)					b	b	b				b								A	A		bL		C		Eua	B,K
22	*Anisus spirorbis* (Linnaeus, 1758)																		b						vR	V	EW	B,K
23	*Anisus septemgyratus* (Zigler)Rossmässler,1801							b																	vR	V	Eur	B,K
24	*Anisus vortex* Linnaeus, 1758	Bielz (1867) 1 quotation at Rupea; Kimakowicz (1885), the same place. Not recovered.																							-	Ex?	EW	B,K
25	*Anisus vorticulus* Troschel, 1852																				A				vR	E	Eur	
26	*Bathyomphalus contortus* Linnaeus, 1758														A										vR	E	Pal	B,K

No.	Species	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	T1	T2	T3	T4	T5	T6	T7	T8	T9	Cs	Cm	Ci	Ar	LR	Bgf	Bibl
27	*Gyraulus laevis* Alder, 1838					b	b		w													b	ba		rC		Hol	B
28	*Gyraulus albus* (O.F.Müller, 1774)	+	b		A				b				A	.	A								L		rC		Hol	B,K
29	*Armiger crista* (Linnaeus, 1758)																						wL		vR	E	EW	B,K
30	*Hippeutis complanatus* (Draparnaud, 1805)	+	b		A								A			A							L		R	I	EW	B,K
31	*Segmentina nitida* (O.F.Müller, 1774)								b														Lb		R	I	Pal	B,K
32	*Planorbarius corneus* Linnaeus, 1758			L		b		b	b				A		A	A	A	L		A	A		L		C		EW	B,K
33	*Succinea putris* (Linnaeus, 1758)	+					b	a	w+	+		+b		w	A				b				+	+	C		Eua	B,K
34	*Succinea oblonga* Draparnaud, 1805				b																A				rC		EW	B,K
35	*Oxyloma elegans* (Risso, 1826)					a							A			A									C		Eua	B,K
36	*Vertigo antivertigo* (Draparnaud, 1801)																						L		R		Hol	B,K
37	*Unio pictorum* Linnaeus, 1758	Bielz (1867) 2 quotations in Ruscior rivulet and pools near Sibiu. Possible present in some wetlands.																							?	I	Pal	B
38	*Unio crassus* Philipsson, 1788					a																			R	V	Eur	B,K
39	*Anodonta cygnaea* Linnaeus, 1758			L														L					L		rC		Pal	B,K
40	*Anodonta anatina* Linnaeus, 1758																							a	R	V	Pal	B
41	*Pseudanodonta complanata* Rossmässler, 1835	E.A.Bielz quoted this species in 1853 from a dead branch at the entrance from Turnu Roşu Defile, south- eastern Boiţa village.																							-	Ex	Eur	B
42	*Pisidium amnicum* (O.F.Müller, 1774)										a											a			R		Eua	B
43	*Pisidium casertanum* (Poli, 1791)											b							w						rC		Cos	B
44	*Pisidium subtruncatum* Malm, 1855													w											vR	V	Hol	B,G
45	*Pisidium obtusale* C.Pfeiffer, 1821								b										w						vR	V	Hol	B,K
46	*Pisidium milium* Held, 1836	Grossu (1962) glacial lakes in Făgăraş Mountains - single collecting point in Romania.																							vR		Hol	G
47	*Pisidium nitidum* Jenyns, 1832	Grossu (1962) glacial lakes in Făgăraş Mountains - single collecting point in Romania																							vR		Hol	G
48	*Pisidium personatum* Malm, 1855	M.v.Kimakowicz (1885) pools at Bungard, Nocrich, Sibiu. Not recovered.																							-	I	Pal	K
49	*Sphaerium corneum* (Linnaeus, 1758)												A								A				R	V	Hol	B,K
50	*Sphaerium lacustris* (O.F.Müller, 1774)				A				+						A										R	I	Hol	B,K
	TOTAL SPECIES = 50	3	4	6	7	8	6	8	13	5	2	8	10	4	11	7	5	5	5	3	8	5	21	6	-	-	-	-

Comparing the freshwater molluskfauna from the main 6 rivers from Transylvania, by using the Sørensen similarity index, we established a matrix of similarity between these basins. In **Fig. 2** the hierarchically clustering of the values from the matrix is shown, using the nearest-neighbour linkage method, and the scale in terms of % of similarity. It is obvious that there are two groups, namely the Olt - Mureş - Someş and the three Criş Rivers, reflecting the faunal characteristics linked to the geomorphological and hydrological conditions. In the first group the Someş River, and in the second the Crişul Repede, are placed apart. In the first case the Someş River is characterised, in opposition with both Olt and Mureş rivers, by less deep waters, faster flowing and lower debits, being also less polluted, but sheltering also less wetlands along its course. In the second case the Crişul Repede River is more affected, than the other two rivers from the group, because of hydrotechnical works, embankments and dams, and also by pollution.

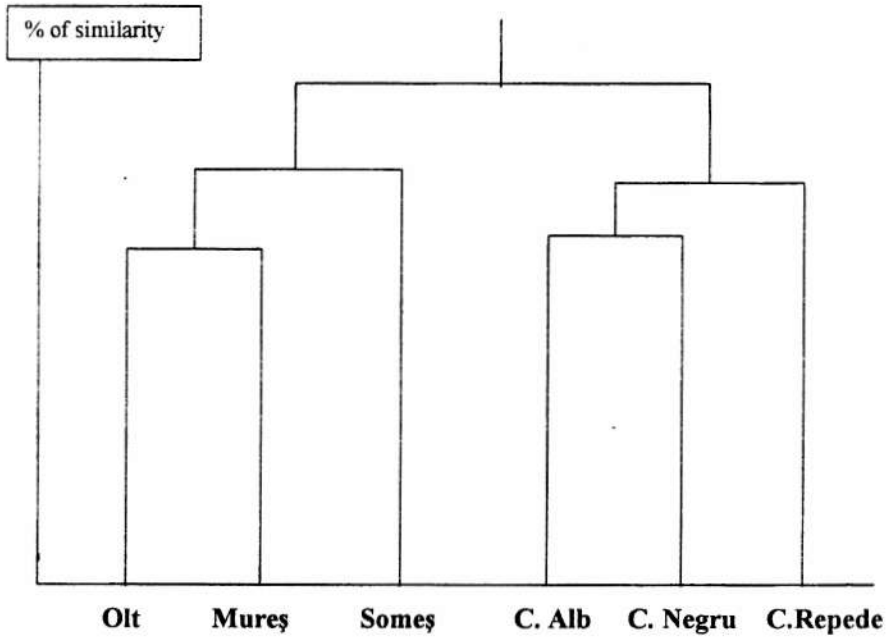

Fig. 2. *Cluster analysis of the freshwater molluskfauna from the main river basins from Transylvania (clustering distance is given in terms of percents of similarity by using the Sørensen index, nearest neighbour joining method)*

Returning to the Olt River, an analysis of the relative abundance of the present-day species (**Fig. 3**) proves that 29.3% of the species are very rare (being found only in one or two sampling stations), 29.3% are rare also, the others (mainly euriecic pulmonates snails) being relatively common or common. Comparing the present-day state with that registered in the past century, one can see that the most affected groups were the prosobranch snails and the Unionaceans. Among the 7 species of freshwater prosobranch gastropods recorded by A.E. Bielz (1867) and M.v. Kimakowicz (1885) only two species have been reported in the past years, in the researched area, namely *Viviparus viviparus* Linnaeus, 1758, in some wetlands near the Râul Negru tributary of the Olt (Molnár Lidia, leg. 1982 and Csata Zoltán - in. verbis) and *Bithynia tentaculata* in the Hârtibaci tributary of the Cibin River (Armean Danina, in. verbis).

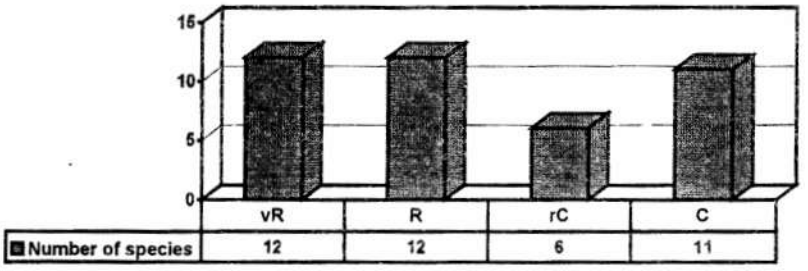

Fig. 3. *Freshwater mollusk species distribution against the four categories of relative abundance*

The prosobranchs usually inhabit more stable and larger habitats, being far less tolerant to environmental fluctuations than the basommatophoran pulmonate gastropods. The species from the last group tend to have a worldwide distribution and to be ubiquitous, a lot of them being highly euriecic species inhabiting a broad range of habitats (R. MacMahon, 1983). When the life conditions became less favourable there is a switch from prosobranch-basommatophoran communities to pulmonate euriecic species exclusive domination. The same fact is valid for the two groups of freshwater bivalves. The Unionidae need more stable and larger habitats with a certain quality of the abiotic factors, while the pisiids tend to group more tolerant, some even ubiquitous and euriecic species, capable to inhabit all kind of habitats, from glacial lakes and springs to lowland temporary pools or - on the other hand - great deltas and estuaries. Besides the prosobranch snails, the Unionidae (except *Anodonta cygnaea* Linnaeus, 1758) have drastically reduced their range in the Olt River Basin. *A. cygnaea* still lives in a lot of fishponds, being well adapted to the conditions from these habitats. *Unio crassus* Philipsson, 1788 has disappeared from the Olt River course, and from different tributaries, like Cibin or Râul Negru downstream the town Târgu Secuiesc, but it still inhabits some clean tributaries, like the Sărata rivulet. *Anodonta anatina* Linnaeus, 1758 was found until now only in one place, in the lower sector of the Tocile rivulet, a tributary of the Cibin River. *Pseudanodonta complanata* and *Unio pictorum* were not found again in the last years, and also a pisiid species, namely *P. personatum* recorded from some pools in the Cibin Basin (M. v. Kimakowicz, 1885). Regarding the basommatophoran pulmonate snails only one species was not recovered, namely *Anisus vortex*, but different other species became very rare in the researched area in the last century; among them we highlight *Armiger crista* and *Anisus septemgyratus*. The former was found in the past 30 years in Transylvania only in one single place, in a wetland from the Mureş River Basin, from where it disappeared soon after its sampling (A. Sárkány-Kiss, in. verbis). In the Olt Basin we have found a few living individuals on stems of *Phragmites australis*, in some pools located in the vicinity of the Cibin River, upstream Sibiu, and in the Şopa fish-ponds (found by M. Petrescu). It is probable that it will also disappear from the first mentioned point because the draining works started by the local municipality.

All the changes in the molluskfauna, displayed until now, have occurred in the last 150 years (most likely in the last 20 years), and are due to enforced industrialisation, hydrotechnical works, pollution and drainage of the former wetlands in order to gain more agricultural land. The most affected was the course of the River Olt and its flood area (which has almost totally disappeared), and the same can be

said about the Râul Negru, Cibin and Bârsa tributaries. In the Olt riverbed, between Bălan and Călineşti, there are no living prosobranchs anymore, and (in the upper and middle course) only one, possibly two, short sectors with Unionidae. The dominant character of the course is given by some few euriecic species of pulmonate gastropods. One of them, *Physa acuta* Draparnaud, 1805, has appeared in this century and has invaded the whole Transylvania. This species had had a former Mediterranean - western - European range and is in full process of natural expansion, like it happened with other Mediterranean species in this century. It has well adapted to local conditions, being very resistant to pollution and degraded water conditions. When the water and the sediments become very rich in organic matter, and the decaying process is very intense, the species still lives in the vicinity of the riverbanks, being adapted to an amphibious life, and it can become the single living aquatic gastropod in such habitats, or, sometimes, it can live together with *Radix auricularia* and *Galba truncatula* (as it happens on some polluted sectors from the Olt and Someş rivers). *Physa acuta* has probably travelled along the river, against the water-flow and has reached Sfântu Gheorghe, in the upper sector of this river.

The Olt River, in the upper course, after it passes through Bălan, is strongly polluted because of the mining residual waters which are discharged in this sector; therefore no living freshwater mollusk species have been found in the riverbed. In the Tuşnad Gorge the flowing water is capable of natural self-cleaning, so that the quality improves and some species, like *Gyraulus albus* and *Hippeutis complanatus* appear. This situation lasts until upstream Sfântu Gheorghe, where we found *Ancylus fluviatilis* in the course of the river, proving a good quality of the water and the presence of relatively high levels of dissolved oxygen. The physical and chemical characteristics of the water deteriorate after it passes through Sfântu Gheorghe town, because of the housework and industrial residual waters that are discharged into the river. At this level *Ancylus fluviatilis* disappears from the whole rest of the river's upper course. The situation improves just in the second half of the Făgăraş Depression. In this zone a series of dam-lakes were build, and its course was embanked by concrete dykes. Although in the main course only few euriecic pulmonate gastropods live, in the lateral channels several more exacting species can be found, like: *Aplexa hypnorum* Linnaeus, 1758, *Gyraulus laevis* Alder, 1838, *Segmentina nitida* (O. F. Müller, 1774) and *Sphaerium lacustris* (O.F. Müller, 1774). There is information that in the dam-lake from Avrig there are living Unionidae, which can be seen when the water level is low (Ciprian Fântână, in. verbis), but we did not find any individuals during the 1998 expedition. Again, the ecological state of the river is strongly affected downstream the confluence with the Cibin River. At the entrance in the Turnu Roşu Defile, only *Physa acuta* has been recorded in the riverbed. In the same place A.E. Bielz (1867) has found in the riverbed two of the prosobranchs species, namely *Theodoxus transversalis* and *Lithoglyphus naticoides*, which are to be considered from now one as extinct or probably disappeared species from this basin. In the defile the course is seriously affected by hydrotechnical works, ballast excavations, to which the residual housework waters discharged by the villages placed along the course have to be added. At the entrance of the dam-lake located downstream Călineşti (the last sampling point selected in the middle course of the Olt River - **Q13**) the substratum consists mainly of fine sand and silt, or even, at the banks, of thick layers of mud. In the riverbed and banks only *Physa acuta, Radix auricularia* and *Galba truncatula* have been found, indicating a bad quality of the water parameters and a storage of organic matter.

In the Olt River Valley some wetlands exist (dead branches, marshes) where the habitat conditions were not tainted and where some traces from the past biodiversity can still be found. Such kind of natural patches are: wetlands from the birch forest from Reci and the dead branches from Sântionlunca (Râul Negru Basin), dead-branches from Arini, Aita Mare, Micloşoara, Augustin and Turnu Roşu, the marshes from Hărman and Prejmer, and others. In such patches several species have found a certain refuge, among them *Acroloxus lacustris* (Linnaeus, 1758), *Anisus spirorbis* (Linnaeus, 1758), *A. vorticulus* Troschel, 1852, *Bathyomphalus contortus* Linnaeus, 1758, *Pisidium subtruncatum* Malm, 1855, *Sphaerium corneum* (Linnaeus, 1758) and other (see **Tab. 1**). A few of them (like the marshes from Hărman - Prejmer, and Reci area) are protected natural areas, but their protection is done only on the paper. There are no marking signs, no shields and nobody takes any measures in order to keep their natural heritage. It is very important, for the future, to protect these wetlands in an efficient way and to gather the main wetlands in larger protected areas.

In the year of 1994 the upper half of the Olt River course from the Făgăraş Depression and the Cibin River downstream Sibiu were classified as D - degraded sectors (In: The Strategy for Environmental Protection, 1996). It is obvious that in the lower half of the Făgăraş Depression the situation is improved, but we have to say that this improvement is not due to environmental rehabilitation measures and to awareness of ecological policy, but to the closing or the reducing of the activity of some polluting industries from this area. Thus the better ecological state is linked to the economical problems that Romania faces in these years and because of this, it is not an acceptable guarantee for the future.

CONCLUSIONS

The reasons for the high biodiversity of the freshwater molluskfauna from the researched area are the very various and heterogeneous habitats existing in this hydrographic basin. The Olt River, itself, remains one of the most polluted and degraded rivers in Transylvania. The present-day status of the freshwater and paludal mollusk fauna proves the great changes which have occurred in the last decades, regarding the specific habitats and the quality of the freshwaters, in comparison with the situation registered by the malacologists from the 19th century. It is definite that the pollution and the hydrotechnical works, which occurred in the past 20 years, determine this changes. The aquatic mollusks have responded to environmental changes in several manners: the disappearance of some less tolerant species, the fragmentation of their former range, so that many of them have today a patched distribution, the prevailing of the euriecic basommatophoran pulmonate snails in correlation with the debasement of the prosobranch snails and most of the najades populations. The improvement of the life conditions from the lotic ecosystems is less probable in the very future, but it could be a good opportunity to save the main wetlands from the basin by enclosing them in a larger protected area, and to apply an efficient environmental management system, including an integrated long-time biomonitoring. The river valley in the Tuşnad Gorge, the sector between Hărman and Augustin and the lower half of the Făgăraş Depression should be declared as protected wetland areas.

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ASPECTS OF THE TERRESTRIAL MALACOFAUNA FROM THE UPPER AND MIDDLE REGION OF THE OLT RIVER VALLEY

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RÉSUMÉ

38 espèces de gastropodes terrestres ont été trouvées, parmi lasquelles 15 ont été mentionnées pour la première fois dans la région. 27 espèces citees le siècle dernier dans les travaux de Bielz (1869) et Kimakovicz (1890), n'ont pas été retrouveès.

On souligne l'importance de la Réservation Sancraieni qui abrite un e riche malacofaune, terrestre et qui est aussi un dépôt important de fossiles. C'est la seule station ou nous avons trouve l'espèce *Vertigo moulinsiana*, connue depuis le Quaternaire. En général le numéro le plus bas d'espèces et les valeurs minimes de l'abondance ont été enregistrées dans les biotopes ou l'impact anthropique est évident. Le facteur le plus important dans l'édification des associations de gastropodes terrestres dans cette étude est l'humidité, que n'est pas influencè ni par l'association végétale ni par l'altitude.

Keywords: malacofauna, Gastropoda, Olt River Valley

INTRODUCTION

The Transylvanian Society of Natural Sciences was founded in Sibiu at the middle of the last century. Among its outstanding members are to be mentioned E.A. Bielz and M. von Kimakowicz whose works about Transylvanian malacofauna were published in the journal of the society. Later on appeared their monographs of Transylvanian mollusks (Bielz 1867 and Kimakowicz 1890), which constitute even nowadays an important source of information on which basis it is possible to make comparisons with the actual state of the malacofauna.

The aim of this paper is to show the present situation of the terrestrial malacofauna of the upper and middle part of the Olt River Valley and to make a parallel between the actual dates and those of Bielz and Kimakowicz.

MATERIALS AND METHODS

Samples were taken from 13 stations (**Q1-Q13**) of the upper and middle part of the Olt River Valley. From all this stations were taken qualitative and quantitative samples (quadrates of 25x25x10cm) excepting station **Q12** from where there were taken only qualitative samples. The samples were selected and identified in laboratory (excepting the representants of Limacide and Arionide families), and the results were grouped in **Table 1**. The last two columns of the table represent the quotation of the species in the works of the authors mentioned above without taking into account the places where they were found. With +* were marked the stations where we found only empty shells of respective species; column **O**, represent the sum of the species found in all the stations, and the last two columns represent the quotation of the species in the papers of Bielz (B) and Kimakowicz (K) without mentioning the localities where they were found. Quantitative samples were used for the estimation of density, relative abundance and frequency.

RESULTS AND DISCUSSION

After the analysis of the samples, 38 species of terrestrial gastropods were identified, from 14 families (**Tab.1**); 15 - species were not quoted before in the Olt River Valley. We mention: *Carychium tridentatum* found in 5 stations, *Vallonia costata* in 7 stations, *Truncatellina cylindrica, Chondrula tridens albolimbata, Macrogastra plicatulla, Punctum pygmaeum, Vertigo moulinsiana.* The last one - a species known since Quaternary, a declining species today, appears in few regions in Europe, especially as a fossil. In Romania, Grossu mentioned its presence in some exemplars, in Cheile Turzii (Grossu, 1986). But Bába and Sárkány (1998) did not refound any exemplar. We found this species in the station **Q2** – Sâncrăieni Reservation. We did not found a number of 27 species of terrestrial gastropods quoted by Bielz and Kimakowicz in the Olt River Valley. We mention: *Vertigo antivertigo, Vertigo pygmaea Granaria frumentum, Chondrina avenacea, Sphyradium doliolum, Alopia bogatensis, Alopia bielzi madensis, Macedonica marginata, Cochlodina marisi, Vestia elata, Vestia turgida, Mascrogastra latestriata, Laciniaria plicata, Balea falax Bulgarica cana, Helicigona banatica, Arianta arbustorum, Helix lutescens.* Many of these species belong to fam. *Clausilidae*, being species characteristic for forest biotopes where we did not take samples. For this reason, and due to the fact that these results were obtained during a single campaign in October 1998, we can not affirm that these species are not present there.

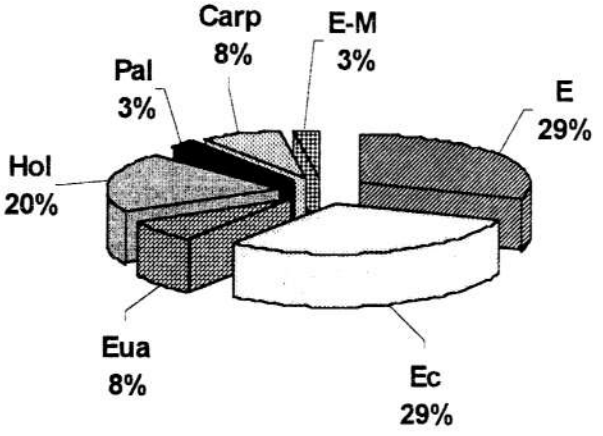

Fig.1. *The zoogeographic elements: E-European, Ec- Central- European, Eua-Eurasiatic, Hol-Holarctic, Pal-Palearctic, Carp-Carpathian, E-M –European-Mediterranean*

Most of the found species are European (29%), and Central-European (29%) followed by Holarctic species (20%) and Carpathian species (8%). Among the endemic Carpathian species we mention: *Oxichylus depressus, Monachoides vicina and Campylaea faustina* (**Fig.1**).

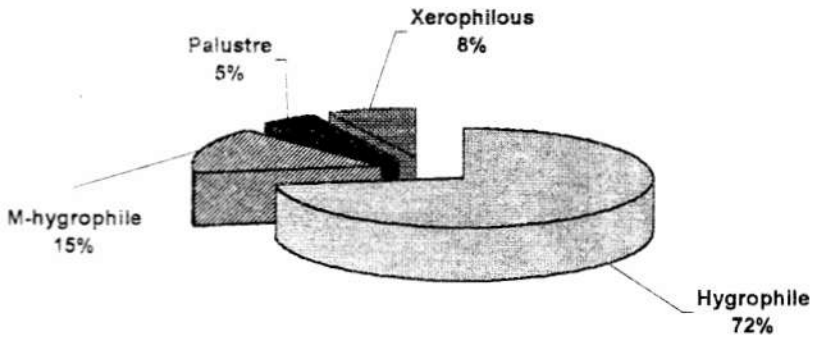

Fig. 2 *The bioforms spectrum of terrestrial gastropods from upper and middle Olt River Valley.*

The bioforms spectrum highlight the predominance of the hygrophilous forms (73%) followed by mezohygrophilous species (15%), but there are xerophilous species too, especially on the middle region of the river (**Fig. 2**)

From the point of view of the number of species per station (**Fig.3**), we can observe that the maximal value was recorded in station **Q2** Sâncrăieni, where it was found also the maximal abundance (1936 ind./m^2). The most important species in these station are (in order of the relative abundance), *Carychium tridentatum, Cochlicopa lubrica, Vertigo angustior, Punctum pygmaeum.*

Generally, we found 10-13 species per station, except stations **Q4** –upstream Sf. Gheorghe, **Q7** – Comăna and **Q12** – downstream Boița where these values are lower. The minimal values of abundance were recorded in stations **Q4, Q8**, and **Q13**. There are stations where the anthropic impact is extremely evident, the biotope being strongly modified.

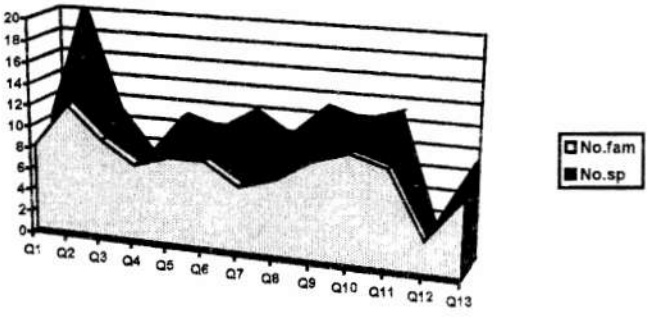

Fig. 3. *The number of species and of families of terrestrial gastropods from the studied stations.*

As it is evident, the low value of the species number in Comăna de Jos station is not reflected in the abundance. It is the matter of hygrophilous species that were collected after the only rain during our expedition. On the other hand, the high density in this station, as well as in station **Q6** Augustin, is generally due to empty shells (**Fig.5**). In this two stations was found the highest. percentage of empty shells.

Regarding the abundance of terrestrial gastropods it was generally recorded (after the exclusion of station **Q2**), an average value easily increased in the middle part comparative with the superior one. This tendency is more emphasized in the case of empty shells.

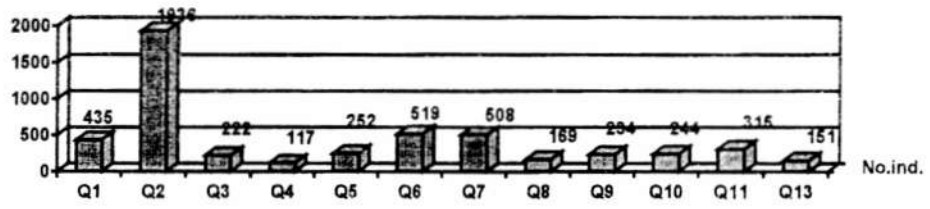

Fig. 4 *The abundance of terrestrial gastropods in the stations from the upper and middle Olt River Valley.*

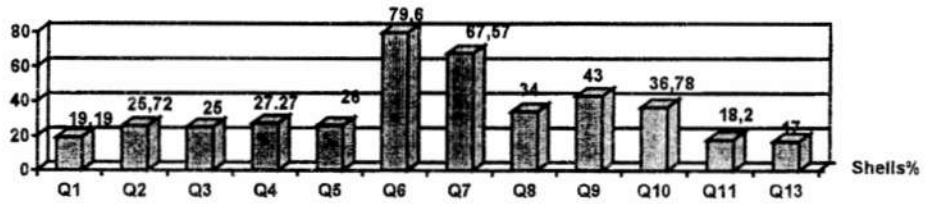

Fig.5. *The percentage of empty shells in the stations from the upper and middle Olt River Valley.*

Associations of terrestrial gastropods.

Nowadays there is a tendency to find a correlation between the vegetal association and that of gastropods. But land snails are fairly generalist feeders. Cain (1977) suggested that the constituents of the same fauna might feed themselves in different places, on the ground and in vegetation. Our samples are taken from 7 types of vegetal associations as follows: *Urticetum dioicae* – **Q1, Q6, Q7, Q10** ; *Rubo-salicetum* – **Q4, Q5, Q9, Q11**; *Salicetum cinereae* – **Q2**; *Querco-carpinetum*– **Q3**; *Rubo-urticetum dioicae* facies with *Senecio fluviatilis* – **Q8**; *Aegopodio-alnetum glutinosae* – **Q13**; Plantation of *Pinus silvestris* - **Q12**.

Fig.6 represents the relative abundance of the principal terrestrial gastropods per station. As it is evident, we cannot sustain the existence of a correlation between the vegetal association type and the association of terrestrial gastropod. This fact is illustrated also in **Fig.7**, the representation of tree diagram resulting from Sørensen similarity matrix. As we can see the nearest stations in the species structure –**Q7** and **Q13**–belong to different vegetal associations *Urticetim dioicae* and *Aegopodio-alnetum glutinosae.*

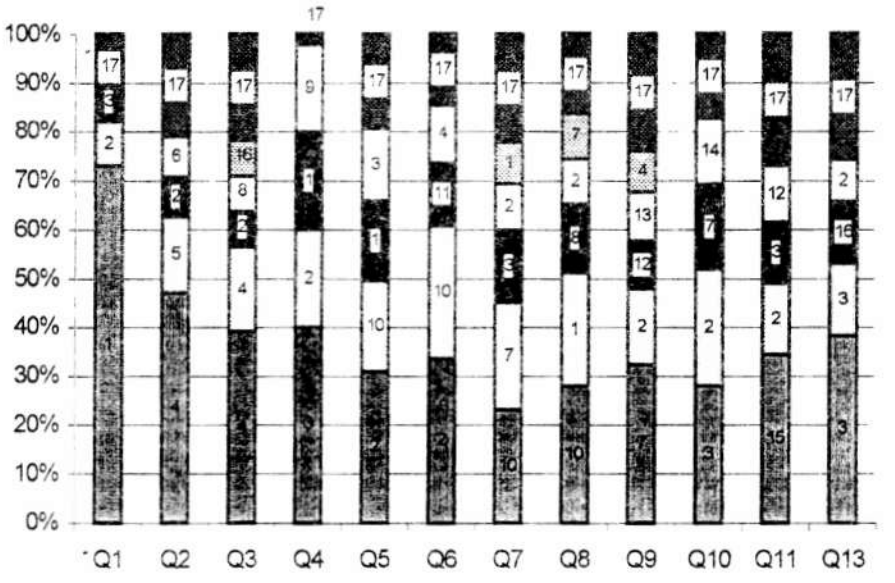

Fig.6. ***The relative abundance of the principal terrestrial gastropods per stations.*** *1.Bradybaena fruticum, 2.Cochlicopa lubricella, 3. Succinea putris, 4. Carychium tridentatum, 5. Vertigo angustior, 6 Punctum pygmaeum, 7.Zonitoides nitidus, 8.Vitrea crystalina, 9.Helix pomatia, 10.Vallonia pulchella, 11.Zenobiella rubiginosa, 12.Vallonia costata, 13.Vitrea contracta, 14.Vitrina pellucida, 15.Truncatellina cylindrica, 16.Perforatella bidentata, 17. other species.]*

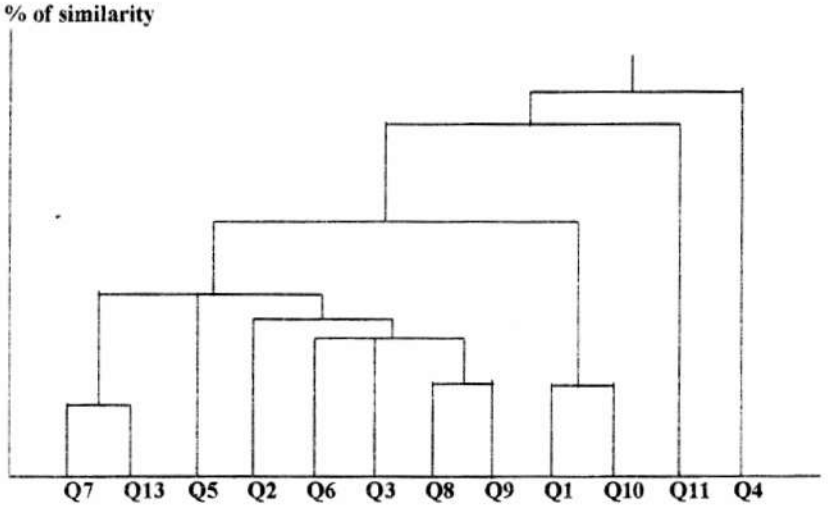

Fig.7. *Tree diagramm resulted from Sørensen similarity matrix*

CONCLUSIONS

The upper and middle basin of the Olt River still shelters a rich malacofauna. Some species are recorded for the first time (15) but much more numerous are those which were mentioned last century and not found now (27). We cannot affirm that

these have disappeared in the Olt basin. To be able to make any affirmation regarding this problem we have to continue our research.

We point out the importance of Sâncrăieni Reservation, which is extremely rich in terrestrial gastropods and constitute in the same time an important accumulation of fossils. Here was found *Vertigo moulisiana*, a relict from Quaternary.

In general, the lower number of species and the decreased values of abundance are recorded in biotopes where the anthropic impact is high. The increasing of the percentage of empty shells and the presence of xerophylous species in the middle part of the Olt River could be an index of the biotope deterioration in this region.

Regarding to the terrestrial gastropods associations we mentioned that we have not found a correlation between these and the vegetal association type. In the establishment of the terrestrial gastropods associations are involved a series of factors. One of them, the vegetation, plays a very important role, but a minor modification in vegetation, in the conditions of the same type of the habitat, is not followed by the modification of gastropods associations. The most important factor in the conditions of this study is humidity, most of the species being hygrophilous. The predominance of this factor is not affected by altitude, because we have found no correlation between the species association from the stations in both studied sectors.

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CONTRIBUTION TO THE KNOWLEDGE OF THE CADDIS FLIES (INSECTA: TRICHOPTERA) FAUNA OF THE OLT RIVER BASIN

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REZUMAT

Din bazinul superior şi mijlociu al râului Olt au fost identificate în total 118 specii de trichoptere, din care 44 specii sunt noi pentru acest bazin hidrografic. Analiza calitativă şi cantitativă a materialului colectat (16.507 exemplare, din care 16.443 adulţi şi 64 larve) arată existenţa, în regiunea cercetată, a unor comunităţi extrem de bogate de trichoptere. Au fost cercetate 4 tipuri de ape curgătoare: izvoare între 800-1500m altitudine, pâraie de munte între 800-950m altitudine, pâraie din depresiunile intramontane şi de câmpie între 380-800m altitudine şi râurile Olt şi Cibin. Din perspectiva faunei de trichoptere cele mai bogate ecosisteme acvatice se dovedesc pâraiele de munte între 800-950m altitudine, cu 83 specii de trichoptere, urmate de pâraiele de la altitudini mai joase cu 67 specii de trichoptere şi izvoarele cu pâraiele lor stenoterme, reci (43 specii). Din râul Olt au fost identificate un număr redus de specii (28), arătând un grad ridicat de poluare a apei în tot sectorul cercetat, chiar aproape de izvoare, lângă oraşul Bălan, efectul poluanţilor accentuându-se spre sectorul mijlociu până la Călineşti.

INTRODUCTION

The upper and middle sector of the Olt River catchment area is regarded as well known with respect of the Trichoptera fauna. The works of Botoşăneanu (1957, 1961, 1965, 1966, 1975), Botoşăneanu and Schneider (1978), Botoşăneanu and Tăbăcaru (1963), Ciubuc (1993), Mey (1978), Mocsáryi (1900), Murgoci (1953), Pongrácz (1914), Ujvárosi (1994), Ujvárosi, Nógradi and Uherkovich (1995) contains more comprehensive lists of species. A number of 127 species of caddis fly are known in this region, which represent 47,56% of the Trichoptera fauna of Romania.

The ecological relations between the caddis flies of the River Olt catchment area are poorly known, only a single paper of Murgoci (1951) treated the distribution of trichoptera larvae in the River Olt, at Jigodin, Ciuc Depression.

In the present paper the authors aim was to determine the species composition of the caddis fly fauna of the upper and middle Olt River Basin, and to analyse their distribution in the different types of running waters (springs, streamlets and brooks, river) present in the researched area.

MATERIALS AND METHODS

Caddis flies (adults and larvae) were collected in the years 1993-1998, from 41 stations, distributed more or less uniformly in the upper and middle sector of the Olt River Basin.

In **Fig.1** one can see the collecting sites in the upper and middle sector of the Olt River Basin.

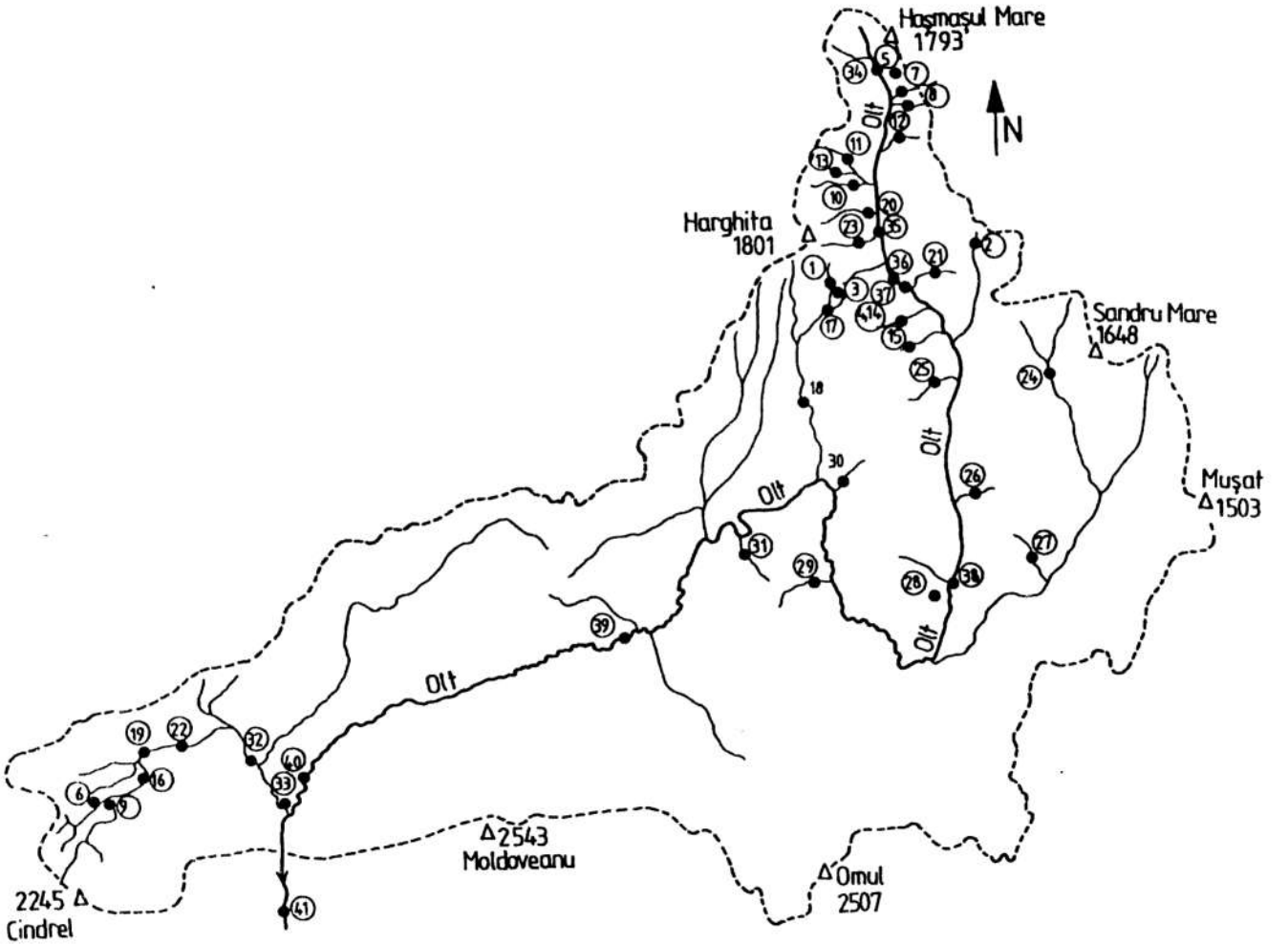
The samples were collected in May-October period. The adult caddis flies were

caught with daytime sweepings from the vegetation in several points; parallely it was used the night collecting ("lighting"), too, which was more fruitful. We used mercury vapour bulbs (160 or 250 W). These lamps were powered by a portable generating set (Honda EM 650 type).The light trap, fitted by a 80 W mercury vapour bulb, was erected nearby the forester's house, along the Valea Mare brook, in the Harghita Mountains and along the Agriş brook, in the Ciuc Depression.

The larvae were caught with a Surber- sampler from an area of about 887 cm^2. The collected material was preserved in alcohol 70-80%. Altogether 16.507 specimens of 118 species were collected and identified.

The sampling sites are located exclusively along the tributaries of the Olt River and nearby the main watercourse. On the map (**Fig. 1**) the sampling sites are marked according to the list presented below:

1. (Q1-Q2/1) springs and streamlets nearby Harghita Băi at 1000-1500m.
2. (Q2-Q3/1) spring at 1050m, Potyond.
3. (Q1-Q2/5) spring at 900m, Piricica.
4. (Q2/1) springs and small tributaries of Valea Mare brook at 800m
5. (upstream Q1/2) Fierarului stream at 950m, Bălan.
6. (R3/1) Râul Mic brook at 950m.
7. (upstream Ql/1) Gal Cut brook at 900m, Bălan.
8. (upstream Q1/3) Sep stream at 900m, Bălan.
9. (R1) Râul Mare brook at the confluence of Dăneasa brook at 900m.
10. (Q1-Q2/6) Groapa Apei stream at 850m, Dăneşti.
11. (Q1-Q2/7) Modicia stream at 850m, Cârţa.
12. (Q1/1) Babos Loco stream at 800m, Sândominic.
13. (Q1-Q2/3) Koves stream at 800m, Cârţa.
14. (Q2/1) Valea Mare stream at 800m, Sâncrăieni.
15. (Q2-Q3/4) streamlets nearby Sântimbru at 800m.
16. (R2) Râul Mare brook in the Cibin Gorge at 800m
17. (Q6/1) Chirui brook at 780m, Băile Chirui.
18. (Q6/2) Vârghiş brook in the Vârghiş Gorge at 750m.
19. (R3/3) Cibin brook at the confluence with Râul Mare and Râul Mic at 750m.
20. (Q1-Q2/4) Silaş brook at 700m, Racu.
21. (Q1-Q2/8) Fitod brook at 700m, Fitod.
22. (R4) Cibin brook, downstream Gura Râului dam at 700m.
23. (Q1-Q2/2) Agriş brook at 690m, Ciaracio.
24. (Q2-Q3/2) Caşin brook at 650m, Iacobeni.
25. (Q2-Q3/3) Mitaci brook at 650m, Tuşnad Sat.
26. (Q4/2) Saldoboş brook at 650m, Malnaş Băi.
27. (Q3-Q4/1) streamlets and ponds at 610m, Dalnic.
28. (Q4/1) streamlets at 600m, Băile Şugaş.
29. (T6/1) Măieruş brook at 520m.
30. (Q5/1) Chepeţ stream at 500m, Căpeni.
31. (T6/2) Bogata brook at 470m.
32. (R8) Cibin River downstream Mohu at 390m.
33. (R9) Cibin River downstream Tălmaciu at 380m.
34. (upstream Q1)the River Olt at 900m, Bălan.
35. (Q1-Q2) the River Olt at 670m, Ciceu.
36. (Q1-Q2) the River Olt at 660m, Miercurea Ciuc.


Hasmaşul Mare
1793
Harghita
1801
Sandru Mare
1648
Muşat
1503
Olt
N
Δ2543
Moldoveanu
Δ Omul
2507
2245 Δ
Cindrel

37. (Q1-Q2) the River Olt at 650m, Jigodin.
38. (Q4) the River Olt at 550m, Sfântu Gheorghe.
39. (Q8) the River Olt at 450m, Mândra.
40. (Q11) the River Olt at 380m, Avrig.
41. (Q13) the River Olt at 350m, Călinești.

In accordance with Czachorowski (1988), the following classes were differentiated for estimating the structure of dominance: eudominants (species whose number exceeded 10%), dominants (5,1-10%), subdominants (2,1-5%) and recedents (below 2%).

Frequency at the stations (Fs) was calculated according to the formula:

$$Fs=\frac{S_i}{S_n}*100\%$$

where:

Si- the number of stations where the given species was found

Sn-the number of all stations (41)

Frequency in the samples (Fp) was calculated according to the formula:

$$Fp=\frac{p_i}{p_n}*100\%$$

where:

pi-the number of samples in which the species was found

. pn-the number of all samples in which Trichoptera were found (113)

RESULTS AND DISCUSSION

In the upper and middle catchment area of the Olt River were identified 118 species of Trichoptera (**Table 1.**).

Tab. 1. ***Characteristics of caddis flies of the upper and middle Olt River Basin.***
*N-number of specimens, **D**-percentage dominancy, **A**-adult, **L**-larvae, **Fs**-frequency at the stations in percentage, **Fp**-frequency in the samples in percentage, **Zoog**.-zoogeographical elements: **H**-Holarctic, **P**-Palearctic, **E**-European, **Bor**-Boreal, **M**-Mediterranean, **B**-Balkanic, **BC**-Balkano-Carpathic, **CE**-Central European, **End**-Endemic species for the Carpathic range.*

Taxa	N	Zoog	D	Fs	Fp
Rhyacophilidae	991				
1. *Rhyacophila aquitanica* McLACHLAN, 1879 A	2	CE	0,02	2,43	0,88
2. *R. doehleri* BOTOŞĂNEANU, 1907 A	1	CE	0,01	2,23	0,88
3. *R. fasciata* HAGEN, 1859 A	298	E	2,92	19,51	34,51
4. *R. hirticornis* McLACHLAN, 1879 L	2	CE	0,02	2,43	0,88
5. *R. laevis* PICTET, 1834 A	1	CE	0,01	2,43	0,88
6. *R. mocsaryi* KLAPALEK, 1898	166	BC	1,62	9,75	21,23
7. *R. nubila* ZETTERSTEDT, 1840 A	203	E	1,99	24,31	38,93
8. *R. obliterata* McLACHLAN, 1840 A	88	P	0,86	4,87	2,65
9. *R. philopotamoides* SCHMID, 1970 A	5	CE	0,05	9,75	3,53
10.*R. polonica* McLACHLAN, 1879 A	128	CE	1,25	24,39	26,54
11.*R.torrentium* PICTET, 1834, A	1	BC	0,01	2,43	0,88
12.*R.tristis* PICTET, 1835 A, L	96	CE	0,94	31,70	15,92

Taxa	N	Zoog	D	Fs	Fp
Glossosomatidae	2969				
13.*Glossosoma boltoni* CURTIS, 1834 A	49	E	0,48	12,19	12,38
14.*G. conformis* NEBOISS, 1963 A	424	CE	4,15	4,87	31,85
15.*G. discophorum* KLAPALEK, 1902 A	50	B	0,49	2,43	14,81
16.*G. intermedium* KLAPALEK, 1892 A	5	H	0,05	4,87	2,65
17.*Synagapetus armatus* McLACHLAN, 1879 A	6	BC	0,06	2,43	0,88
18.*S. mosely* ULMER, 1938 A	3	CE	0,03	7,31	2,65
19.*Agapetus delicatulus* McLACHLAN, 1884 A	3	CE	0,03	14,63	37,16
20.*A. ochripes* CURTIS, 1834 A	1203	E	11,8	12,19	33,32
Hydroptilidae	161				
21.*Ortotrichia costalis* CURTIS, 1834 L	4	P	0,04	4,87	2,65
22.*Hydroptila angustata* MOSELY, 1939 A	2	M	0,02	4,87	1,75
23.*H. forcipata* EATON, 1873 A	115	P	1,13	9,75	8,84
24.*H. lotensis* MOSELY, 1930 A	7	P	0,07	7,31	4,42
25.*H. occulta* EATON, 1873 A	1	P	0,01	2,43	0,88
26.*Agraylea sexmaculata* CURTIS, 1834	10	P	0,10	4,87	4,42
27.*Ithyrtichia lamellaris* EATON, 1873 A	22	P	0,21	2,43	0,88
Philopotamidae	866				
28.*Philopotamus montanus* DONOVAN, 1813 A	310	E	3,03	19,51	29,20
29.*P. variegatus* SCOPOLI, 1763 A	461	P	4,52	12,19	23,89
30.*Wormaldia occipitalis* PICTET, 1834 A	95	CE	0,93	7,31	4,42
Hydropsychidae	3526				
31.*Hydropsyche angustipennis* CURTIS, 1834 A	27	E	0,26	4,87	3,53
32.*H. bulbifera* McLACHLAN, 1878 A	108	P	1,06	12,19	12,38
33.*H. contubernalis* McLACHLAN, 1865 A, L	113	P	1,10	29,26	6,19
34.*H. instabilis* CURTIS, 1834 A	513	E	5,1	29,26	38,05
35.*H. modesta* NAVAS, 1925 A, L	4	M	0,04	4,87	1,75
36.*H.pellucidula* CURTIS, 1824 A	200	P	1,96	26,82	25,66
37.*H. saxonica* McLACHLAN, 1884 A, L	58	CE	0,57	12,19	16,81
38.*H. siltalai* DOEHLER, 1963 L	2	E	0,02	7,31	2,65
39.*Hydropsyche sp.* A	2456		2,09	31,70	31,85
40.*H. tabacarui* BOTOŞĂNEANU, 1960 A	20	B	0,2	4,87	3,53
41.*Cheumatopsyche lepida* PICTET, 1834 A, L	27	P	0,26	26,82	13,27
Polycentropodidae	63				
42.*Plectrocnemia brevis* McLACHLAN, 1871 A	6	CE	0,06	9,75	3,53
43.*P. conspersa* CURTIS, 1834 A	36	E	0,35	17,07	2,23
44.*Polycentropus flavomaculatus* PICTET, 1834 A	17	E	0,16	9,75	7,96
45.*P. irroratus* CURTIS, 1835 A	2	E	0,02	4,87	1,76
46.*Cyrnus crenaticornis* KOLENATI, 1858 A	1	E	0,01	2,43	0,88
47.*C. trimaculatus* CURTIS, 1834 A	1	P	0,01	2,43	0,88
Psychomyidae	92				
48.*Psychomyia pusilla* FABRICIUS, 1781 A	55	P	0,53	17,08	15,04
49.*Lype phaeopa* STEPHENS, 1836 A	2	P	0,02	2,43	1,76
50.*L.reducta* STEPHENS, 1836 A	21	E	0,20	14,63	13,27
51.*Tinodes rostocki* McLACHLAN, 1878 A	14	E	0,14	12,19	4,42
Phryganeidae	18				
52.*Agrypnia varia* FABRICIUS, 1793 A	16	P	0,15	7,31	7,07
53.*Oligotricha striata* LINNAEUS, 1758 A	2	E	0,02	2,43	0,88
Brachicentridae.	1				
54.*Micrasema minimum* McLACHLAN, 1876 L	1	E	0,01	2,43	0,88
Limnephilidae	2031				
55.*Ironoquia dubia* STEPHENS, 1834 A	2	E	0,02	2,43	0,878
56.*Apatania carpathica* SCHMID, 1954 A	442	End	4,33	7,31	5,30

Taxa	N	Zoog	D	Fs	Fp
57.*Drusus brunneus* KLAPALEK, 1898 A	83	End	0,81	12,19	0,88
58.*Drusus discolor* RAMBUR, 1842 A	1	E	0,01	2,43	0,88
59.*Ecclysopteryx dalecarlica* KOLENATI, 1848 A	20	E	0,20	7,31	3,53
60.*E. madida* McLACHLAN, 1867 A	403	CE	3,95	14,63	16,81
61.*Limephilus affinis* CURTIS, 1834 A	3	P	0,03	4,87	1,76
62.*L. auricula* CURTIS, 1834 A	3	P	0,03	7,31	2,65
63.*L. bipunctatus* CURTIS, 1834 A	1	P	0,01	2,43	0,88
64.*L. coenosus* CURTIS, 1834 A	1	P	0,01	4,87	1,77
65.*L. decipiens* KOLENATI, 1848 A	17	P	0,08	7,31	3,53
66.*L..extricatus* McLACHLAN, 1865 A	61	E	0,59	21,95	2,23
67.*L. griseus* LINNAEUS, 1759 A	13	P	0,13	4,87	4,42
68.*L. hirsutus* PICTET, 1834 A	5	E	0,05	9,75	3,53
69. *L. ignavus* McLACHLAN, 1865 A	5	E	0,05	4,87	2,65
70.*L. lunatus* CURTIS, 1834 A	13	P	0,13	7,31	3,53
71.*L. rhombicus* LINNAEUS, 1758 A	5	H	0,05	4,87	1,76
72.*L. sparsus* CURTIS, 1834 A	64	P	0,62	7,31	7,96
73.*L. stigma* CURTIS, 1834 A	3	H	0,02	4,87	1,76
74.*L. vittatus* FABRICIUS, 1798 A	2	P	0,01	2,43	1,76
75.*Colpotailius incisus* CURTIS, 1834 A	7	H	0,07	7,31	4,42
76.*Grammotaulius nigropunctatus* RETZIUS, 1783 A	1	P	0,01	2,43	0,88
77.*Anabolia concentrica* ZETTERSTEDT, 1840 A	2	Bor	0,02	2,43	1,76
78.*A. furcata* BRAUER, 1857 A	64	CE	0,62	7,31	4,42
79.*Phacopteryx brevipennis* CURTIS, 1834 A	11	P	0,10	9,75	4,42
80.*Potamophylax cingulatus* STEPHENS, 1834 A	70	E	0,70	2,43	6,19
81.*P. jungi* MEY, 1976 A	7	End	0,07	7,31	2,65
82.*P. latipennis* CURTIS, 1834 A	115	P	1,13	21,95	15,92
83.*P. luctuosus* PILL. & MITT., 1793	521	P	5,10	4,87	20,35
84.*P. nigricornis* PICTET, 1834 A	16	E	0,15	9,75	7,96
85.*P. rotundipennis* BRAUER, 1875 A	2	CE	0,02	2,43	1,75
86.*Halesus digitatus* SCHRANK, 1781 A	71	P	0,70	2,43	1,75
87.*H. tesselatus* RAMBUR, 1842 A	2	P	0,02	4,87	1,75
88.*H. radiatus* CURTIS, 1834 L	1	E	0,01	2,43	0,88
89.*Micropterna lateralis* STEPHENS, 1837 A	2	CE	0,02	4,87	2,65
90.*Stenophylax meridiorientalis* MALICKY, 1980 A	1	P	0,01	2,43	0,88
91.*S. sequax* McLACHLAN, 1875 A	1	P	0,01	2,43	1,75
92.*S. permistus* McLACHLAN, 1895 A	1	P	0,01	2,43	0,88
93.*Parachiona picicornis* PICTET, 1834 A	1	CE	0,01	2,43	0,88
94.*Chaetopteryx biloba* BOTOŞĂNEANU, 1960 A	3	End	0,03	2,43	0,88
95.*C. bosniaca cyssilvanica* BOTOŞĂNEANU,1960 A	5	End	0,05	4,87	1,7
96.*C. sahlbergi* McLACHLAN, 1876 A	1	Bor	0,01	2,43	0,88
97.*Annitella lateroproducta* BOTOŞĂNEANU,1952 A	84	End	0,82	2,43	1,75
98.*A. obscurata* McLACHLAND, 1870 A	243	E	2,38	2,43	1,75
Goeridae	421				
99.*Goera pilosa* FABRICIUS, 1775 A	2	E	0,02	4,87	1,75
100.*Lithax niger* HAGEN, 1859 L	1	CE	0,01	2,43	0,88
101.*L. obscurus* HAGEN, 1859 A	5	CE	0,05	4,87	1,75
102. *Silo graellsi* E. PICTET, 1865 A	392	E	3,84	2,95	32,74
103.*S. piceus* BRAUER, 1857 A	21	E	0,20	7,31	6,19
Lepidostomatidae	77				
104.*Lepidostoma hirtum* FABRICIUS, 1781 A,L	77	P	0,75	10,07	14,15
Leptoceridae	151				
105.*Athripsodes bilineatus* LINNAEUS, 1758 A	21	P	0,20	9,75	5,30
106.*Ceraclea dissimilis* STEPHENS, 1836 A	4	E	0,04	4,87	1,75

Taxa	N	Zoog	D	Fs	Fp
107.*Mystacides nigra* LINNAEUS, 1758 A	52	P	0,50	7,31	4,42
108.*Ylodes kawraiaskii* MARTINOV, 1909 A	50	M	0,49	2,43	0,88
109.*Y. simulans* TJEDER, 1929 A	1	CE	0,01	2,43	0,88
110.*Leptocerus interruptus* FABRICIUS, 1775 A	1	P	0,01	2,43	0,88
111.*L. tineiformis* CURTIS, 1834 A	21	E	0,20	14,63	6,19
112.*Adicella filicornis* PICTET, 1834 A	2	CE	0,02	2,43	4,75
Sericostomatidae	1820				
113.*Oecismus monedula* HAGEN, 1859 A	51	P	0,50	14,63	17,69
114.*Notidobia ciliaris* LINNAEUS, 1761 L	2	E	0,02	2,43	0,88
115.*Sericostoma flavicorne* SCHNEIDER, 1845 A	1739	P	17,1	10,07	36,28
116.*S. personatum* KIRBY & SPENCE, 1862 A	28	E	0,27	9,75	11,50
Beraidae	10				
117.*Beraea pullata* CURTIS, 1834	10	P	0,10	9,75	4,42
Odontoceridae	31				
118.*Odontocerum albicorne* SCOPOLI, 1763	30	E	0,30	14,63	13,27
119.*O. hellenicum* MALICKY, 1972	1	B	0,01	2,43	0,88

With regard to the species composition, this material constitutes about 44% of the caddis fly fauna of Romania and 88% of the species recorded from the researched area. The following 44 species are new for the upper and middle sector of the Olt River Basin: *Rhyacophila doehleri, R. hirticornis, Glossosoma conformis, G. discophorum, Synagapetus armatus, S. mosely, Agapetus delicatulus, A. ochripes, Ortotrichia costalis, Hydroptila forcipata, H. lotensis, H. occulta, Agraylea sexmaculata, Hydropsyche bulbifera, H. contubernalis, H. instabilis, H. modesta, H. siltalai, H. tabacarui, Cheumatopsyche lepida, Cyrnus crenaticornis, C. trimaculatus, Lype phaeopa, Micrasema minimum, Ironoquia dubia, Limnephilus lunatus, L.stigma, Anabolia concentrica, Phacopteryx brevipennis, Potamophylax cingulatus, P.rotundipennis, Halesus tesselatus, H. radiatus, Micropterna lateralis, Chaetopteryx biloba, C. sahlbergi, Athripsodes bilineatus, Ceraclea dissimilis, Mystacides nigra, Ylodes kawraiskii, Leptocerus tineiformis, Notidobia ciliaris, Sericostoma personatum, Odontocerum albicorne.*

The presence of the following species are doubtful collected by us in the researched area: *Rhyacophila hirticornis, Ortotrichia costalis, Hydroptila siltalai, Micrasema minimum, Halesus radiatus, Lithax nige, Notidobia ciliaris.* The determination was made based only on the more or less characteristically larval morphology. Their presence in the researched area must be confirmed, in some cases, with the presence of the adult stages, too (Waringer-Graf, 1997).

The greatest species differentiation was characteristic for the families *Limnephilidae* (43 species), *Rhiacophilidae* (12 species), and *Hydropsychidae* (10 species) and a lesser one for *Glossosomatidae* (8 species), *Leptoceridae* (8 species), *Hydroptilidae* (7 species) and *Polycentropodidae* (6 species). The largest number of specimens belong to the families *Hydropsychidae*, *Glossosomatidae*, *Limnephilidae*, *Sericostomatidae* and *Rhyacophilidae*. The number of specimens varied very much, from 1 to 2456, as we can observe in the **Table 1**.

All classes of dominance were found in the collected material. The greatest effect of the number of species was represented by the class of recedents (almost 89% of all species recorded) the subdominants with 6,83% and the eudominants and dominants, together with only 4,17%. In the collected material eudominants were *Agapetus ochripes* and *Sericostoma flavicorne.* As dominants they have appeared *Hydropsyche instabilis* and *Potamophylax luctuosus.* The class of subdominants was

represented by *Rhyacophila fasciata, Glossosoma conformis, Philopotamus montanus, P. variegatus, Ecclysopteryx madida, Annitella obscurata, Silo graellsi, Apatania carpathica,* together 8 taxa. The remaining of 106 species belong to the recedent class (**Table 1**).

In the researched area the commonest taxa, with the greatest frequency in the stations were *Rhyacophila tristis, R. nubila, R. polonica, Hydropsyche contubernalis, H. instabilis, H. pellucidula, Cheumatopsyche lepida, Limnephilus extricatus, Potamophylax latipennis* and *Silo graellsi.* The most constant occurrence, with the greatest frequency in the samples, was characteristic for *Rhyacophila fasciata, R. nubila, Glossosoma conformis, Agapetus delicatulus, A. ochripes, H. instabilis, Silo graellsi* and *Sericostoma flavicorne.*

The Palearctic and European elements dominated the zoogeographical structure. Together these categories enclose 75 species. The Central-European element was represented by 21 species. A number of 7 species has a limited distribution in the Carpathian range; these species are: *Rhyacophila doehleri, Apatania carpathica, Drusus brunneus, Potamophylax jungi, Chaetopteryx biloba, Chaetopteryx bosniaca cissylvanica,* and *Annitella lateroproducta.* The rest of 15 belong to the Holarctic, Boreal, Mediterranean, Balkanic and Balkano-Carpathic elements (**Tab. 1, fig. 2**).

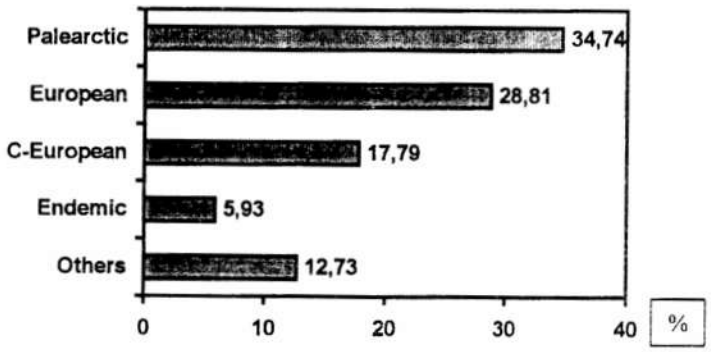


Fig. 2. *Zoogeographical structure of the caddis flies from the Olt River Basin (in species percentage)*

On the basis of the material collected in the researched area and analysed, the changes in the number of specimen and taxa of Trichoptera in different types of running water were arranged according to their range of occurrence (**Table 2**).

Tab. 2. Range of occurrence of caddis flies along different types of running water in the researched area.

*Number of individuals: ooooo 1-15; <<<<<< 5-20; ======20-50; +++++50-100; *******100-300, XXXXXXX above 300.*

*The types of habitats are codified as follows: **I** - Springs and streamlets between 800-1500m (stations 1-4), **II** - Springs between 800-950m (st. 5-16); **III** - Brooks between 380-800m (st.17-33); **IV** -Olt River between 350-900m (st.34-41)*

Species	I	II	III	IV
Rhyacophilidae				
1. Rhyacophila aquitanica		ooooooooo		
2. R. doehleri	ooooooooooo			
3. R. fasciata	=========	*********	<<<<<<<<<	
4. R. hirticornis		ooooooooo		
5. R. laevis	ooooooooooo			
6. R. mocsaryi	<<<<<<<<	*********	<<<<<<<<<	
7. R. nubila	ooooooooooo	*********	=========	oooooooo
8. R. obliterata		+++++++++		
9. R. philopotamoides	ooooooooooo	ooooooooo		
10. R. polonica	ooooooooooo	*********	<<<<<<<<<	
11. R. torrentium		ooooooooo		
12. R. tristis	ooooooooooo	+++++++++	ooooooooooo	
Glossosomatidae				
13. Glossosoma boltoni		========	ooooooooooo	oooooooo
14. G. conformis	ooooooooooo	**XXXXXX**		
15. G. discophorum		+++++++++		
16. G. intermedium		ooooooo		
17. Synagapetus armatus	<<<<<<<<<			
18. S. mosely	ooooooooooo		ooooooo	
19. Agapetus delicatulus		*********	**XXXXXXX**	
20. A. ochripes		*********	**XXXXXXX**	
Hydroptilidae				
21. Ortotrichia costalis				.....
22. Hydroptila angustata		oooooooo	oooooooo	
23. H. forcipata		oooooooo	********	
24. H. lotensis		oooooooo	<<<<<<<<	
25. H. occulta				ooooooooo
26. Agraylea sexmaculata			<<<<<<<<	oooooooo
27. Ithyrtichia lamellaris			========	
Philopotamidae				
28. Philopotamus montanus	<<<<<<<<<	*********	=========	
29. P. variegatus	ooooooooooo	**XXXXXX**	oooooooo	
30. Wormaldia occipitalis	+++++++++			ooooooo
Hydropsychidae				
31. Hydropsyche angustipennis		oooooooo	=========	
32. H. bulbifera		ooooooooo	+++++++++	=========
33. H. contubernalis		ooooooooo	+++++++++	<<<<<<<<<
34. H. instabilis	ooooooooooo	**XXXXXX**	=========	oooooooo
35. H. modesta		oooooooo		
36. H. pellucidula	ooooooooooo	<<<<<<<<	**********	<<<<<<<<<
37. H. saxonica	ooooooooooo	+++++++	oooooooo	
38. H. siltalai				oooooooo
39. Hydropsyche sp.		**XXXXXX**	**XXXXXXX**	**XXXXXXX**
40. H. tabacarui		<<<<<<<<<		
41. Cheumatopsyche lepida		<<<<<<<<<	ooooooooo	oooooooo

Species	I	II	III	IV
Polycentropodidae				
42. Plectrocnemia brevis	<<<<<<<<<			
43. P. conspersa	<<<<<<<<<	========	00000000	
44. Polycentropus flavomaculatus		<<<<<<<<	0000000	
45. P. irroratus		00000000	0000000	
46. Cyrnus crenaticornis		0000000		
47. C. trimaculatus		000000		
Psychomyidae				
48. Psychomyia pusilla	00000000000	========	=========	
49. Lype phaeopa			00000000	
50. L. reducta		00000000	<<<<<<<<<	00000000
51. Tinodes rostocki	00000000000	000000000	<<<<<<<<<	
Phryganeidae				
52. Agrypnia varia		<<<<<<<<	0000000000	0000000
53. Oligotricha striata			00000000	
Brachicentridae.				
54. Micrasema minimum		00000000		
Limnephilidae				
55. Ironoquia dubia			00000000	
56. Apatania carpathica	XXXXXXX			
57. Drusus brunneus	=========	<<<<<<<<	<<<<<<<<<	
58. Drusus discolor		00000000		
59. Ecclysopteryx dalecarlica		00000000	<<<<<<<<<	
60. E. madida	<<<<<<<<<	XXXXXX	<<<<<<<<<	
61. Limephilus affinis	00000000000	00000000		
62. L. auricula	00000000000	000000000		00000000
63. L. bipunctatus		00000000		
64. L. coenosus		00000000		
65. L. decipiens	<<<<<<<<<			00000000
66. L..extricatus		<<<<<<<<	=========	<<<<<<<<<
67. L. griseus	00000000000	<<<<<<<<		
68. L. hirsutus			0000000000	00000000
69. L. ignavus		000000000	00000000	
70. L. lunatus			<<<<<<<<<	00000000
71. L. rhombicus	000000000		0000000000	
72. L. sparsus	0000000000	<<<<<<<<	=========	
73. L. stigma	0000000000	000000000	00000000	
74. L. vittatus	0000000000			
75. Colpotailius incisus			00000000	00000000
76. Grammotaulius nigropunctatus	0000000000			
77. Anabolia concentrica		00000000		
78. A. furcata		000000000	+++++++++	
79. Phacopteryx brevipennis		000000000	000000000	00000000
80. Potamophylax cingulatus		++++++++		
81. P. jungi			<<<<<<<<<	
82. P. latipennis	+++++++++	========	+++++++++	00000000
83. P. luctuosus		XXXXXX	00000000	
84. P. nigricornis	<<<<<<<<<	000000000	00000000	
85. P. rotundipennis		00000000		
86. Halesus digitatus		++++++++		

Species	I	II	III	IV
87. H. tesselatus		00000000	00000000	
88. H. radiatus				00000000
89. Micropterna lateralis		00000000	00000000	
90. Stenophylax meridiorientalis		00000000		
91. S. sequax			00000000	
92. S. permistus		00000000		
93. Parachiona picicornis			00000000	
94. Chaetopteryx biloba	0000000000			
95. C. bosniaca cyssilvanica		000000000		00000000
96. C. sahlbergi		00000000		
97. Annitella lateroproducta		++++++++		
98. A. obscurata		*********		
Goeridae				
99. Goera pilosa			00000000	
100. Lithax niger		00000000		
101. L. obscurus			00000000	
102. Silo graellsi	=========	XXXXXX	=========	
103. S. piceus		00000000	<<<<<<<<<	
Lepidostomatidae				
104. Lepidostoma hirtum		<<<<<<<<	+++++++++	
Leptoceridae				
105. Athripsodes bilineatus		<<<<<<<<	<<<<<<<<<	00000000
106. Ceraclea dissimilis		000000000		00000000
107. Mystacides nigra		<<<<<<<<	<<<<<<<<<	
108. Ylodes kawraiaskii			=========	
109. Y. simulans		00000000		
110. Leptocerus interruptus			00000000	
111. L. tineiformis			<<<<<<<<<	00000000
112. Adicella filicornis	000000000			
Sericostomatidae				
113. Oecismus monedula	0000000000	========	<<<<<<<<<	
114. Notidobia ciliaris		000000000		
115. Sericostoma flavicorne	000000000	XXXXXX	XXXXXXX	
116. S. personatum	00000000	<<<<<<<<		<<<<<<<<<
Beraidae				
117. Beraea pullata	<<<<<<<<	00000000		
Odontoceridae				
118. Odontocerum albicorne	00000000	<<<<<<<<	<<<<<<<<<	
119. O. hellenicum	00000000			

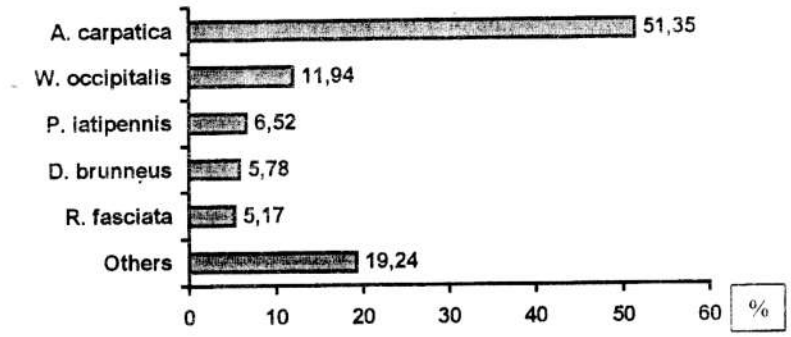


Fig. 3 a. *The dominancy structure of Trichoptera species in springs*

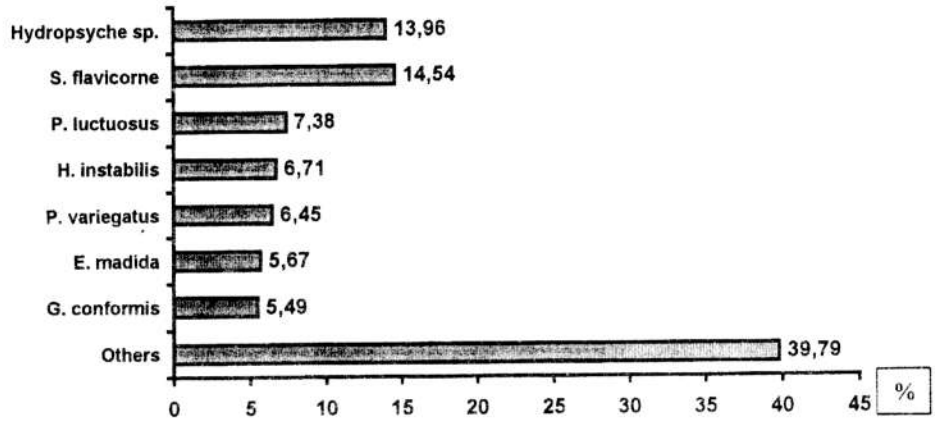


Fig. 3 b. *The dominancy structure of Trichoptera species in streams between 800 - 950 m.*

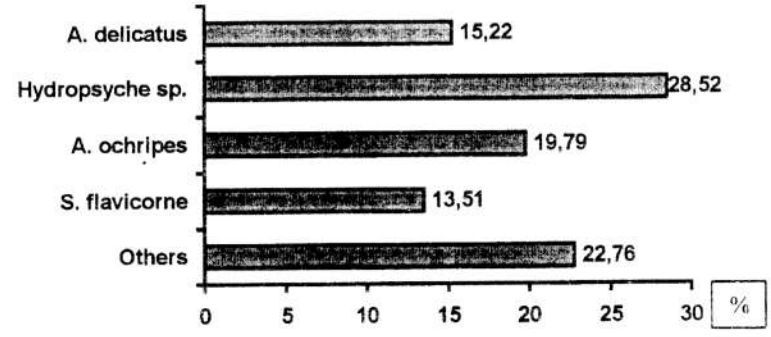


Fig. 3 c. *The dominancy structure of Trichoptera species in brooks between 389 - 800 m.*

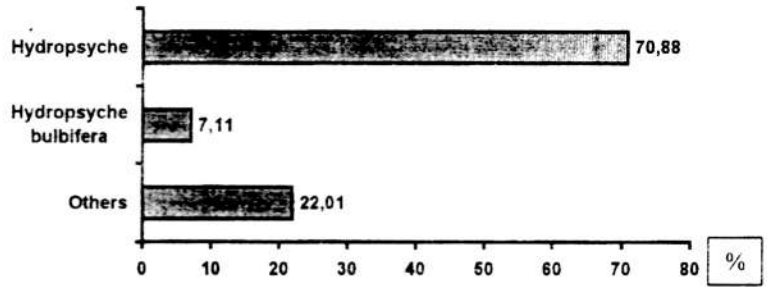


Fig. 3 d. *The dominancy structure of Trichoptera species in the Olt River*

In the springs and streamlets between 800-1500m has been developed a number of 43 species of Trichoptera. From the total number of individuals identified in these ecosistems the dominant species proved to be *Wormaldia occipitalis* (11,94%) and *Apatania carpathica* (51,35%). Dominants are *Rhyacophila fasciata* (5,17%), *Drusus brunneus* (5,78%) and *Potamophylax latipennis* (6,52). The subdominant and recedent forms (**Fig. 3**) represent the other 19,24%.

In the streams between 800-950m we found a total different situation; here it were identified a number of 83 species of caddis flies, the eudominant forms proved to be *Hydropsyche sp.* (13,96%), *Sericostoma flavicorne* (14,54%); the dominant forms are *Glossosoma conformis* (5,49%), *Philopotamus variegatus* (6,46%),*Hydropsyche instabilis* (6,71%), *Ecclysopteryx madida* (5,67%) and *Potamophylax luctuosus* (7,38%). The rest of the species belong to the subdominant and recedent forms (39,79%) (**Fig. 3**).

The brooks between 380-800m contain a lot of common taxa with the previous type of ecosystem. Here it were identified altogether 67 taxa of Trichoptera. Between the eudominant forms we can mention *Agapetus delicatulus* (15,22%), *A. ochripes* (19,79%), *Hydropsyche sp.* (28,72%) and *Sericostoma flavicorne* (13,51%), the dominant forms are missing, the rest of 22,76% belonging to the subdominant and recedent species (**Fig. 3**).

The main watercourse in the researched area, the Olt River, was characterised by a small number of Trichoptera (28 species). Here the eudominant category was represented by *Hydropsyche sp.* (70,88%) and the dominant form is *Hydropsyche bulbifera* (7,11%). The rest of the 22,01% are subdominant and recedent ones (**Fig. 3**).

CONCLUSIONS

The qualitative and quantitative analyse of the collected material (a number of 16.507 specimens) in the upper and middle sector of the Olt River shows, that in the researched area a rich fauna of Trichoptera has been developed. The 118 taxa of caddis flies identified here represent a percentage of 44% of the Trichoptera fauna of Romania.

The spring sector (stations 1,2,3,4) was characterised by a number of 43 Trichoptera species, the largest number occurring in the streams between 800-950m, altogether 83 taxa of caddis fly (stations 5-16). Brooks at 380-800m have a slight lesser number of taxa (67 species of caddis flies). But the number of identified taxa of

Trichoptera was surprisingly very low along the main course of water in the researched area, the Olt River, where it was identified a number of only 28 taxa of Trichoptera. Trichoptera are missing in a number of stations in the middle sector (Olt River near Boiţa, for example) or were represented by a small number of individuals belonging to 1-2 taxa. The decrease of the species number from the upper flow to the middle sector is an effect of pollutants accumulations in these aquatic ecosystems.

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CONTRIBUTIONS TO THE KNOWLEDGE OF THE MAYFLY LARVAE (INSECTA: EPHEMEROPTERA) FROM THE OLT RIVER BASIN

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REZUMAT

Lucrarea prezintă datele cantitative şi calitative despre larvele de efemeroptere din probele colectate în cadrul campaniei desfăşurate în anul 1998 de-a lungul cursului superior şi mijlociu al Oltului şi al afluentului Cibin. În cele 22 de staţii de colectare a probelor, situate în albiile râurilor sau în zone umede învecinate, au fost identificate 17 specii de efemeroptere aparţinând la 5 familii. Sunt discutate aspecte legate de biodiversitatea acestui grup în zona investigată, precum şi efectul acţiunilor antropice asupra acestor specii.

Keywords: Mayflies, Ephemeroptera, wetlands, biodiversity, Olt River Basin.

INTRODUCTION:

Mayfly larvae are one of the most important elements of the macrozoobenthos. They are sensitive to pollutants, that is why the mayflies are used as indicator species for the quality of the wetlands.

In this paper we are going to present the results of a research about the presence of mayfly larvae, from the upper and middle course of the Olt River. Găldean (1992) and Rogoz (1977) have already been thoroughly studying the spreading of the macroinvertebrate fauna and the structure of the benthic zoocoenosis in this river. The present research aims to complement their in-depth study and to analyse their results from the aspect of the water quality.

MATERIALS AND METHODS

The samples were taken during an expedition along the Olt River, that was organised by the Department of Ecology of the "Lucian Blaga" University of Sibiu and the Ecotur Organisation in October 1998. We took samples from 11 spots along the upper and middle course of the Olt River, also 5 spots in the backwater beside the Olt and from 2 scenes in the Bogata Nature Conservation Area.

The quantitative samples were taken with a bottom Surber sampler from an area of 887 cm^2s. We also took qualitative samples with a Băcescu dredge, which was 50 cm long and 30 cm wide. The biological material was preserved in 5% formaldehyde and after being identified it was preserved in 70% alcohol.

The species were identified on the basis of the determinator edited by Macan (1970), Bogoescu (1958) and Újhelyi (1959).

The abbreviations used in the synthetic table of the mayflies found in the upper and middle basin of the Olt River are given below.

The sampling stations: (on the Cibin River) **R1** - Râul Mare, above the confluence with Dăneasa , **R2** - Râul Mare, **R3** - confluence of Râul Mare with Râul Mic rivers, at the entrance in the dam-lake from Gura Râului, **R4** - downstream the dam-lake from Gura Râului, **R6** - upstream Sibiu, **R7** - Sibiu-Guşteriţa, **R8** - downstream Mohu, **R9** - downstream Tălmaciu, (on the Olt River): **Q2** – Sâncrăieni, **Q3** - Bixad, downstream Tuşnad Gorge, **Q4** - upstream Sf. Gheorghe, **Q5** - Ilieni,

downstream Sf. Gheorghe, **Q10/1** - upstream Avrig, **Q12** - downstream Boiţa, **Q13** - downstream Călineşti; (in the Olt River Valley) **T1** - backwater at Sântionlunca, **T3** - backwater at Arini, **T4** - backwater Aita Mare, **T5** - backwater Micloşoara, **T6/1** - Măieruş rivulet, **T6/2** - Bogata rivulet, **T9** - backwater at Turnu Roşu.

The Biogeographic elements (BgE) are codified as follows: **CE**-Central-European , **Eua**-Eurasian, **SCE**-South-Central-European, **NCE**-North-Central-European, **Pal**-Palearctic, **E**-European.

RESULTS AND DISCUSSION

At the 22 collecting stations altogether we found 17 species that belong to 5 families (**Tab.1**).

Along the upper course of the Olt River have been revealed rather varied ecotopes. Gravelled substratum is alternating with areas covered with silt full of organic debris. Also, the bed widens and the water speed gets stabilised. In spite of this, the mayfly-fauna is rather poor in this area.

On the sandy stand close to the banks at Sâncrăieni (**Q2**) a dense population of *Clöeon dipterum* was found. At the next 2 sample spots (**Q3,Q4**) we encountered two species, namely *Baëtis vernus, Habroleptoides confusa*. Both are phytophilous, they like sandy, silty areas with agglomeration of leaves, and indicate the epipotamon. Downstream Sfântu Gheorghe the situation does not change severely. The bottom is sandy and silty too and we found 3 species here. Two of them were phytophilous and one rheophilous. We have no data from the spots **Q6, Q7, Q8, Q9**. At Avrig the species *Clöeon dipterum* (which likes stagnant water) and the euribiont *Baëtis sp.* were present in a large number. Here, samples were taken from waters running parallel to the dykes, The water was clear and there were a lot of plants on the banks. At **Q12** (downstream Boiţa) *Ephemerella notata*, at **Q13** (downstream Călineşti) *Caenis macrura, Baëtis sp.* and *Rhithrogena sp.* were found. The presence of the latter indicates clear water that is rich in oxygen.

In the Olt River Basin there are several dead-branches and other types of wetlands. From 5 of these we took qualitative samples. At Sântionlunca (**T1**) in a dead branch of the Râul Negru River, on the silty bottom, there are stones covered with bioderma. Here we found extensive areas inhabited by *Myriophyllum sp.* and *Ceratophyllum sp.* In the water there were some *Clöeon dipterum* larvae. This species inhabits waters that are strongly eutrophised and rich in plants.

At **T3** (Arini backwater) and **T4** (Aita Mare backwater) the bottom consists of greyish-black, rotten organic debris and silt. Here, among the mayfly larvae, the species *Clöeon dipterum* lives among agglomerations of *Utricularia vulgaris* and *Lemna sp.*

In the Bogata Nature Conservation Area we took samples from 2 brooks. In the Măieruş Brook we identified several mayfly species. These were: *Baëtis rhodani, Ecdyonurus venosus, Rhithrogena semicolorata, Electrogena lateralis.* Even more, a varied group of species was present in the Bogata Brook. At the bottom there are stones settled in the gravel, which serve as ideal shelters for the *Rhithrogena sp., Ecdyonurus sp., Electrogena sp.* and we found one specimen of the phytophilous species of *Caenis horaria* and *Ecdyonurus venosus*, and one of *Habroleptoides confusa.*

The Cibin River is one of the most important tributaries of the Olt River. Along its whole length we pointed out 9 sampling stations. The upper course of the river has a mountainous character, its bed is full of pebbles, the water flows with a high speed, but the flow is low. In this lotic zone we found lithorheophilous species.

Tab. 1. *The synthetic table of mayflies (Ephemeroptera) species found in upper and central region of Olt basin*

SPECIES	SAMPLING POINTS																															BGE
	July 1998							October 1998 - Quantitative samples												October 1998 - Qualitative samples													
	R1	R2	R3	R4	R6	R7	R8	R1	R3/1	R3/2	R3/3	R4	R9	Q 13	Q 12	T6/2	T6/1	Q5	Q4	Q2	R4	T9	Q10/1	T6/2	T5	T4	T4p	T3	T6/1	T1p	Q5	Q4	Q3	T1	
Baetidae																																		
Baetis lutheri Müller-Liebenau, 1967					1													2																CE
Baetis melanonyx (Pictet,1843)																																		CE
Baetis rhodani (Pictet, 1843)				29			1				1					1	2											3						Eua
Baetis scambus Eaton,1870	1	7					1						1	1																				E
Baetis vernus Curtis, 1834			4														1		2				23									23		Eua
Baetis sp.						1						3				1	17				3		998			3			9					
Cloeon dipterum (Linné, 1761)																				494		269	17		176	3	185	136					78	Hol
Heptageniidae																16		1																
Rhithrogena hybrida Eaton, 1885																2								2										CE
Rhithrogena semicolorata (Curtis, 1834)	1	2						2	9	2							5											50						SCE
Rhithrogena sp.														1		18	34											33						
Ecdyonurus venosus (Fabricius, 1775)				1																								6						SCE
Ecdyonurus sp.																	2				4			18										
Electrogena lateralis(Curtis, 1834)																2																		SCE
Ephemerellidae																																		
Ephemerella notata Eaton, 1887				1				4							1	1	9											5						Hol
Caenidae																																		
Caenis horaria (Linné, 1758)																								1										Eua
Caenis macrura Stephens, 1835														2																				Eua
Caenis robusta Eaton, 1884																						1			2		72	10		31			4	NCE
Leptophlebiidae																																		
Paraleptoph. submarginata (Stephens, 1835)																																		E
Habroleptoides confusa Sartori –Jacob, 1986																								1						5	2			E

The presence of *Rhithrogena semicolorata* (which is rather sensitive at water temperature – Găldean, 1992) is proving a high level of dissolved oxygen. In the Gura Râului Lake there lives the euriterm *Baëtis rhodani* and *Ecdyonurus sp.* The presence of species that belong to the *Baëtidae* and *Heptageniidae* families shows the sub-mountainous character of this sector. The *Ecdyonurus* species prefer waters that are less turbulent (Hefti , Tomka and Zurwerra, 1985).

At the collecting station upstream Sibiu (**R6**) were found specimens of *Baëtis lutheri*, which are characteristic for metafiton. We did not find mayfly larvae in the samples from all the points downstream Sibiu and from Orlat sampling station.

At Mohu, residual water from the cleaning-plant of Sibiu is flowing into the Cibin River. Here we found *Baëtis rhodani* and *Baëtis scambus* that probably endure pollution quite well. At the last sampling point individuals of *Baëtis scambus* were found.

CONCLUSIONS

Although the number of samples is not sufficient in order to draw conclusions on the ecological state of the Olt River, we still highlight the followings:

- the mayfly associations illustrate very well the presence of pollution. They respond with the disappearance of sensible species at the environmental degradation;
- we found only euribiont species on the upper and middle course of the river;
- the Cibin River is characterised by heterogeneous habitats, fact that is illustrated by the diverse mayfly fauna.

We have to take mention of the rheophilous *Rhithrogena semicolorata* that is an indicator of the good water quality in the upper sector. Downwards, in the lentic sectors the slow flow makes possible a change of the bottom's structure . Here, fine sediments deposits are locally accumulated. In this stratum mainly the phytophilous species find refuge.

Individuals of the *Baëtidae* family are present along the whole length of the river. The absence of mayfly larvae at Orlat and downstream Sibiu illustrates the fact that the anthropic factors (hydrotechnical works, industrial and domestic sewage) have a declining effect on the presence of the benthic organisms.

The backwaters show a great diversity, they are still in a condition that is close to the natural state. Here the phytophilous *Caenidae* and *Clöeon sp.* species can be found, which are characteristic for stagnant waters. Also, the water of the brooks flowing into the Olt has a quite good water-quality.

The rheophilous species that prefer very clear water (*Rhithrogena sp., Electrogena sp., Ecdyonurus sp.*) are also present there.

In our opinion it would be important to protect the branches, brooks and backwaters of the Olt River. Especially because they offer refuge for quite a lot of species and thus there may be a possibility for them to resettle into the water.

It would be essential to continue the researches and expand them to other periods of the year, in order to get a more accurate picture of the ecological state of the Olt River. In this way, we would be able to follow the phenological changes of the river as well.

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CONTRIBUTIONS TO THE KNOWLEDGE OF THE APOIDEAE FAUNA FROM THE SIBIU DEPRESSION

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ZUSAMMENFASSUNG

Vorliegende Studie verwertet die Ergebnisse unserer Erforschungen Museums aus Sibiu, und versucht das Spezifikum der Fauna der Apoideen in der Hermannstädter Senke, das auf den natürlichen Bedingungen - Relief, Boden, Klima, Vegetation - beruht, zu umreisen.

Für die vorliegende Studie wurden 10.528 Apoideen aus qualitativen Sammlungen aus verschiedenen Ökosystemen und aus unserer Museumsammlung-bestimmt und verarbeitet.

Das faunistische Konspekt für die Hermannstädter Senke, das aufgrund dieses Materials und mit Hilfe der Daten aus der Literatur zusammengestellt wurde, umfasst 245 Apoideen-Arten, was ungefähr 29,69% der Fauna Rumäniens entspricht. Die 245 Apoideen-Arten sind folgenderweise auf 7 Familien verteilt: **1.** Fam. Colletidae: 2 Gattungen und 19 Arten (7,75%); **2.** Fam. Halictidae: 8 Gattungen und 42 Arten (17,14%); **3.** Fam. Andrenidae: 4 Gattungen und 41 Arten (16,73%); **4.** Fam. Melittidae: 3 Gattungen und 9 Arten (3,67%); **5.** Fam. Megachilidae: 10 Gattungen und 50 Arten (20,40%); **6.** Fam. Anthophoridae: 14 Gattungen und 64 Arten (26,12%); **7.** Fam. Apidae: 3 Gattungen und 20 Arten (8,16%).

Die Ergebnisse unserer Forschungen zeigt, dass die studierten Ökosysteme aus der hermannstädter Senke die Eigenschaften natürlicher Ökosysteme bewahren, wobei der Einfluss der antropischen Aktiwitäten relativ gering ist.

INTRODUCTION

The importance of the Apoideae species and their abundance justified the taxonomical, ecological and faunistical study of this group of insects.

The present paper turns to account the results of our field investigations and of the collections from the Natural History Museum in Sibiu, trying to outline the specific of the Apoideae fauna from the Sibiu Depression, which is established by the natural conditions of the relief, soils, climate and the vegetation.

MATERIALS AND METHODS

For this study there have been identified and handled 10,528 specimens of Apoideae proceeding from qualitative samples taken in different ecosystems (deciduous forests, skirts, mezophilous and mezo-hygrophilous meadows, areas in the vicinity of the roads, gardens, orchards and saltings).

RESULTS AND DISCUSSION

The faunistical epitome for the Sibiu Depression, established on the basis of the sampled material and on references, comprise 245 species of Apoideae, which represents about 29,69 % from the Romanian fauna. The 245 species belong to 7 families, namely: 1. Fam. Colletidae (2 genera and 19 species - 7,75%); 2. Fam. Halictidae (8 genera with 42 species -17,14%); 3. Fam. Andrenidae (4 genera with 41 species - 16,73%); 4. Fam. Melittidae (3 genera and 9 species -3,67%); 5. Fam. Megachilidae (10 genera with 50 species -20,40%); 6. Fam. Anthophoridae (14 genera and 64 species - 26,12%); 7. Fam. Apidae (3 genera - 20 species - 8,16%). Among the specified total, the author identified in the researched ecosystems 125

species. Among them 9 species were first quoted in Romania and 8 species were first quoted in the Transylvanian fauna.

Further on we show the faunistical composition of the Apoideae from the Sibiu Depression and the biological characteristics of the species, by using the following abbreviations:

- type of nest: endogeic (En) or hypogeic (Hy)
- number of generations in a year: 1 generation -univoltine (U), 2 generations - bivoltine (B), partial bivoltine (pB)
- flight period (in terms of months); 1: I - III; 2: IV - VI; 3: V - VII; 4: VI - VIII; 5. VII - IX.
- dietary spectrum: oligophagous (oly), polyphagous (poly).

TAXA	Nest type		No. gen	Flight period	Dietary spectrum	
	En.	Hy			Oly	Poly
Fam. COLLETIDAE						
Colletes cunicularis (Linnaeus, 1761)	+		U	1	+	
Colletes daviesanus Smith, 1846	+		U	5	+	
Colletes marginatus Smith, 1846	+		U	4	+	
Colletes similis Schenck, 1853	+		U	5	+	
Colletes succintus (Linnaeus, 1758)	+		U	5	+	
Hylaeus angustatus (Schenck, 1861)		+	U	3.4.5		+
Hylaeus annularis (Kirby, 1802)		+	U	3.4.5		+
Hylaeus brevicornis Nylander, 1852		+	U	3.4.5		+
Hylaeus communis Nylander, 1852		+	B	3.4.5		+
Hylaeus confusus Nylander, 1852		+	pB	3.4.5		+
Hylaeus difformis (Eversmann, 1852)		+	U	3.4.5		+
Hylaeus gracilicornis (Morawitz, 1867)		+	U	3.4.5		+
Hylaeus hyalintus Smith, 1842		+	U	3.4.5		+
Hylaeus nigritus (Fabricius, 1798)		+	U	3.4.5	+	
Hylaeus pictipes Nylander, 1852		+	U	3.4.		+
Hylaeus punctulatissimus Smith, 1842		+	U	3.4.	+	
Hylaeus signatus (Panzer, 1798)		+	U	3.4.5	+	
Hylaeus sinuatus (Schenck, 1853)		+	U	3.4.5		+
Hylaeus variegatus (Fabricius, 1798)		+	pB	4.5.6		+
Fam. HALICTIDAE						
Rhophites quinquespinosus Spinola, 1808	+		U	4.5.6	+	
Rhophitoides canus (Eversmann, 1852)	+		U	4.5.6	+	
Systropha curvicornis (Scopoli, 1770)	+		U	4.5.6	+	
Pseudapis diversipes (Latreille, 1805)	+		U	3.4.5		+
Pseudapis femoralis (Pallas, 1773)	+		U	3.4.5		+
Pseudapis ruficornis (Spinola, 1838)	+		U	3.4.5		+
Dufourea inermis (Nylander, 1848)	+		U	3.4.5	+	
Dufourea vulgaris (Schenck, 1861)	+		U	3.4.5	+	
Sphecodes albilabris (Fabricius, 1793)	P		U	3.4.5		+
Sphecodes crassus Thomson, 1870	P		U	2345		+
Sphecodes gibbus (Linnaeus, 1758)	P		U	3.5.		+
Sphecodes hyalintus Hagens, 1882	P		U	3.4.5		+
Sphecodes monilicornis Kirby, 1802	P		U	2345		+
Sphecodes pellucidus Smith, 1845	P		U	3.5.		+
Sphecodes rubicundus Hagens, 1882	P		U	3		+
Lasioglossum albipes (Fabricius, 1781)	+		U	1.2.4		+
Lasioglossum majus (Nylander, 1852)	+		U	1245		+
Lasioglossum minutulum (Schenck, 1853)	+		U	2.5.		+
Lasiolglossum morio (Fabricius, 1793)	+		U	1.2.4		+

Lasioglossum nigripes (Lepeletier, 1841)	+		U	2345		+
Lasioglossum sexnotatum (Kirby, 1802)	+		U	3.4.5		+
Lasioglossum punctatissimum (Schenck, 1853)	+		U	2345		+
Lasioglossum smeathmanellum (Kirby,1802)	+		U	2.3.4		+
Lasioglossum zonulum (Smith, 1848)	+		U	1245		+
Lasioglossum xanthopum (Kirby, 1802)	+		U	2345		+
Halictus maculatus Smith, 1848	+		U	3.5.6		+
Halictus morbillosus Kirchba, 1873	+		U	2345		+
Halictus quadricinctus (Fabricius, 1776)	+		U	2345		+
Halictus rubicundus (Christ, 1791)	+		U	2345		+
Halictus sexcinctus (Fabricius, 1775)	+		U	2345		+
Halictus tumulorum (Linnaeus, 1758)	+		U	2345		+
Halictus subauratus (Rossi, 1792)	+		U	2345		+
Fam. ANDRENIDAE						
Panurgus calcaratus (Scopoli, 1763)	+		U	3.4.	+	
Melitturga clavicornis (Latreille, 1806)	+		U	3.4.	+	
Melitturga praestans Giraud, 1861	+		U	3.4.	+	
Andrena bicolor Fabricius, 1775	+		B	1.4.5		+
Andrena chrysosceles (Kirby, 1802)	+		U	2.3.4	+	
Andrena cineraris (Linnaeus, 1758)	+		U	2		+
Andrena combinata (Christ, 1791)	+		U	2.3.		+
Andrena distinguenda Schenck, 1871	+		U	2.3.	+	
Andrena dorsata (Kirby, 1802)	+		B	2.3.4		+
Andrena exima Smith, 1847	+		U	2		+
Andrena flavipes Panzer, 1799	+		B	2.3.4		+
Andrena hattorfiana (Fabricius, 1775)	+		U	4.5.	+	
Andrena haemorrhoa (Fabrcius, 1781)	+		U	2.3.		+
Andrena humilis Imhoff, 1832	+		U	2.3.	+	
Andrena labiata Fabricius, 1781	+		U	2.3.		+
Andrena lathyri Alfken, 1899	+		U	2.3.	+	
Andrena marginata Fabricius, 1776	+		U	2.3.	+	
Andrena minutula (Kirby, 18o2)	+		B	2.3.		+
Andrena morio Brullé, 1832	+		B	2.3.		+
Andrena nitidiuscula Schenck, 1853	+		U	2.3.	+	
Andrena nitida (Müller, 1776)	+		U	2.3.		+
Andrena nasuta Giraud, 1863	+		B	2.3.4		+
Andrena nigroaenea (Kirby, 1802)	+		U	2.3.		+
Andrena ovatula (Kirby, 1802)	+		B	2.3.		+
Andrena praecox (Scopoli, 1763)	+		U	1.2.3	+	
Andrena pilipes (Fabricius, 1781)	+		B	3.4.5		+
Andrena proxima (Kirby, 1802)	+		U	2.3.	+	
Andrena rosae Panzer, 1801	+		U	4.5.	+	
Andrena schencki Morawitz, 1866	+		U	2.3.		+
Andrena tibialis (Kirby 1802)	+		U	2.3.		+
Andrena thoracica (Fabricius, 1775)	+		U	2345		
Andrena tscheckı Morawitz, 1872	+		U	2.	+	
Andrena taraxaci Giraud, 1861	+		U	3.4.	+	
Andrena ventralis Imhoff, 1832	+		U	2.3.	+	
Andrena varians (Rossi, 1792)	+		U	2		+
Andrena viridescens Viereck, 1916	+		U	4.5.	+	
Andrena vaga Panzer, 1799	+		U	3.4.	+	
Camptopoeum friesei (Mocsáry, 1894)	+		U	2.3.	+	
Camptopoeum frontale (Fab., 1872)	+		U	2.3	+	
Fam. MELITTIDAE						
Melitta dimidiata Morawitz, 1876	+		U	3.4.	+	
Melitta haemorrhoidalis (Fabricius, 1775)	+		U	3.4.	+	

Melitta leporina (Panzer, 1799)	+		U	3.4.	+	
Melitta tricincta Kirby,1802	+		U	3.4.	+	
Melitta nigricans Alfken, 1905	+		U	3.4.	+	
Dasypoda argentata (Panzer, 1809)	+		U	3.4.5	+	
Dasypoda hirtipes (Fabricius, 1793)	+		U	3.4.5	+	
Dasypoda labiata (Fabricius 1804)	+		U	3.4.5	+	
Macropis fluvipes (Fabricius, 1804)	+		U	3.4.	+	
Fam. MEGACHILIDAE						
Trachusa byssina (Panzer, 1798)	+		U	3.4.	+	
Anthidium cingulatum Latreille, 1805		+	U	3.4.	+	
Anthidium interruptum Fabricius, 1804		+	U	3.4.	+	
Anthidium lituratum (Panzer, 1801)		+	U	3.4.	+	
Anthidium manicatum (Linnaeus, 1758)		+	U	3.4.		+
Anthidium montanum Morawitz, 1864	+		U	3.4.	+	
Anthidium septemdentatum (Lepeletier,1841)	+		U	3.4.		+
Anthidium oblongatum (Illiger, 1806)	+		U	3.4.		+
Osmia adunca (Panzer, 1798)		+	U	3.	+	
Osmia aurulenta (Panzer, 1799)		+	U	2.3.	+	
Osmia brevicornis (Fabricius, 1798)		+	U	3.	+	
Osmia caerulescens (Linnaeus, 1758)		+	pB	2.3.4		+
Osmia cornuta (Latreille, 1805)		+	U	2.3.		+
Osmia fluviventris (Panzer, 1798)		+	U	3.	+	
Osmia leaiana (Kirby, 1802)		+	U	3.	+	
Osmia leucomelena (Kirby, 1802)		+	U	2.3.		+
Osmia parietina Curtis, 1828		+	U	2.3.		+
Osmia rufa (Linnaeus, 1758)		+	U	2.3.		+
Osmia spinulosa (Kirby, 1802)		+	U	3.4.	+	
Osmia uncinata Gerstäcker, 1869		+	U	2.3.		+
Osmia villosa (Schenck, 1853)		+	U	2.3.	+	
Osmia bicolor (Schranck, 1781)		+	U	2.	+	
Osmia bidentata Morawitz, 1872		+	U	3.	+	
Megachile apicalis Spinola, 1808		+	U	2.3.		+
Megachile centuncularis (Linnaeus, 1758)		+	U	2.3.4		+
Megachile circumcincta (Kirby, 1802)	+		U	2.3.		+
Megachile dorsalis Pérez, 1902		+	U	3.		+
Megachile ericetorum Lepeletier, 1841	+		U	3.	+	
Megachile lagopoda (Linnaeus, 1781)	+		U	3.		+
Megachile leadiella Curtis, 1828	+		U	3.		+
Megachile melanopyga Costa, 1863		+	U	3.		+
Megachile rotundata (Fabricius, 1784)		+	U	3.4.		+
Megachile versicolor Smith, 1844		+	U	3.		+
Megachile willughbiella (Kirby, 1802)		+	U	3.		+
Chelostoma fuliginosum (Panzer, 1798)		+	U	3.4.	+	
Chelostoma campanularum (Kirby, 1802)		+	U	3.4.	+	
Chelostoma distinguentum Stoec. 1929		+	U	3.4.	+	
Chelostoma foveolatum (Moraw, 1868)		+	U	3.4.	+	
Chelostoma florisomne (Linnaeus, 1758)		+	U	3.4.	+	
Heriades crenulatus Nylander, 1856		+	U	3.4.	+	
Heriades nigricornis Nylander, 1850		+	U	3.4.	+	
Heriades truncorum (Linnaeus, 1758)		+	U	3.4.	+	
Stelis breviuscula (Nylander, 1848)	P		U	3.		+
Stelis punctatissima (Kirby, 1802)	P		U	3.		+
Dioxys cincta Jurine, 1807	P		U	3.		+
Coelioxys elongata Lepeletier, 1841	P		U	3.4.		+
Coelioxys inermis (Kirby, 1802)	P		U	3.4.		+
Coelioxys polycentris Förster, 1853	P		U	3.		+
Coelioxys rufescens Lepeletier, 1825	P		U	3.4.		+

Lithurgus chrysurus Founcs.	P		U	3.4.		+
Fam. ANTHOPHORIDAE						
Anthophora acervorum (Linnaeus, 1758)	+		U	2.3.		+
Anthophora albigena Lepeletier, 1841	+		U	4.5.	+	
Anthophora bimaculata Panzer, 1798	+		U	3.		+
Anthophora borealis Morawitz, 1864	+		U	3.		+
Anthophora furcata (Panzer, 1798)	+		U	3.	+	
Anthophora garrulus Rossi, 1790	+		U	3.4.		+
Anthophora magnilabris Feds., 1875	+		U	3.4.	+	
Anthophora mucida Gribord, 1873	+		U	3.4.	+	
Anthophora plagiata (Illiger, 1806)	+		U	2.3.		+
Anthophora pubescens (Fabricius, 1781)	+		U	3.		+
Anthophora pubescens (Fabricius, 1781)	+		U	3.		+
Anthophora quadrifasciata Viller, 1789	+		U	3.4.		+
Anthophora retusa (Linnaeus, 1758)	+		U	2.3.		+
Anthophora quadrimaculata (Panzer, 1806)	+		U	3.		+
Melecta luctuosa (Scopoli, 1770)	P		U	2.3.		+
Melecta punctata (Fabricius, 1775)	P		U	2.3.		+
Thyreus histrionicus (Illiger, 1806)	P		U	3.		+
Thyreus orbatus Lepeletier, 1841	P		U	3.		+
Thyreus ramosa Lepeletier, 1841	P		U	3.		+
Thyreus truncata Pérez, 1884	P		U	3		+
Eucera caspica Morawitz, 1873	+		U	3		+
Eucera cinerea Lepeletier, 1841	+		U	3.4.		+
Eucera clypeata Erichson, 1835	+		U	2.3.4		+
Eucera interrupta Ber, 1850	+		U	3.4.	+	
Eucera longicornis Linnaeus, 1758	+		U	3.4.	+	
Eucera nitidiventris Mocsáry, 1879	+		U	3.4.		+
Eucera nigrifaciens Lepeletier, 1841	+		U	3.4.5	+	
Eucera pollinosa Smith, 1854	+		U	3.4.		+
Eucera seminuda Brullé, 1832	+		U	2.3.4		+
Eucera taurica Morawitz, 1871	+		U	2.3.4		+
Tetralonia alticincta (Lepeletier, 1841)	+		U	3.4.	+	
Tetralonia armeniaca Morawitz, 1878	+		U	3.4.		+
Tetralonia dentata (Klug, 1835)	+		U	3.4.5	+	
Tetralonia macroglossa (Illiger, 1806)	+		U	3.4.	+	
Tetralonia nana Morawitz, 1873	+		U	3.4.	+	
Tetralonia pollinosa Lepeletier, 1841	+		U	3.4.	+	
Tetralonia salicariae Lepeletier, 1841	+		U	3.4.	+	
Tetralonia vicina (Mocsáry, 1879)	+		U	3.4.	+	
Xylocopa valga Gerstöcker, 1841		+	U	2.3.		+
Xylocopa violacea (Linnaeus, 1758)		+	U	2.3.		+
Ceratina callosa (Fabricius, 1794)		+	U	2.3.		+
Ceratina cyanea (Kirby, 1802)		+	U	2.3.		+
Nomada alboguttata Heinrich-Schöffer,1839	P		U	2.3.		+
Nomada armata Henrich-Schöffer, 1839	P		U	2.3.		+
Nomada bifida Thomson, 1872	P		U	2.3.		+
Nomada distinguenda Morawitz, 1874	P		B	2.3.4		+
Nomada feruginata (Linnaeus, 1767)	P		U	2.3.		+
Nomada flavopicta (Kirby, 1802)	P		U	2.3.		+
Nomada fueata Panzer, 1797	P		B	2.3.4		+
Nomada hirtipes Pérez, 1884	P		U	2.3.		+
Nomada lineolata Panzer, 1798	P		B	2.3.4		+
Nomada nobilis Henrich-Schöffer, 1839	P		U	2.3.		+
Nomada rhenana Morawitz, 1872	P		B	2.3.		+
Nomada sexfasciata Panzer, 1799	P		U	2.3.		+
Nomada succinta Panzer, 1798	P		U	2.3.		+

Nomada trispinosa Schmied., 1876	P		U	2.3.		+
Nomada zonata Panzer, 1798	P		B	2.3.		+
Epeolus variegatus (Linnaeus, 1758)	P		U	3.4.		+
Biastes brevicornis Panzer, 1798	P		U	3.		+
Biastes emarginatus Schenck, 1853	P		U	3.		+
Ammobates oraniensis (Smith, 1854)	P		U	3.		+
Ammobates punctatus Fabricius, 1804	P		U	3.		+
Parammobates minutus Mocsáry, 1878	P		U	3.		+
Pasites maculatus Jurine, 1807	P		U	3.		+
Pasites maculatus Jurine, 1807	P		U	3.		+
Epeloides coecutiens (Fabricius, 1775)	P		U	3.		+
Fam. APIDAE						
Bombus argilaceus Scopoli, 1763	+		U	1-6		+
Bombus confusus Schenck, 1861	+		U	1-6		+
Bombus humilis Illiger, 1866		+	U	1-6		+
Bombus hortorum Linnaeus, 1761	+		U	1-6		+
Bombus hypnorum (Linnaeus, 1758)		+	U	1-6		+
Bombus lapidarius Linnaeus, 1758		+	U	1-6		+
Bombus laesus Morawitz, 1875		+	U	1-6		+
Bombus mucidus Gerstöcker, 1869	+		U	1-6		+
Bombus pascorum (Scopoli, 1763)		+	U	1-6		+
Bombus pratorum (Linnaeus, 1761)		+	U	1-6		+
Bombus subterraneus (Linnaeus, 1758)	+		U	1-6		+
Bombus soroeensis (Fabricius, 1804)	+		U	1-6		+
Bombus sylvarum (Linnaeus, 1761)	+		U	1-6		+
Bombus terrestris Linnaeus, 1758	+		U	1-6		+
Bombus wurfleini Radoszkowski, 1854	+		U	1-6		+
Psithyrus campestris Panzer, 1801	P		U	3.4.		+
Psithyrus barbutellus Kirby, 1802	P		U	2.3.		+
Psithyrus rupestris Fabricius, 1793	P		U	2.3.		+
Psithyrus vestalis Fourcovy, 1785	P		U	2.3.		+

The results gained by our research prove that the studied ecosystems from Sibiu Depression still maintain their natural characteristics, the influence of the anthropic activities being relatively low.

Depending on the building modality of the nests it comes out that a number of 139 species are building endogeic nests and 59 species epigeic nests. There prevail the endogeic species, fact that is to be explained by the favourable pedological conditions from the researched sites.

From 245 species, a number of 227 have one generation in a year and 18 have two generations.

Regarding the mating period, the Apoideae from the Sibiu Depression are reproducing from the beginning of the spring until the fall. But most of them are reproducing at the beginning of the spring and the summer, when there are the most proper life-conditions (both climatical and trophical).

From the biogeographical perspective, the species from the Sibiu Depression have Palearctic (28,1%), European (50,2%), Central-European (12,65%), Euro-Siberian (8,57%) and Ponto-Mediterranean (3,26%) range.

Analysing the biodiversity of the Apoideae from the studied ecosystems, we have found out that the greatest number of species is inhabiting the mezophilous meadows and the lowest in mezo-hygrophilous meadows. The value of the biodiversity is explained especially by the ecological conditions, and, among them, of highest importance, is the abundance of the trophical basis from each ecosystem. The

majority of Apoideae are pollinating species and, therefore, the number of the phanerogams (flowers) determines their presence.

The results of our investigations show a high ecological diversity of the Sibiu Depression, proved by the richness of the Apoideae fauna.

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DATA CONCERNING THE HUMAN IMPACT ON THE ICHTHYOFAUNA OF THE UPPER AND MIDDLE SECTORS OF THE OLT RIVER

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RÉSUMÉ

Cet étude a le but de surpredre l'état présente de l 'ichtiofaune du cours supérieur et moyen de la rivière Olt, l'utilisation du group des poissons pour l' étude des secteurs avec un equilibre écologique précaire et l'identification des causes déterminantes pour cet ètat des choses.

Les prélèvements ont été faites en août 1997, septembre et octobre 1998.

Les 13 station de prélèvement des échantillons ont été établies en tenant compte de: la morphologie de la valée, le type de soustrat, la confluence avec quelques affluentes considérés representatifs sous l'aspect des conditions écologiques parmi les affluents de la rivière Olt et sous l'aspect de l'impact antropique sur les diferantes secteurs de la rivière.

Le material détérminé contient 29 d'éspèces appartenant à 26 genres et 7 familles.

L'étude de la faune ichtiologique du cours supérieur et moyen de la rivière Olt rélève une structure spécifique relative uniforme, du à l'existence d'un soustrat uniform sur les secteurs étudiés.

Les exceptions sont du, en principal, à l'impact antropique et seulement dans une petite mesure à l'existence de deux courtes secteurs avec les conditions de biotope différentes. La préssion antropique se manifeste expréssivement à la suite de la déversation des eaux industriales et ménajères et par la modification des conditions de biotope du à l'existence d'un system de l'aménagement hidroénergetique de grands proportions.

Keywords: ichthyofauna, biotop conditions, human impact, Olt River.

INTRODUCTION

Petrographical differentiation, vertical range of the relief and radiate – divergent configuration of the hydrographic net generate in Romania the prevalence of the rivers with a relatively reduced length, volume and surface of their basins.

With a length of 699 km, a surface of the hydrographic basin of 24010 km^2, the total length of all 564 tributaries of 8465 km and an average flow at its confluence of 164 m^3/s, the Olt River is one of the exceptions (Roşu, 1980).

As a consequence, the Olt River watershed includes a large diversity of relief forms and climatic types, and a varied human impacts. This fact points out the dimensions of the effort for carrying out a unitary and exhaustive study on the ichthyological fauna of the Olt.

This study was conducted by the following goals:

- to describe the structure of the ichthyological fauna of the upper and middle sector of the Olt;
- to identify the sectors with a hard human impact concerning the study of the ichthyofauna's structure variation;
- to identify factors which generate the changing of the ichthyofauna's structure in comparison with the possible optimum, comparing with existent natural conditions.

In order to assess the impact generated mainly by the dams built during the period 1970 – 1990 and by the wastewater discharge it was done a screening – type expedition for collecting data and biological samples.

The available scientific information on the ichthyofauna before 60's offer the possibility of a comparison with the present situation. Thus could be identified the causes of the changes apeared in time.

MATERIALS AND METHODS

The sampling was made in August 1997, September and October 1998.

The thirteen sampling stations (**Fig. 1**) were chosen according to: the morphology of the valley, the type of substratum, the confluence of some tributaries and of the human impact on the river sections.

For sampling it was used a net (6/1,5m) handled by two persons and a hand–net.

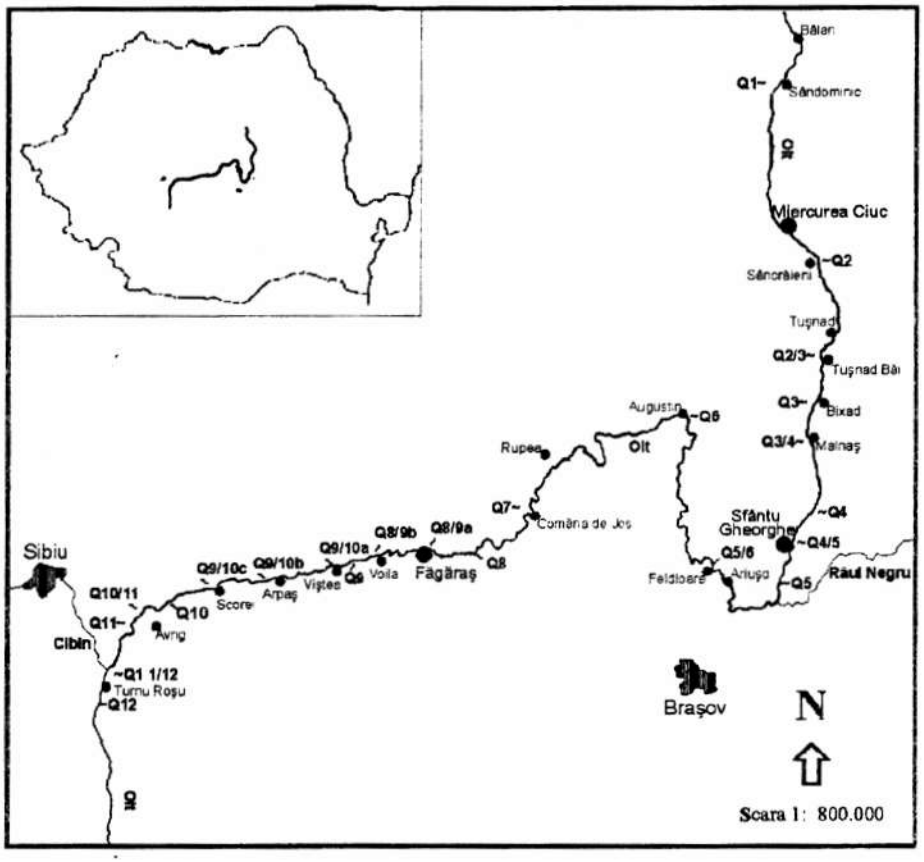

Fig. 1. *Sampling area*

The ichthyological material was fixed in a 4% formaldehyde, than preserved in alcohol 70% and included in the collection of the Aquatic Biology Laboratory within Department of Ecology of "Lucian Blaga" University from Sibiu and of "Grigore Antipa" National Museum of Natural History from Bucarest.

There were collected data of fishing (qualitative and quantitative) from the fishermen around sampling stations and by programs of restocking of the branch offices of the Fishermen's General Association from Sfântu Gheorghe and Făgăraş.

Autonomous Administration "Romanian Waters" offered some data on the physico-chemical parameters of the water

RESULTS AND DISCUSSION

There were identified 29 species belonging to 26 genera and 7 families.

Table 1: *The species found in each sampling station*

SPECIES	COLLECTING STATIONS												
	Q1	Q2 (Sândominic)	Q2 / 3 (Sâncrăieni)	Q3 / 4 (Tuşnad Băi)	Q4 / 5 (Malnaş)	Q5 / 6 (Sfântu Gheorghe)	Q8 / 9a (Feldioara)	Q8 / 9b (Făgăraş)	Q9 / 10a (Voila)	Q9 / 10b (Viştea)	Q9 / Q10c (Arpaş)	Q10 / 11 (Scorei)	Q11 / 12 (Avrig) (Turnu Roşu)
Esox lucius Linnaeus 1758	-	-	-	-	d	-	d	d	d	d	d	d	d
Rutilus rutilus carpathorossicus Vladykov 1930	-	-	-	-	-	-	-	d	d	-	d	d	-
Leuciscus leuciscus leuciscus (Linnaeus) 1758	-	-	-	-	d	-	-	-	-	-	-	-	-
Leuciscus cephalus cephalus (Linnaeus) 1758	-	c	c	c	d	-	d	d	d	d	d	d	d
Phoxinus phoxinus phoxinus (Linnaeus) 1758	-	-	c	-	-	-	-	-	-	-	-	-	-
Tinca tinca (Linnaeus) 1758	-	-	-	-	-	-	-	i	i	d	i	i	-
Scardinius erythrophthalmus er.(Linnaeus) 1758	-	-	-	c	d	-	d	d	d	d	d	d	d
Alburnus alburnus alburnus (Linnaeus) 1758	-	-	c	-	-	-	d	d	d	d	-	d	-
Alburnoides bipunctatus bipunctatus (Bloch) 1782	-	-	-	-	-	-	-	-	-	-	-	-	d
Blicca bjoerkna bjoerkna (Linnaeus) 1758	-	-	-	-	-	-	-	-	d	-	-	-	-
Abramis brama danubii Pavlov 1956	-	-	-	-	d	-	d	d	-	d	d	-	-
Vimba vimba carinata (Pallas) 1811	-	-	-	-	-	-	-	-	-	-	-	-	d
Pelecus cultratus (Linnaeus) 1758	-	-	-	-	-	-	d	d	d	d	d	d	-
Chondrostoma nasus nasus (Linnaeus) 1758	-	-	-	d	d	-	d	d	-	-	-	-	d
Rhodeus sericeus amarus (Bloch) 1782	-	-	-	-	-	-	-	-	-	-	-	-	-
Gobio gobio obtusirostris Valenciennes 1844	-	c	c	d	d	-	d	d	d	d	d	d	d
Pseudorasbora parva (Schlegel) 1842	-	-	-	-	-	-	-	d	d	d	d	d	-
Barbus barbus barbus (Linnaeus) 1758	-	-	-	d	d	d	d	d	d	d	d	d	d
Barbus peloponnesius petenyi Heckel 1847	-	-	c	-	-	-	-	-	-	-	-	-	d
Cyprinus carpio carpio (Linnaeus) 1758	-	-	-	-	d	-	d	d	d	d	d	d	d
Carassius auratus gibelio (Bloch) 1783	-	-	-	-	d	-	d	d	d	d	d	d	d
Orthrias barbatulus barbatulus (Linnaeus) 1758	-	-	c	-	-	-	-	-	-	-	-	-	-
Cobitis taenia taenia Linnaeus 1758	-	-	-	-	-	-	d	-	-	-	-	-	d
Sabanejewia aurata balcanica Karaman 1922	-	-	-	-	d	-	d	-	-	-	-	-	d
Silurus glanis Linnaeus 1758	-	-	-	-	i	-	i	i	i	i	i	i	-
Lota lota lota (Linnaeus) 1758	-	-	-	d	d	-	d	d	d	d	d	d	-
Lepomis gibbosus (Linnaeus) 1758	-	-	-	-	-	-	-	d	-	d	d	d	-
Perca fluviatilis fluviatilis Linnaeus 1758	-	-	-	-	d	-	d	d	d	d	d	d	d
Gymnocephalus cernuus (Linnaeus)1758	-	-	-	-	-	-	-	d	d	d	d	d	-

The species found in each sampling station (**Tab. 1**) were marked: with (c) those sampled, with (d) those identified from the fishermen's captures found around the sampling stations, and with (i) those which belonged to the restocking programs of local Sport Hunters and Fishermen's General Association.

The sectors affected by human impact were identified using the variation of the species diversity of the ichthyofauna.

The river's sections with a few fish species reflect the presence of the human impact.

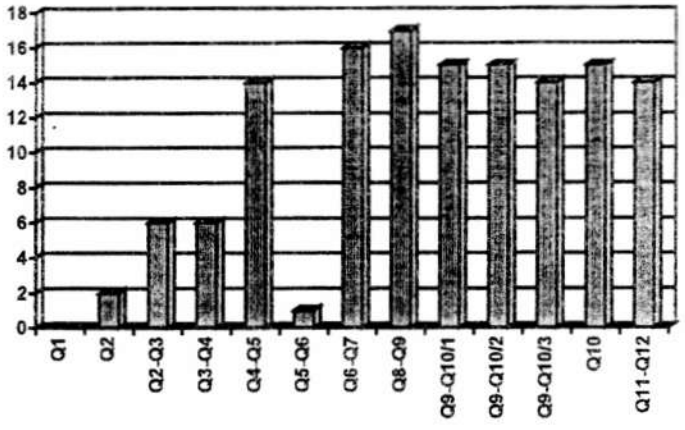

Fig. 1. *The number of the species identified in each sampling station.*

For each section of the upper and middle Olt River there were identified the natural and/or anthropogenetic factors which induce a specific ichthyofauna.

Bălan – Sândominic Section.

The river bed consist of sand and mud, and its slope is decreasing from 25 $^{0}/_{00}$ in the spring area to 2,5 $^{0}/_{00}$ in the Ciuc Depression.

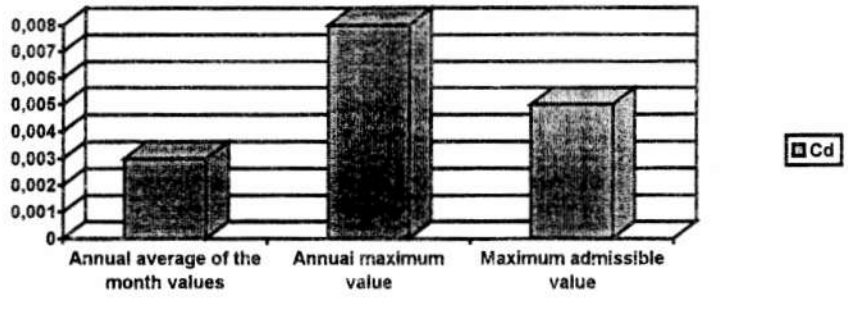

Fig. 2. *Annual average of the month values and maximum of Cd in 1997 in comparison with the admissible maximum value for the ichthyological fauna in Romanian freshwaters for Cd indicator (mg/l).*

It can be mentioned that the absence of the fish specimens in this sector in the period of sampling, is a result of the disharge of cadmium, zinc, copper and iron (**Figs. 2,3,4** and **5**) which result from industrial processing of polymetallic sulphides.

To all these it has to be add the presence of an inadequate filtering station of town Bălan.

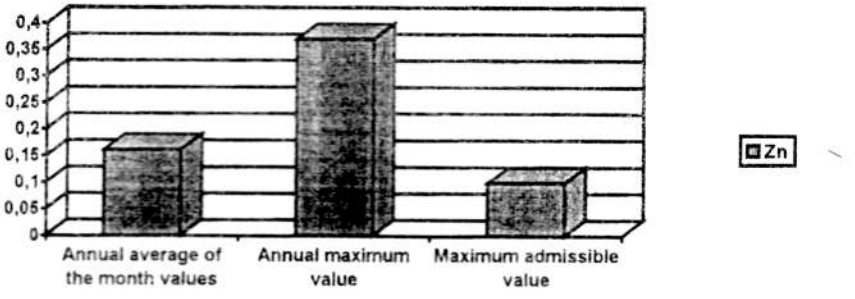

Fig. 3. *Annual average of the month values and annual maximum of Zn in 1997 in comparison with the admissible maximum value for the ichthyological fauna in Romanian freshwaters for Zn indicator (mg/l).*

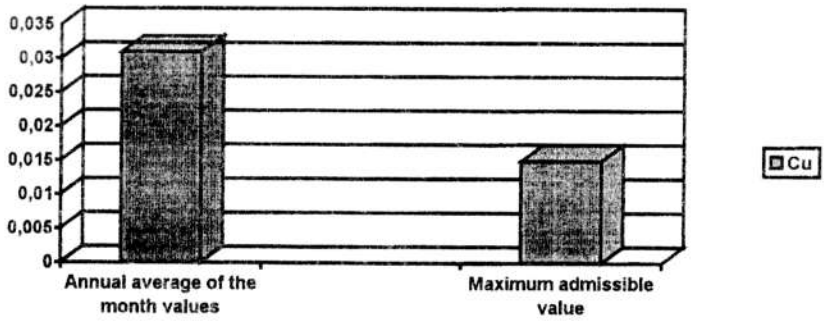

Fig. 4. *Annual average of the month values of Cu in 1997 in comparison with the admissible maximum value for the ichthyological fauna in Romanian freshwaters for Cu indicator (mg/l).*

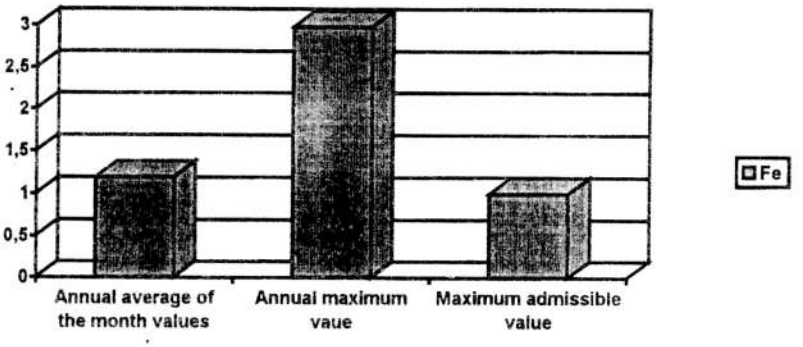

Fig. 5. *Annual average of the month values and annual maximum of Fe in 1997 in comparison with the admissible maximum value for the ichthyological fauna in Romanian freshwaters for Fe indicator (mg/l).*

Toxic effects of cadmium, zinc, copper and iron on fishes vary according to total hardness, pH, temperature and quantity of dissolved oxygen.

As a result of cadmium intoxication behaviour changes appear, the roes are not laid down and the development of juveniles is very much reduced.

Zinc intoxication reduce fish developing, accelerating their breath, produce branchiae inflammation, breath collapse and death.

Adult fishes tolerate relatively high copper concentrations in comparison with the juveniles which are sensitive in a higher degree. In such copper intoxication cases appears: malformations at juveniles, abundant mucosity on the branchiae and on the tegument, persistent cough, haemorrhagic lips, stress, the lose of equilibrium and finally death.

Toxic effects of ferrum on fishes are pointed out by the covering of branchiae by the ferric hydroxide which generate the decreasing rate of surviving and growing of the juveniles, adverse effects on reproduction, and finally suffocation. Ferrum sediments can also have a negative effect on roes and benthic organisms which form the fish's food (Diudea, M., et al.1986).

Sândominic - Tuşnadu Nou Section.

The river slope decreases up to 1 $^{0}/_{00}$ and some braided sectors (especially in the area Miercurea Ciuc – Tuşnadu Nou), favour the presence of some less rheophilic fish species than in the upstream and downstream sections.

The sampled specimens belonging to two species (*Gobio gobio obtusirostris* and *Leuciscus cephalus cephalus*) are representative for the state of ichthyological fauna of the area, determined by the human impact: urban and industrial waste from Miercurea Ciuc (a town with around 38,000 inhabitants) and the discharges of Harghita Mining Industry.

The main problems in this sector consist in the high concentrations of ferrum and zinc (**Fig. 6**).

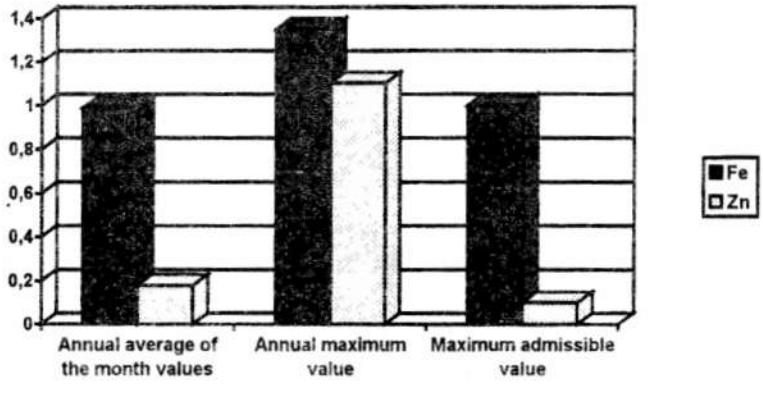

Fig. 6. *Annual average of the month values and annual maximum of Fe and Zn in 1977 in comparison with the admissible maximum value for the ichthyological fauna in Romanian freshwaters for Fe and Zn indicators (mg/l).*

Gorge Tuşnad Section

This 5 km long sector is total different from the rest of the upstream and downstream sectors of Olt River, from the point of view of ichthyological fauna's structure.

The presence of rheophilic and oxiphylic species (*Phoxinus phoxinus phoxinus, Orthrias barbatulus barbatulus, Barbus peloponessius petenyi* and *Gobio gobio obtusirostris*) shows that this sector can be included to grayling and balkan barbel zone, and on the other hand a substantial improvement of water quality in comparison with the upstream sections.

This peculiar situation is induced by the geomorphology of Tuşnad Gorge. That is the increasing of water velocity is determined by the narrowing of the valley and by the growth of the river bed slope up to 4 $^{0}/_{00}$, and the increasing of the dissolved oxygen value is due to the increasing of water velocity and turbulence. The river bed is formed of rocks, boulders, gravel and sand.

Bixad – Malnaş Section

In section Q3 - Q4 species *Scardinius erythrophtalmus erythrophtalmus* is prevalent. Thirty-one specimens of this species were collected and only one specimen of *Leuciscus cephalus cephalus*. Beside these two species, in fishermen's captures were identified the following: *Barbus barbus barbus, Chondrostoma nasus nasus, Gobio gobio obtusirostris* and *Lota lota*. The prevalence of red eye in this section, a less rheophilic species, is due to the decrease of water velocity and of the increase of sandy substratum proportion.

Ghidfalău – Bod Section

This section is characterized by an important increase in species number. In comparison with the upstream section eight more other species were found here. The silty–sandy substratum became prevalent.

Ariuşd – Ungra Section

At Feldioara, although samplings were made in the same effort/time unity as in neighboring stations, the results were significantly different, being collected only two specimens of *Barbus barbus barbus*. In comparison with this results at the upstream station 14 species were found and at the downstream one 16 species.

This obvious difference in ichthyofauna's diversity, in the neighboring river sections is due to the fact that the upstream part of Ariuşd – Ungra section is influenced by the flowing of strongly polluted rivers Ghimbăşel, Bârsa and Vulcăniţa. In this rivers are drained waste waters from Braşov, Zărneşti, Codlea and Râşnov.

Făgăraş – Avrig Section

This is one of the most complex section regarding the variation of the biotope conditions. These are influenced by the presence of some large dam-hydroelectric power station system. The human impact is also present by the modification of water quality due to the upstream drained waters, especially from Făgăraş industry.

A study made in 1988 in Ucea de Jos – Scorei – Avrig sector, demonstrated a drastic diminishing of the ichthyological fauna both quantitatively and concerning its diversity. An illustrative fact on the spot was the absence of the sport fishermen in this area.

The closing and/or diminishing of some industrial activities in Făgăraş, after 1989, has led to an improvement of the present state of the ichthyofauna (there are 7 species in addition).

The section also includes some subsequent accumulations: Voila, Viştea, Arpaş, Scorei and Avrig. Between all accumulations there are short unconcreted banks. Here, water velocity is faster and the biotope features resemble more those present before the dams construction.

This things lead to the presence of a relative polarization of fishes between each dam and the following one, according to the preference of each species and their age classes, for water velocity and depth.

In these areas with a faster velocity of water, diversity is higher in the proximity of confluences with some clean tributaries from Făgăraş Mountains. In these sections rheophilic and oxyphilic species can occur (*Phoxinus phoxinus phoxinus, Orthrias barbatulus barbatulus* and even *Salmo trutta fario*) which can come down accidentally from the above mentioned tributaries. Such cases occurred at

the Olt confluence with Sâmbăta, Breaza, Corbi and Scorei rivers. Unfortunately the positive influence of these numerous tributaries for the quality of Olt water is small, due to their reduced flows.

After 1989, the pollution diminishing of the accumulation lake waters, allowed them not to be obstacles in front of the individual exchangings between fish populations from different tributaries which flows in the same lake.

Avrig – Turnu Roşu Section.

Relative uniformity of environmental conditions downstream Tuşnad Gorge is interrupted only in the proximity of Turnu Roşu Gorge. Station Q11 – Q12 is two km upstream to this 20 km long gorge, this proximity being shown by the presence of the rheophilic species *Barbus peloponesius petenyi*.

CONCLUSIONS

With few exceptions, the presence of very resembling environmental conditions along the upper and middle sectors of the Olt River generates a relatively similar structure of the ichthyofauna in most sections of the river.

Exceptions are represented by Tuşnad Gorge and the Turnu Roşu Gorge proximal sectors, due to the presence of some different environmental conditions in comparison with those specific to the other sectors of Olt River.

To all these we add the polluted sections:

- Bălan – Tuşnadu Nou Section, where its northern side is devoid of fish, they being scarcely present (only two species) in its southern side.
- Bod – Ungra Section , characterized by the presence of a single species.

Beside the necessity of pollution diminishing in the above mentioned sections there are, at least, two sections which might be especially protected:

- Springs – Bălan Section, because it can be used as reference element, in case of ecological reconstruction of heavily damaged downstream areas.
- Tuşnad Gorge Section, this being the place where the water quality and ichthyofauna begin to recover after the bad state of upstream section.

After stopping/diminishing of some industrial activities, after 1989, the middle Olt suffered less because of the polluted waters in comparison with the upper Olt, being remarked an important increasing in fish number species.

Large dam-hydroelectric power station system influence the ichthyofauna. The presence of this system determine a relative polarization according to different velocities, depths and substrata of water, polarization which is repeated identically in all sections included between two subsequent dams.

Acknowledgements

I thank to the National Company "Romanian Waters" for the access to the annual syntheses regarding the surface water quality from the hydrographic basin Olt in 1997.

I also thank to all my friends who helped me in samplings.

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MICRO-EVOLUTIONARY AND DISPERSAL PROBLEMS IN FISHES INVOLVING THE OLT RIVER BASIN

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RÉSUMÉ

La distribution géographique et la variabilité intra-spécifique d'une espéce de cyclostomes et de trois espèces de poissons suggèreent que le cyclostome *Eudontomyzon mariae* est arrivé dans le bassin de l'Olt à partir de l'ouest; *Sabanejewia romanica* àpartir du sud-est, *Gobio kessleri* à partir du nord; l'utilisation des méthodes modernes de systématique est nécessaire afin d'établir l'origine des populations de *Sabanejewia aurata* dans le bassin supérieur et inférieur de l'Olt.

Keywords: ichthyofauna, biogeography, Olt River Basin

The Olt River is the largest of the three rivers having the source in Transylvania and flowing southwards, into the lower Danube, the two others being the Jiu River and the Buzău River. All other rivers from Transylvania and Banat flow west - and south-westwards into the Tisza River or directly into the middle Danube. The entire drainage area of the Danube (upper, middle and lower reaches as well) is zoogeographically unitary; there are however some differences, at the specific and especially at the infraspecific level between close related species and/or conspecific populations inhabiting distinct areas of the Danube basin and these raise problems of microevolution and/or dispersal, four such cases concern the basins of the Olt River and in the neighbourhood of other tributaries of the Danube.

1. Non-predatory lampreys of the genus *Eudontomyzon*

Two species of non-predatory lampreys have been recorded from the Danube Basin: (1) *Eudontemyzon mariae* (Berg, 1931) inhabiting the drainage areas of the rivers on the northern watershed of the Black Sea (Don, Dnieper, Southern Bug, Nistru or Dniester) and the lower Danube, as well as the Vistula and a few rivers on the Adriatic Sea watershed; in Romania is i.e. known from the eastern rivers (Siret River and tributaries) and from the southern ones (including the Argeş River that lies east and the Jiu River that lies west of the Olt River. (2) *E. vladykovi* (Olova et Zanandrea, 1957) distributed mainly in the basin of the upper and middle Danube but was also found in a tributary of the Olt River in Transylvania, it is in the lower Danube basin. In Romania it also lives in the upper reaches of the river Bega River and of the Bistra River, a tributary of the Timiş River (data mainly according to Bănărescu, 1969).

Holcik and Renaud (in Holcik, ed. 1986) consider *E. mariae* and *E. vladikovi* as synonym, accepting that the Danube basin populations may be ascribed to a distinct subspecies, *E. mariae vladikovi*. Actually the two lampreys differ in the shape of the anterior part of the head and the disposition of odontoids (illustrations in Bănărescu, 1969). Specimens identified by me as *E. vladykovi* from Romania (Olt

and Bistra rivers, tributary of the Timiş River) are identical to specimens from the type locality of *E. vladykovi*, while specimens from eastern Romania (drainage areas of the Siret and Argeş rivers) are identical to typical *E. mariae* from Ukraine. Accepting that *E. vladykovi* and *E. mariae* are conspecific subspecies this means that the first subspecies does not range throughout the whole Danube basin, but only in the upper and middle Danube and the upper-middle Olt River, while the populations from the tributaries of the lower Danube, except the Olt, belong to the nominal subspecies. .

It is difficult to explain the occurrence of *E. vladykovi* (or *E. mariae vladykovi*) in the Olt basin, since it is absent from the Transylvanian neighbouring rivers (tributaries of the Mureş River) in which the species is replaced by the predatory *E. danfordi*. Possibly, *E. vladykovi* had formerly a wider range, also in the tributaries of the Tisza River (Mureş etc.) where it has latter been replaced by the more competitive *E. danfordi*.

What it would be very important is the attempt to find *E. vladykovi* in either sites in the basin of the Olt (mainly in the upper reach) and to find if the lower, extra-carpathian drainage of the Olt is inhabited by *E vladykovi* or by *E. mariae* (no lamprey has been collected, until now, in that area).

2. The sand gudgeon, *Gobio kessleri*

Gobio kessleri is subject to a strong geographical variation in the Danube basin. The species was described from the Nistru River. The populations from eastern Romania (that is geographically close to the Nistru) are identical to those of the latter river. Those from the Transylvania (rivers Someş, Mureş, upper-middle Olt) are somewhat different, having lower bodies, shorter snout, larger eyes; they correspond to the form described by Vladykov (1925) as *G. "uranoscopus" carpathorossicus*. These differences are too slight for permitting to consider *carpathorossicus* as a valid subspecies of *G. kessleri*. On the contrary, the populations from the Banat (southwestern Romania) differ more strongly from those of the Nistru, eastern Romania and Transylvania and are ascribed to a distinct subspecies, *G. kessleri banaticus*. Remarkable is the position of the population from south-central Romania. Those of the rivers Jiu (west of the lower Olt) and Argeş (east of the lower Olt) are, to a certain degree, intermediate between the nominal subspecies and *banaticus*, being closer to the former. It seems that the geen pool of *G. kessleri banaticus* has influenced their own gene pool. On the contrary the population from the lower Olt drainage area and from a small river, Vedea, flowing between the Olt and the Argeş rivers are identical in all respects to the Transylvanian populations (from the Someş, Mureş, upper Olt rivers). This means that the Olt River Valley has been a dispersal route for the sand gudgeon from Transylvania to southern Romania.

3. The stone spiny loach, *Sabanejewia aurata*

Sabanejewia aurata is the species that underwent the strongest differentiation in Romania and in the whole basin of the Danube. The morphological aspects have been thoroughly analysed by Bănărescu et. al. (1972) who identified the populations from the upper and middle reaches of the rivers in Transylvania (except the upper Mureş inhabited by the endemic *S. aurata radnensis*), western and south-western Romania as identical to *S. aurata balcanica*. In the lower reaches of the same rivers, they described a gradual transition (intergradation) between this subspecies and *S.*

aurata bulgarica from the main channel of the Danube and its largest tributary, the Tisza River. Another subspecies, *S. aurata valachica*, ranges in the tributaries of the lower Danube in south-eastern Romania (rivers Ialomiţa, Buzău, Putna). At the confluence of these rivers with the Danube *S. aurata vallachica*, contrary to *S. aurata* from western and south-western Romania, does not intergradate with *S. aurata bulgarica*, but both live side by side as "good species". The status of the populations from the lower Danube tributaries in south-central Romania - the rivers Jiu, Olt (including its transylvanian sector), Vedea, Argeş - and in eastern Romania (Siret and its subtributaries) is problematic; these populations are, morphologically, intermediate between the subspecies *balcanica* and *vallachica*.

The unpublished results of the preliminary electrophoretic investigations by Dr C. Tesio do not, however, confirm the opinion of Bănărescu et. al. (1973): all populations from Timiş River in south-western Romania ("typical" *balcanica*, intergrades and almost "typical" bulgarica) are electrophoretically identical also with *S. a. bulgarica* from the Danube, differing much from *S. a. vallachica* while the population from the Argeş River, which is, morphologically, intermediate between the subspecies *balcanica* and *vallachica*, is, electrophoretically, identical with the latter. On the base of these preliminary data, *S. aurata* seem to include two distinct taxa: *balcanica/bulgarica* in the rivers north of the Carpathian Mountains and also in the lower Danube, and *vallachica* in the rivers south of Carpathians, which are tributaries of the lower Danube.

In this situation, it is necessarily to investigate electrophoretically, populations from various tributaries of the Olt, some of which are located north, others south of the Carpathians.

4. The sand-gudgeon, *Sabanejewia romanica*

S. romanica is the closest relative of the complex *S. aurata*. This species is endemic to a restricted area of Romania: tributaries of the lower Danube from the Iron Gates to the west and the Argeş River to the east (occurring in many tributaries of the Olt River in Transylvania north of the Carpathians, but not in the south-eastern rivers, Ialomiţa etc., where it lives to "typical" form of *S. aurata vallachica*; it also ranges in the south-western tributaries of the Mureş River in Transylvania, which belongs to the drainage area of the middle Danube. The range of the species is hence disjunct.

The subspecies of *S. aurata*, most similar to *S. romanica*, is *S. aurata vallachica*. The two are electrophoretically also similar (but not identical). It can hence be accepted that *S. romanica* originated south of the Carpathians, reached the lower Olt River from the east and extended its range northwards into the middle and upper Olt. But how did it reach the tributaries of the Mureş River? Evidently by means of a river capture and there are two possibilities: 1. From the Jiu River into the Strei River (the largest tributary of the Mureş River in which the species lives). 2. From some tributary of the Olt River in the vicinity of the Sebeş River, another tributary of the Mureş River. The second alternative seems more probable.

CONCLUSIONS

Of the four species dealt with, *Eudontomyzon vladykovi* reached the Olt River Basin from the west, *Gobio kessleri* from the north, *Sabanejewia romanica* from the east. Starting from the Olt River, *Gobio kessleri* extended to the Vedea River, *Sabanejewia romanica* to the southern tributaries of the Mureş River. The problems

of the evolution and dispersal of the various local forms of *S. aurata* in the Olt River Basin and in whole Romania can be clarified by using modern taxonomically methods.

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PRELIMINARY REPORT ON HERPETOFAUNA OF THE UPPER AND MIDDLE OLT RIVER BASIN

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REZUMAT

În lucrarea de faţă autorii prezintă noi date despre herpetofauna bazinului superior şi mijlociu al Oltului, realizând totodată şi o sinteză a datelor bibliografice. În această zonă au fost identificate 15 specii de amfibieni şi 12 specii de reptile în 105 habitate investigate. Harta care utilizează sistemul UTM indică localizarea acestor puncte de colectare a probelor (**Fig. 1**).

Keywords: herpetofauna, amphibians, reptiles, UTM system, geographical distribution, Olt River Basin.

INTRODUCTION

The herpetofauna of Romania is not well studied. To date, the most complete summaries are the two volumes of "Fauna R.P.R., Amphibia and Reptilia" by I. Fuhn (1960) and I. Fuhn & Şt. Vancea (1961). D. Cogălniceanu (1991) presents the geographic distribution data for amphibians in Romania, and this work could usefully be extended to reptiles. Data on the herpetofauna of the Olt River Basin occur sporadically in the literature; for example the amphibians of the Braşov Depression have been well studied by Edith Csata & Z. Csata (1996, 1997).

MATERIALS AND METHODS

The investigations were performed in October 1998 and intermittently before this between 1996-1998 in the optimum observation periods for the two studied groups. Data from Fuhn (1960), Fuhn & Vancea (1961) and Cogălniceanu (1991) were used, alongside those obtained by Urlea, M. and Graef, P.R. (pers. comm.). These data show the existence of 27 species of amphibians and reptiles in 105 sampling sites within the Olt River Basin.

We make use of the Universal Transverse Mercator System (UTM) with 2 by 2 km squares to map out all the data appearing herein.

RESULTS

The results obtained in mapping herpetofauna of the Olt River Basin are shown in the **Table 1**. For each locality, an altitudinal characterisation is given.

Tabel 1: ***Herpetofauna of the Olt River Basin***

Ss-*Salamandra salamandra*, **Ta**-*Triturus alpestris*, **Tm**-*Triturus montandoni*, **Tv**-*Triturus vulgaris*, **Bbo**-*Bombina bombina*, **Bva**-*Bombina variegata*, **Pf**-*Pelobates fuscus*, **Bbu**-*Bufo bufo*, **Bvi**-*Bufo viridis*, **Ha**-*Hyla arborea*, **Ra**-*Rana arvalis*, **Rd**-*Rana dalmatina*, **Rt**-*Rana temporaria*, **Rec**-*Rana esculenta complex*, **Eo**-*Emis orbicularis*, **La**-*Lacerta agilis*, **Lvv**-*Lacerta viridis*, **Lviv**-*Lacerta vivipara*, **Pm**-*Podarcis muralis*, **Af**-*Anguis fragilis*, **Nn**-*Natrix natrix*, **Nt**-*Natrix tesellata*, **El**-*Elaphe longissima*, **Ca**-*Coronela austriaca*, **Vb**-*Vipera berus*, **Vaa**-*Vipera ammodytes ammodytes*;
+ personal recordings; **1** recorded by Z.Csata (1996, 1997); **2** P.R Graef. (pers. comm); **3** M.Urlea (pers. comm.);
4 Bruckenthal Museum; **5** recorded by Cogălniceanu (1991); **6** Fauna R.P.R.-Amphibia; 7 Fauna R.P.R.-Reptilia.
Hio.- hillock; **Hill**. –hilly; **Mo.** -mountain.

Nr. crt.	Locality	UTM	Zone	Ss	Ta	Tm	Tv	Tc	Bbo	Bva	Pf	Bbu	Bvi	Ha	Ra	Rd	Rt	Rec	Eo	La	Lvv	Lvi	Pm	Af	Nn	Nt	El	Ca	Vb	Vaa
Olt River flood plain																														
1.	Sândominic	MM 03.53.	Mo			+	+	+		+ 5		+	+				+ 5	+		+					+				+	
2.	Miercurea-Ciuc	MM 03.31	Hill				+ 5	+		+ 5			+				+	+		+ 7					+					
3.	Sâncrăieni	MM 04.24	Hill				+	+		+ 5		+	+ 5	+		+	+	+		+		+	+		+	+			+	
4.	Sântimbru	MM 10.22	Hill					5		+			+						+	+					+				+	
5.	Tuşnad	MM 12.13	Hill	+ 5 6	5	5 6		+ 5		+		+ 5		5			+ 5 6			+ 7		7	+ 7	7	7		+ 7		+ 7	
6.	Bixad	MM 10.02	Hill	+	+	5		5		+ 5	+	+	+	+	+	+	+ 5	+		+	+	+	+	+	+		+	+	+	
7.	Micfalău	MM 04.94	Hill	+						+		+		+	+	+	1 +	+		+				+	+		+		+	
8.	Bodoc	ML 10.84	Hill	+						+ 1		+	+	+	+	+	1	+			+	+	+		+		+		+	
9.	Zălan	ML 04.84	Hill	+	+			+		+ 1	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+		+	
10.	Upstream Sf.-Gheorghe	ML 04.81	Hill			1 5				+		+			+	+	+	+		+	+		+				+		+	
11.	Sf.-Gheorghe	ML 01.74	Hill	1 +	1		1 5	1 + 5		1 + 5		1 + 5	1 + 5	1 +	+ 6	1 + 5 6	1 +	1 5		+ 7	+		+	7	+	+		+		+	
12.	Chilieni	ML 03.73	Hill	+				+		+	+	+		+	+	+	+	+		+	+			+	+	+			+	
13.	Ilieni	ML 01.70	Hill															+ 1												
14.	Chichiş	ML 02.64	Hill					+		+		+		+	+		+	+		+				+	+	+				
15.	Ariuşd	LL 93.64	Hio					+		1 +		1 +	+	+	+	+	+	1 +		+				+	+			+	+	
16.	Hâghig	LL 84.73	Hio	+			1	1 +	+	1 +		+	1 +	+	+	+	+	1 +		+	+		+		+				+	
17.	Belin	LL 83.83	Hio	+					+	+		+	+	+	+	+	+	1 +		+	+			+	+	+			+	
18	Apaţa	LL 82.84	Hio							+		+	+			+	+													
19	Augustin	LL 84.94	Hio	+				+		+	+	+	+	+		+		+		+	+		+	+	+		+		+	

Nr. crt.	Locality	UTM	Zone	Ss	Ta	Tm	Tv	Tc	Bbo	Bva	Pf	Bbu	Bvi	Ha	Ra	Rd	Rt	Rec	Eo	La	Lvv	Lvi	Pm	Af	Nn	Nt	El	Ca	Vb	Vaa
20	Racoş	LL 72.93	Hio							+	+	+	+			+	+	+		+				+	+		+			
21	Hoghiz	LL 63.91	Hio							+								+		+	+			+					+	
22	Comăna de Jos	LL 60.82	Hio												+															
23	Mândra	KL 71.84	Hio												+			+						7	+			7		
24	Sâmbăta de Jos	LL 30.72	Hio															+						7				7		
25	Arpaşu de Jos	LL 12.71	Hio					2				2				2		2												
26	Scoreiu	LL 03.70	Hio				2	2		2																				
27	Porumbacu de Jos	LL 00.64	Hio				2			2							2													
28	Avrig	KL 92.63	Hio	2			2 3	2	2	3		2 3	3	3	2 3	2 3	2	2 3	2 3	2 3	3		3	3	2 3	3	2 3 4			
29	Bradu	KL 91.63	Hio																2											
30	Mârşa	KL 92.62	Hio				2								2				2					2						
31	Racoviţa	KL 90.60	Hio									2																		
32	Sebeşul de Sus	KL 91.54	Hio							+								+		+										
33	Podu Olt	KL 82.63	Hio																		2									
34	Turnu Roşu	KL 84.53	Mo	4				2											2		2		2 4	4	2	2 4				2 4
35	Boiţa	KL 82.53	Mo													2			2		2									2 4
36	Râu Vadului	KL 83.41	Mo																		4		4							
Râul Negru Valley																														
37	Balvanyos	MM 20.02	Mo	+						5		+	+		+	+	+			+	+	+	+	+	+	+	+	+	+	
38	Turia	ML 22.94	Hill	1 +		+		+		+ 5	+	+	+ 5	+	+	1 +	+	+		+	+	+		+	+	+	+	+	+	

Nr. crt.	Locality	UTM	Zone	Ss	Ta	Tm	Tv	Tc	Bbo	Bva	Pf	Bbu	Bvi	Ha	Ra	Rd	Rt	Rec	Eo	La	Lvv	Lvi	Pm	Af	Nn	Nt	El	Ca	Vb	Vaa
39	Sânzieni	ML 31.94	Hill	+				+		+		+	+	+	+	+	+	+		+			+		+	+	+	+	+	
40	Lemnia	MM 41.00	Hill	+	+					1 +		+	+	+	+	+	1 +	+		+	+			+	+					
41	Târgu-Secuiesc	ML 39.91	Hill				1	1 +		1 + 5	1	1 +	1 +	1	1 +	1 5	1 5	1 5		+	+			+	+	+				
42	Cătălina	ML 32.84	Hill	+				+ 5		+	+		+	+	1 + 5	+	+	+		+	+				+				+	
43	Ghelința	Ml 34.83	Hill	+				+		+	+	+	+	+	+	+	+	+		+	+	+			+		+		+	
44	Surcea	ML 24.80	Hill					+		1 +		+	+	+	+	+	+	1 +		+	+		+		+					
45	Pădureni	ML 13.80	Hill	+				1 +		1 +		+	+	1	+	1 +	+	1 +		+	+		+	+	+	+	+		+	
46	Moacșa	ML 14.74	Hill	+				+		+	+	+	+	+	+	+	+	+		+		+	+	+	+	+		+	+	
47	Bita	ML 20.73	Hill					+		+				+	+		+	1 +		+	+			+	+				+	
48	Brateș	ML 23.72	Hill				1	+		+		+	+	+	+	+	+	1 +		+			+		+				+	
49	Covasna	ML 31.73	Mo	+	1 + 5		1	+	5	1 +		1		+	1 5 6		1			+		+	+		+					
50	Reci	ML 12.73	Hill				1 5	1 5	+	1 + 5	1 + 5 6	1 5	1 5	1 + 5	1 + 5 6	1 + 5 6	1 + 5	1 + 5		+ 8				+	+	+				
51	Ozun	ML 04.70	Hill			+		+		+	+			+	+	+	+	+		+	+	+	+		+	+				
52	Boroșneu-Mare	ML 20.71	Hill					+		+	+	+	+	+	+		+	+		+	+				+				+	
Cibin River Valley																														
53	Râul Mare-Cibin gorges	FS 64.00	Mo		2		2			2		2			2															
54	Sibiel	GR 23.70	Hill																				2							
55	Fântânele	GR 24.70	Hill	2	4																								2	
56	Orlat	GR 30.64	Hill		2		2	2		2		2	2				2	2		2		2							4	
57	Gura Râului	GR 31.63	Hill		2		2			2		2					2	2		2									2	

Nr. crt.	Locality	UTM	Zone	Ss	Ta	Tm	Tv	Tc	Bbo	Bva	Pf	Bbu	Bvi	Ha	Ra	Rd	Rt	Rec	Eo	La	Lvv	Lvi	Pm	Af	Nn	Nt	El	Ca	Vb	Vaa
58	Păltiniş	GR 24.60	Hill		4																	2 4					4		2 4	
59	Răşinari	KL 70.62	Hill	2	4							4					4					2		4						
60	Cisnădioara	KL 72.62	Hio	2 4													2 4					2	2	2 4	2				2	
61	Cisnădie	KL 73.62	Hio	2													2 4		2				4	2	2 4			2	4	
62	Şelimbăr	KL 80.70	Hio							4						4	4		4											
63	Bungard	KL 81.71	Hio					2		2						2		2	2											
64	Cristian	KL 63.72	Hio				2											2												
65	Şura Mică	KL 64.74	Hio							2								2	2	4										
66	Sibiu	KL 73.73	Hio	2																										
67	Turnişor Sibiu	KL 73.72	Hio				2	2		2				2		2		2	2	4										
68	Dumbrava Sibiului	KL 72.72	Hio									4		2		4	2	2		4				4	2			4		
69	Guşteriţa Sibiu	KL 74.73	Hio	2	2 4		2 4		2 4	4		2 4	2 4		2		2 4	2 4	2 4	2 4	2 4			2 4	2 4	2	2	4	2	
70	Mohu	KL 81.64	Hio				2	2		2		2						2										2		
71	Veştem	KL 81.63	Hio				2			2		2				2		2												
72	Tălmaciu	KL 83.54	Hio				2	2		2		2				2		2	2 4	2	2			2 4	2 4		2	2		
Sadu Valley																														
73	Râu Sadului	KL 70.53	Hill	2	4																				4				2 4	
74	Sadu	KL 74.60	Hio	2	4							4					2					2	2	2			2	4	2 4	
Hârtibaciu Valley																														
75	Brădeni	LM 30.02	Hio										2		2				2											
76	Agnita	LL 12.91	Hio				2	2		2		2	2	2		2	2	2	2	2	2			2	2		2	2	2	

Nr. crt.	Locality	UTM	Zone	Ss	Ta	Tm	Tv	Tc	Bbo	Bva	Pf	Bbu	Bvi	Ha	Ra	Rd	Rt	Rec	Eo	La	Lvv	Lvi	Pm	Af	Nn	Nt	El	Ca	Vb	Vaa
77	Pelişor	LM 03.00	Hio												4	4		4												
78	Marpod	LL 02.81	Hio															4												
79	Hosman	KL 94.74	Hio									+						+		+										
Cârţişoara Valley																														
80	Cârţişoara	LL 10.62	Hill		2							2			2		2	2											2	
Avrig Valley																														
81	Mărăcini	KL 94.63	Hio															3												
82	Hamuri	KL 92.62	Hio															3												
83	Câmpşor	KL 93.62	Hio															3								3				
84	Fântâna Comisului	KL 94.62	Hio															3												
85	Pârâul Tei	KL 92.61	Hio				3								3			3	3											
86	Valea Neagră	KL 93.61	Hio				3											3												
87	Unghiu	KL 94.60	Hill															3												
88	Ograda Săvuţului	LL 00.60	Hill															3												
89	Gura Jibrii	KL 94.53	Mo		3			3					3			2	2 3	3		2	3		2							
90	Mlăci	KL 94.52	Mo							3						3		3												
91	Medicşeni	KL 00.52	Mo											3			3	3												
92	Poiana Neamţului	LL 01.53	Mo	2 3	2 3 4					3							3	3		2				3 4						
93	Bărcaciu	LL 01.51	Mo	2 3	3													3	3				3						4	
Lotrioara Valley																														
94	Lotrioara	KL 81.50	Mo	2 4+	+			+ 2		2 4		4 +							2	2	2 4		2 4	2 4	2 4	2	2			2 4 7

Nr. crt.	Locality	UTM	Zone	Ss	Ta	Tm	Tv	Tc	Bbo	Bva	Pf	Bbu	Bvi	Ha	Ra	Rd	Rt	Rec	Eo	La	Lvv	Lvi	Pm	Af	Nn	Nt	El	Ca	Vb	Vaa
Other localities in the Olt River Basin																														
95	Sântionlunca	ML 11.72	Hill					+		+	1 +			+	1 +	+	+	1 +		+	+		+	+	+	+				
96	Hărman-Prejmer	LL 93.62	Hill				1	1		1	·		1	1	1	1	1	1		·			·							
97	Arini	LL 84.81	Hio															+							+					
98	Aita Mare	LL 83.90	Hio					+		+		+	+	+	+	+	+	+		+		+		+	+					
99	Micloşoara	LL 84.92	Hill	+				+		+	+	+	+	+	+	+	1 +	+		+	+	+		+	+	+	+		+	
100	Vârghiş	LM 83.04	Hill	+	+			+		1	+	+	+	1 +	+	1 +	+			+	+		+	+	+		+		+	
101	Baraolt	LM 91.01	Hill	+			1	1 +		1 +	+	1 +	1 +	1 +	+	+	+	1 +		+	+		+		+	+				
102	Bățani Mari	LM 94.03	Hill	+				+		+		+	+		+	+	+	+		+	+	+		+	+	+	+		+	
103	Măieruş Valley	LL 82.81	Mo	+						+							+													
104	Bogata Valley	LL 71.91	Mo	+												+														
105	Codlea	LL 73.60	Mo	+	+		+			+		+				+	+	+		+	+		+	+	+		+		+	

Cls. Amphibia
Ord. Caudata
Fam. Salamandridae

1. *Salamandra salamandra salamandra* (Linnaeus, 1758)

A polytypic species with many subspecies. The Romanian population belongs to the nominotypic race. This is a terrestrial, nocturnal species, and a typical inhabitant of deciduous and mixed forests usually between 200-1400 m altitude. The presence of small clean streams and pools are necessary for its reproduction.

We observed this species in 23 new localities; previously it was recorded in 20 localities (in 4 of those it was rediscovered by us).

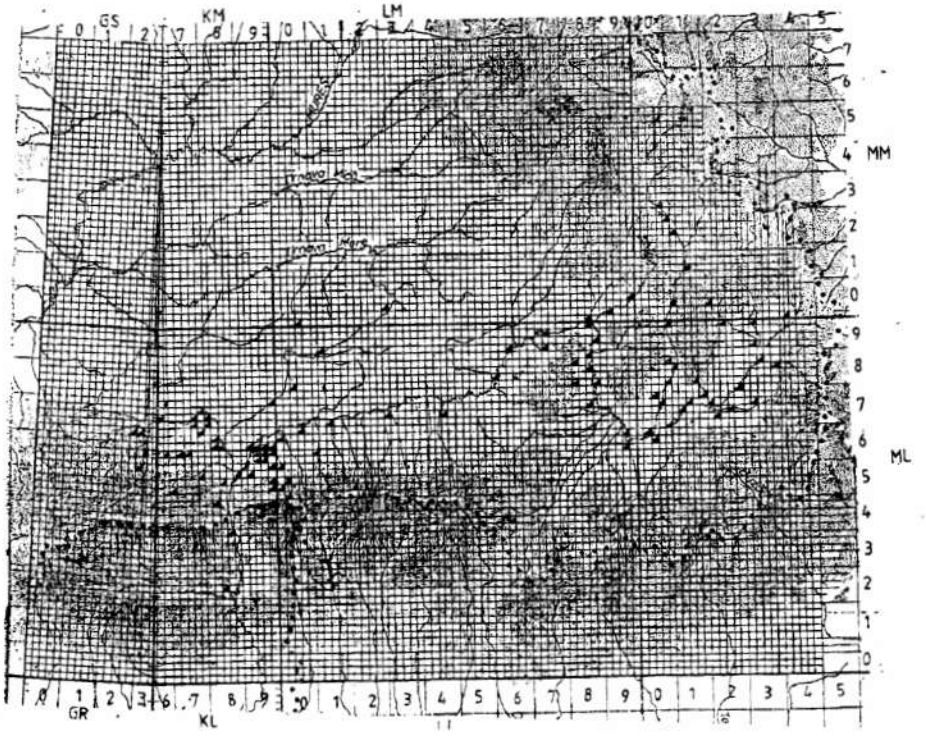

Fig. 1. *UTM system map of the studied zones; the dots represent the localities where amphibian and reptile species were recorded.*

2. *Triturus alpestris alpestris* (Laurenti, 1768)

A highly polytypic species with many subspecies, the nominotypic race occurring in Romania. It prefers shaded, shallow water bodies and inhabits mainly middle to high elevations from 800 - 1900m altitude.

This species was observed in 6 new localities, previously it was recorded in 16 localities (in 1 of those rediscovered by us).

2. *Triturus vulgaris*

A polytypic species, with 2 subspecies which occurr in Romania: *T. vulgaris vulgaris* (Linnaeus, 1758) and an endemic subspecies for Transylvania *T. vulgaris*

ampelensis (Fuhn, 1951). It prefers well-vegetated warm pools, small ponds or puddles up to 1000 m altitude.

It was observed in 3 new localities, previously it was recorded in 25 localities (in 1 of those rediscovered by us).

4. *Triturus cristatus* (Laurenti, 1768)

Recently recognised as a monotypic species. Typical habitats are larger and deeper water bodies up to 1000 m altitude.

We observed this species in 23 new localities, earlier studies found it in 22 sites (in eight of which it was found in our survey).

5. *Triturus montandoni* (Boulenger, 1880)

A monotypic species and it is a Carpathian endemic. It reproduces in small water bodies mainly in forest habitats. It inhabits humid, shaded slopes, mainly in middle to high elevations (500 -1900 m altitude).

It was observed in 3 new localities, earlier it was recorded in other 3 localities.

Ord. Anura
Fam. Discoglossidae

6. *Bombina variegata variegata* (Linnaeus, 1758)

A polytypic species, the populations from Romania belong to the nominotypic race. Typically breeds in small temporary water bodies or puddles mostly in higher elevations (400-1600 m alt.). It inhabits a great variety of habitats including those of human origin. It is unaffected by the water quality.

We observed this species in 26 new localities; previously it was recorded in 39 localities (rediscovered in 19 of those by us).

7. *Bombina bombina* (Linnaeus, 1785)

A monotypic species, showing a more aquatic habitat than *B. variegata*. It prefers permanent pools and ponds. It breeds in shallow water with dense vegetation.

It was observed in 3 new localities, before it was recorded in other 3 localities.

Fam Pelobatidae

8. *Pelobates fuscus fuscus* (Laurenti, 1786)

It is a polytypic species, in our country appearing the nominotypic subspecies. It prefers light sandy soil near large rivers, in agricultural landscapes and wetlands. It occurs in lower and middle elevations, usually up to 800 m altitude.

We observed it in 14 new localities; previously it was recorded in 3 localities (in 2 of those rediscovered by us).

9. *Bufo bufo bufo* (Linnaeus, 1758)

A polytypic species, the nominotypic form occurring in Romania. It inhabits the zone of mixed forests on hilly and mountainous regions to high altitude (max 1400 m). It reproduced in pools, ponds and bogs, occasionally in streams.

We observed it in 31 new localities; before was recorded in 23 localities (in 6 of those rediscovered by us).

10. *Bufo viridis viridis* (Laurenti, 1768)

A polytypic species, the nominotypic race occurs here. Mostly a nocturnal and terrestrial species, occurring mainly in anthropogenic habitats. It avoids extensive forests and high altitudes (max. 1000 m).

We observed it in 25 new localities, previously it was recorded in 14 localities (rediscovered in six of those by us).

Fam. Hylidae

11. *Hyla arborea arborea* (Linnaeus, 1758)

A polytypic species, the nominotypic race occurring in Romania. Generally a diurnal species found in open sun-exposed habitats near water bodies with natural herbaceous vegetation, usually up to 800 m above sea level.

It was observed in 28 new localities, previously it was recorded in 14 localities (in 4 of those rediscovered by us).

Fam. Ranidae

12. *Rana esculenta complex*

We treat these three forms (*Rana ridibunda, R. esculenta* and *R. lessonae*) together since the systematic status of this group is currently under review. They are aquatic frogs (*R. lessonae* is the least aquatic) and they are predominantly diurnal. They inhabit a wide variety of water bodies up to 7-800 m altitude.

They were observed in 30 localities, previous studies recording it in 44 localities (in 12 of which we recorded it as well).

15. *Rana arvalis*

A polytypic species, with two races of which occur in Romania, the nominotypic *Rana arvalis arvalis* (Nilsson, 1842) and *Rana arvalis wolterstorffi* (Fejervary, 1919).

The nominotypic form was found only in Râul Negru Basin (Reci).

Rana arvalis wolterstorffi was observed in 31 new localities, previously being recorded in 13 localities (in 4 of those rediscovered by us).

16. *Rana dalmatina* (Bonaparte, 1840)

A monotypic species. It is active at daytime and it is a typical inhabitant of light deciduous forests, mostly in low and middle elevation from 150 to 800 m altitude.

We observed it in 27 new localities, previously it was recorded in 20 localities (in 5 of those rediscovered by us).

17. *Rana temporaria temporaria* (Linnaeus, 1758)

A polytypic species, the nominotypic race occurs in Romania. It is a terrestrial diurnal frog. It prefers wet and shaded habitats near streams, ponds or other water reservoirs at middle to high elevations (300 to 1800 m alt.).

It was observed in 23 new localities, previously it was recorded in 28 localities (in 8 of those rediscovered by us).

Cls. Reptilia
Ord. Testudines
Fam. Emydidae

1. *Emys orbicularis* (Linnaeus, 1758)

A polytypic species, many subspecies of uncertain status are currently recognised. It is a most aquatic species, usually found in steady or slow running water with some vegetation.

We observed it in 1 locality (close to Sibiu), and local people have observed it near Sântimbru. Earlier studies recorded it in 17 localities.

Ord. Sauria
Fam. Lacertidae

2. *Lacerta viridis viridis* (Laurenti, 1768)

A polytypic species, two subspecies of which occur in Romania. The nominotypic race occurs in Transylvania. It is found over a variety of habitats, commonly in humid and well-vegetated lowland areas, exceptionally up to 700 m altitude.

We observed this species in 27 new localities, previously it was recorded in 11 localities.

3. *Lacerta agilis agilis* (Linnaeus, 1758)

A polytypic species, but in Transylvania only the nominotypic form is found. It is a diurnal lizard and it inhabits wet habitats up to 1500 m alt., including some close to human habitation.

It was observed in 40 new localities, previously it was recorded in 16 localities (in 4 of those rediscovered by us).

4. *Podarcis muralis muralis* (Laurenti, 1768)

A polytypic species, the nominotypic race occurs in Transylvania. It inhabits various dry and warm habitats, often with rock-piles.

We observed it in 20 new localities, previously it was recorded in 11 localities (in 1 sampling site rediscovered by us).

5. *Lacerta vivipara* (Jacquin, 1787)

A monotypic species of diurnal lizard. It inhabits humid habitats with herbaceous vegetation (e.g. alpine meadows, marshes, bogs and banks of streams) between 800-2200 m.

It was observed in 13 new localities, previously it was recorded in 6 localities.

Fam. Anguidae

6. *Anguis fragilis colchicus* (Nordmann, 1840)

A polytypic species with two subspecies, but only *A. fragilis colchicus* occurs in Romania. It is an adaptable species and it inhabits a variety of wet meadows, between 400 - 1900 m altitude.

We observed this species in 25 new localities, previously it was recorded in 17 localities.

Ord. Serpentes
Fam. Colubridae

7. *Elaphe longissima longissima* (Laurenti, 1768)

A polytypic species, the nominotypic race occurring here. It is a diurnal species that prefers variable landscapes exposed to the sun (forest margins, rocky slopes, and ruins).

It was observed in 17 new localities, previously it was recorded in 8 localities (in 1 of those rediscovered by us).

8. *Coronella austriaca austriaca* (Laurenti, 1768)

A polytypic species, the populations from Romania belong to nominotypic form. This diurnal species prefers sun-exposed sites (forest margins, meadows) up to 1500 m altitude.

We observed this species in 7 localities, previously it was recorded in 9 sites.

9. *Natrix natrix natrix* (Linnaeus, 1758)

A highly polytypic species with many subspecies. The Romanian populations belong to nominotypic race. It is a diurnal snake and it swims well. It is the most common snake, distributed almost everywhere close to water bodies, including the vicinity of human settlements.

We observed it in 41 new localities, previously it was recorded in 11 localities.

10. *Natrix tessellata* (Laurenti, 1768)

It is a monotypic species with no presently recognised subspecies. A widely distributed diurnal species, it swims and dives well. It prefers warm habitats, often river valleys with south-exposed stony slopes.

It was observed in 18 new localities, previously it was recorded in 5 localities.

Fam. Viperidae

11. *Vipera ammodytes ammodytes* (Linnaeus, 1758)

A polytypic species with four subspecies. In Romania occur two races, the nominotypic and *V. a. montandoni*. It inhabits heterogeneous habitats exposed to the sun (e.g. forest margins, screes and rock-piles).

This species was not observed by us, but previously it was recorded in 3 localities (Lotrioara, Boiţa and Turnu Roşu).

12. *Vipera berus berus* (Linnaeus, 1758)

A polytypic species with three present recognised subspecies. It is mostly a diurnal species (partly nocturnal in summertime), it prefers sun-exposed but humid habitats at middle to high elevations (up to 2300 m).

We observed this species in 28 localities, previously it was recorded in 13 localities (in 1 of those rediscovered by us).

Altitudinal geographical distribution

The Olt River Basin was divided into three main zones: mountainous, between 800-1800 m; hilly, between 400-800 m and hillock, between 200-400 m altitude (**Fig.**

1). Tables 2 and **3** present the number of localities in which the amphibian and reptile species were found in the three altitudinal zones.

Table 2

The altitudinal spreading of amphibians in the Olt River Basin. The numbers in the table represent the number of localities where the species were recorded. Hio.- hillock region; Hill.- hilly region: Mo.- mountain region. The other abbreviations are as in ***table1****.*

	S.s	*T. a*	*T. m*	*T.v*	*T.c*	*B. bo*	*B. va*	*P.f*	*B. bu*	*B. vi*	*H.a*	*R.a*	*R. d*	*R.t*	*R.e.c*
Hio.	5	2	-	8	9	3	15	1	9	8	8	8	14	11	25
Hill	24	12	5	13	18	5	37	16	32	24	28	33	28	38	42
Mo.	10	7	1	8	5	3	7	-	7	7	3	3	6	8	7
	39	**21**	**6**	**29**	**32**	**11**	**59**	**17**	**48**	**39**	**39**	**34**	**48**	**57**	**74**

Table 3.

The altitudinal spreading of reptiles in the Olt River Basin. The numbers in the table represent the number of localities where the species were recorded. The other abbreviations are as in ***table 1*** *and* ***2***

	E.o	*L.a*	*L.vv*	*L.vi*	*P.m*	*A.f*	*N.n*	*N.t*	*E.l*	*C.a*	*V.b*	*V.a.a*
Hio.	10	10	3	4	5	5	11	3	5	7	8	-
Hill.	5	35	25	12	16	30	33	17	15	11	25	-
Mo.	3	10	6	3	8	7	6	3	4	2	4	3
Tot.	**18**	**55**	**34**	**19**	**29**	**42**	**50**	**23**	**24**	**20**	**37**	**3**

In the hillock zone were studied 46 localities (42 % of all). Because of the modifications of the natural habitats (used for agriculture), the amphibian and reptile species were found in very few localities.

In the hilly zone were studied 41 localities (39 % of all). In this zone a large diversity of habitats was observed and consequently the amphibian and reptile species were observed in approximately 50% of the localities.

The mountain zone (18 localities – 19 % of all) has less favourable habitats for amphibian and reptile species. We observed amphibian and reptile species in about 30% of the studied localities, more than in the hillock zone but less than in the hilly zone.

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DATA ON THE AVIFAUNA FROM THE OLT AND CIBIN VALLEYS

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REZUMAT

Lucrarea de faţă aduce contribuţii la cunoaşterea avifaunei de-a lungul cursului superior şi mijlociu al Oltului şi a văii Cibinului. Până în prezent în regiunea cercetată au fost identificate de către autori, sau citate în bibliografia de specialitate, 196 de specii de păsări. Studiile actuale ilustrează modificările apărute în structura avifaunei, ca urmare a modificărilor habitatelor specifice sub influenţa impactului antropic. Diversitatea cea mai mare a acestui grup se înregistrează în timpul migraţiilor, motiv pentru care zonele umede din bazinul superior şi mijlociu al Oltului trebuie menţinute şi protejate în viitor, pentru a se asigura un loc de odihnă şi refacere pentru speciile legate de mediul acvatic.

Keywords: avifauna, waterfowl, biodiversity, Olt River Basin

INTRODUCTION

The Olt River, one of the most important rivers in Romania because of its length and flow, contributes to the genesis of some most diverse habitats.This way, until its confluence with the Danube, passes through several altitudinal levels, each of them having a specific vegetation and birdfauna.

Studies of the birdfauna of the Olt River have been made since the 19th century especially on the middle course by the German biologists from the Transylvanian Society for Natural Sciences in Sibiu. The studies continued also in this century, many ornitologists publishing data on the birdfauna of some regions crossed by the Olt River, but there is no general study of the birdfauna of the Olt River.

In this article we present the results of a number of birdfauna expeditions made in the Cibin River Basin and on the superior and middle course of the Olt River correlated with the bibliographical data that already exist.

DESCRIPTION OF HABITATS

The habitats in which we made observations can be parted in two categories:

A. Terrestrial habitats
- forest (Gura Râului, Şopa, Pădurea Bogata, Hărman) and riverside coppices (on the course of Olt and Cibin rivers)
- meadows with isolated scrubs (Seviş, Turnu Roşu, Sântionlunca, Scorei)
- agricultural fields (Seviş)

B. Aquatic habitats
- the course of Cibin and Olt rivers
- lakes (Gura Râului, Avrig, Scorei, Rotbav, Călineşti)
- former (dead) meanders (Racoviţa, Turnu Roşu, Arini, Aita Mare, Micloşoara)

METHODS

During the collecting data expeditions we made ornithological observation by means of binoculars and occasionally we used the bird ringing method using bird nets for the elaborated of species list from Cibin and Olt rivers valleys.

Owing to the variation of biotops and the specific vegetation we part the presentation of species. Thus, the Cibin River has been divided into areas: the upper part of the basin and the lower part of the river basin (both, the middle and inferior course of the Cibin River are presented together as the lower part owing to the conditions of biotop and riparian vegetation which are almost the same). The Olt River was also divided into two areas; the upper and the middle course.

We also used the bibliographical notes concerning the birdfauna of the studied areas because the time of the expedition was too short and the period of the year was not propitious to draw up a complete list of species.

FAUNISTICAL CONSIDERATIONS

Table 1. ***The birdfauna of the Cibin River and Olt River basins***
** → species identified by the authors; + → species quoted from the references*

Researched area	Cibin River Basin		Olt River Basin	
Species	Upper Basin	Middle and Lower Basin	Upper Basin	Middle Basin
1. Gavia arctica				+
2. Gavia stellata				+
3. Podiceps cristatus				*
4. Podiceps griseigena				+
5. Podiceps nigricollis				+
6. Tachybaptus ruficollis				*
7. Phalacrocorax carbo				*
8. Phalacrocorax pygmeus				+
9. Botaurus stellaris				+
10. Nyctycorax nyctycorax				+
11. Egretta garzetta				+
12. Egretta alba				+
13. Ardea cinerea		*		*
14. Ardea purpurea				+
15. Ciconia ciconia		*	*	*
16. Ciconia nigra		*	*	*
17. Ixobrychus minutus				*
18. Cygnus olor				+
19. Anser fabalis				+
20. Anser albifrons				+
21. Anser anser				+
22. Tadorna tadorna				+
23. Anas platyrhynchos			*	*
24. Anas strepera				+
25. Anas pénelope				+
26. Anas crecca			+	*
27. Anas querquedula			+	+
28. Anas acuta			+	+
29. Anas clypeata				+
30. Aythya fuligula				+
31. Aythya marila				+
32. Aythya ferina				*
33. Aythya nyroca				+
34. Melanitta fusca				+

35. *Bucephala clangula*				+
36. *Mergus merganser*				+
37. *Mergus serrator*				+
38. *Mergus albellus*				+
39. *Aquila chrysaetos*	+			+
40. *Aquila clanga*			+	
41. *Aquila pomarina*		*	+	+
42. *Circaetus gallicus*			+	
43. *Buteo buteo*	+	*	+	*
44. *Buteo lagopus*				*
45. *Pernis apivorus*			+	
46. *Accipiter gentilis*			+	*
47. *Accipiter nisus*		*	+	*
48. *Circus aeruginosus*				+
49. *Circus cyaneus*		*		+
50. *Pandion haliaetus*				+
51. *Falco peregrinus*				+
52. *Falco subbuteo*	+		+	+
53. *Falco columbarius*				+
54. *Falco tinnunculus*	+	*	+	*
55. *Actitis hypoleucos*				*
56. *Numenius arquata*				*
57. *Limosa limosa*				+
58. *Gallinago gallinago*		*	+	+
59. *Larus ichtyaetus*				+
60. *Larus ridibundus*				*
61. *Larus minutus*				+
62. *Larus melanocephalus*				*
63. *Larus cachinnans*				+
64. *Larus hyperboreus*				+
65. *Larus canus*				+
66. *Rissa tridactyla*				+
67. *Sterna hirundo*				+
68. *Chlidonias niger*				+
69. *Chlidonias leucopterus*				*
70. *Columba livia domestica*		*		*
71. *Columba oenas*		*		*
72. *Columba palumbus*		*		+
73. *Streptopelia turtur*		*	+	+
74. *Streptopelia decaocto*		*	+	+
75. *Cuculus canorus*	+	*	+	*
76. *Tetrastes bonasia*			+	
77. *Tetrao urogallus*	*		+	
78. *Perdix perdix*		*		*
79. *Coturnix coturnix*			+	*
80. *Phasianus colchicus*				*
81. *Rallus aquaticus*				+
82. *Porzana pusilla*				+
83. *Crex crex*				+
84. *Gallinula chloropus*				*
85. *Fulica atra*				*
86. *Himantopus himantopus*				+
87. *Charadrius dubius*				+
88. *Eudromias morinellus*	+			
89. *Pluvialis squatarola*				+
90. *Vanellus vanellus*		*	+	*
91. *Tringa totanus*				+
92. *Tringa nebularia*				+

93. Tringa hypoleucos				+
94. Tringa glareola				+
95. Tringa ochropus				+
96. Philomacus pugnax				+
97. Athene noctua		*	+	+
98. Asio otus				+
99. Apus apus			+	*
100.Alcedo atthis				*
101.Coracias garrulus			+	
102.Merops apiaster				+
103.Upupa epops			+	+
104.Dryocopus martius				+
105.Picus canus		+		+
106.Picus viridis				+
107.Dendrecopos major		*	+	*
108.Dendrecopos medius		*		+
109.Dendrecopos minor		*		+
110.Jynx torquilla			+	
111.Galerida cristata			+	*
112.Alauda arvensis		*	+	*
113.Lullula arborea			+	*
114.Eremophila alpestris	+			
115.Hirundo rustica	+	*	+	*
116.Riparia riparia			+	+
117.Delichon urbica	+	*	+	*
118.Anthus trivialis				+
119.Anthus pratensis		*		*
120.Anthus spinoletta	+		+	+
121.Motacilla alba	*	*	*	*
122.Motacilla flava		*		+
123.Motacilla cinerea	*	*	+	*
124.Cinclus cinclus	+			+
125.Troglodytes troglodytes	+	*	*	*
126.Prunella modularis	+		+	*
127.Prunella collaris	+			
128.Muscicapa striata		*		
129.Erithacus rubecula	*	*	*	*
130.Luscinia luscinia		*	+	+
131.Phoenicurus phoenicurus			+	
132.Phoenicurus ochruros	+		+	+
133.Saxicola rubetra			+	*
134.Saxicola torquata				+
135.Oenanthe oenanthe	+		+	+
136.Turdus merula		*	*	*
137.Turdus torquatus	*		+	
138.Turdus pilaris		*	*	*
139.Turdus iliacus				+
140.Turdus philomelos		*	+	*
141.Turdus viscivorus		*	+	+
142.Monticola saxatilis	+			
143.Locustella fluviatilis				+
144.Acrocephalus palustris				+
145.Acrocephalus arundinaceus				*
146.Acrocephalus schoenobaenus				+
147.Sylvia communis			+	*
148.Sylvia curruca			+	*
149.Sylvia atricapilla		*	+	*
150.Sylvia borin			+	

151.Phylloscopus trochilus		*	+	*
152.Phylloscopus collybita		*	+	*
153.Phylloscopus sibilatrix	+	*	+	*
154.Regulus regulus	*		+	
155.Regulus ignicapillus			+	
156.Panurus biarmicus				+
157.Aegithalus caudatus				+
158.Parus major	*	*		*
159.Parus ater	*	*	+	*
160.Parus cueruleus	*	*	+	*
161.Parus palustris		*	+	*
162.Parus montanus	*		+	
163.Parus cristatus	*		+	
164.Sitta europaea	*	*	+	*
165.Certhia familiaris		*		*
166.Oriolus oriolus				+
167.Lanius excubitor			*	*
168.Lanius minor		*		+
169.Lanius collurio		*	+	+
170.Tichodroma muraria			+	
171.Garrulus glandarius	*	*	*	*
172.Pica pica		*	*	*
173.Corvus monedula		*		*
174.Corvus frugilegus		*		*
175.Corvus corone cornix	+	*	*	*
176.Corvus corax	+	*	*	*
177.Nucifraga caryocatactes	*		+	
178.Sturnus vulgaris		*	*	*
179.Passer montanus		*	*	*
180.Passer domesticus		*	*	*
181.Fringilla coelebs	+	*	+	*
182.Fringilla montifringilla				+
183.Serinus serinus		*		+
184.Carduelis chloris			+	*
185.Carduelis carduelis		*	*	*
186.Carduelis spinus	+			+
187.Carduelis cannabina			+	*
188.Carduelis flavirostris				+
189.Carduelis flammea				+
190.Pyrrhula pyrrhula	*		+	*
191.Loxia curvirostra	+		+	
192.Coccothraustes coccothraustes		*	+	*
193.Plectrophenax nivalis	+			+
194.Emberiza calandra			+	
195.Emberiza citrinella		*	*	*
196.Emberiza schoeniclus				+

Ord. Podicipediformes

Fam. Podicipedidae

The Grebes are present everywhere on the middle course of the Olt River.

Podiceps cristatus (Great Crested Grebe) has been noticed in three stations on the lakes near Avrig, near Rotbav, near Scorei; the greatest number recorded was 10 birds (Scorei).

Tachybaptus ruficollis (Little Grebe) has been noticed on the former meanders near Racoviţa, on the lakes near Avrig, near Rotbav, and near Scorei; the greatest number recorded was 10 birds (Scorei).

Ord. Pelecaniformes

Fam. *Phalacrocoracidae*

Phalacrocorax carbo (cormorant) has been observed on the lake near Călineşti, near Rotbav, and near Scorei; the greatest number was 42 birds (Călineşti).

Ord. Ciconiiformes

Fam. *Ardeidae*

Ardea cinerea (Grey heron) has been noticed on the lakes near Călineşti, near Avrig, and downwards Avrig, at Sântionlunca, at Rotbav and Scorei; the greatest number was 40 birds (Rotbav).

Ixobrychus minutus (Little Bittern)- a juvenile bird has been observed on the former meander of Racoviţa.

Fam. *Ciconiidae*

Ciconia ciconia (White Stork) – it nests frequently along both rivers: Cibin and Olt. In the proximity of Şopa Forest there have been recorded approximately 60 white storks.

Ciconia nigra (Black Stork) – has been seen at Comăna de Jos, Scorei and Şopa Forest.

Ord. Anseriformes

Fam. *Anatidae*

Anas platyrhynchos (Mallard) – has been noticed on the lakes near Călineşti, near Avrig and at Sântionlunca - on Râul Negru- on the lakes near Rotbav and near Scorei; the greatest number was 120 birds (Avrig).

Anas crecca (Teal) – has been remarked on the lakes near Avrig and at Sântionlunca, the greatest number 5 birds – Avrig.

Aythya ferina (Pochard) has been noticed once on the former (dead) meander of Olt River at Turnu Roşu.

Ord. Accipitriformes

Fam. *Accipitridae*

Buteo buteo (Buzzard) is the most frequent species of this order, who has been noticed in almost all the station of the expedition and the greatest number was 8 exemplares.

Buteo lagopus (Rough Legged Buzzard) that appears in Romania only in winter, has been noticed at Turnu Roşu.

Accipiter gentilis (Goshawk) has been noted at Turnu Roşu.

Accipiter nisus (Sparrow Hawk) has been noted near Călineşti, Turnu Roşu, Hărman and Şopa Forest (which is placed in the basin of tributary of the Olt River) and the greatest number recorded is 2 exemplares.

Circus cyaneus (Hen Hamer) has been remarked in the proximity of Şopa Forest in the river valley of Seviş (a tributary of the Cibin River) and the greatest number recorded was 3 exemplares.

Ord. Falconiformes

Fam. *Falconidae*

Falco tinunculus (Kestrel) was noticed very frequently.

Ord. Galliformes

Fam. *Phasianidae*

Perdix pedix (Partridge) was remarked near the lakes at Şopa and on the Sărăţii Valley near Comăna de Jos; the greatest number recorded was that of two birds.

Coturnix coturnix (Quail) was noticed at Scorei – the greatest number 5 birds.

Ord. Gruiformes

Fam. *Rallidae*

Gallinula chloropus (Moorhen) was noticed at the former meanders of Arini and of Micloşoara; the greatest number was 4 individuals (Micloşoara).

Fulica atra was noticed at the former meanders near Racoviţa and on the lakes near Avrig and near Scorei; the greatest number 10 exemplares (Scorei).

Ord. Charadriiformes

Fam. *Recurvirostridae*

Eudromias morinellus (Dotterel) nests within the Iezerele Cibinului region.

Vanellus vanellus (Lapwing) was frequently remarked in the Seviş River Valley and the greatest number noticed is 20 birds.

Fam. *Scolopacidae*

Actitis hypoleucos (Common Sandpiper) was noticed on the former meanders of Arini (one bird).

Numenius arquata (Curlew) - only one bird was remarked at the lakes near Rotbav.

Gallinago gallinago (Snipe) – four exemplares were noticed in the Seviş Valley.

Fam. *Laridae*

Larus ridibundus (Black-headed Gull) it was noticed on the lake near Rotbav; the greatest number being that of 10 exemplares.

Larus cachinnans (Herring Gull) was remarked at the lakes near Călineşti, near Rotbav, and near Scorei, the greatest number being 10 exemplares (Rotbav).

Fam. *Sternidae*

Chlidonias leucopterus (White-winged Black Tern) –two exemplares were remarked at the lakes near Rotbav.

Ord. Columbiformes

Fam. *Columbidae*

Columba livia domestica (Domestic Dove) is a constant presence in the proximity of the villages.

Columba oenas (Stock Dove) and *Columba palumbus* (Wood Pigeon) has been noticed on the Seviş Valley (4ex., 8ex.)

Ord. Caraciiformes

Fam. *Alcedinidae*

Alcedo atthis (King Fisher) has been noticed near Avrig, near Rotbav and on the former meander of Arini, the greatest number being that of 2 exemplares.

Ord. Passeriformes

The willow beds of the Olt River are frequently used by the birds of this order for nesting and also for sheltering (during the migration). That is why there have been remarked non-typical birds for this group: *Motacilla cinerea* (Grey Wagtail), *Prunella modularis* (Dunnock), *Turdus pilaris* (Fieldfare) and *Pyrrhula pyrrhula* (Bullfinch).

One .of the most interesting species is *Eremophila alpestris ssp balcanica* (Shore lark) whose nesting has been noticed within the Iezerele Cibinului area (for the first time in Romania).

The list mentioned above is not complete. For this purpose there is a need for more detailed studies and a long term research program.

CONCLUSIONS

A) By its position the Olt River is a migration way for the birds from the interior of the Carpathians chain to the southern Europe. Thus, during the migration period the birdfauna biodiversity is high.

B) In the nesting time, the importance of the Olt River is reduced for the aquatical birds the main reason being the modification of the initial habitates.

C) The Olt River's birdfauna has suffered qualitative and quantitative modifications, especially on the middle course, where dry lands took the place of the initial habitats (bed rivers, former meanders) and dams have been built (reservoirs – Avrig, Scorei, Cârţişoara)

D) Because of the importance of the Olt River during the migration period it is necessary to preserve the aquatical areas (bed rivers, dead meanders, marshes) which became very scarce because of human intervention.

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CONTRIBUTIONS TO THE STUDY OF THE WATERFOWL FROM DUMBRĂVIȚA LAKE AND PONDS (BÂRSA DEPRESSION)

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REZUMAT

Lucrarea prezintă un studiu efectuat asupra avifaunei acvatice (non-Passeriformes) de la lacul şi eleşteele Dumbrăviţa, depresiunea Bârsei. Sunt prezentate structura calitativă şi cantitativă a avifaunei acvatice, frecvenţele şi variaţiile sezoniere ale speciilor. Au fost efectuate 104 observaţii lunare, între anii 1995 şi 1999, interval în decursul căruia au fost identificate 85 de specii acvatice aparţinând la 9 ordine sistematice.

Keywords: waterfowl, wetlands, Olt River Basin

We thought there is a need to study more closely the waterfowl from the lake and ponds from Dumbrăviţa because on one hand there were no previous studies made upon the birds living in this area and on the other hand there are quite few lakes and ponds in this part of the country.

In fact, a few ornithological studies were made (more or less recently) concerning the waterfowl from Bârsa Depression (Ciochia et. al. 1983, Ciochia 1991, Hodor 1997, Ionescu 1998), but nobody investigated the area mentioned above.

In this paper we wish to present the qualitative and quantitative structure of the waterfowl, its repartition and monthly dynamics, the frequency of the species observation and a few ideas about the seasonal variation of the number of birds. We started our study in 1995 and we finished it in 1999.

STUDIED AREA AND METHODS

The Dumbrăviţa Lake and ponds are located in the Bârsa Depression (the upper Olt River Basin) and are orientated approximately East-West (**Fig. 1**).

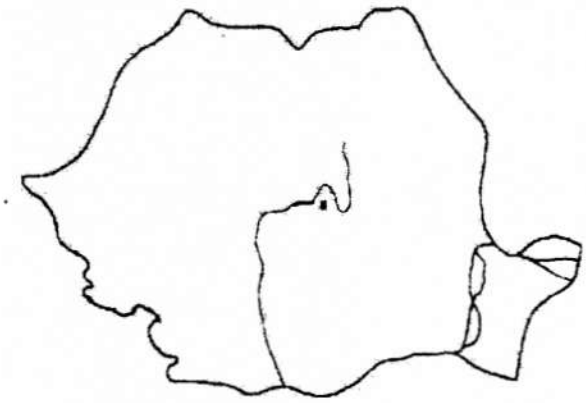

Fig. 1 *Studied area (its position in the Olt River Basin)*

The total area is about 310 ha. Auriu Valley and Homorod River are not included. Dumbrăviţa Lake is 120 ha and it appeared when the Homorod River was blocked in Dumbrăviţa village. The size of the ponds varies from a few hectares to 45,5 ha. Some of these are covered by amphibian vegetation (*Phragmites sp., Typha sp.* etc)

We usually made use of the "point count" method, but we partly modified it, and also we combined it with the counting of moving birds. We used 7x50 and 12x45 binoculars. Hunters often burdened the counting, the moving of the flocks, etc.
In the studied area we made a number of 104 field observations during July 1995-may 1999, in every month of the year, but not monthly in each year. The paper is based exclusively on indubitable data and species.

RESULTS AND DISCUSSION

During the period of our studies (1995-1999) we identified 85 species of waterfowl (non-Passeriformes) on the lake and ponds of Dumbrăviţa. Alltogether they represent 57% of the Romanian waterfowl. These species belong to 9 systematically orders (Gaviiformes, Podicipediformes, Pelecaniformes, Ciconiiformes, Anseriformes, Accipitriformes, Gruiformes, Charadriiformes, Coraciiformes), most of them belonging to Charadriiformes (37 spp of Charadrii and Lari) and Anseriformes (22 spp).

The monthly repartition of the species, the frequency of the observation and the maximum number of each species are presented in the table below (systematical classification after Munteanu, 1992).

Tab.1 ***The monthly repartition, the frequency and the maximum number of species***
Fq = frequency of the observation of the species, as a percentage ratio between the number of the observation dates of the species and total number of the observation dates (104). **Max No Obs** = the maximum number of species

No.	Species	Fq. %	Max No obs	Month of observation											
				j	f	m	a	m	j	j	a	s	o	n	d
1	*Gavia stellata*	0,9	1											x	
2	*G. arctica*	23,0	10				x					x	x	x	x
3	*Tachybaptus ruficollis*	53,8	about 35						x	x	x	x	x	x	
4	*Podiceps cristatus*	82,6	about 50			x	x	x	x	x	x	x	x	x	x
5	*P. griseigena*	17,3	5			x	x	x		x	x	x	x		
6	*P. nigricollis*	16,3	?30				x	x	x	x	x	x	x		
7	*Phalacrocorax carbo*	24,0	9				x					x	x	x	x
8	*P. pygmaeus*	6,7	4				x	x			x		x		x
9	*Pelecanus onocrotalus*	0,9	1						x						
10	*Botaurus stellaris*	17,3	2			x	x	x	x		x	x	x		x
11	*Ixobrychus minutus*	5,7	2						x	x	x				
12	*Nyctycorax nyctycorax*	5,7	?20								x		x	x	
13	*Ardeolla ralloides*	1,9	2					x							
14	*Egretta garzetta*	29,8	about 35					x	x	x	x	x	x		
15	*E. alba*	40,3	8			x	x		x	x	x	x	x	x	x
16	*Ardea cinerea*	97,1	about 100	x	x	x	x	x	x	x	x	x	x	x	x
17	*A. purpurea*	24,0	9				x	x			x	x	x		
18	*Ciconia nigra*	31,7	25				x		x	x	x	x	x		
19	*C. ciconia*	20,1	40				x	x	x	x	x	x			
20	*Plegadis falcinellus*	3,8	4				x	x							
21	*Cygnus olor*	0,9	9											x	
22	*Anser fabalis*	4,8	7										x		

23	*A. albifrons*	17,3	about 150			x						x	x	x
24	*A. anser*	1,9	2									x		
25	*Tadorna tadorna*	5,7	6			x								x
26	*Anas penelope*	40,3	about 350		x	x	x	x				x	x	x	x
27	*A. strepera*	7,6	11			x	x					x	x		
28	*A. crecca*	53,8	about 250		x	x	x	x			x	x	x	x	x
29	*A. platyrhynchos*	99,0	about 1000		x	x	x	x	x	x	x	x	x	x	x
30	*A. acuta*	12,5	15		x	x	x					x	x		
31	*A. querquedula*	23,0	about 300			x	x	x	x	x	x				
32	*A. clypeata*	22,1	36			x	x	x			x	x	x		x
33	*Netta rufina*	0,9	4					x							
34	*Aythya ferina*	74,0	about 250		x	x	x	x	x	x	x	x	x	x	x
35	*A. nyroca*	50,0	about 30			x	x	x	x	x	x	x	x		
36	*A. fuligula*	46,1	about 30			x	x	x	x	x	x	x	x	x	x
37	*A. marila*	5,7	2										x	x	
38	*Melanitta fusca*	0,9	2												x
39	*Bucephala clangula*	19,2	40		x	x	x						x	x	x
40	*Mergus albellus*	7,6	10		x	x	x								
41	*M. serrator*	2,8	6				x					x		x	
42	*M. merganser*	3,8	2				x						x		
43	*Circus aeruginosus*	18,2	5				x	x	x	x	x	x			
44	*Pandion haliaetus*	3,8	1				x						x		
45	*Rallus aquaticus*	1,9	2								x		x		
46	*Gallinula chloropus*	15,3	5				x	x		x	x	x			
47	*Fulica atra*	87,5	about 400		x	x	x	x	x	x	x	x	x	x	x
48	*Haematopus ostralegus*	0,9	1								x				
49	*Recurvirostra avosetta*	0,9	1						x						
50	*Charadrius dubius*	19,2	8			x	x			x	x	x			
51	*C. hiaticula*	2,8	6				x					x	x		
52	*Pluvialis squatarola*	9,6	5									x	x		
53	*Vanellus vanellus*	47,1	about 200		x	x	x	x	x	x	x	x	x	x	
54	*Calidris alba*	1,9	2									x	x		
55	*C. minuta*	15,3	about 30					x		x	x	x			
56	*C. temminckii*	0,9	1									x			
57	*C. ferruginea*	7,6	6						x		x	x			
58	*C. alpina*	13,4	about 15				x				x	x	x		
59	*Limicola falcinellus*	0,9	1									x			
60	*Philomachus pugnax*	29,8	about 80			x	x	x	x	x	x	x	x		
61	*Gallinago gallinago*	32,6	about 25			x	x			x	x	x	x	x	
62	*Limosa limosa*	12,5	15				x		x	x	x	x			
63	*Numenius sp.*	12,5	14				x			x	x	x			
64	*Tringa erythropus*	20,1	20				x	x	x	x	x	x			
65	*T. totanus*	6,7	?10			x	x			x	x				
66	*T. stagnatilis*	0,9	1				x								
67	*T. nebularia*	43,2	45				x	x	x	x	x	x	x		
68	*T. ochropus*	24,0	3			x	x		x	x	x	x	x		
69	*T. glareola*	27,8	30				x	x	x	x	x	x			
70	*Actitis hypoleucos*	30,7	5				x	x	x	x	x	x			
71	*Arenaria interpres*	4,8	2								x	x			
72	*Phalaropus lobatus*	4,8	3								x	x			
73	*Stercorarius parasiticus*	0,9	2									x			
74	*Larus melanocephalus*	0,9	1					x							
75	*L. minutus*	25,0	20				x	x	x		x	x	x	x	x
76	*L. ridibundus*	95,1	about 400		x	x	x	x	x	x	x	x	x	x	x
77	*L. canus*	3,8	2			x	x								
78	*L. fuscus*	0,9	1									x			
79	*L. cachinnans*	1,9	2				x								
80	*Sterna caspia*	1,9	3				x					x			

81	*S. hirundo*	5,7	3				x	x			x				
82	*Chlidonias hybridus*	14,4	16				x	x	x	x	x		x		
83	*C. niger*	30,7	about 70				x	x	x	x	x	x	x		
84	*C. leucopterus*	3,8	about 30					x							
85	*Alcedo atthis*	11,5	3					x			x	x	x	x	

According to the **Table 1**, *Anas platyrhynchos* (99%) had the maximum frequency, then *Ardea cinerea* (97,1%), *Larus ridibundus* (95,1%), *Fulica atra* (87,5%), *Podiceps cristatus* (82,6%), *Aythya ferina* (74,0%) etc. These species can be seen at Dumbrăviţa almost the whole year, excepting the period when the water is frozen. The species which accidentaly halt on this area had the minimum frequency: *Pelecanus onocrotalus* (0,9%), *Cygnus olor* (0,9%), *Melanitta fusca* (0,9%), *Haematopus ostralegus* (0,9%), *Recurvirostra avoseta* (0,9%), *Limicola falcinellus* (0,9%), *Stercorarius parasiticus* (0,9%), *Larus melanocephalus* (0,9%), *Larus fuscus* (0,9%).

April and September are the months when the greatest variety of species can be observed (54 both in April and September), because these are migration months. On January and February (1 and 11 species) when the water is frozen and on June, July (32 and 33 species), breeding time, the most few species have been observed.

Apart seasonal variation of the species number there was a variation of the number of the bird populations. Thus, as soon as the ice melt, the birds came in great number, especially ducks (*Anas platyrhynchos*, *A. crecca*, *A. querquedula*, *Aythya ferina* etc). Their number was decreasing during breeding time and it was increasing during autumn migration. When the lake and ponds were completely frozen (November-December), all of the waterfowls left this aquatic area.

Probably there were some sudden variations brought about by climate factors (storms, heavy snowing, very low temperatures) and hunting.

The species with the greatest number were (in brackets: there is the maximum value): *Anas platyrhynchos* (about 1000), *Larus ridibundus* (about 400), *Fulica atra* (about 400), *Anas penelope* (about 350) etc.

Concerning the breeding, we identified solitary species as well as colonial species. *Ardea cinerea* hatches in a small colony of about15 nests. They are set in an oak (Querqus robur) forest near the ponds. The nests are built in the south-western part at the skirt of the forest. We observed 1 to 4 nests per tree. The following species hatch alone: *Podiceps cristatus* (especially on ponds), *Anas platyrhynchos*, *Aythya ferina* (late hatching time: on 19 and 29.08 we observed two females with ducklings), *Aythya nyroca* (a breeding species less numerous then *A. ferina*), *Gallinula chloropus*, *Fulica atra*. As possible or probable breeding species are: *Botaurus stellaris*, *Ixobrychus minutus*, *Ardea purpurea*, *Aythya fuligula*, *Circus aeruginosus*, *Vanellus vanellus*.

From a phenological point of view, the majority are passage species (57 species), certainly breeding (7 species), accidently (19 species) and there are some species with uncertain phenological status.

Although the studied area is very rich and varied in waterfowl (*Aythya nyroca*- species of global conservation with an Unfavorable conservation status, according to The EBCC Atlas of European Breeding Birds, 1997), it is not a protected area. Until now, this territory has not been included in "Important Bird Area" program. Nevertheless, in Bârsa Depression there is an aquatic ecosystem (Rotbav-Vadu Roşu ponds) included in this program.

At least, the shortening of the hunting season or interdiction of hunting on the lake or on the large ponds would be of a great help for the preservation of the birds.

At the end of our five year study, we can conclude the following:

- the lake and ponds of Dumbrăviţa are very important place for the birds which pass or breed here;
- the conditions of breeding are very good on the lake and on the ponds covered by vegetation;
- the great number of the migrating species and their great abundance prove that Bârsa Depression is a very important area for migratory birds (according to Mătieş, 1986);
- in different periods of the year, there are optimal conditions for feeding and for resting for all the waterfowl ecological groups.

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PRELIMINARY DATA CONCERNING THE AVIFAUNA OF BRĂDENI - FISHPONDS (HÂRTIBACI VALLEY; OLT RIVER BASIN)

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REZUMAT

Lucrarea prezintă rezultatele observaţiilor ornitologice efectuate între anii 1988-1991, pe eleşteele de la Brădeni, de pe albia majoră a văii Hârtibaciului. Amenajarea piscicolă cuprinde 11 bazine acvatice, de o suprafaţă totală de 158 de ha. Este prezentată lista celor 111 de specii , respectiv perioadele în care au fost observate. Rezultatele sunt interpretate calitativ, subliniind importanţa eleşteelor în special pentru avifauna acvatică, în primul rând în perioadele de pasaj. Pentru o analiză mai amănunţită, calitativă, cantitativă, ecologică se impune continuarea sistematică a cercetării.

Keywords: avifauna, wetlands, biodiversity, Olt River Basin

In the present conditions of intensive drainage of natural wetlands, the importance of the artifical aquatic ecosystems for waterbirds, like freshwater reservoirs and fishponds, is increasing. The avifauna of such ponds was observed since the 60's (Munteanu 1968, Mătieş 1982, Szabo & Szombath 1984, Weber 1994, Mitruly 1991, 1992, 1993, 1996), and between 1985 – 1989 there were regularly synchronic observations of waterbirds done on more than 12 anthropogenous water ecosystems within the Synchron Waterbird Census Program (Weber & Szabó 1988 and 1989).

The Brădeni fishponds lie on the main valley of Hârtibaciu River, between the localities Brădeni and Netuş, the squares LM 20 and LL 29 in the Universal Transverse Merkator 10x10 grid.

The 11 ponds occupy 158 ha, wherefrom 3 ponds totalize a surface of 137 ha.

We would like to present the results of 9 days of observation, during the years 1988-1991, in each season, except winter, when the ponds are covered with ice, and the waterbirds have no condition to stay.

During our researches we identified 111 species of birds (**Tab. 1**).

Tab. 1. *List of the identified bird species from Brădeni fisponds*

List of observed species	Spring	Summer	Autumn
	III - V	VI - VIII	IX - XI
Ordo : Podicipediformes			
Fam : Podicipedidae			
1 *Tachybaptus ruficollis* (Pallas, 1764)	*	*	
2 *Podiceps cristatus*(Linnaeus, 1758)	*	*	*
3 *Podiceps griseigena* (Boddaert, 1783)		*	
4 *Podiceps nigricollis* C.L.Brehm, 1831	*		*
Ordo : Pelecaniformes			
Fam : Phalacrocoracidae			
5 *Phalacrocorax carbo* (Linnaeus, 1758)		*	*
Ordo : Ciconiiformes			

Fam : Ardeidae				
6	*Ixobrychus minutus*(Linnaeus, 1766)	*		
7	*Nycticorax nycticorax*(Linnaeus, 1758)	*	*	
8	*Ardea cinerea* Linnaeus, 1758	*	*	*
9	*Ardea purpurea* Linnaeus, 1766	*		
Fam: Ciconiidae				
10	*Ciconia nigra* (Linnaeus, 1758)	*		
11	*Ciconia ciconia* (Linnaeus, 1758)	*	*	
Ordo : Anseriformes				
Fam : Anatidae				
12	*Anser albifrons* (Scopoli, 1769)			*
13	*Anas penelope* Linnaeus, 1758	*		*
14	*Anas crecca* Linnaeus, 1758	*		
15	*Anas platyrhynchos* Linnaeus, 1758	*	*	*
16	*Anas acuta* Linnaeus, 1758	*		
17	*Anas querquedula* Linnaeus, 1758	*		
18	*Anas clypeata* Linnaeus, 1758	*		
19	*Netta rufina* (Pallas,1773)			*
20	*Aythya ferina* (Linnaeus, 1758)	*		*
21	*Aythya nyroca* (Güldenstädt,1770)	*		
22	*Aythya fuligula* (Linnaeus, 1758)	*		
23	*Aythya marila* (Linnaeus, 1761)			*
Ordo : Accipitriformes				
Fam : Accipitridae				
24	*Pernis apivorus* (Linnaeus, 1758)		*	
25	*Milvus migrans* (Boddaert, 1783)	*	*	
26	*Circus aeruginosus* (Linnaeus, 1758)	*	*	*
27	*Circus cyaneus* (Linnaeus, 1766)			*
28	*Accipiter gentilis* (Linnaeus, 1758)	*	*	*
29	*Buteo buteo* (Linnaeus, 1758)	*	*	*
30	*Buteo lagopus* (Pontoppidan,1763)			*
31	*Aquila heliaca* Savigny, 1809		*	
Fam : Falconidae				
32	*Falco tinnunculus* Linnaeus, 1758	*	*	*
Ordo : Galliformes				
Fam : Phasianidae				
33	*Coturnix coturnix* (Linnaeus, 1758)	*	*	
34	*Phasianus colchicus* Linnaeus, 1758	*	*	*
Ordo : Gruiformes				
Fam : Rallidae				
35	*Rallus aquaticus* Linnaeus, 1758	*		
36	*Gallinula chloropus* (Linnaeus, 1758)	*	*	
37	*Fulica atra* Linnaeus, 1758	*	*	
Ordo : Charadriiformes				
Fam : Charadriidae				
38	*Charadrius dubius* Scopoli, 1786	*		
39	*Vanellus vanellus* (Linnaeus, 1758)	*	*	
Fam : Scolopacidae				
40	*Calidris minuta* (Leisler, 1812)	*		
41	*Calidris ferruginea* (Pontoppidan, 1763)	*		
42	*Calidris alpina* (Linnaeus, 1758)	*		
43	*Philomachus pugnax* (Linnaeus, 1758)	*		
44	*Gallinago gallinago* (Linnaeus, 1758)			*
45	*Tringa erythropus* (Pallas, 1764)	*		
46	*Tringa totanus* (Linnaeus, 1758)		*	
47	*Tringa stagnatilis* (Bechstein, 1803)	*		
48	*Tringa nebularia* (Gunnerus, 1767)	*		

49	*Actitis hypoleucos* (Linnaeus, 1758)	*	*	
Fam : Laridae				
50	*Larus ridibundus* Linnaeus, 1766			*
51	*Larus canus* Linnaeus, 1758	*		
52	*Larus cachinnans* Pallas, 1811			*
Fam : Sternidae				
53	*Sterna hirundo* Linnaeus, 1758	*		
54	*Chlidonias leucopterus* (Temminck, 1815)	*		
Ordo : Columbiformes				
Fam : Columbidae				
55	*Columba oenas* Linnaeus, 1758	*		
56	*Columba palumbus* Linnaeus, 1758	*		
57	*Streptopelia decaocto* (Frivaldszky, 1838)	*	*	*
Ordo : Cuculiformes				
Fam : Cuculidae				
58	*Cuculus canorus* Linnaeus, 1758	*	*	
Ordo : Coraciiformes				
Fam: Meropidae				
59	*Merops apiaster* Linnaeus, 1758		*	
Fam : Upupidae				
60	*Upupa epops* Linnaeus, 1758	*	*	
Ordo : Piciformes				
Fam : Picidae				
61	*Picus canus* Gmelin, 1788	*		
62	*Picus viridis* Linnaeus, 1758	*		
63	*Dendrocopos major* (Linnaeus, 1758)	*	*	
Ordo : Passeriformes				
Fam: Alaudidae				
64	*Alauda arvensis* Linnaeus, 1758	*	*	*
Fam : Hirundinidae				
65	*Riparia riparia* (Linnaeus, 1758)			*
66	*Hirundo rustica* Linnaeus, 1758	*	*	
67	*Delichon urbica* (Linnaeus, 1758)	*		
Fam : Motacillidae				
68	*Anthus trivialis* (Linnaeus, 1758)	*		
69	*Anthus spinoletta* (Linnaeus, 1758)			*
70	*Motacilla flava* Linnaeus, 1758	*	*	
71	*Motacilla cinerea* Tunstall, 1771			*
72	*Motacilla alba* Linnaeus, 1758	*	*	*
Fam : Turdidae				
73	*Erithacus rubecula* (Linnaeus, 1758)	*	*	*
74	*Phoenicurus ochruros* (S.G. Gmelin, 1774)	*	*	
75	*Saxicola rubetra* (Linnaeus, 1758)	*	*	
76	*Saxicola torquata* (Linnaeus, 1766)	*	*	
77	*Oenanthe oenanthe* (Linnaeus, 1758)	*		
78	*Turdus merula* Linnaeus, 1758		*	
Fam : Sylviidae				
79	*Locustella naevia* (Boddaert, 1783)	*		
80	*Locustella fluviatilis* (Wolf, 1810)	*		
81	*Locustella luscinioides* (Savi, 1824)	*	*	
82	*Acrocephalus schoenobaenus* (Linnaeus, 1758)	*	*	
83	*Acrocephalus palustris* (Bechstein, 1798)	*	*	*
84	*Acrocephalus arundinaceus* (Linnaeus, 1758)	*	*	*
85	*Sylvia curruca* (Linnaeus, 1758)	*		
86	*Sylvia communis* Latham, 1787	*		
87	*Sylvia atricapilla* (Linnaeus, 1758)	*	*	
88	*Phylloscopus collybita* (Vieillot, 1817)	*	*	*

Fam : Muscicapidae				
89	*Ficedula hypoleuca* (Pallas, 1764)		*	
Fam : Paridae				
90	*Parus palustris* Linnaeus, 1758		*	
91	*Parus caeruleus* Linnaeus, 1758		*	*
92	*Parus major* Linnaeus, 1758	*	*	*
Fam : Sittidae				
93	*Sitta europea* Linnaeus, 1758		*	
Fam : Oriolidae				
94	*Oriolus oriolus* (Linnaeus, 1758)	*	*	
Fam : Laniidae				
95	*Lanius collurio* Linnaeus, 1758		*	
96	*Lanius excubitor* Linnaeus, 1758			*
Fam : Corvidae				
97	*Garrulus glandarius* (Linnaeus, 1758)	*	*	
98	*Pica pica* (Linnaeus, 1758)	*	*	*
99	*Corvus monedula* Linnaeus, 1758	*	*	*
100	*Corvus frugilegus* Linnaeus, 1758	*	*	*
101	*Corvus corone cornix* Linnaeus, 1758	*	*	*
102	*Corvus corax* Linnaeus, 1758			*
Fam : Sturnidae				
103	*Sturnus vulgaris* Linnaeus, 1758	*	*	*
Fam : Passeridae				
104	*Passer domesticus* (Linnaeus, 1758)	*	*	*
105	*Passer montanus* (Linnaeus, 1758)	*	*	*
Fam : Fringillidae				
106	*Fringilla coelebs* Linnaeus, 1758	*	*	*
107	*Carduelis chloris* (Linnaeus, 1758)	*		
108	*Carduelis carduelis* (Linnaeus, 1758)	*	*	*
109	*Carduelis cannabina* (Linnaeus, 1758)		*	*
Fam : Emberizidae				
110	*Emberiza citrinella* Linnaeus, 1758	*	*	*
111	*Emberiza schoeniclus* (Linnaeus, 1758)		*	*
	Total observed species :	**84**	**63**	**47**

Analysing the list of species, we can conclude the following :

1. There are 11 Orders and 29 Families represented.
2. From the total number of 111 species, 39 are strictly waterbirds (they belong to the Orders: *Pelecaniformes, Podicipediformes, Ciconiiformes, Anseriformes*,and *Charadriiformes*) and the presence of other 13 species also depends on the water.
3. There are only 5 species of waterbirds, which certainly breed here: *Podiceps cristatus, Ardea cinerea, Anas platyrchynchos, Gallinula chloropus* and *Fulica atra*. This small number is caused by the missing shore-vegetation and reeds and by the increased anthropic pressure during the breeding period. The existence of a breeding colony of *Ardea cinerea* in the nearest wood, numbering 21-23 breeding pairs, is remarkable.
4. The seasonal distribution shows the main importance of fishponds for birds in spring, in which season there were identified 84 species, from which 32 were seen only in this season.

The relative great number of species which are present during summer is composed mostly of late, respectively early populations of migrating birds and non-breeding individuals, besides the resident and breeding non-waterbirds, and, of course, of the 5 breeding waterbird species.

In our list there were not shown the quantitative data of each species (for a quantitative analysis we have not enough data), but the importance of the researched area is underlined by the great number of individuals, belonging to different species, sometimes more than 500 birds, especially during passage-time.

Tab. 2. *Seasonal distribution of the birdspecies*

SEASONS			No. of species	Percent	Legend
Spring +	Summer +	Autumn	27	24	1
Spring +	Summer		22	20	2
	Summer +	Autumn	4	4	3
Spring +		Autumn	3	3	4
Spring			32	28	5
	Summer		10	9	6
		Autumn	13	12	7
84	63	47	111	100	

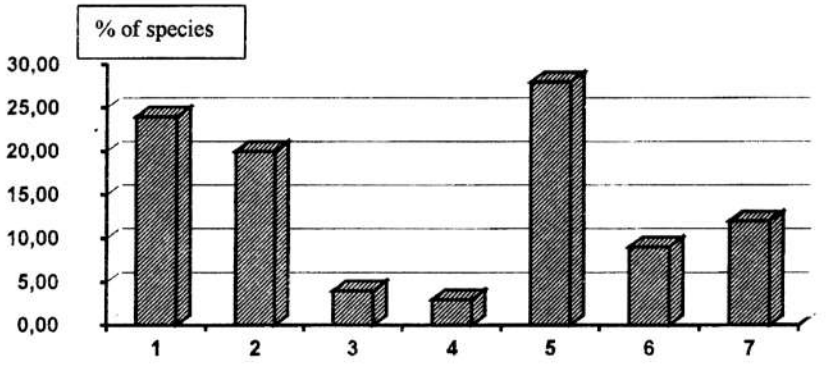

Fig. 1. *Seasonal distribution of the avifauna (% of species)*

The number of 9 species of birds of prey is also remarkable.

Because of difficulties in reaching the site, the fishponds from Brădeni were not researched regularly each month, and therefore they were not included in the Synchron Watrebird Census Program; still our results can be compared, and correspond with those which were obtained in that program.

The fishponds from Brădeni are the only great surfaces of water in the region, having a great attractivity for birds, especially for waterbirds.

For a detailed analisys of the avifauna – qualitative & quantitative aspects, dynamic, ecology, etc. –it is recommended for the researches to be continued.

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DATA ON THE AVIFAUNA FROM THE "SUB ARINI" PARK (SIBIU) IN HIEMAL, PREVERNAL AND AUTUMNAL ASPECTS

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RÉSUMÉ

Le biotop varié du parc offre les conditions necessaires pour l'existence d'un nombre assez grand des éspèces. En 1998 j'ai observé, pendant les trois saisons mentionés, 71 éspèces ce que represent une diminution avec 20% raporté à 1970, quand Dan Stănescu a noté 90 éspèces. La diminution numerique des populations est plus accentuée si nous ne considerons pas les éspèces *Corvus monedula, C. frugilegus* et *C. corone* qui sont representées par des populations plus nombreuses qu'en 1970 ce que determine aussi la diminution de la biodivirsité pendant les saisons hiemal et prevernal. La cause principale de ces modifications est l'augmentation de la pression anthropique.

Keywords: bird communities, trophic groups, biodiversity, human impact.

INTRODUCTION

The avian community of the "Sub Arini" park responds rapidly to the variations of environmental conditions, by changing its qualitative and quantitative structure, thus being a good index for the park's health. This is the main reason for the present study having as object the park's birds.The existence of a similar study published by Dan Stănescu (1971), offers the data for a comparison that illustrates the evolution of the park's avifauna in the last 30 years. This study also presents some of the possible causes of these changes because knowing them is essential for protecting the ecological system represented by the park.

The "Sub Arini" park has a total surface of 49 ha and lies along a valley, running from N to S. Its northern border is in the town's center, while its southern part stretches to Dumbrava Wood, bordering a newly built district of the town, Valea Aurie. The variety of topographic conditions has created a number of habitats: lakes, brook, hygro- and mesophilous lawns, shrubs, and woods. The park is divided into 6 sectors, considering its topographic characteristics and the vegetation.

MATERIALS AND METHODS

For this study was used the transects method, establishing an invariable route that crosses the park all along its length, measuring 3050 m. The author went through this route weekly (sometimes just twice a month), counting the birds seen (excepting the ones that were just flying over the park), or heared (mainly the night birds). The primary data were merged into the tables for the three aspects (hiemal, prevernal and autumnal). The tables include for each species, the number of individuals, relative abundance, frequency and K.A.I..

Regarding the number of individuals, there are some specifications to be made. For the species with constant populations in the park, the tables contain the average number of individuals, that is the sum of all individuals recorded, divided by the

number of observations in that aspect. In case of the accidental birds this was not possible. For example, in the hiemal aspect, it was recorded once (on 02.01.1998) an individual of *Dryocopos martius*. If the average number had been calculated, the number of species would have been 0.07, but this has to be a whole number, so that in the table it was noted 1 and for avoiding the errors resulting from here, it was calculated the frequency, that is the number of days when the species was recorded, divided by the total number of observation days in the park.

Shannon-Wienen index was also used for biodiversity and Morisita index for quantifying changes in qualitative and quantitative structure of the avifauna.

RESULTS AND DISCUSSION

The Hiemal Aspect

This aspect is characterised by a low number of species - 39 - but a very large number of individuals – 3038- (Table 1) due to the presence of the three species of *Corvus: C. corone, C. frugilegus, C. monedula* that count 2664 individuals, that is 7 times more than the other species considered together. In winter these species use the park mainly as a resting place. A large but variable number of these birds gather here in the evening, spending the night in the trees, in the 2nd, 3rd and partly 4th sector. In the morning they leave, heading partly towards the town's districts, where they feed on rubbish, and partly towards the farming lands outside the town - especially *C. frugilegus* and *C. corone*. A small number of individuals (100-200) can be found in sometimes feeding in the 4th and 5th sectors, on the lawn.

Due to the large populations of *Corvus*, the hiemal aspect has the lowest biodiversity: Shannon-Wiener index H = 2.2674.

All the 7 trophic groups recorded in the park are present in this aspect. The omnivores are dominant, counting 13 species (33.33%). This group includes besides the typical omnivores (*Anas platyrhynchos, Corvus sp., Passer sp.*), species that during the warm season feed mainly on insects, but now this kind of food being difficult to find, they have a mixed diet, consuming also fruits and seeds (*Parus major, Turdus merula, Sturnus vulgaris*). The insectivores count 11 species (28.2%), including mainly the species that feed on insects found under the rind of the trees, the most accesible insect category in this season (*Picoides major, P. medius, Sitta europaea, Certhia familiaris, Picus canus*). The granivorous, represented by 10 species (25.64%), wander in flocks, feeding on the seeds of various trees (*Acer, Almus, Platanus*, etc.). *Carduelis sp., Parus caeruleus, Parus palustris, Coccotraustes coccothraustes* are included in this group. The two species of carnivores (5.12%), *Accipiter nisus* and *Athene noctua*, feed on little birds that live here. The fish-eaters are represented by *Alcedo atthis*, consuming fish from the brook, the potamotrophs (term introduced by Dan Stănescu) include *Cinclus cinclus*, that feed mainly on aquatic larvae, and the fruit-eaters are represented by *Turdus viscivorus*, that feeds on the fruits of the semiparasite *Viscum album* thus helping it to spread. Each of these groups represents 2.56 % of the total number of species.

Table 1. *Bird communities in hiemal aspect*

SPECIES	Number of individuals	Relative abundance	Frequency	K.A.I.
Accipiter nisus	1	0,0003	0,35	0,16
Aegithalos caudatus	14	0,0045	0,50	2,30
Alcedo atthis	1	0,0003	0,28	0,16
Anas plathyrhynchos	4	0,0013	0,35	0,65
Carduelis carduelis	8	0,0026	0,28	1,31
Carduelis spinus	36	0,011	0,50	5,90
Certhia familiaris	4	0,0013	0,85	0,65
Cinclus cinclus	1	0,0003	0,14	0,16
Coccothraustes cocc.	27	0,0087	0,64	4,42
Corvus corax	2	0,0006	0,28	0,32
Corvus corone	352	0,11	0,35	57,70
Corvus frugilegus	1238	0,4075	0,35	202,95
Corvus monedula	1074	0,34	0,42	176,06
Columba livia	2	0,0006	0,14	0,32
Dryocopus martius	1	0,0003	0,07	0,16
Erithacus rubecula	2	0,0006	0,35	0,32
Fringilla coelebs	6	0,0019	0,5	0,98
Fringilla montifringilla	3	0,001	0,07	0,50
Garrulus glandarius	5	0,0016	0,78	0,82
Loxia curvirostris	3	0,001	0,07	0,50
Parus ater	8	0,0025	0,35	1,31
Parus caeruleus	32	0,01	0,92	5,24
Parus major	93	0,03	1	15,24
Parus palustis	7	0,0022	0,71	1,14
Passer domesticus	16	0,0051	0,35	2,62
Passer montanus	11	0,0035	0,35	1,80
Picoides major	18	0,0058	1	2,95
Picoides medius	3	0,001	0,85	0,50
Picus canus	2	0,0006	0,28	0,32
Pyrrhula pyrrhula	2	0,0006	0,35	0,32
Pica pica	2	0,0006	0,35	0,32
Regulus regulus	6	0,0019	0,71	0,98
Sitta europaea	14	0,0045	1	2,30
Streptopelia decaocto	2	0,0006	0,21	0,32
Troglodytes troglodytes	4	0,0013	0,57	0,65
Turdus merula	20	0,0064	0,71	3,28
Turdus viscivorus	3	0,001	0,64	0,50
Athene noctua	1	0,0003	0,21	0,16
Sturnus vulgaris	12	0,0038	0,28	1,96
TOTAL 39	**3038**			

The Prevernal Aspect

Being a transitional aspect, the prevernal aspect counts the highest number of species – 60 (**Table 2**). Besides the sedentary species, winter guests that haven't left for the nesting places yet, the summer guests that begin to arrive in the park, as well as accidental species can be seen. The number of individuals is kept high by the same species of *Corvus* that begin to nest, being now permanently here.

Regarding the biodiversity, despite the high number of species, the index has a relatively low value H = 3.25, due to the fact that the populations of *Corvus* exceed the other populations considered together.

In this aspect 6 trophic groups are present. The insectivores, counting 31 species (51.66%), include species that consume insects found under the rind of the trees (*Picoides sp., Picus sp., Sitta europaea, Certhia familiaris*), species that feed in the canopy (*Parus sp., Phylloscopus sp., Sylvia sp., Ficedula sp., Muscicapa striata, Fringilla coelebs*) and on the ground (*Turdus sp., Sturnus vulgaris*). The omnivores, 11 species (18.33%), include *Corvus sp., Passer sp.,* and the aquatic species *Anas platyrhynchos, A. querquedula* and *Gallinula chloropus*. The 8 granivorous species (13.33%) find their food either in the canopy (*Carduelis sp., Coccothraustes coccothraustes*) or on the ground (*Columba livia, Streptopelia decaocto, Emberiza calandra*). The carnivorous are represented by day prey-birds (*Accipiter nisus, Buteo buteo, Falco subbuteo*), night prey-birds (*Athene noctua*) and *Ciconia ciconia* which feeds on the lawn next to the lakes. The 4 species of fish-eaters (6.66%) are *Alcedo athis*, found along the brook, *Podiceps ruficollis* that fishes on the lakes, and the two species of herons, *Ardea cinerea* and *Nycticorax nycticorax*, found accidentally in the park. *Turdus viscivorus* is the representative of the fruit-eaters (1.66%).

Tab. 2. *Bird communities in prevernal aspect*

SPECIES	Number of individuals	Relative abundance	Frequency	K.A.I.
Accipiter nisus	1	0,0011	0,5	0,16
Aegithalos caudatus	4	0,0046	0,82	0,65
Alcedo atthis	1	0,0011	0,32	0,16
Anas plathyrhynchos	8	0,0093	0,82	1,31
Anas querquedula	4	0,0046	0,16	0,65
Ardea cinerea	1	0,0011	0,16	0,16
Athene noctua	1	0,0011	0,32	0,16
Buteo buteo	1	0,0011	0,16	0,16
Carduelis carduelis	8	0,0093	1	1,31
Carduelis chloris	2	0,0023	0,5	0,32
Carduelis cannabina	1	0,0011	0,16	0,16
Carduelis spinus	36	0,042	0,5	5,90
Certhia familiaris	4	0,0046	1	0,65
Ciconia ciconia	1	0,0011	0,16	0,16
Coccothraustes cocc.	24	0,028	0,82	3,93
Columba livia	3	0,0035	0,65	0,50
Corvus corax	1	0,0011	0,16	0,16
Corvus corone	8	0,0093	0,65	1,31
Corvus frugilegus	436	0,51	1	71,47
Corvus monedula	38	0,04	1	6,22
Erithacus rubecula	4	0,0046	0,5	0,65
Emberiza calandra	1	0,0011	0,16	0,16
Falco subbuteo	2	0,0023	0,65	0,32
Ficedula albicollis	2	0,0023	0,5	0,32
Ficedula hypoleuca	2	0,0023	0,5	0,32
Fringilla coellebs	36	0,042	1	5,90
Gallinula chloropus	1	0,0011	0,16	0,16
Garrulus glandarius	2	0,0023	0,65	0,32
Hirundo rustica	10	0,011	0,16	1,64
Jynx torquilla	1	0,0011	0,16	0,16

SPECIES	Number of individuals	Relative abundance	Frequency	K.A.I.
Motacilla alba	2	0,0023	0,65	0,32
Motacilla cinerea	1	0,0011	0,16	0,16
Muscicapa striata	2	0,0023	0,65	0,32
Nycticorax nycticorax	1	0,0011	0,16	0,16
Parus caeruleus	10	0,011	1	1,64
Parus major	32	0,037	1	5,24
Parus palustris	4	0,0046	1	0,65
Passer domesticus	18	0,021	0,82	2,95
Passer montanus	32	0,037	1	5,24
Phoenicurus phoenic.	2	0,0023	0,5	0,32
Phylloscopus collybita	3	0,0035	0,65	0,50
Phylloscopus trochilus	2	0,0023	0,5	0,32
Pica pica	1	0,0011	0,16	0,16
Picoides major	9	0,01	1	1,47
Picoides medius	2	0,0023	0,85	0,32
Picoides minor	1	0,0011	0,16	0,16
Picus canus	2	0,0023	0,5	0,32
Picus viridis	2	0,0023	0,16	0,32
Podiceps ruficollis	1	0,0011	0,32	0,16
Regulus regulus	4	0,0046	0,32	0,65
Sitta europaea	14	0,016	1	2,30
Streptopelia decaocto	4	0,0046	0,82	0,65
Sturnus vulgaris	15	0,017	0,65	2,45
Sylvia atricapilla	3	0,0035	0,5	0,50
Sylvia curruca	3	0,0035	0,32	0,50
Troglodytes troglodytes	4	0,0046	0,82	0,65
Turdus merula	16	0,018	1	2,62
Turdus philomelos	9	0,01	0,5	1,47
Turdus pilaris	6	0,006	0,65	0,98
Turdus viscivorus	1	0,0011	0,32	0,16
TOTAL 60	**853**			

The Autumnal Aspect

This is also a transitional aspect, counting a high number of species - 54 - (although it doesn't reach the value of the prevernal aspect) but the lowest number of individuals – 480 (**Table 3**). The biodiversity index has the maximum value, H = 4.7173.

The insectivorous are dominant in this aspect, being represented by 30 species (55.55%) that feed in the canopy (*Regulus regulus, Aegithalos caudatus, Parus ater* - in the coniferous wood and *Parus sp., Ficedula sp., Phylloscopus sp.* - in the leaf wood), in the shrubs (*Erithacus rubecula, Lanius collurio, Troglodytes troglodytes*), in the air (*Delichon urbica*), on the banks of the brook (*Motacilla sp.*), on the ground (*Turdus sp.*) or on the trunks (*Picoides sp., Picus sp.*). The omnivores, 10 species (18.51%), are represented by *Corvus sp., Passer sp., Anas plathyrhynchos, Fulica atra* and *Gallinula chloropus*. The granivores include 7 species, feeding in the canopy (*Carduelis sp.*) or on the ground (*Columba livia, Streptopelia decaocto*). Two species of day prey-birds (*Falco subbuteo, Buteo buteo*) and two species of night prey-birds (*Asio otus, Athene noctua*) represent the carnivores (7.4%). Fish-eaters include *Alcedo atthis* and *Podiceps ruficollis* (3.7%) and fruit-eaters *Turdus viscivorus* (1.85%).

Table 3. *Bird communities in autumnal aspect*

SPECIES	Number of individuals	Relative abundance	Frequency	K.A.I.
Aegithalos caudatus	11	0,022	0,50	1,80
Alcedo atthis	1	0,002	0,25	0,16
Asio otus	1	0,002	0,25	0,16
Athene noctua	1	0,002	0,50	0,16
Anas plathyrhynchos	7	0,014	0,75	1,14
Buteo buteo	1	0,002	0,25	0,16
Carduelis cannabina	2	0,004	0,25	0,32
Carduelis carduelis	8	0,016	0,75	1,31
Carduelis chloris	4	0,008	0,25	0,65
Carduelis spinus	12	0,025	0,75	1,96
Certhia familiaris	4	0,008	0,75	0,65
Coccothraustes cocc.	8	0,016	0,75	1,31
Corvus corone	5	0,01	0,75	0,82
Corvus frugilegus	17	0,035	1	2,78
Corvus monedula	36	0,075	1	5,90
Delichon urbica	4	0,008	0,25	0,65
Columba livia	5	0,01	0,75	0,82
Erithacus rubecula	12	0,025	0,75	1,96
Falco subuteo	2	0,004	0,50	0,32
Fulica atra	3	0,006	0,25	0,50
Ficedula albicollis	3	0,006	0,25	0,50
Fringilla coelebs	18	0,037	1	2,95
Garrulus glandarius	8	0,016	0,75	1,31
Gallinula chloropus	3	0,006	0,25	0,50
Lanius collurio	4	0,008	0,25	0,65
Motacilla alba	2	0,004	0,25	0,32
Motacilla cinerea	1	0,002	0,25	0,16
Muscicapa striata	7	0,014	0,50	1,14
Parus ater	9	0,018	0,50	1,48
Parus caeruleus	15	0,031	1	2,46
Parus major	60	0,125	1	9,83
Parus palustris	12	0,025	1	1,96
Passer domesticus	17	0,035	1	2,78
Passer montanus	39	0,081	1	6,40
Phoenicurus phoenic.	2	0,004	0,50	0,32
Phoenicurus ochruros	1	0,002	0,25	0,16
Phylloscopus collybita	4	0,008	0,50	0,65
Phylloscopus trochilus	3	0,006	0,25	0,50
Podiceps ruficollis	4	0,008	0,25	0,65
Picoides major	21	0,043	1	3,44
Picoides medius	5	0,01	0,75	0,82
Picoides minor	1	0,002	0,25	0,16
Picus canus	1	0,002	0,50	0,16
Picus viridis	1	0,002	0,25	0,16
Pica pica	1	0,002	0,25	0,16
Regulus regulus	1	0,002	0,5	0,16
Sitta europaea	23	0,047	1	3,77
Streptopelia decaocto	3	0,006	0,75	0,50
Sylvia atricapilla	2	0,004	0,50	0,32
Troglodytes troglodytes	4	0,008	0,75	0,65
Turdus merula	50	0,104	1	8,20

SPECIES	Number of individuals	Relative abundance	Frequency	K.A.I.
Turdus philomelos	1	0,002	0,50	0,16
Turdus pilaris	2	0,004	0,75	0,32
Turdus viscivorus	4	0,008	0,75	0,65
TOTAL 54	**480**			

Qualitative and quantitative changes of the avifauna in the last 30 years

The hiemal aspect

Although the number of individuals is relatively constant (3180-3038) and the number of species has dropped only with 27.77%, the modification of Shannon-Wiener index, from H = 3.9656 to H = 2.2674, shows a decrease in biodiversity, due to the growth of the *Corvus sp.* populations from 1408 individuals to 2664 (89.2%). The development of these populations shows a degradation of the natural environment. The other populations, considered together, have suffered a decrease of 78.89%.

Some of the species recorded in 1970 and not seen this year are: *Anser anser, Tringa glareola, Accipiter gentilis, Buteo lagopus* and *Bombycilla garrulus*. The species that have recorded a great decrease in population size: *Streptopelia decaocto* (-96.87%), *Passer domesticus* (-95.68%), *Parus palustris* (-92.13%), *Anas plathyrhynchos* (-91.66%), *Loxia curvirostra* (-89.28%), etc. Some of the species have the same number of individuals *(Dendrocopos major, Certhia familiaris, Regulus regulus*) and some have even a larger one (*Parus caeruleus* (+18.57), *Corvus corone* (+30.85%), *Corvus monedula* (+99.25%), *Corvus frugilegus* (+106.7%), *Coccothraustes coccothraustes* (+ 107.39%)). The species recorded this year but not observed in 1970 are: *Columba livia, Dendrocopos medius, Dryocopus martius* and *Sturnus vulgaris.*

The prevernal aspect

The number of species is constant (61 in 1970, 60 in 1998), the number of individuals has dropped only by 7.28% (from 920 to 853), so that the only sign of the changes in this aspect is the modification of Shannon-Wiener index from H = 4.3083 to H = 3.25. The reason of the biodiversity's decrease is the growth of the *Corvus sp.* populations from 50 in 1970 to 482 in 1998 (+ 864%). The other populations considered together have diminished by 59.67%.

Among the species seen by Dan Stănescu, that were not observed this year are: *Columba oenas, Streptopelia turtur, Milvus milvus, Cuculus canorus, Galerida cristata, Luscinia megarhynchos*, etc.

Some of the species that have recorded a smaller number of individuals in 1998 are: *Jynx torquila* (-90%), *Parus palustris* (-86.66%), *Passer domesticus* (-85%), *Parus major* (-83.58%). In this aspect were recorded most of the species that were not seen 30 years ago: *Anas querquedula, Ardea cinerea, Nycticorax nycticorax, Falco subbuteo, Ficedula albicollis, Muscicapa striata, Phylloscopus trochilus, Sylvia atricapilla*, etc. This is one of the reasons why the Morisita index shows the lowest similitude between 1970 and 1998 regarding the park's avifauna in this aspect.

The autumnal aspect

The number of species dropped with 23.94% (from 71 to 54) and the number of individuals with 72.12% (from 1722 to 480), but the value of the Shannon-Wiener index shows a greater biodiversity (H 1970 = 4.6544, H 1998 = 4.7173).

This aspect records the largest number of species not observed in 1998 (see **Table 4**). Some species have a lower number of individuals: *Motacilla alba* (-96.07%), *Corvus corone* (-92.85%), *Anas plathyrhynchos* (-91.76%), *Carduelis cannabina* (-87.5%), *Delichon urbica* (-85.71%). A few species are new, not recorded in 1970: *Asio otus, Falco subbuteo, Alcedo atthis, Phoenicurus ochruros, Turdus pilaris.*

Tab. 4. *The species recorded in the park in the years 1970 and 1998*

No.	SPECIES	1970			1998		
		H	P	A	H	P	A
1	*Gavia arctica arctica* (L., 1758)			+			
2	*Tachybaptus ruficollis fuficollis* (Pall., 1764)					+	
3	*Podiceps griseigena griseigena* (Bodd., 1783)			+			
4	*Nycticorax nycticorax nycticorax* (L., 1758)					+	
5	*Ardea cinerea cinerea* L., 1758					+	
6	*Ciconia ciconia ciconia* (L., 1758)		+			+	
7	*Anser anser rubirostris* (Swinhoe.,1871)	+					
8	*Anas plathyrhynchos plathyrhynchos* L., 1758	+	+	+	+	+	+
9	*Anas querquedula querquedula* L., 1758					+	
10	*Aythya marila* (L., 1761)			+			
11	*Aythya nyroca* (Guldenst., 1770)			+			
12	*Mergus serrator* (L., 1758)			+			
13	*Rissa tridactyla* (L., 1758)	+					
14	*Chlidonias niger niger* (L., 1758)			+			
15	*Scolopax rusticola* (L., 1758)	+					
16	*Tringa glareola* (L., 1758)	+					
17	*Gallinula chloropus* (L., 1758)			+		+	+
18	*Fulica atra atra* L., 1758	+		+			+
19	*Accipiter nisus nisus* (L., 1758)	+	+	+	+	+	
20	*Accipiter gentilis gentilis* (L., 1758)	+		+			
21	*Buteo buteo buteo* (L., 1758)	+	+	+		+	+
22	*Buteo lagopus lagopus* (Pont., 1763)	+					
23	*Milvus milvus milvus* (L., 1758)		+				
24	*Falco subbuteo subbuteo* L., 1758					+	+
25	*Falco tinnunculus tinnunculus* L., 1758			+			
26	*Athene noctua noctua* (Scop., 1769)	+	+	+	+	+	+
27	*Asio otus otus* L., 1758						+
28	*Strix aluco aluco* (L., 1758)	+	+	+			
29	*Strix urslensis* (Pall., 1771)			+			
30	*Columba oenas oenas* L., 1758	+	+	+			
31	*Columba livia domestica* L., 1758				+	+	+
32	*Streptopelia decaocto decaocto* (Friv., 1838)	+	+	+	+	+	+
33	*Streptopelia turtur turtur* (L., 1758)		+	+			
34	*Cuculus canorus canorus* L., 1758		+				
35	*Alcedo atthis ispida* L., 1758	+			+	+	+
36	*Upupa epops epops* L., 1758		+				
37	*Jynx torquilla torquilla* L., 1758		+	+		+	
38	*Picus viridis viridis* L., 1758	+	+	+		+	+
39	*Picus canus canus* Gmel., 1788	+	+	+	+	+	+

40	*Picoides major major* (L., 1758)	+	+	+	+	+	+
41	*Picoides medius medius* (L., 1758)		+	+	+	+	+
42	*Picoides minor buturlini* (Hart., 1912)	+		+		+	+
43	*Dryocopus martius martius* (L., 1758)			+	+		
44	*Galerida cristata cristata* (L., 1758)		+	+			
45	*Alauda arvensis arvensis* L., 1758		+				
46	*Hirundo rustica rustica* L., 1758		+			+	
47	*Delichon urbica urbica* (L., 1758)			+			+
48	*Anthus trivialis trivialis* (L., 1758)		+				
49	*Motacilla alba alba* L., 1758		+	+		+	+
50	*Motacilla cinerea cinerea* Tunst., 1771	+	+	+		+	+
51	*Lanius excubitor excubitor* (L., 1758)		+				
52	*Lanius minor minor* (Gmel., 1758)		+				
53	*Lanius collurio collurio* (L., 1758)		+	+			+
54	*Bombycilla garrulus garrulus* L., 1758	+		+			
55	*Cinclus cinclus aquaticus* Bechst., 1803	+	+	+	+		
56	*Troglodytes troglodytes troglodytes* L., 1758	+	+	+	+	+	+
57	*Sylvia atricapilla atricapilla* (L., 1758)					+	+
58	*Sylvia curruca curruca* (L., 1758)		+			+	
59	*Hippolais icterina* (Vieill., 1817)		+	+			
60	*Phylloscopus trochilus trochilus* (L., 1758)	+				+	+
61	*Phylloscopus collybita collybita* (Vieill., 1817)	+	+	+		+	+
62	*Erithacus rubecula rubecula* (L., 1758)	+	+	+	+	+	+
63	*Phoenicurus ochruros gibraltariensis* (Gmel., 1789)						+
64	*Phoenicurus phoenicurus phoenicurus* (L., 1758)		+	+		+	+
65	*Turdus merula merula* L., 1758	+	+	+	+	+	+
66	*Turdus philomelos* C.L.Brehm, 1831		+			+	
67	*Turdus pilaris* L., 1758	+				+	+
68	*Turdus viscivorus viscivorus* L. 1758	+	+	+	+	+	+
69	*Luscinia megarhynchos megarhynchos* C.L.Brehm,1831		+	+			
70	*Regulus regulus regulus* L., 1758	+			+	+	+
71	*Muscicapa striata striata* Pall., 1764					+	+
72	*Ficedula hypoleuca hypoleuca* (Pall., 1764)		+			+	
73	*Ficedula albicollis albicollis* (Temm., 1815)					+	+
74	*Aegithalos caudatus europaeus* (Herm., 1804)	+	+	+	+	+	+
75	*Parus palustris palustris* L., 1758		+	+		+	+
76	*Parus ater ater* L., 1758	+	+	+	+		+
77	*Parus caeruleus caeruleus* L., 1758	+	+	+	+	+	+
78	*Parus major major* L., 1758	+	+	+	+	+	+
79	*Sitta europaea caesia* Wolf, 1819	+	+	+	+	+	+
80	*Certhia familiaris familiaris* L., 1758	+	+	+	+	+	+
81	*Oriolus oriolus oriolus* (L., 1758)		+				
82	*Sturnus vulgaris vulgaris* L., 1758		+	+	+	+	
83	*Fringilla coelebs coelebs* L., 1758	+	+	+	+	+	+
84	*Fringilla montifringilla* (L., 1758)	+			+		
85	*Carduelis chloris chloris* (L., 1758)	+	+	+		+	+
86	*Carduelis spinus* (L., 1758)	+	+	+	+	+	+
87	*Carduelis carduelis carduelis* (L., 1758)	+	+	+	+	+	+
88	*Carduelis flammea flammea* (L., 1758)			+			
89	*Carduelis cannabina cannabina* (L., 1758)			+		+	+
90	*Loxia curvirostra curvirostra* (L., 1758)	+		+	+		
91	*Pyrrhula pyrrhula pyrrhula* (L., 1758)	+		+	+		
92	*Coccothraustes coccothraustes coccothraustes* L., 1758	+	+	+	+	+	+
93	*Passer domesticus domesticus* (L., 1758)	+	+	+	+	+	+
94	*Passer montanus montanus* (L., 1758)	+	+	+	+	+	+
95	*Emberiza calandra calandra* L., 1758					+	

96	*Emberiza citrinella citrinella* L., 1758	+	+	+			
97	*Garrulus glandarius glandarius* (L., 1758)	+	+	+	+	+	+
98	*Pica pica pica* (L., 1758)	+		+	+	+	+
99	*Corvus monedula soemmerringii* Fisch., 1811	+	+	+	+	+	+
100	*Corvus frugilegus frugilegus* L., 1758	+	+	+	+	+	+
101	*Corvus corone cornix* L., 1758	+	+	+	+	+	+
102	*Corvus corax corax* L., 1758	+	+	+	+	+	

Table 5 *Synthetic table showing the modifications of the park's avifauna*

Aspect	No. of species		Variation	No. of individuals		Variation	Shannon-Wiener index		Morisita index
	1970	1998		1970	1998		1970	1998	
Hiemal	54	39	-27,77 %	3180	3038	-4,46 %	3,9656	2,2674	0,7445
Prevernal	61	60	-1,63 %	920	853	-7,28 %	4,3083	3,2499	0,1799
Autumnal	71	54	-23,94 %	1722	480	-72,12 %	4,6544	4,7173	0,7078

These changes are represented in **Fig. 1, 2, 3** and **4.**

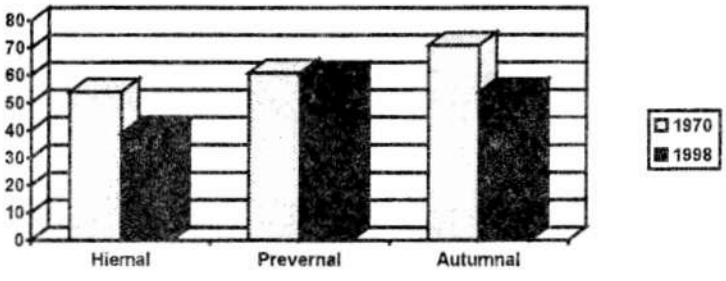

Fig. 1. *Variation of the number of species*

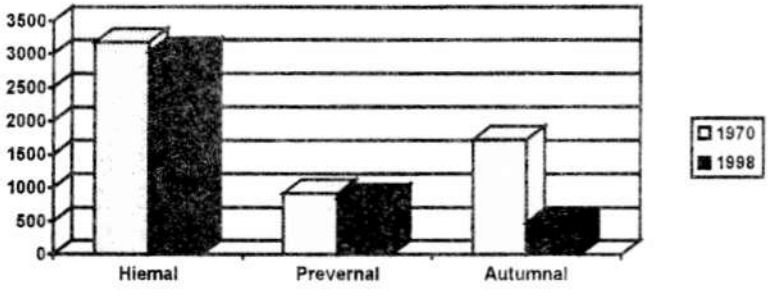

Fig. 2. *Variation of the number of individuals*

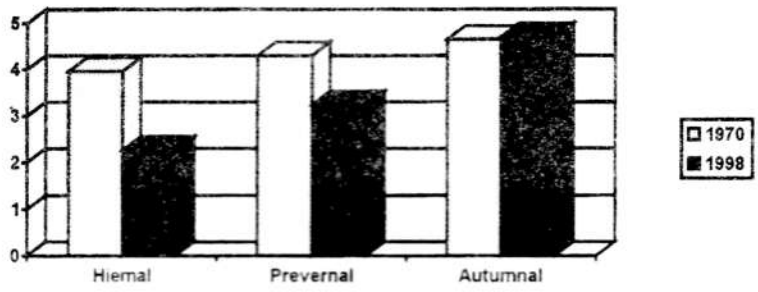

Fig. 3. *Variation of Shannon-Wiener index*

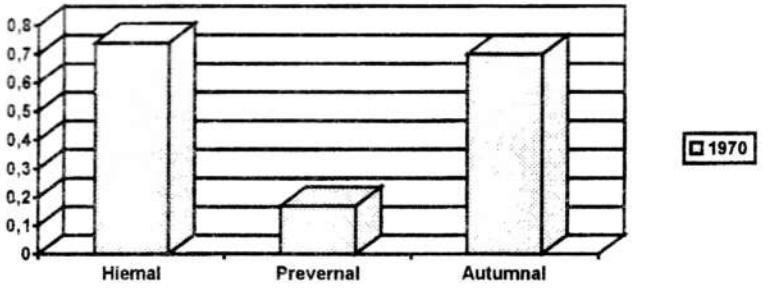

Fig. 4. *Variation of Morisita index*

Causes of the park avifauna's modifications in the last 3 decades

In the "Sub Arini" Park, the causes of the changes in the avifauna's structure, are related to the town's evolution, in every aspect (demographic, economic, and urbanistic). The substantial growth of the town's population in the last decades has determined the growth of the town's area. This was achieved by building new housing districts around the old town, districts that are areas with a high density of people and very few green spaces (there are no gardens). One of these districts is Valea Aurie, in the southern part of Sibiu, near the Dumbrava Wood. It influences the park's avifauna in two ways. First, it raised the flux of people and cars along the valley in the park, thus increasing the anthropic pressure exerted upon the different components of this ecological system represented by the "Sub Arini" Park. Second, the district is an obstacle for the birds that like open spaces, the lawns along the brook now being isolated from other similar ecosystems.

Besides this increased flux of the people in the park, the grazeing has a negative influence on the vegetation and the fauna.

Another area of the park that has suffered great changes is the lake system, which, in turn influenced the populations of aquatic species. The lakes in the 4th and 5th sector are not permanent, so they can not always offer the conditions needed for their nesting The permanent lakes (from the 6th sector) are frequently used for fishing, and the fishermen considering the water birds as their competitors,often scare them away.

Regarding the passage species noted in 1970*: Aythya marila, A. nyroca, Mergus serrator, Podiceps griseigena, Anser anser*, etc., the fact that they did not appear this year can be either accidental or caused by the degradation of the environmental conditions in the park- meaning that now their migration route avoids

it – or in their breeding and wintering regions –meaning that their populations have decreased in number. This is valid for all the migratory and accidental species. The only species that are influenced exclusively by the environmental conditions in the park are the sedentaries.

Opinions on the increasing of the *Corvus sp.* populations are very different, both about the cause and the ways of stopping this process. In general, the numerical increase of these highly adaptable species, is considered the result of the ecosystem's degradation. But the growth of populations takes place only in the condition of the existence of an abundant food resource. For the crows, the trophic base is not offered by the park but by the town districts in the case of *C. monedula* and partly *C. frugilegus* and by the farming lands around Sibiu in case of *C. corone* and *C. frugilegus*. Thus, considering the fact that the abundance of the rubbish in the town is one of the causes of this phenomenon, common in many other regions too, a way of controlling it would be a better hygienization of the town.

CONCLUSIONS

- 71 species of birds were recorded in "Sub Arini" park hiemal, in prevernal and autumnal aspects;
- the hiemal aspect is dominated by the species *Corvus corone, C. frugilegus* and *C. monedula*, which count together 7 times more individuals than the rest of the species considered together;
- the hiemal aspect records the lowest biodiversity (Shannon- Wiener index H = 2.26) due to the high relative abundance of *Corvus sp.*;
- the prevernal aspect, being a season when migration occurs, records the highest number of species – 60 – but the biodiversity is still quite low for the same reason;
- the highest biodiversity is recorded in the autumnal aspect, when the Shannon–Wiener index is H = 4.71;
- the species recorded in the park belong to 7 trophic groups: fruit-eaters, granivorous, omnivorous, carnivorous, fish-eaters, potamotrophs, and insectivorous. The latter are the best represented are the;
- the growth of the *Corvus sp.* populations in hiemal and autumnal aspects compensate the diminishment of the other populations, reducing in the same time the biodiversity;
- the most obvious change in bird communities' structure, indicated by the similitude indicex, was observed in prevernal aspect;
- the main cause that determines changes in the qualitative and quantitative structure of the park's avifauna is the increasing anthropic pressure;
- in this case, as a human impact indicator can be used only the sedentary species and not also the migratory and passage ones.

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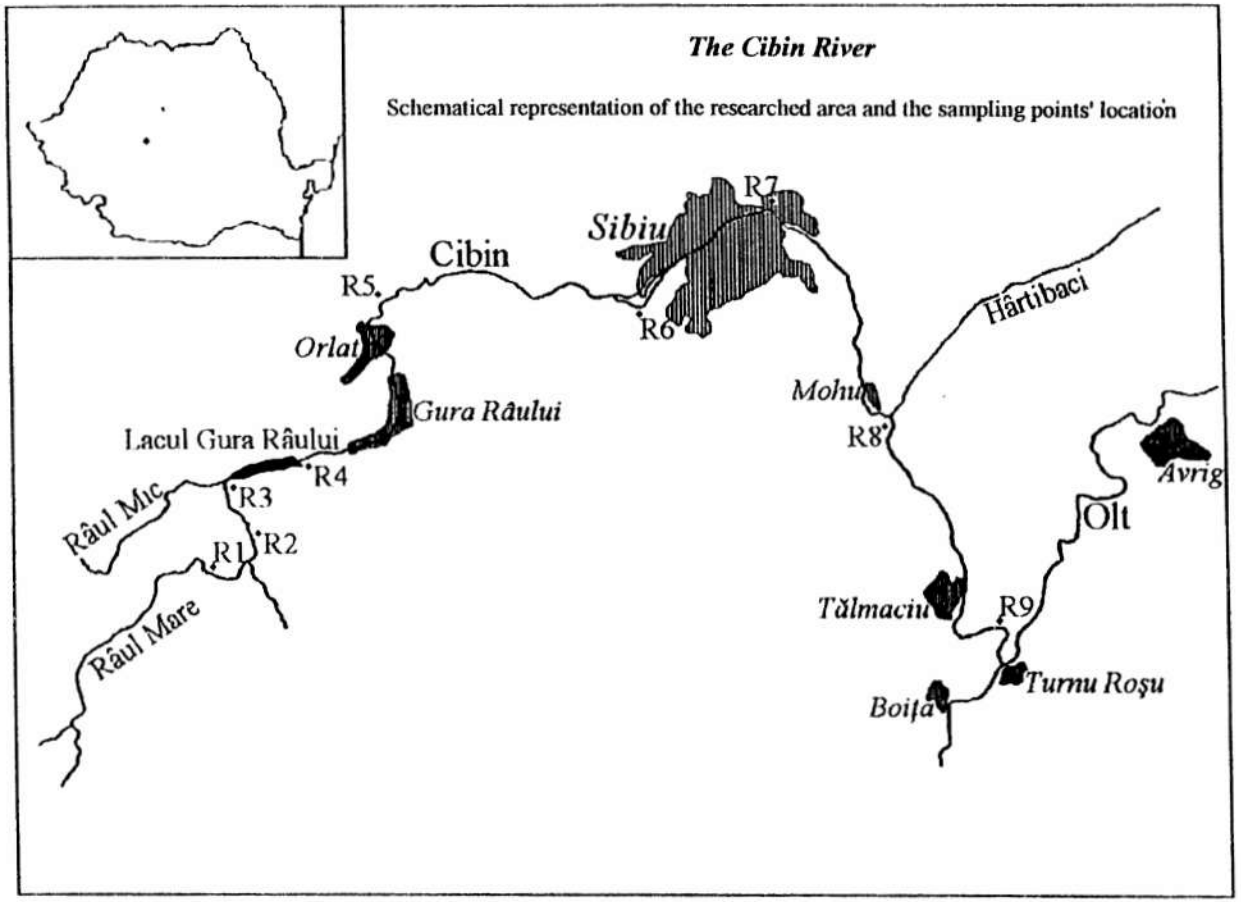
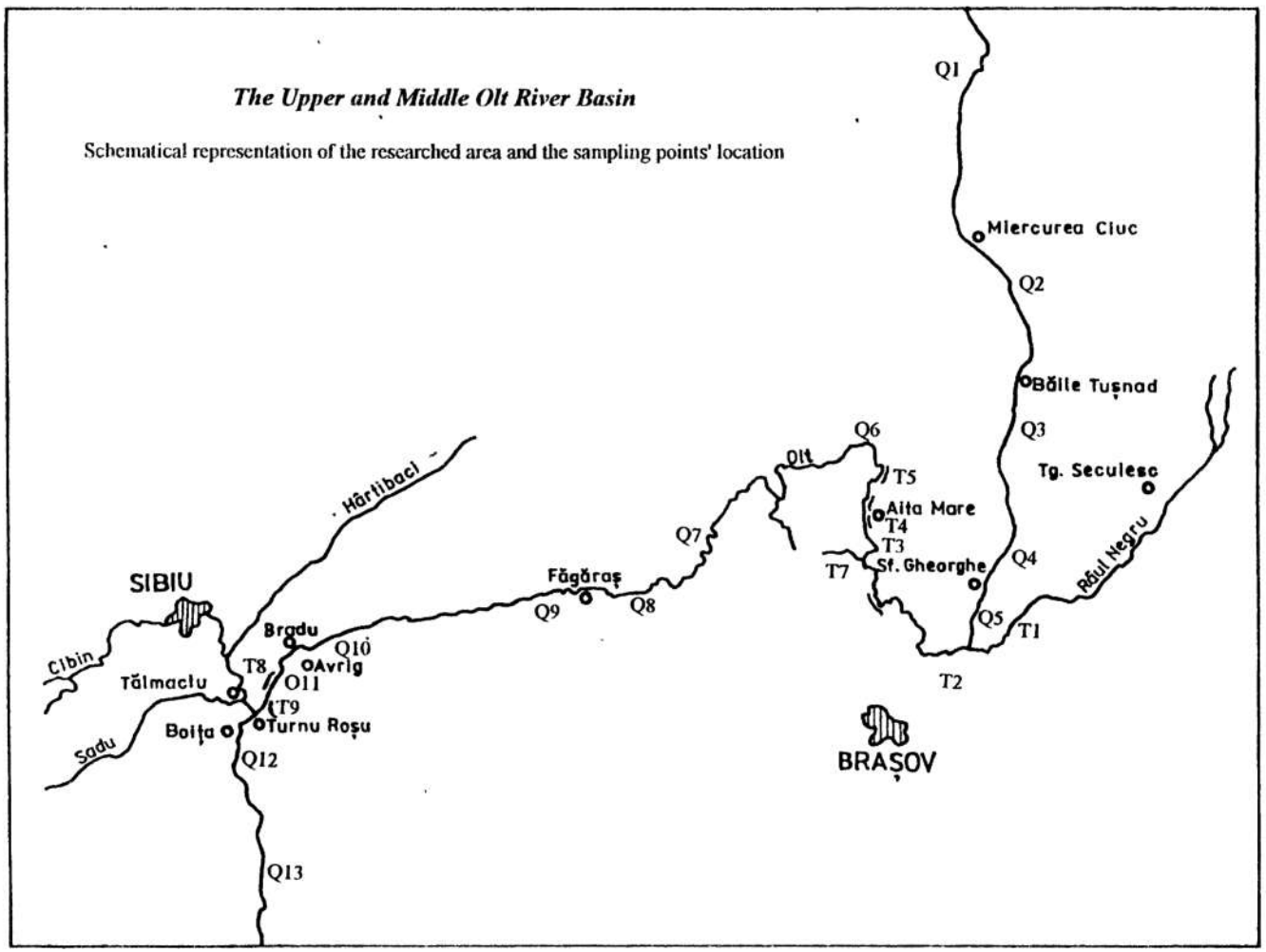

The Cibin River
Schematical representation of the researched area and the sampling points' location
Cibin
Sibiu
R7
R5
R6
Orlat
Gura Râului
Lacul Gura Râului
R4
R3
R2
R1
Râul Mic
Râul Mare
Hârtibaci
Mohu
R8
Avrig
Olt
Tălmaciu
R9
Turnu Roşu
Boiţa


The Upper and Middle Olt River Basin
Schematical representation of the researched area and the sampling points' location
Q1
Miercurea Ciuc
Q2
Băile Tuşnad
Q3
Tg. Seculesc
Q4
Q5
T1
T2
Râul Negru
Q6
Olt
T5
Aita Mare
T4
T3
T7
Sf. Gheorghe
Q7
Făgăraş
Q8
Q9
Hârtibaci
SIBIU
Cibin
Brądu
Q10
Avrig
T8
Q11
Tălmaciu
T9
Turnu Roşu
Boiţa
Sadu
Q12
Q13
BRAŞOV