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The Maros/Mureş River Valley

A study of the geography, hydrobiology and ecology
of the river and its environment

Szolnok - Szeged - Tîrgu Mureş

1995

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Contents

"The river is present itself
If you touch it
You have encroached upon
The last drop of the past
And the first of the future."

Leonardo da Vinci

Preface

The Maros/Mureş River with its 768-km length is the largest waterway in the Tisza River catchment area, and like the other rivers in the Carpathian Basin it is the lifeblood of the settlements, industrial and agricultural facilities in its valley. The ecological condition of these rivers and of their catchment area is economically important, but its value increases exponentially if we consider the natural values here, and their conservation. The rivers of the region connect the neighboring countries, making the environmental problems of these rivers international; the solutions must also be international, and cooperative.

Since 1991 Hungarian and Romanian non-governmental organizations (NGOs), by calling in experts from both countries, has started interdisciplinary research to assess the common river's environmental condition (see Appendix). The cooperating social organizations have aimed to create a database for public awareness and protection.

This book is the first published results of the cooperation between Tisza Klub and the Environmental Group of Liga Pro Europa. The information here may serve as a basis for future comparisons on the condition of the environment. It may also provide a foundation for NGOs to outline proposals for the organizations and agencies concerned.

We would like to offer our thanks to all who have helped us with our work: the generous support of other NGOs, media representatives, ministeries, universities, museums and research institutions in both countries made this project possible.

We would like to particularly express our thanks to the Hungarian Parliament, the Regional Environmental Center and the Council of Europe.

In the course of our work we have covered the Szamos/Someş in 1992, and in 1994 the Fekete and Fehér Körös/Crişul Negru and Alb. Next will be the Sebes Körös/Crişul Repede and the Berettyó/Berătău River, culminating with the Upper Tisza.

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FOREWORD

Just when modern, urban man is losing contact with wilderness, the interest to reestablish this contact — to know as much as possible about plants, animals, wilderness — spreads. People are increasingly turning to the forests, caves, seashores for their recreation; even indoor nature lovers — aquarium hobbyists, flower gardeners — are increasing. Hundreds of amateur and professional field books are published annually in a variety of languages. And from all this, people are increasingly interested in nature conservation, especially the protection of threatened or endangered species.

Some quiet observer once noted that the disappearance of any species equals the loss of a cultural document. In truth each species is a document that clarifies just a single small, but vital, detail in the dazzlingly complex process of organic evolution. Collections are underway, across countries and continents, for both plants and animals that will soon disappear altogether. Everything from subject-specific areas, to drastic modifications to life conditions (so-called "development"), are being collected for historical preservation in herbaria and museum collections.

But this is not a solution; not even for pure science. The phyletic position of any species cannot be established solely through morphological study; biochemical, molecular, and other characteristics which cannot be determined in preserved specimens, are presently used. Other, perhaps more significant characteristics will surely be discovered in the near future. But these can only be established in living specimens.

Wilderness preservation is necessary not only to satisfy the scientific curiosity of zoologists and botanists. Each species plays a role in nature; nothing is isolated. Every species for a given location is intimately interrelated and interdependent within that community. Man is a member of that community. And human survival depends on a "sane" nature, an ecological stability with other species. Air and water pollution, deforestation (invariably followed by wholesale modification of the local climate) have drastic effects on all life.

The resistance of different species to environmental modifications varies; the most sensitive disappear at the slightest deterioration in their environment. Others can withstand substantial changes — some species actually favor moderate levels of water pollution, climate modification, etc.

But the total number of species, the biodiversity, is diminishing constantly. Within a given community, the higher the biodiversity, the more stable is a biotic community (biocoenosis). When biodiversity diminishes, a true ecological catastrophe becomes possible, spilling inevitably into the human realm.

To prevent such catastrophes, we need detailed information on biodiversity, species composition. Specialists must establish floral and faunal communities (zoologists and botanists), as well as other scientists trained to determine life conditions: temperatures, soil and water chemistry, geology, hydrology.

The following works comprise one such multi-disciplinary study, devoted to the Mureș/Maros River, the largest tributary to the Tisza, itself the largest tributary of the Danube River system. The Mureş is also the largest river system in Translyvania and

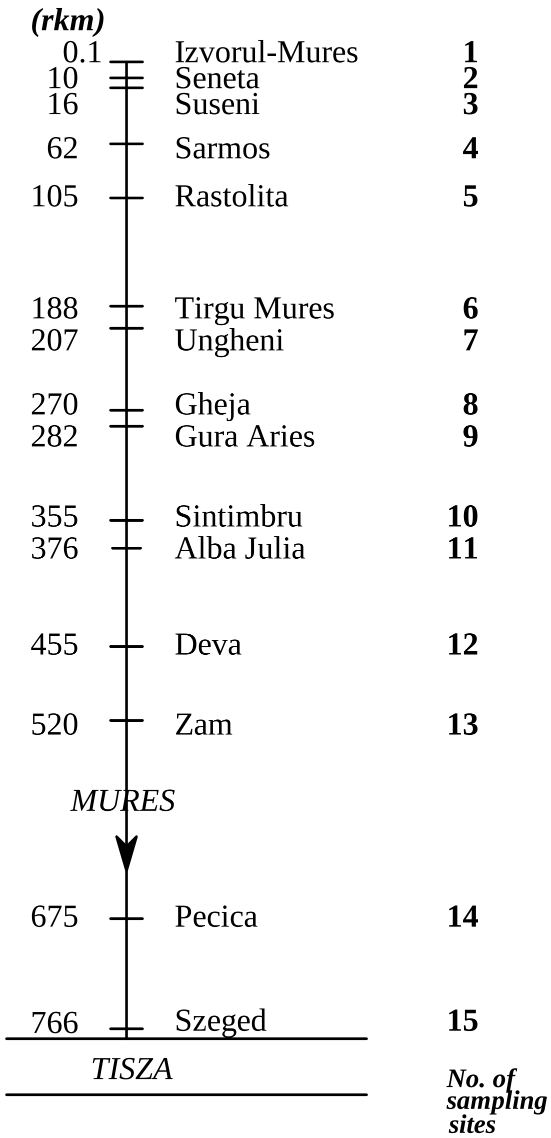
Romania. It has sources in eastern Translyvania, and drains the majority of this historical province as well as the more western provinces of Romania (Crişana and Banat) and southeastern Hungary, joining the Tisza in Hungary just north of the Serbian frontier.

The Mureş/Maros' upper reaches flow through an almost horizontal plateau, lacking a true montane (trout) zone; it develops a montane character further downstream, between Toplişa and Deda. Throughout most of its Translyvanian path the river is again a lowland stream, becoming once again a rapid river as it crosses the western Carpathians between historical Translyvania and western Romania.

This study is the result of a collaborative effort between Romanian and Hungarian scientists. Most of the data in this volume was collected on two expeditions along the river, from its source to its confluence with the Tisza. At the time of the expeditions, the Mureş/Maros River itself was already in an advanced state of pollution. The water chemistry, bacteriological conditions (as relates to public health), and faunal community compositions clearly demonstrated good conditions in the upper reaches of the river, deteriorating downstream. The terrestrial vegetation of the flood plain and river valley is also more degraded. Currently, data in the scientific literature is scarce, particularly concerning conditions prior to industrialization; early data refers only to molluscs, fish and bird life.

The Mureş/Maros Project was extraordinarily successful: rich, detailed information on the biological status of the river has been collected in just one year of investigation. Continuing studies will be necessary, to collect more data (primarily on the aquatic groups not dealt with in the present study – various orders and families of aquatic insects, amphibians) and to extend the study along the tributaries of the Mureş, all of which influence the life of the main river.

Petru M. Bănărescu
corresponding member
Romanian Academy of Sciences



The schematic longitudinal section of the Mureş/Maros river. Distance of the sampling regions from the source in river kilometer is indicated at the left side. Numbers at the right side are used in most of the contributions to identify the sampling sites.

THE GEOGRAPHY OF THE RIVER MAROS (MUREŞ) AND ITS RIVER SYSTEM

MIHÁLY ANDÓ

Introduction

The Maros drains the Transylvanian basin in a westerly direction and it meets the Tisza River at Szeged. The full length of the Maros is 749 km, the length of its valley is 651 km, the distance between its source and its mouth is 425 air km. Its length and 30,000 km^2 large drainage basin make the Maros one of the most significant rivers of the Carpathian basin. Most of its drainage area is covered with mountains and hills, and only a smaller proportion is plain surface. 25% of this territory is highland, 55% is plateau and hill-country, 15% is river valley and 5% is lowland. (Fig. l.)

Geohistory of the Maros drainage area

The beginnings of the hydrogeological aspects of the Maros coincide with the formation of the Transylvanian basin and its spur mountain regions in the Tertiary period. The presence of the Poiana Ruscă and Bihor Mts.was especially important in the Miocene epoch, since these stood erect in the Mediterranean Sea as island mountains. Later the rise of the ranges of the Eastern Carpathians, (Carpații Orientali; Keleti Kárpátok) and the Transylvanian Mountains finalized the formation of the Transylvanian basin (Bazinul Transsilvaniei, Erdélyi medence).

The interior of the Transylvanian basin was further formed by the slow rotation of the volcanic and the inside blocks accompanying the movements in the mountain structure. Traces of the most intensive volcanic activity can be found in the Bihor Mountains and around the Maros river head, in the Călimani (Kelemen), the Gurghiu (Görgényi-) and the Harghitei (Hargita) Mts. The center of the basin subsided relatively quickly compared to the rise of the rings of the spur mountains. The forceful rise of the rings of the spur mountains and the relative backwardness of the basin resulted in the gradual and substantial recession of the shores of the Miocene (Pliocene) inner sea. [3., 4., 8.,12.,13].

The present territory of the Maros valley, between the Metaliferi and the Poiana Ruscă Mountains (Ruszka- havasi legelő), however, did not rise and thus the Pannonian sea of the Hungarian Plain (Alföld) and the Transylvanian inner sea were connected for a long time. This narrowing was the Zám-pass (Defileul Zam, Zámi szoros), the oldest element of the Maros valley and of the Transylvanian river system as well.

In the beginning of the Pliocene the lowland section of the Maros was still covered by the Miocene lake. In the central territory of the Transylvanian basin significant bay-like depressions formed. Even in the beginning of the Pliocene, shorter streams characteristically

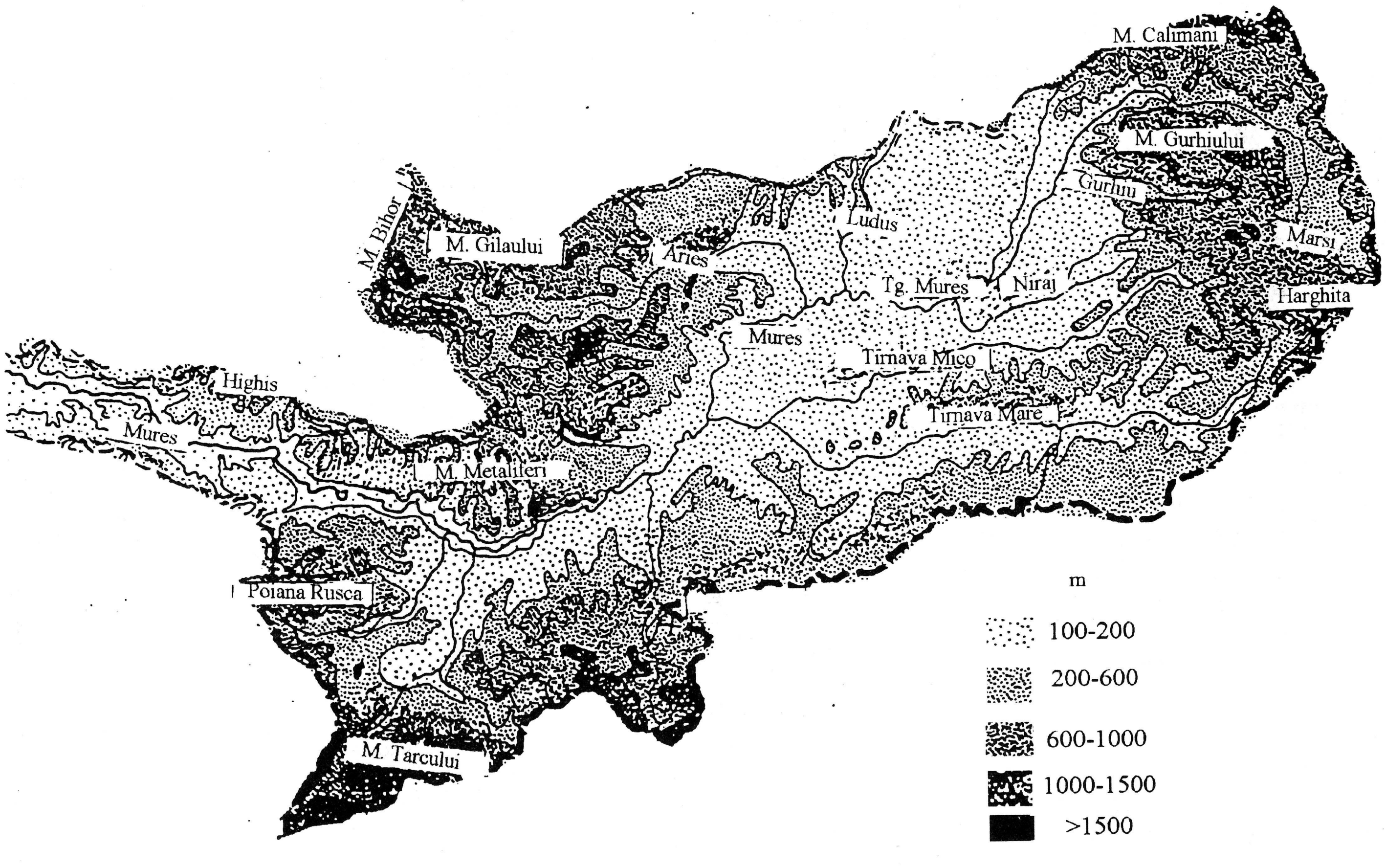


Fig.1. Surface of the Transylvanian drainage basin of the Maros (m above sea level)

started off from the surfaces of the surrounding higher mountains. Some of these streams were later taken up and further deepened by the Pleistocene Old Maros.

The Transylvanian bay formation developed into an independent closed lake and was filled up significantly only by the middle of the Pliocene. The talus, which determined the lowland section of the later Old Maros, accumulated from the coarse alluvium carried by the waters rushing down from the Highis-Drocea (Hegyes-Drócsa) and Măgura areas around this time as well. The torrential streams also deposited a significant quantity of alluvium at the meeting of the Hungarian Plain and the base of the surrounding mountains [5., 7].

An important rise in the drainage area of the Maros at the end of the Pliocene caused a recession in the inner lakes. By the end of the Tertiary period (and the beginning of the Pleistocene) the Maros had become a quick river, carrying the water of the Transylvanian inner lake to the significantly lower Hungarian Plain.

The Old Maros left the mountains and appeared in the Hungarian Plain in the Pliocene and left a large alluvial deposit in the tectonic valley. This deposit had been growing as a Levante talus, first only at the feet of the mountains and then slowly, with the further development of the talus system, it reached the talus systems of the Bega and the Criş (Körösök). [11].

The Hungarian Plain had been subsiding at the end of the Pliocene, and this process continued in the Pleistocene and even in the New Holocene. This significant subsidence can be traced back through the structure of the regional debris of the talus system beginning at Lipova (Lippa) and fanning out in the southeastern plain region. [1]. There was no permanent surface riverbed on the Maros Pliocene alluvium surface; the alluvium was spread in several branches. In the early Pleistocene the Maros took on a definite direction that coincides with the seismotectonic lines of the rim of the Hungarian Plain. One of these directions is the "Păuliş-Lipova" (Ópálos-Lippa) tectonic line, the other follows the foot of the Highis-Drocea (Hegyes-Drócsa) Mountains in northwest-southeast direction.

A very important change occurred in the "Günz" glacial, a large-scale deepening of the riverbed and a significant erosion. The destructive force of the river broke up and carried away the taluses and alluvial slopes it had built up, and formed a valley plain several kilometers wide.

A similar process took place in the "Mindel" glacial as well. During the "Günz" and "Mindel" periods the river formed a terrace system on its previous valley plain, influenced by the climatic change and the rise of the area, too. In the "Mindel" the Old Maros left the Lipova (Lippa) gorge and, supplying several meanders, turned northwest on the talus system of the Hungarian Plain. First the river ran on the southern rim of the talus, then, turning north, its main branch met the Old Tisza together with the Criş (Körösök). (Fig. 2.)

In the "Riss" period the talus developed mostly in the central area of the present talus. Significant surface changes occurred mostly in the glacial and interglacial periods of the "Würm," when predominantly coarse and medium sand deposits leveled the earlier deepenings of the riverbed. Simultaneously in the Transylvanian area the usually wide but not too high terrace systems of the Maros developed; these can be traced from Deda to Lipova (Lippa) [15].

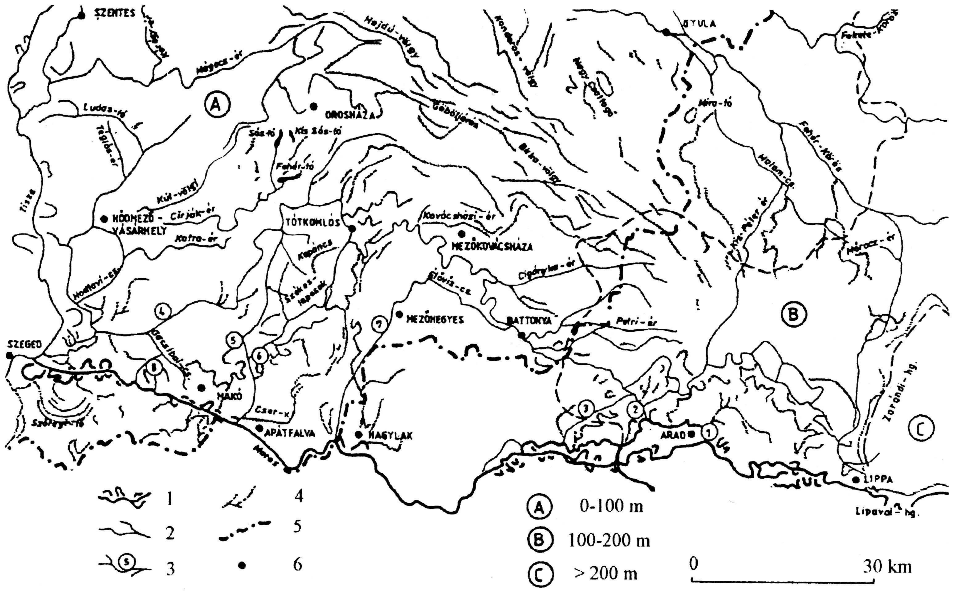


Fig. 2. The river system of the Hungarian Plain section of the Maros 1. The present bed and bends of the Maros 2. Brooks 3. Artificial canals 4. Lines of Old Holocene beds 5. Borders 6. Town or village A, B, C= m above sea level.

In the Holocene period the Maros settled in the Transylvanian basin and its horizontal bed changes became insignificant compared to the previous stages. The 5- to 10-meter-high Holocene terrace follows the river. At the same time, however, the Hungarian Plain section underwent a serious transformation due to the subsidence of the region surrounding the Criş (Körös) river. [1]. The oldest Holocene Maros reached the Tisza, the base of erosion 6., at Kürtös and Kevermes. However, the Tisza moved northwest forcefully; the Maros beds followed it on fan-like taluses. The river first followed the Békés-Kondoros, then the Kürtös-Nagykamarás-Orosháza, then the Dombegyháza-Mezőhegyes-Makó and then the Szárazér line (Fig. 3). The present bed was basically formed by the regulation of the river, since before this, in the Holocene, it also supplied the (Aranca) Aranka brook system.

Climatic and hydrographic characteristics of the Maros drainage basin

The temperature and precipitation of the Maros drainage basin is influenced by air masses from the Atlantic Ocean, the Mediterranean and Eastern Europe. Besides these, ground features also account for regional differences; for example, compared to the precipitation on the plains, in the mountain region the precipitation doubles. [2]. Similarly to the Hungarian Plain, the annual quantity drops in the Transylvanian basin as well. In the case of the latter, the lack of precipitation is the result of the climate modifying influence of the Southern and Eastern Carpathians, especially in winter.

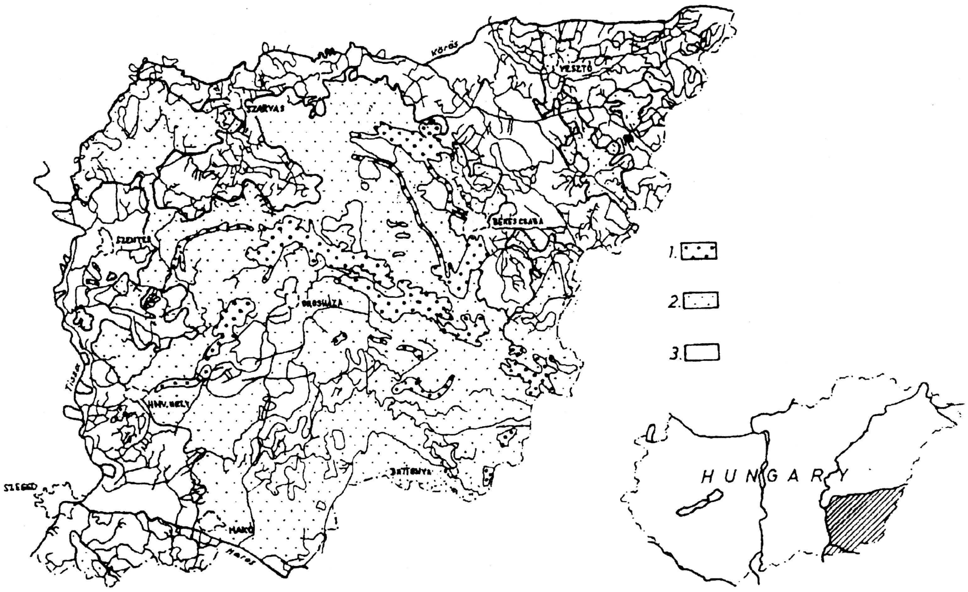


Fig. 3. Hungarian area of the Maros talus, with indications of the porosity of the sediment near the surface
1. Sediment with good water permeability (coarse and medium size sand) $K=10^{-3}$-10^{-4} cm/sec
2. Sediment with moderate water permeability (sand, warp and fine sand) $K=10^{-4}$-10^{-6} cm/sec
3. Sediment with poor water permeability (clay with loess and warp) $K=10^{-6}$-10^{-8} cm/sec

Since the drainage area of the Maros is supplied with water by the western winds, there are significant differences between the quantity of the precipitation in the "luw" and "lee" sides of the surface. This is especially characteristic on the western expositions of the Călimani Mountains (Kelemen) and the Gurghiu (Görgény) Mountains where the annual precipitation is over 1,500 mm while in the Transylvanian basin it is only 500-600 mm and on the "luw" sides of the lower mountain areas it is 700-1,000 mm. The distribution of the temperature is similar; the annual mean temperatures correspond to the elevation. The annual mean temperature for the whole drainage area of the Maros is 4-11 ^{o}C. The coldest area is the Arieş (Aranyos) River region, the Maros river head and the Giurgeu Mountains (Gyergyói havasok) with 3-6 ^{o}C mean temperature. Most of the Transylvanian basin, and the Maros valley that is open to the west,has an annual mean temperature of 8-10 ^{o}C; Szeged is 11 ^{o}C.

Table 2. Range of absolute maximums (a) and minimums (b) of monthly precipitation at regions of the Maros drainage area, according to the mean values of several years. A: Cimpia Tisei; B: Depresiunea Transilvaniei; C: Muntii Apuseni; D: Lantul Carpatic interior.

		XII	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
A	a	80	50	50	80	60	100	100	100	90	80	100	50
		160	100	100	100	100	150	150	200	150	170	200	100
	b	0	0	0	0	0	5	2	0	0	5	0	0
		10	15	12	10	5	30	46	20	20	15	15	10
B	a	50	40	40	50	50	100	200	127	100	200	100	50
		100	60	80	100	100	150	250	230	180	260	200	100
	b	0	0	0	0	0	20	10	6	5	0	0	0
		5	15	12	10	10	50	40	20	25	5	10	12
C	a	150	100	100	150	100	150	150	100	150	100	100	150
		180	150	150	220	150	200	230	270	250	150	150	200
	b	10	0	0	0	10	10	20	10	0	0	0	0
		15	15	12	10	20	30	50	20	30	2	10	15
D	a	150	100	158	150	150	150	200	300	150	200	100	150
		200	150	180	200	180	200	310	470	200	340	150	250
	b	10	0	0	0	10	20	20	10	20	0	0	0
		20	15	12	10	20	30	50	30	30	2	10	10

Influencing the water level of the affluents, the regional water absorption is of great importance. This leads to significant regional differences in the different parts of the drainage area because of the great seasonal differences. For example, in the winter months the surface precipitation is mostly snow, therefore the monthly averages of the water absorption distribution can be characterized by the snow accumulation that increases with elevation. In the drainage areas, especially in the mountain regions above 1,000-1,500 m, the winter precipitation is not more than 15 mm. This also means that the water absorption in the drainage basins is the lowest in winter, which is due to snow accumulation.

In the spring, as the snow melts from March till April, the surface water absorption increases significantly. This time even 50-60 mm of water can occur on the territories 500-1,500 m above sea level. At the same time on the Hungarian Plain and in the Transylvanian basin only 15 mm water can be measured. On the surfaces of the higher mountains the water absorption begins to increase only in April, and in this period values between 100-200 mm are often observed in the mountains.

In April, on the plains and hills comprising a large proportion of the drainage basin, the total water supply comes from precipitation; in the summer this is characteristic of the whole basin. In the fall the surface water absorption significantly drops and on the territories 1,500 m above sea level the accumulation of snow begins, while in the Hungarian Plain and in the Transylvanian basin less than 30 mm precipitation occurs. This latter is mainly due to the Mediterranean climate connected to the Adriatic cyclones.

The data presented here suggest that the annual distribution of the precipitation is connected to periods and not certain seasons. Two characteristic periods can be distinguished: a "wet" period and a long "dry" one. The wet period sets in between April and August, the dry from September to March. The floods of the rivers do not exactly correspond to this temporal distribution, since the early spring flood and the high waters of the river in the spring are not caused directly by falling rains, but rather these are the consequences of the snow melt later.

In the drainage area of the Maros the melting of the snow is a quick process which significantly raises the stock of water. When the melting lasts longer, the slow and gradual water supply does not lead to floods. The Maros has two important floods in a year (spring and summer green flood), and both are equally dangerous. [2]. In the first case the snow melts in the mountains because of the strong insolation at the end of February. The river swells very quickly, but equally fast is the retreat of the inundation (8-12 days). The spring flood of the Maros precedes that of the Tisza, sometimes reaching its peak at Szeged when the inundation of the Tisza has not even culminated at Szolnok.

Since 80% of the Maros drainage basin is made up of impermeable layers and because of the significant differences in level and the significant slopes the Maros becomes a quick river. [2]. Considering the distribution of the precipitation within the drainage basin, we can approximate the dates of the floods. In the mountains and in the Transylvanian basin the quantity of precipitation increases from January to June and decreases from July to January. Therefore there are only spring and summer green floods on the Maros, and regularly it does not have a flood in the fall, as there are no larger and significant rains in Transylvania in the fall.

The precipitation of the drainage area is carried away by the dense water system of the Maros, therefore the water level of the river is influenced by the precipitation and the specific flow rate and the circumstances of the accumulation as well. The specific flow rate greatly varies, depending on the surface features, development and edaphic conditions of the given area.

In the high mountain areas of the drainage basin the specific flow rate is 30-50 l/s/km^2, in most of the Transylvanian basin it is 1-3 l/s/km^2, and on the plain it is below 1.0 l/s/km^2. Extremism characterizes the specific flow rate of the individual drainage basins of the affluents. For example, in the riverheads of the Arieş (Aranyos), Ampoi (Ompoly) and Geoagiu (Gyógy), the average flow rate is between 5-30 l/s/km^2, but the value corresponding to the highest water output is 350-1,000 l/s/km^2, and the lowest output is 0.8-1.1 l/s/km^2. The highest flow rate values are observed in the riverheads of the Sebeº (Sebes), Strei (Sztrigy) and Rîul Mare. Here the average flow rate is over 40 l/s/km^2, the highest output can be over 1,000 l/s/km^2, but the lowest output is 2.0-6.0 l/s/km^2. [13,.14]. The affluents are characterized by the virulent changes of water level, the quick rise and the quick recession.

Hydrographically the drainage basin can be divided into two characteristic areas, a plain section and a basin surrounded by mountains. The varied territory of the drainage basin narrows down on the plain while it broadens in Transylvania. The territory of the drainage basin is expanded with asymmetric hydrographical characteristics especially east of Deva (Déva) [3]. The highest point of the drainage area is 2509 m in the Retezat (Retyezát) Mountains, the lowest point is 78 m above sea level where the Maros meets the Tisza (Fig. 1).

The Maros is a high falling river, running on elevated surfaces to its mouth and keeping its fall all along. The fall is evenly distributed. For example it falls 46 cm/km from Luduş (Marosludas) to Alba Iulia (Gyulafehérvár), 40-43 cm/km to Branişca (Braniska), to Săvîrşin (Soborsin), to Radna (Radna), and 38 cm/km from Radna (Radna) to Lipova (Lippa). On the Hungarian Plain, its fall decreases somewhat, but the number of the bends significantly increases. The development of the bends is especially important on the sections where the fall of the bed is small (Periam (Perjámos), Igreş(Egres) Cenad (Csanád), Kiszombor, Szőreg.)

On the Hungarian Plain the width of the bed also varies, for example its average width is 150 m between Radna (Máriaradna) and Pecica (Pécska), 180 m between Pecica and Csanád, and 100 m between Csanád and Tápé. The riverbed stretches out on the plains so that its water depth becomes shallow, while at other sections it narrows and deepens.

There can be distinguished four sections of the riverbed with uneven falls: l. Lipova (Lippa) - Arad, 39.8 km, 0.28 m/km fall; 2. Arad-Pecica, 23.6 km, 0.44 m/km fall; 3. P ecica- Canad , 52.6 km, 0,28 m/km fall; 4. Canad-Tápé, 37.5 km, 0.13 m/km fall.

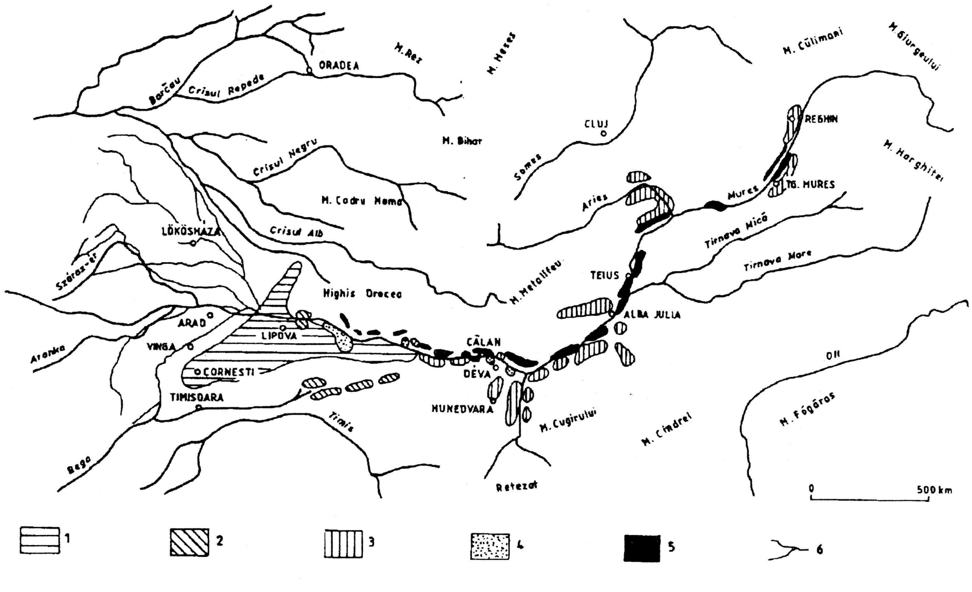


Fig.4. Terraces of the Maros in Transylvania and the traces of its old bed on the Hungarian Plain (source: OHV map). l. Levante pebble deposit; 2. Günz terrace traces; 3. Mindel terrace remnants; 4. Riss terrace remnants; 5. Würm terrace remnants; 6. Old Holocene Maros bed lines

The environment of the riverbed is varied by terrace formations of different ages. Of these, the Old Holocene terrace can be found occasionally 10 meters higher than the average water level of the river. These terraces are not covered even by the highest flood. The Holocene terrace is made up of mainly alluvium piled up in the Pleistocene, rinsed through and restructured by the floods of the river. Several upper Pleistocene terraces can be observed which do not form a continuous terrace system. (Fig. 4) These are 20 m above the river flats. A coarse pebbly layer containing loess and red clay covers the Pleistocene terraces.

In the mountain valley there are several Pleistocene terrace remnants that can be found 40-60 m above the river flats. In the mountain section different reefs of rock frequently emerge from the river sediment. Occasionally there are no terraces and the river had deepened into the bedrock (between Deva and Lipova).

On the Hungarian Plain section of the Maros a different development of the valley from the Pliocene till now has taken place. Leaving the mountains, the river built a talus which is fanning out. Only in the Holocene did the river take on a definite direction on the alluvial system and this riverbed usually coincides with the seismotectonic lines of the Hungarian Plain. [11].

On the drainage basin of the Maros the dense river system of the affluents comprise about 430 streams. [9.,14]. (Fig. 5).The latest Romanian map shows only 161 streams meeting the Maros, classifying 50 of these as periodically drying up. [15]. The map in the appendix paid special attention to the brooks with permanent water. In the appendix the indication of the comprising drainage areas are evaluated according to the river parameters. We could divide the Transylvanian territorial drainage basin of the Maros into 18 mountain drainage units.

Drainage units of the Maros

The Maros riverhead

The riverhead is comprised of the short reach mountain streams of the slopes of the Harghita, Gurghiu , Giurgeu Mountains, (Hargita, Gögényi-, Gyergyói havasok). The main spring branch can be found on the territory of Izvorul Mureş (Marosfő), on the lower mountain ridge in the direction of the Harghita and Giurgeu Mountains (Hargita and Gyergyói havasok). The mountains structurally surround the Giurgeu (Gyergyói) basin, and in its axis the Maros is navigable at 15 km from its spring. The basin is covered by sediments of varied composition. The right valley slope is made up of cristalline rocks, while the left valley slope is of andesite and tufa. Several of the mountain streams are left side affluents, there are considerably less streams on the right side. The spring of the river is at 856 m above sea level. It meets a major affluent, the Topliþa (Maroshévíz), at 656 m above sea level. The territory of the drainage area is 1297 km^2 with 997 m average surface height. Since the sloping is 192 m/km, the river becomes speedy and its high water disappears from the bed in a very short time.

The Topliþa and its watershed system

The Topliþa collects the water of the slopes of the Eastern Carpathians and the Cãlimani Mountains (Kelemen havasok). It is one of the main right side affluents of the Maros with a 212 km^2 drainage area and 254 km/km^2 surface fall. The river is only 29 km long, but its fall is considerable, 38.7 m/km. 14.,15. The southeastern slope of the drainage area is mostly a transition between the luw and lee type slopes. Because of this, compared to the mountain areas the precipitation significantly decreases (between 500-700 mm). The density of the water system is 0.7 km/km^2, but this value is generally characteristic on the crystalline and volcanic blocks of the high mountains.

Fig. 5. 1. Border of the mountain drainage area of the Maros 2. Borders of the supplementary drainage areas 3. Surface hydrography of the major brooks and streams. Names of the major streams: a =Maros; b=Tirnava Mică; c=Tirnava Mare; d=Toplița; e=Luț; f=Comlod; g=Luduș; h=Arieș; i=Ampoi; j =Dobra; k=Cerna; l=Strei; m=Sebeș; n=Secaș; o=Niraj; p=Gurghiu; r=Almaș; s=Pîriul Mare; Names of settlements: A=Gheorgheni; B=Toplița; C=Gurghiu; D=Batoș; E=Cetatea de Balt; F=Tîrgu Mureș; G=Aiud; H=Remetea; I=Turda; J=Abrud; K=Zlatna; L=Alba Julia; M=Miercurea Sibiului; N=Deva; O=Hunedoera; R=Zam; T=Rodna; U=Lipova;

The highland Maros bed

After meeting the Toplilþa, the river turns west, and runs in a transversal valley between the Gurghiu and Cãlimani Mountains (Görgényi and Kelemen havasok). The streams running toward the highland Maros bed are short reach with consequent water. The river density is 0.7-0.8 km/km^2, the data collected over years suggest that the average quantity of water is 30-50 l/sec/km^2.

The Gurghiu (Görgényi) stream and its drainage area

The Gurghiu (Görgény) leads the waters of the Northwestern Harghita and the northern slopes of the Gurghiu mountains (Görgényi havasok) to the Maros. The drainage area is composed of a mountain and a hill drainage basin. Both surfaces are built up of impermeable (volcanic, crystalline and clayey) formations. The western slope of the highest surface of the area, Sacã (Mezõhavas), 1777 m a.s.l. has over 1.000 mm precipitation per year. This significant quantity of water develops on a 564 km^2 area the sloping of which is 216 m/km. The high speed riverbed slopes 17.0 m/km. There is also a notable average surface height of 910 m above sea level.

The Luț (Lucz) and its drainage area

The riverhead of the affluent can be found on the southwestern fore area of the Călimani Mountains (Kelemen havasok). Meeting the Batoş (Bátos) stream after a relatively short section, their bed cuts deep into the alluvial sediment of the mountain foot. Also, the lower bed is relatively deep because of its tectonic origin. The total area of the two drainage basins is 460 km^2; the Luþ (Lucz) is 42 km, the Batoş (Bátos) is 127 km long. The other hydrographical characteristics of the area are the same as those of the Cîmpia Transiveniei (Mezőség) hills.

The Cîmpia Transiveniei (Mezőség) and Dealurile Mureşului (Marosszék) section of the Maros

The drainage basin is comprised of short-reach brooks and streams. On the right side of the river lie the Cîmpia Transiveniei (Mezőség), on the left there are the Dealurile Mureºului (Marosszék) hills. The direction of the hill line reaching across the area is parallel with the direction of the rivers running from the northwest to the southwest. The slope of the stream beds is even, their valleys are narrow, the surface of their environment is characterized by bare altitudes and badly watered rifts. The covering sediment of the drainage basin is sandy, clayey; the upper layer is of good water permeability, but below 1 m an impermeable formation can be found. Therefore, especially in springtime when there is a lot of rain, landslides occur on the valley slopes, that is, the soil fills up with groundwater and slides down to the valley. Especially cloud-bursts cause greater landslides.

The Niraj (Nyárád) stream and its drainage area

The drainage area of the stream can be found on the western slope of the Gurghiu Mountains (Görgényi havasok). The area is 609 km^2 with the average fall of 136 m/km. With its spring at 1,300 m a.s.l., the 78-km-long river collects the precipitation and snow melt of the Gurghiu Mountains (Görgényi havasok) at 13.0 bed fall. The average slope of the water drainage area is 133 m/km, but the average height is 512 m. The water-levels of the Niraj (Nyárád) are characterized by high inundations developing in the mountains which reach the lower parts of the basin causing tragic floods and damage.

The drainage area of the Comlod (Kapus) and Luduş (Ludas) brooks

Showing the same features, these brooks collect the waters of the Cîmpia Transilvaniei (Mezőség) hills. They are 60 km long, their drainage areas are similar, the two stream systems have 1175 km^2 drainage area with 120-130 m average sloping. The mouths are at 270 m above sea level, the fall of the beds is 0.5-0.25 m/km. There are several water basins (storage lake) by the bed line of Luduş in the inner and wide valleys of the hills. The drainage basin is mostly covered by impermeable sediment (sandy clay) where areal wash-off and landslides frequently occur. The area receives only 600 mm annual precipitation and the annual average temperature is 8-9 ^{o}C.

The drainage are of the Tîrnava Mică (Kis-Küküllő)

The branches of the Tîrnava Mică(Kis-Küküllő) river head can be divided into two parts. The northeast streams spring on the southwest slope of the Gurghiului Mountains between the Bucin (Bucsin) peak and Sacă (Mezőhavas). The southwest streams come from the northern slope. Running northwest through the Praid (Parajd) salt territory, the two branches unite at Sovata (Szováta). The stream turns southwest on the neogen rocks of the hills and merges with the Tîrnava Mare (Nagy-Küküllő) before meeting the Maros. The mountain stream is 294 km long, its drainage basin is 17,820 km^2. The spring is 1190 m, the mouthis 219 m above sea level. The average height of the drainage area is 636 m, the average slope is 176 m/km. The fall of the bed is 5.0 m/km, the average water output of the river is 8.0 m^3/sec.

The water drainage area of the Tîrnava Mare (Nagy-Küküllő)

The spring branches of the river can be found at 1455 m above sea level on the slope of the Harghita (Hargita). The Somlyó Ridge stretching south divides the river head into a western and a northern territory. The streams running down the Harghita (Hargita) are abounding in water. After several streams meet, the Tîrnava Mare (Nagy-Küküllõ) first turns southwest, then west, and cuts through the Tînava Hills. On its way it receives several streams on the right side that spring on mostly trachit rock textures and then, when reaching the basin, they draw on the water supply of the neogen surface covering sediment. Of the affluents we should mention the Sărat (Sós), Fejérnyik, and Gagy streams, and the Soimuş (Solymos) border stream. On the left side of the river there are only insignificant streams, draining the water of the neogen clayey surfaces. At its mouth, the Tîrnava Mare is at 223 km a.s.l., the drainage area is 3606 km^2, with 564 m average height and 150 m/km average slope. On its lower part it carries 13.0 m^3/sec water; the water output of the united Tîrnava is 22.0 m^3/sec.

The Arieş (Aranyos) stream and its drainage area

The Arieş is one of the main affluents of the Maros, its riverhead is on the southeast slope of the Bihor (Bihari) Mountains. After its several branches meet as Arieş, the river collects the water of the southern parts of the Gilău (Gyalui) Mountains and the northern parts of the Transylvanian Mountains. The weesterly riverbed becomes quick, then it reaches the Arieş(Aranyos) hills and meets the Maros with a southeast bed. The 164 km long river has a 2970 km^2 drainage basin and a significant (215 m/km) average fall. The riverhead is 1195 m, the mouth is 263 m above sea level. Because of the different characteristics of the surface, the fall line of the riverbed varies. Compared to the previous, the fall of the bed is so even, that the fall is only 5.68 m/km. The density of the water drainage area is between 0.8-1.2 km/km^2. Since the surface gets high precipitation (between 1.000-1.300 mm), the average of the mean water output significantly increases (23.5 m^3/sec).

The drainage area of the Ampoi (Ompoly) stream

The stream collects the water of the river heads of the middle Apuseni (Nyugati) Mountains. The valley runs on mostly mountain areas where mesoic and tertiary rocks form the surface. The composition of the rocks is mainly sandstone and conglomerate with good water permeability. In the drainage basin there are several locations where Jurassic lime, augit, porphyrit and hornstone can be found. The area is 576 km^2, the stream is 60 km long. The spring of the stream is 1220 m, the mouth is 219 m above sea level. The slope of the drainage basin is significant, 253 m/km, and so is the fall of the river bed (17.16 m/km). The mean water output of this highly falling river is only 1.3 m^3/sec because of the lack of precipitation in the drainage area since the surface features produce a foehn effect on the lee side expositions.

The drainage area of the Sebeş (Sebes) and Cugir (Kudzsir) streams

The drainage basin can be found on the northwest territory of the Cugir (Kudzsiri) Mountains where several quick brooks and streams run on the high slopes. In the mountain areas the covering rock of the Cugir (Kudzsir) and Sebeş (Sebes) drainage areas is crystalline shale and other impermeable formations. The covering sediment of the hills of the northern fore area is Pannonian clay, while in the immediate Maros valley we find washland sediment.

In the dry period the high falling streams are supplied by springs only, which are quite abounding in water. After the thaw and storms the streams swell and bring large quantities of debris and blocks of stone down from the high mountains, only to leave them behind rounded in their low and narrow valley. There happens a large scale pounding because of the large fall, but these streams leave considerable amounts of coarse pebbles even in the Maros valley.

The spring of the Sebeş (Sebes) is 2060 m above sea level, its united drainage basin with that of the Secaş (Székás) stream is 1289 km^2. With its affluents, the Cugir (Kudzsir) stream north of this drainage area drains the water of similarly exposed slopes. The riverhead of this stream is 1900 m above sea level and its drainage basin is 358 m^2. Although the slope of the surface is considerable (280 m/km), the fall of the riverbed is only 28.2 m/km and the mean water output is 4.0 m^3/sec. The same characterization applies to the brook system of the Sebeş (Sebes), which has a 1800 m difference between its source and mouth. The fall of the 93 km valley is 20.1 m/km. The water characteristics of the flow in the two drainage basins are similar.

The drainage area of the Strei (Sztrigy) stream

Of all the affluents of the Maros, the highest surface stream density can be found in the stream system of the Strei (Sztrigy). The drainage area stretches out on the Northern Cugir (Kudzsuiri) Mountains, the Eastern Retezat (Retyezát) Mountains and the Northeastern Semenic (Szörényi) Mountains. The spring of the Strei (Sztrigy) is in the Cugir (Kudzsiri) Mountains 1600 m above sea level. After meeting several affluents, the 92-km-long river reaches the Maros at 170 m above sea level. Of its affluents, it is worth mentioning the Rîul Bărbat (Borbat; its spring is 1880 m above sea level), the Lapuşul Mic and Mare (Kis and Nagylápos; 2216 m), the Rîul Mare and the Rîul Secaş. The whole drainage basin, including the drainage areas of the affluents, is 1926 km^2. The streams mentioned here run across territories with an average slope of around 267 m. All the stream valleys have, on the mountain sections, torrential beds. The bed of the Strei (Sztrigy) falls 15.5 m/km; the mean water output of this quick river is 23.3 mg/sec. On the higher mountain drainage areas there are mainly crystalline shale, Crete sand and limestone, while on the hills we can find Neogen clayey formations. It is characteristic that the pebble terraces by the valleys are formations of the Pleistocene period and the sediments of the immediate washlands are recent formations. In the hills the river valleys have wide north-south washlands and along these there are wide pebble terraces to the Maros. The crystalline mountain area rises from the hills very suddenly and this accounts for the torrents and the fast flow rate of the streams.

The drainage area of the Cerna (Cserna)

The drainage area can be found on the eastern slopes of the Poiana Ruscă Mountains. After meeting its mostly east-west affluents, the river bed turns to north on the hills in the Maros valley. The spring of the 78 km long Cerna (Cserna) can be found 1,130 m above sea level and it reaches the Maros at 184 m a.s.l. This relatively short river has a significant fall (960 m), the slope of the bed is 13.15 m/km, therefore this is a stream system with a quick flow which shows extreme water levels (the mean water output is 3.3 m^3/sec). The drainage basin is 738 km^2 with 229 m/km average slope. The rock surface influencing the surface flow is similar to that of the Strei (Sztrigy) area.

The drainage area of the Dobra

Of the several short-reach streams on the northern slope of the Poiana Ruscă Mountains, the Dobra is worth mentioning. Between Deva (Déva) and Lipova (Lippa) the Maros valley narrows. The spring of the 43-km-long Dobra can be found in the Poiana Ruscă Mountains, at 1,100 m above sea level, and it reaches the Maros at 162 m. The relatively short river runs through 938 m level difference which causes a significant (21.8 m/km) fall in the system where the mean water output is only 0.95 m^3/sec.

The drainage basin of the Almaş (Almás) and the Bîrzava

From Deva (Déva) and Radna (Radna) on the right side of the Maros on the slopes of the Zărand (Zarándi) Mountains there is a system of short reach and high falling rivers.

These relatively narrow, high-gradient streams are usually seasonal with relatively low water outputs from precipitation and their springs.

The drainage area of the Pîriul Mare

The drainage basin collects the water of the short reach valley system on the left side of the Maros, which belongs to the immediate fore regions of the Hungarian Plain. The river cut its bed on the surface into its previous Levante and Pleistocene alluvium. Mostly the springs and the groundwater supply the short reach stream system with water, because, similarly to the Hungarian Plain, the area receives a relatively small quantity of precipitation.

Summary of the main hydrographical characteristics of the Maros drainage basin

- The riverbed and the flood plain of the Maros with the 30,000 km^2 drainage basin make the river one of the most important affluents in the Tisza river system.

- On the surface of the Hungarian Plain drainage basin there are sandy and clayey formations, while in the basin and in the mountains crystalline volcanic and clayey impermeable formations occur. In the river system permeable formations can rarely be found.

- The areal rate and speed of the flow in the supplementary drainage basin is determined by the slope and the impermeable covering formations.

- The floods rising suddenly on the affluents of the Maros in spite of their quick flow are equalized in the nearly 300-km-long riverbed.

- The quick disappearance from the supplementary drainage basins leads to floods almost every time there is a large quantity of precipitation. However, the floods disappear as suddenly as they have appeared.

- The floods of the Maros can be approximated on the basis of the distribution of the precipitation in the drainage basin and the water absorption of the supplementary drainage basins.

- The distribution of the precipitation over the year in the area depends on periods rather than seasons of the year. The two characteristic periods are the "wet" (May-August) and the "dry" (September-April) periods.

- The Maros has two floods, the spring and summer "green floods". Both cause inundations on the lower section of the Tisza.

- At Szeged the flood caused by the spring thaw usually appears earlier than the Tisza inundation, therefore catastrophes are avoided.

- In the summer the Transylvanian basin receives only little precipitation, therefore on the lower Tisza the summer inundation flattens out and here spring floods are more significant.

- The river line is followed by segmented terrace formations from different periods (Holocene- Pleistocene) the average height of which is 10-80 m above the water level of the river.

- The rocks of the terraces are comprised of coarse sediments and clayey formations of surface erosion.

- In the upper regions the Maros meets spring waters containing sodium, sulfate, magnesium, iodine, bromine and ammonia, but this does not lead to natural pollution because the water of the river becomes clear due to its quick flow and the considerable amount of alluvium.

- The deterioration of the water cleanness is mainly caused by anthropogenic pollution. The industrial areas and agglomerations of human settlements are responsible for the water pollution that is especially significant in the territories of the supplementary drainage basins (Arieş, Tîrnava, Strei, Cerna) and larger towns (Tîrgu Mureş, Alba Iulia, Turda (Torda), Deva, Arad, Mezőhegyes, Makó).

- The deterioration of water quality caused by anthropogenic pollution reached catastrophic dimensions with the presence of large amounts of cyanide, phenol suspensions, ammonia, nitrate, household and other chemical materials. Although it must be noted that there is a certain self-cleansing process due to the quick flow of the river, the huge water output of its floods and the quantity of the alluvium it carries, but still, the Maros River needs effective water protection.

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SOILS OF THE FLOOD PLAIN OF THE MUREŞ (MAROS) RIVER

SÁMUEL JAKAB

Introduction

Along its 768-km route the Mureş River - the most important tributary of the Tisza River - crosses several relief features with varying lithological structures, which leave their marks on the soil cover of the flood plain, including the active flood plain.

Having its source in Hãsmaşu Mare (Nagy Hagymás) Mountain, the Mureş River steps in the Intracarpathian fluviolacustrine Depression of Giurgeu, a large, poorly drained Quaternary subsidence zone, surrounded by a mountainous area built of silicatic metamorphic rocks, on the one hand, and volcanic andesitic rocks, on the other. All alluvia arriving in the bottom of the depression consists of deposits from gravel to fine sand, originating from these surrounding montains.

Leaving this depression area, the Mureş crosses its longest gorge - Topliþa - Deda - (60 km) through volcanic mountains. The alluvia consists of coarse gravel with few fine particles, mostly andesitic.

At its emergence from the narrows through the volcanic mountains (Deda), the river flows at first in a Quaternary paleodelta, developed exclusively in the subsidence zone, at the contact point of the mountain. This hinterland fandelta is situated between the foot of the mountain and the mouth of the Gurghiu River, a tributary of the Mureş, near Reghin. On this extent the alluvial deposits consist of a mixture of coarse andesitic gravel, sand and fine particles, the two latter originating from the nearby piemontane region.

The further path of the river cuts the large Transylvanian Plateau, a relief developed on friable Sarmatian and Pliocen deposits, consisting mostly of pellitic-psephitic, and subordinately of psamitic sediments (marly clay, sandy clay, loam and bench of sand). Consequently, the recent alluvia of the river are, in most cases, band water conductors, finely granulated, rich in lime.

Breaking through the diapir zone of Ocna Mureş - Teiuş, the alluvia of Mureş frequently becomes salty.

Due to the nearness of the South Carpathians (Sebeş Mountains) and Apuseni Mountains along the Alba Iulia - Orăştie trough-like depression, and mainly in the Deva - Zam gorge, the alluvial deposits are coarser and contain less lime, than that in the section of the Transylvanian Plateau.

At the issue from the mountain at Lipova the Mureş flows on a succession of self-built deltas, situated between the foot of the mountain and the mouth of the river, belonging to the low-level Holocene area of the southeastern Hungarian Plain.

Prior to river regulation in this deep alluvial area, the running waters wandered freely, virtually without beds, due to the very low gradients in the region.

Nowadays, several sections of the Mureş River are regulated, and flood-control levees have been erected.

Materials and Method

In this paper we present the soil cover of the flood plain of the Mureş River, on a scale of 1:300 000. Within the limits of the flood plain, the active flood plain represents frequently a relative narrow stripe, extremely difficult to delineate at the scale we used.

We present the soil map of the flood plain on fourteen sheets, with a profile of the signifcant soils found in the presented area sketched on each.

The materials used consist of soil maps published by the Romanian Research Institute of Pedology and Agrochemistry [(10,11,12,13,14)], soil maps of Mureş County [(6)] and Hunedoara County [(15)] and several other published or unpublished soil surveys and studies.

In compiling Table 1 we have used data from the offices of Pedology and Agrochemistry of counties intersected by the Mureş River, as well as proper ones. In all chemical procedures air-dry samples were crushed, care being taken to avoid fragmenting nonsoil material, to pass a 2-mm roundhole sieve. Material retained by the sieve was reported as greater than 2 mm. All determinations were performed on the less than 2 mm fraction, and results were reported on this basis.

The heavy metal analyses were performed by means of atomic absorbtion spectrofotometric analysis (PYE-UNICON, Model SP-2900), in order to determine if any heavy metal pollution exists.

The soils of the flood plain, in particular those of the active flood plain, are of great importance for aquatic biocoenoses, generally for the state of running water, for many reasons. First of all, the soil cover is an important natural filter, which retains in large quantities the waste products. Its efficiency depends considerably on certain soil characteristics affecting permeability, cation mobility, such as clay, humus, pH, and their integration as cation-exhange capacity. Secondly, as a component of riverside biotopes, the soils of the flood plain determine to a great extent the nature, the structure of biocoenoses.

Table 1. Physical and chemical characteristics of several soil samples

Soil	Clay %	pH-H_2O	Org.mat. %	$CaCO_3$ %	P ppm	K ppm	HCO_3 (mg/100g)	Cl (mg/100g)	SO_4 (mg/100g)	T (mg/100g)	Na % from T
AP1- Morăreni											
Ao 0-20 cm	15,4	7,8	1,78	0,41	41	69					
C 20-40 cm	15,4	7,8	1,22	0,41	23	45					
AP2- Sintana de											
Ao 0-30 cm	28,8	8,2	1,87	0,50	39	78					
C1 30-75 cm	16,5	8,2	0,85	0,40	27	78					
C2 75-(120) cm	13,4	8,2	-	0,50	-	-					
AP3- Chelmac											
Ao 0-30 cm	36,9	8,0	2,30	0,69	31	79					
AC 30-45 cm	36,8	7,8	1,60	0,20	8	51					
C 45-(120) cm	30,2	8,2	0,60	0,30	-	-					
AP4- Deva											
Ao 0-30 cm	8,7	8,0	1,09	1,73	67	110					
C1 30-60 cm	18,8	8,0	0,91	2,32	25	85					
CGo 60-(120) cm	27,5	8,0	1,29	3,12	-	-					
AP5- Zam											
Ao 0-20 cm	24,2	7,9	1,2	2,40	72	170					

Soil	Clay %	pH-H_2O	Org.mat. %	$CaCO_3$ %	P ppm	K ppm	HCO_3 (mg/100g)	Cl (mg/100g)	SO_4 (mg/100g)	T (mg/100g)	Na % from T
AC 20-50 cm	36,0	7,8	0,7	1,70	44	150					
CGo 50-(120) cm	34,2	8,0	0,6	2,60	-	-					
AS1- Ogra											
Ao 0-70 cm	30,7	7,8	2,45	2,3	156	170					
AC 70-80 cm	28,5	7,8	2,23	2,0	48	100					
C 80-(150) cm	28,4	7,9	0,65	1,6	-	-					
AS2- Deda											
Ao 0-40 cm	27,0	6,5	3,42	0,0	34	14					
R 40-(80) cm	4,2	6,2	0,14	0,0	-	-					
AS3- Pecica											
Ao 0-50 cm	43,4	8,0	2,77	8,8	20	155					
C1 50-70 cm	30,9	8,4	2,35	5,3	15	105					
C 70-(120) cm	18,7	8,6	0,37	5,1	-	-					
AS4- Deda											
Ao 0-30 cm	27,7	7,2	3,84	0	36	150					
30-60 cm	27,8	7,1	1,17	0	11	80					
CGor 60-(120) cm	33,0	7,0	0,82	0	-	-					
AS5- Ocna Mures											
Ao sc 0-40 cm	39,0	8,7	2,98	4,4	17,0	120	61,0	12,4	144		
AC sc 40-60 cm	38,0	8,8	1,80	4,7	15,0	107	42,7	14,2	120		
CGo sc 60-(120) cm	36,0	8,7	1,07	14,6	10,0	98	24,4	17,8	105		
AS6- Cenad											
Am 0-30 cm	43,1	7,5	4,0	9,2						29,5	2,13
Cna 30-85 cm	38,3	9,2	0,8	9,2						29,1	17,10
CGona 85-(120) cm	40,3	9,4	0,5	7,9						-	-
LG1-Deva											
AGo 0-50 cm	11,5	8,1	1,05	13,23	16	70					
Gr 50-(120) cm	18,0	7,8	-	4,90	-	-					
LG2- Singeorgiu de											
Ao 0-25 cm	50,5	7,6	3,88	1,5				14,7	12,5		
A/Go 25-40 cm	49,5	7,8	2,98	2,1				51,8	2,5		
Gor 40-(120) cm	61,5	8,0	1,39	1,1				21,7	2,0		
Hg1- Joseni											
Am 0-20 cm	33,0	5,4	6,0	0	6	80					
Gr 20-70 cm	13,2	5,6	2,7	0	21	50					
HG2- Toplita											
Am 0-25 cm	57,0	5,1	5,91	0	78	130					
AGr 25-40 cm	58,2	5,0	5,08	0	-	-					
Gr 40-100 cm	60,4	5,0	-	-	-	-					
HG3- Teisus											
Am sc 0-50 cm	31,0	8,2	3,20	2,7	28	70	61,0	12,4	144		
AGo sc 50-70 cm	38,9	8,5	1,10	0,6	-	-	42,7	14,2	120		
Gr 70-(120) cm	52,0	8,7	-	7,3	-	-	24,4	17,8	105		
DG- Orästie											
Am 0-45 cm	47,0	7,6	3,10	-	22	178					
Cna 45-64 cm	51,0	8,3	2,30	4,3	11	164					
CGona 64-(120) cm	42,0	8,6	0,72	4,6	10	125					
TB- Voslobeni											
T1 0-25 cm	0	7,5	32,00	16	39						
T2 25-70 cm	0	7,0	26,60	136	27						
Gr 70-(120) cm	0	7,4	2,32	-	-						

Short description of soils

Characteristics of the soils described in this paper are presented in Table 1. Four groups of soil have been found in the flood plain of the Mureş River, as follows: alluvial protosoils, alluvial soils, gley soils and peaty soils.

Alluvial protosoil

The recent formations of the flood plain are represented by alluvia or alluvial protosoils. In most cases the soil-forming processes are incipient or absent, because of more or less frequent flooding that hinders pedogenesis. The spreading of alluvial protosoils is limited to the active flood plain, or the flood-controled stripe.

Generally, the alluvial protosoils are stratified, having in most cases a loose consistency and coarse texture (gravels, sands, loamy sands), but here and there, they also can be moderately coarse-textured (sandy loam) and medium-textured (loam and silt). This group of soils has a low organic matter and clay content, consequently a weak cation-exchange capacity and low retaining power, mostly the coarse-textured ones. The lime content and in connection with this the pH-value vary along the river, but they do not limit plant growth.

Due to their particle-size distribution and the lack of an impermeable layer, even in the deeper levels, most of the alluvial protosoils are excessively permeable, therefore they cannot retain a great part of the substances which pollute the running water. In this respect the storage of various wastes on the active flood plain can be harmful for the river, however the heavy metal analysis of some soil samples originating from the active flood plain did not show any sign of pollution (Table 2).

When the alluvial protosoils are covered with vegetation, their retaining and filtering power becomes more efficient. Consequently, in order to enhance the retaining and filtering power of these soils, forestation with poplar species is desirable.

Table 2. Heavy metal concentration of some soil samples of the active flood plain in mg/kg dry matter

Characteristic Soil	1	2	3	4	5	6
pH-H_2O	6,6	6,6	5,3	5,9	8,0	7.9
Clay, %	0	13,2	36,0	13,0	25,6	19,6
Org. Matter, %	22,7	2,0	3,9	9,0	4,4	4,0
Cd, mg/kg	0	0	0	0	0,2	0,1
Cr, mg/kg	0	0	0	0	21,0	17,0
Cu, mg/kg	0	0	0	0	0	0
Fe, mg/kg	0	382	478	400	23,0	123
Mn,mg/kg	0	118	100	118	104	87
Ni, mg/kg	0	0	0	0	0	0
Pb, mg/kg	0	0	0	0	0	0
Zn, mg/kg	0	0	5	19	0	7

Provenance of soil samples: 1. Voslobeni; 2. Senetea; 3. Remetea; 4. Lunca Bradului; 5. Lernut - Cipau; 6. Teius.

Alluvial soils

The alluvial soils occupy most of the parts of the floodwater-free, or rarely flooded, higher level of the river plain, being in various stages of development and fertility. Contrary to alluvial protosoils, their upper-Ao or Am- horizon is deep, with a humus content exceeding 2-2.5%, reaching even 4% in some cases.

With the exception of those of the Toplişa-Deda gorge, showing neutral or slightly acid reaction, all alluvial soils showed an alkaline reaction.

The clay content was also higher, as compared with alluvial protosoils, and varied from 27% to 43%. As a result of this higher clay content, the water penetrated through their profile is well filtered.

Generally having high fertility, the alluvial soils of the Mureş River are used almost totally as plough-land, in some cases employing irrigation.

The groundwater level fluctuates seasonally between 0.50 and 2.50 meters, in close connection with the water level of the river.

Though large quantities of fertilizers have been employed in the last decades, no chemical pollution of the soil cover could be proved. Nevertheless groundwater pollution with nitrates is not out of question.

Nearby the greater cities - Tîrgu Mureş, Alba Iulia, Deva, Arad - large amounts of waste are deposited on the flood plain, extensive surfaces of fertile alluvial soils being withdrawn from agricultural use, harming in the same time not only more or less broad neighbouring soil strips, but also the groundwater and running water, too.

An important source of soil - and groundwater pollution can be the waste-water purification plants, when because of frequently filling up of their drying beds, large amounts of sewage sludges are deposited directly on the soils, not far from the river.

Gley soils

Two groups of gley soils have been distinguished: low humic gley soils and humic gley soils. Both are hydrogenic soils with high groundwater levels during a long period of the year.

Most of this soil type have a high clay content, and thus are bad water conductors. The most extensive occurrence of the gley soils is in the Intracarpathian fluviolacustrine Depression of Giurgeu. After emerging from the volcanic mountains, the gley soils are spread mainly in the deep-lying marginal areas of the flood plain. The important river-regulation and floodwater-prevention works performed, especially downstream from Arad, led to many changes in the position of the riverbed. As a result, the present flood plain is full of cut-off branches and oxbows, filled with poor water-conducting silty and clayey materials, favorable for hydrogenic soil-forming processes.

On these soils grows generally a luxuriant herbaceous vegetation, representing not only an important fodder source for cattle, but at the same time a favourite transitional place for some migratory birds. Transformation of these soils into farmland is not indicated.

Peaty soils

In the upper course of the Mureş River, a considerable part of the active flood plain is covered by a thick organic matter layer, partly transformed into peat or peaty soil. Their existence is due to a permanent water supply from lateral thick alluvial fans, that maintain a high groundwater levels. As a result the organic matter layer is saturated permanently. Near Voslobeni, in these waterlogged soils grow some relic plants of the last glacial period. Protection of these relicts by law is necessary.

Conclusions

On the flood plain of the Mureş River, four groups of soils were distinguished: alluvial protosoils on the active flood plain with a low retaining and filtering power, alluvial soils on the greatest part of the floodwater-free higher level of the river plain, gley soils on the marginal deep lying areas of the flood plain, and peaty soils in the upper course of the river.

No harmful chemical pollution of the soil cover could be proved along the entire course of the river. Some exceptions exist, however, mainly around the waste-water purification plants of the greater cities.

In order to enhance the retaining and filtering power of the alluvial protosoils on the active flood plain, forestation with popular species is recommended.

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Figs. 1-14. The soil cover types of the flood plain of the Mureº River.

LEGEND OF SOILS

I. ALLUVIAL PROTOSOILS

AP1	Loamy sandy stratified alluvial protosoil on gravelly andesitic substratum.
AP2	Loamy sandy and sandy stratifed alluvial protosoil on sandy substratum.
AP3	Sandy loam alluvial protosoil on loamy substratum.
AP4	Deep gley loamy alluvial protosoil on sandy loam or loam.
AP5	Moderately gleyied silty alluvial protosoil on silty substratum.

II. ALLUVIAL SOILS

AS1	Loamy alluvial soil on sandy loam.
AS2	Loamy sandy skeletal alluvial soil on gravelly andesitic substratum.
AS3	Loamy and clayey loam alluvial soil on sandy loam and silt.
AS4	Deep gley sandy loam alluvial soil on sandy loam and silt.
AS5	Salt-aff'ected poorly drained alluvial soil on salt clay.
AS6	Alkali alluvial soil on clayey substratum with cut-off branches and remnants of oxbow lakes

III.GLEY SOILS

LG1	Low humic gley soil on sandy substratum.
LG2	Low humic gley soil on silty and clayey substratum.
HG1	Humic gley soil on gravelly andesitic and silicatic substratum.
HG2	Humic gley soil on silty and clayey substratum.
HG3	Salt-affected humic gley soil on silty and clayey substratum.
DG	Drained humic gley soil on silty substratum.

IV. PEATY SOILS

TB	Peaty soil on gravelly andesitic and silicatic substratum.

OTHER SIGNS

Water covered area

Place of soil samples

Regulated river section

Floodcontrol level

Fig.1.

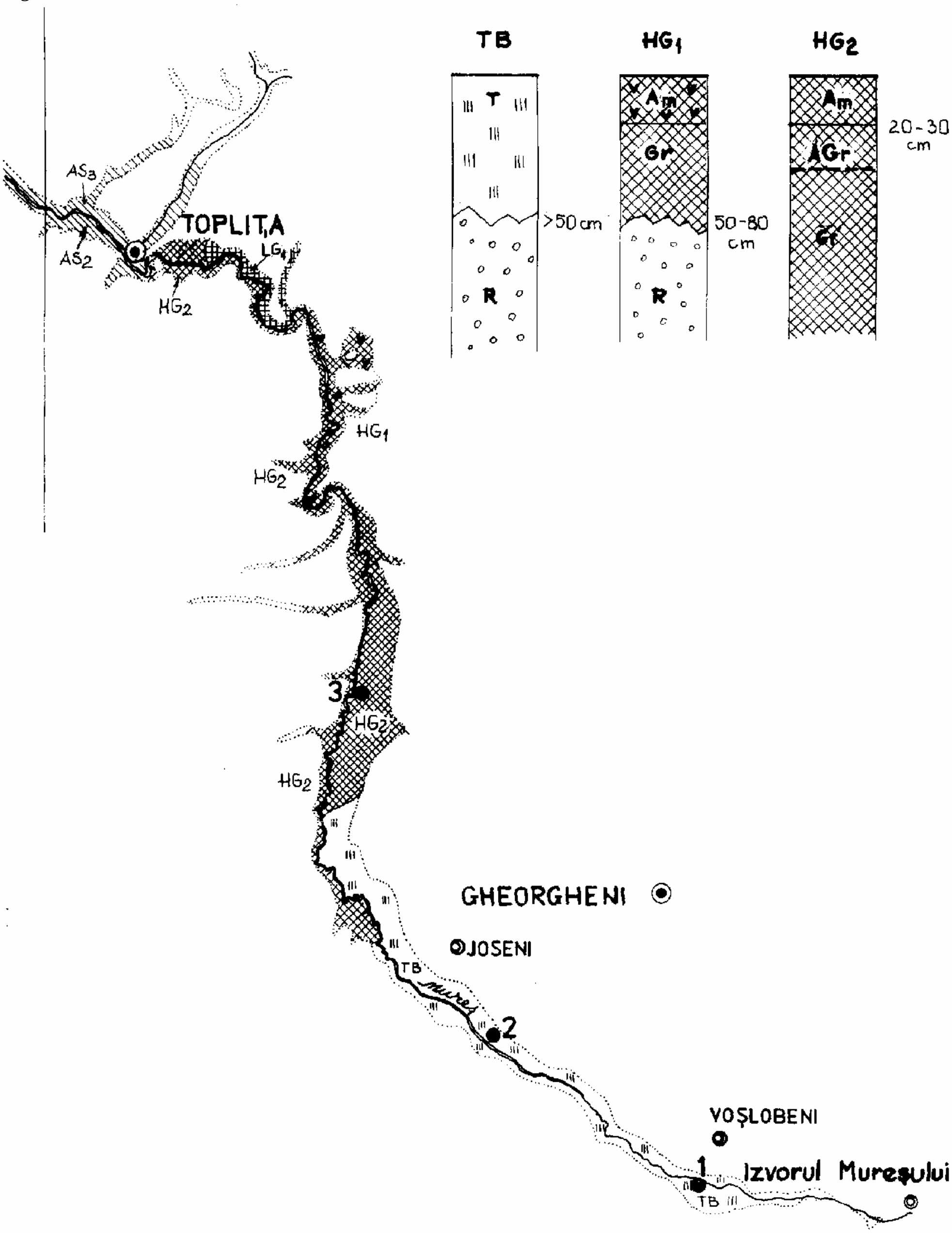

TB
HG1
HG2
T
R
>50 cm
Am
Gr
50-80 cm
R
Am
AGr
20-30 cm
Gr
TOPLIȚA
AS3
AS2
LG1
HG2
HG1
HG2
3
HG2
HG2
GHEORGHENI
JOSENI
TB
Mureș
2
VOȘLOBENI
1
Izvorul Mureșului
TB

Fig.2.

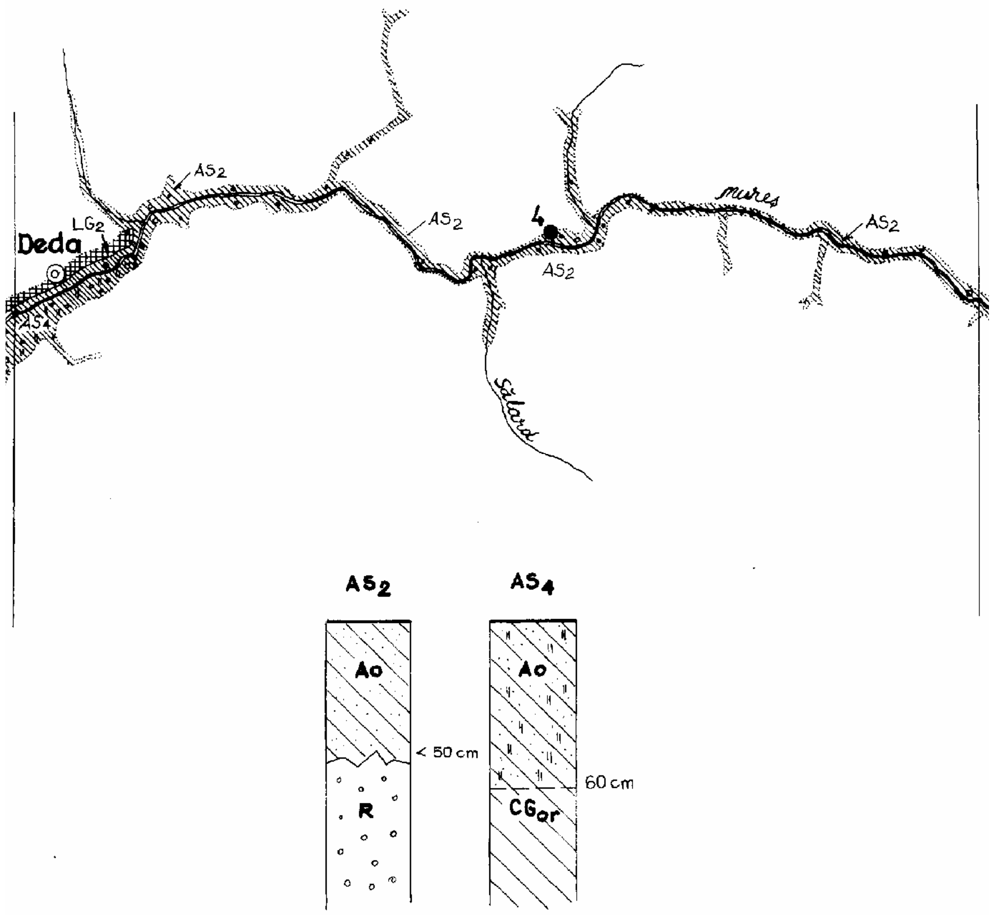
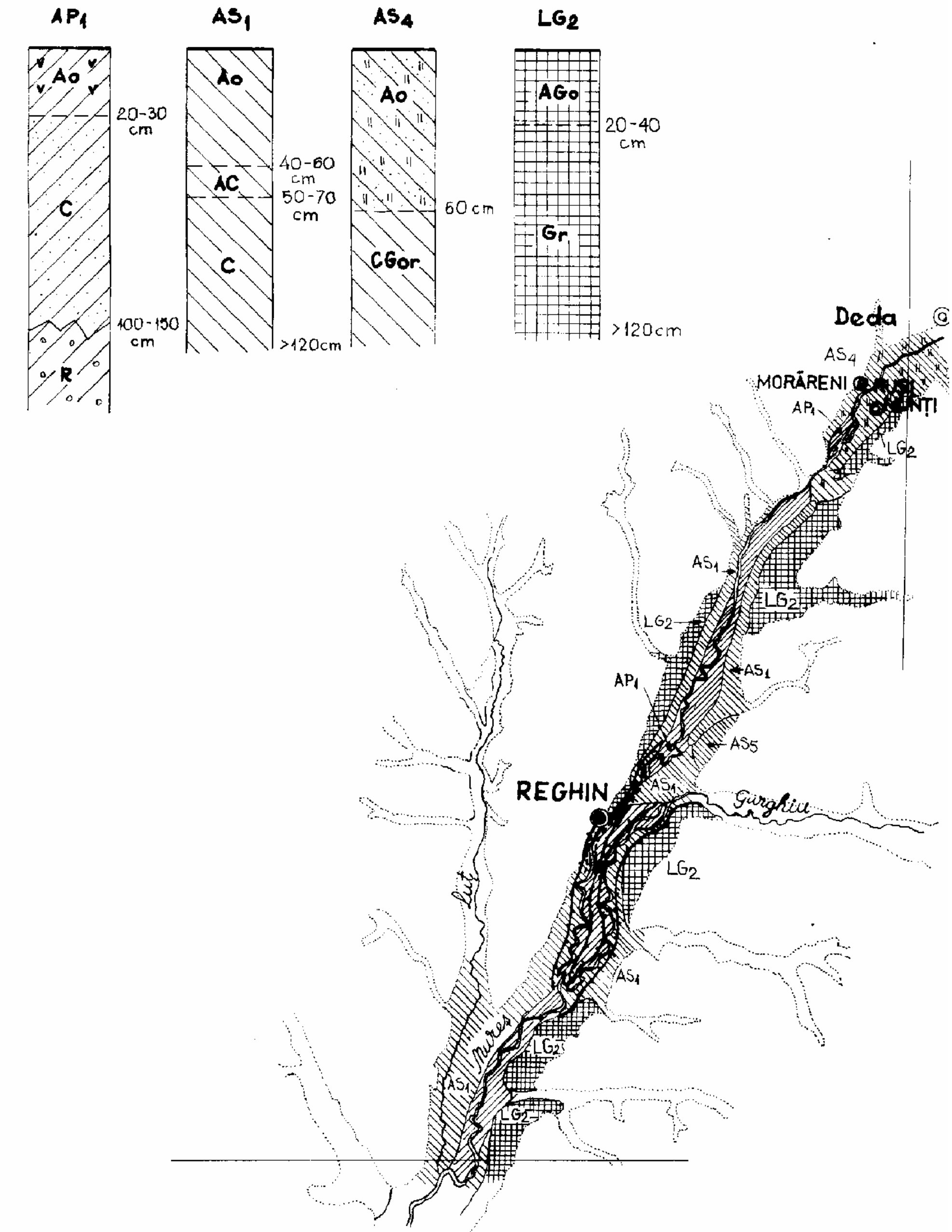
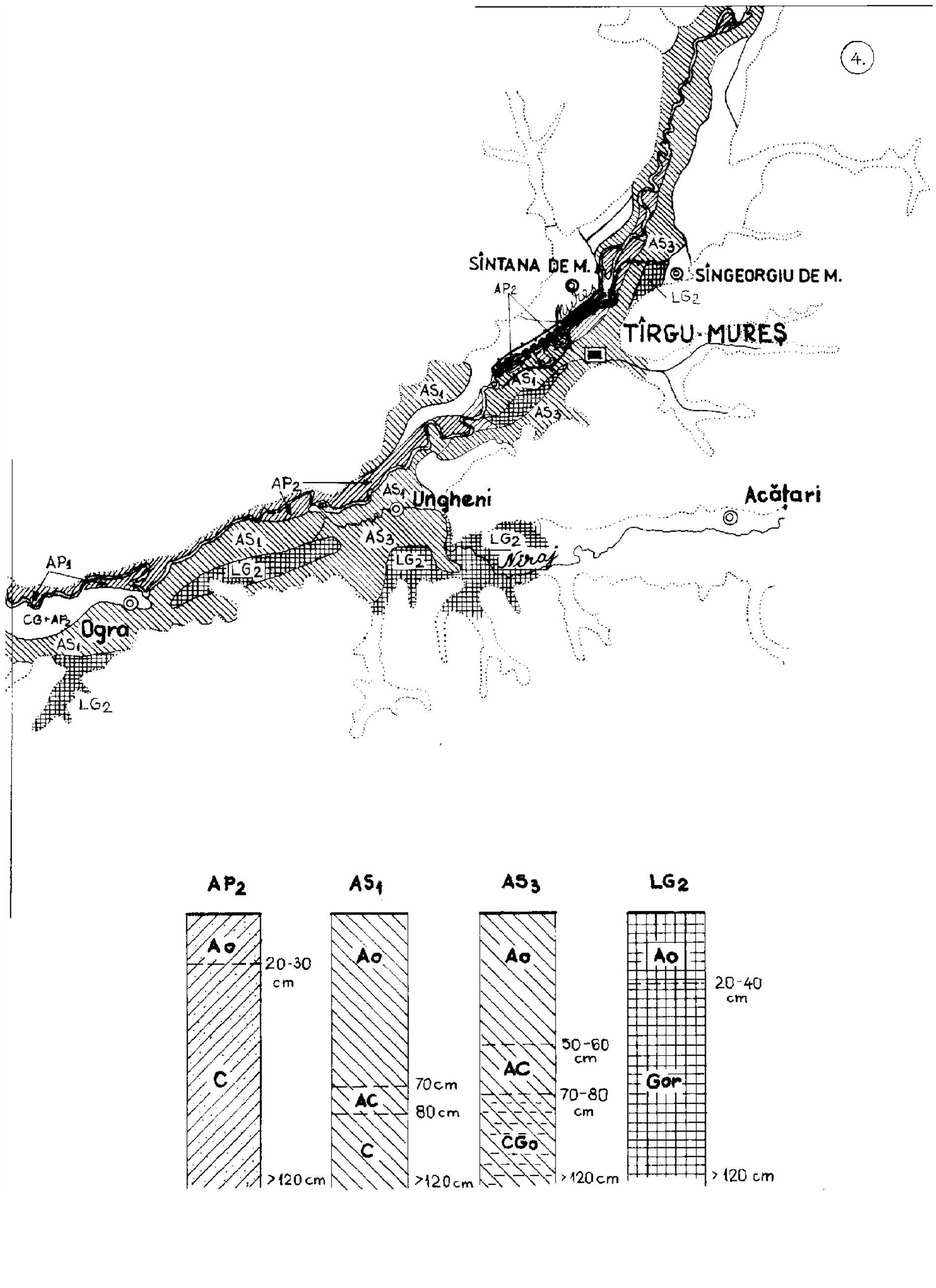

AS2
LG2
Deda
AS2
4
AS2
mureș
AS2
AS2
Sălard
AS2
AS4
Ao
< 50 cm
R
Ao
60 cm
CGor

Fig. 3.



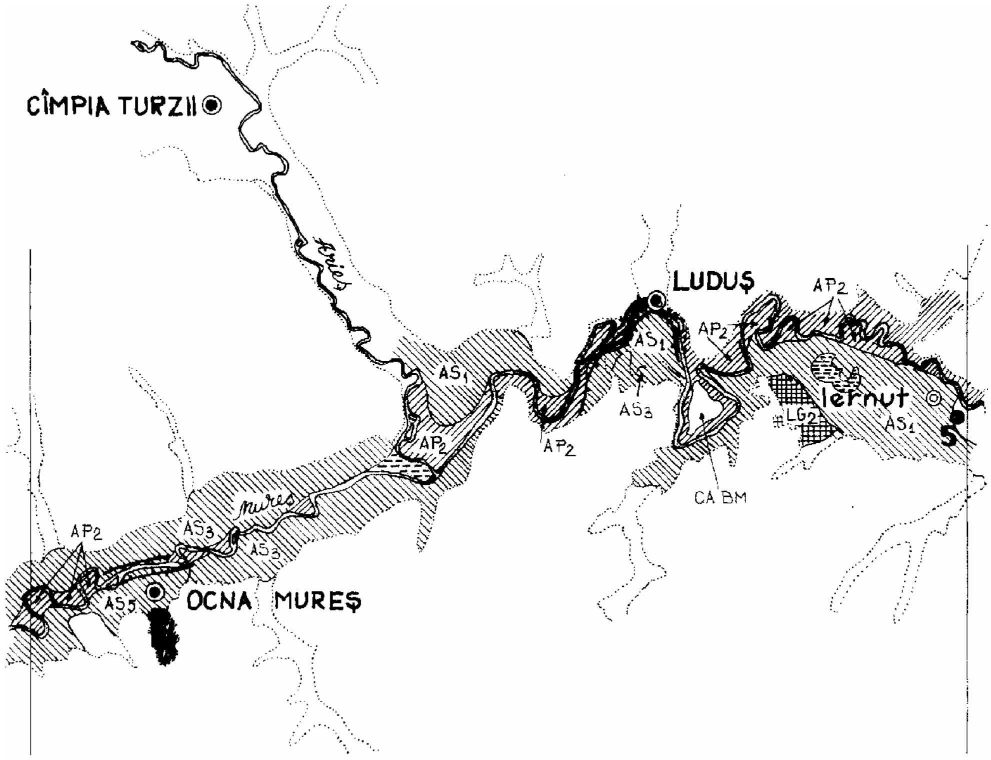
AP1
Ao
20-30 cm
C
100-150 cm
R
AS1
Ao
40-60 cm
AC
50-70 cm
C
>120cm
AS4
Ao
60 cm
CGor
LG2
AGo
20-40 cm
Gr
>120cm
Deda
AS4
MORĂRENI
AP1
LG2
AS1
LG2
AS1
AP1
AS5
REGHIN
AS1
Gurghiu
LG2
Lut
AS1
mureș
LG2
AS1
LG2

Fig. 4.



4.
SÎNTANA DE M.
SÎNGEORGIU DE M.
TÎRGU-MUREȘ
AP2
AS3
LG2
AS1
Ungheni
Acățari
Niraj
AP1
CG+AP2
Ogra
AP2
AS1
AS3
LG2
Ao
20-30 cm
C
>120 cm
AC
70 cm
80 cm
50-60 cm
70-80 cm
CGo
20-40 cm
Gor

Fig. 5.


CÎMPIA TURZII
LUDUŞ
Iernut
OCNA MUREŞ
Arieş
Mureş
AP2
AS1
AS3
AS5
LG2
CA BM
5

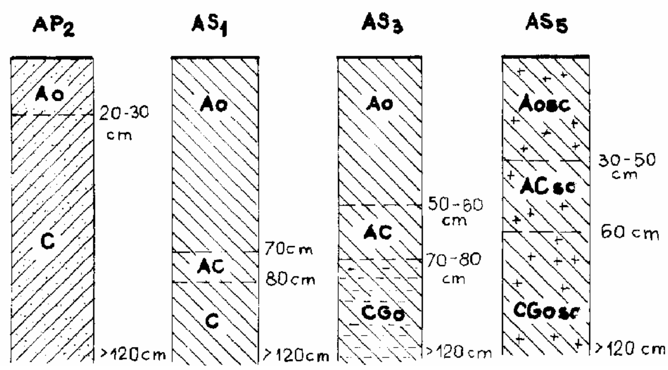
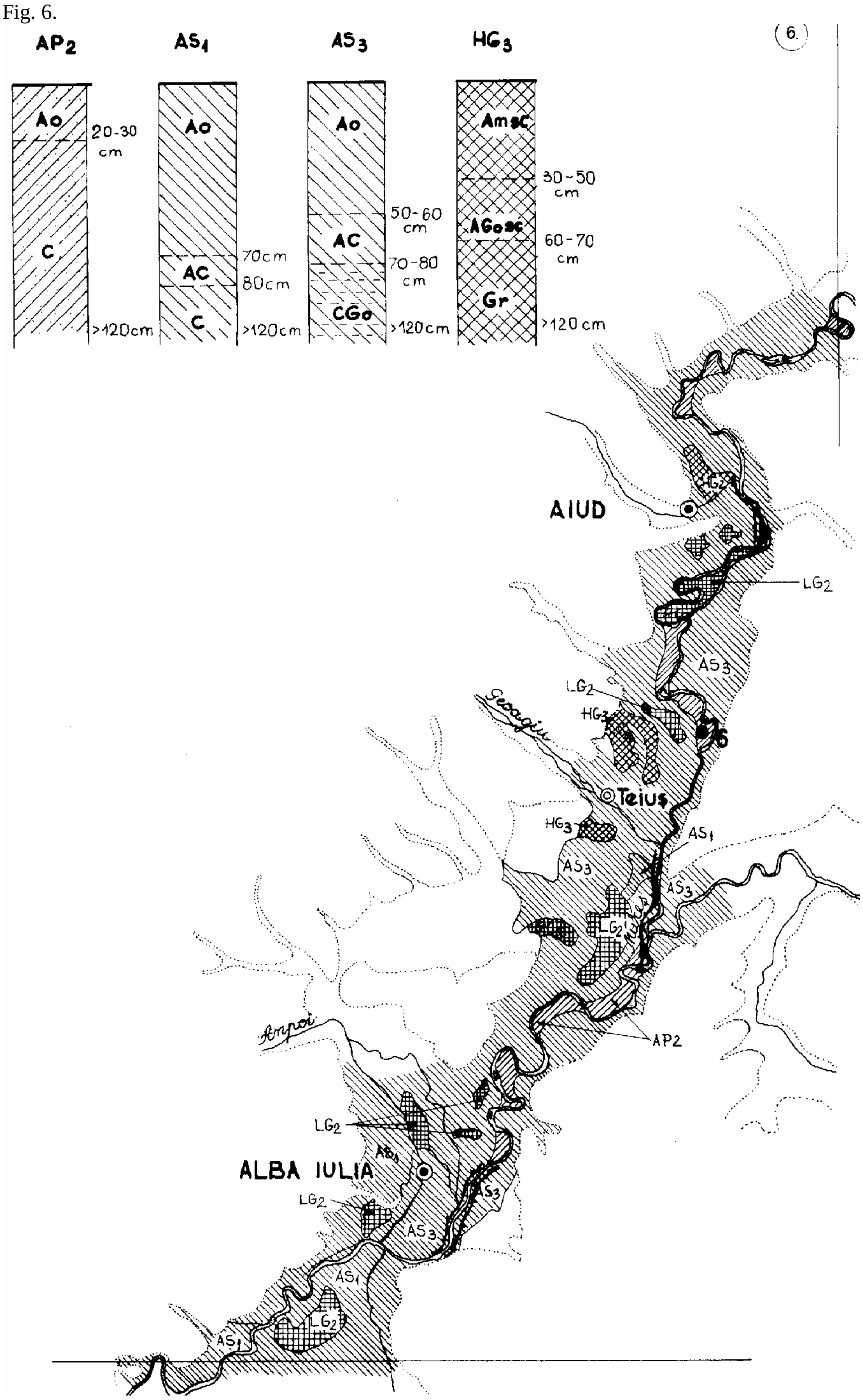
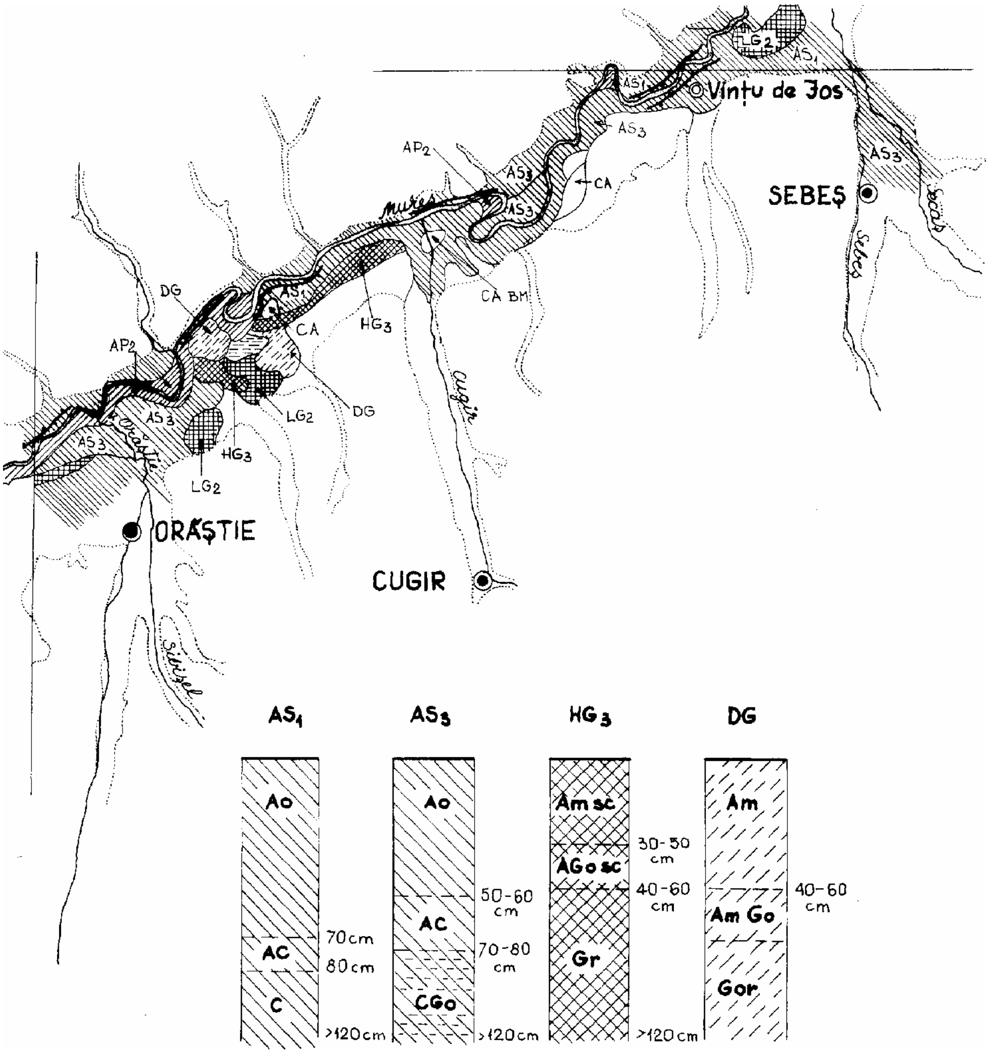

AP2
AS1
AS3
AS5
Ao
C
20-30 cm
>120cm
Ao
AC
C
70cm
80cm
>120cm
Ao
AC
CGo
50-60 cm
70-80 cm
>120cm
Aosc
ACsc
CGosc
30-50 cm
60 cm
>120 cm

Fig. 6.



AP2
AS1
AS3
HG3
6.
Ao
20-30 cm
C
>120cm
Ao
70cm
AC
80cm
C
>120cm
Ao
50-60 cm
AC
70-80 cm
CGo
>120cm
AmsC
30-50 cm
AGosc
60-70 cm
Gr
>120 cm
AIUD
LG2
AS3
HG3
Geoagiu
Teiuş
AS1
AP2
Ampoi
ALBA IULIA

Fig. 7.



Vințu de Jos
SEBEȘ
ORĂȘTIE
CUGIR
Mureș
Cugir
Sebeș
Secaș
Sibișel
Orăștie
LG2
AS1
AS3
AP2
CA
CA BM
DG
HG3
AS1
AS3
HG3
DG
Ao
AC
C
70cm
80cm
>120cm
Ao
AC
CGo
50-60 cm
70-80 cm
>120cm
Am sc
AGo sc
Gr
30-50 cm
40-60 cm
>120cm
Am
Am Go
Gor
40-60 cm

Fig. 8.

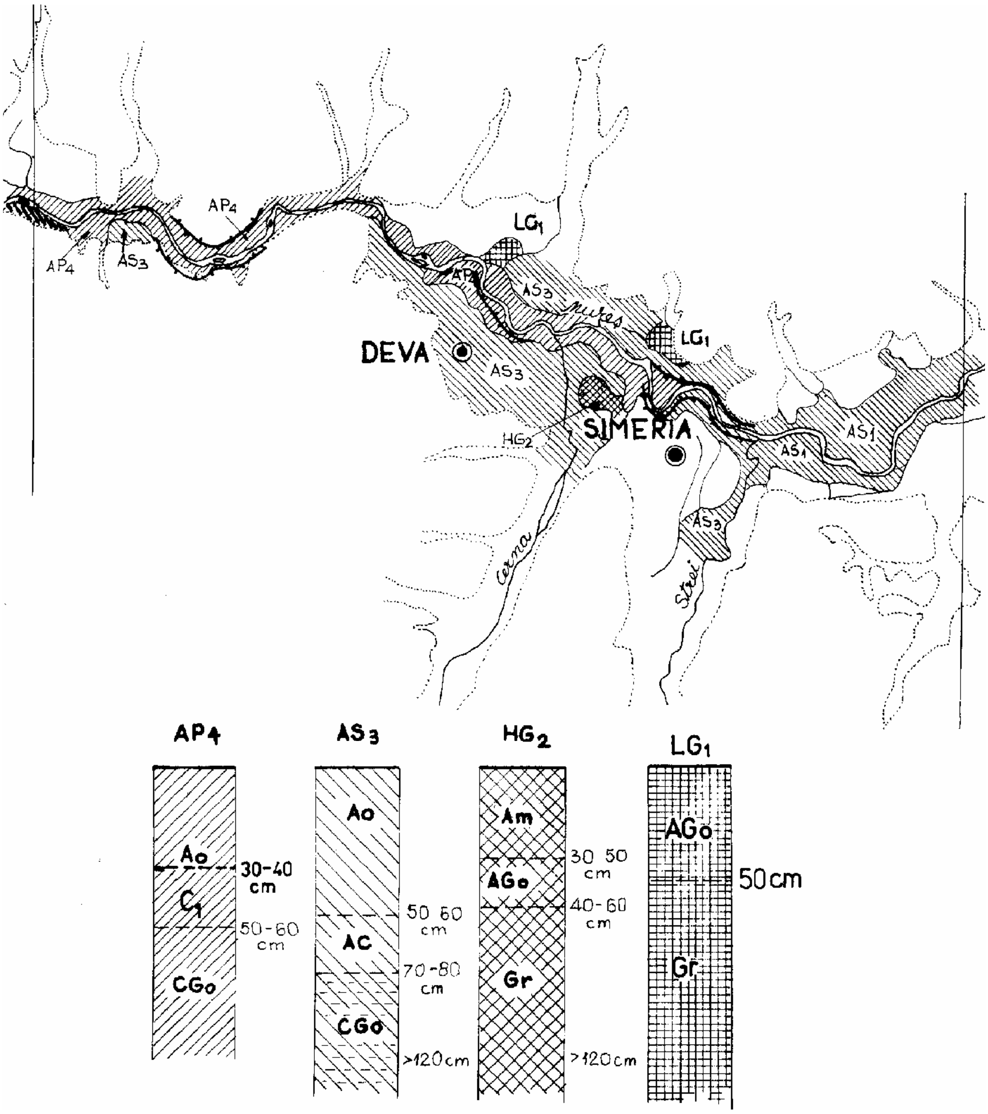

AP4
AS3
LG1
AS3
DEVA
AS3
LG1
HG2
SIMERIA
AS1
AS1
AS3
Cerna
Strei
AP4
Ao
30-40 cm
C1
50-60 cm
CGo
AS3
Ao
50 60 cm
AC
70-80 cm
CGo
>120cm
HG2
Am
30 50 cm
AGo
40-60 cm
Gr
>120cm
LG1
AGo
50cm
Gr

Fig. 9.

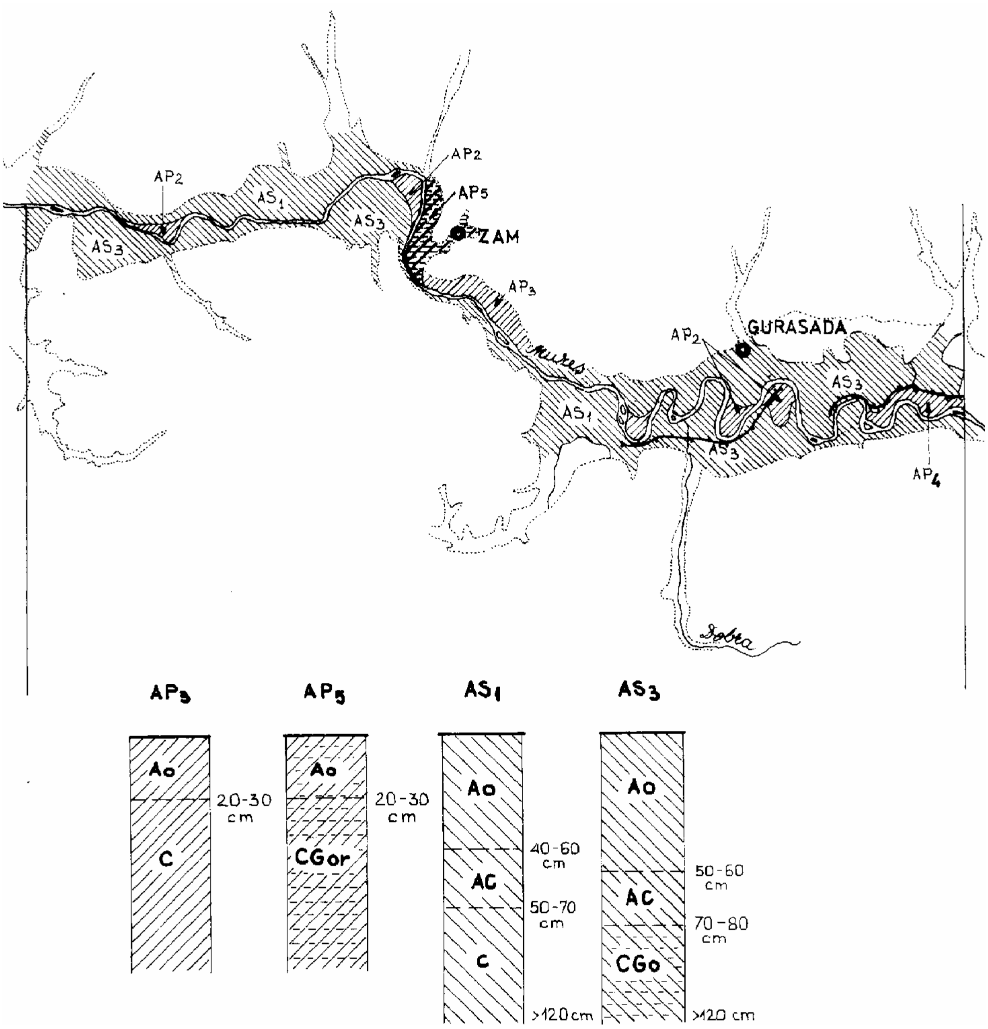
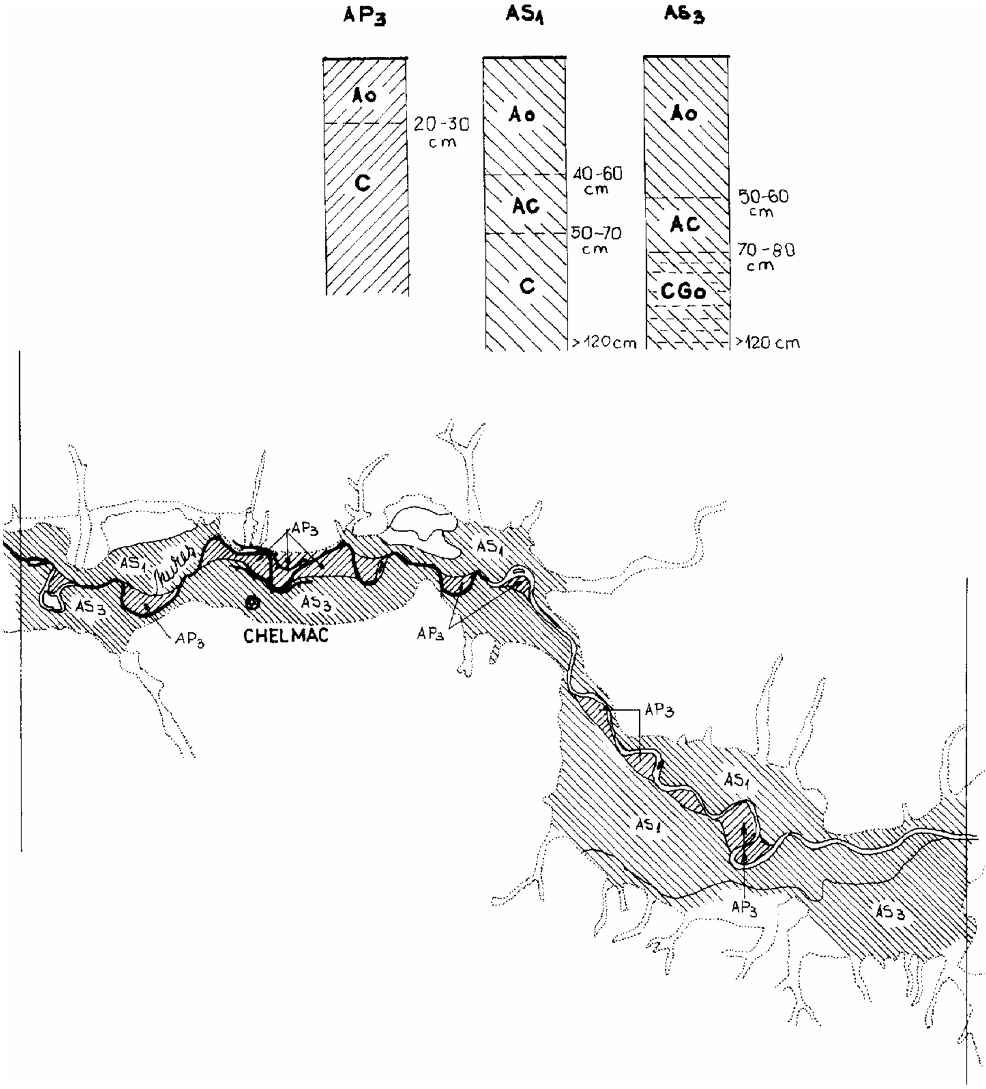
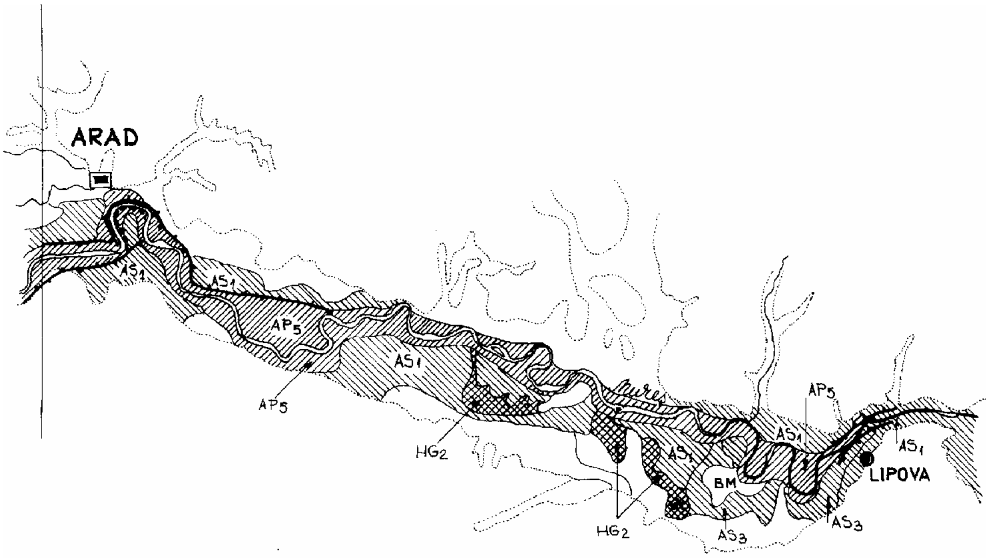

AP2
AS1
AS3
AP2
AP5
ZAM
AP3
Mureş
AP2
GURASADA
AS3
AS1
AS3
AP4
Sobra
AP3
AP5
AS1
AS3
Ao
20-30 cm
C
Ao
20-30 cm
CGor
Ao
40-60 cm
AC
50-70 cm
C
>120 cm
Ao
50-60 cm
AC
70-80 cm
CGo
>120 cm

Fig. 10.


AP3
AS1
AS3
Ao
C
20-30 cm
Ao
40-60 cm
AC
50-70 cm
C
>120cm
Ao
50-60 cm
AC
70-80 cm
CGo
>120 cm
AS1
Mureş
AP3
AS3
AP3
CHELMAC
AS3
AS1
AP3
AP3
AS1
AS1
AP3
AS3

Fug. 11.


ARAD
AS1
AP5
AS1
AP5
HG2
Mureş
HG2
AS1
BM
AS3
AP5
AS1
LIPOVA
AS1
AS3

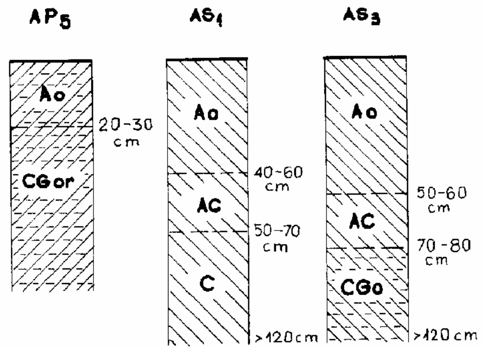

AP5
Ao
20-30 cm
CGor
AS1
Ao
40-60 cm
AC
50-70 cm
C
>120cm
AS3
Ao
50-60 cm
AC
70-80 cm
CGo
>120 cm

Fig. 12.

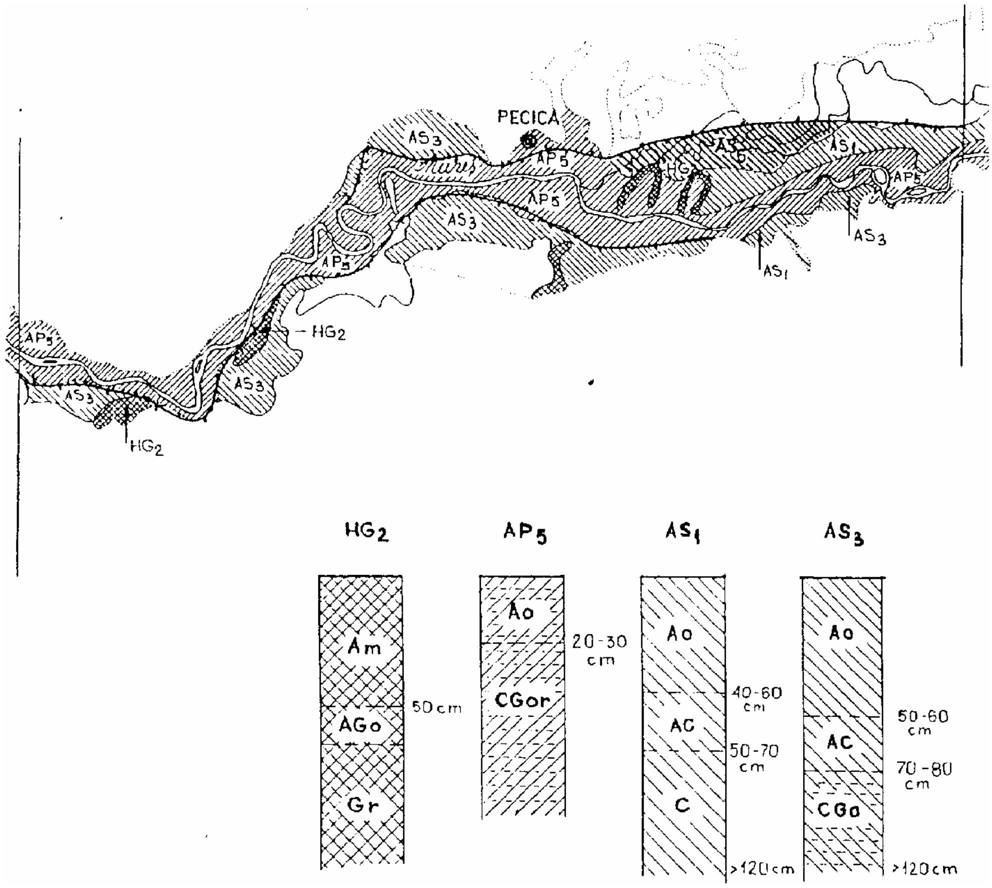
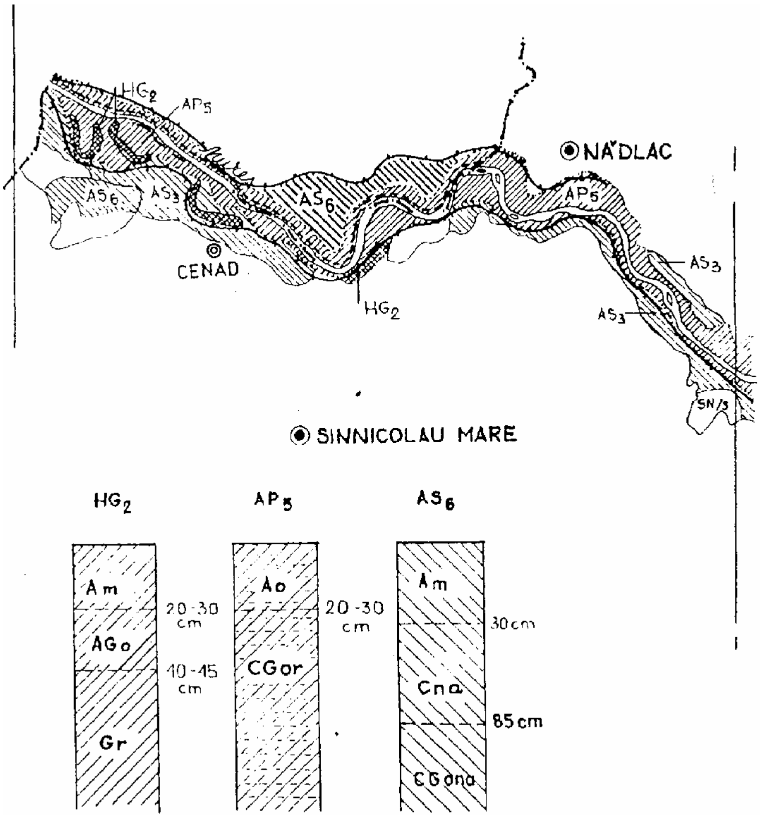
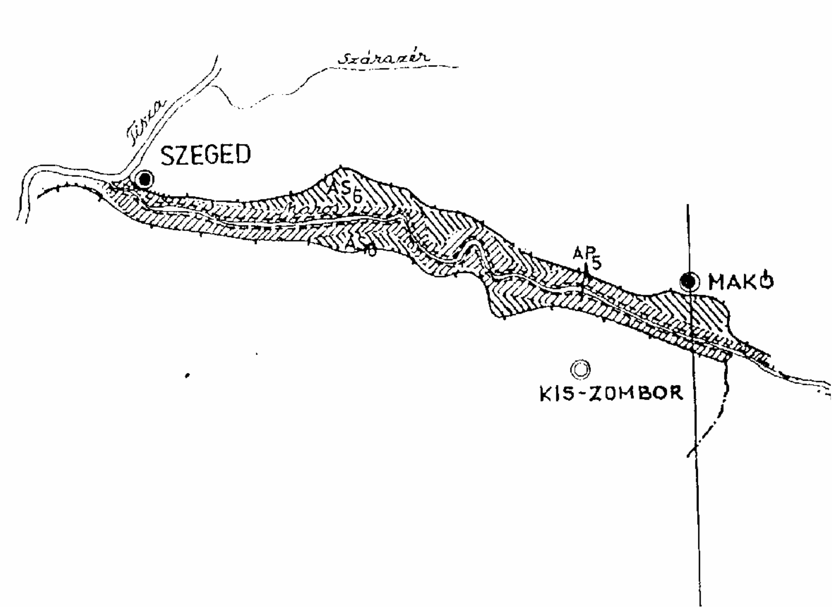

PECICA
AS3
AP5
HG2
AS1
HG2
AP5
20-30 cm
CGor
Ao
Am
AGo
Gr
50 cm
AS1
Ao
AC
C
40-60 cm
50-70 cm
>120 cm
AS3
Ao
AC
CGo
50-60 cm
70-80 cm
>120 cm

Fig. 13.



HG2
AP5
AS6
AS3
CENAD
HG2
NĂDLAC
AP5
AS3
AS3
SINNICOLAU MARE
HG2
AP5
AS6
Am
20-30 cm
AGo
40-45 cm
Gr
Ao
20-30 cm
CGor
Am
30cm
Cna
85cm
CGona

Fig. 14.



THE FLORA AND VEGETATION OF THE MUREŞ (MAROS) VALLEY

CONSTANTIN DRĂGULESCU

Introduction

Having its springs in the Oriental Carpathians, running across the Transylvanian Plateau, separating the Occidental Carpathians from the Meridional ones and finally flowing through the plain from western Romania and eastern Hungary, the Mureş and its valley include several various ecotopes with a rich flora and diverse vegetation.

Although some botanical investigations were done in the Mureş Valley by J. Lerchenfeld and P. Sigerus as early as the 18th century (Herb. Sibiu), the first pieces of botanical information were given by J. Chr. G. Baumgarten (1816), P. Kitaibel (1863), E. Schur (1866), E. Porcius (1878), A. Cserni (1879), L. Walz (1878), J. Csató (1896), A. Halász (1889) and particularly by M. Fuss (1866) and L. Simonkai (1886, 1893).

During the 20th century floristic and phytocenological research was conducted by E. I. Nyárády (1914, 1931), I. Prodan (1928), L. Tímár (1952, 1957), R. Soó (1938, 1940, 1943), St. Csûrös (1956, 1970), E. Pop (1960), Al. Borza, V. Lupşa (1964-1965, 1968), I. Gergely (1964), Fl. Raţiu (1968, 1969, 1971, 1972), I. Pop (1978, 1979), E. Täuber (1973, 1986), R. Samu (1982) and others. "Flora R.P.R.", respectively "Flora R.S.R.", collating the results of these botanists, returned 915 species of cormophytes in the Mureş Valley.

This study presents an enumeration of the flora and vegetation which grows in the Mureş river valley, from its spring (Izvorul Mureşului) to its confluence with the Tisza River (Szeged).

Methods

In order to offer a floristic-phytocenologic and ecological characterization as detailed as possible of this river, and, also to reduce the dimensions of our study especially of the chorological informations (the river runs through more than 100 localities), we divided the whole water course of the river into five segments (sectors), pointed out in the study by roman numerals I through V: I. Izvorul Mureşului- Topliţa, respectively the Depression of Giurgeu (Gheorgheni); II. Topliţa-Deda, which corresponds to the Mureş Strait between the Mts. of Călimani and Gurghiu; III. Deda-Alba Iulia or the central-Transylvanian water course of the Mureş; IV Alba Iulia-Lipova or the Mureş Corridor between the Occidental Carpathians (Metalliferous and Zărand Mts.) and the Meridional Carpathians (Sureanu Mts., Poiana Ruscă Mts.); V. Lipova-Szeged, the flatland course of the river.

These segments distinguish themselves not only by discharge and water speed of the river, but also by its level of pollution, by zooanthropic influences on woody and grassy vegetation which grows on both banks of the waterway, by the geological structure, the geomorphology of the valley, etc.

Relying on the consulted bibliography and after our site investigations, we drew up a card index of species and plant associations. The index was set up according to the phylogenetic system used in "Flora R.S.R." from which we also adopted the names of the species with the underlined corrections in volume XIII. Each plant species is accompanied by its ecological indices (humidity, temperature and soil reaction), the life strategy (life form), the floristic element (geoelement) and the waterway segment where it grows. The value of the ecological indices is given according to R. Soó (1964-1980) and V. Sanda et al. (1983).

Classification of the life forms follows C. Raunkiaer's system, developed by J. Braun-Blanqet (1951). The determination of the floristic elements was carried out according to the works of R. Soó (1964-1980) and V. Sanda et al. (1983).

For vegetation analysis we adopted J. Braun-Blanquet's method, adjusted for conditions in Romania and Hungary. The classification of the plant associations is in accordance with the systems of E. Oberdorfer (1970,1977) and R. Soó (1964-1980). By each plant association, the waterway segment is marked where they occur.

Abbreviations in the text

Life-forms: Ph- phanerophyte (MPh- megaphanerophyte, mPh- mezophanerophyte, nPh- nanophanerophyte); Ch- chamaephyte; H- hemicryptophyte; G geophyte; T therophyte (Th- annual, TH- biennial); Hh- helohydatophyte; Ep- epiphyte.

Floristic elements: Cosm- cosmopolitan; Cp- circumpolar; Eua- Eurasian; E- European; Ec- Central-European; Atl-M- Atlantic-Mediterranean; M- Mediterranean; MP- Mediterranean-pontic; P- Pontic; Pn- Pannonic; B- Balcanic; D- Dacic; Carp- Carpathic; Alp- Alpin; Cauc- Caucasian; Anat- Anatholian; Adv- adventive.

Ecological indexes: H- humidity; T- temperature; R- soil reaction.

I, II, III, IV, V- waterway segments of Mureş.

The mark (!) indicates that plant (or association) was noticed by the author.

Results

The flora of the Mureş Valley

After volumes I-XIII of "Flora R.S.R." had been issued, 472 species were newly identified by us and also published by different botanists. Our research, correlated to the data published by other authors (see References), point out 1316 species of higher plants (cormophytes) plus 71 hybrids (altogether 1387 items), to which must be added 60 subspecies, 231 varieties and 168 forms. These taxa belong to 502 genera of 117 families. Among genera Carex (53 species), Hieracium (32 species), Euphorbia (25 species), Centaurea, Ranunculus (22-22 species), Veronica (21 species), Rumex, Trifolium (19-19 species), Silene (17 species), Chenopodium, Cirsium (14-14 species), Juncus, Salix, Viola (13-13 species), Potentilla, Senecio (12-12 species), Potamogeton (11 species), Rorippa and Vicia (11-11 species) are better represented. The families richest in species are Asteraceae

(206 species), Poaceae (100 species), Cyperaceae (68 species), Brassicaceae (67 species), Caryophyllaceae (65 species), Fabaceae (64 species), Rosaceae (54 species), Lamiaceae, Ranunculaceae (52-52 species), Scrophulariaceae (51 species), Apicaceae (49 species), Liliaceae (37 species), Chenopodiaceae (32 species) and Polygonaceae (31 species).

From all the 1846 referred taxa, 220 spp. are considered to be rare or protected plants, such as Botrichium multifidum, Marsilea quadrifolia, Taxus baccata, Betula humilis, Betula x warnstorfii, Silene x grecescui, Euphorbia x csatoi, Trollius europaeus, Nymphaea alba, Nuphar luteum, Elatine alsinastrum, Sempervivum heuffelii, Ribes heteromorphum, Spiraea salicifolia, Trapa natans, Vitis silvestris, Pleurospermum austriacum, Cnidium dubium, Lysimachia thyrsiflora, Pedicularis sceptrum-carolinum, Plantago schwarzenbergiana, Nymphoides peltata, Bryonia dioica, Achillea x girgioensis, Petasites x celakovsky, Ligularia sibirica, Centaurea x nyaradiana, Hieracium x auriculoides, Typha laxmannii, Lilium martagon, Fritillaria meleagris, F. montana, Scilla autumnalis, Streptopus amplexifolius, Tamus communis, Iris nyaradyana, Traunsteinera globosa, Calla palustris, Arum maculatum. The 1316 species from the following list were analysed by ecological preferences (humidity, temperature, soil reaction), life strategies (life forms) and the floristic element to which they belong in order to give a characterization of the flora of the Mureş Valley from spring to mouth, as accurate and detailed as possible.

The flora

LYCOPODIACEAE

1. Lycopodium annotinum L.: I-II (22, 23);Ch, Cp; H4T2.5R2

EQUISETACEAE

2. Equisetum arvense L.: I-V; G, Cosm; H3T3R0
- f. obtusatum Kluge: IV-V (43,!)
3. E. fluviatile L. (E. limosum L.): I-III (6,23,31,22,14,!);Hh,Cp; H5T3R0
4. E. hiemale L.: II (14); G, Cp; H3.5T2.5R4
5. E. x littorale Kuhl. (arvense x fluviatile): III (5.14);
6. E. palustre L.: I-V; G, Cp; H5T2R0
7. E. pratense Ehrh.: II (14); G, Cosm; H3.5T2.5R4
8. E. ramosissimum Desf: III-V (14,5,36,40,25,18); G, Cosm; H2T0R0
- f. simplex (Doll)Milde: III (14)
9. E. silvaticum L.: I (14,23,30,!); G, H3.5T2R0
10. E. telmateja Ehrh. (E. maximum Lam.); II-IV (22,14,!); G, Cp; H3.5T2R0

OPHIOGLOSSACEAE

11. Ophioglossum vulgatum L.: I (14), V (37,40,14); G, Cp; H4T3R0
12. Botrychium lunaria (L.)Sw : I (14); G, Cosm; H2.5T2R0
13. B. multifidum (S.G.Gmel.)Rupr.: I (14); G, Cp; H2.5T2R0

HYPOLEPIDACEAE

14. Pteridium aquilinum (L.)Kuhn: II-V (22,14,25,40,!); G, Cosm; H3T3R0

ASPLENIACEAE

15. Asplenium adiantum-nigrum L.: III-IV (14,29,25,43); H, E; H2.5T3R3

- f. argutum Heuil.: IV (14,25)

16. A. ruta-muraria L.: IV V (14,37,40,!); H, Cp; H1.5T3R5

17. A. septentrionale (L.)Hoffm.: II (14), IV (14,25); H, Cp; H1T3R2

18. A. trichomanes L.: II (22,!); IV (14,37,25,5,!); H, Cp; H3T0R4

19. Phyllitis scolopendrium (L.)Newman: II (14,!), IV (14); G, Cp: H3.5T3R5

ATHYRIACEAE

20. Athyrium filix-femina (L.)Roth: I-II (14,22,23,30,!), IV (14,37,25,!) H, Cosm; H4T2.5R0

21. Cystopteris fragilis (L.)Bernh.: II (22,!), IV (14,37,25); H, Cosm; H3.5T0R0

- ssp. fragilis f. anthriscifolia (Hoffm.)Koch: IV (14) and f. angustata Koch: IV (14,37,25)

- ssp. alpina Hartm. (C. regia (L.)Presl.): IV (14)

22. C. sudetica A. Br. et Milde: II (22); H, Eua; H3.5T2R0

23. Matteuccia struthiopteris (L.)Tod.: II (22,!), IV (25); H,Cp; H4T2R0

ASPIDIACEAE

24. Polystichum braunii (Spenn.)Fee: II (14,22); H, Cp; H3.5T2.5R3

25. P. setiferum (Forsk.)Woynar: IV (14,25); H, Cosm; H3.5T0R4

26. Dryopteris carthusiana (Vill.)H.P Fuchs (D. spinulosa O.F. Mull.): I (23); H, Cp; H4T3.5R0

27. D. cristata (L.)A. Gray: I (14,23,!); H, Cp; H3.5T2R3

28. D. filix-mas (L.)Schott: I-V; H, Cosm; H4T3R0

THELYPTERIDACEAE

29. Thelyperis palustris Schott (Dryopteris thelypteris (L.)A. Gray): I (23); Hh, Cp; H4T0R3

30. T. phegopteris (L.)Slasson (Phegopteris polypodioides Fee): I-II (22,23); G, Cp; H3.5T2R2

POLYPODIACEAE

31. Polypodium vulgare L.: II (22,!), IV (25); G, Cp; H3.5T3R4

MARSILEACEAE

32. Marsilea (Marselia) quadrifolia L.: IV (14,25,38); Hh, Eua (M); H6T3R0

SALVINIACEAE

33. Salvinia natans (L.)All.: IV V (37,25,38,14,!); Hh, Eua; H6T3R3

TAXACEAE

34. Taxus baccata L.: II (14,22); mPh, E; H3T3.5R4

PINACEAE
35. Abies alba Mill.: II (22); MPh, Ec; H4T3R0
36. Picea abies (L.)Karst.: I-II (22,14,!); MPh, E; H0T0R0
37. Pinus silvestris L.: I-II (22,14); MPh, Eua; H0T0R0

CUPRESSACEAE
38. Juniperus communis L.: I (6,23,30,!), IV (25); mPh, Cp; H2T0R0

EPHEDRACEAE
39. Ephedra distachya L.: III (14,4,5); mPh, Eua (C); H2T4.5R4.5

BETULACEAE
40. Betula humilis Schrank: I (23,31,32); mPh, Eua; H5T2.5R1
41. B. x hybrida Bechst. (pubescens x pendula): I (14,23,!);
42. B. pendula Roth (B. verrucosa Ehrh.): I-II (6,23,22,!), III (29), IV (5,25); MPh-mPh, Eua; H3T2R2
43. B. pubescens Ehrh.: I-II (14,23,6,30,31,32,!); MPh-mPh, Eua; H0T0R0
- f. glabra (Fieck.)Georgescu: I (14)
44. B. x warnstorfii C.K.Schneid. (humilis x pubescens): I (23);
45. Alnus glutinosa (L.)Gaertn.: I-V; Mph-mPh, Eua; H5T3R3
46. A. incana (L.)Mnch.: I-IV (30,22,14,!); MPh-mPh, Eua; H4T2R4

CORYLACEAE
47. Carpinus betulus L.: II-IV (14,22,29,5,!), V (40); MPh-mPh, E; H3T3R3
48. Corylus avellana L.: I-IV; mPh, E; H3T3R3

FAGACEAE

49. Fagus sylvatica L.: II (22,!); MPh-mPh, E; H3T3R0
50. Quercus cerris L.: IV V (14,37,25,24,27,!); MPh-mPh, M; H2T3.5R3
- f. austriaca (Willd.)Hegi: V (40)
51. Q. frainetto Ten.: IV (14,37,25); MPh, B; H2T4R3
52. Q. petraea (Matt.)Liebl.ssp. petraea: II-IV (22,29,5,25,!); MPh-mPh, E; H2.5T3R0
53. Q. pubescens Willd.: IV (14,25), III (14); MPh, M; H1.5T4R5
- var. undulata (Kit.)Schwz.: IV (43)
54. Q. robur L.: II-V; MPh, E; H3.5T3R0
- var. tardiflora Cernaiev: V (14,40)
- var. puberula (Lasch)Schwz. : V (40)
55. Q. virgiliana (Ten.) Ten.: I V (14,5); MPh, M; H2T4R4

SALICACEAE

56. Populus alba L.: III-V (14,24,18,!); MPh-mPh, Eua; H3.5T3R3
57. P. x canescens Sm. (alba x tremula): V (18,40,!);
58. P. nigra L.: III-V (14,25,27,40,!); MPh, Eua; H4T3R4
59. P. tremula L.: I-V; MPh-mPh, Eua; H3T2R2
60. Salix alba L.: I-V; Mph-mPh, Eua; H5T3R4
61. S. aurita L.: I (14); mPh, H4.5T0R2
62. S. caprea L.: III-V (23,27,5,!); mPh, Eua; H3T3R3
63. S. cinerea L.: I-V; mPh, Eua; H3T3R3
64. S. daphnoides Vill.: III (14); mPh, E; H4.5T2.5R4.5
65. S. fragilis L.: I-V; mPh-MPh, Eua; H4.5T3R4
66. S. pentandra L.: I-III (14,22,23,31,29,!); MPh. Eua; H4.5T0R3.5
67. S. purpurea L.: I-V; mPh, Eua; H5T3R4.5
- f. angustifolia Kern.: IV (25)
68. S. rosmarinifolia L.: I (14,23,6,32,!); mPh, Eua; H4T0R0 69. S. x rubens Schrank (alba x fragilis): V (40);
- var. excelsior (Host.)A. et G.: V (40,27)
- var. palustris (Host.)Seem: V (40)
70. S. triandra L.: I-V; mPh, Eua; H5T3R0
- f. glaucophylla Ser.: V (40)
- f. semperflorens (Host.)Beldie: I (!), V (40)
71. S. x undulata Ehrh. (alba x triandra): IV V (14,37,40);
72. S. viminalis L.: I-V; mPh, Eua; H5T2R4.5
- f. tenuifolia Kern.: I (23,!)

ULMACEAE
73. Ulmus glabra Huds. (U. montana Stokes): II (22), V (24,27,40); mPh-MPh, Eua; H4T3R3
74. U. levis Pall.: V (14,25,40,27,!); Mph-mPh, E; H4T3R3
75. U. minor Mill. (U. foliacea Gilib.): III-V (37,40,9,5,24,!); MPh, Eua; H3T3R4
- var. minor f. carpinifolia (Bokh.)Beldie: IV (25) and f. suberosa (Henry) Beldie: IV V (25,43,40,!)
- var. stricta (Lindl.)Rehd.: IV (25)
- var. asperrima Simk.: IV (43)

CANNABINACEAE
76. Humulus lupulus L.: I-V; H, Eua; H3.5T3R4

URTICACEAE
77. Urtica dioica L.: I-V; H-G, Cosm; H3T3R4
- f. pubescens (Ldb.)Trautv : V (14)
78. U. urens L.: III-V (5,18,!); Th, Cosm; H3T3R4
79. Parietaria officinalis L.: IV (14,25); H, M; H4T3.5R4

SANTALACEAE

80. Thesium alpinum L.: I (14); H, E; H2.5T2R2.5
81. T. arvense Horvatovszky (T. ramosum Hayne): V (18,40); TH-H, Eua(C); H1.5T3.5R4.5
82. T. dollineri Murb.: IV V (14,5,40); Th-H, P-B; H2T3R0
83. T. linophyllon L.: IV (14,5,!); G-H, Ec; H2T4R4

LORANTHACEAE
84. Loranthus europaeus Jacq.: III-V (14,37,25,40,29); Ch-nPh, E;H3T3.5R0
85. Viscum album L.: III-V (14,25,!); Ch-nPh,Eua; H3.5T3R0

POLYGONACEAE
86. Polygonum amphibium L.: I (31), III-V (29,5,25,40,!); G-Hh, Cosm; H6T3R0
- f. aquaticum (Leyss)Grint.: IV-V (25,40,14,!)
- f. terrestre (Leyss)Grint.: I (31)
87. P. arenarium W. et K.: IV (14,25); Th, P-Pn; H1T3.5R0
88. P. aviculare L.: I-V; Th, Cosm; H2.5T0R3
- var. erectum (Roth)Hayne: V (40)
89. P. bistorta L.: I-III (14,30,23,6,22,29,!); H,Eua; H4T2.5R3
- f. puberulum Beck: I (14)
90. P. hydropiper L.: I-V; Th, Eua (M); H4.5T3R4
91. P. lapathifolium L.: III-V (14,9,6,27,40,!); Th,Cosm; H4T0R4
- var. tomentosum (Schrank)Beck: III-V (14,26,40)
- f. lanceolatum (A.Br.)A. et G.: V (40)
- var. brittingeri (Opiz)Beck: V (14,40)
92. P. minus Huds.: III-V (14,5,25,40);Th, Eua; H5T3R4
93. P. mite Schrank: III (14), V (14,25,40); Th, Eua ; H5T3R4
- f. angustifolium (A.Br.)Beck: III (14)
94. P. persicaria L.: III-V (29,14,27,25,40,!); Th, Eua; H4.6T3R0
95. P x subglandulosum Borb. (hydropiper x minus): II (14);
96. Bilderdykia convolvulus (L.)Dumort (Fagopyrum convolvulus (L.) H. Gross): III-V (14,5,25,18,47); Th, Eua; H2.5T3R3
97. B. dumetorum (L.) Dumort (Fagopyrum (L.)Schreb.): IV V (14,37,40,25,43,!); Th, Eua (M); H2.5T3R3
98. Rumex acetosa L.: I-V; H, Cosm; H3T0R0
99. R. acetosella L.: I-V; H-G, Cosm; H2T3R2
- f. multifidus (L.)Prod.: I (14), III (14)
100. R. x acutus L. (crispus x obtusifolius): III (14,29), IV (14);
101. R. aquaticus L.: I (14,30,23,31,!), V (14); Hh, Cp; H4.5T0R4
102. R. conglomeratus Murray: III-V (14,40,27,5,!); H, Cp; H4T4R4
103. R. crispus L.: I-V; H, Eua; H4T3R0
104. R. x erubescens Simk. (obtusifolius x patientia). III (14);
105. R. x heteranthos Borb. [(maritimus x conglomeratus)x stenophyllus)]:V (14,40);
106. R. hydrolapathum Huds.: III-V (14,29,5,40,!); H(G), E; H6T4R4
107. R. x intercedens Rech (crispus x stenophyllus) ssp. aradensis Prod.:V (14)

108. R. kerneri Borb.: V (14,25,40); H, D-Pn-B; H3T5R3
109. R. maritimus L.: III (14), V (14,40,!);Th, Eua: H5T3.5R4.5
110. R. obtusifolius L.: III-V (14,18,40,!); H, E; H4T0R3
- ssp. silvestris (Lam.)Rech: III-V (14,40)
- ssp. transiens (Simk.)Rech f : III (14)
- ssp. subalpinus (Schur)Simk.: III, V (14)
111. R. palustris Sm. (R. limosus Thuill.): III-V (14,5,40,!); Th-TH,Eua;H5T3R4
112. R. patientia L.: I (14), II-V (5,25,14,40,!); H, Eua (C); H3T4R0
- ssp recurvatus (Rech)Rech f.: I, III-IV (14)
113. R. pulcher L.: IV V (14,25,40); Th-TH, Atl-M; H4T3R3
114. R. sanguineus L.: III-V (14,37,25,!); H, E ; H4T3R4
- var. viridis (Sibth.)Koch: V (18,40)
115. R. stenophyllus Ldb.: III-V (14,34,18,45,!); H, Eua (C); H5T4R4
116. R. x stenophylloides Simk. (maritimus x stenophyllus): V (14,37,40)

CHENOPODIACEAE
117. Polycnemum arvense L.: IV V (14,25,47,40); Th, Eua (M); H2T3R3
118. P. majus A. Br.: III-V (14,5,40); Th, Eua (M); H1.5T4.5R4
119. Chenopodium album L.: I-V; Th, Cosm; H3T3R0
- ssp. spicatum (Koch)Nyár. var. praeacutum (Murr)Prod.: IV V (14,25)
- f. laciniatum (Murr)Prod.: V(14)
- ssp. viride (L.)Murr var. rhombeum Peterm.: III (14)
- ssp. striatum (Kras.)J. Murr (C. strictum Roth): V (47)
- f. krasani Beck: V (14)
120. C. bonus-henricus L.: I-V; H, E; H3.5T2R3
121. C. botrys L.: III-V (14,9,5,40,25,43); Th, Cosm; H3.5T4R0
122. C. ficifolium Sm.: III (14), V (14,40); Th, Eua (M); H3.5T4R0
123. C. foliosum (Mxch.)Aschers.: II (14); Th, Eua (M); H0T0R0
124. C. glaucum L.: III-V (29,5,14,45,!); Th,Eua; H3.5T4R0
125. C. hybridum L.: III-V (14,29,25,47,40); Th, Eua (M);H3T3R0
126. C. murale L.: III (14); Th, Adv; H2.5T4R0
127. C. opulifolium Schrad.: III-V (14,42,40); Th, Eua; H2T3.5R4
128. C. polyspermum L.: IV V (5,47,40,37); Th, Eua; H3T4R0
129. C. rubrum L.: III (14,42), V (14,40); Th, Cp; H3.5T0R0
- ssp. blitoides (Lej.)A. et G.: V (14,37,40)
130. C. schraderianum Schult.(C.foetidum Schrad.): III (14); Th, Adv; H2T3.5R4
131. C. urbicum L.: III-V (14,5,25,47); Th, Eua (M); H3T0R3
132. C. vulvaria L.: III-V (14,5,40); Th, Eua (M); H3T4R4
133. Atriplex hastata L.: III-V (14,37,40); Th,Cp; H3.5T0R0
- var. microtheca C.F.Schumach: V (40,47)
134. A. littoralis L.: III (14), V (14,45); Th, Eua (M); H0T0R0
135. A. nitena Schuhr.: III-V (14,25,40,!); Th, Eua (C); H3T3R0
136. A. oblongifolia W et K: III-IV (14,5,25); Th, Eua (C); H2T3.6R4
137. A. patula L.: III, V (14,18); Th,Cp; H0T0R0

- var. angustifolia (Sm.)Lange: V (14)
- var. erecta (Huds.)Lange: V (14,40)

138. A. rosea L.: III-V (14,37,40); Th, Eua (C);H3.5T3R3
139. A. tatarica L.: III (14), V (18,47); Th, Eua (M); H2T4R0
140. Camphorosma annua Pall. (C. ovata W et K.): V (13,18);Th, P-Pn; H2T4R5
141. Kochia laniflora (Gmel.)Borb.: IV (14); Th, Eua(C); H1.5T4.5R4.5
142. K. prostrata (L.)Schrad.: III (14,4); Ch-nPh,Eua (C);H1.5T4R4.5
143. K. scoparia (L.)Schrad.: III (14), V (14,40); Th, Eua (Adv);H3T3.5R0
144. Corispermum nitidum Kit.: IV (14); Th, P-Pn; H2.5T4R0
145. Salicornia europaea L. (S. herbacea L.): III (14,29,!);Th,Cosm; H4T0R5
146. Salsola kali L. ssp. ruthenica (Iljin)Soó (S. ruthenica Iljin): V (14,40); Th, Eua (C); H0T4R4

- f. tenuifolia Tauschin: V (40)

147. Suaeda maritima (L.)Dum.: V (18,40); Th, Cosm; H4.5T3.5R5
148. Petrosimonia triandra (Pall.)Simk.: III (14,29); Th, Eua(C); H2T4R4.5

AMARANTHACEAE

149. Amaranthus albus L.: III-V (9,25,47); Th,Adv; H3T3R3
150. A. blitoides S. Watson: V (46,47);Th,Adv; H2T4R0
151. A. crispus (Lesp. et Thev)N. Terracc.: III-V (14,9,25,!);Th, Adv; H3T4R3

- f. ruber F. Zimm. et Thell.: III (14,!)
- f. macrophyllus Deg. et Thell.: IV V (14)

152. A. deflexus L.: V (14,40); H, Adv; H2.5T4R4

- f. scandens (L. f.)Thell.: V(14)

153. A. hybridus L. (A. hypochondriacus L.): III (14), V (47);Th,Adv;H3T3R0

- var. chlorostachys (Willd.)Thell.: V (47)

154. A. lividus L.: III (14), V (14,40); Th, Cosm; H3.5T4R4

- var. ascendens (Lois)Thell.: V (37,40,18)
- f. procumbens (Spenn.)Morariu: III (14)

155. A. retroflexus L.: III-V (14,5,47,!); Th, Adv; H3T3R0

PORTULACACEAE

156. Portulaca oleracea L.: III-V (9,5,40,18,!); Th, Cosm; H3T0R0

CARYOPHYLLACEAE

157. Myosoton aquaticum (L.)Mnch. (Stellaria aquatica (L.)Scop.): III-V (9,29,14,25,27,18); Th-TH, Eua (M);H4T3R0
158. Stellaria graminea L.: I-V; H, Eua (M); H2.5T2R3
159. S. holostea L.: III-V (29,5,25,37,40,!);H-Ch, Eua; H3T3R0
160. S. longifolia Muhl.: I (23,32); H, Cp; H4.5T2R2
161. S. media (L.)Cyr.: I-V; Th-Th, Cosm;H3T0R0
162. S. nemorum L.:I-V; H, E; H3.5T3R3
163. S. palustris Ehrh.: IV (14,5); H, Eua; H4.5T3R3
164. Cerastium arvense L.: I (14), III (14,29), IV (5); Ch, Cp, H2.5T0R3.5

165. C. brachypetalum Desp.: III-V (14,37,47,40,!); Th, M; H3T3R0
- f. strigosum Fries: III (14)
- f. taurinum (Spr.)Prod. : IV V (14,40)
166. C. dubium (Bast.)Guepin (C. anomalum W et K.): III-V (35,14,25);Th, P-M; H3T3R0
167. C. fontanum Baumg. ssp. triviale (Link.)Julas (C. caespitosum Gilib.): I-V; H-Ch, Cosm; H3T0R0
168. C. glomeratum Thuill.: IV V (5,37,40); Th, Cosm; H2.5T3R0
169. C. pumilum Curt.: IV V (5,25,37,40); Th, Eua (M);H2T3R0
170. C. semidecandrum L.: I11-V (37,40,!); Th, E; H2T3.5R0
171. Holosteum umbellatum L.: III-V (15,14,29,5,25,18); Th, Eua (M);H2T3.5R0
172. Sagina procumbens L.: V (37,40,25,27,!); H(Ch), Cp; H4T3R3
173. Arenaria procera Spreng. ssp. glabra (F.N. Wiliams)Holub (A. graminifolia Schrad.): IV V (14,37,40); H,Eua (C); H2T3.5R4
174. A. serpyllifolia L.: III-V (5,25,37,40,18,!); Th,Cp; H2T2.5R0
175. Moehringia muscosa L.: I-II (22,14), IV (14,5,25); H, E; H4T2R4
176. M. trinervia (L.)Clairv : III-V (15,29,5,25,40,!); Th-TH, Eua (M); H2.5T3R3
177. Spergula arvensis L. III-V (15,5,40,!); Th, Cosm; H3T0R0
178. Spergularia marina (L.)Grisb.(S. salina J. et C. Presl.): III-V(14,34,40,!); Th-TH, Eua; H2T3R2
179. S. media (L.)C. Presl. (S. marginata Kitt.): V (40); Th-H, Eua(M);H4T0R0
180. S. rubra (L.) J. et C. Presl.: V (37,40,!); Th (H), Cp; H4T3R4
181. Herniaria glabra L.: III-IV (14); Th-H, Eua(M); H2.5T3.5R3
182. H. incana Lam.: III-IV (14,5); H (Ch), Eua(M); H2T3.5R4.5
183. Scleranthus annuus L. ssp. annuus: II-V (22,5,14,25,!); Th, Eua; H2T3R2
- ssp. polycarpus (Torn.)Thell. (S. polycarpus Torn.): V (40); Th, E(M); H2T3R2
184. S. perennis L.: IV V (37,14,25,!); H-Ch, Eua; H3T0R3
- var. dichotomus (Schur)Prod.: IV (5)
185. S. uncinatus Schur: II (14); Th TH, Carp-B-Anat-Cauc; H3T2R0
186. Agrostemma githago L. : III-V (29,5,25,!); Th, Eua(M); H2T4R0
187. Lychnis coronaria (L.)Desr.: IV (14,25); H,M; H2.5T4R3
188. L. flos-cuculi L.: I-V; H, Eua; H3.5T2.5R0
189. L. viscaria L. (Viscaria vulgaris Rohl.): I-IV (6,22,34,29,25,!); H, Eua; H3T4R0
190. Silene alba (Mill.)E.H.L. Krause (Melandrium album (Mill.)Gaerke): III-V (5,18,!); Th-TH,Eua; H3.5T2R3
191. S. armeria L.: I-II (14,22,!), IV (14); Th, M; H2.5T4R3
192. S. bupleuroides L. (S. longiflora Ehrh.): III-V (14,29,40); H, P-M; H1.5T4.5R4
193. S. conica L.: III-IV (14,29,25); Th, Eua(M); H1T3.5R4
194. S. dioica (L.)Clairv (Melandrium rubrum (Weig.)Gaerce): I-II (14); H, Eua; H3.5T0R4
195. S. dubia Herb.: II (48,22,!); H, Carp (End); H2T3R0
196. S. flavescens W et K.: IV (14,25); H, D-B-Pn; H2T3R4
197. S. x grecescui Gusul. (nutans x viridiflora): III (14);
198. S. heuffelli Soó (Melandrium nemorale (Heuff)A Br.): IV-V (35,14,25,24,!); Th-TH, Carp-B; H3.5T2R0

199. S. italica (L.)Pers.: I (!), IV (5,25); H, Eua (M); H3T0R3
- var. nemoralis (W et K.)Heuff.: I (14)
200. S. multiflora (Ehrh.)Pers.: IV (14); H, Eua (C); H3.5T3R4
201. S. noctiflora L. (Melandrium noctiflorum (L.)Fries: IV-V (5,40); Th-TH, Eua; H2T3.5R0
202. S. nutans L.: I-IV (14,22,35,!); H, Eua; H2T3R4
203. S. otites (L.)Wib. ssp. otites: III-V (14,29,5,18,!); H, Eua (C);H1.5T4R4.5
- var. pseudotites (Bess.)Borb.: V (40)
- var. effusa (Otth.)Gusul.: III (14)
204. S. viridiflora L.: III-IV (14,5,25,!); H, M; H2T3.5R3
205. S. viscosa (L.)Pers. (Melandrium viscosum (L.)Celak.): III (14,29), V (40); Th-TH, Eua (C); H2.5T3R4
206. S. vulgaris (Mnch.)Gaerke (Behen vulgaris Mnch.) ssp. vulgaris: III-V (9,29,5,25,40,!); H (Ch), Eua; H3T3R4
207. Cucubalus baccifer L.: III-V (29,24,25,40,!); H, Eua; H3.5T3R4
208. Gypsophila muralis L.: III-V (14,5,25,!); Th, Eua(C); H2T3R2
- f. ramossisima (Schur)Prod.: III (14)
- f. capillaris Fiek et Schuber: IV (25)
209. G. paniculata L.: IV (14); G (Ch), Eua (C); H2T4R4.5
210. Petrorhagia prolifera (L.)P.WBall. et Heywood (Tunica prolifera (L.)Scop.: III-V (14,29,25,37,40); Th,P-M; H1.5T4R3
211. Vaccaria pyramidata Medik.: V (18,40); Th, Eua (M); H3T3R0
-ssp. graminiflora (Fisch)Prod.: III (14), V (14,37,40)
212. Dianthus armeria L. ssp. armeria: IV V (25,24,40); Th-TH, E;H2T3R3
- f. glaber Scholz: IV (43)
- ssp. armeriastrum (Wolfn.)Velen. (D. armeriastrum Wolfn.): IV (14,25); Th-TH, E;H2.5T4R0
213. D. barbatus L. ssp. compactus (Kit.)Tutin (D. compactus Kit.): II (14,!), IV (5); H, Alp-Carp-B; H2.5T3.5R4
- f. umbrosus Nyár.: II (22,14,!)
214. D. carthusianorum L.: I-IV (6,22,29,5,!); H,E; H2T4.5R5
- ssp. latifolius (Gris. et Schenk)Hegi var. parviflorus Celak.: I (14)
215. D. giganteus D'Urv : IV (14); H,B; H2.5T3R4
- f. luxurians Prod.: IV (14)
216. D. kitaibelli Janka ssp. spiculifolius (Schur)Sanda (D. spiculifolius Schur): IV (5,14); H, Carp (End);H2T3.5R4
217. D. pontederae Kern.: V (37,14,25,40); H, B-Pn; H2T5R5
- ssp. giganteiformis (Borb.)Soó (D. giganteiformis Borb.): I (14), V (14, 43,25); H, Pn; H3T4R0
218. D. puberulus (Simk.)Kern.: III-IV (14,5,25); H, B; H2T4R4
- var. laevigatus (Simk.)Hand.-Mazz.: IV (14)
219. D. superbus L.: I (23,!); H, Eua; H3T0R0
220. D. trifasciculatus Kit.: III-IV (37,14,25); H, B; H3T3R3
221. Saponaria officinalis L.: II-V (29,5,37,14,25,!); H, Eua(M);H3T3R0

EUPHORBIACEAE

222. Euphorbia amygdaloides L.: IV (!);Ch, E(M);H3T3.5R4
223. E. angulata Jacq.: III-IV (14,35,5); H-G, P-M; H2.5T3R4.5
224. E. x angustata (Roch.)Borza (salicifolia x virgata); III, V (14);
225. E. carniolica Jacq.: IV (14,25); H, Ec; H3T4R4
226. E. x csatoi (Simk.)Borza (agraria x paradoxa): III (14);
227. E. cyparissias L.: III-V (29,5,33,18,!); H (G), Eua; H2T3R4
228. E. dulcis L.: III (29); H-G, Ec; H4T3R3
229. E. epithymoides L. (E. polychroma Kern.): III-IV (14,29,5,25); H, Pn-B; H2.5T4R3
230. E. esula L.: IV-V (37,14,25,40); H,Eua; H2T3R3
- var. riparia Schur: IV (14)
231. E. exigua L.: III (!) ; Th, E (M); H2.5T3.5R4.5
- f. tricuspidata (Lapeyr.)Borza: III (14,29)
232. E. falcata L.: III-V (29,14,5,40,!); Th, Eua (M); H2T3.5R4.5
233. E. helioscopia L.: III-V (35,29,5,25,18,!); Th, M; H3T3R0
234. E. lucida W et K.: IV V (14,18,47); H, E (C);H5T3R4
235. E. maculata L.: IV (14); Th, Adv;H2T3.5R4.5
236. E. nicaeensis All. (E. pannonica Host.): V (14,40);H, P-Pn-B;H1.5T5R5
237. E. palustris L.: IV V (37,14,5,40); H-Hh, E; H4.5T3.5R4.5
238. E. x paradoxa (Schur)Podp. (esula x salicifolia): III-V (14,25,40);
239. E. platyphyllos L.: IV V (25,40,!); Th, Ec(M); H3T3R3
240. E. x pseudolucida Schur (lucida x virgata): V (40);
241. E. salicifolia Host.: III-V (29,5,25,40,!); H,P-Pn; H2T3.5R3
242. E. segetalis L.: V (14,40); Th-H, M; H3T3.5R0
243. E. seguieriana Neck.: IV-V (14,5,25,40,!); H, Eua(M); H1T3.5R4
244. E. stricata L. : IV-V (25,40); Th, E(C); H4T3R5
245. E. villosa W et K.: III-V (14,5,37,25); H,P-M; H3T3.5R0
246. E. virgata W et K.: III-V (35,37,14,18,47,!); H, Eua(C); H2T4R3
- f. angustissima Schur : V (46)
247. Mercurialis perennis L.: II-V (22,29,25,!); H-G,E; H3.5T3R4

CALLITRICHACEAE

248. Callitriche cophocarpa Sendtn. (C. polymorpha Lonnr.): III-V (14,38,!); Hh, Eua; H6T3R0
249. C. palustris L. em. Druce (C. verna L.): I (14,31,38); Hh, Cp; H6T3R0

RANUNCULACEAE

250. Trollius europaeus L.: I (30,6,23,14,!),III (14,29); H, E; H4T2R4
251. Caltha palustris L. ssp. laeta (Schott, Nyman et Kotschy)Hegi: I-V; H,E; H5T3R0
- var. pseudocornuta Zap.: I-II (14)
- var. alpina (Schur)Graebn.: I-IV (14,!)
252. Helleborus purpurascens W et K.: III-IV (14,29,25,!); H, Carp-B-Pn; H2.5T3R4
- f. baumgartenii (Kov)Nyár. : III-IV (14,25)

253. Nigella arvensis L.: III-V (14,29,25,18); Th, E(M); H2T4R4
254. Isopyrum thalictroides L.: III-V (15,29,14,24,25); G, Ec; H3T3.5R3
255. Actaea spicata L.: II-III (14,29); H, Eua; H3.5T3R3
256. Consolida orientalis (J.Gray) Schroding. (Delphinium orientale Gray): V (14,18,47,!); Th, Eua(C); H2.5T4R4.5
- f. rhodochroa (So¢)A.Ny r.: V (40)
257. C. regalis S.F.Gray (Delphinium consolida L.): III-V (15,29,5,25,18,!); Th, Eua; H2T4R4
258. Aconitum anthora L.: II-IV (37,14); H,E(C); H2T3R5
259. A. firmum Rchb. ssp. multifidum (Rchb.)Grint. (A. multifidum Rchb.): II (14); H, Carp-B-Sudet; H2.5T2.5R4.5
260. A. moldavicum Hacq.: I-II (22,14,!) H, Carp (End); H3T2R3
- var. hacquetianum G. Grint.: I-II (14)
- f. piliferum G. Grint. : II (14)
- var. confusum G. Grint.: II (14)
261. A. toxicum Rchb.: I (23,30,!); H,Carp-B; H4T2.5R4.5
262. A. variegatum L. ssp. gracile (Rchb.)Gay (A. gracile Rchb.): III (29,14); H, Alp-Carp; H4T2.5R4.5
263. Anemone nemorosa L.: I-V; G, E; H3.5T4R0
264. A. ranunculoides L.: II-V (22,29,40,!); G, E; H3.5T3R4
265. A. silvestris L.: III-IV (14,29); H, Eua (C); H, Eua(C); H2T3.5R4
266. Hepatica nobilis Mill.: II-IV (15,22,29,14,!); G, E; H3T3R4
267. H. transsilvanica Fuss: I-II (14); G, Carp (End); H3T2R4
268. Clematis alpina (L.)Mill. (Atragene alpina L.): I-II (14,30,!); H(nph),Eua; H3T2R2
269. C. integrifolia L.: IV V (14,43,40,!); H,Eua (C); H3T3.5R5
270. C. recta L.: III-V (37,14,40,5,!); H, P-M; H2.5T3R4
271. C. vitalba L.: II-V (27,29,5,40,!); nPh, Ec (M); H3T3R3
272. Myosurus minimus L.: III-V (14,!); Th, Cp; H4T4R3
273. Ceratocephalus testiculatus (Cr.)Roth (C. orthoceras DC): III-V(14,5,40); Th, P-PN; H2T4R4.5
274. Ranunculus acris L.: I-V; H, Eua (M); H3.5R0R0
- f. stipitatus Ny r.: III (14)
- ssp. strigulosus (Schur)Hyl. (R. stevenii Andrz.): I (14,!),III-IV (5,14, 25); H-G, P-M; H3.5T2R3
- var. friseanum (Jord.)A.Ny r.: I (14)
275. R. x alliariifolius (Rchb.)A.Ny r. (cassubicus x flabellifolius): III (14)
276. R. arvensis L.: III-V (14,29,5,18,!);Th,Eua (M); H3T3R0
- var. tuberculatus (DC)Mert. et Koch: IV (5)
277. R. auricomus L.: I-V; H, Eua; H3.5T3R3
278. R. bulbosus L.: III-V (42,40,!); H-G, E; H2T3R3
279. R. carpaticus Herb.: II (14); G, Carp (End); H3.5T2R4
280. R. cassubicus L. : IV-V (24,25); H, E(C); H3.5T3R0
281. R. x fallax (Wimm. et Grab.)Kern. (auricomus x cassubicus):III (14),V (!);
- var. incisifolius (Rchb.)A.Nyár.: III, V (14)

282. R. ficaria L. (Ficaria verna Huds.) ssp. ficaria: I-V; H-G, Eua (M); H3.5T3R3
- ssp. calthifolia (Rchb.)Vel. : V (40); H-G, E; H3.5T3R3
283. R. flammula L.: I (6,23,!), II (!); H, Eua; H4.5T3R0
- f. serratus (DC)Prod.: I (14)
284. R. lateriflorus DC.: II (22), V (40); Th, Eua(C); H5T3R5
285. R. lingua L.: I (23), III (14), V (40); Hh, Eua; H6T3R4
286. R. pedatus W et K.: V (18,40); H-G, Eua (C); H1.5T3R4
287. R. peltatus Schrank (Batrachium triphyllos Waller.)Dum.): IV-V (14,40); Hh, E; H6T3R0
288. R. platanifolius L.: I (14); H, E; H3.5T2.5R0
289. R. polyanthemos L.: I-V; H, Eua (c); H2.5T3R3
290. R. repens L.: I-V; H, Eua (M); H4T0R0
291. R. oreophilus M.B.: I (14); H, Alp-Carp-B; H2.5T4R4
292. R. rionii Lagg. (Batrachium rionii (Lagg.)Nym.): III (14), V (40);Hh, Eua (M);H6T3R
293. R. sardous Cr. : IV-V (5,47); Th-H, Eua; H3T3R4
294. R. sceleratus L.: I (32), III-V (14,27,5,25,18,!); Th, Cp; H4.5T3R4
295. R. trichophyllus Chaix. (Batrachium divaricatum (Schrank)Schur): III-V (14,5,25,34,40,18,!); Hh, E; H6T3R0
296. Thalictrum aquilegifolium L.: I-IV (6,23,22,6,29,!); H, E; H2.5T2.5R4
297. T lucidum L.: I-V; H, Ec; H4.5T3R5
- var. lucidum f. angustissimum (Cr.)Nyár.: V (40)
- f. peucedanifolium (Gris. et Schenk)A. Nyár. : V (18,40)
- var. stenophyllum (Wimm. et Grab.)Hay : I-II (14)
- f. subglabrum (Simk.)Nyár.: V (37,14)
- var. heterophyllum (Wimm. et Grab.)Hay : I-IV (14,!)
- f. scopolii-nigricans Nyár.: I (23)
298. T. flavum L.: III-V (14,29,40); H, Eua; H4.5T0R4.5
299. Adonis aestivalis L.: III-V (15,29,5,25,18,47); Th,Eua (M); H3T4R3
300. A. annua L. (A. autumnalis L.): IV (14); Th, Adv; H2T3.5R3.5
301. A. flammea Jacq.: V (40); H, P-M; H2T3.5R3.5

ARISTOLOCHIACEAE

302. Asarum europaeum L.: III-IV (14,5,25); H-G, Eua; H3.5T3R4
303. Aristolochia clematitis L.: III-V (14,29,25,5,18,!); H-G, Ec (M);H2.5T3.5R5

BERBERIDACEAE

304. Berberis vulgaris L.: III-IV (15,29,14,5); mPh, E; H2T3R4

NYMPHAEACEAE

305. Nuphar luteum (L.)Sm.: III (14,29,!); Hh, Eua (M); H6T0R3.5
- var. sericeum (Lang)Kitt.: III (14)
- var. tenellum (Rchb.)Richt.: III (14)
306. Nymphaea alba L.: III (14), V(14,40,!); Hh, E (M); H6T0R4
- var. minoriflora (Borb.)A. et G.: V (40)

CERATOPHYLLACEAE
307. Ceratophyllum demersum L.: III-V (14,37,38,25,40,!); Hh, Cosm; H6T3R0
- f. leve Crepin: V (40,14)
308. C. submersum L.: III-V (37,14,40); Hh,Eua (M); H6T3.5R0
- var. haynaldianum (Borb.)Beck: V (14,40)

PAPAVERACEAE
309. Glaucium corniculatum (L.)J.H.Rudolph: III-V (14,29,25,40); Th-TH, M; H2T4R3
- var. phoeniceum (Cr.)DC: V (40)
310. Chelidonium majus L.: III-V (15,29,5,18,!); H, Eua; H3T3R4
311. Papaver dubium L.: IV-V (14,25,40); Th, M; H2T3.5R3
312. P. rhoeas L.: IV-V (5,14,18,!); Th, Eua (M); H3T3.5R4
- ssp. strigosum (Boenningh.)Simk. var. verum A. Ny r.: V (14)
- var trifidum (O.Ktze.)Fedde: V (14)
- var. agrivagum (Jord.)Beck: IV-V (14)
- var. magno-genuinum Nyár.: IV (14,25)
313. Corydalis bulbosa (L.)Pers. (C. cava (L.)Schweigg. et Koerte):
- ssp. cava: III (14,29), V (40); G, Ec; H3T3R0
314. C. capnoides (L.)Pers.: I (14); Th-TH, Eua; H3T3R4
315. C. solida (L.)Sw : II-V (14,22,5,25,40); G, E; H3T3R0
316. Fumaria officinalis L.: III-V (29,14,5,40); Th, Eua (M); H3T0R.3.5
317. F. rostellata Knaf.: IV V (5,14,40); Th,Ec-B; H3T0R3.5
318. F. schleicheri Soyer-Willemet: I (14), III-V (14,5,18);TH,Eua(M);H2.5T4R4
319. F. vaillantii Liosel.: III-V (5,14,18,4?,40); Th,Eua; H2.5T3.5R4.5

BRASSICACEAE (CRUCIFERAE)
320. Sisymbrium altissimum L.: III-IV (14); Th-TH, Eua(C); H2T3.5R0
321. S. loeselii Jusl.: III-V (14,5,25,37,40); Th-TH, Eua (C); H2.5T4R3
- f. ciliatum (Beck)Nyár.: III (14)
322. S. officinale (L.)Scop.: III-V (14,29,5,40,!); Th, Eua (M);H2.5T4R3
323. S. orientale Torn.: V (47,40); Th-TH, Eua (M); H2.5T4R3
- f. hygrophilum (Fourn.)Thell.: II (14)
324. S. strictissimum L.: III (14,29); H, Ec; H3.5T4R4.6
325. Descurainia sophia Webb. (Sisymbrium sophia L.): II-V (14,22,29,5,18,!); Th,Eua; H2.5T4R4
326. Alliaria petiolata (M.B.)Cavara et Grande (A. officinalis Andrz.):III-V(14,15,29,5,25,24,40,!); Th-TH,Eua (M); H3T3R4
327. Arabidopsis thaliana (L.)Heynh.: III-V (29,5,37,14,25,40); Th-TH, Eua(M); H2T3R3
328. Myagrum perfoliatum L.: III-V (14,5,40); Th, M; H2T4R3
329. Isatis tinctoria L.: III-V (29,25,14,40); H, P-Pn; H1.5T3.5R4
330. Bunias erucago L.: IV (14); TH, Adv; H3T3.5R3
331. B. orientalis L.: II-V (22,14,5,40); TH-H, Eua (C); H3T3.5R3
332. Erysimum cheiranthoides L.: II-V (14,29,5,18); Th, Cp; H3T0R4

333. E. odoratum Ehrh. (E. pannonicum Cr): IV V (5,14,40);H-Th,P; H2.5T3R4
- var. speciosum Nyár.: I (14)
334. E. repandum Hojer: III-V (15,29,14,18,!); Th, Eua (C); H2.5T4R4.5
335. Hesperis silvestris Cr.: III-V (14,29); H, M-P; H4T2R3
- var. runcinata (W et K.)Borb.: III (14), V (40)
336. Euclidium syriacum (L.)R.Br.: V (40); Th, Eua (C); H2T4R4
337. Barbaraea vulgaris R. Br : I (14), III-V (14,40,5,29,34); TH-H,Eua (M); H3.5T3R3
338. Rorippa amphibia (L.)Bess. : III-V (14,29,25,18);Hh,Eua (M); H6T3R4
339. R. x armoracioides (Tsch.)Fuss (austriaca x silvestris): III-V (14,40);
- var integrifolium (Tsch.)Nyár.: III (14), V (40)
- var. semisilvestris Borb.: III(14)
- var. pinnatifida (Tsch.)Borb.: III-V (14,40)
340. R. austriaca (Cr.)Bess.: II-V (22,14,%,18); H-G, Ec; H4T3.5R4
- var. angustifolia (Schur)Nyár.: V (14)
341. R. x barbaraeoides (Tsch.)Cel. (islandica x silvestris): III (14)
- var. capillipes Borb.: III-V (14)
- var. reichenbachii Knaf III (14), V (40)
- f. pubescens (Borb.)Ny á.: III (14)
- f. arenaria (Knaf)Nyár.: III (14)
- f. macrostylis (Tsch.)Nyár.: III (14)
342. R. x hungarica Borb. (amphibia x austriaca): V (40)
- var. riparia (Simk.)Nyár.: V (37,14,40)
343. R. islandica (Oed.)Borb.: I (14,!) III-V (14,29,27,25,40,!); Th-TH, Cosm; H5T3R4
344. R. x permixta Borb. (barbaraeoides x silvestris): III (14)
345. R. prolifera (Heuff:)Neilr.: IV (14); TH, B; H4T4R4
346. R. pyrenaica (L.) Rchb.: II-IV (14,22,5,!); H, M; H2.5T3R3
347. R. silvestris (L.)Bess.: I-V; H-G, E; H4T3R4
- f. dentata (Koch)Borb.: I,III (14)
- f. tenuifolia (Tsch.)Beck: III (14)
- f. densiflora Borb.: III (14)
348. R. x stenophylla Borb. (silvestris x pyrenaica): III (14)
349. Armoracia macrocarpa (W.et K.)Baumg.: V (18); H, Pn; H3T3.5R0
350. A. rusticana (Lam.)G.M.Sch.: III-V (14,40,!); G (H)Adv; H3T3.5R0
351. Nasturtium officinale R. Br.: III-IV (29,5); Hh, Cosm; H5T2.5R4
352. Cardamine amara L.: I (30), IV (14); H, Eua (M); H5T0R0
353. C. glanduligera Schw. (Dentaria glandulosa W et K.): I-II (14,22,23); G, Carp (End); H4T2.5R4
354. C. impatiens L. : II-V (22,14,25,27); Th-TH, Eua (M); H4T3R3
355. C. pratensis L. ssp. pratensis: I-V; H, Cp; H5T3R0
- var. grandiflora Neilr.: IV (14)
- var. palustris W et Gr.: V (14,40)
- ssp. matthiolii (Moretti)So¢ (C. matthiolii Moretti, C. hayneana Welw): II (14), IV (25), V (40)
356. Cardaminopsis arenosa (L.)Hay : II (22,140, IV V (37,14,40);TH-H,Ec; H2.6T3R4

- var. perturbata Nyár.: II (14)
- var. segetalis (Schur)Nyár.: III (14)

357. Arabis glabra (L.)Bernh. (Turritis glabra L.): II-IV (22,14,29,5,25,!); TH, Cp; H2T3R3
358. A. hirsuta (L.)Scop. ssp. hirsuta: III-V (14); TH-H, Cp; H1.5T3R4

- f. sagittata (Betol.)Tuzs.: V (14,37,40)

359. Alyssum alyssoides (L.)L.: II (22), IV (5), V (40); Th-TH, E (C); H1T3R0
360. A. desertorum Stapf.: V (40,14); Th, Eua (C); H1.5T4R4
361. Berteroa incana (L.)DC.: III-IV (29,6,25,!); Th-TH, Eua (C); H2T3.5R0
362. Draba muralis L.: II (22,14,!), III (29); Th, E (M); H2.5T3.5R4.5
363. D. nemorosa L.: I (14), III-V (14,5,40); Th,Cp; H3T0R4.5
364. Camelina alyssum (Mill.)Thell.: I-II (14); Th, E; H3T3R3

- f. integrifolia (Fr.)K. Maly: I-II (14)

365. C. sativa (L.)Cr. ssp. sativa: III-V (14,29,40); Th, Eua; H3T3R3

- ssp. microcarpa (Andrz.)E. Schmid (C. microcarpa Andrz.): IV-V (14,18); Th, Eua; H3T3R0

366. Neslia paniculata (L.)Desv.: III-V (14,40); Th, Eua; H2.5T3R4.5
367. Capsella bursa-pastoris (L.)Medik.: I-V; Th, Adv (M); H3T0R0
368. Thlaspi alliaceum L.: IV (14,25); Th, Atl-M; H2T4R0
369. T. arvense L.: III-V (29,5,25,18,!); Th, Eua (M); H2T3R4
370. T. perfoliatum L.: III-V (15,29,5,40,18); Th, Eua; H2.5T3.5R4.5
371. Cardaria draba (L.)Desv (lepidium draba L.): III-V (5,25,18,!); H, Eua; H2T4R4
372. Lepidium campestre (L.)R.Br.: III-V (14,25,40); Th, E (M); H2.5T3R0
373. L. cartilagineum (L. May)Thell.: V (40); G,Pn; H3.5T4R4
374. L. perfoliatum L.: III (14,18); V (14,18); Th, Eua(C); H2T4R3
375. L. ruderale L.: IV-V (5,18); Th, Eua; H2T4R3
376. Coronopus squamatus (Forsk.)Aschers. (C. procumbene Gilib.): V (47,40); Th, M; H3.5T4R4
377. Conringia orientalis (L.)Andrez.: III-V (14,5,40); Th, Eua (M);H2T3.5R5
378. Diplotaxis muralis (L.)Dc.: III-V (5,14,25,47,40); TH(H), M; H2.5T3.5R4

- f. caulescens Kit.: V (40)

379. D. viminea (L.)DC.: IV (5,14); Th, M; H2.5T4R0
380. Brassica nigra (L.)Koch: III-V (14,29,5,40); Th,Eua (M);H3T4R0
381. Sinapis alba L.: III (14), IV (25); Th, Adv; H3T4R4
382. S. arvensis L.: III (14,29,!), V (14,18); Th, Cosm; H3T3R3

- var. arvensis f. orientalis (Jusl.)Godr.: V (37,14,18)
- var. schukuhriana (Rchb.)Hagenb.: III (14), V (25,40)

383. Erucastrum gallicum (Willd.)O.E.Schulz: III-IV (14,5); Th-TH,Atl-M; H2.5T3.5R4.5
384. Rapistrum perenne (L.)All.: I (14), III-V (14,4,18,40); TH-H (G),E (M); H2T3.6R4
385. Calepina irregularis (Asso)Thell.: III-V (14,5)
386. Raphanus raphanistrum L.: III-V (15,29,5,40,!); Th, M; H2.5T3R0

RESEDACEAE

387. Reseda lutea L.: III-V (29,5,14,43,18); Th-H,Eua (M); H2T3.5R4.5

388. R. luteola L.: IV (14,5,43,26,40); TH, Eua (M); H2T3R0

CISTACEAE

389. Helianthemum nummularium (L.)Mill. ssp. nummularium: I (6), III (29), IV (5,14); Ch-H, Ec-M; H2T3R4

- ssp. obscurum (Pers.)Prod. (H. hirsutum (Thuill.)Merat): I-II(14,22), IV (43); Ch-H, Ec-M; H2.5T3R4
- f. lanceolatum Willk.: IV (43)

TAMARICACEAE

390. Myricaria germanica (L.)Desv : I, III (14); nPh, Eua; H0T0R4.5

ELATINACEAE

391. Elatine alsinastrum L.: V (14); Hh, Eua (M); H5T4R3

DROSERACEAE

392. Drosera rotundifolia L.: I (14,23,6,!); H, Cp; H5T2.5R1

VIOLACEAE

393. Viola alba Bess.: IV (5,14); H, Ec-M; H3T4.5R4
394. V. arvensis Murr.: III-V (14,5,25,18,47); Th, Eua; H3T3R0
395. V. canina L.: I-IV (15,29,14,22,6,5,!); H, Eua; H2.5T3R2
396. V. elatior Fries: V (40,18); H, Eua; H4T4R4.5
397. V. epipsila Ldb.: I (23,32,14,!); H, Eua (C); H5T0R1.5
398. V. hirta L.: III-V (29,5,25,40,!); H, Eua; H2T3R4
399. V. luteola (Schur)Gay : II (22); Th-H, Eua; H2.5T3R0
400. V. montana L.: I (23); H, Eua; H2T3R2
401. V. odorata L.: III-V (5,29,25,40,!); H, Atl-M; H2.5T3.5R4
- f. simonkaiana Gay : III (14)
402. V. persicifolia Schreb. (V. stagnina Kit.): I (32), IV-V (14,40); H, Eua; H4.5T3R3.5
403. V. pumila Chaix: I (14), IV-V (5,14,40); H, Eua; H3T3R4
404. V. reichenbachiana Jord. (V silvestris Lam.): IV V (25,24,40);H, Eua; H3T3R3.5
405. V. tricolor L. ssp. tricolor: I-V; Th-H, Eua; H2.5T3R0
- ssp. subalpina Gaud. (V. bielziana Schur): I (14)
- var. perrobusta Borb.: I (14)

HYPERICACEAE

406. Hypericum hirsutum L.: IV-V (25,24); H, Eua; H3T3R3
407. H. maculatum Cr.: I (6,32,!), IV (25); H, Eua; H4T3R2
408. H. montanum L.: I-II (30,14); H, E; H3T3R4
409. H. perforatum L.: I-V; H, Eua; H3T3R0
- var. latifolium Koch: IV (14)
- var. angustifolium DC.: I,III (14)
410. H. tetrapterum Fr. (H. acutum Mnch.): IV-V (14,40); H, E; H4T3R4

CRASSULACEAE
411. Sedum annuum L.: I (22,!); Th-TH, Eua; H3T2R0
412. S. caespitosum (Cav)DC.: V (14,40); Th, M; H2T4R4
413. S. cepaea L.: IV (25); Th-TH, M; H3T4R0
414. S. hispanicum L.: II (22,!), IV (25); Th(Ch), M; H1T3.5R4
415. S. maximum (L.)Hoffm.: II-IV (5,14,29,22,25,!); H (G),Eua (M);H2T3R0
416. S. reflexum L.: I (14); Ch, E; H1.5T3R2.5
417. Sempervivum heuffelii Schott: II (!); Ch, Carp-B; H1.5T2R0
418. S. marmoreum Gris. (S. schlehani Schott) ssp. blandum (Schott)Hay: II (14,!); Ch, Carp-B; H1.5T2.5R2.5

SAXIFRAGACEAE
419. Saxifraga tridactylites L.: II (14); Th, E (M); H2T3.5R4
420. Chrysosplenium alternifolium L.: I-V; H,Cp; H4T2R4

PARNASSIACEAE
421. Parnassia palustris L.: I (23,31,!); H, Cp; H4.5T2R1.5

GROSSULARIACEAE
422. Ribes grossularia L.: I-II (30,22,14,!); mPh, Eua; H0T3R0
423. R. heteromorphum Topa: I (23,14); mPh, Eua; H4T2.5R3.5
424. R. nigrum L.: I (23,30,!);H0T0R3
425. R. rubrum L.: I (23); mPh, Eua; H4.5T0R3.5

THYMELAEACEAE
426. Thymelaea passerina (L.)Coss. et Germ.: IV V (14,25,40); Th,Eua(C);H1T4R3
427. Daphne mezerum L.: I-III (30,22,29,!); nPh, Eua; H3.5T3R3

ROSACEAE
428. Spiraea salicifolia L. : T (23,32,14,!); mPh, Eua (C); H4.5T2.5R2
429. S. ulmifolia Scop.: I-II (30,22,!) mPh, Eua; H3.5T2.5R0
430. Aruncus dioicus (Walter)Fernald. (A. vulgaris Raf): II (22,!);H, Eua; H4T2.5R3
431. Pyrus pyraster (L.)Burgsd.: I-V; MPh-mPh, E; H2T3R4
432. Malus silvestris (L.)Mill.: I (23), III-V (29,6,25,24,!); mPh, E;H3.5T3R4
433. Sorbus aucuparia L.: I-II (22,23,!), IV (5,26,!); MPh-mPh, E; H3T2.5R2
- var. lanuginosa (Kit.)Beck: I (14,23)
434. S. torminalis (L.)Cr.: IV (5,14,!); MPh, E(M); H2.5T3R4
435. Crataegus x intermixta (Wenzig)Beck (laevigata x monogyna): V (40)
436. C. laevigata (Poir.)DC. (C. oxyacantha Auct. non L.): IV (14,25), V (24,27); mPh, Ec; H3T3R3
437. C. monogyna Jacq.: II-V (22,6,25,24,!); mPh, E; H2.6T3R3
- var. kyrtostyla (Fingerh.)Beck: V (40,14)
438. Rubus candicans Whe.: II (14), IV (14,25); nPh, M; H2T2.5R0

- var. menyhazensis (Simk.)Nyár.: II (14)
439. R. caesius L.: I-V; H (nPh), Eua (M); H4.5T3R4
- var. arvalis Rchb.: IV (14,!)
440. R. hirtus W et K.: IV (25); nPh, E; H3T2.5R3
441. R. idaeus L.: I-IV (22,29,25,!); nPh, Cp; H3T3R3
442. R. x longiramulus Sabr. (rivularis x serpens): II (14)
443. R. plicatus Whe. et Nees: III(29); nPh, Atl-Ec; H3.5T3.5R2
444. R. rivularis P.J.Mull. et Wirtg.: II(14); nPh, Atl-Ec;H2.5T2.5R2
- var. incultus (Wirtg.)Focke: II (14)
445. R. saxatilis L.: I (30); nPh, Eua; H3T1.5R0
446. R. x scythicus (Sabr.)Gay (rivularis x tereticaulis): II (14)
447. R. suberectus G. Anders.: II (14); H (nPh), Ec; H4T2.5R3
448. Fragaria vesca L.: I-V; H, Eua; H3T2.5R0
449. F. viridis Duch.: I (14), IV (5,14,25); H, E (C); H2T4R3
450. Potentilla anserina L.: I-V; H, Cosm; H4T3R4
451. P. argentea L.: I-V; H, Eua; H2T4R2
- var. dissecta Walr.: I (14)
452. P. chrysantha Trev : IV V (14,24,27); H, Eua (C); H2T0R3
453. P. erecta (L.)Rauschel: I-IV (6,31,29,25,!); H, Eua(M); H0T0R0
454. P. inclinata Vill. (P canescens Bess.): I (14); H, Eua (C); H3T0R4
- var. laciniosa Beck: I (14)
455. P. palustris (L.)Scop. (Comarum palustre L.): I (23,31,14,!);Hh(Ch),Cp; H5T2R3
456. P. patula W et K.: II (22); H, P-Pn; H2.5T3.5R3
457. P. recta L.: II-IV (22,29,5,!); H, Eua (C); H1.5T3.5R4
458. P. reptans L.: I-V; H, Cosm; H3.5T0R4
459. P. x semiargentea Borb. (argentea x inclinata): III (14)
460. P. supina L.: III-V (5,25,40,!); Th-H, M; H4T3R0
461. P. thuringiaca Bernh.: II-IV (14,22,25,!); H, Ec; H2T3R3
- var. nestleriana (Tratt.)Schinz et Kell.: III-IV (14,25,!)
- var. elongata (Goldb.)Th. Wolf. II (14)
462. Geum aleppicum Jacq.: II (22,14,!); H, Cp; H3.5T2.5R4.5
463. G. rivale L.: I-II (6,23,14,!); H, Cp; H4.5T0R4.5
464. G. urbanum L.: II-V (22,29,5,24,25,!); H, Eua (M); H3T3R4
465. Waldsteinia ternata (Stephan)Fritsch: I (14); Ch, Eua; H4T2.5R4
466. Filipendula ulmaria (L.)Maxim: I-IV (30,12,22,31,29,!); H, Eua;H4.5T2R0
- ssp. denudata (J. et C Presl.)Hayek: I (14)
467. F. vulgaris Mnch. (E hexapetala Gilib.): II-V (22,34,5,25,40,!); H, Eua; H2.5T3R0
468. Alchemilla glabrescens Wallr. (A. hybrida Acut. non Mill.): I (14);H,Ec; H2.5T2.5R2.5
- ssp. plicata (Buser)Palitz: I (14); H, E; H3T2.5R3
469. A. vulgaris L.: I-III (31,29,!); H, Ec; H3.5T2R2
- ssp. acutangula (Buser)Paalitz: II (22,14); H, E; H3T2R0
- ssp. micans (Buser)Palitz: I-II (14); H, E; H3T2R0
470. Agrimonia eupatoria L.: I-V; H, Eua; H2.5T3R4

- f. fallax (Fiek.)Buia: I (14)
471. Sanguisorba officinalis L.: I (23,31,!), III-V (14,29,25,40);H,Eua; H3T3R0
472. Rosa arvensis Huds.: II-IV (14,29);nPh, Atl-M; H3T3R2.5
473. R. canina L.: II-V (22,5,14,29,40,!); nPh, E; H2T3R3
- var. lutetiana (Lem.)R.Kell. f. muscrolunata (Desegl.)Borb.: IV (14)
- var. transitoria R. Kell. f. marisensis Simk.: IV (14)
474. R. corymbifera Borkh. (R. dumetorum Thuill.): III-V (14,24,!); nPh,E; H2.5T3R3
- var. lembachensis J.B.Kell. f. ciliata (Borb.)Borza: IV (14,25)
- var. thuillieri Chr. f. solstitialis (Bess.)Borb.: III-IV (14)
475. R. dumalis Bechst.: III-V (14,40,46,!); nPh, E; H2.5T3R4
- var. villosiuscula (Rip.)H.Br. f. villosiuscula: IV-V (14)
476. R. gallica L.: III-V (14,25,18,40); nPh, M; H2T4R4
477. R. pendulina L.: I-II (23,22,14,!); nPh, Ec; H3T2.5R3
478. R. spinosissima L.: IV V (14); nPh, Eua; H2T3R4
479. Prunus avium L. (Cerasus avium L.):IV (25,!); Mph-MPh, E; H3T3R3
480. P. padus L. (Padus racemosa (Lam.)C.KSchneid.): I (23,30), III (14,29), V (14); MPh, Eua; H3.5T3.5R4
481. P. spinosa L.: III-V (29,5,25,24,18,!); mPh, Eua; H2T3R3

FABACEAE (LEGUMINOSAE)
482. Genista tinctoria L. ssp. tinctoria: I-V; Ch-nPh, Eua; H2.5T3R2
- ssp. ovata (W et K.)Arc.: IV (5,14); Ch-nPh, Alp-Carp-B; H2.5T3R3
- var. transsilvanica Lerch. f mayeri (Jka.)Borza: IV (5)
483. Cytisus banaticus Gris. et Sch. (C. albus Hacq. var. pallidus Schrad.): V (14); Ch-nPh, B-Pn; H1.5T4R3
484. C. hirsutus L. ssp. hirsutus (C. leucothricus Schur): II-IV (22,29,14,!); nPh, Ec (M); H2T3.5R4
485. C. nigricans L.: II-IV (22,15,29,5,25,!); nPh, Ec; H2.5T3R0
486. Ononis arvensis L. (O. bircina Jacq.): I (6), II-V (14,29,34,5,25.!); Ch-H, Eua (C); H3T4R0
487. O. pseudohircina Schur: IV V (5,14,40,!); Ch-H, D-B-Cauc; H2.5T3R0
488. Trigonella procumbens (Bess.)Rchb.: III-IV (14,5), V (40); Th, P-M; H4T4R4.5
489. Medicago falcata L.: II-V (22,34,29,l8,!); H,Eua (M); H2T3R5
490. M. lupulina L.: I-V; Th-TH, eua; H2.5T3R4
491. M. sativa L.: III-V (14,5,18,!); H, M; H2T3R5
492. M. x varia Martyn (sativa x falcata): IV-V (37,14,25,40)
- f. pseudofalcata (Rouy)Nyár.: IV (25)
493. Melilotus albus Desr.: III-V (34,5,25,40,!); Th-TH, Eua; H2.5T3R0
494. M. dentatus (W et K.)Pers.: IV V (14,40); TH (Th), Eua (C); H4T3.5R4
495. M. officinalis (L.)Pall.: I (32,!), III-V (34,5,25,18,!); TH-TH,Eua; H2.5T3.5R0
496. Trifolium alpestre L.: I-IV (6,22,14,5,25,!); H, E (M); H2.5T3R4
497. T. angulatum W et K.: III (34), V (14,27); Th, B-Cauc; H0T4R4.5
498. T. arvense L.: III-V (14,34,29,25,40,!); Th,Eua (M); H1.5T3R4
499. T. aureum Pollich (T. strepens Cr.): I (14,32), IV (14,25); Th-TH, Eua (M); H3T3R0

500. T. campestre Schreb.: I (31), II (!), III-V (29,6,40,18,1);Th-TH, E;H3T3R0
- f. pseudoprocumbens (Gmel.)A. Ny r : III, V (14)
501. T. dubium Sibth.: II-V (14,5,40,27,!); Th-TH, E(M); H3.5T2R0
502. T fragiferum L.: III-V (15,29,%,18,!); H, Eua; H3T3R5
503. T. hybridum L.: I-V; H, E(M); H3.5T3R4
- var. fistulosum (Gilib.)Hegi: III (14)
- var. elegans (Savi)Boiss.: V (14)
504. T. medium L.: I-V; H, Eua; H3T3R0
505. T. montanum L.: I-III (6,22,29,!); H, Eua (C); H2.5T2R4
506. T. ochrolecum Huds.: I (6), III-IV (14,25,!); H, Ec-M; H2.5T2R4
507. T. ornithopodioides Sm.: V (14); Th, Atl-M; H4T4R2
508. T. pallidum W et K: V (14,27,40); Th-TH, M; H2T4R4
509. T. pannonicum Jacq.: I-IV (6,14,22,5,!); H, P-M; H2T3R0
510. T. pratense L.: I-V; H-TH, Eua; H3T0R0
511. T. repens L.: I-V; H,Eua; H3.5T0R0
512. T. retusum Hojer (T. parviflorum Ehrh.): V (27,14); Th, P-M; H2T4R4.5
513. T. spadiceum L.: I (14,32,23); Th, E; H4.5T3R2
514. T. striatum L.: IV-V (37,14,25); Th, Atl-M; H1.5T3R4
515. Anthyllis vulneraria L.: II-IV (22,29,5,33,25,!); H, E(M); H2T0R4
- ssp. kerneri (Sag.)Domin: II-IV (14)
516. Lotus angustissimus L.: V (14,40); Th, P-M; H2T4R4
517. L. corniculatus L.: I-V; H, Eua; H2.5T0R0
518. L. tenuis Kit.: III (14,34,!), V (14,!); H, Eua(M); H3.5T3R4
519. Amorpha fruticosa L.: III-V (4,46,25,!); mPh, Adv; H3T4R0
520. Galega officinalis L.: III-V (15,6,18,!); H, P-M; H4.5T3R4
521. Astragalus cicer L.: IV V (5,37,40,!); H, E(C);H2.5T4R4
522. A. glycyphyllos L.: II-V (22,5,25,24,40,!); H, Eua; H3T3R4
523. Glycyrrhiza echinata L.: IV V (14,27,40,!); H,P-M; H4T4R0
524. Coronilla varia L.: II-V (22,29,6,26,18,!); H, Ec-M; H2T3R4
525. Onobrychia viciifolia Scop.: II-V (22,14,5,40,!); H,M; H2T4R4.5
526. Vicia cracca L.: I-V; H, Euaa; H3T0R3
527. V. dumetorum L.: III (14), V(40); H, H3T3R4.5
528. V. grandiflora Scop.: III-IV (14,26);Th-TH, B-P-Cauc; H3T3R0
- var. sordida (W et K.)Gris.: III-IV (14,42,5)
529. V. hirsuta (L.)S.F.Gray: IV-V (5,14,25,40); Th, Eua (M); H2.5T3.5R4
530. V. lathyroides L.: IV-V (14,18,40); Th,Atl-M; H2T4R2.5
531. V. pannonica Cr.: III-V (29,5,40); Th, P-M; H2.5T3.5R4
- ssp. striata (M.B.)Nym. (V. striata M.B.): III (14), V(40)
532. V. pisiformis L.: V (14,40); H, Ec; H2T3R4.5
533. V. sativa L. ssp. sativa: IV-V (14,18,40); Th, Adv; H0T3R0
- ssp. nigra (L.)Ehrh. (V. angustifolia L.); II (22), III-V (14,6,40,47,!) Th, Eua (M); H0T3R0
534. V. sepium L.: I-V; H, Eua; H3T3R3
535. V. tetrasperma (L.)Schred.: IV V (5,26,40,!); Th, Eua; H3.5T3R3

536. V. villosa Roth: I (6,30,31), III-V (5,14,29,18); Th-TH, M; H2.5T3.5R2.5
537. Lathyrus aphaca L.: III-V (14,29,5,47,40); Th,M;H3T3R3
538. L. hirsutus L.: III-V (15,29,5,37,40); TH,Eua; H3T3.5R4
539. L. latifolius L.: III-V (14,29,5,25); H, M; H2T3.5R4
- var. rotundifolius (Willd.)Rchb.: V (14)
540. L. paluster L.: I (31), III, V (14,40); H, Cp; H5T0R4.5
541. L. pannonicus (Jacq.)Gaerce ssp. asphodeloides (Gouan)Bassler (L. versicolor Auct. non Beck): III-IV (14,6,4,42); H-G, Eua (C); H2T4R4.5
542. L. pratensia L.: I-V; H, Eua; H3.5T3R4
543. L. silvestris L.: II-V (14,40,!); H, E (M); H2.5T3R4
- var. oblongus Ser.: II-III (14)
- var. platyphyllus (Retz)Aschers.: V (40,14,43)
544. L. tuberosus L.: III-V (29,5,25,18,!); H (G), Eua (M); H2T4R4
545. Pisum sativum L. ssp. arvense (L.)Cel. (P. arvense L.): II-III (14); Th, E; H3T3R4

LYTHRACEAE
546. Peplis portula L.: I (14); Th, Atl-M; H4T3R0
547. Lythrum hyssopifolia L.: III-V (14,40); Th,Cosm; H4T3R0
548. L. salicaria L.: I-V; H-Hh, Cosm; H4T3R0
- f. glabrescens (Neilr)Todor: III (14)
549. L. virgatum L.: III-V (14,34,43,18,!); H-Hh, Eua (C); H4.5T3.5R4

ONAGRACEAE (OENOTHERACEAE)
550. Epilobium adenocaulon Hausskn.: II,IV (14); H, Adv; H4T3R3
551. E. angustifolium L. (Chamaenerion angustifolium (L.)Scop.): I-IV (30,22,29,5,!); H, Cp; H4T1.5R0
552. E. hirsutum L.: I (31,!), III-V (34,29,25,40,!); H (Hh), Eua (M); H4T3R3
553. E. montanum L.: II (22,!), IV (25,!), V (27,40); H, Eua (m); H3T0R3.5
554. E. palustre L.: I-II (23,12,!), IV (5); H, Cp; H5T0R2
655. E. parviflorum (Schreb.)Wither: III-IV (29,5,25,!); H, Eua; H5T3R4.5
556. E. tetragonum L. (E. adnatum Gris.) ssp. tetragonum: IV-V (14,25,40); H, Eua; H4.5T3R0
- ssp. lamyi (F.Schultz)Nym. (E. lamyi F. Schultz): IV-V (14,25,40); H, E; H0T3.5R0
557. E. x wiessenburgense E. Schultz (adnatum x parviflorum): V (40)
558. Oenothera biennis L.: III-V (14,5,25,18,!); Th, Adv; H2T4R0
559. Circaea lutetiana L.: II-V (29,24,40,!); G, Eua; H3.5T3R4

TRAPACEAE
560. Trapa natans L.: IV V (14,25,!); Hh, Eua (M); H6T4R4
- var. laevigata (Nath.)Gluck: V (40)
- var. conocarpa Aresch: V (38)

HALORAGACEAE
561. Myrophillum spicatum L.: III (14,38,29), V (38,40); Hh, Cp; H4T0R4.5

562. M. verticillatum L.: I11 (14,38,!), IV (5), V (38,40,!); Hh, Cp; H6T3.5R3.5
- f. pinnatifidum (Wallr.)Topa: V (40)

MALVACEAE
563. Hibiscus trionum L.: III-V (14,5,18,!); TH,Eua; H2.5T4R4
564. Abutilon theophrasti Medik.: III (42,14), V (14,40,!); Th, Eua; H3T3R3
565. Althaea officinalis L.: III-V (25,18,!); H, Eua (C); H3T4R4
566. Lavatera thuringiaca L.: III-V (29,5,25,40,!); H, Eua (C); H2.5T3R0
567. Malva neglecta Wallr.: II-V (29,5,18,40,!); Th-TH, Eua (M); H3T3R3
568. M. pusilla Sm.: III-V (9,5,18,!); Th-H, Eua (m); H3.5T3R3
- f. glabrescens Morariu: III (14)
569. M. silvestris L.: III-V (5,29,25,18,!); Th-H, Eua (Cosm); H3T3R0
- var. hispidula Beck: III (14)

TILIACEAE
570. Tilia cordata Mill.: I-IV (23,22,29,5,25,!); MPh, E; H3T3R3
571. T. platyphyllos Scop.: IV V (5,25,24,!); MPh, Ec; H2.5T3R4
572. T tomentosa Mnch.: IV (14,25,!); MPh, B; H2.5T3.5R3

LINACEAE
573. Linum catharticum L.: I-IV (6,31,12,33,5,25,!); Th (TH), E(M);H3T2R4
574. L. flavum L.: III-IV (29,5); H, P-Pn-B; H2T4R4
- var. angustifolium J v.: I (14)
575. L. perenne L.: IV (5,14); H, Eua (C); H0T3.5R4

OXALIDACEAE
576. Oxalis acetosella L.: II (22,!); H-G, Cp; H4T3R3
577. O. europaea Jord. (O. stricta Auct. non L.): II-III, V (14,!);Th-H, Adv; H3.5T0R0

GERANIACEAE
578. Geranium columbinum L. : IV (5,25); Th, Eua; H2T3.5R4
579. G. divaricatum Ehrh.: I, IV (14); Th, Eua (M); H2.5T3R4
580. G. palustre Torn.: I (23,30,!), III (29,14); H, Eua (C); H4T3R4.5
581. G. phaeum L.: II-IV (22,15,5,!); H, Ec; H4T3R3
582. G. pratense L.: I-V; H, Eua; H3.5T3R5
583. G. pusillum Burm.: IV-V (5,18,!); Th, E (M); H2.5T3R0
584. G. robertianum L.: II (!), IV-V (5,25,40,!); Th, Cosm; H3.5T3R3
585. G. rotundifolium L.: IV (14,5,!); Th, Eua (M); H2T3.5R4
- var. trichospermum Sanio et Bob.: IV (14,25)
586. Erodium cicutarium (L.)L'Hérit: IV-V (5,18,!); Th, Cosm; H2.5T0R0

BALSAMINACEAE
587. Impatiens glandulifera Royle (I. roylei Walp.): I, IV (14); Th, Adv; H4T4R4
588. I. noli-tangere L.: II-IV (29,25,!); Th, Eua; H4T3R4

ZYGOPHYLLACEAE

589. Tribulus terrestris L.: IV V (14,5); Th, Cosm; H0T4R4
- var. orientalis (Kern.)Beck: V (14,40)

POLYGALACEAE

590. Polygala amara L.: I (14); H (Ch), E; H0T2R4.5
591. P. comosa Schkuhr.: I (6,32), II (34); H (Ch), Eua; H2T4R4
592. P. vulgaris L.: I (14,6,!), III-V (29,5,!); H (Ch), Eua; H3T3R3
- f. rosulata (Fries)Hegi: I (14)
- f. major (Koch)Hegi: I (14)

ACERACEAE

593. Acer campestre L.: III-V (15,29,6,25,24,!); MPh-mPh, E; H2.5T3R3
594. A. platanoides L.: II-III (14,22,29); MPh, Eua; H3T3R3
595. A. tataricum L.: III-V (14,5,40,25;!); mPh-MPh, E (C); H2.5T3.5R4

CELASTRACEAE

596. Evonymus europaeus L.: I (30,23), III-V (5,27,18,!); mPh, E; H3T3R3
- f. angustifolia (Schultz)Borza: V (14)
597. E. nana M.B.: I (23,14); mPh, Eua (C); H0T3R3.5
598. E. verrucosus Scop.: II-IV (22,9,5,!); mPh, E; H2.5T3R4

STAPHYLEACEAE

599. Staphylea pinnata L.: III-V (14,5,25,24,!); mPh, E(M); H2.5T3.5R4

RHAMNACEAE

600. Frangula alnus Mill. : I (23,31,!), IV V (25,24,40); mPh, Eua; H4T3R3
601. Rhamnus catharticus L.: IV V (5,27,40); mPh,Eua; H2T3R4

VITACEAE

602. Vitis silvestris Gmel.: V (14,24,40,!); mPh-Ep, P-M; H3.5T4.5R4.5

CORNACEAE

603. Cornus mas L.: IV V (25,24,27,!); mPh, P-M; H2T3.5R4
604. C. sanguinea L.: III-V (29,5,24,40,!); mPh, Ec; H3T3R4

ARALIACEAE

605. Hedera helix L.: III-IV (29,5,!); nPh-Ep, Atl-M; H3T3R3

APIACEAE (UMBELLIFERAE)

606. Sanicula europaea L.: II (22,!); H, Atl-M; H3.5T3R4
607. Eryngium campestre L.: III-IV (29,5,25,!); H,P; H1T5R4
608. E. planum L.: III-V (14,5,40,!); H, Eua (C); H2T3R4
- f. subglobulosum (Uechter.)Schube: IV (43)

609. Chaerophyllum aromaticum L.: I-II (14,22,!); H, Ec (C); H3.5T3R3
- var. longipilum Thell.: II (14)
- f. cinerascens Borb.: I (14)
- var. brevipilium Murbeck f. tomentellum Todor: I (14)
610. C. bulbosum L.: III-IV (29,5,!); TH-H, E (C); H4T3.5R4.5
- f. tenuissimum (Vel.)Jav : III (14)
611. C. hirsutum L. (C.cicutaria Vill.): I-III (31,14,29,!); H, Ec; H4.5T2R0
612. C. temulum L.: III-V (29,14,25,24); Th-TH, E; H3T3R4
613. Anthriscus caucalis M.B. (A. scandicina (Web.)Mansf): IV-V (5,15,40); Th, P-M; H2T4R0
614. A. cerefolium (L.)Hoffm. ssp. trichosperma (Spreng.)Arc. (A. trichosperma Spreng.): IV-V (5,18,!); Th,M; H2.5T4R4
615. A. silvestris (L.)Hoffm.: II-V (22,29,14,5,24,!); H, Eua (M); H3T3R4
- f. glabrescens (Schur)Todor: III-IV (14)
616. Turgenia latifolia (L.)Hoffm. (Caucalis latifolia L.): IV V(14,40); Th, Eua (M); H2.5T4R0
617. Caucalis platycarpos L. (C. lappula (Web.)Grande): III-V (29,6,40); Th, Ec-M; H2T4R5
- var. muricata (Bisch.)Gren. et Godr.: IV-V (14,25,5,18)
618. Torilis arvensis (Huds.)Link: IV-V (14,40); Th, Ec-M; H2.5T3.5R4
- var. aglochis (Simk.)Jav : V (14)
619. T. japonica (Houtt.)DC. (T. rubella Mnch.): III-V (29,5,40); Th-TH,Eua; H3T3.5R4.5
620. Daucus carota L.: I-V; TH-H, Eua (M); H2.5T3R0
621. Bifora radians M.B.: III-IV (14,29,!); Th, M; H3T4R0
622. Conium maculatum L.: III-V (29,5,25,18,!); Th-TH, M; H3T3R3
623. Pleurospermum austriacum (L.)Hoffm.: I (14); H, Ec; H3T2R4
624. Bupleurum falcatum L.: I-IV (14,22,5,!); H, Eua; H2T3.5R4
625. B. tenuissimum L.: IV V (14,27,18); Th, Atl-M; H0T3.5R4.5
626. Cicuta virosa L.: I-V; Hh,Eua; H5T0R3
627. Trinia ramosissima (Fisch et Trev)Koch (T. kitaibelli M.B.): IV V (5,27,40); H, B-P; H2.5T3.5R4
628. Carum carvi L.: I-V; TH, Eua; H3.5T3R3
629. Aegopodium podagraria L.: I-V; H (G), Eua; H3.5T3R3
630. Pimpinella major (L.)Huds.: I (14,!); H, E; H3.5T0R4
- var. rubra (Hoppe et Schleich.)Fiori et Paol.: I (14)
631. P. saxifraga L.: I-V; H, Eua; H2.5T0R3
- var. ovata Spreng. f. pubescens (Mert. et Koch)Ny r : III, V(14)
632. Berula erecta (Huds.)Caville (Sium erectum Huds.): III (!); Hh, Cp; H6T3.5R0
633. Sium latifolium L.: III-V (14,40,!); Hh, Eua; H6T0R4
634. S. sisaroideum DC. (S. lancifolium M.B.): IV-V (14,43,25,40);Hh, Eua (C) H5T3R4
635. Seseli annuum L.: I (34), IV (5); Th (th,H), E (C); H2T3R3
636. S. libanotis (L.)Koch (Libanotis montana Cr.): II-IV (14,22,5.!); H, Eua (C); H3T0R4
- var. sibirica (L.)Patze, Mey et Eik.: II (14)
637. Oenante aquatica (L.)Poir.: I-V; Hh,Eua; H6T3R0

638. O. banatica Heuff.: I (14), III-V (14,25,27,!); H, D-B-Pn; H4T3.5R0
639. O. fistulosa L.: III-IV (14,29); Hh, E; H5T4R4
640. O. silaifolia M.B.: I (6,31); IV-V (14,6,40); H, M; H5T3.5R0
641. Aethusa cynapium L.: III-V (14,29,5,40,!); Th-TH, E; H3.5T3R0
- ssp. cynapioides (M.B.)Nym.: III (14)
- ssp. agrestis (Wallr.)Dost.: V (14,40)
642. Cnidium dubium (Schkuhr)Thell.: I (23,32,14,!); TH (H), Eua; H4.5T4R3.5
643. Selinum carvifolia L.: I (6,23,14,!), IV (14,25); H, Eua; H3.5T3R3
644. Angelica palustris (Bess.)Hoffm.: I (14); H, Eua (C); H5T2.5R0
646. A. silvestris L.: I-V; H, Eua; H4T3R3
- var. vulgaris Fisch f. stipulazis (Schur)Thell.: III (14)
646. Peucedanum alsaticum L.: IV-V (14,6,40); H, Ec; H2T3.5R4
- f. angustifolium Erdn.: V (14)
647. P. carvifolia Vill. (P. chabraei (Jacq.)Rchb.): IV (14,25,!); H, Ec; H3T3R4
648. P. officinale L.: III (29), V (14,27); H,E; H2T3R3
649. P. oreoselinum (L.)Mnch.: II-IV (22,29,5,!); H, Ec-M; H2.5T3R0
650. P. palustre (L.)Munch.: I (14,23); H, Eua; H5T3R0
651. Pastinaca sativa L.: II-V (34,29,5,!); TH-H, Eua; H3T4R4
652. Heracleum sphondylium L.: II-IV (22,14,5,25,!); H, Eua; H3T2.5R0
- ssp. sphondylium var. branca-ursina (Cr.)Thell.: III-IV (14,25)
653. Laserpitium latifolium L.: I-II (14,22,!), IV (5); H, E; H0T0R4
- var. asperum (Cr.)Soy-Will.: I (14)
654. L. ruthenicum L.: I (14,23); H, Ec; H4T3.5R4
- var. hirtum Wallr.: I (14)

PLUMBAGINACEAE

655. Limonium gmelini (Willd.)O. Ktze. (Statice gmelini Willd.): III-V (14,29,34,18,!); H, Eua (C); H3.5T4R4

PRIMULACEAE

656. Lysimachia nummularia L.: I-V; Ch,E; H4T3R0
657. L. punctata L.: III-V (29,25,40); H, P-M; H3.5T3.5R3
658. L. thyrsiflora L.: I-II (14,23,31); Hh, Cp; H5T0R0
659. L. vulgaris L.: I-V; H-Hh, Eua; H5T0R0
660. Angallis arvensis L.: III-V (5,18,25,!); Th,Cosm; H3T3R0
661. A. foemina Mill.(A. coerulea Schreb.): IV V (5,18,40,!); Th, Cosm; H3T3.5R0
662. Centunculus minimus L.: IV (14,5); Th, Eua; H4T3.5R3
663. Samolus valerandi L.: III (14); H, Eua; H4.5T3.5R0
664. Soldanella montana Willd.: II (14); H, Ec; H3.5T2R1.5
665. Androsace elongata L.: V (14,40); Th, Eua; H2T3.5R4
666. Hottonia palustris L.: II-III (14,38); Hh, E; H6T3.5R3
667. Primula acaulis (L.)Gruib.: IV (14,25); H, Atl-M; H3T3R3
668. P. veris L. (P. officinalis (L.)Hill.): II-IV (22,29,25,!); H, Eua; H3T2R5

PYROLACEAE
669. Pyrola rotundifolia L.:I (14,23,6), IV (14); H, Cp; H3T0R2.5
670. Monotropa hypopitys L.: III (14,29) V (14,40); G, Cp; H3T2R0

ERICACEAE
671. Vaccinium myrtillus L.: I (!); nPh (Ch), Cp; H0T2R1
672. V. vitis-idaea L.: I (6,!); Ch (nPh), Cp; H3T2R1

CONVOLVULACEAE
673. Calystegia sepium (L.)R.Br : II-V (12,29,5,25,18,!); H, Eua; H4T3R4
674. Convolvulus arvensis L.: II-V (29,5,18,!); H-G,Cosm; H0T0R0

CUSCUTACEAE
675. Cuscuta campestris Yuncker ssp. pentagona (Engelm.) (C. pentagona Engelm.): IV-V (14,40); Th,Adv ; H3T3R0
676. C. epithymum (L.) Murr : I-II (14), IV-V (5,40,!); Th, Eua; H0T3R0
677. C. europaea L.: IV V (14,5,40); Th,Eua; H4T0R0
- var. nefrens Fries: IV (14)
678. C. epilinum Weihe: III-IV (14); Th, Eua; H0T4R0
679. C. lupuliformis Krock: IV V (14,43,40,!); Th,Eua (C);H0T3R0
680. C. trifolii Babigt.: II-V (14,40,!); Th, Eua ; H0T3R0
- var angustissima (Engelm.)Buia f. longisquama Buia: II-III (14)
- var. muresensis Buia: III (14)

POLEMONIACEAE
681. Polemonium caeruleum L.: I-II (14,23,32); H, Cp; H4T2.5R4.5

HELIOTROPIACEAE
682. Heliotropium europaeum L.: III-V (14,5,47,40); Th, Ec-M; H2T4R0
683. H. supinum L.: V (40); Th, M; H0T4R4.5

BORAGINACEAE
684. Cerinthe minor L.: III-V (29,5,33,46,18); TH, P-M; H3T3R0
685. Lithospermum arvense L.: III-V (15,5,18); Th-TH, Eua; H0T0R4
- var. caerulescena DC.: III (14)
686. L. officinale L.: IV V (5,18); H, Eua; H2T3.5R4
687. L. purpureo-caeruleum L.: IV (5,25,!); H-G, Ec (M); H2.5T4R4.5
688. Onosma arenarium W et K: IV V (14,40); H, E (C); H1.5T3.5R4
689. Echium vulgare L.: II-V (22,29,5,18,!); Th, Eua; H2T3R4
690. Myosotis arvensis (L.)Hill.: III-V (29,5,18,40); TH,Eua; H3T3R4
691. M. caespitosa K.F.Schultz: V (40); Th-TH (H), Cp; H4.5T0R0
692. M. alpestris F.W. Schmidt ssp. stenophylla (Knaf.)Grint. et Ny r. (M. stenophylla Knaf.): II (14); H, Ec; H1.5T1.5R3

693. M. scorpioides L. (M. palustris (L)Nathh.): I-V; H,Hh, Eua; H5T3R0
- var memor Kitt. : I (14), V (14,25)
694. M. silvatica (Ehrh.)Hoffm.: II-IV (22,29,5,25); H, Eua; H3.5T3R3
695. M. sparsiflora Mikan: V (18,40); Th, Eua (C); H3.5T3R4
696. Pulmonaria mollis Wulfen (P. montana Lej.): IV (25); H, Eua; H2.5T3R4
- ssp. mollissima (Kern.)Nym.: IV (25), V (40)
697. P. officinalis L.: III-V (14,29,6,40,!); H, E; H3.5T3R3
698. P. rubra Schott: I-II (14,22,!); H, Carp-B; H3.5T2R3
699. Symphytum cordatum W et K.: II (14,22,!); H-G, Carp-B; H3.5T2R3
700. S. officinale L.: I-V; H, Eua; H4T3R0
- ssp. uliginosum (Kern.)Nym.: IV (14)
701. S. tuberosum L.: IV (5,25); H-G, Ec;H3T3R3
702. Anchusa officinalis L.: II-V (22,29,5,25,18,!); TH-H, E(M); H2T3.5R0
- var. arvalis Dum.: II, V(14)
703. Cynoglossum officinale L.: IV V (5,18,40); TH, Eua (C); H2T3R4

SOLANACEAE
704. Atropa belladonna L.: II (22); H, Atl-M; H3T3R3
705. Scopolia carniolica Jacq.: II (14,22); G,E; H4T3R5
706. Hyoscyamus niger L.: III-V (29,5,18,14,!); TH-H, Eua(M); H3T3.5R4
- f. pallidus (W et K.)Rchb.: IV (14)
707. Physalis alkekengi L.: III-V (29,5,40,!); H, Ec-M; H3T3R4
708. Solanum alatum Mnch.: IV V (14,40); Th, Eua (M); H3T4R3
709. S. dulcamara L.: I-V ; Ch (nPh), Eua (M); H4.5T3R4
710. S. luteum Mill.: IV (14); Th, Eua (M); H3T3.5R4
711. S. nigrum L.: III-V(29,5,25,18,!); Th, Cosm; H3T4R0
712. Datura stramonium L.: III-V (15,29,6,25,18,!); Th, Cosm; H3T4R4

SCROPHULARIACEAE
713. Verbascum blattaria L.: III-V (34,29,5,25,18,!); H, Eua (M); H2.5T3.5R4
714. V. densiflorum Bertnl. (V. thapsiforme Schrad.): IV V (14,5); TH, E (M); H2.5T3.5R4.5
715. V. lychnitis L.: II-V (22,29,40,18,!); Th, E; H1T3R5
- ssp. kanitzianum (Simk. et Walz.)So¢: II (14)
716. V. nigrum L.: III-V (29,25,27,40,!); TH-H, Eua; H2T3R4
717. V. phlomoides L.: III-V (6,25,18,!); TH, E; H2.5T3.5R4
- f. australe (Schrad.)Ghisa: III-V (14)
718. V. phoeniceum L.: III-V (4,29,5,25,18,!); H, Eua (C); H2T4R4
719. V. x schottianum Schrad. (chaixii ssp. austriacum x speciosum): I (14)
720. Linaria angustissima (Lois.)Borb.: IV-V (14,5,40); H,M; H1T3.5R5
721. L. genistifolia (1.)Mill. ssp. genistifolia: III-V (14,6,25,40,!); H, Eua (C); H1T3.5R5
- var. procera Sims.: IV-V (14,40)
- var. angustata Wierzb.: V (40)
722. L. x kocianovichii Aschers. (genistifolia x vulgaris): IV V (14,25,40)

723. L. vulgaris Mill.: II-V (22,34,29,5,18,!); H (TH), Eua; H2T3R4
- var. glabra Peterm.: IV V (5,40)
724. Kickxia elatine (L.)Dumort: III (42), V(40); Th, Ec (M); H2.5T3.5R4
725. Scrophularia laciniata W et K. ssp. lasiocaulis (Schur)Borza: IV (14); H, Carp-B; H2T3.5R0
726. S. nodosa L.: I (30), III-V (29,5,24,!); H, Eua; H3.5T3R0
727. S. scopolii Hoppe: I (30,!); IV V (25,40,!); H, P-m; H4T3R0
728. Gratiola officinalis L.: IV V (25,18,40,!); H, Eua; H4.5T3R4
729. Limosella aquatica L.: V (14,40); Th, Cosm; H4.5T3R0
730. Lindernia procumbens (Krocker)Philcox (L. pyxidaria All.): V (14,40); Th, Eua (m); H4.5T4R0
731. Veronica acinifolia L.: IV V (14,40); Th,M; H4T3.5R0
732. V. anagallis-aquatica L.: I (31,!), III-V (5,40,18,!); H-Hh, Cp; H5TOR4
- f. limosa Krosche: V (14)
- f. maxima (Schur)J. Kell.: III(14)
- f. tenerrima (Schm.)Vhal.: V (14)
733. V. anagalloides Guss.: IV-V (14,40,47); H-Hh, Eua; H4.5T0R4
734. V. agrestis L.: III-IV (29,5); Th, E; H3.5T2.5R4
735. V. arvensis L.: III-V (15,29,5,18,47); Th, Eua; H2.5T3R3
736. V. beccabunga L.: II-V (29,14,40,!); Hh-H, Eua; H5T3R4
- var. limosa (Lej.)Math.: IV-V (14,40);
737. V. catenata Pennel (V. aquatica Bernh.): III (14); H-Hh, Cp; H5T3R4.5
738. V. chamaedrys L.: I-V; H-Ch, Eua; H3T0R0
739. V. hederifolia L.: IV-V (5,40,47,!); Th, Eua; H2.5T3R4
740. V. longifolia L.: I (14,23,!), V(18,40,!); H, Eua; H4T3R4
- f. media (Schrad.)Koch: I,III (14)
- f. salicifolia (Wallr.)Hay : V (14)
741. V. officinalis L.: II-IV (22,29,6,25,!); Ch, Eua; H2T2R2
742. V. opaca Fries.: IV-V (5,40); Th, E; H2.5T3R4.5
743. V. paniculata L. (V. spuria L.): IV-V (43,18); H, Eua; H0T3R4
744. V. persica Poir.: IV-V (5,40,!); Th, Adv; H3T0R4
745. V. polita Fries (V. didyma Auct.): IV-V (47,40); Th, Eua (M); H2.5T3.5R4.5
746. V. praecox All.: IV-V (14,5,25,40); Th, EC-M; H1.5T3.5R3
747. V. prostrata L.: III (33), V (18,40,!); Ch, Eua; H2T4R3
748. V. scutellata L.: I (14,31,!), III (14), IV (14,5); H-Hh, Cp; H4T3R4
749. V. serpyllifolia L.: I-V; H, Cosm; H3T3R0
750. V. spicata: III (34,29); H-Ch, Eua; H1T4R4
- var. lancifolia Koch: V (40)
- ssp. orchidea (Cr.)Celak.: II-V (34,33,40,!); H, P-M; H1.5T5R4
- f. pseudocrassifolia Borb.: IV (14,25)
751. V. triphyllos L.: IV V (25,50); Th, E; H2T3.5R2
752. Digitalis grandiflora Mill.: II-IV (22,29,25,!); H, E; H3T3R3
753. Odontites serotina (Lam.)Rchb.: I-V; Th, Eua; H3T3R0
754. Euphrasia rostkoviana Hayne: I (14,!), III (29,!); Th,Ec; H3T3R3

- var. montana (Jord.)Wettst.: I (14,42)
755. E. stricta Host.: I (6,23,!), IV (25); Th, Ec; H3T3R0
756. Pedicularis palustris L.: I (23,!), IV (14,5); H, Eua; H5T0R0
757. P. sceptrum-carolinum L.: I (23,31,!); H, Eua; H4.5T2.5R4.5
758. Rhinanthus angustifolius Gmel. (R. glaber Lam.): I-II (22,!); Th, Eua; H0T0R0
- var. bosnensis Behr. et Stern: I (14)
759. R. minor L.: I-IV (14,40); Th, D-B-Anat; H3T4R0
760. R. rumelicus Velen.: IV-V (14,40); Th, D-B-Anat; H3T4R0
- var. simonkaianus (Soó) Nyár.: IV-V (14,40)
761. Melampyrum barbatum W. et K.: III-V (14,29,40); Th, Pn-D; H2.5T3.5R4
- var. filarszkyanum (Soó)Pauca et Nyár.: V (14)
762. M. bihariense Kern.: I (32), III-IV (29,14); Th, D-B; H2.5T3R3
- var. kummerlei (Dahl.)Nyár.: I (14)
763. M. cristatum L.: I (6,30,!), III-V (29,14,5,25,!); Th, Eua; H2T3R4.5
- var. ronnigeri (Poev)Beauv.: I, IV-V (14,40)

LENTIBULARIACEAE
764. Pinguicula vulgaris L. : I (6,23); H, Cp; H3T0R4
765. Utricularia australis R.Br. (U. neglecta Lehm.): II,III (14); Hh,Atl-M; H6T3.5R3
766. U. vulgaris L.: I (31,14), II (14), III (14,!), IV (5,38), V (14,40,!); Hh, Cp; H6T0R3.5

OROBANCHACEAE
767. Orobanche lutea Baumg.: II-IV (14,5); G, Eua (M); H2T3R4
- var. buekiana Koch: IV (14,25)
- f. collecta Beck: IV (14,25)
768. O. picridis F.W. Schultz: II,IV (14); G, Ec-M; H2T3R0
769. O. ramosa L.: IV-V (5,40,!); Th (G), Ec-M; H3T4R0
770. O. vulgaris Poir. (O. caryophyllacea Sm.): II-V (14,40,!); G, Ec-M; H4T4R0
- var. incurvata Beck f. brevispicata Beck: IV (25)

VERBENACEAE
771. Verbena officinalis L.: III-V (29,5,18,!); Th-H, Cosm; H3T3R4
772. V. supina L.: V (40,!); Th, P-M; H4T4R0

LAMIACEAE (LABIATAE)
773. Ajuga genevensis L.: I-IV (32,22,29,5,25,!); H, Eua (C); H2.5T3R4
774. A. reptans L.: I (30,23,!), III-V (29,25,40,!); H-Ch, E; H3.5T0R0
775. Teucrium chamaedrys L.: II-IV (22,29,5,25,!); Ch, Ec-M; H2T3.5R4
776. Scutellaria galericulata L.: I (23,31,!), III-V (14,5,25,40,!); H, Cp; H4T3R4
777. S. hastifolia L.: III-V (29,14,5,18,!); H, Ec; H5T3R3
778. Marrubium peregrinum L.: IV-V (14,5,40); H, Eua (M);H2T4R0
779. M. x remotum Kit. (peregrinum x vulgare): IV-V (14,5,40)
780. M. vulgare L.: III-V (14,5,25,18,!); H (Ch), Eua (M); H1.5T4R4
781. Nepeta cataria L.: III-V (14,29,40); H (Ch), Eua (M); H3T3R4

782. N. pannonica L.: II-IV (22,29,14,!); H-Ch, Eua (C); H2T3R0
783. Glechoma hederacea L.: I-V; Eua; H3.5T3R0
- ssp. hirsuta (W. et K.) F. Hermann (G. hirsuta W et K.): IV-V(25,24,40,!); H-Ch, P-M; H2.5T3R4
784. Prunella grandiflora (L.)Jacq.: I (6), IV (5,!); H, E (M); H3T3R4.5
785. P. vulgaris L.: I-V; H, Cp; H3T3R0
786. Lamium amplexicaule L.: IV-V (5,18,!); Th, Eua (M); H2.5T3.5R0
787. L. album L.: I-V; H, Eua; H3T3R0
788. L. galeobdolon (L.)Nathh. (Galeobdolon luteum Huds.): II-IV (29,5,!); H (Ch), Ec; H3T0R4
789. L. maculatum L.: II-IV (22,5,25,!); H (Ch), E; H3.5T0R4
790. L. purpureum L.: III-V (29,5,25,18,40,!); Th (H), Eua; H3T0R4
791. Galeopsis ladanum L.: III-V (15,29,5,40,!); Th, Eua; H2T0R4.5
792. G. pubescens Bess.: I (23), IV (14,25); Th, Ec; H3T3R0
793. G. speciosa Mill.: I-V; Th, Eua (C); H3T2R0
794. G. tetrahit L.: I (23,!), III-IV (29,5,25,!); Th, Eua; H3T3R0
- var. sylvestris Schlecht: I (14)
795. Chaiturus marrubiastrum (L.)Rechb.: IV-V (5,25,40,!); Th-TH, Eua (C); H4T3R0
796. Leonurus cardiaca L.: III-V (14,5,25,18,!); H, Eua; H3T4R4.5
797. Ballota nigra L.: I-V; H (Ch), Ec-M; H2T3.5R4
798. Stachys alpina L.: I (14); H, Ec; H3T2R0
799. S. annua (L.)L.: III-V (29,6,18,!); Th,M; H3T3.5R4.5
800. S. palustris L.: I (23!), IV-V (5,43,18,!); H (G), Cp; H4T3R4
801. S. recta L.: III-V (14,29,5,33,18,1); H, P-m; H2T4R4.5
802. S. sylvatica L.: III-V (29,5,25,24,40,!); H, Eua; H3.5T0R0
803. Betonica officinalis L.: I-V ; H, Eua (M); H3T3R0
804. Salvia austriaca Jacq.: III-V (33,6,18,!); H, P-Pn; H2T3.5R4
805. S. glutinosa L.: II (22,!); H, Eua; H3.5T4R3
806. S. nemorosa L.: III-V (29,5,25,40,!); H, Ec; H2.5T4R3
807. S. pratensis L.: III-V (15,5,33,40,!); H, E(M); H2.5T3R4.5
808. S. x sylvestris L. (nemorosa x pratensis): III (14), V (14,40)
809. Melissa officinalis L.: IV-V (14,40); H,M; H2T4R0
810. Calamintha acinos (L.)Clairv.: II (22,!); IV (5,25,!); Th-TH, E(M); H1.5T3.5R4
811. C. clinopodium Spenn. (C. vulgaris (L.)Druce): IV-V (25,5,24,!); H, Cp; H2T3R3
812. C. sylvatica Bromf.: IV-V (14,27,25,!); H, Ec-M; H2.5T3.5R5
813. Origanum vulgare L.: II-IV (29,25,!); H, Eua (M); H2.5T3R3
814. Thymus glabrescens Willd.: II-IV (14,25); Ch,P-Pn; H2T4R0
815. T. pannonicus All. (T. marschallianus Wild.): II-V (22,14,40,5,!); Ch, Eua (C); H1.5T3.5R4
816. T. pullegioides L.: I-IV 932,6,25,!); Ch,Ec; H2.5T3R3
817. Lycopus europaeus L.: I-V (23,31,12,34,5,24,!); Hh, Eua; H5T3R0
818. L. exaltatus L. f.: V (24,40,!); Hh, Eua (C); H5T3R0
819. Mentha aquatica L.: I (31,!), IV (6,43,!); Hh-H, Eua; H5T3R0
- var. riparia (Schreb.)Gusul.: III (14), V (14,40)

820. M. arvensis L. ssp. arvensis: I (30,!), IV (5), V 940,!); H-G, Cp; H4T3R0
- var. foliicoma (Op.)Top: III, V (14)
- var. varians (Host)Top: I (14)
- var. pascuorum Top: V (40)
- ssp. austriaca (Jacq.)Top var. austriaca: V (14,40)
- var. hostii (Bor.)Top: IV (14)
- var. politzensis Top: V (14)
- var. cuneifolia Lej. et Court.: V (40)
821. M. x dalmatica Tausch (arvensis x longifolia): V (40)
- var. skofitziana (A.Kern.)Briq.: IV-V (14,40)
822. M. longifolia (L.)Nathh. ssp. longifolia: I-V; H (G), Eua (M); H4.5T3R0
- var. ensidens Briq.: V (40)
- var. barthiana (Borb.)Top: IV-V (14)
- var. balsamiflora (H.Br.)Top: V (40)
- ssp. mollissima (Borkh.)Dom.: V (40)
- var. brassoensis Top: III (14)
- var. eclytanthea Top: IV (14)
- var. hollosyana (Borb.)Top: III (14), V (14,40)
- var. ischnostachya Top: IV (14)
- var. leioneura (Borb.)Top: III-V (14,40)
- var. marisensis (Simk.)Top: V (40)
- var. paramecophyllon Top: III (14), V (40)
- ssp. incana (Willd.)Gusul. var. macilenta Briq.: V (14,40)
- var. planitiensis Top: V (14,40)
- var. retinervis (Borb.)Gusul.: IV (14)
- var. wierzbickiana (Op.)Briq.: III (14), V (40)
- var. viridescens (Borb.)Gusul.: III, IV (14)
823. M. pulegium L.: I-V; H, Eua (M); H4T3R5
824. M. verticillata L.: I (32); H, E; H4.5T0R0
- var. calaminthaefolia (Host.)Top: III (14)
- var. ovatifolia Top: III (14), V (14,40)
- var. serotina (Host.)Top: I (23)

PLANTAGINACEAE

825. Plantago altissima L.: III (14); H, B-Pn; H4T3R4
826. P. argentea Chaix.: III-IV (14,29,25); H, M; H1.5T4.5R4
827. P. lanceolata L.: I-V; H, Eua; H0T0R0
828. P. major L.: I-V; H, Eua; H3T0R0
829. P. media L.: I-V; H, Eua; H2.5T0R4.5
830. P. maritima L.: III (14), V (18); H, Eua; H4T0R5
831. P. schwarzenbergiana Schur: III (14); H, Pn-D; H3.5T4R5

GENTIANACEAE

832. Menyanthes trifoliata L.: I-III (14,23,32,!); Hh, Cp; H5T5R5

833. Nymphoides peltata (S.G.Gmel.)O.Ktze.: V (!); Hh,Eua (M); H6T3R4
834. Centaurium erythraea Rafn. (C. umbellatum Gilib.): III-V (34,29,5,40,!); Th, Eua; H3T3R2
835. C. littorale (D. Turner)Gilmour ssp. uliginosum (W. et K.)Rothm. (C. uliginosum (W. et K.)Beck): III (14,); Th-TH, Eua; H4T3R4.5
836. C. pulchellum (Sw.)Druce: I (14), III-V (14,40,25,!); Th, Eua; H4T3.5R4
837. Gentiana asclepiadea L.: I-IV (6,23,29,14,!); H, Ec; H4T2R4
- f. cruciata Wartm. et Schlatt. : I (32)
838. G. pneumonanthe L.: I (23,32,!), III (14,29). IV (14); H, Eua (M) ; H4T3R0

VINCACEAE
839. Vinca minor L.: III-V (14,5,29,25); Ch, Ec-M; H3T3R3

ASCLEPIADACAE
840. Cynanchum vincetoxicum (L.)Pers.: II-V (22,29,5,25,24,40,!); H, E (M); H2T4R4

OLEACEAE
841. Fraxinus angustifolia Vahl.: V (24,!); MPh, P-Pn; H4,5T4R4.5
842. F. excelsior L.: II (22,!), III (29), V (24,27,!); MPh, E; H3T3R4
843. F. ornus L.: IV (14,5,25); mPh-MPh, M; H1,5T3.5R5
844. Ligustrum vulgare L.: III-V (29,5,25,24,!); mPh, E (M); H2.5T3R3

RUBIACEAE
845. Sherardia arvensis L.: IV-V (14,5,25,40); Th, Eua; H3T3R3
846. Asperula arvensis L.: III (14), IV (14,25): Th, M; H2T4R4
847. A. campanulata Klokov (A. glauca (L.)Bess.): II-IV (14,22,29,5,25,!); H, P-M; H2T4R4
- f. hirsuta (Wallr.)Borza: III (14)
848. A. cynanchica L.:11 (!), IV-V (5,40,!); H, P-M; H2T3.5R4.5
849. A. odorata L.: II-IV (22,29,25,!); G, Eua; H3T3R3
850. A. rivalis Sibth. et Sm.: I (14,23), III-IV (14); H, Eua; H5T3R3
851. Galium aparine L.: I-V; H Eua; H3T3R3
852. G. boreale L.: I-III (14,6,29,!); H, Eua; H4T2R4
853. G. mollugo L. ssp. mollugo: III-V (29,5,18,!); H, Eua; H3T0R3
- ssp. erectum (Huds.)Briq. var. erectum: I (14),11 (14,22,!),III, V (14)
- f. deminutum (Nyár.)Borza: III (14)
854. G. palustre L.: I-II (23,22,!), V (27,40,!); H, Cp; H5T3R0
855. G. schultesii Vest.: IV V (5,25,24,!); G, Ec; H2.5T3R3
856. G. rubioides L.: III-V (14,5,40); H, Ec; H4T3R4
857. G. tricornutum Dandy: III-V (14,5,25,40); Th, Eua (M); H2.5T3.5R0
858. G. uliginosum L.: I (6,23,14,!), IV (14); H, Eua; H4.5T3R4
859. G. verum L.: I-IV (6,22,34,29,25,!): H, Eua; H2.5T2.5R0
860. Cruciata glabra (L.)Ehrend. (Galium vernum Auct.): I-V; H, Eua; H3T2R2

861. C. laevipes Opiz (Galium cruciata (L.)Scop.): I-IV; H, Eua; H2.5T3R3

CAPRIFOLIACEAE
862. Sambucus ebulus L.: III-V (29,5,18,!); H, Eua (M); H3T3R4.5
863. S. nigra L.: III-V (15,5,25,24,!); mPh-MPh, E; H3T3R3
864. S. racemosa L.: I (!), II (22,!); mPh, Eua; H3T2R3
865. Viburnum lantana L.: II-IV (22,6,25,!); mPh, Ec-M; H2.5T3R4.5
866. V. opulus L.: I-V; mPh, Cp; H4T3R4
867. Lonicera nigra L.: I (23,30,!); mPh, E; H3T2R3
868. L. xylosteum L.: III-IV (29,5,!); mPh, Eua; H3T3R4

VALERIANACEAE
869. Valerianella locusta (L.)Betcke: III-V (14,29,47); Th, Ec-M; H3T3.5R4
- f. dasycarpa (Rchb.)Borza: V (40)
871. Valeriana officinalis L.: I-V; H, Eua (M); H4T3R4
- f. altissima
872. V. simplicifolia (Rchb.)Kabath: I (6,32,!); H, Ec; H5T2R2
873. V. tripteris L.: II (22,!); H, Ec; H3T0R4.5

DIPSACACEAE
874. Cephalaria pillosa (L.)Gren. (Dipsacus pilosus L.): IV-V (14,25,40,!); TH, Atl-M; H4T3.5R4
875. Dipsacus laciniatus L.: III-V (29,40,!); Th,Eua (C); H4T3.5R4
876. Succisa pratensis Mnch.: I (6,32,!), III-IV (14,29); H, Eua; H4T3R0
877. Succisella inflexa (Kluk)G. Beck: IV V (14,40); H, Ec; H4T3R0
878. Knautia arvensis Coult. ssp. arvensis: I (32,!), III (29), IV (5,25,!); H, E; H2.5T3R0
- var. polymorpha (Schm.)Szabó f. pratensis (Schm.)Szabó: I (14),II (22),V (14)
- f. jasionea (Borb.)Szabó: V (14)
- var. kitaibeli (Svhult.)Szabó: V (40)
- ssp. rosea (Baumg.)Borb. (K. dumetorum Heuff.): IV (5,!); H,D-B; H2T4R3
- f. heterotoma (Borb.)Szabó: IV (14)
- f. nitidula (Simk.)Szabó: IV (14)
- f. rosea (Baumg.)Szabó: IV (14)
879. Scabiosa banatica W. et K.: I (14), III (14), IV (14,25); H, D-B;H2T2.5R4
880. S. ochroleuca L.: I (6), III-V (34,5,18,!); H, Eua (C); H2T4R4

CUCURBITACEAE
881. Bryonia alba L.: III-V (29,5,40,!); H-G, Eua (C); H3.5T4R0
882. B. dioica Jacq.: IV (14,5,25); H, E; H3.5T3R5
883. Echinocystis lobata (Mchx.)Torr. et Gray (E. echinata (Muhlb.)Britt., Stern et Pogg.) II-V (25,!); Th, Adv; H4T0R4
884. Sicyos angulata L.: IV (14); Th, Adv; H4.5T3R4

CAMPANULACEAE

885. Campanula abietina Gris. et Sch.: II (14); TH, Carp-B; H3.5T2R2
886. C. cervicaria L.: I (6); H, Eua (C); H2.5T3R3
887. C. glomerata L.: I (6), III-V (29,5,25,40); H, Eua; H2.5T3R4
- f. ramosa Nyár.: III(14)
888. C. latifolia L.: III-IV (29,14); H, Eua; H3T0R3
889. C. patula L.: I-IV (6,22,29,5,25,40,!); TH, E; H3T2.5R3
- f. flaccida (Wallr.)Nyár.: IV (43)
890. C. persicifolia L.: II (!), III-IV (29,5,!); H, Eua (M); H3T3R0
891. C. rapunculoides L.: I (!), II (22,!), IV (5,!); H, Eua; H3T2R0
892. C. serrata (Kit.)Hendrych (C. napuligera Schur): I (14); H, C-B; H0T2.5R0
893. C. trachelium L.: II (22), IV (5), V (24,!); H, Eua (M); H3T3R3
894. Adenophora liliifolia (L.)Bess.: I (23,14); H, Eua (C); H0T4R4
- f. stylosa (Lam.)Jav : I (42)
895. Phyteuma tetramerum Schur: I (14); H, Carp (End); H3T3.5R3

ASTERACEAE
896. Eupatorium cannabinum L.: II-V (29,5,25,40,!); H, Eua (M); H4T3R0
897. Solidago canadensis L.: III-V (14,!); H, Adv; H3.5T3R3
898. S. gigantea Ait. (S. serotina Ait.): IV-V (14,40,25); H, Adv; H3.5T3R3
899. S. virgaurea L. ssp. virgaurea: II-IV (29,!); H, Cp; H2.5T3R3
- var. latifolia Koch f. cylindrica Ny r.: IV (43)
900. Bellis perennis L.: IV-V (5,25,40,!); H, E (M); H3T2.5R0
901. Aster amellus L.: III-IV (14,25); H, Eua (C); H2T3R4
902. A. punctatus W. et K. ssp. punctatus (A. sedifolius L.): III-V (29,14,27,25,40,!); H, Eua (C); H4T3R2
- var. squamosus (Lallem.)Morariu et Nyár.: V (14,40)
903. A. tripolium L. ssp. tripolium: III (29,34,!); H, Eua (M); H5T0R5
- ssp. pannonicus (Jacq.)Soó: V (45,!);
904. Erigeron acris L. ssp. acris: I-IV (14,6,22,5,!); Th-H, Cp; H2.5T3R0
905. E. annuus (L.)Pers. (Stenactis annua (L.)Nees) ssp. annuus: II-V (14,5,18,!); Th, Adv; H4T0R4
- ssp. strigosus (Muhlbg.)Soó (Stenactis ramosa (Wallr.)Don.): III-V (25,43,18,!); Th, Adv; H3T3R0
906. E. canadensis L.: II-V (5,25,18,!); Th-TH, Adv; H2.5T0R0
907. Filago arvensis L.: III-V (29,5,25,40); Th, Eua (M); H2T3.5R0
908. F. germanica L.: III-V (14,25,40,!); Th, eua (M); H2T3R0
909. F. minima (J.E.Sm.)Pers. (F. montana L.): IV-V (14,5); Th, Eua; H2T3R4
910. Antennaria dioica (L.)Gaertn.: I-II (6,23,22,!); H-Ch, Cp; H3T1R2.5
911. Gnaphalium luteo-album L.: IV-V (43,14,40); Th, Cosm; H4T3.5R3
912. G. uliginosum L.: III (!), V (18,!); Th, Eua;H5T3R4
- var. nudum (Hoffm.)Koch-Hall. f. pilulare (Wahlbg.)Ny r.: V (40)
- var. strictum Nyár.: III (14)
913. Inula britannica L.: III-V (14,34,25,4,27,!); TH-H, Eua (M); H3T3R0

914. I. helenium L.: III-V (14,29,5,!); H,Adv; H4T3R3
915. I. hirta L.: I (6,!), III-IV (14,29,5,!); H, Eua (C); H2T4R5
916. I. salicina L. ssp. salicina: I (6,!), III-V (14,29,25,!); H, Eua; H2.5T3R3
- var. glabra Beck: V (14)
- var. subhirta C.A.Mey: III (14), V (40)
917. Pulicaria dysenterica (L.)Gaertn.: IV-V (5,14,40,!); H, E (M); H4T3.5R0
918. P. vulgaris Gertn.: III-V (14,25,18,!); Th, Eua (M); H4T3R3
919. Carpesium cernuum L.: IV-V (14,25,24); Th, Eua (M); H3.5T3.5R5
920. Telekia speciosa (Schreb.)Baumg.: II (22,!), IV (25); H, C-B-Cauc; H4T2R0
921. Xanthium italicum Moretti: IV-V (14,25,43,40,!); Th, Adv; H3.5T4R0
922. X. spinosum L.: III-V (29,5,18,!); Th, Adv; H2.5T4R3
923. X. strumarium L.: III-V (14,29,18,!); Th, Eua; H3.5T3.5R4
924. Helianthus decapetalus L.: III-IV (14,!); H, Adv; H3.5T3R4
925. Rudbeckia laciniata L.: III (14); H, Adv; H4.5T4R4
926. Bidens cernua L.: III-V (29,40,!); Th,Eua; H5T0R0
927. B. tripartita L.: II-V (22,5,27,18,!); Th,Eua; H4.5T3R0
- f. dumosa Nyár.: V (14)
928. Galinsoga parviflora Cav.: III-V (40,!); Th, Adv; H3.5T0R3
929. Anthemis arvensis L.: I-V; Th, E (M); H3T3R0
930. A. austriaca Jacq.: III (42), V (47,40); Th, Eua (C); H2T4R4.5
931. A. cotula L.: V (18,40); Th, Cosm; H2.5T4R0
932. A. macrantha Heuff : IV (14) ; H, Carp-B; H3.5T2R4
933. A. ruthenica M.B.: III-IV (14,5); Th, E (C); H2T4R4
934. A. tinctoria L.: II (22,!), IV (25); H, Eua; H1.5T3R3
- ssp. tinctoria f. monocephala Jka.: IV (14)
- ssp. fussii (Gris.)Beldie: II (14); H, Carp-B; H2T2R3
935. Achillea collina Becker: II-V (22,33,5,25,47,!); H, Ec; H2T3R3
936. A. chritmifolia W. et K.: IV-V (5,14,25,27); H, B-Pn; H2.5T4R0
937. A. distans W. et K. ssp. distans: I (6,32,!), II (22,!); H, Ec; H2.5T3R4
- ssp. stricta (Schleich.)Janch. (A. stricta Schleich.): I-II (14); H, Alp-B; H2.5T2R3
938. A. x girgioensis Ny r. (impatiens x ptarmica): I (14,23,!);
- f. serrata Nyár.: I (14)
- f. incisa Nyár.: I (14)
939. A. impatiens L.: I (14,6,23); H, Eua (C); H4.5T2.5R2.5
940. A. x maxima (Heuff.)Prod. (distans x millefolium): I (14,42)
941. A. millefolium L.: I-V ; H, Eua; H3T0R0
942. A. ptarmica L.: I (14,23,6,!), IV (14); H, Eua; H4.5T0R2.5
943. A. setacea W. et K.: I (!), IV-V (25,40,!); H, Eua (C); H2T3R5
944. Matricaria chamomilla L.: III-V (29,5,18,!); Th, Eua (M); H3T3R0
945. M. matricarioides (Less.)Porter: I-III (14,!); Th, Adv; H3T0R0
946. Tripleurospermum inodorum (L.)Schultz-Bip. (Matricaria inodora L.): III-V (6,18,47,!); Th-TH, Eua; H0T3R3.5
947. Chrysanthemum corymbosum L.: II-V (14,22,29,5,25,!); H, Eua (M); H2.5T2.5R3
- ssp. clusii (Fischer)Heywod: I (14)

948. C. leucanthemum L. ssp. leucanthemum: I-V; H, Eua; H3T0R0
- var. lanceolatum (pers.)Beck f. lanceolatum: I (!), IV (43)
- var. auriculatum (Peterm.)Nyár. f. pinnatifidum (Lec. et Lam.) Jav.: I (14)
- f. ramosum Nyár.: I (14)
- f. silvestre (Pers.)Nyár.: I (14)
- f. praestans (Burm.)Nyár.: III (14)
- f. aequidentatum Nyár.: V (14)
- f. ramulosum Nyár.: II, IV (14)
949. C. serotinum L.: IV-V (14); H, P-Pn; H4T4R0
950. Tanacetum vulgare L. (Chrysanthemum vulgare (L.)Bernh.): II-V (29,27,40,!); H, Eua; H3T3R0
951. Artemisia absinthium L.: II-V (22,5,25,40,!); Ch-H, Eua (M); H2T3.5R0
952. A. annua L.: III-V (25,43,!); Th, Eua; H3T4R4
953. A. maritima L. ssp. salina (Willd.)Gams: III (14), V (!); Ch (H), Eua (C); H2.5T3R0
- ssp. monogyna (W. et K.)Gams: III (14)
954. A. pontica L.: V (27,40,!); H (Ch), Eua (C); H2.5T4R4.5
955. A. scoparia W. et K.: IV-V (14,25); H, Eua (C); H3T3R0
956. A. vulgaris L.: II-V (22,34,18,!); H-Ch, Cp; H3T3R4
957. Tussilago farfara L.: II-V (22,29,5,40,!); G-H, Eua; H3.5T0R4.5
958. Petasites albus (L.)Gartn.: II-III (22,29,!); G (H), Eua; H3.5T0R0
959. P. x celakovskyi Matuschek (albus x kablikianus): II (14,22)
960. P. hybridus (L.)G.M.Sch.: II-IV (22,29,5,!); G (H), Eua; H5T3R3
961. P. x intercedens Matuschek (hybridus x kablikianus): II (14)
962. P. kablikianus Tausch.: II (22,!); G (H), Carp-B; H4T0R0
963. P. x rechingeri Hay. (albus x hybridus): II (14)
964. Homogyne alpina (L.)Cass.: I (23); H, E; H3.5T2.5R2.5
965. Doronicum austriacum Jacq.: I-II (23,22,!); H, Ec; H3.5T2R3
966. D. hungaricum (Sadl.)Rchb. f.: III-IV (14,29); G (H), Ec-B; H2T3R4
967. Senecio barbaraeifolius (Krock.)Wimm. et Grab.: III (14), IV V (14,40); H, Ec; H3.5T3.5R4.5
- f. foliosus Nyár.: III (14), IV (43)
968. S. doria Nath.: III-V (14,18,!); H, Eua (C); H3T0R3.5
- ssp. schwetzovii (Korsch)Nyár.: III-V (14,5,40)
969. S. erucifolius L.: IV-V (14); H, Eua; H3T3.5R4.5
- var. tenuifolius (Jacq.)DC.: IV (14,5)
970. S. fluviatilis Wallr.: I (23,!), III-IV (14); H, Eua (C); H5T4R4
971. S. jacobea L.: I (6,!), III-V (29,5,40,!); H, Eua; H2.5T3R3
972. S. nemorensis L. ssp. nemorensis: I (!); H, Eua; H3.5T3R3
- var. germanicus (Wallr.)Beck f. jacquinianus (Rchb.)Weiss:1 (14)
- ssp. fuchsii (Gmel.)Celak. (S. fuchsii Gmel.): I (30,!)
973. S. paludosus L.: I (14,31,23,!), V (14,18,!); H, Eua; H4.5T3.5R0
- var. glabratus Koch: V (40)
- var. tomentosus (Host.)Koch: V (40)
974. S. papposus (Rchb.)Less.: I (14,32), IV (14); H, Carp-B; H3T2R2.5

- var. sulphureus (Baumg.)Cuf.: I (14)
- var. integerrimus (Schur)Cuf.: I (14)
- f. wolffii (Schur)Cuf.: I (42)
- var. heuffelii (Jav.)Cuf.: IV (14)
975. S. sylvaticus L.: IV-V (14); Th, E; H3T3R3
976. S. vernalis W. et K.: III-V (14,40,!); Th-TH, Eua (C); H2.5T4R0
977. S. viscosus L.: IV (14); TH, E (M); H2T3.5R2.5
978. S. vulgaris L.: III-V (29,25,18,!); Th-TH, Eua; H3T0R0
979. Ligularia sibirica (L.)Cass.: I (14,23,32,!); H, Eua; H4T2R3.5
- f. araneosa (DC.)E.Pop: I (23,!);
980. Echinops commutatus Jur.: III-V (14,5,!); H, Alp-Carp-B; H2T0R4
981. E. sphaerocephalus L.: III-V (14,29,5,43,40,!); H, Eua (C); H2T4R4.5
982. Xeranthemum annuum L.: III-V (29,5,25,40); Th, P-M; H2T4R3
983. X. foetidum Munch.: V (14,!); Th, P-M; H1.5T4R3
984. Carlina vulgaris L.: II-IV (14,29,5,!); TH-H, Eua (M); H2.5T3R0
985. Arctium x ambiguum (Cel.)Nym. (lappa x tomentosum): IV (14)
986. A. lappa L.: II-V (5,18,!); TH, Eua (M); H3T3R4
987. A. minus (Hill.)Bernh.: II (14), V (40); TH, E; H3T3R4.5
- var. involucratum Nyár.: III (14)
988. A. x nothum (Ruhm.)Weiss (lappa x minus) f. subracemosum (Simk.) M th,: III-IV (14)
989. A. nemorosus Lej. (A. vulgare (Hill.)A.H.Evans): IV-V (14,25); TH, E; H3.5T3R0
990. A. tomentosum Mill.: IV-V (5,40,!); TH, Eua; H3T0R5
991. Carduus acanthoides L.: II-V (22,29,5,25,18,!); TH, E (M); H2T3R0
- var. albifrons Schur: IV (43)
992. C. candicans W. et K.: IV-V (14); H, B-Pn; H2T3R5
993. C. crispus L.: III-V (29,5,25,40,!); TH, E; H4T3R0
994. C. hamulosus Ehrh.: III-V (14,40); TH, P-Pn; H2T4R2
995. C. nutans L.: IV-V (5,18,!); TH-Th, Eua (M); H1.5T0R4.5
996. C. x orthocephalus Wallr. (acanthoides x nutans): V (14,40)
997. C. personata (L.)Jacq.: II, V(14); H, Ec; H4.5T2.5R4.5
998. Cirsium arvense (L.)Scop.: I-V; G, Eua (M); H0T0R0
999. C. brachycephalum Jur.: V (14,40); TH-H, Pn (End); H4T3R0
1000. C. canum (L.)All.: I-V; G, Eua (c); H4.5T3R4.5
- f. sagittatum Ny r.: III (14)
1001. C. erisithales (Jacq.)Scop.: I-II (6,32,!); H,Ec; H3T3R4.5
1002. C. x erucagineum DC. (oleraceum x rivulare): I (14)
1003. C. furiens Geis. et Sch.: III-IV (14,5,!); Th, Carp-Pn; H2T3.5R4
1004. C. oleraceum (L.)Scop.: I-II (30,22,!); H, Eua; H4T3R4
1005. C. palustre (L.)Scop.: I-II (30,22,6,23,!); TH, Eua (M); H4.5T3R2.5
- f. glomeratum Naeg.: I (14)
1006. C. x praealpinum Beck (erisithales x rivulare): II (14,42)
1007. C. rivulare (Jacq.)Link.: I-II (23,6,22,!); H, Ec; H4T3.5R0
1008. C. x subalpinum Gaud. (palustre x rivulare): I (14),

1009. C. x tataricum (L.)All. (canum x oleraceum): I (14)
1010. C. vulgare (Savi)Ten. (C. lanceolatum (L.)Scop.): III-V (34,5,25,18,!); TH, Eua; H3T3R0
1011. C. waldsteinii Rouy: II (14); H, Aip-Carp-B; H4T2R2
1012. Onopordon acanthium L.: III-V (29,5,18,!); TH, M; H2.5T4R4
1013. Serratula tinctoria L.: I (6,!), III-V (34,29,5,18,!); H, Eua (M);H3.5T3R0
- var. variifrons (Beck)Nyár : I, III (14)
1014. Centaurea x austriacoides Woloszcz (phrygia x jacea): I (14,42)
1015. C. x beckeriana J. Wagn. (jacea ssp. banatica x indurata): IV (14,25)
1016. C. x baumgarteniana J. Wagn. (indurata x pseudophrygia): I (14,42)
1017. C. x brasoviana (melanocalathia x pseudophrygia): I (14)
1018. C. calcitrapa L.: IV-V (14,5,40); TH-Th, Eua (M); H1.5T4R0
1019. C. cyanus L.: I (!), III-V (5,25,18,!); Th, Cosm; H3T4R0
1020. C. x erdneri J. Wagn. (phrygia x pseudophrygia): I-II (14(!)
1021. C. indurata Janka: I, III (!), IV V (40,!); H, D-Pn; H3T3R3
1022. C. jacea L.: I-II (!), III (14,34), IV-V (33,14,!); H, Eua; H3T0R0
- ssp. banatica (Roch.)Fiay (C. banatica Roch.): IV-V (14,5,40)
- f. fastigiata Prod.: V (14)
1023. C. x markiana J. Wagn. (jacea ssp. banatica x pseudophrygia): IV-V (14,25)
1024. C. melanocalathia Borb.: I-II (14,6); H, Ec; H3T2.5R0
1025. C. micranthos Gmel.: II-V (14,5,22,34,4,25,40,!); Th-H, Ec; H2T3.5R4
1026. C. nigrescens Willd.: III-V (14,25,40); H, Ec; H3.5T3R3
1027. C. x nyaradyana J. Wagn. (jacea x melanocalathia): I (14)
1028. C. x orodensis J. Wagn. (jacea ssp. banatica x nigrescens). V (14,40)
1029. C. phrygia L. (C. austriaca Willd.): I-V; H, Ec; H3T2.5R3
1030. C. pseudophrygia C.A.Mey : I-II (14,6,32); H, Ec; H3T0R3
1031. C. scabiosa L. ssp. scabiosa: I (14), V (18); H, Eua (M); H2.5T0R4
- f. silesiaca (Borb.)Soó: I (14)
- ssp. spinulosa (Roch.)Hay (C. spinulosa Roch.): IV-V (14,25);
1032. C. solstitialis L.: III-V (14,5,40,25,!); TH-Th, Eua (M); H2T4R0
1033. C. x spuria Kern. (jacea ssp. angustifolia x stenolepis): V (14)
1034. C. stoebe L. (C. rhenana Boreau): II-IV (14,!); TH-H, Ec (M); H2T3.5R4.5
1035. C. x szõllösii J. Wagn. (indurata x jacea ssp. angustifolia): III-V (14,26)
1036. Cichorium intybus L.: II-V (34,29,5,25,18,!); H-TH, Eua; H2.5T3.5R4.5
1037. Lapsana communis L.: IV-V (5,25,24,40,!);Th-TH, Eua (M); H2.5T3R3
1038. Hypochoeris maculata L.: I-III (6,32,29,22,!); H, Eua (C); H0T3.5R3.5
- f. leiophylla (Borb.)Nyár.: I (14)
- f. nitida Nyár.: I (14)
1039. H. radicata L.: III-IV (25,!); H, E; H3T3R2.5
1040. Leontodon autumnalis L.: I-V; H, Eua; H3T0R0
1041. L. hispidus L. ssp. hispidus: III-IV (33,5,25,!), I (6,!); H, Eua; H2.5T0R0
- f. denticulatus Csong.: III (14)
- f. lobatus Ny r.: III (14)
- f. variifrons Ny r.:III-IV (14)

- ssp. hastilis (L.)Rchb. (L. danubialis Jacq.): I (6,!), II (!), III(29), IV (25); H, Eua; H3T3R0
- f. integrifolius Csong.: I (14)
- f. sinuato-dentatus Csong.: I-II (14)

1042. L. saxatilis Lam. (L. nudicaulis (L.)Banks.): III (14,34); TH-H, Atl-M; H3T3R4

1043. Picris echioides L. (Helminthia echioides (L.)Gaertn.): V (14); TH-Th, Adv; H2.5T4.5R4

1044. P hieracioides L. ssp. hieraiocides: III-IV (29,5,25,!), V (18); TH-H, Eua; H1.5T3R4
- f. racemosa Nyár.: III (14)
- f. ruderalis (Schm.)Beck: III (14)

1045. Tragopogon dubius Scop.: III-IV (14,!); TH, P-M; H2.5T3.5R0
- var. campestris Bess. : IV (5)

1046. T. orientalis L.: II-V (22,33,5,40,!); TH-H, Eua; H3T3R4
- var. hayekii (So¢)Nyár.: III (14)

1047. Scorzonera hispanica L.: III-IV (14,29,25); H, Eua (M); H2T5R4

1048. S. parviflora Jacq.: III (14,34,!); V (!); TH-H, Eua (C); H4T3.5R4

1049. Podosperum canum C.A.Mey.: IV-V (14,40); H (TH), P-M; H2T4R4.5

1050. P. laciniatum (L.)DC.: III-V (14,5,18,!); Th (TH), Eua; H2T0R4
- var. muricatum (Baalb.)Bisch.: III (14)

1051. Chondrilla juncea L.: IV-V (5,25,40,!); H, Eua (C); H1.5T3.5R4
- var. latifolia (M.B.)Koch: V (40)

1052. Taraxacum bessarabicum (Hornem.)Hand.-Mazz.: III (34,!); V (14,40,!); H, Eua (C); H4T3R4

1053. T. officinale Weber: I-V; H, Eua (Cosm); H3T0R0

1054. T. serotinum (W. et K.)Poir.: IV-V (14,18); H, P-Pn; H2T4R4.5

1055. Mycelis muralis (L.)Dum.: III-V (29,24,25); H, E; H3T3R0

1056. Lactuca x dichotoma Simk. (saligna x serriola): V (14,40)

1057. L. quercina L. ssp. quercina: III-IV (14,29,25); TH, Ec; H2.5T3.5R4
- ssp. sagittata (W. et Kc)Celak. (L. chaixii Auct.): III-IV(14,5,25); TH, P-Pn; H2T3.5R4

1058. L. saligna L.: IV-V (5,25,18,!); Th-TH, M; H1.5T4R4
- f. runcinata (Gren. et Godr.)Beger: V (40)

1059. L. serriola Torner: III-V (25,18,!); Th-TH, Eua(M); H1.5T3.5R0
- var. integrata Gren. et Godr.: V (40)

1060. Sonchus arvensis L.: III-V (5,25,!); H, Eua (Cosm); H3T3R4

1061. S. asper (L.)Hil1.:III-V (5,25,18); Th, Eua; H3.5T3R4
- f. glandulosus Beckh.: III (14)

1062. S. oleraceus (L.)Gou.: II-V (29,25,18,!); Th, Eua; H2.5T3R4.5
- var. laceratus (Willd.)Wallr.: V (14,40)

1063. S. palustris L.: I (14), III (14,29); H, Eua; H4.5T3.5R4

1064. Crepis biennis L.: I-V; TH, E; H3T3R4
- var. lacera Wimm. et Grab. f. banatica (Roch.)Ny r.: V (40)

1065. C. foetida L. ssp. foetida: IV (26); Th, Eau; H2T3.5R3
- ssp. rhoeadifolia (M.B.)Fiori et Paol. (C. rhoeadifolia M.B.): IV-V (5,40,18,!); Th, Eua; H2.5T3.5R3

1066. C. paludosa (L.)Mnch.: I (31), II (12); H, E; H4.5T0R4.5
1067. C. praemorsa (L.)Tausch: I (14), III (14,29), IV (14,25); H, Eua;H2T3.5R5
1068. C. setosa Hall.: V (18); Th, Atl-M; H2T3R3
1069. C. tectorum L.: III-V (29,40,!); Th, Eua (C); H2.5T0R0
1070. Hieracium x atramentarius N.P. (aurantiacum x piloselloides)
- var. atramentarius: I (14)
- f. csikense Nyár.: I (14)
- var. hypochoerifolius Nyár.: I (14)
1071. H. aurantiacum L. ssp. aurantiacum: I-II (6,31,23,22,!); H, Eua; H2.5T2.5R2
- var. aurantiacum f. brevipilum (N.P.)Nyár.: I (14)
- f. longipilum (N.P)Nyár.: II (14)
- ssp. carpathicola Naeg. et Peter: II (14)
- var. subkajanense (Zahn)Nyár.: I (14)
- f. longifolium Nyár. et Zahn: I (14)
- f. ramosum Nyár.: I (14)
1072. H. auricula Lam. et DC.: I-IV (22,34,29,25,!); H, E; H3T0R3
- var. acutisquamum (N.P)Nyár.: II (14)
- var. lampreilema (N.P)Nyár.: I, III (14)
- f. astolonum Nyár.: I (14)
- f. perlongum Nyár.: I (14)
- var. melaneilema (N.P)Nyár. f. subpilosum (N.P)Ny r.: III (14)
- var. amaureilema (N.P.)Nyár.: I (14)
- var. magnauricula (N.P)Nyár.: I (14)
1073. H. x auriculoides L ng (bauhini x echioides): V (18,40)
- var. paniculosum Nyár.: III (14)
- f. flagellatum Nyár.: III (14)
- var. gyergyoense Nyár.: I (14)
- var. flexiramum (N.P.)Nyár.: I (14)
- var. tanythrix (N.P)Nyár.: I (14)
- var. sarmentosum (Froel.)Nyár.: III (14)
- var. parvicapitulum (N.P)Nyár.: III (14)
- var. semipraecox (Zahn)Nyár.: III (14)
- var. mirum (N.P.)Nyár.: III (14)
1074. H. bauhini Besser: I-V; H, Eua (C); H1.5T3R3.5
- ssp. cryptomastix (N.P)Nyár. var. gemmiferum (N.P)Ny á.:IV (14)
- ssp. aerostolonum Zahn var. bükkense Nyár.: III (14)
- var. pseudosparsum (Zahn)Nyár.: I (14)
- ssp. magyaricum (N.P.)Nyár. var. magyaricum: III (14)
- f. pilosum N.P : III (14)
- var. besserianum (Spreng.)Nyár.: I (14)
- f. calvius N.P : I (14)
- var. nigrisetum (N.P)Nyár.: I (14)
- var. pseudoauriculoides (N.P)Nyár. : III (14)
- var. filiferum (Tausch)Nyár.: I, IV (14)

- var. heothinum (N.P)Nyár. : I (14)
- ssp. bauhini var. adenocladum (Rehm.)Nyár.: I (14)
- var. ingricum (N.P.)Nyár.: I, IV (14)
- var. melachaetum (Tausch)Nyár.: I (14)
1075. H. bifidum Kit.: I (14); H, Ec;H2.5T2R4.5
1076. H. x blyttianum Fr. (aurantiacum x auricula): I (14)
- var. sandui (Prod.)Nyár.: I (14)
- var. detonaticum (N.P)Ny r.: I (14)
1077. H. x brachiatum Bertol. (bauhini (vel piloselloides) x pilosella): II (14,22)
1078. H. caespitosum Dumort ssp. caespitosum: I (23), III (14), IV (5);H, Eua; H3T3R3
- var. silvicolum Nyár.: I, III (14)
1079. H. x cochleatum (N.P)Zahn (auricula x caespitosum): I (14)
1080. H. cymosum L.: III-IV (14,5,25); H, Eua (C); H2T3R4
- ssp. cymosum var. cymosum f. geotropum Borb.: III (14)
1081. H. x diaphanoides Lbg. (lachenalii x sylvaticum): I (14)
1082. H. echioides Lumn.: IV (25); H, Eua (C); H2T3.5R4
1083. H. x fuscum Vill. (aurantiacum x auricula): I (14)
1084. H. hoppeanum Schult.: I (14), III (34), IV (25); H, Ec-M; H3T0R2
- var. leucolepioides (Deg. et Zahn)Nyár.: IV (25)
1085. H. x koernickeanum N.P. (auricula x bauhini): I, IV (14)
- var. bauhiniforme Nyár.: I (14)
- var. kreuzenense (Durrnb. et Oborny)Nyár.: I, III (14)
- var. abortistolonum Nyár.: III (14)
- var. denigratum (N.P.)Nyár.: I (14)
- f. paucicapitatum Nyár.: I (14)
- var. auriculifolium Nyár.: I (14)
- f. acutum Ny r.: I (14)
1086. H. x levicaule Jord. (bifidum x lachenalii): I (14)
- var. psammogeton (Zahn)Nyár.: I (14)
- ssp. triviale (Norrl.)Nyár. var. serratilanceum (Zahn)Nyár.:I-II (14)
1087. H. laevigatum Willd. ssp. tridentatum (Fr.)Zahn: I (14); H, Eua; H3T3R2
1088. H. x leptophyton N.P. (bauhini x pilosella) var. leptophyton: I (14)
- f. stolonicaule Zahn: I (14)
1089. H. x longiscapum Boiss. et Ky. (auricula x caespitosum): I (14)
1090. H. x megatrichum Borb. (auriculoides x cymosum): I (14)
1091. H. x phaedrocheilon Zahn (lachenalii x pseudobifidum): I (14)
1092. H. pilosella L.: I-IV (32,22,29,5,25,!); H, Eua (M); H2.5T0R0
- var. tricholepium (N.P.)Nyár.: III (14)
- var. tomentisquamum (N.P.)Nyár.: IV (14)
1093. H. piloselloides Vill.: IV (14,25); H, E (M); H2.5T3.5R4
- var. devanum (Zahn)Nyár.: IV (14)
1094. H. x praecurrens Vukot (murorum x transsilvanicum): I (14)
- var. pseudopleiophylloides (Maly et Zahn)Nyár. f. palotae Ny r. et Zahn: I (14)

1095. H. racemosum W. et K.: I (6,!), IV (5,25); H, Ec-M; H2T3R3
1096. H. sabaudum L.: IV (14,25); H, E; H2.5T3.5R2.5
1097. H. x sulphureum Doll (auricula x piloselloides): I (14)
1098. H. sylvaticum (L.)Grufb. (H. murorum L.): IV (25); H, Eua; H3T0R3
1099. H. x schultesii F. Sch. (auricula x pilosella): II (14,22)
1100. H. transsilvanicum Heuf.: II (14); H, Carp-B; H3T0R0
1101. H. umbellatum L.: I (23), IV (25,!); H, Cp; H2.5T3R3

ALISMATACEAE
1102. Alisma gramineum Gmel.: I (31), V (14); Hh, Cp; H6T0R4.5
1103. A. lanceolatum Wither: I (14), III (34); Hh, Eua; H6T0R4
1104. A. plantago-aquatica L.: I (31,!), III (34,29,!), IV-V (5 ,18,!); Hh, Cosm; H6T0R0
1105. Sagittaria sagittifolia L.: III-V (14,43,25,40,!); Hh,Eua (M);H6T3R4

BUTOMACEAE
1106. Butomus umbellatus L.: III-V (29,5,18,!); Hh, Eua (M); H6T3R0

HYDROCHARITACEAE
1107. Hydrocharis morsus-ranae L.: II-V (14,29,38,!); Hh, Eua; H6T3.5R.3.5

JUNCAGINACEAE
1108. Triglochin maritima L.: II-IV (14,12,34,!); H, Cosm; H4T0R4
1109. T. palustris L.: I-IV (31,12,14,5,!); H, Cp; H5T0R0

POTAMOGETONACEAE
1110. Potamogeton acutifolius Link.: III (14,39); Hh, E; H6T3R4
1111. P. alpinus Balb.: I (14,23); Hh, Cp; H6T2.5R2.5
1112. P. crispus L.: II-V (38,29,5,40,!); Hh, Cosm; H6T3.5R4
- f. rotundifolius (Fisch)Topa: V (14,39)
- f. cornutus Topa: IV (14,39)
1113. P. x cymatodes A. et G. (crispus x perfoliatus): II (14)
1114. P. gramineus L.: I, V (14,39,!); Hh, Cp; H6T2.5R4
- var. lacustris Fr.: V (14,39)
- var. amphibius Fr.: V (14,39)
- var. myriophilus (A. et G.)Soó: V (40)
- ssp. heterophyllum Fr. : V (14,39,40)
- var. riparius Fr.: V (14,39)
- var. terrestris Fr.: V (14,39)
1115. P. lucens L.: III (14,38), V (14,40); Hh, Eua (M); H6T0R4
1116. P. natans L.: I-V; Hh, Cosm; H6T2.5R4
- var. prolixus Koch: III (38), V (40)
1117. P. nodosus Poir. (P. fluitans Roth): V (14,40); Hh, Cp; H6T3.5R4
1118. P. perfoliatus L.: II-III (14,22,39,!); Hh, Cosm; H6T0R4
1119. P. pusillus L.: I (38), III-V (14,29,38); Hh, Cosm; H6T3R4

- var. major Mert. et Koch: I (38)
- var. tenuissimus Mert. et Koch: I, V (14,39,40)
1120. P. trichoides Cham. et Schlecht.: I (14,23); Hh. Eua (M); H6T3R4
1121. Zannichellia palustris L.: III (14,29,38), V (39); Hh, Cosm; H6T0R4
- var. arcuata (Schur)Topa: III (14)

NAJADACEAE
1122. Najas minor All.: III-V (14,38,40); Hh, Eua; H6T4.5R4.5
- f. intermedia (Balb.)Ces.: III (14)

TYPHACEAE
1123. Typha angustifolia L.: I (23,!), III-V (29,5,18,!); Hh, Cosm; H6T4R0
- f. media Kronf.: III (14)
1124. T. latifolia L.: I-V; Hh, Cosm; H6T3.5R0
1125. T. laxmannii Lep.: V (!); Hh, Eua; H5T4R0

SPARGANIACEAE
1126. Sparganium emersum Rehman (S. simplex Huds.): I (14), III (14,29), IV (25); Hh, Eua; H6T3R3.5
1127. S. erectum L. ssp. erectum (S. ramosum Huds.): I (!), V (40,18,!); Hh, Eua; H5.5T3.5R0
1128. S. minimum Hill.: IV (14); Hh, Cp; H6T3R3

LILIACEAE
1129. Colchicum autumnale L.: I (31), III-IV (14,29,43,!); G, E-M; H3.5T3R4
1130. Veratrum album L.: I-IV (6,30,22,29,25,!); G, Eua; H4T2.5R4
- ssp. album f. semilobelianum Nyár.: I (14)
1131. Anthericum liliago L.: III-IV (14,29,5); G, Ec-M; H1.5T3.5R3
1132. A. ramosum L.: I (14), III-IV (14,29,25); G, Ec-M; H2.5T3.5R4
1133. Gagea lutea (L.)Ker.-Gawl.: III-V (14,25,24,40); G, Eua; H3.5T0R3
1134. G. minima (L.)Ker-Gawl.: III (14), IV (5), V (40); G, Eua (C);H3.5T3R4
1135. G. pratensis (Pers.)Dumort: III-V (14,25,18,40); G, Ec; H2T3R3
1136. G. villosa (M.B.)Duby (G. arvensis (pers.)Dumort): III-V (14,5,25,40); G, M; H2.5T4R0
1137. Allium angulosum L.: III (14); G, Eua (C); H4.5T0R4.5
1138. A. atropurpureum W. et K.: III-V (14,29,18); G, Pn-B; H2.5T3R4
1139. A. flavescens Bess. var. ammophilum (Heuff.)Zahariadi: III (34), IV (14); G, P-B; H1.5T4R4.5
1140. A. oleraceum L.: IV-V (14,25,40); G, Eua; H3T3R0
1141. A. scorodoprasum L.: IV-V (14,25,18,40); G, Ec-M; H2T3R4
1142. A. vineale L. : IV-V (14,40); G, Ec-M; H2T3R4
1143. Lilium bulbiferum L.: III (14,29); G, E (M): H3T2.5R3
1144. L. martagon L.: II-V (22,14,29,43,24,!); G, Eua; H3T0R4
1145. Fritillaria meleagris L.: I (31), II (14); G, E (M); H4T3.5R4

1146. F. montana Hoppe: I (14); V (14); G, B-Cauc; H3T3R4
1147. Scilla bifolia L.: III-V (29,5,40); G, E; H3.5T3R4
1148. S. autumnalis L.: V(!); G, M; H4T3R4.5
1149. Ornithogalum boucheanum (Kunth)Aschers.: III (14), V (40);G, P-B;H2.5T4R4
1150. O. kochii Parl. ssp. kochii: V (14,40); G, P-M; H2T4R4
1151. O. pyramidale L.: III (14), V (14,40); G, M; H2.5T4R4
1152. O. umbellatum L.: III (34), V (47,40); G, Ec-M; H0T3.5R4
1153. Muscari botryoides (L.)Mill.: I11-IV (14,29,25); G, Ec-M; H2.5T3.5R4
1154. M. comosus (L.)Mill.: III-IV (14,29,18); G, Ec-M; H1.5T3.5R0
1155. M. racemosus (L.)Mill.: III (14), V (14,18,40); G, Ec-M; H1.5T4R5
1156. M. tenuiflorum Tausch: III-V (14,25,5); G, P-Pn; H2T4R4
1157. Asparagus officinalis L.: III-V (14,29,5,18,!); G, Eua (M);H1.5T4.5R3
1158. Majanthemum bifolium (L.)F.W. Schm.: I (32!), III-IV (14,29,5); G, Eua; H3T3R0
1159. Polygonatum latifolium (Jacq.)Desf.: III-V (14,24,5,18,!); G, P-Pn-B; H3T3.5R4
1160. P. multiflorum (L.)All.: III-V (29,5,25,24); G, E; H3T3R3
1161. P. odoratum (Mill.)Druce: I (14,!), III-V (14,29,25,24,!); G, Eua (M); H2T3R4
1162. P. verticillatum (L.)All.: I-II (14,30,!); G, E; H3T2.5R2.5
1163. Streptopus amplexifolius (L.)DC.: I (23); G, Cp; H4T2R2
1164. Convallaria majalis L.: IV-V (25,5,24); G, E; H2.5T3R3
1165. Paris quadrifolia L.: I (23,30,!), IV-V (5,27); H, Eua; H3.5T0R4

AMARYLLIDACEAE

1166. Galanthus nivalis L.: IV-V (5,24); G, E (M); H3.5T3R4
1167. Leucojum aestivum L.: V (40); G, Atl.-M; H4.5T4R4

DIOSCOREACEAE

1168. Tamus communis L.: IV (14,25); G, Atl-M; H3T3.5R4

IRIDACEAE

1169. Gladiolus imbricatus L.: I (6,!), III (29); G, Eua (C); H4T3R3
1170. Crocus banaticus Gay.: II (14), IV (14,25); G, D-B; H3T3R0
1171. C. heuffelianus Herb.: II (22), V (24); G, Carp-B; H3T1R2
1172. Iris nyaradyana Prod.: II (14); G, E; H3T2.5R3
1173. I. pseudacorus L.: III-V (14,29,25,18,!); G-Hh, E; H5.5T0R0
1174. I. sibirica L.: III, V (14,40); G, Eua (C); H4.5T3R4.5
1175. I. spuria L.: III (14); G, Pn-D; H4T3.5R5
1176. I. variegata L.: II (22,!), III-V (14); G, P-Pn-B; H2T3.5R4

JUNCACEAE

1177. Juncus acutifolius Ehrh.: I (14); G, E; H4.5T3R2
1178. J. articulatus L.: I (31,!), III-V (34,5,18); H, Cp; H5T2R0
1179. J. atratus Krick.: I (14,32,6), III (14,34); H, Eua; H4T3R4
1180. J. bufonius L.: I (23,!), III-V (47,!); Th, Cosm; H4.5T0R3
1181. J. bulbosus L. var. uliginosus Fries: I (14); H, E; H4.5T2.5R0

1182. J. compressus Jacq.: I (23), IV-V (14,18); G, Eua; H4T3R4
1183. J. conglomeratus L.: I-V; H, Eua; H4.5T3R3
1184. J. effusus L.: I-V; H, Cosm; H4.5T3R3
1185. J. gerardi Lois.: I (32), III (34,14), V (14); G, Cp; H4.5T3R5
1186. J. inflexus L.: I-II (23,12!), V (18,40); H, Eua (M); H4T4R4
1187. J. subnodulosus Schrank.: IV (14); Hh, E; H4.5T3.5R0
1188. J. tenuis Willd.: I-III (14,23,22,!); H, Adv; H3.5T3R4
1189. J. thomassii Ten.: I (14); H, D-B; H4T2.5R3
1190. Luzula campestris (L.)Lam. et DC.: I (6,!), IV-V (14,5,25,!); H, E (M); H3T0R3
1191. L. luzuloides (Lam.)Dandy et Willmott: I (23), II(22,!), IV (14,25,!); H, E; H2.5T2.5R2
1192. L. multiflora (Ehrh.)Lej.: I (32); H, Cp; H3T2R2
1193. L. pallescens (Wahlbg.)Bess.: I (23); H, Eua; H3T2.5R3
1194. L. pilosa (L.)Willd.: II (14), IV (14,25); H, Eua; H2.5T2R0
1195. L. silvatica (Huds.)Gaud.: II (14); H, Ec; H3.5T2.5R2

CYPERACEAE

1196. Scirpus sylavticus L.: I-V; Hh-G, Cp; H4.5T3R0
1197. Eriophorum angustifolium Honckeny: I (23,6,!); G, Cp; H4.5T3R3
1198. E. latifolium Hoppe: I-II (6,23,22,!); H, Eua; H5T0R4.5
1199. Bolboschoenus maritimus (L.)Palla: III-V (34,25,18,!); Hh, Cosm; H6T0R4.5
- f. digynus (Godr.)Jav.: III-V (14,5)
1200. Schoenoplectus lacustris (L.)Palla: II (22), IV (5,25,!); Hh-G, Cosm; H6T3R4
1201. S. tabernaemontani (Gmel.)Palla: III-V (14,34,5,40,!); G (Hh), Eua; H5T3R4
1202. Eleocharis acicularis (L.)R.Br.: V (14,40,!); Th, Cp; H5.5T0R0
1203. E. carniolica Koch: I (31); Th, Alp-Carp-B; H5T0R5
1204. E. palustris (L.)R.Br.: I-V; G-Hh, Cosm; H5T0R4
1205. Cyperus fuscus L.: III-V (14,40,!); Th, Eua (M); H6T3R4
- var. virescens (Hoffm.)Vahl.: III-V (14,40)
1206. Blysmus compressus (L.)Panz.: I (14,23); G, Eua; H4.5T3R4.5
1207. Chlorocyperus glomeratus (Torn.)Palla: IV-V (14,40); Hh, Eua (M); H5T3R4
1208. C. glaber (L.)Palla: V (40); Th, Eua (M); H5T3R4.5
1209. Pycreus flavescens (L.)Rchb.: III-V (14,40,!); Th, Cosm; H6T3R4
1210. Dichostylis micheliana (L.)Nees: V (40); Th, Eua (M); H4.5T4R4
1211. Acorellus pannonicus (Jacq.)Palla: IV (14); Th, Eua (C); H4.5T3R5
1212. Carex acutiformis Ehrh.: I (31,!), IV (5,25); Hh, Eua (M); H6T3R4
1213. C. x alsatica Zahn (flava x oederi): II (14)
1214. C. atrata L.: I (6); H, Cp; H3T1.5R3.5
1215. C. buekii Wimm.: I (14); Hh, P-Pn; H5T3R0
1216. C. buxbaumi Waahlbg.: I, III(14,23,32); G, Cosm; H4.5T0R0
1217. C. brunnescens (Pers.)Poir : I (31); H, Cp; H4T1.5R2
1218. C. brizoidis Jusl.: IV-V (25,24); H-G, Ec; H3.5T3R2
1219. C. appropinquata Schumacher: I (31,14,23); Hh, Eua; H5T3R4
1220. C. caespitosa L.: I (14,30,31), II (12), III (14); Hh,Eua; H5T3R3

1221. C. canescens L.: I-II (14,31,!); H, Cp; H5T0R2
1222. C. caryophyllea Latour.: III-IV (29,5,33,25); G, Eua (M); H2T2.5R0
1223. C. davalliana Sm.: I (14,32); H, Ec; H3.5T2.5R3
1224. C. diandra Schrank.: I (14,31,32); G, Cp; H4T2R3
1225. C. digitata L.: IV (14,5,25); H, E; H3T3R3
1226. C. dioica L.: I (14,23); G, Cp; H4T2R0
1227. C. distans L.: I (23), III-IV (34,26,!); H, E; H4T3R4
1228. C. disticha Huds.: I (14,23); G-Hh, Eua; H5T3R4
1229. C. divisa Huds.: IV-V (14,5,40); G, Eua; H4T3.5R5
1230. C. divulsa Stokes.: IV-V (25,24); H, Eua; H2.5T3R0
1231. C. elongata L.: I (14,23); H, Eua; H5T2.5R4
1232. C. elata All.: I (14); Hh, E; H5T2.5R4
1233. C. flava L.: I-II (6,31,12,!); IV (5); H, Cp; H4.5T3R0
1234. C. gracilis Curtis: I-V; Hh-G, Eua; H5T3R0
1235. C. hirta L.: I-V; G, E (M); H0T3R0
1236. C. hordeistichos Vill.: III (14), V (40); H, Pn-P-M; H4T4R4
1237. C. lasiocarpa Ehrh.: III (14); Hh, Cp; H5T2.5R2.5
1238. C. lepidocarpa Tausch: I-II (14,23,12,6,!); H, E; H4.5T3R0
1239. C. leporina L.: I (6,23,31,!), V (27,40,!); H, Eua; H4T2.5R3
1240. C. melanostachya Willd.: V (18); Hh, Eua (C); H4T3R0
1241. C. michelii Host.: III-IV (14,34,25); G, Ec-P; H2T3R4
1242. C. nigra (L.)Reichard (C. fusca All.) ssp. nigra: I (31,23,6,!); G, Cp; H4T3R2
- ssp. juncella Fries.: I (31)
1243. C. pairaei F. Schultz: I, IV (14); H, Eua; H3T3R0
1244. C. pallescens L.: I (6,23,!), IV (25); H, Cp; H3.5T3R3
1245. C. panicea L.: I (14,6,32); H (G), Eua; H3.5T3R0
1246. C. paniculata Jusl.: I (31,32); Hh, Ec; H5T3R5
1247. C. pendula Huds.: I (31); H, Atl-M; H4T2R3
1248. C. pilosa Scop.: IV (25); H, Eua; H2.5T3R3
1249. C. praecox Schreb.:1V-V (5,18); G-H, Eua; H2T3R3
1250. C. pseudocyperus L.: I (31), III (14); Hh, Cp; H6T3.5R3.5
1251. C. remota Grufb.: V (14,40); H, E; H4.5T3R3
1252. C. riparia Curt.: I-II (31,22,!); V (18,40,!); Hh, Eua (M); H5T4R4
1253. C. rostrata Stokes.: I-II (14,23,23,!); Hh, CP; H5T2R0
1254. C. serotina Merat (C. oederi Auct.): II (14); H, Eua (M); H4.5T0R0
1255. C. spicata Huds.: II (40); H, Eua (M); H0T3R0
- var. nemorosa (Lumn.)Serb. et Nyár.: V (14)
1256. C. stellulata Good.: I (14,23,!); H, Cp; H5T2R1
1257. C. stenophylla Wahlbg.: IV V (14); G, Pn; H3T0R4.5
1258. C. sylvatica Huds.: IV V (5,25,40); H, E; H3.5T3R4
1259. C. x schatzii Kneucker (lepidocarpa x oederi): I (14)
1260. C. tomentosa L.: IV (25,40); G, Eua (M); H3T3R0
1261. C. x toezensis Simk. (melanostachya x riparia): V (14,40)
1262. C. umbrosa Host.: I (14); H, Ec; H3T3R3

1263. C. vesicaria L.: I (14,23,31,!), III-V (14,25,40,!); Hh, Cp; H6T3R4
1264. C. vulpina L.: I-V; Hh H, Eua (M); H4T3R4

POACEAE (GRAMINEAE)
1265. Botriochloa ischaemum (L.)Keng.: III-V (29,5,25,40,!); H, Eua (M); H1.5T5R3
1266. Digitaria ischaemum (Schreb.)Muhlbg.: V (14,40); Th, Cosm; H3T3.5R3
1267. D. sanguinalis (L.)Scop.: III-V (14,5,25,47,!); Th,Cosm; H1.5T0R4
1268. Setaria glauca (L.).P.Beauv.: III-V (18,47,!); Th, Cosm; H3T4R0
1269. S. verticillata (L.)P.Beauv.: III-V (14,5,25,18,!); Th, M; H2T4R0
1270. S. viridis (L.)P.Beauv.: III-V (5,25,18,47,!); Th, Eua; H2T3.5R0
1271. Echinochloa crus-galli (L.)P.Beauv.: III-V (25,27,18,!); TH, Cosm; H4T0R3
- f. oryzoides (Ard.)Fritsch: III (14), IV (43)
1272. Tragus racemosus (L.)All.: IV-V (14,40); TH, M; H0T0R4
1273. Anthoxanthum odoratum L.: I-V; H, Eua; H0T0R0
1274. Typhoides arundinacea (L.)Mnch. (Phalaris arundinacea L.): I-V; Hh-H, Cp; H5T3R0
1276. Leersia oryzoides (L.)Sw.: V (40); Hh, Cp; H5T3R0
- f. patens Wiesb.: III (14)
1276. Alopecurus aequalis Sobol.: IV (26); H, Cp; H5T3R5
1277. A. geniculatus L.: I (14,31), IV-V (14,5,43,18); H, E; H5T0R4
1278. A. myosuroides Huds.: III (14,29); Th, M; H3.5T3.5R4
1279. A. pratensis L.: I-V; H, Eua; H4T3R0
1280. Phleum montanum K. Koch: I (14), III-IV (14,6,25); H, Carp-B-Cauc-Anat; H1.5T4.5R4
1281. P. phleoides (L.)Karsten: I (6,!), III-IV (34,5,!); H, Eua; H2T3R4
1282. P. pratense L.: I-V; H, Eua (M); H3.5T0R0
1283. Crypsis aculeata (L.)Ait.: V (18,40); Th, Eua; H3.5T4R4
1284. Heleochloa alopecuroides (Piller et Mitterp.)Host.: V (!); Th, Eua; H0T4R4.5
- f. angustifolia Beck: V (40)
1285. H. schoenoides (L.)Host.: III (14), V (14,40); Th, Eua; H0T4R4.5
1286. Beckmannia eruciformis (L.)Host.: III (34), V (14,!); H, Cp; H4.5T3R4
1287. Cynodon dactylon (L.)Pers.: III-V (5,25,18,!); G (H), Cosm; H2T3.5R0
1288. Agrostis canina L.: I (31,!), IV-V (25,40); H, Eua; H3.5T3R3
- var. pudica Doll.: I (14)
1289. A. stolonifera L. ssp. stolonifera: I-V; H, Cp; H4T0R0
- ssp. gigantea (Roth)Beldie var. silvatica (Host.)Beldie: V (40)
1290. A. tenuis Sibth.: I-V; H, Cp; H0T0R0
1291. Apera spica-venti (L.)P. Beauv.: IV (5,25); TH, Eua; H3.5T0R2.5
1292. Calamagrostis arundinacea (L.)Roth: I (30); H (G), Eua; H2.5T3R2
1293. C. canescens (Web.)Druce: I (14,23,6); H, Eua; H5T3R3
1294. C. epigeios (L.)Roth: III-IV (34,25,5); H (G), Eua (M); H2T3R0
1295. C. neglecta (Ehrh.)Gaertn.: I (14,23,6,31); H, Cp; H4.5T2R3
- var. fallax Baner: I (14)
1296. C. pseudophragmites (Haller f.)Koeler: II (22), IV-V (25,40); H, Eua (C); H5T3R5

1297. C. villosa (Chaix) J.F.Gmel. var. gracilescens (Blytt.)A. et G.: I (14,23); H, Eua; H4T2.5R1.5
1298. Milium effusum L.: V (24); H, Cp; H3.5T3R3
1299. Stipa capillata L.: III-IV (4,5,25); H, Eua (C); H1T5R4
1300. S. pulcherrima K.Koch: III (4); H, Eua (M); H1T4R5
1301. Phragmites australis (Cav.)Trin. et Steud. (Ph. communis Trin.):I-V; Hh, Cosm; H5T0R4
- var. flavescens Custer: III-IV (14,40)
1302. Sesleria heufleriana Schur: IV (6); H, Cerp (End); H2T3.5R4.5
1303. Koeleria cristata (L.)Pers. (K. macrantha (Ldb.)J.A. et J.H. Schult): I-V; H, Cp; H2T4R5
1304. Melica nutans L.: I (30), IV (5); H-G, Eua (M); H3T0R4
1305. Holcus lanatus L.: I-V; H, Eua; H3.5T3R0
1306. Deschampsia caespitosa (L.)P.Beauv : I-V; H, Cosm; H4T0R0
1307. D. flexuosa (L.)Trin.: I-II (30,22,!); H, Cp; H2T0R1
1308. Arrhenatherum elatius (L.)J. et C. Presl.: II-V (22,28,25,5,40,!); H, E (M); H3T3R4
1309. Avena fatua L. ssp. fatua: III-V (14,40,!); Th, Eua (M);H3.5T0R4
- var. glabrata Peterm.: V (14)
1310. Helictotrichon pubescens (Huds.)Pilger: IV (14,5); H, Eua; H3.5T2.5R4
1311. H. alpinum (Smith)Heward: I (14), III-IV (14,5); H, Carp; H2T2R3
1312. H. pratense (L.)Pilger: I (14,6); H, Eua; H2.5T3R0
1313. Sieglingia decumbens (L.)Bernh.: I (6,!), III (34); H, E;H0T3R2
1314. Bromus arvensis L.: II-V (22,34,25,40,!); Th-TH, Eua (M); H2.5T3R0
1315. B. commutatus Schrad.: IV-V (5,25,18,40); Th, E; H0T3R0
1316. B. inermis Leyss.: III-V (34,5,25,40,!); H, Eua (C); H2.5T4R4
1317. B. japonicus Thunb.: I (!); Th, Eua (M); H1.5T3.5R4
- var. transsilvanicus (Auersw.)Hay : I (14), V (40)
- var. vestitus (Schrad.)Stapf.: V (40)
1318. B. mollis L.: II-V (22,5,18,47,!); Th, Eua; H0T3R0
- var. mollis f. nanus (Weig.)Nyár.: III (14)
- var. effusus Schur: III (14)
1319. B. ramosus Huds.: II (22); H, Ec; H3T3R3
1320. B. secalinus L.: I, III (14), V (40); Th, Eua (M); H0T0R0
- f. submuticus (Rchb.)Nyár.: III (14)
1321. B. sterilis L.: IV-V (25,18,!); Th, Eua (M); H2T4R4
1322. Cynosurus cristatus L.: I-V; H, E; H3T3R3
1323. Brachypodium silvaticum (Huds.)P.Beauv : III-V (25,40,!) H, Eua (M); H3T3R4
1324. Eragrostis chilianensis (All.)Link.: IV-V (14,6,40); Th,Eua;H2T4R4.5
1325. E. poioides P.Beauv.: V (18,47,!); Th, Cosm; H3T4R0
1326. Molinia coerulea (L.)Mnch. ssp. coerulea: I (6,31,!); H, Eua; H4T3R0
- ssp. arundinacea (Schrank.)Paul: I (14)
1327. Dactylis glomerata L.: I-V; H, Eua (M); H3T0R4
- var. pendula Dumort: III (14)
1328. Poa annua L.: I-V; Th-TH, Cosm; H3.5T0R0

1329. P. bulbosa L.: IV-V (25,18,47); G-H, Eua (C); H2T3.5R4
1330. P. compressa L.: II (22,!), IV (5,25); H, E; H1.5T3R0
1331. P. nemoralis L.: II-V (22,5,25,40,!); H, Eua; H3T3R0
1332. P. palustris L.: I (31,6,!), IV-V (25,40); H, Cp; H5T3R4
1333. P. pratensis L. ssp. pratensis: I-V; H, Cp; H3T0R0
- ssp. angustifolia (L.)Hay (P. angustifolia L.): II-IV (22,33,25); H, Eua; H2T3R0
- var. setacea (Hoffm.)Doll: I (14)
1334. P. stiriaca Fritsch et Hay: I (14); H, E; H1.5T2.5R4
1335. P. trivialis L.: I-V ; H, Eua; H4T0R0
1336. Briza media L.: I-V; H, Eua; H0T3R0
1337. Catabrosa aquatica (L.)P.Beauv.: I-II (22,!); H, Cp; H5T2.5R4
1338. Glyceria fluitans (L.)R.Br.: I-V; Hh-H, Cosm; H5T3R0
1339. G. maxima (Hartm.)Holmberg: I-V; Hh-H, Cp; H5T3R4
1340. G. nemoralis (Uechtr.)Uechtr. et Koern.: IV (14); Hh, Ec-Sarm;H5T3R3
1341. G. plicata Fries.: I-II (23,31,22,!); Hh, Eua; H6T3R4.5
1342. Puccinellia distans (L.)Parl.: III-V (34,5,!); H, Eua (C); H3.5T0R5
1343. P. limosa (Schur)Holmberg: III-IV (14); H, Eua (C); H3.5T0R5
1344. Vulpia myuros (L.)Gmel.: IV-V (14,25,27); Th, Eua (M); H1T3.5R2
1345. Festuca arundinacea Schreb.: II (22), V (40); H, Ec; H4T3R4
- var. mediteranea (Hack.)A. et G. f. baltica A. et G.: V (14);
- var. orientalis (Kern.)A. et G.: II (14)
1346. F. drymeia Mert. et Koch: II (14,22,!), IV (14,25,43); G-H, Carp-B; H4T2R3
1347. F gigantea (L.)Vill.: II (22), V (24,40); H, Eua; H4T3R2.5
- f. nemoralis A. et G.: IV (14,43)
1348. F. pratensis Huds.: I-V; H, Eua; H3.5T0R0
- var. subspicata (G.F.W. Meyer)A. et G.: II (14)
1349. F. pseudovina Hack.: III-V (34,5,!); H, Eua (C); H2T4R4
1350. F. rubra L.: I-V; H, Cp; H3T0R0
1351. F. rupicola Heuff. ssp. rupicola: II-V (22,33,5,25,40,!);H, Eua (C); H1.5T4R4
- var. rupicola f. hirsuta Host.: III (14), V (40)
- var. sulcataeformis Mgf-Dbg.: II (14)
1352. Pholiurus pannonicus (Host.)Trin.: V (14,40); Th, P-Pn-B; H0T4R4.5
1353. Lolium multiflorum Lam.: III-V (14,25,40); Th-TH, Adv (M);H2.5T4R0
1354. L. perenne L.: I-V; H, Eua (M); H2.5T4R4.5
- var. tenue (L.)Sm.: III (14)
1355. L. remotum Schrank.: I (14); Th, Adv; H2T3R4
1356. L. temulentum L.: IV (14,5); Th-TH, Adv; H2.5T4R4.5
1357. Hordelymus europaeus (L.)Jessen: II (22); H, E; H3.5T3R3
1358. Hordeum marinum Huds.: V (14,18); Th, Atl-M; H2T4R3
- ssp. gussoneanum (Parl.)A. et G.: III (14), IV (14,25), V (14,!); Th, Eua; H2T4R4.5
- f. hirtellum Degen: V (40)
1359. H. murinum L.: III-V (5,25,18,!); Th, Eua (M); H2.5T4R0
1360. Agropyron caninum (L.)P.Beauv.: IV-V (25,40); H, Cp; H3.5T0R4
- var. pauciflorum (Schur)Volkart: V (40)

1361. A. intermedium (Host.)P.Beauv.: III-V (5,18,!); G, Eua; H2T4R4
1362. A. pectiniforme Roem. et Schult.: V (40,!); H, Eua; H2T4R4.5
- f. ciliatum Degen: V (40)
1363. A. repens (L.)P.Beauv.: I-V; G, Eua; H0T0R0
- var. glaucum (Host.)Doll: V (40)
- var. aristatum (Neilr.)Hay: V (40)
1364. Nardus stricta L.: I (6,31,!), IV (5); H, E; H0T0R1.5

ORCHIDACEAE
1365. Orchis cordigera Fries.: I-II (14,!); G, Alp-Carp-B; H4.5T2R2
- var. cordigera f. macrobracteata Schur: II (14)
- var. siculorum (Soó)Pauca et Beldie: I-II (14)
1366. O. laxiflora Lam.: III-V (5,!); G, Eua (M): H4T3R0
- ssp. elegans (Heuff)Soó: III-V (34,29,5,!);
- var. javorkae Soó: III (14)
1367. O. incarnata L.: I (14,32,!), III-IV (14,!); G, Eua (M); H4.5T0R4
1368. O. maculata L. ssp. maculata: I (6,31,!), IV (25,!); G, Eua (M); H0T0R0
- var. transsilvanica (Schur)Doin: I (14,!);
- ssp. elodes (Gris.)Camus var. schurii (Kinge)Pauca et Beldie: I (14,42)
- ssp. fuchsii (Druce)Christens f. karpati Borsos: I (14)
1369. O. militaris L.: III-IV (14); G, Eua; H3T3R4
1370. O. morio L.: III-IV (34,29,5,!); G, Ec; H2.5T3R4
1371. O. sambucina L.: II (14,22), IV (14); G, Ec; H3T2R3
1372. Traunsteinera globosa (L.)Spreng.: II (22); G, Ec; H3T2R4.5
1373. Gymnadenia conopsea (L.)R.Br.: I (6,!), III-V (14,6); G, Eua; H4T0R4.5
1374. Platanthera bifolia (L.)L.C.Rich.: I (6,23,!), III-V (29,5,25,!); G, Eua (M); H3.5T0R3
1376. P. chlorantha (Cust.)Rchb.: I, V (14); G, Eua (M); H3.5T3R3
1376. Listera ovata (L.)R.Br.: I (32), IV (5), V (27); G, Eua (M); H3.5T0R4
- f. multinervia (Peterm.)Hegi: III (14)
1377. Neottia nidus-avis (L.)L.C.Rich.: IV-V (25,5,40); G, Eua (M); H3.5T3R3
1378. Cephalanthera longifolia (Huds.)Fritsch.: II (22,14); G, E; H2.5T3R4
1379. Epipactis helleborine (L.)Cr.: III-V (14,25,24,40,!); G, Eua; H3T3R3
1380. E. palustris (L.).Cr.: I-II (14,6,23,!); G, Eua; H4.5T3R4.5

ARACEAE
1381. Acorus calamus L.: IV-V (14); Hh (G), Adv; H6T3.5R4
1382. Calla palustris L.: I-II (14,22); Hh, Cp; H5T2.5R3.5
1383. Arum maculatum L.: IV-V (5,18); G, Ec; H3.5T3.5R4
- var. alpinum (Schott et Kotschy)Topa et Beldie: IV-V (14,40)

LEMNACEAE
1384. Lemna gibba L.: III-V (14,25,40); Hh, Cosm; H6T3.5R4
1385. L. minor L.: I-V; Hh, Cosm; H6T0R0

1386. L. trisulca L.: III-V (25,38,40,!); Hh, Cosm; H6T0R4
1387. Spirodela polyrrhiza (L.)Schleichen: I (31), V (38,!); Hh, Cosm; H6T3.5R0

Study of the ecological preferences

Analysing the humidity (H) needs of the plant species from the Mureş Valley, we see that most of the plants belong to the mesophytic category (H3-H3.5). Forming 32.8% of the total flora list, they are here favoured by the moderate humidity both of the soil and from the atmosphere. The considerable representation (29.3%) of the mesohygrophytes (H4-H4.5), hygrophytes (H5-H5.5) and hydrophytes (H6) may be explained by the existence of several marshes, lakes and oxbow lakes of the Mureş. There are also xeromesophilous species (H2-H2.5) and xerophilous (H1-H1.5) ones in the flora, comprising 28.7% and 4.9%, respectively, which inhabit some rocky regions and sunny slopes characterized by water deficit.

Concerning the temperature factor (T) the richness of the micromesothermic species (T3-T3.5) holding for 56.6% can be noticed as the longest part of the waterway of Mureş is situated in a moderate climate with an annual mean temperature of about 9-10 ^{o} Celsius. The microthermic species (T2-T2.5) are also well represented (10.9%), being favoured by the mountainous relief of the straits and particularly by the specific climate of the Depression of Giurgeu (Gheorgheni) which is one of the coldest poles of Transylvania with an annual mean temperature of only 4-5 ^{o} Celsius. Both mesothermophilous (T4-T4.5) and thermophilous (T5) species are present (16.0%); their occurrance is connected to south-facing slopes from the pass Topliţa- Deda, the Transylvanian Plateau and the Mureş Corridor.

In soil reaction (R), we notice the abundance of the weaker acid-neutrophilous (R4-R4.5), euryionic (R0) and acid-neutrophilous (R3-R3.5) species, in percentages: 40.3%, 28.5% and 20.6%, respectively. The acidophilous species (R1-R1.5) occur with a 6.5 % frequency, while the neutro-basiphilous ones (R5) represent a portion of 3.9 %. The above distribution reflects sufficiently well the preponderance of alluvial deposits and soils from the river and also the existence of the following soil types: brown podsolic, clayey podsoled, acid brown, peat and salty soils.

Life-form composition

The analysis of life forms shows some characteristics of the biotopes and the influences exerted on them by different factors. The very high percentage of hemicryptophytes (42.7 %) is closely connected to the large surfaces of lawn and the presence of a grass layer in riverside coppices and woods. The therophytes (30.7 %) are the manifestation of the warmer climate from the center of Transylvania and the plain of Mureş, plus a pronounced anthropogenic influence on these areas. The helohydatophytes (7.2%) point out the lakes and the wet meadows of the riverside. The ratio between the number of therophytes and that of hemicryptophytes gives the anthropisation (altitude) coefficient

(Ka=T/H+Ch*100) (Pop & Drăgulescu 1983), by means of which it is possible to determine the level of degradation for an area. For the Mureş Valley its value is 72, which corresponds to a territory with considerable landscape disturbance.

Analysis of the floristic elements

The flora of the area is characterized by the predominance of eurasian (45.2%), European (13.1%), circumpolar (9.1%) and Central-European (8.3%) elements, respectively. The main components of the mesophilous and mesohygrophilous lawns, and of the riverside coppices and woods, are the temperate-continental climate and the geographical position of the region. The meridional elements (Mediterranean, Submediterranean, Mediterranean-Pontic, Pontic, Ponto-Pannonic and Balcanic) alltogether represent 10.1%. They indicate some biotopes with a warmer microclimate from the Transylvanian Plateau and the neighborhood of the lower basin of Mureş upon the Pannonian province. The Daco-Balcanic plus Carpatho-Balcanic (2.1%) and endemic or Carpathic (0.8%) elements provide a peculiar color to the valley.

The vegetation

Relying on our phytocoenologic relevés, we identified 174 associations with 40 subassociations and facies. Until our research in the area, only 81 have been previously mentioned.

Associations

ASPLENIETEA RUPESTRIS H. Meier et Br.-Bl. 1934
ASPLENIETALIA SEPTENTRIONALIS Oberd. et all. 1967
Asplenion septentrionalis Gams 1927
l. Asplenio trichomanes-Poaetum nemoralis Boşcaiu (1970)1971: II (!)
2. Sempervivetum heuffelii E.Schneider-B. 1969: II (!)
3. Hypno-Polypodietum vulgare Jko. et Pec. 1963: IV (43)

LEMNETEA W. Koch et Tx. 1954
LEMNETALIA W. Koch et Tx. 1954
Lemnion minoris W. Koch et Tx. 1954
4. Lemnetum minoris (Oberd.1957)Muller et Gors 1960: I-V
5. Spirodeletum polyrrhizae W. Koch 1954: V (!)
6. Lemno-Salvinietum natantis Miyawaki et Tx. 1960: V (!)
7. Salvinio-Spirodeletum polyrrhizae Slavnic 1956: V (!)
Utricularion vulgaris Pass. 1964
8. Lemno-Utricularietum Soó 1928: III (!)
- lemnetosum trisulcae (Kárpáti 1963)Soó 1964: III (!)
- ceratophylletosum demersi Soó (1957)1964: III (!)
HYDROCHARIETALIA Rubel 1933
Hydrocharition Rubel 1933

9. Ceratophylleto-Hydrocharetum I.Pop 1962: III, V (!)
Ceratophyllion Den Hartog et Segal 1964
l0. Ceratophylletum demersi (Soó 1927)Hild 1956: III (!)
POTAMETEA Tx. et Prsg.1942
POTAMETALIA W. Koch 1926
Ranunculion aquatilis Pass. 1964
11. Ranunculetum (Batrachietum) trichophylli Soó (1927)1971: V (!)
Potamion W. Koch 1926 emend. Oberd.1957
12. Myriophyllo-Potametum Soó 1934: V (!)
13. Potametum crispi Soó 1927: II-III (!), IV (32a)
- potametosum pusilli Soó (1927)1973: V (!)
Nymphaeion Oberd.1957 emend. Neuhausl 1959
14. Nymphaeetum albo-luteae Nowinski 1928: III, V (!)
- nymphaeetosum V. Kárpáti 1963: V (!)
- nupharetosum Soó (1957)1964: III (!)
15. Polygonetum natantis Soó 1927: III, V (!)
16. Potametum natantis Soó 1927, Eggler 1933: III, V (!)
17. Nymphoidetum peltatae (Allorge 1922) Oberd. et Muller 1960: V (!)
18. Trapetum natantis Muller et Gors 1960: IV (26,43), V (!)
PHRAGMITETEA Tx. et Prsg.1942
PHRAGMITETALIA W. Koch 1926 emend. Pign.1953
Phragmition australis (*communis*) W. Koch 1926 emend. Soó 1947
19. Scripo-Phragmitetum W. Koch 1926: I-V
- phragmitetosum Soó 1957: IV V (25,43,!)
- butomosum Paun (1964)1967: III (!)
- hydrocharitosum I. Pop 1962: III, V (!)
- solanetosum dulcamarae Krausch 1965: V (I)
20. Typhaetum angustifoliae (All.1922)Pign.1943: I, III, V (I)
21. Typhaetum latifoliae Soó 1927: I-III, V (!)
22. Typhaetum laxmannii (Ubrizsy 1961) Nedelcu 1968: V (!)
23. Schoenoplectetum lacustris Eggler 1933: I, V (!)
24. Glycerietum maximae Hueck 1931: I-V
25. Oenanthetum aquaticae Soó 1927, Eggler 1933: III, V (!)
Bolboschoenion maritimi Soó (1945)1947
26. Bolboschoenetum maritimi Soó (1927)1957: IV (6a,32a,25,43), V (!)
- schoenoplectetosum tabernaemontani Soó 1957: V (!)
27. Schoenoplectetum tabernaemontani Soó (1927)1949: V (!)
28. Eleocharietum palustris Schennikow 1919; Soó1933: I, III (!)
NASTURTIO-GLYCERIETALIA Pign.1953
Glycerio-Sparganion Br.-Bl. et Sising ex Boer 1942
29. Sparganio-Glycerietum fluitantis Br.-B1.1925: IV (25,43), V (I)
30. Glycerietum plicatae Oberd. (1952)1957: I (!)
31. Alismato-Eleocharitetum Máthé et Kovács 1967: III, V (I)
Phalarido-Glycerion Pass.1964

32. Equisetetum fluviatilis (limosi) Soó (1927)1947: I (31)
33. Leersietum oryzoidis Krause 1955 em. Pass.1957: I (49)
MAGNOCARICETALIA Pign.1953
Magnocaricion elatae W. Koch 1926
34. Caricetum rostratae Rubel 1912: I (31,!)
35. Caricetum paniculatae Wangerin 1926, Soó 1969: I (31,!)
36. Caricetum appropinquatae (W. Koch 1926) Tx.1947: I (31)
37. Carici-Menyanthetum Soó (1938)1955: I (32), II (!)
38. Caricetum gracilis Almquist 1929; Tx. 1937: I (31,!), II (12)
39. Caricetum acutiformis Suer 1937: I (31,!), III (4), IV (6a)
40. Caricetum ripariae Soó 1928: I (31,!)
41. Caricetum vesicariae Br.-B1. et Denis 1926; Zólyomi 1931: I (31,!), IV-V (25,43,!)
42. Caricetum vulpinae Soó 1927: I (31), IV (6a)
43. Poetum palustris Resmeriță et Rațiu 1974: I (31)
44. Typhoidetum arundinaceae Eggler 1933: I-III (31,4,!), IV (32a), V (!)
ISOETO-NANOJUNCETEA Br.-Bl. et Tx. 1943
NANOCYPERETALIA Klika 1935
Nanocyperion flavescentis W. Koch 1926
45. Pucreetum (Cyperetum) flavescenti-fusci W. Koch 1926 em. Philippi 1968: V(!)
46. Cypero-Juncetum Soó et Csûrös 1944: III (9)
47. Juncetum bufonii Morariu 1956; Philippi 1968: I, III, V (!)
Verbenion supinae Slavino 1951
48. Lythreto-Pulicarietum vulgaris Tímár 1954: V (!)
SCHEUCHZERIO-CARICETEA NIGRAE (FUSCAE) Nordh.1936
SCHEUCHZERIO-CARICETALIA NIGRAE (FUSCAE) (WKoch1926)Gors et Muller ex Oberd.1967
Caricion lasiocarpae Van den Bergen 1949
49. Caricetum diandrae (Jon.1932)Oberd.1957: I (32)
Caricion canescenti-nigrae (*fuscae*) (W. Koch 1926)Nrdh. 1936
50. Carici-Agrostietum caninae Tx. 1937: I (32)
51. Caricetum nigrae (fuscae) Br.-B1.1915; W. Koch 1928: I (32,!)
52. Carici stellulatae (echinatae)-Sphagnetum Soó (1934)1954: I (32,!)
53. Caricetum stellulatae (echinatae) Csûrös 1956: III (!)
TOFIELDIETALIA Prsg. apud Oberd. 1949
Eriophorion latifolii Br.-B1. et Tx. 1943
54. Carici flavae-Eriophoretum Soó 1944: I-II (32,12,!)
55. Valeriano-Caricetum flavae Pawl., Pawlowska et Zazycki 1960: I (32)
MOLINIO-ARRHENATHERETEA Tx. 1937
CARICETALIA DAVALLIANAE Br.-Bl.1949
Caricion davallianae Klika 1934
56. Caricetum davallianae W. Koch 1928: I (49)
MOLINIETALIA W. Koch 1926
Agrostion stoloniferae (albae) Soó (1933)1971
57. Agrostidetum stoloniferae (Ujvárosi 1941) Burduja et all.1956: I-V

- eleocharetosum Soó 1964: III (!)
58. Poetum pratensis Rav., Cazac. et Turenschi 1956: III (!), IV-V (25,43,!)
- lolietosum perennis Grigore 1971: V (!)
59. Alopecuretum pratensis Nowinski 1928: IV (6a)
60. Agrostideto-Festucetum pratensis Soó 1949: III (!), IV-V (6a,11a,32a,!)
61. Lolietum perennis Safta 1943: III, V (!)
62. Lythro-Calamagrostidetum epigei I.Pop 1968: IV (!)
Molinion coeruleae W. Koch 1926
63. Molinietum coeruleae (All.1922)W. Koch 1926: I (6,!)
- caricetosum nigrae (fuscae) Borza et. F1.Rațiu 1970: I (6,!)
64. Junco-Molinietum Prsg.1910: I (6,!)
- nardetosum strictae (Jon.1933) Kovács 1956: I (6)
Calthion palustris Tx. 1937
65. Calthaetum laetae Krajina 1933: I (!)
66. Scirpetum sylvatici Schwick.1944: I-V
67. Cirsietum cani Tx. 1951: I, III (!)
68. Trollio-Cirsietum (Kuhn 1937) Oberd. 1957: I (!)
Filipendulo-Petasition Br.-B1. 1947
69. Petasitetum hybridi (Dost. 1933) Soó 1940: II (!)
70. Filipendulo-Geranietum palustris W. Koch 1926: I (!)
71. Filipenduletum ulmariae W. Koch 1926: III-IV (!)
72. Chaerophyllo-Equisetetum palustre Vicol et Stoicovici 1977: I-II (!)
ARRHENATHERETALIA Pawl. 1928
Arrhenatherion elatioris (Br.-B1. 1925) W. Koch 1926
73. Arrhenatheretum elatioris (Br.-Bl. 1919 s.l.) Scherrer 1925; Soó 1969: III (28,!), IV (6a), V (11a)
- holcetosum Csûrös 1970: III (11,28)
- trisetosum flavescentis Horvatic 1930: III (11,28)
- festucetosum rupicolae (sulcatae) Eggler 1958: III (28)
- pastinacetosum comb. nova (Pastinaco-Arrhenatheretum elatioris) (Knapp 1954) Pass. 1964:II-III (!)
- geranietosum pratensis subass. nova:II-III (!)
74. Poaeto-Festucetum pratensis Soó 1949: III (28,!)
Cynosurion cristati Br.-B1. et Tx. 1943
75. Anthoxantho-Agrostietum tenuis Sillinger 1933; Jurko 1969: IV (!)
76. Agrostideto-Festucetum rupicolae (sulcatae) Cs.-Káptalan (1962)1964: III-IV (28,25,43,!)
77. Agrostideto-Danthonietum Soó 1947: III (28)
78. Agrosti-Cynosuretum Resmerita 1963: II-III (28,I)
79. Agrosti-Festucetum rubrae Horv. (1951)1952: I-II (!)
80. Lolio-Cynosuretum Tx.1937: IV (6a, 43)
DESCHAMPSIETALIA CAESPITOSAE Horvatic 1956
Alopecurion pratensis Soó 1938; Pass.1946
81. Festucetum pratensis Soó 1938: III-IV (28,!)

Deschampsion caespitosae (Horvatic 1930) Soó 1971
82. Agrostideto-Deschampsietum caespitosae Ujvárosi 1947: I-II (!)
- caricosum nigrae (fuscae) Stoicovici 1977: I (!)
PUCCINELLIO-SALICORNIETEA Topa 1939
SALICORNIETALIA Br.-Bl. (1928) 1933
Thero-Salicornion Br.-B1. (1930)1933, Pign. 1933
83. Salicornietum europaeae Wendelbg. 1953: III (!)
PUCCINELLIETALIA Soó 1940
Puccinellion limosae (Klika 1937) Wendelbg. 1943,1950
84. Staticeto-Artemisietum monogynae Topa 1939: III, V (!)
85. Hordeetum hystricis (Soó 1933) Wendelbg. 1943: V (!)
Puccinellion peisonis (Wendelbg. 1943) Soó 1957
86. Puccinellietum distantis Soó 1937, Knapp 1948: III, V(!)
Juncion gerardii Wendelbg. 1943
87. Juncetum gerardii (Warming 1906) Nordh. 1923; Wenzl 1934: III (4,!),V(!)
88. Agrostio-Caricetum distantis (Rapaics 1927)Soó 1930: III(!), IV (6a), V (11a)
Festucion pseudovinae Soó 1933
89. Artemisio-Festucetum pseudovinae (Magyar 1928) Soó (1933)1945: V (!)
- puccinellietosum Soó 1964: V (!)
- limonietosum Bodrogk. 1962: V (!)
90. Achilleo-Festucetum pseudovinae (Magyar 1928) Soó (1933)1945: V IV (6a), V (11a,!)
- cynodontetosum Borza 1959; Bodrogk. 1965: V (11a,!)
Beckmannion eruciformis Soó 1933
91. Agrostio-Beckmannietum (Rapaics 1916) Soó 1933: V (!)
FESTUCO-BROMETEA Br.-B1. et Tx. 1943
BROMETALIA ERECTI (Koch 1926 n.n.) Br.-B1. 1936
Bromion erecti (Koch 1926 n.n.) Br.-B1. 1936 s.str.
92. Brometum erecti Pázmány 1963: III (33)
Cirsio-Brachypodion Hadac et Klika 1944 emend. Krausch 1961
93. Cariceto humilis-Brachypodietum pinnati Soó(1942)1947: III (4)
- globularietosum Borza et Lupşa 1962: III (4)
- salvietosum transsilvanicae Borza 1959: III (4)
Festucion rupicolae (*sulcatae*) Soó (1929 n.n.)1940 corr. Soó 1964
94. Cynodonto-Poetum angustifoliae (Rapaics 1926) Soó 1957: III (28,!), V (11a)
95. Festucetum rupicolae Burduja et all. 1956: II-III (28,!), V (11a)
96. Festuceto-Botriochloetum ischaemi Resmeriță 1965: III-IV (28,!), V (11a)
SECALIETEA Br.-Bl. 1931
APERETALIA R. et J. Tx. 1960
Aphanion J. et R. Tx. 1960
97. Echio-Rumicetum acetosellae Soran 1962: III (!)
SECALIETALIA Br.-B1.1931 emend. J. et R. Tx.1960
Caucalidion platycarpos Tx. 1950 corr. Soó 1971
98. Consolido-Polygonetum convolvulus (Morariu 1943) Morariu 1967: III(4,!), V (47)

Trifolio-Medicaginion sativae Balázs 1944 emend. Soó 1959
99. Plantagini lanceolatae-Medicaginetum (Balázs 1944) Soó et Tímár 1964: V(47)
- verbenetosum officinale Tímár 1953: V (!)
ERAGROSTETALIA J. Tx. 1961 emend. Soó 1968
Consolido-Eragrostion pooidis Soó et Tímár 1957
100. Amarantho-Chenopodietum albi (Morariu 1943) Soó (1947)1953: II (!), III (4,!), V (47,!)
Tribulo-Eragrostion pooidis Soó et Tímár 1957
101. Hibisco-Eragrostetum poaeoidis Soó et Tímár (1951)1957: V (!)
102. Digitario-Portulacetum (Felföldy 1942) Tímár et Bodrogk. (1943)1955: V (!)
CHENOPODIETEA Br.-Bl. 1951 emend. Lohn., J. et R. Tx. 1961
SISYMBRIETALIA J. Tx. 1961
Sisymbrion officinalis Tx., Lohm. et Prsg. 1950
103. Hordeetum murini Libbert 1932 em. Pass. 1964: III (!)
104. Atriplicetum nitentis Knapp 1945: III, V (!)
105. Atriplicetum tataricae (Prodan 1923) Borza 1926: III (!)
106. Polygono avicularis-Amaranthetum crispi Vico1, Schneider-B. et Täuber 1971: III,1V (!)
107. Malvetum neglectae Aichinger 1933 em. ass. 1966: I, III-IV (!)
108. Descurainetum sophiae Krech 1935 corr. Oberd. 1970: III (!)
109. Malvetum pusillae Morariu 1943: III (!)
110. Xanthio spinosae-Amaranthetum Morariu 1943: III (!)
Convolvulo arvensi-Agropyrion repentis Gors 1966
111. Agorpyretum repentis Felföldy 1942: III-IV (!)
- convolvuletosum arvensis Grigore 1971: III (!)
Veronico-Euphorbion Siss. 1942
112. Galeopsidetum speciosae Krusem. et Vlieg.1939: III (!)
ONOPORDETALIA Br.-Bl. et Tx. 1943 emend. Gors 1966
Dauco-Melition Gors 1966
113. Echio-Melilotetum albi Tx. 1942: III-IV (4,!)

Onopordion acanthi Br.-Bl. 1926 s.str.
114. Onopordetum acanthi Br.-Bl. (1923)1936: III (4,!)
115. Carduetum acanthoidis (Allorge 1922) Morariu 1939: II-III (!)
POLYGONO-CHENOPODIETALIA (Tx. et Lohm.1950) J. Tx. 1961
Panico-Setarion Siss. 1946
116. Setario-Galinsogetum Tx. 1950: III-V (!)
ARTEMISIETEA Lohm., Prsg. et Tx. 1950
ARTEMISIETALIA Lohm. et Tx. 1947
Arction lappae Tx. 1937 emend. Siss. 1946
117. Artemisietum annuuae Morariu 1943 emend. Dihoru 1970: III (!)
118. Tanaceto-Artemisietum vulgaris Br.-Bl. (1931)1949: I, III,V (4,!)
- pastinacetosum Szabó 1971: III (!)
119. Conietum maculati I. Pop 1968: III, V (!)

120. Sambucetum ebuli (Kaiser 1926) Felföldy 1942: III-IV (4,25,!)
121. Arctio-Ballotetum nigrae (Felföldy 1942) Morariu 1943: I (!), III (4,!), V (!)
122. Urticetum dioicae Steien 1931; Turenschi 1966: I-V
123. Potentillo-Artemisietum absinthii (Prodan 1948) Falinski 1964: II-IV (!)
124. Lycietum barbarum Felföldy 1942 corr. Soó 1971: III, V (!)

Tussilaginion Szabó 1971 n.n.

125. Tussilaginetum farfarae Oberd. 1949: II, IV (!)

CALYSTEGIETALIA (CONVOLVULETALIA) SEPIUM Tx. 1950

Calystegion sepium Tx. 1947 ex Oberd. 1949

126. Rudbeckio-Brachypodietum silvaticae Szabó 1970: III (!)
127. Glycyrrhizetum echinatae (Soó 1940 n.n.; Tímár 1947) Slavnic 1951: V (!)
128. Polygonetum cuspidati Tx. et Raabe 1950 apud Oberd. 1967: III, V (!)
129. Helianthetum decapetali Morariu 1967 n.n.: III (!)
130. Eupatorietum cannabini Tx. 1937: II, III (!)

BIDENTETEA TRIPARTITI Tx., Lohm. et Prsg. 1950

BIDENTETALIA TRIPARTITI Br.-Bl. et Tx. 1943

Bidention tripartiti Nordh. 1940

131. Bidentetum tripartiti (W. Koch 1926) Libbert 1932: III, V(!)
132. Ranunculetum scelerati Siss. 1946 em. Tx. 1950: III (!)
133. Bidentetum cernui Slavnic 1951: III (!)
134. Xanthio strumarii-Chenopodietum albi (Tímár 1947) I. Pop 1968: V (!)

Chenopodion fluviatile (rubri) Tx.1960

135. Echinochloo-Polygonetum lapathifolii (Ujvárosi 1940) Soó et Csûrös (1944)1947: III-V (4,47,!)

- chenopodietosum albi Soó 1961: III (4,!)

136. Echinochloo-Setarietum lutescentis Felföldy 1942 corr. Soó 1971: III (!)
137. Chenopodietum glauci (Wenzl. 1934) Raabe 1950: I, III (!)
138. Xanthietum italici Tímár 1950: III-IV (25,!)

PLANTAGINETEA MAJORIS Tx. et Prsg. 1950

PLANTAGINETALIA MAJORIS Tx. (1947)1950

Polygonion avicularis Br.-Bl. 1931 emend. Tx. 1950

139. Lolio-Plantaginetum majoris (Linkola 1921) Beger 1930: IV-V (43,!)
140. Poëtum annuae Gams 1927: I (!), III-IV (4,!)
141. Polygonetum avicularis Gams 1927: II-V (4,25,!)

- matricarietosum discoideae Morariu 1967 n.n.: II (!)

142. Dauco-Matricarietum inodorae I. Pop (1966)1968: III (!)
143. Juncetum tenuis (Diemont, Siss. et Westhoff 1940) Schwick. 1944: I-II (!)

Agropyro-Rumicion crispi Nordh. 1940

144. Myosuretum minimi Diem., Siss. et Westh. 1940: V (!)
145. Trifolio repenti-Lolietum Krippelova 1967: IV (25)
146. Lolio-Potentilletum anserinae Knapp 1946: II (!), IV (43)

147. Rorippo silvestri-Agrostietum stoloniferae (Moor 1958) Oberd. et Th. Muller 1961: IV-V (25,!)
148. Rorippo austriaceae-Agropyretum repentis (Tímár 1947)Tx. 1950:IV (6a,32a)
149. Rumici-Alopecuretum geniculati Tx. (1937)1950, Simon 1957: V (11a)
150. Ranunculetum repentis Knapp 1946 emend. Oberd. 1957: II-III (!)
151. Juncetum effusi Soó (1931)1949: I-V
EPILOBIETEA ANGUSTIFOLII Tx. et Prsg.1950
EPILOBIETALIA ANGUSTIFOLII Tx.1950 corr. Soó 1961
Atropion bella-donnae (Br -Bl. 1930) Tx. 1931
152. Rubo-Epilobietum Hadac et all. 1969: I-II (!)
PETASITETO-CHAEROPHYLLETALIA Morariu 1967
Telekion speciosae Morariu 1967 n.n.
153. Telekio speciosae-Petasitetum albae Beldie 1967: II (1)
SALICETEA PURPUREAE Moor 1958
SALICETALIA PURPUREAE Moor 1958
Salicion albae (Soó 1930 n.n.)Muller et Gors 1958
154. Salici-Populetum (Tx. 1931)Mejer Drees 1936: III-IV (4,11a,32a,!)
155. SaIicetum albae-fragilis Issler 1926 em. Soó 1957: II-V (22,25,!)
- amorphosum fruticosae Morariu et Danciu 1970: III-V (25,!)
- echinocystosum nov. fac.: III-V (!)
Salicion triandrae Muller et Gors 1958
156. Salicetum triandrae Malcuit 1929: III-V (!)
- amorphosum fruticosae Borza 1954 n.n.: IV-V (!)
- salicetosum viminalis Soó 1958: III-V (!)
157. Salicetum purpureae (Soó1934 n.n.) Wendelbg.-Zelinka 1952: II-III (9,!)
ALNETEA GLUTINOSAE Br -Bl. et Tx. 1943 em. Muller et Gors 1958
SALICETALIA AURITAE Doing 1962 em. Westh. 1969
Salicion cinereae Muller et Gors 1958
158. Calamagrosti-Salicetum cinereae Soó et Zólyomi 1955: I (30,!), II, IV (!)
- spiraeaetosum salicifoliae Fl. Rațiu 1968: I (30,!)

QUERCETEA PUBESCENTI-PETRAEAE (Oberd. 1948)Jakucs 1960
ORNO-COTINETALIA Jakucs 1960
Quercion farnetto I.Horvat. 1954 corr. Soó 1960
159. Quercetum farnetto-cerris Georgescu 1945,Rudski 1949: IV (25,!)
160. Quercetum cerris Georgescu 1941: IV (25)
PRUNETALIA Tx. 1952
Prunion spinosae Soó (1930 n.n.)1940
161. Pruno spinosae-Crategetum (Soó 1927)Hueck 1931: IV-V (4,25,!)
162. Coryletum avellanae Soó 1927: II (22,!), IV (25,!)
QUERCO-FAGETEA Br.-Bl. et Vliger 1937 em. Soó 1964
FAGETALIA SILVATICAE (Pawl. 1928) Tx. et Diem. 1936
Alno-Padion Knapp 1942 em. Medwecka-Kornas 1957
163. Fraxino-Ulmetum (Tx. 1952) Oberd. 1953: V (24,!)

- fraxinetosum angustifoliae I. Pop 1979: V (24,!)
- quercetosum robori I. Pop 1979: V (25)

164. Alnetum incanae (Brockman 1907) Aichinger et Siegrist 1930: I (30,!),II(!)

- matteuccetosum Soó 1962; Lungu 1971: II (!)
- spiraeaetosum salicifoliae Fl. Rațiu 1968: I (30)

165. Alnetum glutinosae-incanae Br.-Bl. (1915)1930: II (!)

166. Aegopodio-Alnetum J. Kárpáti et Jurko 1961: IV (25,!)

Moehringio muscosae-Acerion (Soó 1964)Boşcaiu 1979

167. Staphyleo-Tilietum platyphylli Täuber 1986: IV (44)

168. Carpino-Tilietum platyphylli Täuber 1986: IV (44)

-aceretosum tatarici Täuber 1986: IV (44)

Carpinion Oberd. 1953

169. Melampyro bihariense-Carpinetum Soó 1964: III-IV (4,25)

170. Carpino-Quercetum petraeae Borza 1941; I. Pop et Hodisan 1960: IV (25,!)

171. Carpino-Fagetum Pauca 1941: IV (25)

Symphyto-Fagion (Vida 1959)Soó 1964

172. Festuco drymeae-Fagetum morariu et. al. 1968: II (!), IV (25)

173. Chrysanthemo rotundifolio-Piceo-Fagetum Soó 1962, Vida 1959: II (!)

VACCINIO-PICEETEA Br.-Bl. 1939

VACCINIO-PICEETALIA Br.-Bl. 1939 em. Hadac 1962

Vaccinio myrtillo-Piceion abietis Brezina et Hadac 1962

174. Hieracio tarnssilvanico-Piceetum abietis (Zlatnik 1935)Pawl. 1939: I-II (!)

Discussion

Analysis of the flora and vegetation points out that the Mureş Valley is now moderately degraded by human activity. The rate of degradation increases from the springs to the river mouth, and it has repercussions not only on the water ways of the Mureş, but also on the landscape of its banks. The best preserved sectors are I and II while the most deteriorated ones are V, III and IV, respectively. This fact is revealed also by the small number of therophyte species in the former two sectors (54 in I, 66 in II) as compared to the latter ones (318 in V, 304 in IV and 253 in III). The therophytes are indicators of drought and a degraded environment, by growing especially near localities as ruderal weeds and in crops as segetal ones. The cosmopolites and adventive elements our allegation by their number in which they occur in the five sectors. Thus, the cosmopolites are distributed as follows: 33 in I, 32 in II, 60 in III, 64 in IV and 68 in V; the adventive elements: 5 in I, 8 in II, 24 in III, 30 in IV and 27 in V.

The vegetation of the Mureş valley is only to a limited extent natural and primary. It is about the riverside coppices (especially on the inferior course), the peat bogs and the rocky regions of the superior flow. Most of the vegetation is secondary, being represented by lawns (mainly sectors I and IV) and farming areas (particularly sectors V and III).

- The following areas must be at least partly protected and preserved for their floristic-phytocoenologic and landscape values: swamps from sector I (e.g. Voşlobeni, Joseni, Remetea), rocky regions of the Topliţa-Deda strait, woods near Arad (Ciala, Bezdin) and salt marshes at Ideciu, Nagylak, Makó and Szeged.

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DATA ON THE CHEMICAL COMPOSITION OF THE MUREŞ (MAROS) RIVER

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Introduction

Knowledge of the chemical composition of the Romanian section of the Mureş River is very limited in the scientific literature (Bedő 1986, 1990, Lepşi 1937a,b, Ujvári 1972). In April 1991 the Environmental Protection Agency (Tîrgu Mureş) held a scientific session that expanded our knowledge.

The chemical composition of the Mureş River is to that of the Carpathian Mountains and in the Carpathian Basin generally.

The mineral content of the water is low in the upper catchment area of the river, about 30-80 mg/l, where the right side from Giurgeului Mountain is a little bit higher. The mineral springs characterize this region with Na, Mg, Cl, SO_4 I, B ions, and natural carbondioxide content, but their effect on the Mureş is negligible. In the middle section of the river (Cîmpia Transilvaniei- Transylvanian Plateau), the mineral content changed drastically. These changes caused some effects as a (1) different type of minerals in the catchment area, where content of sodium and chloride are higher; (2) increasing of natural heavy-metal content; and (3) important human effects. The lower section is also polluted with high mineral content.

Materials and methods

The evaluation of the chemical composition of the Mureş river was made by data from the Environment Protection Agency and the University of Medicine from Tîrgu Mureş. Statistical analyses were made for evaluation.

Results and discussion

Some parameters were first compared from a section of the river near Tîrgu Mureş. Average values of the years 1975-1979 and 1986 (Table 1.), where compared, seem to show that a majority of the values increased along the river. On the basis of the comparative investigation between periods, no significant difference in parameters, such as temperature, turbidity and colour were shown. At the same time increasing of other parameters is significant at (all the) time scale. We can presume the changes were caused by human activity.

Tab.1. Comparative water analysis of the Middle-Mureş

	1975-1979	1986	Difference	%
Water temperature (gr.C)				
1.Brîncoveneşti	11.1	10.4	-0.70	-7.0
2.Glodeni	12.5	11.2	-1.30	-10.4
3.Tg.Mureş	13.2	12.4	-0.60	-4.55
4.Ungheni	14.6	13.7	-0.90	-6.17
5.Cipău	15.0	15.2	+0.20	+1.34
6.Luduş	19.2	18.9	-0.30	-1.57
7.Cheţani	19.3	16.5	-2.80	-14.51
Turbidity value				
1.Brîncoveneşti	5.4	5.7	+0.30	+5.56
2.Glodeni	8.7	6.0	-2.70	-31.04
3.Tg.Mureş	10.6	6.9	-3.70	-34.91
4.Ungheni	15.5	9.7	-5.80	-37.42
5.Cipău	13.6	16.9	+3.30	+24.27
6.Luduş	19.2	25.4	+6.20	+32.3
7.Cheţani	16.8	14.5	-2.30	-13.69
Color (Pt-Co degree)				
1.Brîncoveneşti	11.8	12.3	+0.50	+4.24
2.Glodeni	13.2	10.4	-2.80	-21.22
3.Tg.Mureş	13.0	13.1	+0.10	+0.77
4.Ungheni	14.3	14.3	0	0
5.Cipău	14.8	16.6	+1.80	+12.17
6.Luduş	13.3	15.5	+2.20	+16.55
7.Cheţani	14.2	14.0	-0.20	-1.41
Total dissolved solids mg/l				
1.Brîncoveneşti	79.8	135.4	+45.6	+51.21
2.Glodeni	121.1	140.8	+19.7	+16.27
3.Tg.Mureş	143.7	160.4	+16.7	+11.62
4.Ungheni	213.7	220.9	+7.2	+3.37
5.Cipău	216.2	235.4	+19.2	+8.88
6.Luduş	252.3	283.1	+30.8	+12.21
7.Cheţani	292.2	306.9	+14.7	+5.03
Conductivity µS/cm				
1.Brîncoveneşti	125.4	180.7	+55.3	+44.1
2.Glodeni	184.4	187.7	+3.3	+1.79
3.Tg.Mureş	194.4	213.7	+21.6	+11.29
4.Ungheni	274.5	294.5	+20.0	+7.29
5.Cipău	288.0	317.2	+29.2	+10.14
6.Luduş	336.2	377.5	+41.3	+12.29
7.Cheţani	389.9	389.2	-0.7	-0.18
Total suspended solids mg/l				
1.Brîncoveneşti	100.8	139.4	+38.6	+38.3
2.Glodeni	125.0	149.4	+24.4	+19.52
3.Tg.Mureş	146.5	176.8	+30.3	+20.69
4.Ungheni	212.8	223.2	+10.4	+4.89
5.Cipău	218.6	244.8	+26.2	+11.99
6.Luduş	266.5	311.5	+45.0	+16.89
7.Cheţani	300.9	310.7	+9.8	+3.26

Table 1. (continued)

	1975-1979	1986	Difference	%
Total hardness (G.d.)				
1.Brîncoveneşti	2.9	4.7	+1.8	+62.07
2.Glodeni	3.6	7.5	+3.9	+108.34
3.Tg.Mureş	4.1	6.5	+2.4	+58.54
4.Ungheni	5.7	8.2	+2.3	+40.35
5.Cipău	6.4	9.6	+3.2	+50.0
6.Luduş	8.1	9.9	+1.8	+22.23
7.Cheţani	9.3	12.0	+2.7	+29.04
Redox pot. (v)				
1.Brîncoveneşti	0.374	0.447	+0.073	+19.52
2.Glodeni	0.384	0.428	+0.044	+11.46
3.Tg.Mureş	0.380	0.423	+0.043	+11.32
4.Ungheni	0.383	0.428	+0.045	+11.75
5.Cipău	0.381	0.410	+0.029	+7.62
6.Luduş	0.378	0.400	+0.022	+5.82
7.Cheţani	0.379	0.401	+0.022	+5.81
pH-value				
1.Brîncoveneşti	7.19	7.41	+0.22	+3.06
2.Glodeni	7.44	7.58	+0.14	+1.89
3.Tg.Mureş	7.52	7.61	+0.09	+1.20
4.Ungheni	7.17	6.64	+0.47	+6.56
5.Cipău	7.18	7.56	+0.38	+5.30
6.Luduş	7.25	7.64	+0.39	+5.38
7.Cheţani	7.15	7.76	+0.61	+8.54
rH-value				
1.Brîncoveneşti	27.6	30.3	+2.7	+9.79
2.Glodeni	28.1	29.7	+1.6	+5.70
3.Tg.Mureş	28.2	29.8	+1.6	+5.68
4.Ungheni	26.4	29.0	+2.6	+9.85
5.Cipău	26.6	29.1	+2.5	+9.40
6.Luduş	27.5	28.7	+1.2	+4.47
7.Cheţani	27.3	28.5	+1.2	+4.40

Recent longitudinal examination of the Romanian section (Table 2.) confirm earlier information about the water quality of the Mureş. There are two important influences which fundamentally change the conditions. First, communal and industrial sewages of Tîrgu Mureş decrease the dissolved oxygen content, increase ammonium, nitrate and nitrite content. Similarly the content of macro-ions as chloride, sulphate, calcium, magnesium and sodium are enlarged (see sampling point at Ungheni). Second, the river Tîrnava transports higher chloride-, sulphate- calcium- and sodium ions, which causes changes in the water type of the Mureş, from Ca-type into Na-type (see sampling point at Mihalţ).

Increases in the salt content and the load of organic materials was considerable along the river; similarly mineralization of reductive nitrogen forms (as ammonium and nitrite-ions)

Tab.2. Chemical composition of the Romanian section of the Mureş River.

	Izvorul Mureş	Stînceni	Glodeni	Ungheni	Cipău	Ocna Mureş	Mihalţ Pod	Alba Iulia	Gelmar	Branişca	Lipova	Arad	Nădlac
	km 4 Aug.	km 70 Aug.	km 153 Aug.	km 185.3 Aug.	km 207.2 Aug.	km 272 Aug.	km 325 Aug.	km 348 Aug.	km 393 Aug.	km 440 Aug.	km 590 Jul.	km 638 Jul.	km 704 Jul.
Water output, cu.m./s	0.564	4.6	8.62	8.98	9.4	14.6	14.18	18.5	46	51.5	74.1	77	88
pH	7.3	8.5	7.56	7.5	7.3	7.2	7.5	7.5	7.4	7.41	7.8	7.95	7.8
Dissolved oxigen mg/l	8.0	8.42	7.74	3.6	6.92	8.2	8.2	8.2	8.39	5.1	10.02	9.37	8.18
BOD5 mg/l	0.96	1.64	2.84	3.51	5.45	2.3	2.5	2.1	4.64	3.03	7.09	6.07	13.07
COD-Mn mg/l	2.72	2.51	2.24	3.53	5.18	4.3	7.9	7.8	6.77	7.01	5.2	4.16	11.09
COD-Cr mg/l			7.9	13.2	19.4						21	17.5	52.1
Total suspended solids mg/l	210	150	164.3	280	290	490	1538	1324	607.33	586.66	485.3	460.7	509
Cl ion mg/l	8.52	14.2	28.4	49.7	53.3	87.46	638.28	527	223.86	216.63	164.6	155.3	166.3
SO4 ion mg/l	11.2	24.7	23.4	49.5	50.9	99	235	214	72	75.84	50.7	51.3	51
Ca ion mg/l	46.6	24	21.3	32	38	65.4	124	90.1	101.53	92.18	82.7	77.9	81.1
Mg ion mg/l	15.5	7.3	5.7	7.3	6.9	20.8	8.7	24	2.43	12.96	7.46	7.13	10.38
Na ion mg/l	9.5	12	18.5	38	39.5	60	400	350	107	98.33	70	64	72
NH4 ion mg/l	0	0.28	0.75	7.94	4.59	1.52	0.81	0.64	8.49	0.58	0.19	0.36	1.38
NO2 ion mg/l	0	0.034	0.125	1.42	4,987	0	0.66	1.5	0.42	0.32	0.211	0.471	1.56
NO3 ion mg/l	1.2	1	1.17	16.2	20.7	15.8	22	18	13.23	10.13	10.52	10.99	16.34
CN ion µg/l			0.002	0.003	0.006	0	0	0.016	0	0	0.033	0.029	0.01
Phenols µg/l	0		0.001	0.001	0.002	0.005	0.004	0.004				0	0
ANA detergents µg/l						0.02		0.017			0.04	0.04	0.04
total P µg/l	0	0.035	0.052	0.21	0.11	0.06	0.06	0.076	0.016	0.01	0.038	0.046	0.179

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PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE MAROS (MUREŞ) RIVER

JÁNOS WAIJANDT

Introduction

The expedition-like examination of the longitudinal section of a river is an efficient method for discovery of the typical changes in a longitudinal section. The analyses of the sediment are especially informative because the sediment integrates the effects of a longer period (several months, eventually several years).

The most examinations of longitudinal sections in the Carpathian Basin have been conducted on the Tisza River. In 1979, a detailed study of the sediment was performed (Győri, Végvári, 1981; László, Berta, 1981), in 1986, the toxic metal contents of the water and the sediment were examined (Waijandt, Bancsi, 1989), and in 1989, detailed chemical and biological examinations were performed in the water body and in the sediment (Waijandt et al, 1990).

Materials and methods

Samples were taken along the longitudinal section of the Maros at 15 sampling sites on the following dates:

12.08.1991 at sample sites 1-5
20.08.1991 at " " 6-10
26.08.1991 at " " 11-15

Water samples were taken from a bridge, ferry, or boat in the median of the river; the sediment samples were taken by Eckman sampler.

The temperature of the air and the water, the smell, the colour, the transparency, the dissolved O_2, the free CO_2, and water velocity were determined at the site. The conservation of water samples was made there, too.

The sampling, the conservation and the examination of the chemical components were performed according to Hungarian Standards. For surface waters we used the Hungarian Standards MSZ 12750 series. For sediment, we used the HS MSZ 12739 series. The examination of the toxic elements (metals and arsenic) was performed by atomic absorption spectrometer type VARIAN 20BQ.

Results and discussion

Physical characteristics and suspended solids

The measurements of the colour of the Maros at the five upper sampling sites showed colourless or mildly yellowish water colour. It was greenish below Tîrgu Mureº, grayish downstream to Luduº and light yellowish on the lower section as far as the mouth of the river.

In the upper reaches the water was odorless while different smells were noticed at lower sections, related to some kind of pollution (Table 1)

The transparency of water, which is fundamentally determined by the concentration of suspended solids (especially by the number of planktonic algae), is the greatest in the colourless upper section where the quantity of suspended solids and the number of algae were small at the same time (see chapter of algalogical discussion). The transparency decreased at the five middle sections and the five lower sections of the river.

The temperature of the water was the lowest (12.5 ^{o}C) at the sections near the source and the highest at the lower reaches of the river (Table 1). In the next table values of specific concentrations are plotted against the river kilometres.

The concentration of the suspended solids is very low at the upper section. At the middle section (between sample sites 6-10) it increases significantly. At the lower section (between sample sites 11-15) it increases gradually (Figure 1).

Inorganic components

The free CO_2 content of the river in the upper section where the total number of algae was very low was fundamentally influenced by the spring water (so called "wine water") with relatively high concentrations of CO_2. The free CO_2 content is relatively high in this section, it is less in the middle section, and it disappeared in the lower section (Figure 1).

The pH-value changed in total harmony with the carbon dioxide content. In the two upper sections pH-values between 7.5 and 7.9 were measured, in the lower sections the values increased; they were between 8.1-8.6 (Figure 1). It is assumed to be in connection with the increased algal activity, which means more unfavourable water quality.

The concentration of the total dissolved matter (and its other form of expression, the value of the conductivity) is low 110-209 mg/l in the upper section of the Maros. It was increased more than threefold (Figure 2) by Tîrnava in the middle section, and it changed only as a function of the discharges and the regime after the little dilution effect of the Sebes (Sebeº) and the Sztrigy (Strei).

Fig. 3. shows that the biggest part of the mineral salt increase goes from the Küküllõ (Tîrnava) to the Maros in the form of NaCl. The water hardness was increased by the influence of the Tîrnava, but in a smaller degree. The percentage of Sodium (Na %-value) increased from 8.5- to 36% in the longitudinal section.

Fluoride content could be measured in the lower section (Table 1).

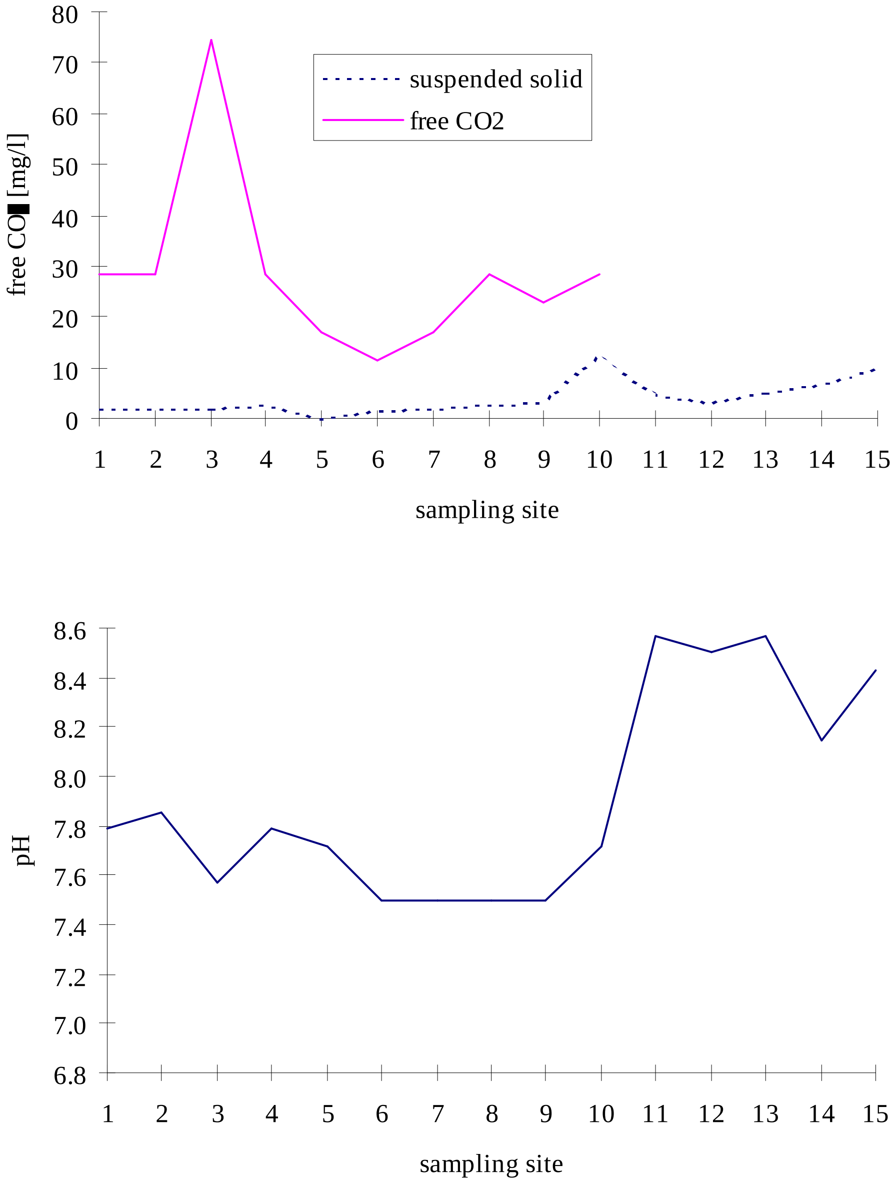


Fig. 1. The suspended solid and free CO_2 concentrations, and pH-values in watre of the Maros (1991).

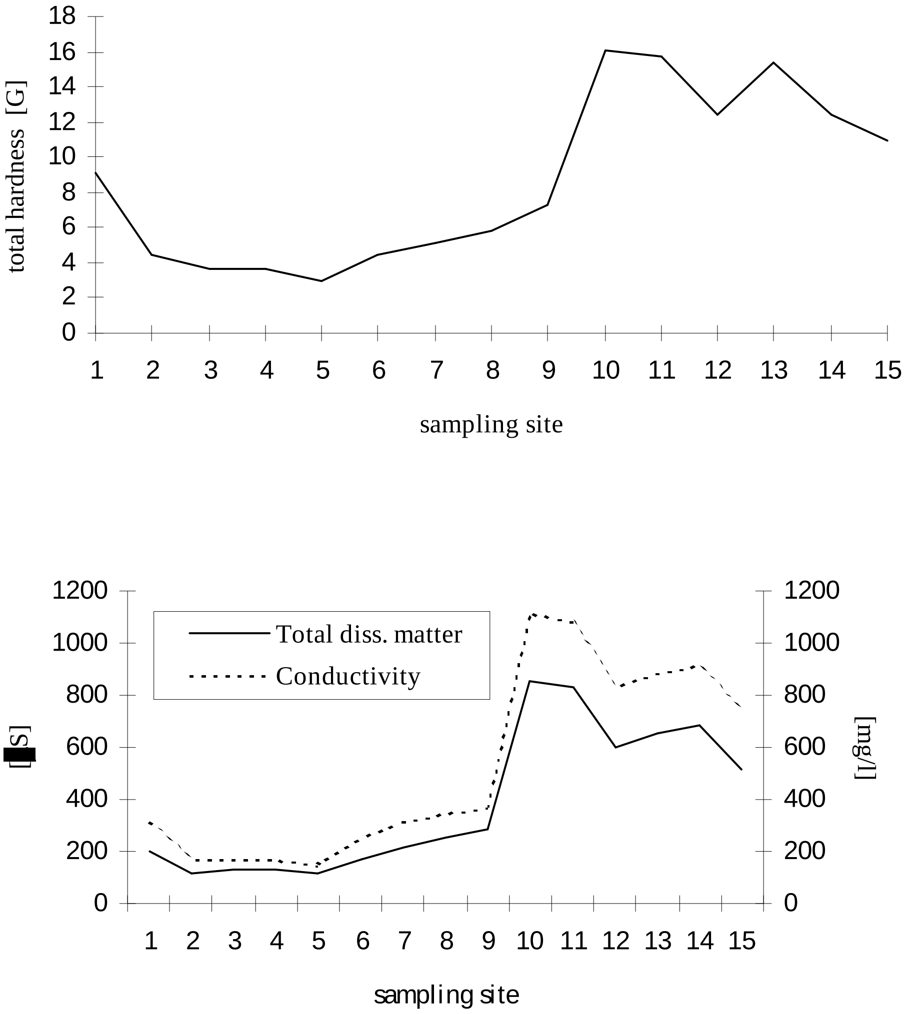


Fig. 2. Values of total hardness, total dissolved solids and conductivity in water of Maros at 15 sampling sites (1991)

Table 1. Some physical and chemical characteristics of the Maros at different sampling sites

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Colour	CL	Y	Y	Y	Y	G	G	GR-Y	Y	Y	Y	Y	Y	Y	Y
Smell	OL	OL	OL	OL	OL	M	CL	CL	OL	MU	MA	CL	OL	OL	MU
Transparency (mm)		800	900	800	800	600	600	500	500	350	600	650	500	400	250
Wether	CR	CR	CR	CY	CY	CY	CR	CR	CY	CY	CY	CY	CY	CY	CY
Air temp. (°C)	18	15	25	24	23	14	17	27	23	24	16	21	22	26	21
Water temp. (°C)	13	12,5	15	19,5	20,5	16	18,5	20	21,5	22	19,5	19,5	20,5	22	21,5
pH	7,8	7,9	7,6	7,8	7,7	7,5	7,5	7,5	7,5	7,7	8,6	8,5	8,8	8,1	8,4
Free CO_2 (mg/l)	3,75	3,5	9,7	3,5	2,4	1,75	2,85	3,5	2,65	3,95	0	0	0	0	0
CO_3 (mg/l)	0	0	0	0	0	0	0	0	0	0	18	18	24	12	12
HCO_3 (mg/l)	193,4	111	83,6	76,9	54,9	79,9	81,1	98,8	97	119,6	25	47,6	87,2	118,3	111
Total Hardness (Germ.)	9	4,6	3,8	3,5	3,8	4,3	5	6	6,9	16,9	15,8	12,6	15	14,7	12,7
Sodium (mg/l)	6,9	6,9	7	9,2	8,1	20,7	24,2	25,3	23	101,2	105,6	80,5	78,2	80,5	62,1
Potassium (mg/l)	0,6	0,8	0,8	2,3	2	4,3	5,1	6,6	5,5	10,2	10,2	9	9	9,4	8,8
Chloride (mg/l)	8,9	3,6	5,3	7,1	7,1	28,1	33,7	33,7	34	257	254	186	183	179	139
Sulfate (mg/l)	4,8	2,4	7,2	12	14,4	21,6	33,6	40,8	50,4	72	113	76,8	76,8	77	64,8
Fluoride (mg/l)	0	0	0	0	0	0	0	0	0	0	0,1	0,2	1,4	0,4	0,45
Sodium percent (%)	8,5	15,2	18	23,4	25	35,2	35,2	32,2	27,9	41,1	43,8	42,5	37,9	38,9	36,1
Conductivity (uS/cm)	314	174	163	165	141	258	313	342	359	1117	1088	827	906	923	742
Total dissolved solid (mg/l)	209	122	127	128	110	190	216	250	267	869	837	595	678	683	525
Suspended matter (mg/l)	17	18	20	24	3	15	18	26	28	100	39	38	39	57	81
NH_4 (mg/l)	0,15	0,3	0,3	0,35	0,25	0,3	1,8	0,75	0,35	0,4	0,3	0,2	0,2	0,35	0,2
NO_2 (mg/l)	0,036	0,026	0,026	0,075	0,042	0,085	0,42	0,42	0,22	0,14	0,085	0,15	0,06	0,07	0,03
NO_3 (mg/l)	6	1,7	2	3,4	3,4	2,6	8	11,5	6,5	9,5	8	7	8,5	8,5	8
Total inorganic N (mg/l)	1,5	0,6	0,7	1,1	1,0	0,7	3,0	2,9	1,5	2,1	2,1	1,8	2,1	2,2	2,0
Total N (mg/l)	2,0	1,0	1,1	1,5	1,2	0,9	3,4	3,4	1,8	2,5	2,9	2,7	2,7	2,6	2,4
Dissolved PO4 (mg/l)	0,11	0,07	0,19	0,16	0,13	0,15	0,48	0,65	0,2	0,34	0,04	0,04	0,01	0,26	0,32
Total P (mg/l)	0,04	0,05	0,07	0,07	0,06	0,12	0,16	0,26	0,14	0,24	0,13	0,13	0,14	0,22	0,26
COD-Mn (mg/l)	4,8	7,2	6,1	6,1	5,8	4,8	6,1	6,2	4	7,4	11,5	10	10	7,6	8,8
COD-Cr (mg/l)	12	22	14	14	14	13	15	17	10	22	26	29	32	22	29
Dissolved O2 (mg/l)	8,4	9,4	9,4	9	9	7	7,8	4,3	7,8	7,2	12,5	11,1	11,9	9	9,4
Oxygen sat. (%)	60	89	94	99	101	71	84	55	89	83	137	102	133	104	107
Phenols (ug/l)	2	0	0	2	2	6	8	8	10	8	6	8	6	8	6
ANA Detergents (mg/l)	5	10	5	5	0	20	30	25	20	5	5	5	10	35	15
Water quality (I=clear, II=polluted)	I	I	I	I	I	I	I	I	I	II	II	II	II	II	II
Water velocity (cm/s)	4	110	90	50	60	10	20	20	25	30	15	5	15	25	20

Table 2. Toxical element content in the water and sediment of Maros at different sampling sites

Toxical elements in WATER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total Cu (mg/l)	2.3	2.2	3.7	2.2	3.6	0.5	2.3	5.8	37	25	13	11	15	19	19
Total Cd (mg/l)	< 0.2	< 0.2	< 0.2	0.2	0.3	< 0.2	< 0.2	< 0.2	0.3	2	0.8	0.7	0.5	0.8	0.8
Total Ni (mg/l)	2.6	1.4	2.5	0.8	6.4	0.5	0.8	0.5	0.6	4	1.2	0.6	0.6	0.8	0.6
Total Zn (mg/l)	4	2.8	8	31	11	6	14	12	80	147	73	71	66	84	82
Total Pb (mg/l)	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	12	30	5.7	6.3	12	18	19
Total Cr (mg/l)	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	75	53	35	22	24	13
Total Hg (mg/l)	0.26	0.1	0.4	0.19	1.1	0.06	1.5	1.2	3	9	0.3	2.1	3.9	2.2	0.9
Total As (mg/l)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.8	< 0.5	< 0.5	0.6	1.3	0.6	1.4	1	0.9
Total Fe (mg/l)	1.2	1	0.8	1.1	0.8	0.6	0.8	0.9	1.5	2.4	0.3	0.4	0.6	1.5	1.7
Total Mn (mg/l)	0.12	0.18	0.1	0.07	0.06	0.07	0.1	0.09	0.21	1.8	0.1	0.18	0.15	0.16	0.14
Water quality	I	I	I	I	I	I	I	I	II	II	I	II	II	II	II
SEDIMENT															
Cu (mg/kg)	13.8	18.9	18.3	20.6	22.4	37.7	10.5	29.3	68.1	114	524	417	73.1	80.9	77.2
Cd (mg/kg)	0.1	0.1	0.1	0.75	0.48	0.9	0.1	0.53	0.19	6.7	5.9	11.3	2.3	3.6	5.3
Ni (mg/kg)	8.4	16.5	3.4	8.3	3.5	26.9	13.2	24.1	12	21.6	37.6	31.7	22.5	23.4	23.2
Zn (mg/kg)	93.6	67.9	41.9	83.5	92.1	126	50.2	96.5	151	664	991	1380	367	468	558
Pb (mg/kg)	19.2	12.1	11.6	38.2	17.5	29.2	13.2	20.2	161	133	215	375	56.2	140	94.4
Cr (mg/kg)	10.8	7.8	2	8.7	3.5	15.7	1.8	26.3	4.6	53.9	61.9	242	28.5	56.1	55.8
Hg (mg/kg)	0.02	0.24	0.02	0.008	0.04	0.39	0.07	0.08	0.124	3.9	0.83	3.3	0.33	0.63	0.51
COD-Mn (g/kg)	65	28	12	28	58	74	8.2	33	2.8	12	23	40	11	16	15
COD-Cr (g/kg)	103	50	29	53	108	119	18	53	6.6	25	47	106	21	38	32
Organic matter (g/kg)	125	57	42	59	103	131	20	56	13	37	62	99	48	43	41
Total N (g/kg)	1.5	0.9	3.22	0.84	2.2	3.3	0.8	1.2	0.54	0.74	1.6	3	0.64	1.2	1.2
Total P (g/kg)	0.39	0.39	0.35	0.88	1.1	1	0.43	0.8	0.31	0.55	0.73	1.9	0.71	0.76	0.93

Nutrients

Values of NH_4-ion concentrations were relatively low because of the high water temperature in summer and the fast nitrification, except below Tîrgu Mureº and Luduº, where the values indicate some sewage discharges (Figure 4).

It is strange that nitrate ions (1.7-6.0 mg/l) occurred even in the water of the upper section. Its concentration increased up to 8 mg/l downstream to Tîrgu Mureº and it maintained with small variation all along to the mouth (Figure 4).

There were no significant nitrite concentrations measured down to Tîrgu Mureº, indicating that no significant pollution sources are present. The major part of the total N in the water was in inorganic form (Figure 5), especially in the form of nitrate. In the upper section of Maros almost all of the total phosphate consisted in ortho-phosphates. Both P forms increased in the middle section. In the lower section down to Zam, there was hardly any PO_4 ion, then the total P increased to the mouth (Fig. 5).

Components of the oxygen budget

The COD values measured by the method of dichromate were not high in the upper sections of the river, the easily oxidable matter fraction (COD-Mn) belonging to the COD-Cr was about 5mg/l (Figure 6). It increased slightly in the middle section below Tîrgu Mureº and Luduº, and increased considerably due to the influence of Tîrnava. It is possible that the high content of organic matter was caused by the secondary production of organics due to algal activity.

For a given distance from the spring, the O_2 saturation of the water was nearly 100% (Figure 7). The decrease of concentrations of dissolved O_2 at the middle section indicates organic matter pollution which can easily be degraded. The most unfavourable conditions were downstream to Luduº, where the dissolved oxygen concentration decreased to 4.3 mg/l. Along the lower section, the saturation was more than 100% (due to high algae populations) which decreased all along to the mouth.

Other components

The values of phenol index (which was determined by the 4-amino-antipyrin method) were worth mentioning only in the middle and the lower sections (Table 1).

Concentrations of anion active detergents were low along the Maros relatively higher values were measured in the sections downstream to Tîrgu Mureº and Arad (Table 1).

Qualification

The present valid standard has three categories and it is too liberal. (MSZ-10-172/1-83. Evaluation and classification of surface water quality.)

The water of the Maros belonged to Class I down to sample site 9. From that point on, it belonged to the Class II. pH-values and concentrations of nitrite ions were in Class III at some sampling sites.

Toxic elements in the waters of the Maros River

In the upper section of the Maros River, Fe and Mn contents of the water are relatively high for geological reasons. The Fe concentrations were 1 mg/l or higher, the same for Mn were 0.1-0.2 mg/l. The maximum values were measured downstream to Tîrnava (Table 2).

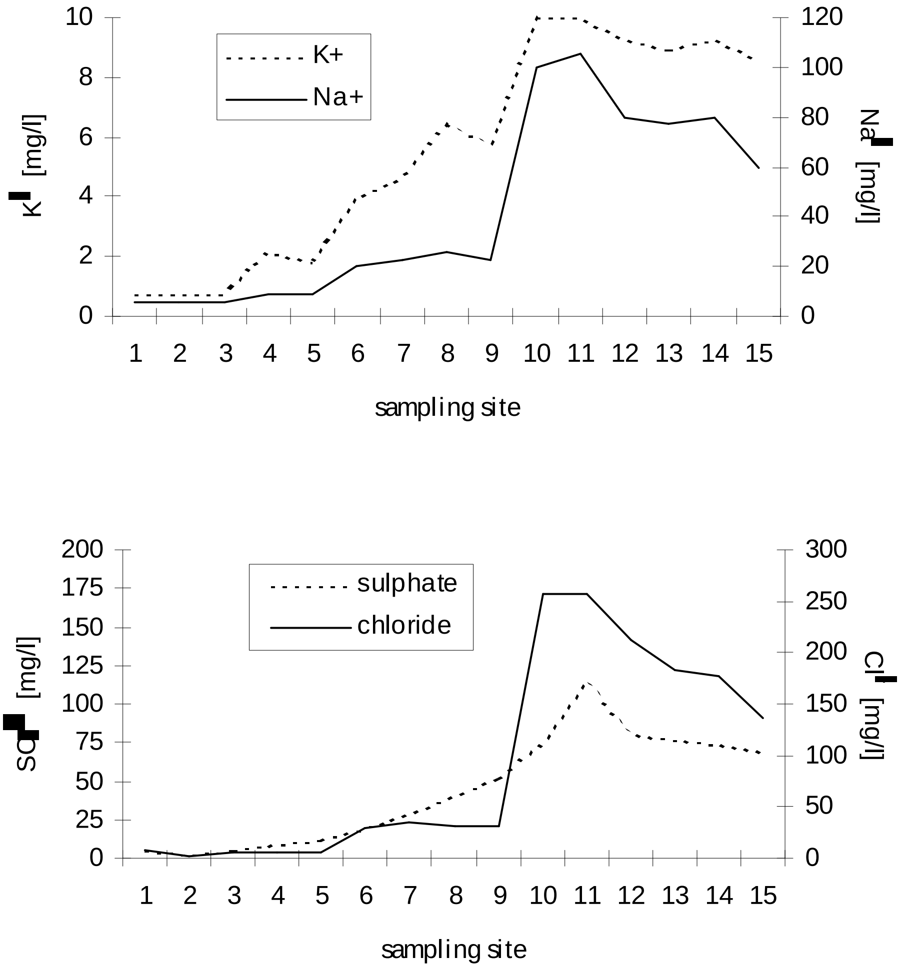


Fig. 3. Concentration of Na^+, K^+, Cl^- and SO_4^{2-} ions in water of Maros (1991)

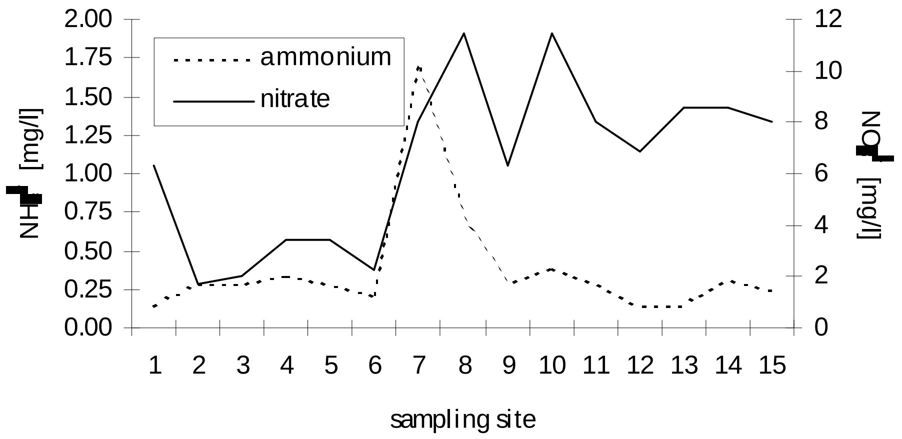


Fig. 4. Concentration of ammonium and nitrate ions in water of Maros (1991)

Arsenic concentrations were under the measuring limit or were found slightly over it, occurring at some sampling sites in the lower sections of the river.

The values of Ni and Cd concentrations were very low, they did not change considerably in the longitudinal section (Table 2).

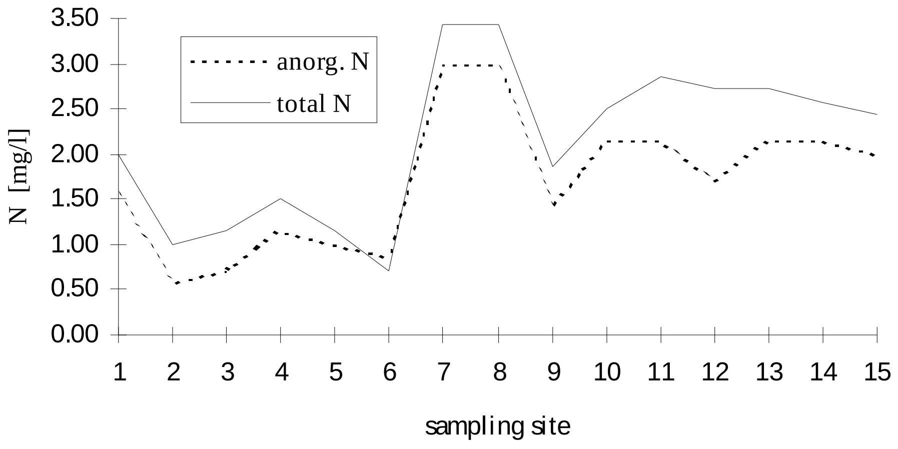
Concentrations of Zn, Cr, Pb, Cu and Hg probably can be considered as being geological background values all along to the sampling site (8) at Ludus. Downstream to the mouth of Aries, the Zn, Cu and Hg concentrations were increased very much (Fig. 8). Downstream to the mouth of Tîrnava, the Zn and Hg concentrations were still increased, and high Cr and Pb values were measured. The above mentioned metals were found in much higher concentrations downstream to the sampling sites 8 and 9 along the river down to the mouth, than in the upper section.

On the basis of the limits given in the integrated qualification, the water quality of the Maros River was Class I down to the mouth of Aries and Class II downstream of it except for one sampling point.

Limit values of metals in water.

1-MI-10-172/3-85. Hungarian technical guideline for limit values. Classification on the basis of the 80% value of the duration curve. Limit values in the integrated requirement system.

2-Proposal of the European Economic Committee. Classification on the basis of median value.



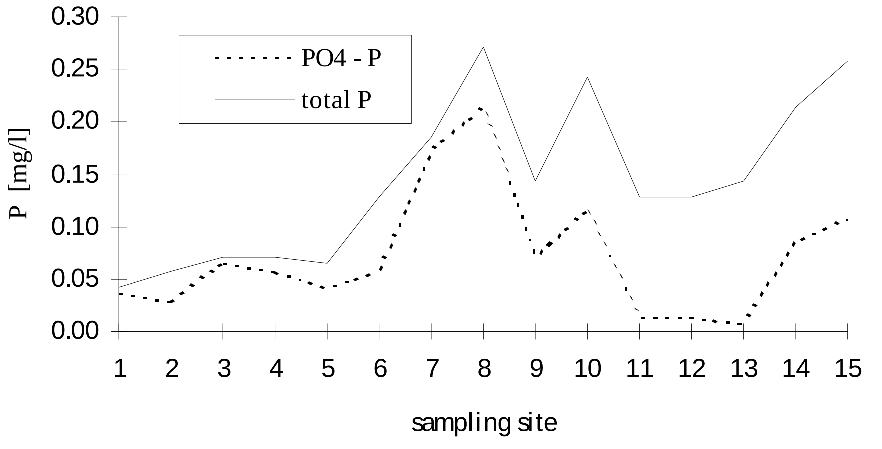


Fig. 5. The nutrient content in water of Maros (1991)

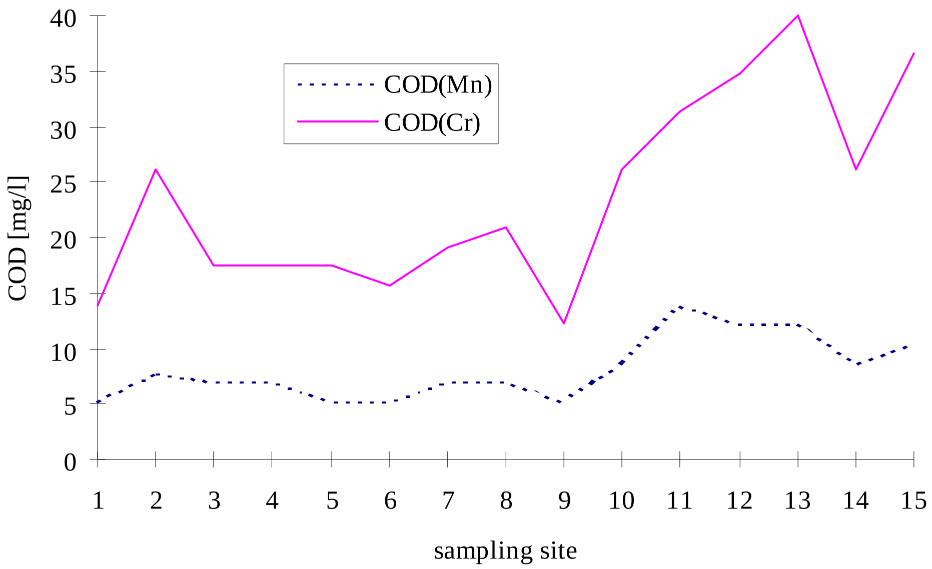


Fig. 6. Chemical oxygen demand of the water of Maros (1991)

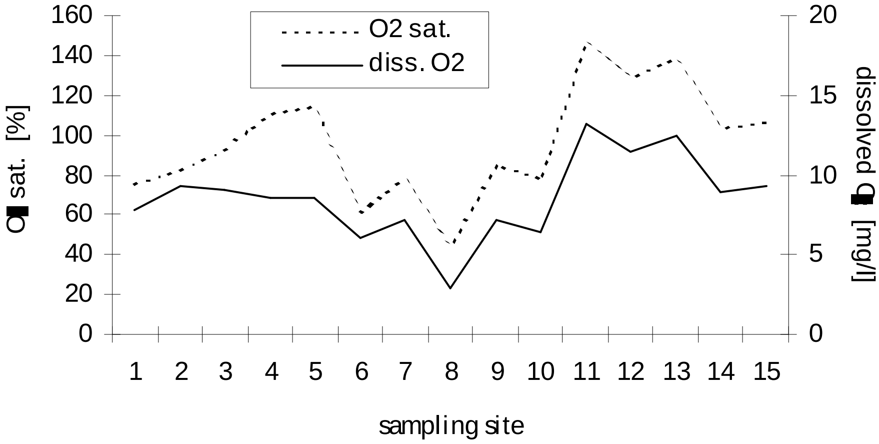


Fig. 7. Dissolved oxygen and oxygen saturation values in water of Maros (1991)

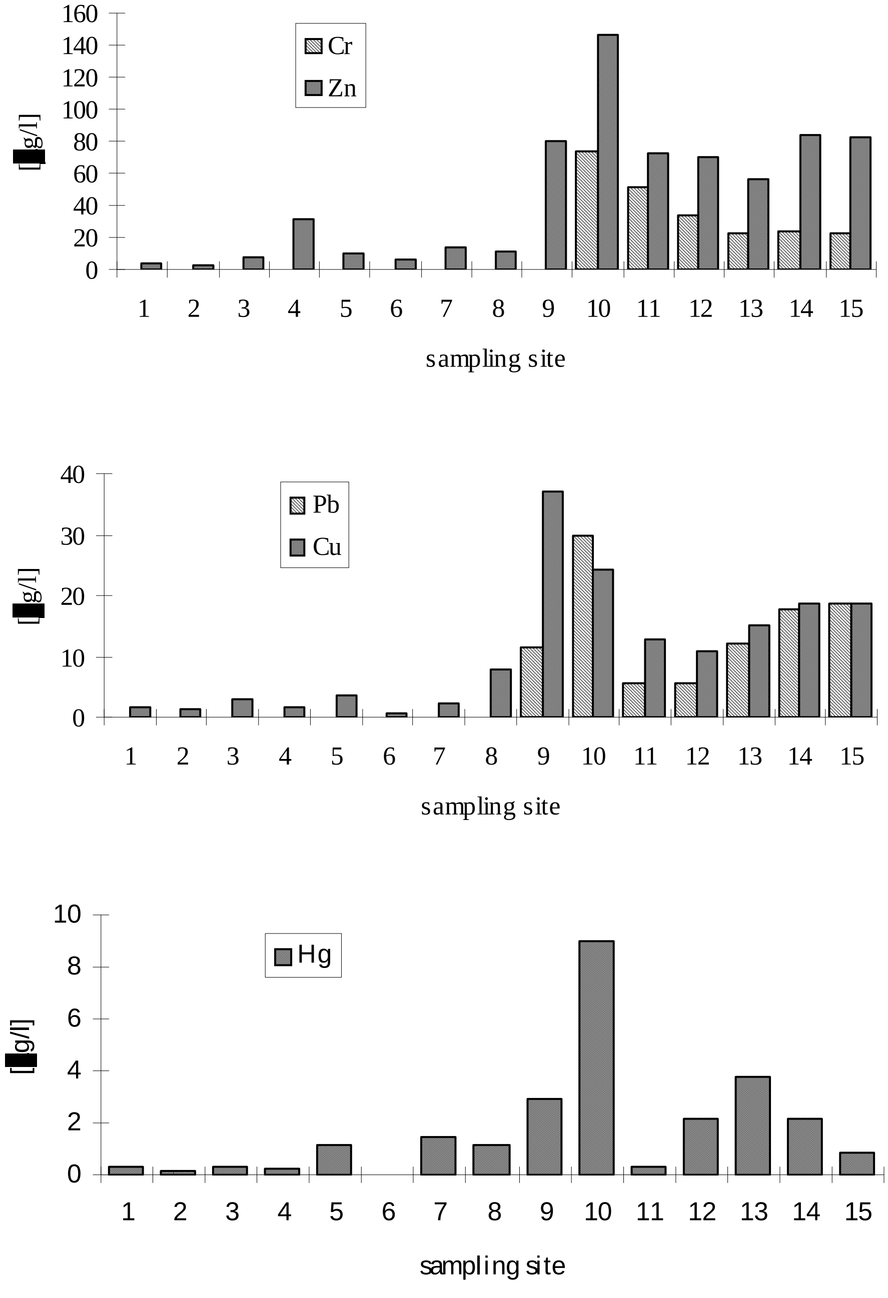


Fig. 8. Heavy metal concentrations in water of Maros (1991)

Results of sediment examination

Concentrations of chemical components in the sediment depend mainly on the grain composition of the sediment and naturally on the contamination of the water. This was the conclusion of earlier investigations made on the Tisza River (Györi and Végvári 1981; László and Berta 1981), and it was supported by other authors (Waijandt et al, 1990) and investigating Tisza River sediment in Kisköre Reservoir (Végvári and Waijandt, 1989).

The organic matter content of the sediment in the longitudinal section of the Maros which was measured by two different methods, and the total N and total P concentrations showed similar figures, which proved indirectly that grain size distribution could play an important role (Fig. 9). The highest values were measured at sampling points in the retained-water sectionsnear Tîrgu Mureº and below Deva. Characterizations of organic matter content by modely incineration at 650 C and by measuring COD-Cr, were in good correlation with each other (Table 2). The ratio of the total and the easily oxidatable organic matter (COD-Cr/COD-Mn) changed between 1.6-2.4, the main value was 2.0.

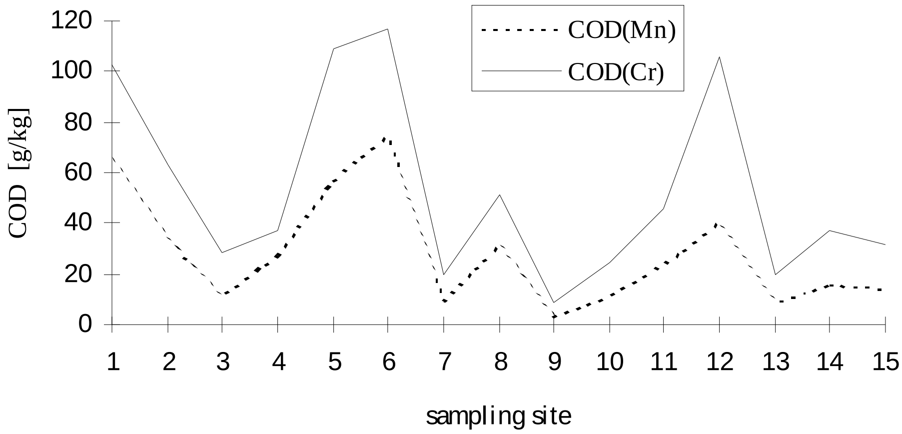
I would like to stress the importance of the finding that the total N and total P concentration values did not differ considerably from each other in particular in the lower section of the river. The sediment quality showed significant changes in functions of the changing river profile in the two upper sections of the river, while downstream to Zam and continuing to the mouth, it was quite balanced.

The concentrations of some metals in 1979 (László and Berta, 1981), many metals in 1986 (Waijandt and Bancsi, 1989) and in 1989 (Waijandt et al, 1990) were higher at the sampling site near the Maros' mouth and the sampling site on the Tisza River below the mouth of the Maros than at the sampling points on the Tisza upstream to the source of the Maros.

The metal content of the sediment indicated prolonged pollution. Below the mouth of the Arieº, the Cu and Pb content in the sediment increased considerably (Fig. 10) in harmony with the concentration values in the water (Fig. 9.). Below the mouth of the Tîrnava, the concentration of Zn, Cu, Cr, Cd and Hg increased suddenly. Most of the metals reached their maximum values below Deva at sampling site 12. Along the 246 km section of the Maros between Zam and Szeged the concentration of the metals were similar and much higher than the upper section of the river, partly because the sediment is spread out by the current.

Conclusions

Water quality showed fundamental differences at the three sections of the Maros. The sampling of the sections were made in three different weeks. The upper section is in a natural state characterized by mineral and pollutant concentration. In the middle section deterioration of water quality was found due to the considerable pollutant load, moreover the Tîrnava tributary increased fundamentally the concentrations of inorganic components in the water. The quality of the lower section, which represents more than half of the total river length, is relatively unfavorable and is classified as Class II. The concentrations of some components indicating anthropogenic effects showed slow increase.



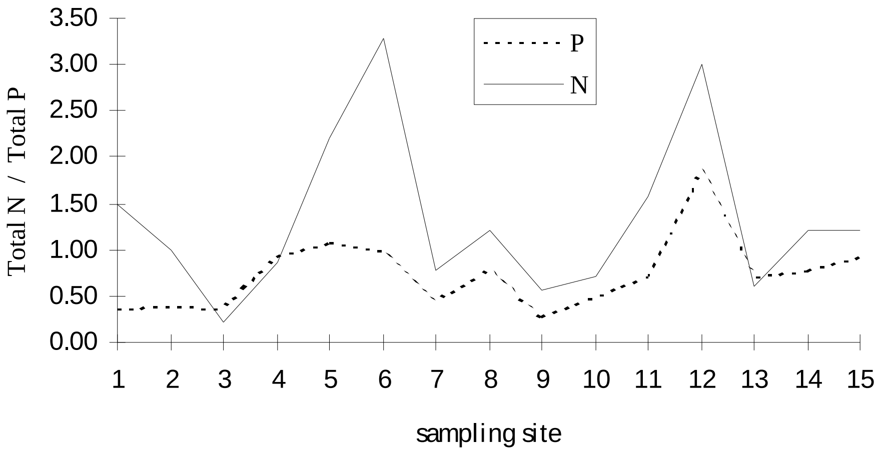


Fig. 9. Chemical oxygen demand and nutrient concentrations in the sediment of Maros (1991)

Metal concentrations, namely Pb and Cu downstream to Aries and Zn, Cu, Pb, Cr, Cd, Hg concentrations downstream to the mouth of Tîrnava were particularly high. Due to the sedimentation of the above-mentioned heavy metals, usually high toxic metal concentrations were produced in the sediment. Spreading of this toxic rediment could be measured on the lower river section as well.

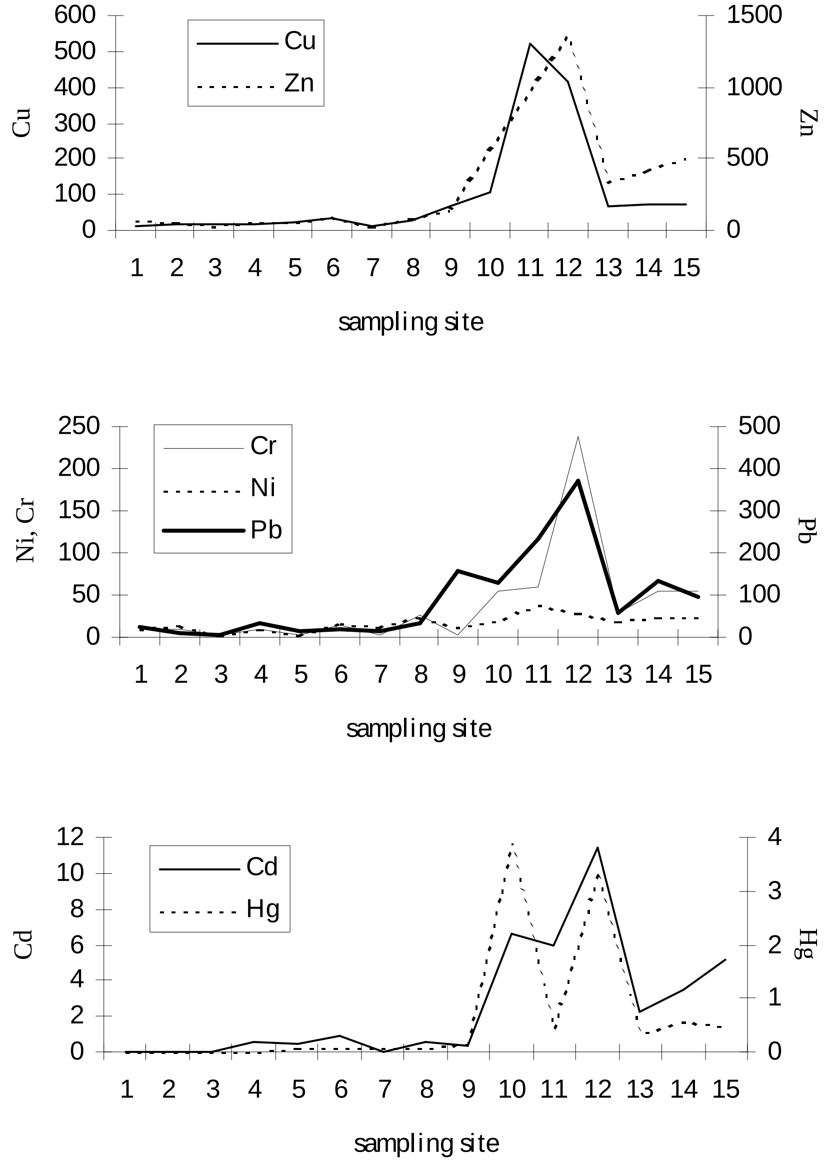


Fig. 10. Heavy metal concentrations in the sediment of Maros (1991)

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STUDY ON ORGANIC MICROPOLLUTANTS OF THE MAROS (MUREŞ) RIVER

ANNA FERGE and LÁSZLÓ SÉLLEI

Introduction

Samples from the Maros River at three sites were investigated by gaschromatograph/mass-spectrometry system (GC/MS).

Sampling sites: 1. Toplița
2. Sîntimbru
3. Makó

The sample preparations and the extraction of organic materials were completed within 24 hours after sampling.

Since we had not known anything about the sampling sites and their characteristics, the sample preparation was completed for multipurpose investigation.

It was particularly a great difficulty in the case of the sample taken at Makó because of its high contents of algae and their metabolic products which distributed the evaluation of mass spectra.

On the basis of the results, the source of the compounds cannot be identified.

Material and methods

Sample preparation

The sample preparations were carried out by means of the USEPA methods.

The extraction of materials that were present in small quantity in the water (between 0.1 and 100 g/l) was carried out from 1000 ml by the following procedure:

— Centrifugation (2000 rpm for 35 min.) was made to eliminate the interfering suspending materials.

— Adsorption of organic materials on XAD-4 resin. The water samples were run through 5 ml of resin at a rate of 30-40 ml/min. After this, the resin was rinsed by 20 ml of supra pure water and the residue of water was purged out by nitrogen stream.

The organic pollutants adsorbed on XAD-4 resin were diluted by 30+30 ml of acetone and 80 ml of dichloromethane.

The elimintion of the water traces of the organic phase was carried out by running it through a column packed with 10 cm 3 of sicc. Na_2SO_4. The column was washed by 30 ml of dichloromethane.

This solution was concentrated in a normal and a micro Kuderna-Danish apparatus down to approx. 0.5 ml. It was then filled up to 1 ml by dichloromethane and stored in a glass vial with PTFE cap at -6 ^{o}C.

Sample analysis

The GC/MS analyses were completed with the following equipment:

Gaschromatograph (GC):

Type: Hewlett-Packard HP-5710A

Column: SPB-5, 50 m x 0.25 mm LD.

Injector temp.: 250 ^{o}C

Temperature program: 30 C/min. up to 250 ^{o}C

Carrier gas: 2 ml/min. He

Mass-spectrometer (MS)

Type: VG-7035

Ionization: EI

Electron energy: 70eV

Ion source temp.: 200 ^{o}C

Ion current: 200 A

Scan time: 0.3 s/decade

Total ion chromatograms (TIC) of the above 3 samples can be seen on Figures 1.,2.,3.

The numbers in circles on the TICs signify the compounds in Table 1, the other numbers are the numbers of scans.

The mass spectra of each compound are available but here they are not shown because of their large amount.

Evaluation

On the basis of TICs and mass spectra we can note the following about pollution in the Maros River:

- In sample 1 compared to the others, there were considerable concentrations of alkanic hydrocarbons which indicate a close pollution source and weak self purification of the water.
- In samples 2 and 3 this kind of pollution was lower. It may be the result of the diluting effects of the effluents of the Maros, the self purification of the water and/or ceasing of pollution sources.
- The presence of 9H-carbazol in each sample indicates the influence of industrial plants being all along the river or the stability of this compound.
- Pesticide residuals can be detected all along the river (e.g. atrazine, terbutrine, etc.). Their concentrations are not so high, they are less than 2 g/l for each, but more than 5 g/l in total.
- The high level of pollution of sample 3 caused by algae and plants did not make it possible to identify the sources of compounds obtained from the TIC (plant, algae origin or industrial, agricultural origin).

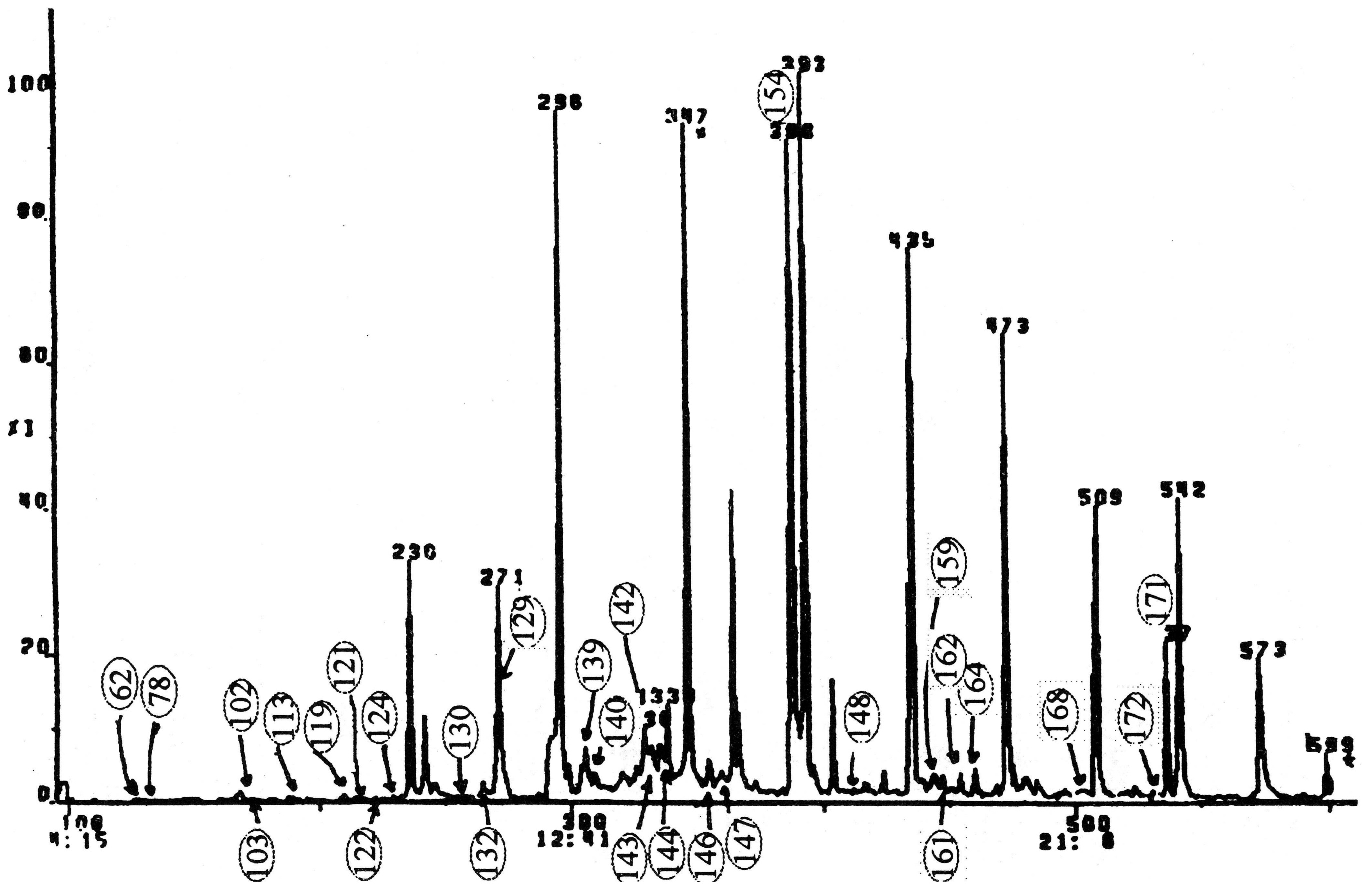

Fig 1. Chromatogram of organic compounds from Toplita region

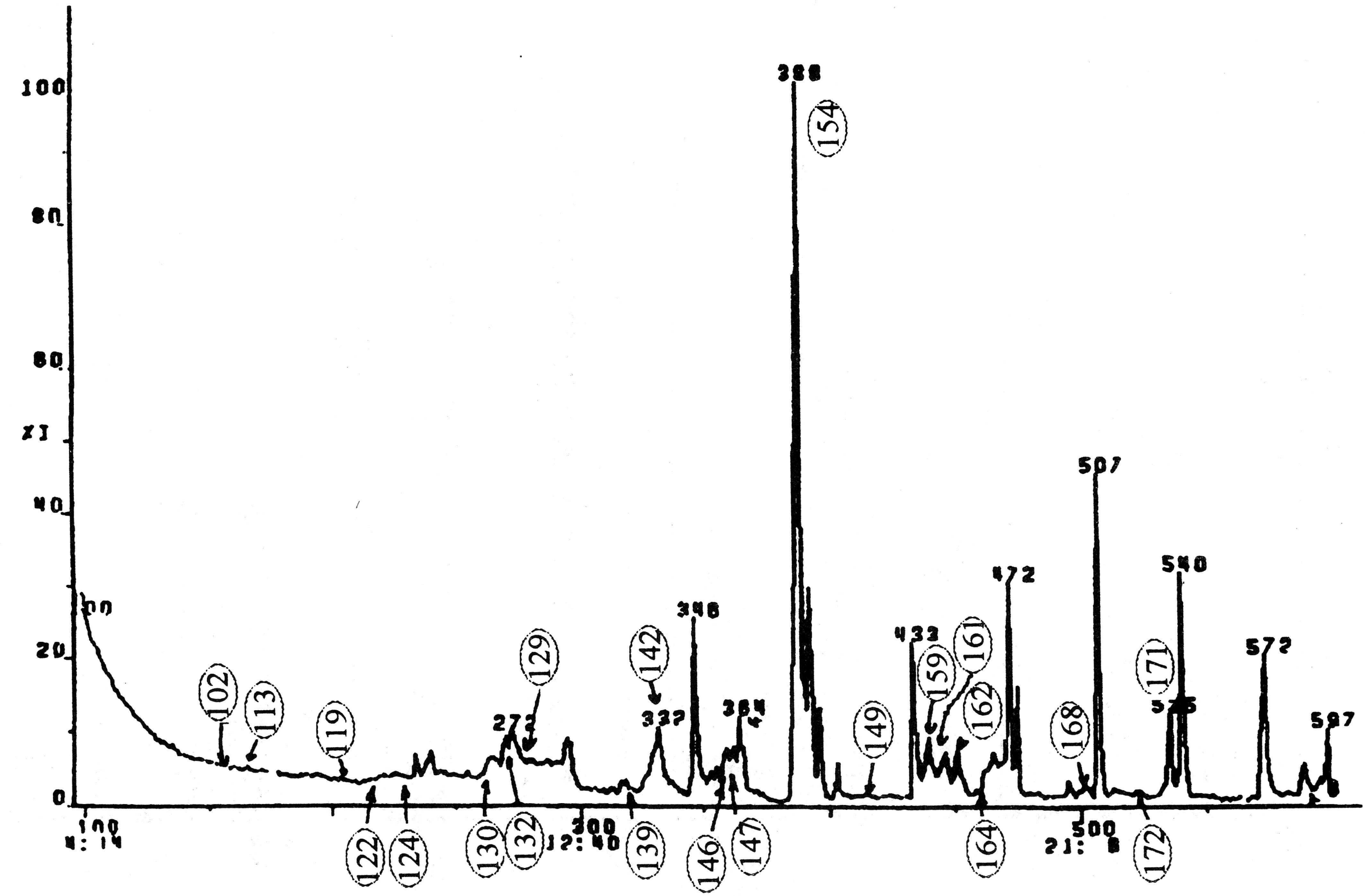

Fig 2. Chromatogram of organic compounds from Sintimbru region

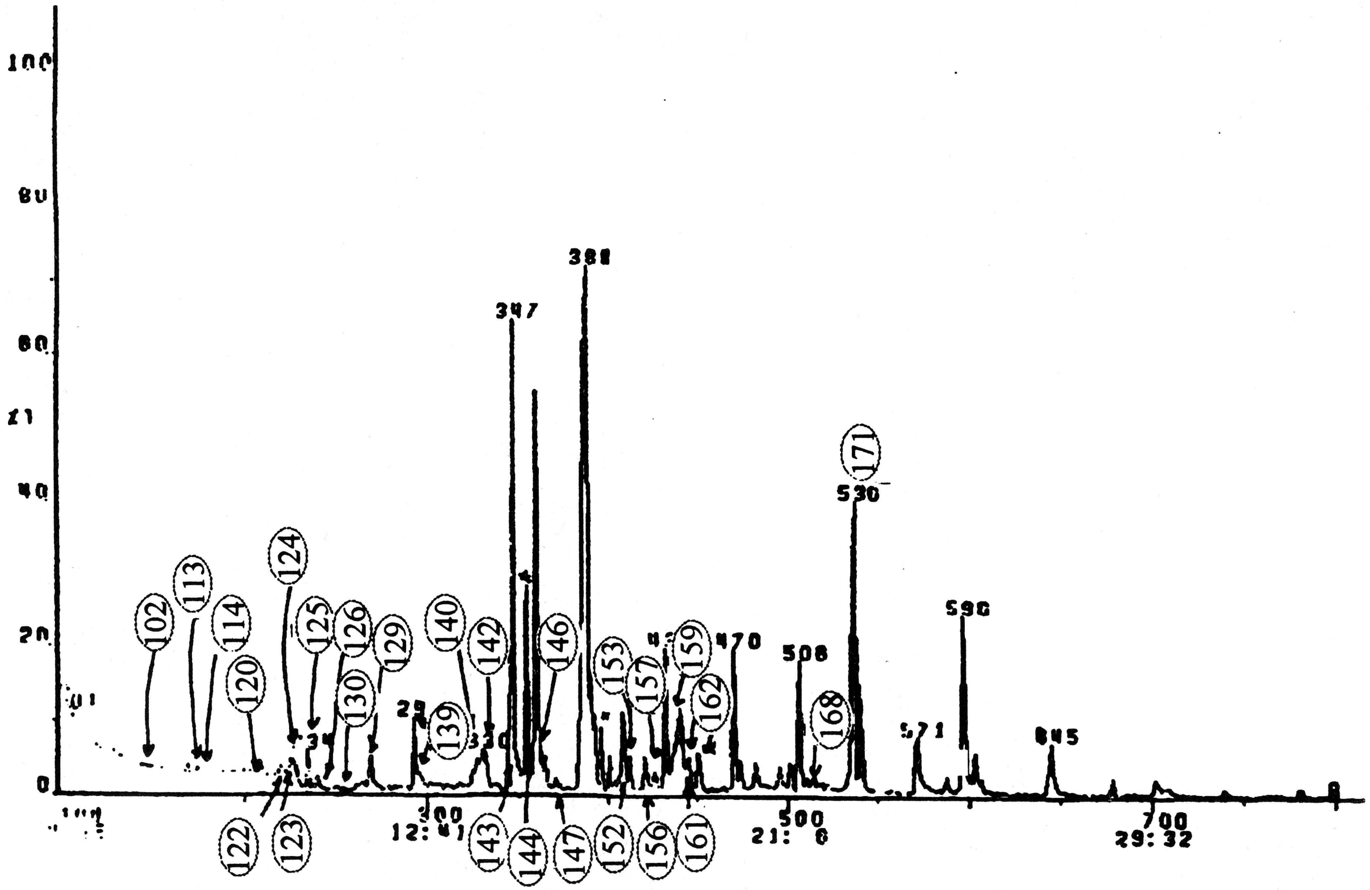

Fig 3. Chromatogram of organic compounds from Makó region

Number of compounds marked on figures

62. o-Cresol
78. 2,4-Dimethylphenol
102. EPTC
103. Biphenyl
113. N-Aca
114. Acenaphtyhlene
119. Anelda
120. 4-Nonylphenol
121. Pyrogallol
122. Propachlor
123. Molinate
124. Dimethyl phthalate
125. Diphenylmethane
126. Acenaphthene
129. Diethyl phthalate
130. Fluorene
132. 9-Methylfluorene
139. 2,6-Di-tertbutyl-4-methylphenol
140. 2,6-Di-tertbutyl-4-ethylphenol
142. Phenanthrene
143. 2,6-Di-tertbutyl-4-methoxyphenol
144. Bisphenol A
146. 2,6-Di-tert-butylmethylphenol
147. Xanthone
148. C18 alkane
149. Ametryn
152. Benzoic acid
153. Anthraquinone
154. Dibutyl phtalate
156. Methylphenathrene
157. 3,6-Dimethylphenathrene
159. Atrazine
161. Tetrabutrine
162. Dimethylphenathrene
164. Pyrene
171. Di(2-etylhexyl,)phtalate
172. Terpenes

Summary

Having finished the first general purpose investigations concerning the organic micropollutants in the Maros River we can state that:

- The occasional samples are useful for only general purpose. For estimating the pollution and its characteristics and self purification efficiency of the river it is necessary to do regular sampling and to know the nature of the polluting sources.
- In order to choose the appropriate methods for the sample preparation and GC analysis, it is essential to know the sampling sites, the expectable kinds of pollutants and the other chemical and biological characteristics of the water.
- The above results describe only a given state of the river at these sites. The applied analysis method does not deal with the volatile materials and those that are adsorbed on the suspending particles eliminated by centrifuging.
-These investigations are useful to plan further studies, to make the polluting sources better known and they indicate that we need much more data to describe the pollution of the 749-km-long River Maros.

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DATA ON THE ESTIMATION OF THE HYGIENIC BACTERIOLOGICAL CONDITION OF THE MAROS (MUREŞ) RIVER

FERENC CSÉPAI

Introduction

The actual bacteriological state of the surface, so called fresh waters - with its chemical and biological parameters - can change not only by means of abiotic factors along the river or its stretch. Extreme changes, which can damage the biosphere, can take place due to environmental effects, negative activities of people. Over the last 20 years there have been scores of publications in the international literature which have dealt with pragmatic chemical- microbiological investigations on surface waters. A lot of data was published in the Hungarian scientific literature dealing with the investigations on rivers and lakes (e.g. Estók, Andrik, Csépai, 1978; Hamar, 1976; Hegedűs, Fodré, Zsigó 1980; etc.).

In this study the author has tried to determine the hygienic bacteriological state of the river and its level of organic matter pollution, implied from the former, in the longitudinal stretch of the Maros by the means of point samples taken from relatively low waters. The results are tentative.

Materials and Methods

We took a total of 15 water samples on three occasions, each time from different sampling sites of the longitudinal stretch of the Maros from 5 to 25 August 1991. During transportation to the laboratory the samples were kept in sterile bottles. The samples were analysed on the day of arrival. The names of the sampling sites are shown in Table 5. For the purpose of investigation 500 ml water samples were taken. In the course of the laboratory investigations the author has determined the mesophilic total bacterial count, the numbers of coliform- and fecal-coliform bacteria, the number of fecal streptococci, the number of Clostridium and Salmonella bacteria. Only 350 ml water samples were available for the determination of Salmonella bacteria instead of 1000 ml. The bacteriological investigations were carried out on the basis of Hungarian standards in "The bacteriological investigation into the drinking water (1971)" and the "Methodological Guide (1977)".

In Table 2 (Hegedűs, Fodré, Zsigó 1980), Table 3 (Regional Environmental Laboratory, Szolnok, 1990) and Table 4 (National Institute of Public Health, Budapest, 1990) there are data from the literature relating to the Tisza and Maros rivers. The author's results are summarized in Table 5. Categories which mark the levels of contamination of water samples are indicated at the bottom of the tables.

Table 1. Limiting values of hygienic water qualifcation (Hungarian Standard)

Categories of water qualification		I Clear	II Moderate polluted	III Polluted	IV Strongly polluted
Hygienic bacteriological parameters	Units				
Coliform	count/ml	0-10	10.1-100	100.1-1000	>1000
Faecal coliform	count/ml	0-1	1.1-10	10.1-100	>100
Faecal streptococcus	count/ml	0-1	1.1-5	5.1-50	>50
Clostridium	count/40 ml	0-10	11-50	51-100	>100
Salmonella positivity in 1000 ml	%	0	<33	33	>33

In Table 1, the table of the National Institute of Public Health and thee Hungarian Ministry of Health (Budapest, 1984) which is suggested for the hygienic qualification of surface waters can be seen. The author has made the bacteriological qualification of samples on the basis of this (Table 1).

Table 2. The mean values of results of hygienic bacteriological investigations by 12 samples for a year on the Maros and Tisza rivers in 1986

No. of samplig sites		1	2
Samlipng site		River Maros at Makó	River Tisza at Tápé
Hygienic bacteriological parameters	Units		
Mesoph. total bact. (37 ^{O}C)	1000*count/ml	20	31.6
Mesoph. total bact. (20 ^{O}C)	1000*count/ml	33.4	36.7
Coliform	count/ml	1000	222
Faecal coliform	count/ml	156	60
Faecal streptococcus	count/ml	15	10
Clostridium	count/40 ml	50	25
Salmonella positivity in 1000 ml	%	15.6	10
Categories of qualification		IV	III

Results and Discussion

It is mentioned above that the investigations carried out on the Maros River are tentative, because there are only limited data for estimating the real state of the Maros. Therefore the evaluation is somewhat strict because the small number of samples would not be enough to qualify on the basis of more than 10% of objectionable sample numbers according the qualification. The parameter which is in the most unfavourable category is the basis of the arrangement. It could be stated from the investigations that the mesophilic total count is relatively great in each of the 15 samples, it is significantly over the "expected" level in the "moderately polluted" category. The number of the coliform bacteria is above the value, which is characteristic of category II, except in sample N'1 and sample N'3. The number of the anaerobic sulfite reductive Clostridium bacteria is "satisfactory" only in the samples N'1-5, it is remarkably greater in samples N'6-15 (category III and IV). The number of fecal coliform bacteria is above the upper limit of category II in samples 5, 10,11,14 and the number of fecal streptococci is above category II only in sample N'14.

Table 3. The results of hygienic bacteriological investigations of the Maros and Tisza rivers (1990) Regional Environmental Laboratory (Szolnok). 1990. (Non published data).

River Maros at Makó

Date of sampling (1990)		05.02.	01.04.	04.06.	06.08.	08.10.	03.12.
Hygienic bacteriological parameters	Units						
Mesoph. total bact. (37 ^{o}C)	1000*count/ml	2.76	2.1	3.5	4.8	2.9	0.62
Mesoph. total bact. (20 ^{o}C)	1000*count/ml	12.3	4.5	7.3	6.9	4.9	13.2
Coliform	count/ml	160	7.8	35	2.1	1.1	160
Faecal coliform	count/ml	3.3	2.6	4.9	0	0.2	22
Faecal streptococcus	count/ml	35	0.3	0.4	0	45	34
Clostridium	count/40 ml	356	150	22	114	60	310
Categories of qualification		IV	IV	II	IV	III	IV

River Tisza at Tápé, above mouth of river Maros

Date of sampling (1990)		05.02.	01.04.	04.06.	06.08.	08.10.	03.12.
Hygienic bacteriological parameters	Units						
Mesoph. total bact. (37 ^{o}C)	1000*count/ml	1.1	1.69	0.72	11.2	3.7	0.45
Mesoph. total bact. (20 ^{o}C)	1000*count/ml	28	7.3	1.17	36	5.2	1.9
Coliform	count/ml	22	23	11	1.3	11	7
Faecal coliform	count/ml	7	7.9	4.9	0	0	2.3
Faecal streptococcus	count/ml	7.5	0.4	0.2	0.1	0.4	1.2
Clostridium	count/40 ml	121	37	32	52	3	79
Categories of qualification		IV	II	II	III	II	III

The author has tried to isolate the Salmonella bacteria from the obligate pathogenic bacteria as well, but there was considerably less water than necessary. As it was found there were Salmonella in seven of the 15 samples, and 4 different serotypes of Salmonella were identified (Table 5), it means that the occurrence and variety of the Salmonella bacteria, causing fever, diarrhoea and vomit, is very frequent. They seem to exist in the water continuously. Of the bacteria, shown in Table 5, the S. typhi-murium is frequent in the Hungarian surface waters. The other isolated Salmonella serotypes also exist in our country but their occurrence is relatively rare. For instance the S. blockley isolated from the samples N'9,11 and 12 is almost a curiosity.

By means of analyzing the hygienic bacteriological states of the Hungarian stretch of the Tisza and Maros, written in the literature (Tables 2, 3 and 4), the author has tried to state the water quality of the Romanian stretch. The comparison of the rivers has been hampered by the fact that the Romanian samples were too little and the quality of the Tisza and Maros changes annually, seasonally and depends on the water output. All of the above mentioned information is needed to give a good bacteriological qualification. On the basis of the available results it may be stated that: The river Tisza, above the inflow of the Maros

(Tables 2, 3) is clearer in a greater proportion of the samples than the Hungarian stretch of the Maros (Tables 2, 3, 4). The more contaminated state of the Maros manifests itself in an earlier high Clostridium numbers, which indicates an intensive bacteriological decomposition. The reason for this is connected with the permanent organic matter load which can be proved indirectly by the bacteriological results.

Table 4. The results of hygienic bacteriological investigations of the Maros river at the mouth at Szeged (764 rkm -1990) National Institute of Public Health (Budapest). 1990. (Non published data).

Date of sampling (1990)		03.01.	08.03.	13.06.	16.08.	10.10.	05.12.
Hygienic bacteriological parameters	Units						
Mesoph. total bact. (37 ^{o}C)	1000*count/ml	22.8	15.6	15	12	24	21
Mesoph. total bact. (20 ^{o}C)	1000*count/ml	20.4	66	18.8	21	27	36
Coliform	count/ml	14	160	170	24	35	700
Faecal coliform	count/ml	17	54	92	3.3	2.2	160
Faecal streptococcus	count/ml	0.9	19	2	80	8	21
Clostridium	count/40 ml	360	220	11	46	40	60
Salmonella serotypes (37 oC)	in 1000 ml	0	0	0	0	S. enteritidis	0
Categories of qualification		IV	IV	III	IV	III	IV

It follows from the earlier and present results (Tables 2, 3, 4 and 5) that organic pollution is entering the river continuously. It seems that this is the reason why the river cannot get to a more progressive period of self-purification. This is primarily due to the fact that whenever chemical and microbiological decomposition could take place, a subsequent contamination happens.

It may be established from the present investigations that the number of the mesophilic heterotrophic and fecal indicator bacteria are far above the "normal" value. This fact is connected with the organic matter load of fecal character, which is likely owing to the frequent occurrence of Salmonella bacteria.

From these facts it emerges that the self purification of the investigated stretch of the Maros River is rather slow. In the future it seems to be advisable to carry out more investigations in order to know the level and regularity of the pollution and to determine the self purification in time and in area as well.

Table 5. The results of hygienic bacteriological investigations of the Maros River (1991) Author's data.

No. of sampling sites		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hygienic bacteriological parameters	Units															
Mesoph. total bact. (37 ^{o}C)	1000*count/ml	8.5	26	3.5	9.5	1.5	1.3	4.8	5.1	3.9	4.6	2.1	2.5	4.2	16	1.5
Coliform	count/ml	4.7	350	3.4	160	170	350	3500	2400	1600	240	24	35	35	1600	13
Faecal coliform	count/ml	0	0.78	0.4	1.7	21	4.9	1.1	0.4	0.2	17	11	14	2.2	1.4	2.2
Faecal streptococcus	count/ml	0.8	1.1	0.7	0.9	0.6	0.8	2.5	0.6	0.7	2.1	1.5	0.9	0.8	6.8	1.3
Clostridium	count/40 ml	2	2	2	8	18	190	120	150	130	520	30	70	65	140	120
Salmonella serotypes (37 oC)	in 1000 ml	0	0	S. typhy-murium	0	0	S. virchow	0	S. typhi-murium	S. blockley	0	S. blockley	S. blockley	S. branden	0	0
Categories of qualification		I	III	II	III	III	IV	IV	IV	IV	IV	III	IV	IV	IV	IV

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ALGOLOGICAL STUDIES OF THE MAROS (MUREŞ) RIVER

JÓZSEF HAMAR

Introduction

Algae play an important role in riverine ecosystems: they produce oxygen, serve as food for animals, and indicate conditions of and changes to the environment.

At points near the source and upper sections of rivers, attached algae (periphyton) are subsurface as inhabitants of the planktonic environment (pseudoplankton, tychoplankton). Due to both the high velocity of water flow in upper sections of river basins, and high turbidity caused by inorganic particles, diatoms are the main group of algae. A decrease in velocity and/or increasing nutrient load can lead to the dominance of other groups (e.g. green algae) of algae. In the middle and lower sections of rivers real planktonic algae (potamoplankton) can become increasingly dominant.

The first records on algae in the Maros River were provided by Schaarschmidt (1880). Lepşi (1925-26) studied the plankton of the river at Orăştie, and recorded 13 species. Péterfi and Róbert (1958) described two new species of Cymbella (Cymbella subcapitata and Cymbella semielliptica) from samples that were taken at Tîrgu Mureş. Róbert (1960,1962), specialist in diatomology, studied the diatoms of the closely connected Tîrgu Mureş backwater between 1960-62. In this backwater an interesting mixture of diatoms that are characteristic for different habitats was found: the planktonic Melosira granulata var. angustissima, the epiphytic Synedra parasitica var. subconstricta and Nitzschia sigmoidea, the alpin-boreal Pinnularia karelica, the rheophyl Ceratoneis arcus and Surirella tenerea var. nervosa and the halophyl Cyclotella meneghiniana, Epithemia sorex, Bacillaria paradoxa and Nitzschia hungarica. He considered most of the species of the identified 92 to be ubiquists. Róbert (1962) described two new taxa from this backwater (Pinnularia interrupta W.Sm. var. intermedia Róbert and Gomphonema augur Ehr. var. marisiensis Róbert). Róbert (1968) studied the diatoms in samples taken from the Maros river at Tîrgu Mureş in 1953.

Diatoms found in the phytobenthos (the term bioderma used in the cited paper) had rheophyl, bentonic, eutrophic and b-mesosaprobic indication values. He characterized the species as having pseudoplanktonic elements; and numerous diatoms had their origin in the saline waters nearby (Sîngiorgiu de Mureş).

Uherkovich (1971) took samples in 1962 and in 1967 at the mouth of the Maros near Szeged. Rheon-type diatoms dominated, characteristic potamoplankton was not observed even when the water level was low. The total number of individuals (1.8-4.8 x 10^6 individuum/l) was higher than that in the Tisza River. The presence of Cyclotella meneghiniana, Nitzschia acicularis and Nitzschia palea among the dominating species indicated a high level of pollution. He concluded that although the Mures has a detectable influence on the Tisza, this is not of considerable significance.

Ádámosi et al. (1978) analyzed the algae of the river along a longitudinal section in 1977. Their conclusion was that the phytoplankton which indicate a high level of pollution and hypertophic conditions have an essential influence on the Tisza River. A significantly increased number of euplanktonic diatoms and green algae was found.

Dobler & Kovács (1981) analyzed the diatoms in the benthos of the Maros River at the mouth. The eu-politrophic indicator Cyclotella pseudostelligera, the planktonic Skeletonema potamos and Nitzschia acicularis, which can be found in polluted waters, were the dominants. The Maros had a considerable influence on the benthic diatom assemblages of the Tisza River.

Váncsa (1981) analyzed the other group of algae in parallel samples of the above survey. His conclusion was that the impact of the Maros on the Tisza is the highest among all the tributaries.

Hamar (1991) established that the phytoplankton of the Maros River is characterized by the dominance of μ-algae (2-3 μ) during the vegetation period. Also, either green algae or Cyclotella meneghiniana can be subdominants. When the total number of algae exceeds 100×10^6 individuum/l, the water is slightly polluted and politrophic. Impact on the Tisza River is considerable.

Material and methods

Samples were taken on 15 sampling sites during a longitudinal sampling trip along the Maros in August 1991. Samples were fixed in Lugol`s Iodine. Algae were counted under an inverted microscope. An Olympus type microscope was used in identifications.

Results

Species composition (fig. 1.)

In this study 159 taxa of algae were found in Mures:

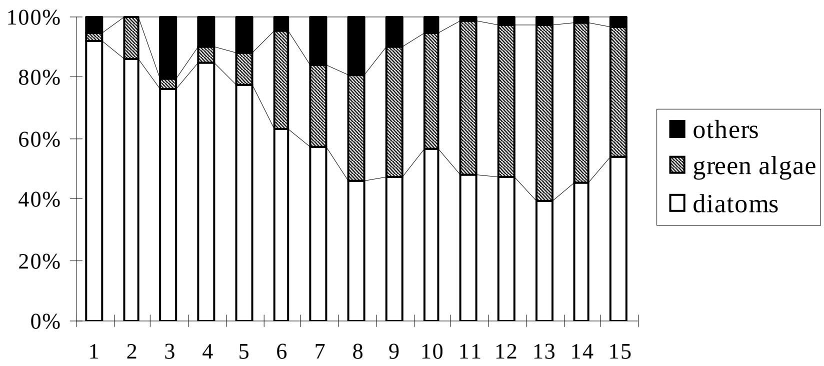
Cyanophyta	10
Euglenophyta	14
Pyrrophyta	7
Chrycophyceae	6
Bacillariophyceae	46
Chlorophyceae	76
Total	159

Cyanophyta

Blue-green algae are sporadic in upper sections of the river. In the middle and upper sections three species, Oscillatoria limnetica Lemm., Phormidium molle (Kutz.) Gom. and

Spirulina laxissima G.S. West are characteristic. All the three planktonic elements can occur in polluted and saline waters. Phormidium molle is saprophytic.

Fig.1. Percentage composition of algal communities



Euglenophyta

Algae belonging to this group are sporadic in the upper and middle sections. Below Alba Iulia species (Euglena polymorpha Dang., Euglena proxima Dang., Euglena viridis Ehr.) indicating polluted conditions appear. The record of Petalomonas involuta Skuja is interesting.

Pyrrophyta

They are rare in the upper section, Rhodomonas lacustris Pasch. et Rutt. and Cryptomonas species are frequently found in lower sections of the river.

Chrysophyceae

Their occurence is sporadic all along the river basin.

Bacillariophyceae

The upper section is characterized by rheophyl elements, although the number of species that are occuring mostly in streams (like Achnanthes minutissima v.minutisima Kutz., Meridion circulare Ag., Nitzschia fonticola Grun.) is rather low. Species indicating eutrophic conditions or modetately polluted environments appear next below the source (Nitzschia acicularis (Kutz.) W.Sm., Navicula cryptocephala Kutz.). Nitzschia palea (Kutz,) W.Sm. is also characteristic in the upper region. Ecological qualification of diatoms lies in a wide range in this river section: oligotrophic and eutrophic, oligosaprobic and a-mesosaprobic indicators are present, they are mostly cosmopolitan. In the midstream section Cyclotella meneghiniana Kutz., Nitzschia palea (Kutz.) W.Sm., Nitzschia acicularis (Kutz.)W.Sm. and Nitzschia palacea Grun. are constant elements. These species indicate eutrophic conditions and polluted environments. Planktonic diatoms appear in this section like Aulacoseira distans (ERhr.) Simon., Acanthoceras zachariaschii (Brun.)Simon.; and Nitzschia reversa W.Sm. which indicate saline waters. The lower section is similar to the midstream one with more planktonic diatoms like Aulacoseira granulata var. angustissima (O.F. M.) Simon.and Skeletonema potamos (Weber) Hasle.

Chlorophyta

Green algae are practically absent in the upper section. A large number of green algae can be found in the middle section, most of them are cosmopolitan and occur in eutrophic waters. Carteria wisconsinense H.P. is a rarity, and occurs in planktonic lakes. The number of taxa increases from the upper section, algae belonging to Chlorococcales dominate. A small sized (2-3 μm) coccoid green alga appears in this region. μ-algae invasion has began some years ago in small eutrophic streams, canals and backwaters are found in larger quantities and recently in rivers too. This coccoid green alga regularly occurs in the Maros River in summer (Hamar 1991). Several rare species, like Chlorogonium elegans (Dang.) Dang., Micractinium crassisetum Hortob., Polyedropsis spinulosa (Schmidle) Schmidle and Pascherina tetras (Kors.) Silva were also recorded.

List of algal taxa of the Maros River (1980-)

CYANOPHYTA
Anabaena spiroides Kleb.
Anabaenopsis elenkinii Mull.
Aphanizomenon issatschenkoi (Uss.)Prosch.
Microcystis aeruginosa Kutz.
Oscillatoria granulata Gard.
O. limnetica Lemm.
O. prolifica (Grev.)Gom.
Oscillatoria spp.
Phormidium molle (Kutz.)Gom.
Spirulina laxissima G.S.West

EUGLENOPHYTA
Euglena acus Ehr.
E. allorgei Defl.
E. geniculata Duj.
E. limnophila Lemm.
E. polymorpha Dang.
E. proxima Dang.
E. viridis Ehr.
Petalomonas involuta Skuja
Phacus arnoldii Swir.
P. pusillus Lemm.
P. pyrum (Ehr.)Stein 3.
P. skujae Skv.
Strombomonas fluviatilis (Lemm.)Defl.
Trachelomonas hispida (Perty)Stein
T. volvocina Ehr.

PYRROPHYTA
Cryptomonas curvata Ehr. em. Pen.
C. erosa Ehr.
C. marssonii Skuja
C. obovata Skuja
C. ovata Ehr.
C. reflexa Skuja
Gymnodinium excavatum Nygaard 3.
Rhodomonas lacustris Pasch. et Rutt.

CHRYSOPHYTA
CHRYSOPHYCEAE
Chrysococcus biporus Skuja
C. rufescens Klebs
Dinobryon divergens Imhof
Mallomonas sp.
Synura globosa (Schiller)Starmach
S. uvella Ehr.

XANTHOPHYCEAE
Goniochloris mutica (A.Braun)Fott 3.

BACILLARIOPHYCEAE
Acanthoceras zachariaschii (Brun.)Simon.
Achnanthes clevei Grun. 2.
A. hungarica (Grun.)Grun. 2.
A. lanceolata (Bréb.)Grun. 2
A. lanceolata v. minor (Straub)Lange-Bertalot. 2.
A. minutissima v. minutissima Kutz.
A. plonensis Hust. 2.
Achnanthes sp.
Amphora normanii Rabh. 2.
Amphora spitzbergiensis Van Land. 2.
A. pediculus (Kutz.)Grun.
Asterionella formosa Hass.
Aulacoseira distans (Ehr.)Simon.
A. italica (Ehr.)Simon. 3.
A. granulata (Ehr.)Simon.
A. gr. v. angustissima (O.F.M.)Simon.
Caloneis amphisbaena (Bory)Cl. 2.

Cocconeis neodiminuta Krammer 2.
C. disculus (Schumann)Cl. 2.
C. placentula Ehr.
Cyclotella radiosa (Grun.)Lemm. 2.
C. glomerata Bach. 2.
C. meneghiniana Kutz.
C. pseudostelligera Hust. 2.
Cylindrothaeca gracilis (Breb.)Gun. 2.
Cymatopleura solea (Breb.)W.Sm.
Cymbella helvetica Kutz. 2.
C. microcephala Grun. 2.
C. silesiaca Bleisch
C. sinuata Greg. 2.
C. silesiaca Bleisch in Rabenh. 2.
Diatoma tenuis Ag.
D. vulgaris Bory
Fragilaria arcus (Ehr.)Cl. v. arcus
F. capucina v. rumpens(Kutz.)Lange-Bertalot 2.
F. ulna (Nitzsch)Lange-Bertalot
Fragilaria ulna v. acus (Kutz.)Lange-Bertalot
Gomphonema angustatum (Kutz.)Raben.
G. augur Ehr.
G. parvulum (Kutz.)Kutz. 2.
G. pseudoaugur Lange-B.
G. olivaceum (Horn.)Breb.
Gyrosigma acuminatum (Kutz.)Rabh. 2.
G. scalproides (Rabenh.)Cl.
M. varians Ag.
Meridion circulare Ag.
N. cari Ehr. 2.
N. cincta (Ehr.)Ralfs
N. cryptocephala Kutz.
N. gregaria Donk. 2.
N. lanceolata (Ag.)Ehr.
N. menisculus Schuman
N. rhynchocephala Kutz.
N. tripunctata (O.F.M.)Bory 2.
N. veneta Kutz.
N. viridula (Kutz.)Ehr.
Nitzschia acicularis (Kutz.)W.Sm.
N. amphibia Grun. 2.
N. constricta (Kutz.)Ralfs in Pritch.
N. dissipata (Kutz.)Grun.
N. fonticola Grun.
N. fruticosa Hus.
N. gracilis Hantzsch 2.
N. hungarica Grun.
N. intermedia Hantzsch
N. palea (Kutz.)W.Sm.
N. paleacea Grun.
N. perminuta (Grun.)Peral.
N. recta Hantzsch 2.
N. reversa W.Sm.
N. subacicularis Hus.
N. sublinearis Hust. 3.
Nitzschia spp.
Rhizosolenia eriensis H.L.Smith
Skeletonema potamos (Weber)Hasle
Stephanodiscus hantzschii Grun. 2.
Stephanodiscus spp.
Surirella angusta Kutz. 2.
S. ovalis Breb.

CLOROPHYTA
Actinastrum hantzschii Lagerh.
Carteria wisconsinensis H.P.
Chlamydomonas spp.
Chlorogonium elegans (Dang.)Dang.
Closterium acutum v. variabile (Lemm.)Krieg. 3.
Coccomonas orbicularis Stein
Coelastrum microporum Naeg.
C. sphaericum Naeg.
Cosmarium botrytis Menegh.
Crucigenia apiculata (Lemm.)Schmidle
C. fenestrata Schmidle
C. quadrata Morr. 3.
C. tetrapedia (Kirschn.)W. et G.S.West
Dictyosphaerium anomalum Kors.
D. ehrenbergianum Naeg. sensu Skuja
D. pulchellum Wood 3.
Didymocystis planctonica Kors.
Didymogenes palatina Schmidle 3.
Eudorina elegans Ehr.
Franceia ovalis (France)Lemm.
Golenkinia viridis (Frenzel)Printz 3.
Gonium pectorale O.F.Muller
Granulocytopsis pseudocoronata (Kors.)Hind. 3.
Hyaloraphidium contortum Pasch.et Kors.
H. cont. v. tenuissimum Kors.
Kirchneriella irregularis ((G.M.)Smith)Kors. 3.
Komarekia appendiculata (Chod.)Fott
Korschikoviella limnetica (Lemm.)Silva 3.
Lagerheimia balatonica (Scherff.)Hind.
L. genevensis (Chod.)Chod.
L. longiseta (Lemm.)Wille
L. quadriseta (Lemm.)G.M.Smith
L. wratislaviensis Schroed.
Lobomonas ampla v.mammilata (Svir.)Kor.
Micractinium crassisetum Hortob.
M. pusillum Fres.
Monoraphidium arcuatum (Kors.)Hind.
M. contortum (Thur.)Kom.-Leg.
M. griffithii (Berk.)Kom.-Leg.
M. komarkovae Nyg.
Neodesmus danubialis Hind.
Nephrochlamys willeana (Printz)Kors.
Oocystis borgei Snow 3.
O. lacustris Chod. 3.
O. marssonii Lemm.
Pandorina morum (O.F.Muller)Bory
Pascherina tetras (Kors.)Silva
Pediastrum boryanum (Turp.)Menegh.

P. duplex Meyen
P. simplex Meyen 3.
P. tetras (Ehr.)Ralfs
Polyedropsis spinulosa (Schm.)Schmidle
Scenedesmus acuminatus (Lagerh.)Chod.
S. acutus Meyen
S. apiculatus (W. et G.S.West)Chod.
S. armatus Chod.
S. bicaudatus Dedus.
S. brevispina (G.M.Smith)Chod.
S. brevispina v. bicaudatus Hortob.
S. denticulatus Lagerh.
S. denticulatus v.linearis Hangs.
S. dispar (Breb.)Rabenh.
S. ecornis (Ehr.)Chod.
S. ecornis v.disciformis Chod.
S. ellipsoideus Chod.
S. intermedius Chod.
S. intermedius v.bicaudatus Hortob.
S. longispina Chod.
S. magnus Meyen
S. opoliensis P.Richt
S. ovalternus Chod.
S. protuberans Fritsch
S. quadricauda (Turp.)Breb.
S. spinosus Chod.
Schroederia indica Phil. 3.
S. setigera (Schroed.)Lemm.
S. spiralis (Printz)Kors.
Scourfieldia cordiformis Takeda
Staurastrum paradoxum Meyen
Tetraedron arthrodesmiforme (West)Wol.
T. caudatum (Corda)Hangs.
T. minimum (A.Br.)Hangs
T. proteiforme (Turn)Brun. 3.
T. triangulare Kors. 3.
Tetraselmis cordiformis (Carter)Stein
Tetrastrum glabrum (Roll)Ahl. et Tiff.
T. punctatum (Schmidle)Ahl. et Tiff.
T. staurogeniaeforme (Schroed.)Lemm.

μ alga (2-3 μ); markless: this study; 2. Dobler-Kovács (1981) only; 3. Hamar (1991) only

Quantitative changes

In the upper section of the river low numbers of individuals were found (0.06 - 0.14 x 10^6 ind/l) and diatoms dominated (72-92 %). Eutrophic indicator species: Nitzschia palacea Grun., Nitzschia acicularis (Kutz.) W.Sm. and Nitzschia palea (Kutz.) W.Sm. dominated. (Table 1, Fig. 2)

Diatoms remain the dominant group in the middle section; they contribute to total numbers by more than 50% . Dominants: Cyclotella meneghiniana Kutz. and the three diatoms listed before. Contribution of green algae is around 30% . Total numbers is higher (0.08 - 0.75 x $1o^6$ ind/l) than in upper sections. Diatoms and green algae almost equally contribute to total numbers in the lower river sections. Cyclotella meneghiniana, Stephanodiscus spp., Nitzschia acicularis and green μ-algae are important. Total numbers changed between 21.5 - 55 x 10^6 ind/l, which indicates that the water is eu-polytrophic and moderately polluted.

Ecological considerations

Composition of algal communities reflect both the hydrographical properties of the rivers and the effects of allochtonous factors, like pollution (Figs. 2-3). The quickly running (50 - 110 cm/s) Maros receives many small streams in its upper section. Correspondingly, algal abundance is low, diatoms dominate. However, species that indicate pollution appear in this section.

Flow velocity is lower in the middle section (20 - 30 cm/s). Beside rheophyl diatoms, planktonic diatoms and green algae are increasingly dominant. Composition of the algal assemblage indicates considerable pollution. There is a further decrease in velocity (5 - 25 cm/s) in the lower section, in addition the pollution is significant. A large number of planktonic species that characterize eu-polytrophic conditions and moderate pollution can be experienced (Figs. 1-3).

Fig.2. Dinamisms of the taxa and number of algae

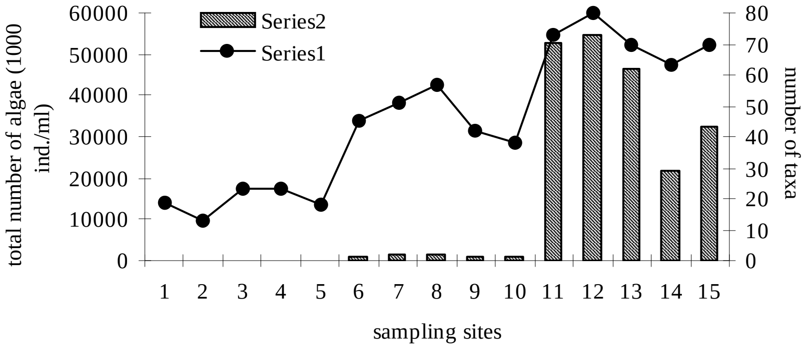
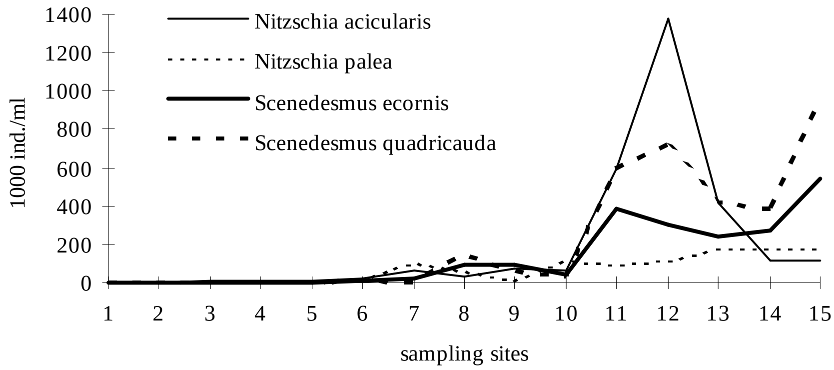


Fig.3. Indications of pollution by increase of individual number of some algal taxa



The above described phenomena are also reflected in correlation analyses. Algal numbers and number of species positively correlated (r= 0.85), while both are negatively correlated with Shannon-diversity (r= -0.64 and r= -0.86, respectively). The considerable

Table1. Quantitative dinamism of phytoplankton of the Maros river

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CYANOPHYTA															
Anabaena spiroides Kleb.								3			6				6
Anabaenopsis elenkinii Mull.										6			30		
Aphanizomenon issatschenkoi (Uss.)Pros.							3	6							
Microcystis aeruginosa Kutz.												6			
Oscillatoria granulata Gard.												6			
O. limnetica Lemm.							6	210	75	30	60	6		6	6
O. prolifica (Grev.)Gom.															6
Oscillatoria spp.	1.5		3	3	6			9	3	3					
Phormidium molle (Kutz.)Gom.					1.5						390	1200	960	120	600
Spirulina laxissima G.S.West								60	9	3	30	30			
total Cyanophyta	1.5		3	3	7.5		9	288	87	42	486	1248	990	126	618
EUGLENOPHYTA															
Euglena acus Ehr.						3		3							
E. allorgei Defl.											6				
E. geniculata Duj.						3	3								
E. limnophila Lemm.											6	6	30		6
E. polymorpha Dang.								6		6	30	6	6		6
E. proxima Dang.				1.5			3	3	3	3		30	30	30	6
E. viridis Ehr.											30	30			
Petalomonas involuta Skuja						3									
Phacus arnoldii Swir.	1.5														
P. skujae Skv.							3								
P. pusillus Lemm.							3								
Strombomonas fluviatilis (Lemm.)Defl.														6	
Trachelomonas hispida (Perty)Stein														6	
T. volvocina						3		3	3		30		6		6
total Euglenophyta	1.5			1.5		12	12	15	6	9	102	72	72	42	24

Table 1. (continued)

PYRROPHYTA														
Cryptomonas curvata Ehr. em. Pen.						3	3	3	3	30	24	60	60	60
C. erosa Ehr.										6	6	6	18	6
C. marssonii Skuja		1.5	1.5											
C. obovata Skuja		1.5	3	3		6					90	60	60	180
C. ovata Ehr.		1.5									6	6	120	60
C. reflexa Skuja					3		3							6
Rhodomonas lacustris Pasch. et Rutt.					9	150	3			60	30	6	30	6
total Pyrrophyta		4.5	4.5	3	12	159	9	3	3	96	156	138	288	318
CHRYSOPHYCEAE														
Chrysococcus biporus Skuja					3	3	3							
C. rufescens Klebs		4.5			15	24				30	30			
Dinobryon divergens Imhof		1.5			3									
Mallomonas sp.		9		1.5										
Synura globosa (Schiller)Starmach		4.5												
S. uvella Ehr.					3	3								
total Chrysophyceae		19.5		1.5	24	30	3			30	30			
BACILLARIOPYCEAE														
Acanthoceras zachariaschii (Brun.)Simon.							3					6	6	18
Achnanthes minutissima v.minutissima Kutz.			4.5	1.5	435	300	90	45		150	90	300	6	6
Achnanthes sp.								6						
Amphora pediculus Grun.							6							
Asterionella formosa Hass.														6
Aulacoseira distans (Ehr.)Simon.								135	30		12	120	6	6
A. granulata (Ehr.)Simon.					3	3	9		3	6	12	60	90	60
A. gr. v.angustissima (O.Mull.)Simon.								6		30	6	120	30	90
Cocconeis placentula Ehr.	1.5		4.5	3		6		3						
Cyclotella cf. meneghiniana Kutz.	1.5	3	1.5		150	195	540	105	120	22500	18675	9600	7800	16000
Cymatopleura solea (Breb.)W.Sm.			1.5											
Cymbella silesiaca Bleisch		1.5												
Diatoma tenuis Ag.												12	6	
D. vulgaris Bory								3						
Fragilaria ulna (Nitzsch)Lange-Bertalot	1.5		6			6		3				6		

Table 1. (continued)

F. ulna v.acus (Kutz.)Lange-Bertalot	3											30	60	6	
Gomphonema angustatum (Kutz.)Raben.	1.5			4.5	7.5		3								
G. augur Ehr.	1.5	1.5	1.5												
G. pseudoaugur Lange-Bertalot															
G. olivaceum (Horn.)Breb.															6
Melosira varians Ag.			1.5		1.5										
Meridion circulare (Grev.)Ag.				1.5											
Navicula cincta (Ehr.)Ralfs								3				6			
N. cryptocephala Kutz.	1.5	1.5	3			3							6		
N. lanceolata (Ag.)Ehr.	1.5														
N. menisculus Schuman							6								
N. rhynchocephala Kutz.	3		3	1.5	1.5	3	3	3	9			60	6		
N. veneta Kutz.		1.5													
N. viridula (Kutz.)Ehr.	3			1.5		3	6		6						
Nitzschia acicularis (Kutz.)W.Sm.	4.5		7.5	6	9	18	60	30	75	60	600	1380	420	120	120
N. dissipata (Kutz.)Grun.		1.5													
N. fonticola Grun.	4.5	9	7.5	1.5						3					
N. fruticosa Hus.											6	30	60	6	180
N. hungarica Grun.						3				3				18	
N. intermedia Hantzsch		24								3					
N. palea (Kutz.)W.Sm.		4.5	10.5	4.5	4.5	24	105	60	6	120	90	120	180	180	180
N. paleacea Grun.	9	10.5	36	28.5	27	3	27	6	15	105	6	30			
N. perminuta (Grun.)Peral.	6	4.5	7.5	1.5											
N. reversa W.Sm.						6	6	6		30	30	6	6	60	18
N. subacicularis Hus.						3		3	12	30	30	60		60	180
Nitzschia spp.	7.5	4.5	6	3	1.5	15	24	3	6	45	60	6	12	60	120
Rhizosolenia eriensis H.L. Smith											6	6	6	6	
Skeletonema potamos (Weber)Hasle											18	30	6	6	120
Stephanodiscus spp.											1800	5400	7200	1200	1200
Surirella ovalis Breb.		1.5	1.5	1.5	1.5										
oher diatoms	3	1.5	12	1.5	18		3	3	9	6	6	12	6	60	
total Bacillariophyceae	54	66	102	75	76.5	669	750	762	444	558	25338	25971	18192	9726	16322

Table 1. (continued)

CHLOROPHYTA															
Actinastrum hantzschii Lagerh.											6	60	60		
Carteria wisconsinensis H.P.						3	3								
Chlamydomonas spp.	1.5	10.5	4.5	1.5		135	60	60	9	9	120	160	240	120	180
Chlorogonium elegans (Dang.)Dang.											6	30			
Coccomonas orbicularis Stein							3		6						
Coelastrum microporum Naeg.								3			12	120	120	12	30
C. sphaericum Naeg.											6	12	60		6
Cosmarium botrytis Menegh.													120		
Crucigenia apiculata (Lemm.)Schmidle						3	3	6			6	90			
C. fenestrata Schmidle															6
C. tetrapedia (Kirschn.) W. et G.S.West						3	3	6		3			60	6	6
Dictyosphaerium anomalum Kors.											30				
D. ehrenbergianum Naeg. sensu Skuja											150	150	60	60	
Didymocystis planctonica Kors.						6		3	3	6	60	90		12	60
Eudorina elegans Ehr.							3						6		
Franceia ovalis (France)Lemm.												30			
Gonium pectorale O.F.M.						3									
Hyaloraphidium contortum Pasch. et Kors.									9	3					
H. c. v.tenuissimum Kors.						3	3								
Komarekia appendiculata (Chod.)Fott															30
Lagerheimia balatonica (Scherff.)Hind.											6	6		90	60
L. genevensis (Chod.)Chod.											12	30	60		
L. longiseta (Lemm.)Wille												30			
L. quadriseta (Lemm.)G.M.Smith										3					
L. wratislaviensis Schroed.											6	60			30
Lobomonas ampla v.mammilata (Svir.)Kor.											6	6			
Micractinium crassisetum Hortob.											30				
M. pusillum Fres.											60	60	6	6	30

Table 1. (continued)

Monoraphidium arcuatum (Kors.)Hind.				3	3		30				
M. contortum (Thur.)Kom.-Leg.		24	105	90	3	45	810	540	1140	420	780
M. griffithii (Berk.)Kom.-Leg.		3	3	3	3	6	30	90	160	60	6
M. komarkovae Nyg.		45	24	3	9		30	30	240	60	60
Neodesmus danubialis Hind.		3	3				6				
Nephrochlamys willeana (Printz)Kors.		3		3	3		6		60		30
Oocystis marssonii Lemm.								6		6	60
Pandorina morum (O.F.M.)Bory											6
Pascherina tetras (Kors.)Silva							6	12			
Pediastrum boryanum (Turp.)Menegh.				3	3			30	60	6	
P. duplex Meyen					3			60	60		
P. tetras (Ehr.)Ralfs									6		60
Polyedropsis spinulosa (Schmidle)Schmidle							12			6	30
Scenedesmus acuminatus (Lagerh.)Chod.			3	3	3		90	180	60	6	90
S. acutus Meyen				3			12			6	
S. apiculatus (W. et G.S.West)Chod.									6		
S. armatus Chod.			3								
S. bicaudatus Dedus.			3	6	3	9	30		60	6	30
S. brevispina (G.M.Smith)Chod.				3		3					
S. b. v.bicaudatus Hortob.							6	30		6	30
S. denticulatus Lagerh.				3			6	30	6	30	
S. d. v.linearis Hangs.				3				6	60	6	60
S. dispar (Breb.)Rabenh.						3					
S. ecornis (Ehr.)Chod.		9	24	90	90	45	390	300	240	270	540
S. e. v.disciformis Chod.	1.5										
S. ellipsoideus Chod.										6	
S. intermedius Chod.			3	3	3		6	120	180	60	120
S. i. v.bicaudatus Hortob.				3			6	6			
S. longispina Chod.					3	3	6	6	6		6
S. magnus Meyen						3	30	6	6	60	30
S. opoliensis P.Richt							60	6	6		120
S. ovalternus Chod.			3					60	60	90	6

Table 1. (continued)

S. protuberans Fritsch								3		9		60	60	12	120
S. quadricauda (Turp.)Breb.						6	3	150	60	30	600	720	420	390	960
S. spinosus Chod.						9	9	12	3	6	240	180	240	210	240
Scourfieldia cordiformis Takeda															60
Schroederia setigera (Schroed.)Lemm.								3			12	30	60	6	60
S. spiralis (Printz)Kors.						3		3			6	12	30		6
Staurastrum paradoxum Meyen						3	3					6			
Tetraedron arthrodesmiforme (West)Wol.											30	60			6
T. caudatum (Corda)Hangs.												30		6	
Tetraedron minimum (A.Br.)Hangs.						6	3	6			30	120		12	6
Tetraselmis cordiformis (Carter)Stein						3	3	3					6		
Tetrastrum glabrum (Roll)Ahl. et Tiff.						3			3	3	30	90	6	60	60
T. punctatum (Schmidle)Ahl et Tiff.						3		3			60	120	6		
T. staurogenieforme (Schroed.)Lemm.							3				30		6	6	120
other Chlorococcales				1.5	10.5	60	75	90	180	180	240	120			
u alga (2-3 u)											23250	23400	22630	9000	9000
total Chlorophyta	1.5	10.5	4.5	4.5	10.5	339	351	573	402	369	26616	27400	26742	11112	13140
TOTAL NUMBER OF ALGAE	58.5	76.5	134	88.5	99	1044	1284	1653	942	981	52668	54877	46534	21534	32410
Number of taxa	19	13	23	23	18	45	51	57	42	38	73	80	70	63	70
H`= diversity (Shannon-Weaver)	3.9	3	3.8	3.8	3.3	3.3	3.9	3.7	4	4.1	2	2.4	2.5	2.5	2.8
S= saprobity index (Pantle-Buck)	2.14	2.07	2.05	2	1.83	2.25	2.35	2.2	1.95	2.16	2	2.34	2.27	2.1	2.2

decrease in diversity in the lower section clearly indicates the immense changes in community structure which is caused by pollution. From Alba Iulia - from this point, which marks the beginning of the lower section of the river, phytoplankton structures strike one more as a well-operated sewage oxidation pond than a river.

Conclusions

Composition of algal communities of the Maros River well reflects both the hydro-geological background and human impacts. Surroundings of the heleocren type source has been already slightly polluted. In its upper region the river flows through a basin with only a slight slope (Giurgeu Basin), where the level of pollution increases. In the Toplişa-Deda strait self-purification occurs.

The middle section begins above the river dam at Tîrgu Mureş. Downstream impacts of sewage water from Tîrgu Mureş and Luduş can be observed. The two considerable streams, Arieş and Tîrnava, dilute the river.

The lower section begins at Alba Julia, where the river receives a high level of pollution. The leads to an algal community structure that characterizes sewage oxidation ponds. The water quality slightly improves in the lower section, where sewage from Makó contributes to an increase in the level of pollution.

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THE PROTOZOAN PLANKTON AND THEIR SAPROBITY RELATIONS IN THE MAROS (MUREŞ) RIVER

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Introduction

Protozoa are without doubt of great importance for both the natural living system and human activity. Their significance regarding the latter cannot be restricted only to the medical and/or veterinary aspects, as their role in the process of self purification or their use as indicator organisms is just as important.

The aims of our investigations were to determine the species composition, abundance relations of planktonic protozoan communities, and to follow the changes of the saprobity relations of the Maros River from its source to the mouth. This investigation was the very first for protozoological research.

Materials and Methods

Water samples were collected from 15 sampling sites along the Maros River. Each time 30 l water was filtered through a net of 10 mesh size. The method used for protozoa is the bromphenol blue test, applied to estimate the protozoa density in planktonic and periphytic communities (Bereczky 1985). In this technique the fresh sample is fixed in HgCl2 solution and "stained" with bromphenol blue. This method allows an accurate counting of individuals in natural samples. We used Protargol impregnation (modified by Wilbert 1974), as well. Evaluation of saprobity by Foissner (1992).

Discussion

Though we looked through many protozoological works we did not find any previous protozoological investigations of the Maros. This was the reason why at first we wanted to get to know what kind of heterotrofic protists live in this river. We found 148 protozoa species from the source to the mouth:

Amoeba: 9
Testacea: 25
Heliozoa: 22
Ciliata: 92

Ciliata appeared to be the richest community. They are dominant according to both their species number and individual number. Regarding the species diversity and distribution three areas can be distinguished along the river.

The first section is between Izvorul Mureº (source) and Sãrmaº (62 km), where the species number was low-average and the individual number was in accordance with flow velocity (see Table 1-4).

From Rastoliþa (105 km) through Tîrgu Mureº (188 riv km, retained water) to Gura Arieºului (282 riv km) extends the region which we identified as the middle section. In this area at Ungheni-Moreºti (207 km) we found the highest species number (39). This community - rich in species - is characteristic of eutrophic waters. In running waters, current rate is one of the most effective factors selecting distribution. In this section, because of the retained water, the river slows and thus the euplanktonic organisms multiply. At site 7 we found Trachelophyllum clavatum (Stokes Cl- ion 33.7 mg/l), which is of small density, but is a good indicator organism for salt water occurrence (Table 7).

At Gura Arieºului (below Arieº) the individual number decreases, which may refer to changes in the nearly natural conditions. A drastic anthropogenic environmental effect occurs at Sîntimbru (355 km), proved by conductivity of 1117 s/cm and the total lack of protozoan communities. We could not identify even a single representative of the investigated groups (Amoeba, Testacea, Ciliata), only a few empty testacean shells and some ciliata cysts indicate the rich community mentioned above.

The third section of the river begins at Alba Iulia (376 km). The low species number and the high individual number is characteristic of mesosaprobic waters. That is without question. Only 8 species form the community where Phascolodon vorticella is dominant and this indicates advanced eutrophication.

The great masses of algae and at the same place the Protozoa become competitors and at this stage (mainly at 375, 445 and 520 km) the autotrophs push the heterotrophs out of the plankton. Under such conditions the afore-mentioned Phascolodon vorticella became absolutely dominant with $1359*10^3$ ind/m^3.

At Deva (455 riv km) the abundance of Protozoa increases and the community is invariably formed of euplanktonic organisms (Table 12).

At Zam (520 km) the individual number begins to decrease, later on at Pecica (676 km) and over Szeged (766 km) come into force such conditions which are characteristic of rivers of the same order (Table 13,14,15).

Most of the Protozoan species found in the Maros as indicators have unknown saprobial classification. The plankto-seston of the upper section is formed by many rare species and is similarly formed by the potamoplankton of the middle and lower sections.

Most species of known saprobity are oligo-beta, betamesosaprobic ones. Though we found alpha- and polysaprobic organisms several times downwards over Rastoliþa, their abundance, though essential to determine indicator values, never reached more than 20% of any community. We found a greater polysaprobic population of Vorticella microstoma only below Arieº (282 km).

The saprobic indexes can be found as percentages in Table 16, they are characteristic of water in summers with high temperatures. In this period the elimination of dissolvable organic matters needs shorter time than in winter. Probably, in colder seasons we could find species which indicate much worse water quality.

Introducing the protozoan community according to their nutrition types helps the evaluation of trophy. It can be read from Table 17, that we found mainly algivorous, algibacteriavorous and bacteriavorous organisms. Detritus- and bacteriavorous species, predators, omnivores and ectocommenzalists are relatively few.

At 207 km, and below Arieº we found species in a relatively high percentage of unknown nutrition types. At Alba Iulia the algivorous dominance of 94.5% indicates a change of conditions from eutrophy to hypertrophy. Algivorous species are dominant at Szeged, too.

Summary

In the Maros River there exists a rich protozoan community which would be worth investigating systematically. I found many organisms, which I could identify only to species. This means that it would be possible to find new species for science with the help of quick examinations. I have to mention that the perishing of protozoa at Sîntimbru may indicate the beginning of more significant, irreversible environmental damage.

At numerous places I found amoeba belonging to the Naegleria genus, which can be identified to species only in laboratory cultures. Some stock of these amoeba has been stated pathogenic. It would be worth extending the investigations to this direction, too.

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Table 1.

Izvorul Mures (Marosfô) 1. 850 m a.s.l. 0 rkm

Mayorella sp.		AB
Arcella gibbosa Penard		A
Arcella vulgaris Ehrenberg b		AB
Bullinula sp.		A
Centropyxis platystoma Penard		AB
Difflugia lobostoma Leidy		AB
Euglypha alveolata Dujardin	b	AB
Qudrulella symmetrica Wallich		AB
Aspidisca marsupialis Penard		B
Lagynophrya sp. ?		
Rakovicia sp. Tucolesco ?		
Thigmogaster potamophilius Foissner		AB
Vorticella citrina O.F. Muller	b	B
Vorticella incisa Stiller		AB
Species number		14
Individual number 1000 x ind/m3		153
Saprobity relations (%)	Nutrition types (%)	
b 23.5	A 11.8	
sn 76.5	A+B 58.8	
	B 17.6	
	? 11.8	

Table 2.

Senetea (Szenete) 2. 780 m a.s.l. 10 rkm

Amoeba proteus (Pallas)	b	AB
Vahlkampfia dubia Kahl	B	
Centropyxis platystoma Penard	AB	
Cyphoderia trochus Penard	AB	
Euglypha alveolata Dujardin	b	AB
Qudrulella symmetrica Wallich		B
Trinema enchelys Ehrenberg	b	B
Histiobalantium sp.		?
Holophyra hexatricha Savi		A
Pseudoprorodon sp.		A
Telotrichidium sp.		B
Vorticella microscopica Fromentel		B
Vorticella sp.		B
Species number		13
Individual number 1000 x ind/m3		180
Saprobity relations	(%) Nutrition types (%)	
b 20.0	A 10.0	
sn 80.0	A+B 20.0	
	B 65.0	
	? 5.0	

Table 3.

Suseni (Gyergyóújfalu) 3. 744 m a.s.l. 16 rkm

Mayorella vespertilio Penard		B
Trichamoeba villosa Wallich		B
Arcella gibbosa Penard		A
Arcella hemisphaerica Perty		A
Centropyxis aculeata Stein	ob	DB
Centropyxis constricta Ehrenberg		DB
Centropyxis hirsuta Deflandre		DB
Cyclopyxis arcelloides (Penard)		DB
Euglypha alveolata Dujardin	b	AB
Trinema enchelys Ehrenberg	b	B
Trinema linea Penard	b	B
Aspidisca marsupialis Penard		B
Cyclidium sp.		B
Enchelys sp.		?
Holophrya hexatricha Savi		A
Oxytricha sp.		?
Prorodon sp.		?
Strobilidium sp.		?
Stylonychia mytilus complex	a	AB
Suctoria sp.		P
Trichodina sp.		EC
Trithigmostoma cucullulus (O.F. Muller) Jankowski	a	AB
Vorticella nebulifera O.F. Muller	ob	BA
Vorticella sp.		?
Species number		24
Individual number 1000 x ind/m3		207
Saprobity relations (%)	Nutrition types (%)	
ob 6.8	A 14.0	
b 18.8	A+B 17.0	
a 6.8	B 24.0	
sn 67.6	B+A 3.4	
	D+B 17.4	
	EC 3.4	
	P 3.4	
	? 17.0	

Table 4.

Sarmas (Salomas) 4. 671 m a.s.l. 62 rkm

Centropyxis constricta Ehrenberg		DB
Centropyxis discoides Penard	ob	DB
Aspidisca marsupialis Penard		B
Cyclidium sp.		B
Epistylis elegans Stiller		B
Glaucoma myriophylli Penard		BA
Lembadion lucens (Maskell)	b	A
Nassula sp.		?
Trichodina sp.		EC
Species number		9
Individual number 1000 x ind/m3		99
Sarobity relations (%)	Nutrition types (%)	
ob 9.1	A 27.3	
b 27.3	A+B 27.3	
sn 63.6	B+A 9.1	
	D+B 18.1	
	EC 9.1	
	? 9.1	

Table 5.

Rastolita (Rastonya) 5. 522 m a.s.l. 105 rkm		
Centropyxis aculeata Stein	ob	DB
Centropyxis constricta Ehrenberg		DB
Cyclopyxis arcelloides (Penard)		DB
Difflugia oblonga Ehrenberg		DB
Difflugia sp. ures hej		?
Euglypha alveolata Dujardin	b	AB
Aspidisca marsupialis Penard		B
Carhesium sp.		?
Colpidium colpoda (Losana)	p	B
Enchelys simplex Kahl		P
Epistylis elegans Stiller		B
Epistylis sp.		?
Lembadion lucens (Maskell)	b	A
Lembadion magnum (Stokes)	b	A
Paramecium caudatum Ehrenberg	a	B
Pseudocohnilembus pusillus (Quennerstedt)	ap	BA
Vorticella similis Stokes	ob	A
Vorticella striata v. octava Stokes	p	B
Species number		18
Individual number 1000 x ind/m3		207

Saprobity relations (%)	Nutrition types (%)
ob 8.7	A 30.4
b 30.4	A+B 4.3
a 8.7	B 26.1
ap 4.3	B+A 4.3
p 8.7	D+B 17.4
sn 39.1	P 4.3
	? 13.0

Table 6.

Tirgu Mures (Marosvásárhely) 6. 307 m a.s.l. 188 rkm		
Amoeba priteus (Pallas)	b	AB
Mayorella sp.		?
Mayorella vespertilio Penard		AB
Arcella c.f. hemisphaerica Perty		AB
Arcella discoides Ehrenberg	ob	AB
Centropyxis aculeata Stein	ob	DB
Cyphoderia ampulla Ehrenberg	ob	AB
Euglypha alveolata Dujardin	b	AB
Hyalosphaenia cuneata Stein		?
Trinema enchelys Ehrenberg	b	B
Heliozoa sp.		P
Balanonema sapropelica Foissner		B
Bizonula parva (Linneaus) Corliss		B
Chilodontopsis vorax (Stokes)	ba	BA
Cyclidium sp.		?
Glaucoma myriophylli Penard		BA
Halteria grandinella (O.F. Muller)	ba	?
Holoprya hexatricha Savi		A
Lembadion lucens (Maskell)	b	A
Lembadion magnum (Stokes)	b	A
Litonotus fasciola (O.F. Muller)	a	P
Paramecium aurelia complex	b	B
Paramecium bursaria (Ehrenberg)	b	B
Rhabdostyla congregata Zacharis ?		
Tachysoma pellionella (O.F. Muller)	ap	BA
Tintinnidium semiciliatum Sterki		B
Tracheilus ovum Ehrenberg	ba	P
Trichodina sp.		EC
Vorticella incisa Stiller		AB
Species number		29
Individual number 1000 x ind/m3		372

Saprobity relations (%)	Nutrition types (%)
ob 6.7	A 8.3
b 28.8	A+B 22.0
ba 6.7	B 25.5
a 1.6	B+A 15.6
ap 1.6	D+B 5.1
sn 54.6	EC 8.6
	P 4.8
	? 9..9

Table 7.

Unheni-Moresti (Nyárádtô) 7. 287 m a.s.l. 207 rkm

Amoeba proteus (Pallas)	b	AB
Amoeba sp.		?
Mayorella sp.		?
Mayorella vespertilio Penard		AB
Arcella hemisphaerica Perty		A
Centropyxis constricta Ehrenberg		DB
Centropyxis platystoma Penard		DB
Cyclopyxis arcelloides Penard		DB
Cyphoderia ampulla Ehrenberg	ob	DB
Difflugia oblonga Ehrenberg		DB
Euglypha alveolata Dujardin	b	AB
Sphenoderia lenta Schlumberger		?
Trinema enchelys Ehrenberg	b	B
Chilodontopsis vorax (Stokes)	ba	BA
Colpidium campylum (Stokes)	p	B
Condylostoma vorticella (Ehrenberg)	b	O
Glaucoma myriophylli Penard		BA
Loxophyllum meleagris (O.F. Muller)	b	P
Nassula sp.		?
Oxyitricha saprobia Kahl	ap	BA
Paramecium aurelia complex	b	B
Paramecium bursaria (Ehrenberg)	a	B
Paramecium multimicronucleata (Powers)		B
Podophrya fixa (O.F. Muller)	p	P
Stentor polymorphus (O.F.Muller)	b	O
Stentor sp.		?
Tachysoma pellionella (O.F. Muller)	ap	BA
Trachelius ovum Ehrenberg	ba	P
Trachelophyllum clavatum (Stokes)		?
Trithigmostoma cucullulus (O.F. Muller)Jankowski	a	AB
Vorticella convallaria (Linneaus)	b	A
Vorticella incisa Stiller		AB
Vorticella margaritata Fromentel	b	A
Vorticella mayeri Faure-Freimet	b	AB
Vorticella nebulifeta (O.F. Muller)	ob	AB
Vorticella picta (Ehrenberg)	o	AB
Vorticella striata v. octava Stokes	p	B
Zoothamnium ramosissimum Sommer		BA
Peritricha (Telotroch phase)		?
Species number		39
Individual number 1000 x ind/m3		938

Saprobity relations (%)	Nutrition types (%)
o 0.6	A 5.5
ob 4.8	A+B 20.5
b 21.2	B 11.6
ba 1.3	B+A 7.5
a 2.0	D+B 4.7
ap 2.0	P 1.9
p 5.4	O 2.8
sn 62.6	? 45.5

Table 8.

Ludus-Gheja (Ludas) 8. 263 m a.s.l. 270 rkm

Amoeba proteus (Pallas)	b	AB
Amoeba sp.		?
Mayorella sp.		?
Mayorella vespertilio Penard		B
Naeglaria sp.		?
Pelomyxa palustris Greef	p	BA
Arcella gibbosa Penard		A
Cochliopodium bilimbosum Auerbach		B
Sphenoderia lenta Schlumberger		?
Chilodontopsis vorax (Stokes)	ba	BA
Cinetochilum margaritaceum (Ehrenberg)	p	B
Codonella cratera Leidy	ob	BA
Coleps hirtus v. lacustris Faure-Fremiet		P
Colpes nolandi Kahl		P
Condylostoma vorticella (Ehrenberg)	b	O
Enchelyomorpha vermicularis (Smith)	p	?
Enchelys simplex Kahl		?
Epistylis plicatilis Ehrenberg	a	B
Epistylis rotans Svec	ob	B
Euplotes eurystomus (Wrzesniokowski)	a	O
Euplotes patella f. planktonicus Kahl		O
Glaucoma myriophylli Penard		BA
Glaucoma scintillans Ehrenberg	p	B
Holophrya hexatricha Savi		AB
Litonotus faciola (O.F. Muller)	a	P
Pleuronema crassum Dujardin	BA	
Prorodon sp.	?	
Stentor coeruelus Ehrenberg		O
Stentor igneus Ehrenberg	b	O
Stentor polymorphus (O.F. Muller)	b	O
Tachysoma pellionella (O.F. Muller)	ap	BA
Vorticella incisa Stiller		BA
Vorticella monilata Tatem		B
Vorticella nebulifeta (O.F. Muller)	ob	BA
Species number		34
Individual number 1000 x ind/m3		352

Saprobity relations (%)	Nutrition types (%)
ob 6.0	A 2.0
b 12.2	A+B 6.2
ba 2.0	B 13.9
a 8.2	B+A 20.2
ap 2.0	P 8.2
p 7.9	O 25.0
sn 61.4	? 24.4

Table 9.

Gura-Ariesului (Aranyos) 9. 262 m a.s.l. 282 rkm

Amoeba sp.		?
Mayorella sp.		?
Trichamoeba villosa Wallich		B
Arcella hemispharerica Perty		A
Centropyxis constricta Ehrenberg		DB
Trinema enchelys Ehrenberg	b	B
Coleps hirtus v. lacustris Faure-Fremiet		P
Colpidium colpoda (Losana)	p	B
Euplotes eurystomus (Wrzesniokowski)	a	O
Loxophyllum meleagris (O.F. Muller)	b	P
Spirostomum ambiguum (O.F. Muller)	a	B
Stentor igneus Ehrenberg	b	O
Tintinnidum sp.		?
Vorticella convallaria (Linneaus)	b	A
Vorticella microstoma Ehrenberg		?
Vorticella nebulifeta (O.F. Muller)	ob	BA
Vorticella sp.		?
Peritricha (Telotroch phase)		?
Species number		18
Individual number 1000 x ind/m3		318

Saprobity relations (%)	Nutrition types (%)
ob 6.9	A 2.2
b 6.6	B 24.8
a 9.1	B+A 11.6
p 18.9	D+B 2.2
sn 59.1	P 4.4
	O 4.4
	? 50.3

Table 10.

Sintimbru (Marosszentimre) 10. Küküllô, Trnavelli, 229 m a.s.l. 355 rkm
Neither Amoeba, Testacea nor Ciliata can be found in the collected samples.

Table 11.

Alba Julia (Gyulafehérvár) 11. 213 m a.s.l. 376 rkm

Arcella arenaria Greeff		A
Coleps hirtus (O.F. Muller)	ba	P
Euplotes moebiusi Kahl	p	B
Holosticha sp.		?
Phascolodon vorticella Stein	b	A
Urceolaria sp.		EC
Urosona butschlii Schewiakoff	p	B
Vorticella similis Stokes	ob	A
Species number		8
Individual number 1000 x ind/m3		1431

Saprobity relations (%)	Nutrition types (%)
ob 0.6	A 96.2
b 95.0	B 1.9
ba 0.6	EC 0.6
p 1.9	P 0.6
sn 1.9	? 0.6

Table 12.

Deva (Déva) 12. 182 m a.s.l. 455 rkm

Naegleria sp.		?
Halteria grandinella (O.F. Muller)	ba	?
Halteria oblonga Kellicott		?
Phascolodnon vorticella Stein	b	A
Strobilidium sp.		?
Vorticella mayeri Faure-Fremiet	b	B
Vorticella sp.		?
Species number		7
Individual number 1000 x ind/m3		2420

Saprobity relations (%)	Nutrition types (%)
b 95.4	A 94.5
ba 1.4	B 0.9
sn 3.2	? 4.5

Table 13.

Zam (Zam) 13. 155 m a.s.l. 520 rkm

Astrmoeba radiosa Dujardin	ba	B
Naegleria sp.		?
Actinosphaerium eichonii (Ehrenberg)	ob	P
Coleps hirtus v. lacustris Faure-Fremiet		P
Phascolodnon vorticella Stein	b	A
Stylonychia pustulata (O.F. Muller)	b	A
Vorticella citrina O.F. Muller		B
Vorticella mayeri Faure-Fremiet	b	B
Species number		8
Individual number 1000 x ind/m3		1969

Saprobity relations (%)	Nutrition types (%)
ob 11.7	A 81.6
b 82.1	B 2.8
ba 1.7	P 12.8
sn 4.5	? 2.8

Table 14.

Pecica (Pecske) 14. 97 m a.s.l. 675 rkm

Naegleria sp.		?
Centropyxis constricta Ehrenberg		DB
Euglypha alveolata Dujardin	b	AB
Actinosphaerium eichonii (Ehrenberg)	ob	P
Codonella cratera Leidy	ob	AB
Condylostoma vorticella (Ehrenberg)	b	O
Epistylis plicatilis Ehrenberg	a	B
Holophrya hexatricha Savi	AB	
Litonotus lamella (Ehrenberg) Schewiakoff	b	P
Oxytricha saprobia Kahl	ap	O
Paramecium aurelia complex	b	B
Paramecium caudatum Ehrenberg	a	B
Paramecium putrinum Clapaderei & Lachman	p	B
Phascolodon vorticella Stein	b	A
Prorodon sp.		?
Trichodina sp.		?
Vorticella convallaria (Linneaus)	a	AB
Vorticella microstoma Ehrenberg	p	B
Vorticella natans (Faure-Fremiet)	b	A
Vorticella nebulifeta (O.F. Muller)	ob	AB
Vorticella sp.		?
Vorticella striata v. octava Stokes	p	B
Peritricha (Telotroch phase)		?
Species number		23
Individual number 1000 x ind/m3		638

Saprobity relations (%)	Nutrition types (%)
ob 15.5	A 34.5
b 41.4	A+B 17.2
a 10.3	B 17.2
ap 3.4	D+B 1.7
p 10.3	P 8.6
sn 19.0	O 5.2
	? 15.5

Table 15.

Szeged 15. 82.5 m a.s.l. 766 rkm

Trinema enchelys Ehrenberg	b	B
Actinosphaerium eichonii (Ehrenberg)	ob	P
Codonella cratera Leidy	ob	AB
Cyclidium citrullurs (Cohn)	a	B
Euplotes eurystomus (Wrzesniowski)	a	O
Euplotes moebiusi Kahl	p	B
Oxytricha saprobia Kahl	ap	O
Paramecium caudatum Ehrenberg	a	B
Phascolodon vorticella Stein	b	A
Prorodon sp.		?
Strobilidium humile Penard	b	A
Strobilidium velox Faure-Fremiet		A
Strombidium viride Stein	b	A
Vorticella nebulifeta (O.F. Muller)	ob	AB
Vorticella picta (Ehrenberg)	o	AB
Vorticella similis Stokes	ob	A
Vorticella sp.		?
Species number		23
Individual number 1000 x ind/m3		638

Saprobity relations (%)	Nutrition types (%)
o 1.5	A 62.1
ob 15.1	A+B 12.1
b 56.1	B 7.6
a 4.5	P 3.0
ap 3.0	O 4.5
p 1.5	? 10.6
sn 18.2	

A = alga, A+B = alga+bacterium, B = bacterium, D = detrius,
EC = ectocomens, P = predator, O = omnivorus.

Table 16.

Saprobity relations %		
Izvorul Mures	b	23.5
	sn	76.5
Senetea	b	20.0
	sn	80.0
Suseni	ob	6.8
	b	18.8
	a	6.8
	sn	67.6
Sarmas	ob	9.1
	b	27.3
	sn	63.6
Rastolita	ob	8.7
	b	30.4
	a	8.7
	ap	4.3
	p	8.7
	sn	39.1
Tirgu Mures	ob	6.7
	b	28.8
	ba	6.7
	a	1.6
	ap	1.6
	sn	54.6
Uheni-Moresti	o	0.6
	ob	4.8
	b	21.2
	ba	1.3
	a	2.0
	ap	2.0
	p	5.4
	sn	62.6
Ludus-Gheja	ob	6.0
	b	12.2
	ba	2.0
	a	8.2
	ap	2.0
	p	7.9
	sn	61.4
Gura-Ariesului	ob	6.9
	b	6.6
	a	9.1
	p	18.2
	sn	59.1
Sintimbru -Alba Julia	ob	0.6
	b	95.0
	ba	0.6
	p	1.9
	sn	1.9
Deva	b	95.4
	ba	1.4
	sn	3.2
Zam	ob	11.7
	b	82.1
	ba	1.7
	sn	4.5
Pecica	ob	15.5
	b	41.4
	a	10.3
	ap	3.4
	p	10.3
	sn	19.0
Szeged	o	1.5
	ob	15.1
	b	56.1
	a	4.5
	ap	3.0
	p	1.5
	sn	18.2

Table 17.

Nutrition types %

Izvorul Mures	A	11.8
	A+B	58.8
	B	17.6
	?	11.8
Seneta	A	10.0
	A+B	20.0
	B	65.0
	?	5.0
Suseni	A	14.0
	A+B	17.0
	B	24.0
	B+A	3.4
	EC	17.0
Sarmas	A	27.3
	B	27.3
	B+A	9.1
	D+B	18.1
	EC	9.1
	?	9.1
Rastolita	A	30.4
	A+B	4.3
	B	26.1
	B+A	4.3
	D+B	17.4
	P	4.3
	?	13.0
Tirgu Mures	A	8.3
	A+B	22.0
	B	25.5
	B+A	15.6
	D+B	5.1
	EC	8.6
	P	4.8
	?	9.9
Unheni-Moresti	A	5.5
	A+B	20.5
	B	11.6
	B+A	7.5
	D+B	4.7
	P	1.9
	O	2.8
	?	45.5
Ludus-Gheja	A	2.0
	A+B	6.2
	B	13.9
	B+A	20.2
	P	8.2
	O	25.0
	?	24.4
Gura-Ariesului	A	2.2
	B	24.8
	B+A	11.6
	D+B	2.2
	P	4.4
	O	4.4
	?	50.3
Sintimbru		-
Alba Julia	A	96.2
	B	1.9
	EC	0.6
	P	0.6
	?	0.6
Deva	A	94.5
	B	0.9
	?	4.5
Zam	A	81.6
	B	2.8
	P	12.8
	?	2.8
Pecica	A	34.5
	A+B	17.2
	B	17.2
	D+B	1.7
	P	8.6
	O	5.2
	?	15.5
Szeged	A	62.1
	A+B	12.1
	B	7.6
	P	3.0
	O	4.5
	?	10.6

ZOOPLANKTON INVESTIGATIONS IN A LONGITUDINAL SECTION OF THE MAROS (MUREŞ) RIVER

KATALIN ZSUGA

Introduction

A detailed examination of a longitudinal section of the Maros River was conducted in August 1991. I performed the determination of the zooplankton from the biological examinations. The composition of the zooplankton stock, the large-scale presence or lack of certain organisms provides important information for evaluating the quality of a given waterway. I examined the groups of Rotatoria, Cladocera and Copepoda from the zooplankton elements in detail. In the course of the investigation of samples I addressed the following main questions:

- What sort of qualitative and quantitative changes characterize the zooplankton fauna of the Maros River?
- What sort of species describe the river in the given period?
- What sort of riparian categories are found along the longitudinal section? Are they separable, and, if so, what kinds of reaches are they?
- How can we describe the water quality of the Maros by the composition of the zooplankton fauna during the period of the examination?
- How can we evaluate the results of a single examination?

In Romania Rudescu (1960), Damian-Georgescu (1963,1970), Negrea (1983) refer to faunal, taxonomic research which mainly refers to the Danube, to the delta of the Danube, to the sea, to the high mountains, etc. I did not find any Romanian literature referring to the Maros. In the Hungarian reaches of this river Megyeri (1955,1970,1971,1972), Bancsi (1981), Zsuga-Nagy (1989), Zsuga (1981,1990) performed examinations in the area around Makó and Szeged. I would like to contribute with this research to the disclosure of the Maros zooplankton fauna, to a more exact determination of changes in its water quality.

Material and methods

Time and location of the examination:

A zooplankton examination from the river Maros was performed in August 1991. The samples were taken from source to mouth in 15 segments (see Figure at p. 6).

Collecting method:

50-litre samples of water were filtered through plankton net, which is made of silk bolting cloth. The size of its mesh was 45 µm. The condensed samples were approx. 15-20 mls each, conserved on site with a 4-5% formaldehyde solution.

Processing method:

In the course of microscopic examinations I performed all the quantitative and qualitative processing of 15 samples. I used an Ergaval microscope and I did the counting in a box sized 80x35x6 mm and cubby-hole numbered with a graticule of 5x5 mm. For the preparation of mastax of Rotatoria I used hypoklorid (NaOCl). I gave the quantitative data in 100 i/l unit of measure. For identification of the species I used the taxonomic books from Bancsi (1986,1988), Damian-Georgescu (1983,1970), Dévai (1977), Donner (1965), Carlin (1943), Gulyás (1974), Negrea (1983), Rudescu (1960), Ruttner-Kolisko (1974) and Voigt (1956).

Results

The development of the zooplankton of the rivers is influenced in great measure beside the known ecological factors (weather, nutrient state, temperature, etc.) by the hydrographical fundamentals of the area, the quality of the riverbed, the rise, the water speed, the quantity of the suspended load, etc. These effects are all observable in the development of the zooplankton of the Maros.

Rotatoria

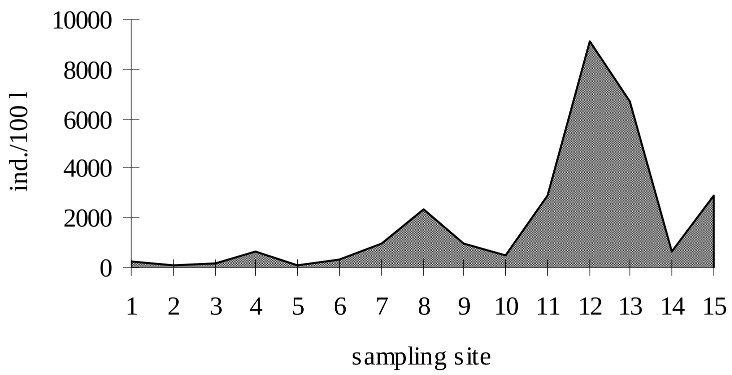
The samples were taken in a period following a small flood. The numbers of the Rotatoria were rather few, in the 15 segments between 72 and 9120 i/100 l individual density was measured (Fig. 1). This great difference relates to the subsequent changes from the source to the mouth, to the differences between biotopes. During the examinations there were 62 species found altogether (Table 1). Around the source (Izvorul Mureº) and downwards to it (Senetea, Suseni) a few species numbers were found beside the few individual numbers. The Maros River has a low water output here, with mountanous characteristics. In its Rotatoria fauna the organisms typical of low water, sources and streams (e.g. Encentrum orthodactylum, Lecane arcuata, Trichocerca myersi etc. Fig. 3) are present. Also there are a great number of representatives of the benthic and crust-dwelling creatures (e.g. Cepalodella forficata v. macruca, Encentrum grande, Lophocharis oxysternon, Notommata tripus, Pleurotrocha hyalina etc. Fig. 5), as the planktonic and benthic living spaces do not separate definitely from each other as a consequence of the state of riverbeds, and the littoral region plays a great role as well.

In Sãrmaº area greater individual numbers (640 i/100 l) and a higher number of species (19) were found than in the upper reaches (Figs. 1-2).

The Rotatoria fauna was the least at Rãstoliþa and the species number was very few too, it was 4 altogether (Figs. 1-2). These organisms have a wide limit of tolerance

(Cephalodella sterea, Lecane closterocerca, Lepadella patella, Rotaria sp.) and are even well adaptable to the great water-velocity too.

Fig. 1. Number of the Rotatoria (ind/100 l) in the Ruver Maros



The most varied Rotatoria fauna (23 species) was developed in the neighborhood of Tîrgu Mureº and to Sîntimbru the characteristic organisms of both upper and lower courses can be found. The species of shallow waters, littoral region and euplanktonic elements were found equally (Fig. 2). The individual number grew as an effect of swelling and where this effect is not yet appreciable, decreased again.

Fig. 2. Number of Rotatoria species in the River Maros

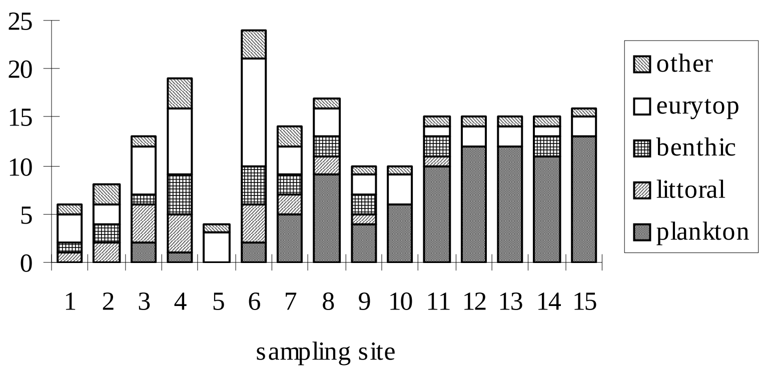


Table 1. The zooplankton organisms of the river Maros

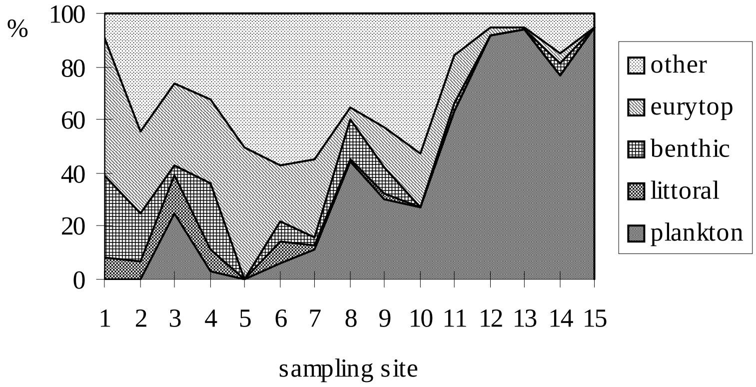
TAXON	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
R O T A T O R I A															
Anuraeopsis fissa				16			40	80	48	16	288	1776	384	12	24
Brachionus angularis						12	16	288	120	48	216	1152	672	12	120
Brachionus budapestinensis								192	24	8	240	240	512	24	72
Brachionus calyciflorus f. calyciflorus							8	16		8		3216	3328	228	2064
Brachionus calyciflorus f. dorcas											312				312
Brachionus calyciflorus f. spinosus								80							
Brachionus quadridentatus v. quadridentatus						4								12	24
Brachionus urceolaris								288	48					12	
Cephalodella biungulata	20		4	16		16	16	48							
Cephalodella forficata v. macrura			4												
Cephalodella forficula				16							24				
Cephalodella gibba			4	16											
Cephalodella gigantea						4					48				
Cephalodella gracilis						4									
Cephalodella intuta						4									
Cephalodella sterea					12										
Cephalodella ventripes v. angustior						4									
Cephalodella sp.				32		4	16								
Colurella adriatica	40		8	16		8									
Colurella colurus						8	16								
Colurella uncinata				48		8		16							
Encentrum grande				112											
Encentrum orthodactylum		4													
Encentrum putoris v. armatum				16		4			120						
Encentrum saundersiae		16													
Encentrum sp.						4									
Eothinia elongata							8								
Epiphanes macrourus							8	80	96	16	504	816	512	24	12
Euchlanis dilatata				32		4									
Filinia longiseta											48	48	64		24
Hexarthra mira													32		
Keratella cochlearis v. cochlearis											24	48			
Keratella cochlearis v. tecta							16	180		32	120	720	448	100	24
Keratella valga														12	12

Table 1. (continued)

Keratella valga f. monospina														64		
Lecane arcuata				4												
Lecane bulla							4	248			8					
Lecane closterocerca		20	4	4	48	12	12	16	64		80	552	240	64	24	12
Lecane lunaris				8												
Lepadella acuminata							4									
Lepadella ovalis							4									
Lepadella patella		80	36	20	16	12	16	32		24	8					12
Lepadella patella v. similis				4	32								96			
Lindia torulosa										48						
Lophocharis oxysternon		20	4	4			8	8							12	
Lophocharis salpina					16				32							
Notommata tripus			4													
Platyias quadricornis							8									
Pleurotrocha hyalina					16											
Pleurotrocha petromyzon							4									
Polyarthra dolichoptera																
Pompholyx sulcata												24	96	32	24	48
Proales sp.					16								48		12	
Resticula melandocus										24						
Rotaria sp.		80	44	32	144	36	192	496	784	408	264	408	336	320	96	72
Synchaeta pectinata				4								48	96	64		12
Synchaeta tremula				28					16					128	12	84
Testudinella mucronata					16											
Testudinella patina							4		16			24				
Trichocerca myersi					16											
Trichocerca pusilla									64				192	32		
Trichocerca sp.			8													
Σ ROTATORIA	i/100 l	260	120	128	640	72	336	952	2304	960	488	2904	9120	6656	624	2928
C L A D O C E R A																
Alona guttata				4												
Alona rectangula				4												
Σ CLADOCERA	i/100 l	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0
C O P E P O D A																
nauplius			36	16	48		4	40	32			48		64	12	12
copeodit		20						8	32				24			
Σ COPEPODA	i/100 l	20	36	16	48	0	4	48	64	0	0	48	24	64	12	12

The number of individuals grew at Luduº-Gheja too. The composition of the zooplankton stock relates to pollution in this area; the Rotatoria spp, which consume organic debris, dominated.

Fig. 3. Percentage composition of the Rotatoria in the River Maros



The following section of the Maros can be marked off from Alba Iulia, where the euplanktonic Rotatoria are found in the highest proportion (Fig. 3) (e.g. Anuraeopsis fissa, Brachionus angularis, Brachionus calyciflorus, Keratella cochlearis v. tecta, Filinia longiseta, Polyarthra dolichoptera) and the individual numbers multiplied proportionately to the upper areas (Fig. 1).

From the middle section downwards the trophic and saprobic degree grow on the flowing tributaries and pollution, the river becomes richer in nutrients and moderate pollution. This change was indicated by e.g. Lindia torulosa, Resticula melandocus, Pleurotrocha petromyzon, Brachionus spp., Epiphanes macrourus, etc. (Fig. 3).

Independent of the different section charactersistics, Lecane closterocerca and Rotatoria spp. were found at almost every sampling location. This relates to the wide range of tolerance of these organisms.

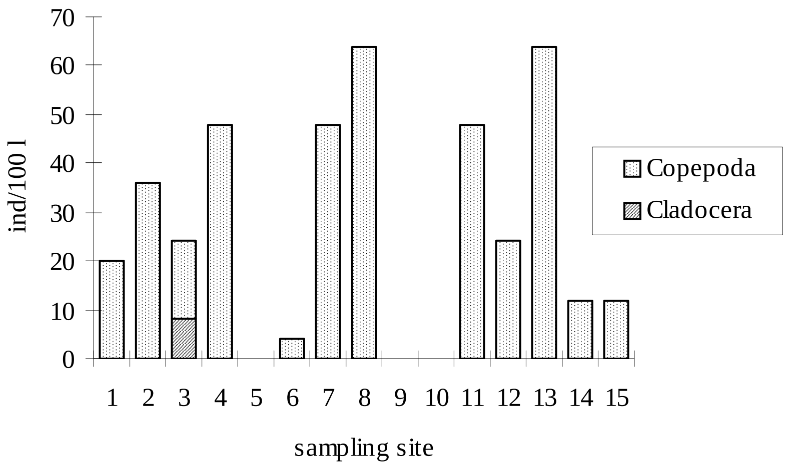
It is not typical in the course of the actual examination, but earlier examinations showed that very high individual densities can develop from time to time on the lower reaches of the river with the multitudinous swarming of 1-2 species (e.g. Brachionus spp., Anuraeopsis fissa etc.). In this case the influence of the Maros for the Tisza can grow considerably too. (Megyeri 1972, Zsuga-Nagy 1989.).

Crustacea

The results of the examinations showed the hydroecological conditions of the Maros were not favourable to Cladocera. They were only found in one area (Suseni), in small individual numbers (8 i/100 l). Both identified species (Alona guttata, Alona rectangula) are eurytop organisms, they can live in completely different waters. It is documented by the earlier examinations performed in the neighborhood of Makó and Szeged that the Cladocera species are not frequent even in the lower reaches (Zsuga-Nagy 1989, Zsuga 1990).

The representatives of Copepoda are found at almost every sampling location though in few numbers (Fig. 4). The dominance of juvenile forms are identifiable by generation, thus nauplius and copepodite forms were found in different developmental phases and no adult species were found in the samples during the period of examination.

Fig. 4. Number of the Crustacea (ind/100 l) in the Ruver Maros



Summary

The following conclusions may be drawn from this examination of the zooplankton in a longitudinal section of the Maros River.

-The quantity of zooplankton was generally low during the given time.

-By quantitative composition the proportion of Rotatoria dominated, the hydroecological conditions of the Maros were not favourable to Cladocera and in the Copepoda group the predominance of juvenile forms was characteristic in contradiction to adults.

-We could separate the Maros into three sections by the qualitative composition of Rotatoria, and by the presence of indicator species (Fig. 3).

1. Between Izvorul Mureº and Rãstoliþa the section has an upper course character, the oligotrophic, oligosaprobic water category was typical with low numbers of both species and individuals.

2.Between Tîrgu Mureº and Sîntimbru the most varied species-composition developed; the benthic, planktonic and littoral elements were mixed. The tropic and saprobic degree rose, the nutrient state and the pollution of the river grew.

3.Between Alba Iulia and Szeged the composition of the Rotatoria euplanktonic elements dominated. The number of the Rotatoria multiplied in proportion to conditions in the upper areas.

-In the different sections of the river, aside from the typical indicator species colouring elements were found which have good adaptability and a wide range of tolerance.

-This single examination gave only a few appreciable results for the characterization of Crustacea fauna of the Maros River. Repeated examinations are needed to know this group in greater detail.

-This results of this single examination have a disclosing character and indicating value. Because data in the scientific literature is limited, concerning zooplankton of the Maros, further examinations would be expedient for more detailed knowledge of the river. These present data may be considered as a basis for comparison.

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MACROZOOBENTHOS IN THE MAROS (MUREŞ) RIVER

ANDRÁS SZITÓ

Introduction

The ecological demand of living organisms determines the presence or absence of species in a biotope. Certain water organisms are very sensitive to ecological changes, and thus are useful as environmental indicators, if we know their ecological requirements.

The sediment fauna, except Mollusca, has been examined by other authors (Horváth, 1943; Wagner, 1943; Gyurkó et al. 1971; Sárkány-Kiss, 1983a,b, 1986). Their data and results serve as a basis for contemporary comparisions.

Material and methods

Sediment samples were collected from the spring to the mouth in 15 cross sections. In each profile three samples were taken by a benthometer (with a drifting net) from sections 1-6 and by a modified Petersen sampler of 18×31 cm surface from sections 7-l5. Sampling sites were at various distances from the left (1), right (2) bank and in the main current (S) as well. The weight of each empty bag was approx. 30 kg; which made it possible to take sediment samples from the river's main channel.

Sampling sites were denoted by symbols of three numbers or letters (Bancsi et al. 1981). Accordingly the symbol 011 means the sample collected in the profile 01 near the left (1) bank (Table 1).

Each sample was washed through a metal screen of 200-mm pore mesh size and placed into a separate plastic dish of 2,000 cm^2 volume. Animals were picked up by tweezers from the remaining sediment, using a lupe with 3x magnification.

Animals were preserved in an 80% alcohol solution. Special works and keys of authors were used for identification (Bíró, 1981; Botoşăăneanu, 1963; Cărăuşu et al. 1955; Chernovski, 1949; Cîrdei et al 1965; Davies, 1968; Ferencz, 1979; Fittkau, 1962; Hirvenoja, 1973; Hynes, 1977; Macan, 1970; Pennak, 1953; Pinder et al. 1983; Richnovszky et al. 1979 and Steinmann, 1964).

Some insect larvae groups were determined for genera only due to a lack of suitable keys. The individual numbers of species were extrapolated to ind./m^2.

Results

The Maros Rriver divided into three parts by indicator animals. The first part (rhitone and potamon) ran from the spring to the "reservoir" and the third was the remaining river section from the dam by Tîrgu-Mureş to where it debouches into the Tisza River.

The characteristic animal species for a middle river course were absent, therefore the classification and qualification of river parts was possible by sediment quality only (moving gravels and rough sand). The large number of species and individual density was characteristic for upstream courses, mainly in profile 5. Ephemeroptera and Trichoptera species were dominant here but Amphipods were absent from the profile by the 16th river km on, as well as the Trichoptera and Chironomid species from the 62nd river km (Table 1). Greater species richness (59 species) was detected in the 5th profile: Ephemeroptera - 15 (mainly Bäetis sp.) and Trichoptera 13 species were present as well as 6 species of Oligochaets and 9 Chironomid species.

In the 6th profile (188 river km), 15 species were found in the dammed river section about 1,000 m from the barrage beside Tîrgu-Mureş, and they have composed a mixed fauna: the running-water species were dominant over the standing-water species. While the abundance of running-water species was 1ow (Tubifex nevaensis 6 ind./m^2 Chironomus fluviatilis; 12.2 ind./m^2 the others were compliant and found on both the middle and lower (lowland) river courses. These were the following species: Limnodrilus udekemianus, L. profundicola, L. hoffmeisteri, Procladaus choreus, Cryptochironomus redekei and Polypedilum scalaenum. The sediment was deep and consisted of clay and sand of fine particle size.

On the ground of zoocoenose, the third river section went from Tîrgu-Mureş to the mouth with Oligochaets dominance. It was mainly Limnodrilus hoffmeisteri that showed a high density. That same species formed an extraordinary result in the 12th profile (455 river km) below the town of Deva: the density of Potamothrix vejdovskyi was 7,058 ind./m^2 Isochaeta virulenta was 4,152 ind./m^2 and Limnodrilus hoffmeisteri was 30,308 (!) ind./m^2. The abundance of these species together was 41,518 ind./m^2, but they were in low abundance in the later sections.

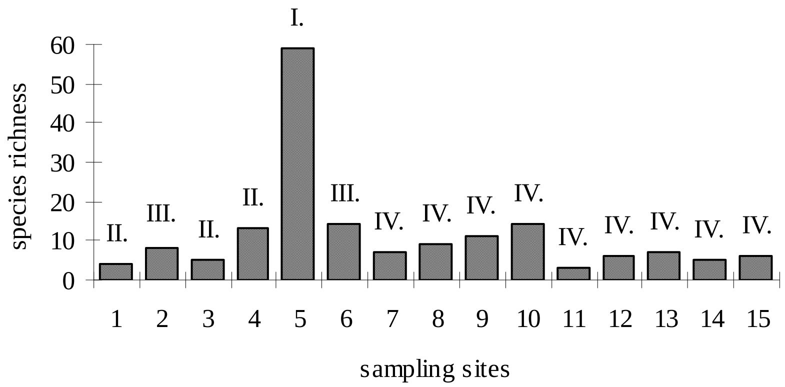
Discussion

The present zoological composition cannot be explained by simple geography. Amphipods were present in profiles 1-4 but were absent from the 5th profile. This situation was probably caused by environmental pollution: high detergent concentrations in the upper four profiles were detected (Waijandt 1991). Simuliidae were present in the 5th profile only, though previous sections had the same stony riverbed.

The Chironomid abundance was lower in the dammed section of the river than would have been with the high concentrations of heavy metals and detergents (water and sediment chemical data by Waijandt 1991).

Chironomid larvae were sensitive to these ecological factors (Saether 1979; Szitó et al. 1989). The abundance of Oligochaets was high here because of the rich sedimentation and food sources (detrite, bacteria and algae). Because the Chironomid larvae were in low abundance, Oligochaets have not had food and place competitors.

Fig.1: Qualifications of the different profiles of the Maros River by indicator benthos species and their richness. I: excellent; II: good; III: middle; IV: polluted



The presence of Amphipods, Ephemeroperta, Trichoptera and Chironomid species would be reasonable after the dammed part of river in profiles 7-11 (207-376 river km), but they were absent from these sections. Limnodrilus hoffmeisteri and L. profundicola (Oligochaeta) species were present, which have already indicated a high organic matter concentration in the water on this river course.

The detergents and heavy metal concentrations were greater than the earlier levels (see the chemical analysis data). The absence of these sensitive animal groups and species from these profiles indicated high anthropogenic pollution (Figs 1-2).

After Deva the Maros gives a typical lowland river picture (profile 12, 455 river km) with a wide riverbed and very small sand particle size. A huge “field” of Oligochaets was found near the right bank in the deep fine-sand sediment. The density of Oligochaets was higher here than in other sampling sites. Limnodrilus hoffmeisteri species was dominant. This species has always shown a hard eutrophication (= pollution) of waters (Ferencz 1979). This same situation was indicated by two other species: Potamothrix vejdovskyi and Isochaeta virulenta (Table 1).

The high abundance of Oligochaets may be caused by a sewage water inflow up-stream on the right side and a typical hypertroph zoocoenose. This might be the reason that such typical Chironomid species were absent from the river course, which were often dominant in other rivers, for example in the Tisza River. Such Chironomid species included the following: Paratendipes, Beckidia and Chironomus fluviatilis (Szitó 1981). An industrial pollution effect might be present here, like a coal distillery earlier (Mălăcea et al.1954).

The importance of Simuliidae as environmental pollution indicators was studied and explained by Kovachev (1977) because these species have shown a "whole strict stenotopicity".

Table 1. Distribution of macrozzoobenthos individual numbers at different sampling sections

Profile (section)		01			02			03			04			05	
Sampling site	1	S	2	1	S	2	1	S	2	1	S	2	1	S	2
SPECIES:															
Annelida															
Oligochaeta															
Branchiura sowerbyi Beddard															
Potamothrix vejdovskyi Brinkhurst		12				6								6	6
Potamothrix hammoniensis Brinkhurst															
Isochaeta virulenta Point															
Limnodrilus claparedeianus															
Limnodrilus udekemianus Claparede															6
Limnodrilus profundicola Brinkhurst		6													
Limnodrilus hoffmeistrei Claparede															
Peloscolex speciosus Hrabe															
Tubifex ignotus Stolc															
Tubifex nevaensis Mich.															
Aurodrilus limnobius Bretscher															
Thalassodrilus prostatus Knöll.															
Lumbricillus lineatus Mich.				6											
Eiseniella tetraedra Mich.															
Hirudinea															
Glossiphonia comolanata L.						6									
Glossiphonia heteroclita L.															
Oligobdella biannulata Moore															
Placobdiella picta Verril															
Arachnida															
Hydracarina															
Lebertia sp.				18											
Hydrachna sp.															
Crustacea															
Amphipoda															
Dicerogammarus haemobaphes fluviatilis Mart.		564		216	174	78			24						
Rivulogammarus balcanicus dacicus Dobr.-Man.				36		30	18		72						
Insecta															
Ephemeroptera															
Siphlonurus armatus Etn.				18				12	12		12				

Profile (section)		06			07			08			09			10	
Sampling site	1	S	2	1	S	2	1	S	2	1	S	2	1	S	2
SPECIES:															
Annelida															
Oligochaeta															
Branchiura sowerbyi Beddard															
Potamothrix vejdovskyi Brinkhurst					12						12				
Potamothrix hammoniensis Brinkhurst											6		12		
Isochaeta virulenta Point															
Limnodrilus claparedeianus													6		
Limnodrilus udekemianus Claparede				12											
Limnodrilus profundicola Brinkhurst															
Limnodrilus hoffmeistrei Claparede															
Peloscolex speciosus Hrabe															
Tubifex ignotus Stolc															
Tubifex nevaensis Mich.															
Aurodrilus limnobius Bretscher															
Thalassodrilus prostatus Knöll.															
Lumbricillus lineatus Mich.															
Eiseniella tetraedra Mich.															
Hirudinea															
Glossiphonia comolanata L.															
Glossiphonia heteroclita L.															
Oligobdella biannulata Moore															
Placobdiella picta Verril															
Arachnida															
Hydracarina															
Lebertia sp.															
Hydrachna sp.															
Crustacea															
Amphipoda															
Dicerogammarus haemobaphes fluviatilis Mart.															
Rivulogammarus balcanicus dacicus Dobr.-Man.															
Insecta															
Ephemeroptera															
Siphlonurus armatus Etn.															

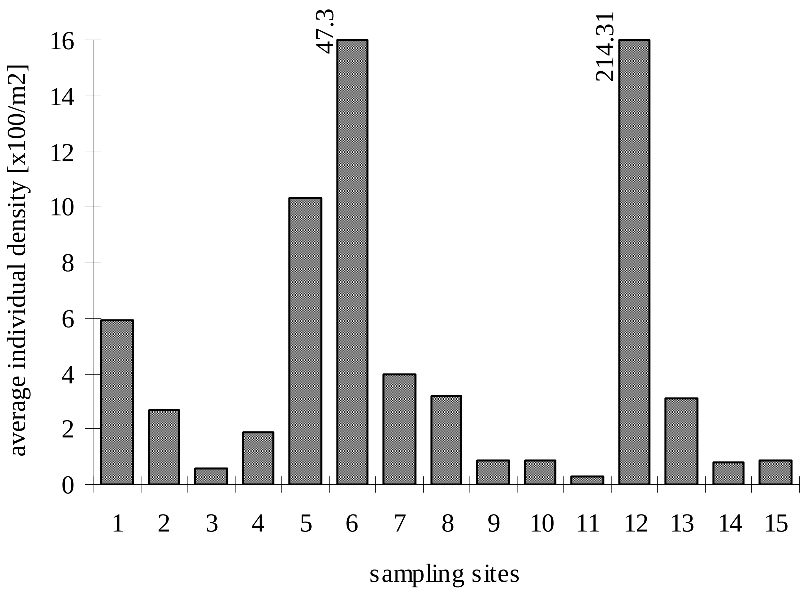
Profile (section)		11			12			13			14			15	
Sampling site	1	S	2	1	S	2	1	S	2	1	S	2	1	S	2
SPECIES:															
Annelida															
Oligochaeta															
Branchiura sowerbyi Beddard									6						42
Potamothrix vejdovskyi Brinkhurst				6		7058	18								30
Potamothrix hammoniensis Brinkhurst				66											
Isochaeta virulenta Point						4152									
Limnodrilus claparedeianus															
Limnodrilus udekemianus Claparede															
Limnodrilus profundicola Brinkhurst															
Limnodrilus hoffmeistrei Claparede															
Peloscolex speciosus Hrabe															
Tubifex ignotus Stolc															
Tubifex nevaensis Mich.															
Aurodrilus limnobius Bretscher															
Thalassodrilus prostatus Knöll.															
Lumbricillus lineatus Mich.															
Eiseniella tetraedra Mich.															
Hirudinea															
Glossiphonia comolanata L.															
Glossiphonia heteroclita L.															
Oligobdella biannulata Moore															
Placobdiella picta Verril															
Arachnida															
Hydracarina															
Lebertia sp.															
Hydrachna sp.															
Crustacea															
Amphipoda															
Dicerogammarus haemobaphes fluviatilis Mart.															
Rivulogammarus balcanicus dacicus Dobr.-Man.															
Insecta															
Ephemeroptera															
Siphlonurus armatus Etn.															

Siphlonurus lacustris Etn.				12																																									
Siphlonurus linneanus Etn.											18																																		
Ameletus inopinatus Etn.																																													
Baetis atrebatinus Etn.																																													
Baetis muticus L.											6																																		
Baetis niger L.																																													
Baetis rhodani Pict.			6																																										
Baetis pumilus Burm.			12																																										
Baetis scaxbus Etn.			84		30	18		6	72																																				
Ecdyonurus insignis Etn.																																													
Ephemerella notata Etn.																																													
Prodiamesa olivaeca Meig.		6													36																														
Brillia modesta Meig.														6																															
Cricotopus bicinctus Meig.				24																																									
Cricotopus sylvestris Fabr.																																													
Metriocnepus hygropetricus																																													
Kieff.				6																																									
Chironomus fluvitilis Lenz.																	12					6																							
Chironomus riparius Meig.																	78	6																											
Chironomus semireductus																		6																											
Lenz.																																													
Chironomus plumosus L.																24	186	192																											
Microcricotopus bicolor Zett.														6																															
Cryptochironomus redekei													6		24		24	12								6	24																		
Krus.																																													
Dicrotendipes nervosus Staeg.																						24																							
Dicrotendipes pulsus Walk.																						18																							
Einfeldia pectoralis Kieffer																6		6																											
Microdentipes chloris Meig.													186	84	6																														
Paracladopelpa camtolabis																															6										6				
Kieff.																														6															
Paratendipes albimanus Meig.															6																														
Polypedilum convictum Walk.													24	114																															
Polypedilum nubeculosum																			312																										
Meig.																																													
Polypedilum scalaenum Schr.															6		96			6						6		66	18									6				126			12
																									12			18																	
Robackia demeijerei Krus.																																								18	12				
<u>Ceratopogonidag</u>																																													
Culicoides nubeculosus Meig.																18		6																											
<u>Athericidae</u>																																													
Atherix variegata Walk.				6									12	18																															
<u>Ephydridae</u>																																													
Ephydra macellaria Egg.													12																																
<u>Mollusca</u>																																													
Ancylus fluviatilis Müll.														12																															
Others	4			4																																									

The Mollusca fauna gave a depressing picture. From 1974 to 1982 more than 30 species lived in the Maros River (Lamellibranchiata 7 species, Gastropoda 23 species, Ancylus fluviatilis was found from 40 to 188 river km (Sárkány-Kiss 1983a,b,1986).

Now, Molluscs were found by the source, in the second, fifth and sixth profiles, and Ancylus fluviatilis was present in the fifth profile, but two specimens only. The indicator importance of this last species is well known (Richnovszky et al. 1979; Sárkány-Kiss 1986). Our last data showed a withdrawal in Ancylus fluvatilis from earlier river sections: Toplişa and Voşlobeni. Its total disappearance may be realized in the immediate future.

Fig.2: Average individual densities of sediment fauna in the profiles of the Maros River



Summary

Animals were found in all profiles of the river at the time of sampling. The Maros River has three characteristic sections by its zoocoenose: upper course, dammed river portion and lowland river. The typical middle summer fauna was absent due to anthropogenic pollution. Our opinions and signs given by indicator species were confirmed by data from water and sediment chemical analyses as well (Table 1, Fig. 1-2).

The different communal pollutions of the Maros River have continued, which was shown by the withdrawal of the earlier rich and wide-spread Mollusca fauna.

The clean water indicator Ancylus fluviatilis was found in the fifth profile, 12 ind./m^2 only. Oil was often present in the sediment and the animal richness was very low in such samples. The classification of sampling sites by presence or absence of indicator species was as follows: Izvorul Mureş II, Senetea III, Suseni II, Sărmas II, Răstoliþa I, Tîrgu-Mureş III, Ungheni-Moreşti IV, Luduş-Gheja IV, Gura-Arieşului IV, Sîntimbru IV, Alba Iulia (below) IV, Deva (below) IV, Zam IV, Pecica IV, Szeged IV (Fig. 1).

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MALACOLOGICAL SURVEY ON THE MUREŞ (MAROS) RIVER

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Introduction

The freshwater mollusks living in the bed and flood area of the Mureş River have a significant role in the life of the river. The mollusks often form over 90% of the benthic biomass (1120 g/m^2, Gorneşti-Mureş). They serve as food for fish, birds and mammals. They contribute to biological water purification, and by consuming they retard algal bloom. The different species have different sensitivities to water pollution, therefore the various degrees of pollution can be measured with these species functioning as bio-indicators (Sárkány-Kiss 1977,1988).

In the course of our investigations since 1968 we have explored the Mollusca fauna of the Mureş valley and we have examined, case by case, its qualitative and quantitative changes. The present paper compares these former research results with the results of our newer research made in the summer of 1991. This comparison enables us to draw some conclusions referring to the quality of the environment.

A brief historical sketch of the research

In the literature one can find only scattered data about the range of the water mollusks in the Mureş valley.

Kobelt (1911) describes a new form in Mureş: Unio crassus marisaensis Kobelt 1911.

Soós (1943,1955,1959) mentions the occurence in the Mureş of the following species: Theodoxus transversalis, Aiud; Lithoglyphus naticoides, B1aj and Aiud; Bithynia leachi, Aiud; Valvata cristata, Alba Iulia. In the case of other species we can find only more general remarks like ‘rare, often in Transylvania.

Wagner (1943) identifies the Anodonta cygnea, Ancylus fluviatils and Theodoxus prevostrianus species in the material of a Transylvanian research expedition.

Horváth (1943,1955) reports on the surprising occurence of the Ancylus fluviatilis, investigated in 1938, around the mouth of the Mureş River(above its flowing into the Tisza River).

Bába (1958) on the basis of his collection made in 1956-1957, lists from the Mureş river-bed between Makó and Szeged: Theodoxus transversalis (in great numbers around Makó), Litholyphus naticoides, Unio pictorum balatonicus, Unio tumidus zelebori, Unio crassus ondavensis decurvatus and he describes several cosmopolitan gastropods from the flood-area of the Maros in Hungary.

Grossu (1955,1956,1962,1986,1987) in his fauna-volumes based on the material collected from the whole territory of Romania and on the bibliographical data, mentions some species in the Mureş without giving the exact data referring to their occurrence (Theodoxus transversalis, Lithoglyphus naticoides, Unio crassus decurvatus).

Gyurkó and Nagy (1965,1971) investigating the basic food resource of fish of the Mureş, in the benthometer examples they found the Ancylus fluviatilis species in great numbers on the upper and middle area of the Mureş down to Gorneşti.

Materials and methods

The malacological investigations started in 1968 ranged from the source to the mouth (768 km). Besides the river bed we have explored the flood area and 46 tributaries.

The research work was divided in time and zones as follows:

- Between 1968 and 1974 we explored the area from the source to Iernut (230 km). We traversed the area in 10- 50 km zone - divisions on both banks, on foot and by rubber boat.
- During the years 1974-1991 we extended our research to the entire length of the river in the upper area on foot, in the lower area by boat.
- We explored the entire river in 1978, 1989 and in 1991, but in the meantime we returned to certain areas for research several times. In July 1991 we traveled on the river by boat from Luduş to Pecica, and in August from the source to Szeged.

We performed the collecting manually and by means of the following equipment:

- limnological net (1.5 mm and 7 mm diameter of one mesh)
- triangular dragnet (7 mm of one mesh)
- shell-collector dragnet with rake (20x40 cm, 7 mm diameter of one mesh)
- shell-collector rake
- Peterson dredger (18x31 cm)
- benthometer (28x31.5 cm)

The collected material used for research (about 10,000 ex.) can be found in the Tîrgu Mureş Museum, but in many cases the samples, after having been identified, were taken back to their original biotope.

Results and discussion

As Tables l., 2., and 3. show we identified 41 Mollusca species and subspecies in the biotops of the Mureş valley between 1968 and 1991. Of these 9 are bivalvia species and 32 gastropods. When comparing our results with previously published data we realized that Theodoxus prevostrianus and T. transversalis species, often mentioned in the literature, have not been found during our research. Wagner (1944) and Soós (1943, 1956) mentioned the occurrence (Răstolița valley - Secu source) of Theodoxus prevostrianus following the fact of an empty shell of a single specimen. It is known that this species likes

Table 1. Range of Unionidae species in 1978

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Lythoglyphus naticoides (C. PFEIEF. 1828)	-	-	-	-	-	xxx xx	xxx xxx	xxx xxx	xxx xxx	xxx xxx	xxx xxx	xxx xxx	xxx x	xxx xxx	xxx xxx
Lynnaea stagnalis (L. 1758)	-	-	-	-	-	xx	-	-	-	-	-	-	-	-	-
Stagnicola palustris (O.F.Muller 1774)	-	xxx	-	x	-	xx	-	-	-	-	-	-	-	-	-
Radix peregra (O.F.Muller 1774)	xx	xxx	-	xx	xx	-	-	-	-	-	-	-	-	-	-
Planorbarius corneus (L. 1758)	-	xx	-	-	-	xx	-	-	-	-	-	-	-	-	-
Planorbis planorbis (L. 1758)	-	xx	-	xx	-	xx	-	-	-	-	-	-	-	-	-
Ancylus fluviatilis (O.F.Muller 1774)	-	3.3	-	37	80	-	-	-	-	-	-	-	-	-	-
Unio pictorum (L. 1758)	-	-	-	-	-	xxx xxx	xxx xx	xxx xx	xxx xx	xxx xx	xxx xx	xxx xx	-	xxx xx	xxx xx
Unio tumidus (Retz. 1758)	-	-	-	-	-	xxx xxx	xxx xx	xxx xx	xxx xx	xxx xx	xxx xx	xxx xx	-	xxx xx	xxx xx
Unio crassus (Retz. 1758)	-	xxx xx	-	xxx xx	-	xxx	xxx x	xxx x	xxx x	xxx	xxx	xxx	xx	xxx	xxx
Andonta cygnea piscinalis (Nilss. 1822)	-	-	-	-	-	xxx xx	xxx x	xxx	xxx	xxx x	xxx x	xxx xx	-	xxx x	xxx x
Andonta cygnea anatina (L. 1758)	-	-	-	xx	-	-	-	-	-	-	-	-	-	-	-
Pseudanodonta complanata (Rossm. 1865)	-	-	-	-	-	-	-	xx	xx	xx	xx	xx	-	xx	xx
Sphaerium rivicola (Lamarck. 1799)	-	-	-	xx	-	-	-	-	-	-	-	-	-	-	-
Sphaerium corneum (L. 1758)	-	-	-	-	-	-	-	-	-	-	-	xxx	-	xxx	xxx
Pisidium amnicum (O.F.Muller 1774)	-	-	-	xxx x	xxx x	-	-	-	-	-	-	-	-	-	-
Pisidium casertanum (Poli. 1791)	-	xxx	-	xx	xxx	-	-	-	-	-	-	-	-	-	-
Pisidium subtruncatum (Malm. 1855)	-	-	-	-	xx	-	-	-	-	-	-	-	-	-	-
Pisidium personatum (Malm. 1855)	-	xx	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2. Range of Unionidae species in 1991

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Lythoglyphus naticoides (C. PFEIEF. 1828)	-	-	-	-	-	XXX	XX	XX	X	-	-	-	-	-	-
2. Lymnaea stagnalis (L. 1758)	-	-	-	-	-	XX	-	-	-	-	-	-	-	-	-
3. Stagnicola palustris (O.F.Muller 1774)	-	XXX	-	X	-	XX	-	-	-	-	-	-	-	-	-
4. Radix peregra (O.F.Muller 1774)	XX	XXX	-	XX	XX	-	-	-	-	-	-	-	-	-	-
5. Planorbarius corneus (L. 1758)	-	XX	-	-	-	XX	-	-	-	-	-	-	-	-	-
6. Planorbis planorbis (L. 1758)	-	XX	-	XX	-	XX	-	-	-	-	-	-	-	-	-
7. Ancylus fluviatilis (O.F.Muller 1774)	-	3	-	21.3	46.3	-	-	-	-	-	-	-	-	-	-
8. Unio pictorum (L. 1758)	-	-	-	-	-	XXX	XX	XX	XX	-	-	-	-	-	-
9. Unio tumidus (Retz. 1758)	-	-	-	-	-	XXX	XX	XX	XX	-	-	-	-	-	-
10. Unio crassus (Retz. 1758)	-	XXX XX	-	XXX	-	XXX	XX	XX	XX	-	-	-	-	-	-
11. Andonta cygnea piscinalis (Nilss. 1822)	-	-	-	-	-	XXX	XX	XX	XX	-	-	-	-	-	-
12. Andonta cygnea anatina (L. 1758)	-	-	-	XX	-	-	-	-	-	-	-	-	-	-	-
13. Pseudanodonta complanata (Rossm. 1865)	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
14. Sphaerium rivicola (Lamarck. 1799)	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
15. Sphaerium corneum (L. 1758)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16. Pisidium amnicum (O.F.Muller 1774)	-	-	-	XXX X	XXX	-	-	-	-	-	-	-	-	-	-
17. Pisidium casertanum (Poli. 1791)	-	XXX	-	XX	XXX	-	-	-	-	-	-	-	-	-	-
18. Pisidium subtruncatum (Malm. 1855)	-	-	-	-	XX	-	-	-	-	-	-	-	-	-	-
19. Pisidium personatum (Malm. 1855)	-	XX	-	-	-	-	-	-	-	-	-	-	-	-	-

warm water, so its existence in the cold springs of the M. Călimani is quite doubtful. We could not find it there even after careful search.

Teodoxus transversalis is mentioned by several researchers (Soós, Bába and Grossu) as noticed between Aiud and Szeged between1943 and 1957. It is especially remarkable that Bába still found it in large quantities in the area belonging to Hungary on 16. 9.1956. In 1978 and during our later investigations we could nowhere identify this species. Its extinction was probably caused by the growing pollution of the river.

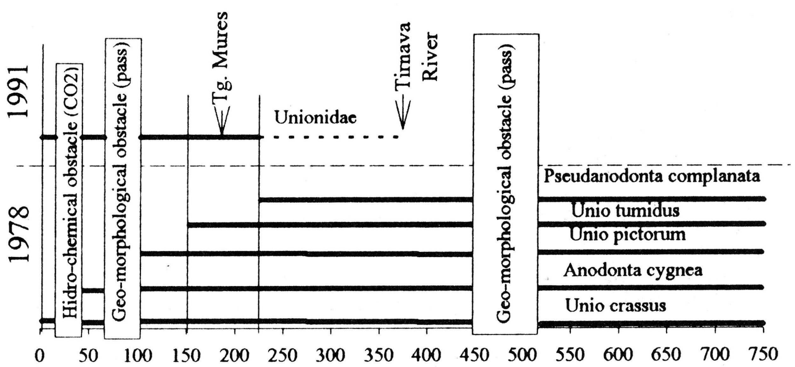
The range and dynamics of the Mollusca in the Mureş riverbed.

Between 1973 and 1983 we noticed the decrease of Ancylus fluviatilis (609 specimen/m^2 in 1973; 80 spec./m^2 in 1979 at Răstolița) as well as the narrowing down of the area of this species. As an earlier paper described in detail (Sárkány-Kiss,1986), Nalbant in 1956 collected this species still in Tîrgu Mureş (personal communication). Comparing to occurrence the species has with-drawn around 70 km, that is up to Deda-Bistra. As known from the literature Durrant (1976,1977) Ancylus fluviatilis needs much oxygen; thus its extinction can be explained by the significant amount of decomposing organic material found. Table 2 shows the actual range of the species.

Table l reflects that the Unionidae still populated the Mureş riverbed all along its length in 1978. During our research (Sárkány-Kiss, 1977, 1988) according to the range of 6 species of the Unionidea shells, we divided the river into 9 portions. From the second reach (Voşlobeni - Remetea, 27 km) the shells and the huge mollusks were completely absent, because here the carbonic mineral water forms a hydro-chemical obstacle to the spreading of the Unionidae.

The fourth reach, the Toplița-Deda defile (40 km, 210 m level difference) constitutes a new barrier against the range of the shells, due to the geo-morphological structure of the section. The fast water and the changing water level have a modifying effect on the bottom of the water which is unfavorable for the establishment of the shells. The only young specimen Unio crassus collected in 1991 (Table 2) in this research of the river can be considered an accidental occurrence, drifted by the rising river.

Fig. 1. Range of Unionidae in 1978 and 1991



The research conducted in 1989 found drastic changes, in comparison with the 1978 results, in the range of the Unionide (Fig. 1). As Table 2 shows, from the portion where the Tîrnava flows into the Mureş (350 km down from the source of the Mureş) downward there was not found a single living example. This decay affected Sphaerium rivicola and Lithoglyphus naticoides previously generally well spread here. Some living examples of the L. naticoides, however, could be detected at a single spot, the Ilia - Zam pass. According to the chemical examinations we concluded that the water of the Tîrnava is polluted, in an increased measure, by mercury and chromium.

Table 3. Distribution of mollusks in the three part of the river

	Upper P.	Middle P.	Lower P.
SPECIES			
1. Viviparus contectus (Mill. 1813)	-	-	+
2. Viviparus acerosus (Burg. 1862)	-	+	-
3. Bythinella austriaca (Frauen. 1859)	+	-	-
4. Bithynia leachi (Schepp. 1823)	-	+	+
5. Bithynia tentaculata (L. 1758)	-	-	+
6. Acroloxus lacustris (L. 1758)	-	+	+
7. Lymnaea stagnalis (L. 1758)	-	+	+
8. Stagnicola palustris (O.F.Muller 1774)	+	+	+
9. Stagnicola corvus (Gmel. 1788)	-	+	-
10. Radix auricularia (L. 1758)	+	+	+
11. Radix peregra (O.F.Muller 1774)	+	+	-
12. Galba truncatula (O.F.Muller 1774)	+	+	+
13. Physa fontinalis (L. 1758)	-	+	+
14. Physa acuta (Drap. 1805)	-	+	+
15. Aplexa hypnorum (L. 1758)	+	+	+
16. Planorbarius corneus (L. 1758)	+	+	+
17. Planorbis planorbis (L. 1758)	+	+	+
18. Anisus septemgyratus (Rossm. 1835)	-	+	+
19. Anisus spirorbis (L. 1758)	+	+	-
20. Anisus vortex (L. 1758)	-	+	-
21. Bathyomphalus contorus (L. 1758)	+	-	+
22. Armiger crista (L. 1758)	-	+	-
23. Gyraulus albus (O.F.Muller 1774)	+	+	-
24. Segmenta nitida (O.F.Muller 1774)	+	+	-
25. Hippeutis complanatus (L. 1758)	-	+	-
26. Succinea oblonga (Drap. 1801)	+	+	+
27. Succinea putris (L. 1758)	+	+	+
28. Oxyloma elegans (Risso. 1826)	-	-	+
29. Unio pictorum (L. 1758)	-	+	+
30. Unio tumidus (Retz. 1758)	-	+	+
31. Unio crassus (Retz. 1758)	+	+	+
32. Andonta cygnea piscinalis (Nilss. 1822)	-	+	+
33. Andonta cygnea anatina (L. 1758)	+	+	-
34. Spaerium lacustre (O.F.Muller 1774)	-	+	+
35. Pisidium amnicum (O.F.Muller 1774)	+	-	-
36. Pisidium casertanum (Poli. 1791)	+	-	-
37. Pisidium subtruncatum (Malm. 1855)	+	-	-
38. Pisidium personatum (Malm. 1855)	+	-	-

It is obvious in the literature that the shells are sensitive to heavy metals (Boyden, 1977), and it is more than probable that this caused the extinction. During our malacological investigations (1982) on the Tîrnava Mică we also noticed that Unio crassus sp. pollutes proportionally the riverbed as far as the chemical factory of Tîrnaveni, but there could not be found any example of this species along the rest of the riverbed. The extinction of the shells in the Mureş probably happened two or three years before our 1989 research, since we found only very few and much abraded scallops in the alluvium. In our opinion in the last ten years the concentration of the polluting substances in the water of the river has significantly increased, owing to the almost chronic lack of precipitation and to the low water level.

Comparing the results of Table 1 and 2 one can see that the number of shell populations has greatly decreased also on the upper and middle portions of the river. The danger of extinction is especially present in the portion after Tîrgu Mureş. In the middle reaches of the river, in 1991 we could find a few examples of Unionidae only after strenuous searching, while in the seventies the density of 10-20 ind./m^2 was not rare. We identified 80 specimens per m2 at the mouth of the Luț stream in 1974. The Pseudanodonta complanata appeared only at one spot and in one example near the locality Gheja in 1991.

The Lymnaea and Planorbis species (Table 1 and 2) occur only in the riverside lentical biotops and in the portions of retained water, and they are not characteristic species of the river-bed.

The range and dynamics of flood area mollusks

Table 3 reflects the range of the species in the upper, middle and lower reaches. The composition, dynamics of certain populations, the evolution of the cenosis have been described in detail in the mentioned papers (Sárkány-Kiss,1977,1983a, 1983b, 1986). In these biotopes the water pollution had a smaller effect. We noticed the decay of Physa fontinalis only in the case of the dead branches of the river which have a continuous or frequent relation with the water of the river. The existence and the population dynamics of the mollusks in the flood area biotopes depend entirely on the chages of the water level of the river. The chronic lack of precipitation in the last ten years has caused violent changes in the composition of the cenoses. Table 4 shows the changes of the flood area lakes in Moreşti in this respect.

The number of the shells in the flood area biotopes has also decreased. We can mention two causes:

a) The riverbed has been deepened by the ever increasing, large-scale extraction of pebbles. Because of this much water has been drawn away from the dead branches of the river and from the smaller lakes in the flood area.

b) The lack of floods in the last few decades; it obviously affects negatively the proliferation of the freshwater mollusks (Sárkány-Kiss, 1977).

Conclusions and proposals

Examining the mollusis of the Mureş and its flood area, and their dynamics over many years we can draw the following conclusions:

1. The mollusk population has greatly decreased in the middle portion and has totally disappeared from the riverbed in the lower portion on a 418 km length, due to water pollution (Figure 1). We consider the extinction of Unionidae to be a particularly alarming loss, due to their important role in biological water purification.

2. Theodoxus transversalis and Sphaerium corneum are now permanently extinct in the Mureş valley. Extinction endangers Pseudanodonta complanata in the very near future.

3. The degree of the water pollution was aggravated by low water levels in the last ten years. The low water level and the lack of floods are themselves impediments to the proliferation of the mollusks.

4. The fauna of the river has been heavily affected by large pebble extraction. The deepening of the riverbed in many cases drew the water away from the flood area biotopes, and annihilated the most important places of proliferation and nutrition.

5. The mollusk fauna of the flood area has in store significant resources of the species; this would make the repopulation of the riverbed possible if the quality of the water improved.

6. We suggest that the still unpolluted upper portion of the Mureş (Izvorul Mureş-Deda) should be absolutely protected, the collateral rivulets as well. In the same region, we suggest the creation of strictly protected reserves, such as the Voşlobeni peat bog, the stream Gudea and Ilva. We propose to stop urgently any further drainage and river regulation. These activities lead to the annihilation of a natural water reserve, and of its rare and characteristic flora and fauna.

7. In the middle and lower sections, significant change may come only with the proper purification of the industrial and communal outlet waters.

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SNAIL ASSEMBLAGES OF GALLERY FORESTS BETWEEN LIPPA (LIPOVA) AND MAKÓ

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Introduction

This study deals with the snail assemblages of gallery forests along the Hungarian section of the Maros River. These forests have been little investigated for snail assemblages.

In the Hungarian section of the Great Plain, several new records of Chilostoma banatica have been reported, either in recent or near recent state. This species is distributed from the southern Carpathians to the Bihar (Bihor) Mts. and Máramaros (Maramureº) and has been known since the Miocene (Soós 1943) as the leading species of interglacials (Lozek 1964). The species is distributed along the rivers in Hungary (Bába 1979). In the plain the first record was taken in the Csála forest in 1915 at Nagyvárad (Oradea) by Soós. In Hungary, the first occurrence was reported by Bába (1979) from Bagiszeg at the Upper Tisza River. Only shells were found in the alluvial deposits of the Maros and Tisza rivers by Czógler and Rotarides in 1938. A. Horváth found a single living specimen in the drift at the confluence of the Tisza and Maros rivers, Szeged.

Before river regulations, the species was native to the Fekete and Fehér Körös area. Shells were found in ploughed land in sites formerly covered by gallery forests. Living specimens were found by Domokos (1992) near Gyulavári, in the Sitkei forest. At the Maros River near Makó-Landor, a population was discovered which was subsequently analyzed by Bába and Domokos (1992). Bagiszeg and Landor are now nature reserves.

This study will also compare the associated species of Chilostoma banatica with snail assemblages in Romania.

Material and methods

Quadrat sampling was performed in the locations of Chilostoma banatica by Bába at Bagiszeg between 1967 and 1985, at Makó-Landor (Maros) between 1986 and 1991 and in the Csála forest, Romania, in 1973. Between Lippa and Bezdin, Romania, P. Kondorossy made collections at three locations. Quadrat size was 25 by 25 cm,10 quadrats were taken in each site. Seasonal investigations were performed at Bagiszeg for 10 years, and at Landor for two years (three times a year). In the Landor site soil samples were also collected to measure soil humidity. At the Maros River canopy closure and percentage cover of herbs were recorded at each site. For a biometric study of Chilostoma banatica, 50-50 individuals were collected by Domokos, and the shell breadth data were compared with climatic data (temperature and precipitation) as averaged for the two previous years.

The figures were prepared using the data of the National Meteorological Service, and are reproduced from Bába and Domokos (1992).

The data were evaluated by clustering and ordination methods. Shannon-Wiener diversity index was also calculated. Species associations were identified using regional grassland and forest studies from the plain (Podani 1991). Block clustering, as followed by Feoli-Orlóci's (1979) evaluation procedure, allowed determination of ecological species groups, whereas nutritional types were defined according to Frömming (1954). The habitat typology developed by Lozek (1964) was also used in the analysis of community structure. The percentage distribution of habitat types was used to detect structural changes caused by external factors (floods, sylviculture). The results are generalized to characterize the current environmental status of forests along the Maros River. The forests were evaluated by clustering, based on the Czekanowski Index, and by principal component analysis (Podani 1991).

The ecological species groups are as follows:
A. hygrophilous, mezohygrophilous, shade species
B. photophilous species of swamps and marshes
C. photophilous mezohygrophilous and mesophilous species
D. xerophilous and xeromesophilous species of open habitats
E. hygrophilous ubiquists along lakes and watercourses

The nutritional types are:
1. O. Omnivorous
2. H. Herbivorous
3. Sz. Saprophagous.

We made four groups out of Lozek's habitat types. These are: 1. Forest dwellers (Lozek's W, Wh, Wm), bush forest dwellers (Lozek's Sw, Ow, Ws, Wm, m, Wf). Riparian species (H, P) and steppe species (o, x, sf).

Macroclimatic differences were evaluated after Kakas (1960) and Andó (1992). Nomenclature of plant communities follows Soó (1980).

Locations

The study sites are as follows:

Salicetum albae-fragilis (Soó 1933) Issler 1926

l. Lippa,1992.08.25., Salicetum albae-fragilis,15-20 km from the water.

2. Bezdin, I992.08.26. at a swamp on the floodplain, 200 m from the river. The understorey is Xanthium and Urtica.

3. Bezdin,1992.08.28. Urtica stand at the same site as 2.

Fraxino pannonicae-Ulmetum (Zólyomi 1934) Soó 1960.

4. Upper Tisza, Bagiszeg,1967.07.28. caricetosum subassociation.

5. Bagiszeg,1969.07.28. convallarietosum subassoc., the willows surrounding the forest will be cut.

6. Bagiszeg,1971.07.28. asperuletosum subass. Covered by water for two weeks during the 1970 flood.

7. Bagiszeg,1972.07.22. asperuletosum.

8. Bagiszeg,1974.06.6. asperuletosum, canopy only one-fourth of the original due to Lymantra gradation.

9. Bagiszeg,1975.08.22. asperuletosum.

10. Bagiszeg,1978.07.15. asperuletosum.

11. Bagiszeg,1985.06.13. asperuletosum. The forest was thinned in 1984 to promote faster reproduction. Due to cutting, the canopy cover has decreased considerably.

12. Csála forest,1973.08.15. brachypodietosum, treated by sylviculture.

13. Csála forest,1973.08.15, asperuletosum, treated by sylviculture

14. Csála forest,1992.07.28, with shrubs (Crataegus monogyna)

15. Csála forest,1992.07.28, Urtica - Rubus facies, treated by sylviculture

I 6. Pécska,1991. 08.20. Rubus - Urtica (brachypodietosum), treated by sylviculture, 50 m from the river.

17. Csála forest,1992.07.28. Poor understorey. Forests 14-15 lie 3-400 m from the river

18. Bezdin,1992.08.26. 200 m from water, only shells.

19. Landor 1987.09.26.

20. Landor 1988.06.07.

21. Landor 1989.09.26.

22. Landor 1990.05.11.

23. Landor 1990.07.10.

24. Landor 1990.09.18.

25. Landor 1991.05.08.

26. Landor 1991.07.12.

27. Landor 1991.09.04.

28. Makó, strand forest,1986.10.12. 50 m from water.

The Landor site belongs to the brachypodietosum subassociation, 100-150 m from the river.

Species recorded

From the sites at Upper Tisza and Maros,1871 specimens belonging to 35 species were collected. Along the Upper Tisza (Bagiszeg) 483 were found,1388 at the Maros River. The species composition of the two sites is different, but both include Chilostoma banatica. Carychium tridentatum, Oxyloma elegans, Columella edentula, Arion hortensis and Vitrina pellucida were not found at the Maros River, whereas Vitrea subrimata, Nesovitrea hammonis, Deroceras laeve, D. agreste, Clausilia pumila, Balea biplicata, Hygromia transsylvanica, and three - probably drifted species (Vitrea transsylvanica, Euconulus fulvus and Trichia hispida) are absent from Bagiszeg. Of the species found at Bagiszeg, 85.7% also occur at the Maros River, whereas 71.4% of species at the Maros River occur also at the Upper Tisza. There are probably two factors responsible for the differences. Based on Kakas' (1960) climatic classification, Bagiszeg has a climate with an oceanic character, with moderately warm summer (type B4), whereas most of the Great

Hungarian Plain belongs to the continental type with moderately dry climate (A3). The Romanian section is more humid, because the area is open towards the northwest. Due to impermeable layers and slope, the Maros River has a considerable gradient. Its watershed includes 18 mountainous regions and covers twice as much area as the Tisza River. It floods very rapidly (Andó 1992) facilitating transportation of the fauna. The number of species per forest ranges between 6 and 14. The Balea, Clausilia and Hygromia species and Vitrea transsylvanica and Trichia hispida were found at the Romanian section.

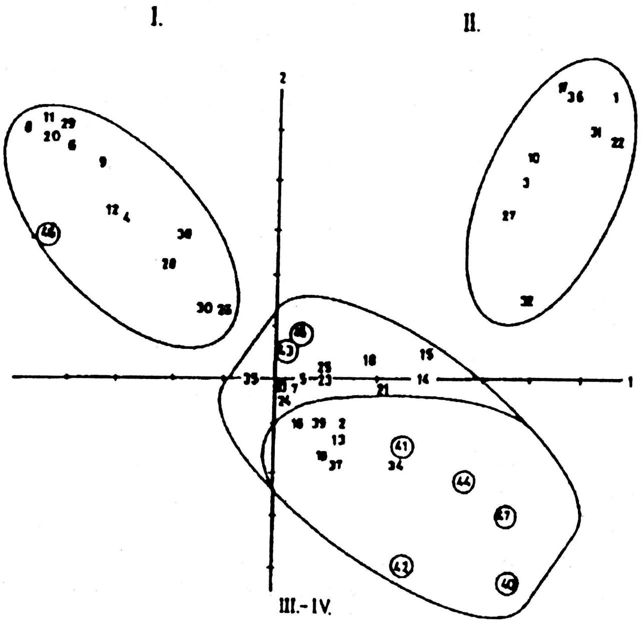


Figure 1. Principal components ordination of species and abiotic factors.
Numbers of groups: I. species of open areas: 4. Cochlicopa lubricella; 6. Truncatellina cylindrica; 8. Granaria frumentum; 9. Pupilla muscorum; 11. Vallonia costata; 12. Chondrula tridens; 20. Vitrina pellucida; 26. Euconulus fulvus; 28. Helicella obvia; 29. Helicopsis striata; 30. Monacha carthusiana; 38. Cepaea vindobonensis; II. riparian Ubiquists: 1. Carychium minimum;3. Cochlicopa lubrica; 10. Vallonia pulchella; 17. Punctum pygmeum; 22. Vitrea crystallina; 27. Bradybena fruticum; 31. Perforatella bidentata; 32. Perforatella rubiginosa; III. subhygrophylous and hygrophylous species: 5. Columella edentula; 7. Vertigo antivertigo; 14. Succinea putris; 15. Succinea oblonga; 18. Aryon sylvaticus; 21. Zonitoides nitidus; 23. Aegopinella minor; 24. Nesovitrea hammonis; 25. Deroceras agreste; 33. Perforatella incarnata; 35. Hygromia kovácsi; 2. Carychium tridentatum; 13. Cochlodina tridentata; 16. Oxyloma elegans; 19. Arion subfuscus; 34. Perforatella vicina; 37. Chilostoma banaticum; 39. Helix pomatia. Habitat parameters: 40. humidity; 41. hydrology; 42. forest age; 44. canopy closure; 46. pH; 47. climatic district.

Associated species

The gallery forests of the Upper Tisza and the Maros have a species group in common. For the Great Hungarian Plain as a whole, based on the abundance data of 39 species and 6 environmental variables, principal coordinates analysis indicates four main groups (Bába 1992, Fig.1). I. Species of open areas (xeromesophilous and xerophilous species affected by pH). II. Riparian ubiquists, III-IV. subhygrophilous and hygrophilous species, influenced by hydrological conditions, forest age, canopy closure, physical soil type and climate. Of group IV, the presence of Chilostoma is maintained by the large water production of rivers coming from Transylvania and the constant humidity of the habitats. Group IV is characterized by the Dacic Chilostoma banatica and the Carpathian Perforatella vicina. The gallery forests described in terms of group IV are separated from other gallery forests of Hungary, perhaps because of the heavy sylvicultural impact and dry continental climate.

Coenological characteristic species of group IV in gallery forests

The coenological character species in the gallery forest, considering the constancy (percentage) and total dominance percentages, can be divided into three groups: constant (51-100% constancy), subconstant (20-50% constancy) and co-occurring species (1-19%). The dominance values strongly vary in the first two groups. Of the constant species, Chilostoma, Cochlodina, Perforatella, Helix and of the subconstant species Arion subfuscus belong to group IV (Fig. 1). Bradybaena, a riparian ubiquist, also belongs to the group of constant species. Most of the constant species in other parts of the Great Hungarian Plain are forest dwellers (group III) and riparian ubiquists (group II). Perforatella vicina, and its substitute P. incarnata, Helix pomatia, Bradybaena and occasionally Cochlodina remain constant in the gallery forests of the Upper Tisza and the Danube. Chilostoma banatica, coming from Transylvania via the rivers Fehér- and Fekete Körös, and Szamos before water regulations, is now characteristic in the gallery forests along the left tributary of the Tisza.

Similarity between the gallery forests of the Upper Tisza and the Maros

These similarities were evaluated via cluster analysis using the Czekanowski Index as applied to the Makó, Landor and Bagiszeg data (Table 1). Note that numbering in the figure differs from the list of locations. Bagiszeg is now 1-8, Makó is 9, and Landor is 10-18. The snail assemblages of the three forests form three cluster seeds, connected through locations 4, 9 and 10. The locations 11-18 from Landor are separated for two reasons. They belong to a different humidity type (Kakas 1960): Bagiszeg has an oceanic character, whereas Makó-Landor are more continental. The other reason is the intensive thinning performed in Landor in 1989.

The climatic differences in the two forests are indicated by the mean shell breadth values of Chilostoma. The data were obtained between 1968 and 1991 in Landor,1979-1985 in Bagiszeg (Bába & Domokos 1992).

Table 1. Coenological character species of forests from the Upper Tisza and Maros forests.

	C%	D%
Chilostoma banatica	96	13.140
Bradybachia futicum	88	10.956
Helix pomatia	80	2.832
Perforatella vicina	76	12.613
Cochlodina laminata	68	6.467
Carychium minimum	48	8.551
Succinea oblonga	44	3.580
Cochlicopa lubricata	44	7.322
Cepaea vindobonensis	44	1.015
Vallonia pulchella	36	21.165
Arion subfuscus	36	1.122
Zonitoides nitidus	32	0.801
Limax cinereoniger	28	0.748
Euomphalia strigella	24	1.656
Arion sylvaticus	20	1.175
Deroceras agreste	16	1.122
Succinea putris	16	0.320
Helix lutescens	16	0.587
Perforatella rubiginosa	12	0.213
Carychium tridentatum	8	3.687
Clausilia pumila	8	0.106
Aegopinella minor	8	0.106
Punctum pygmeum	8	0.106
Deroceras laeve	8	0.106
Oxyloma elegans	4	0.160
Columella edentula	4	0.106
Vitrina pellucida	4	0.053
Balea piplicata	4	0.374
Hygromia transsylvanica	4	0.213
Vitrea subrimata	4	0.053
Nesovitrea hammonis	4	0.053
Vitreea transsylvanica	(4)	0.053
Arion hortensis	4	0.053
Trichia hispida	(4)	0.053

Fluctuation and oscillation

The forests in Bagiszeg and Landor were influenced by natural and anthropogenic effects during the study years. These include: cut of the willow grove in Bagiszeg in 1969 so that the agricultural land gets close to the forest (50% decrease in abundance); flood in 1970 (20% decrease); Lymantria dispar gradation in 1974 (63% decrease); forest thinning to enhance growth of young trees in 1984 (18% decrease). In 1989 in Landor selective thinning (77-38% decrease). Figure 4 shows the A/m^2 changes. The proportion of living and dead specimens and the density data illustrate that the proportion of dead animals steadily increases after sylvicultural intervention in Landor. In the forest at Makó, the permanent anthropogenic effects contribute to the increased proportion of dead animals. In the figure, arrows indicate the time of impact. Fig. 6 shows the changes of species number, species density (mean species number per quadrat) and diversity.

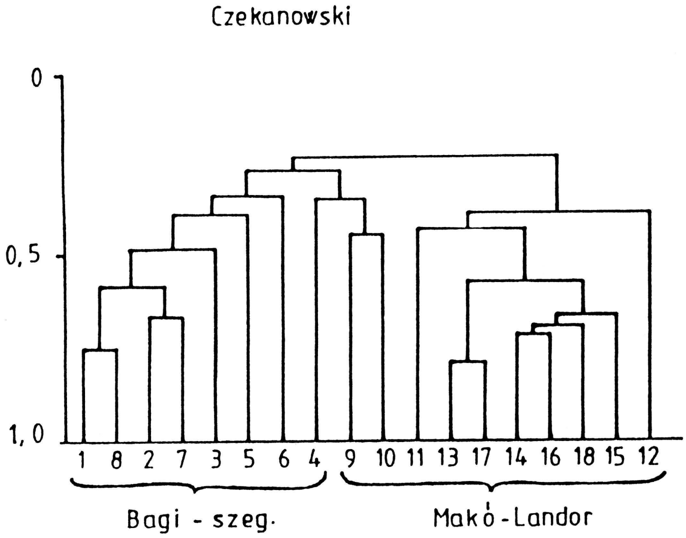


Figure 2. Cluster analysis by the group average method using the Czekanowski Index.

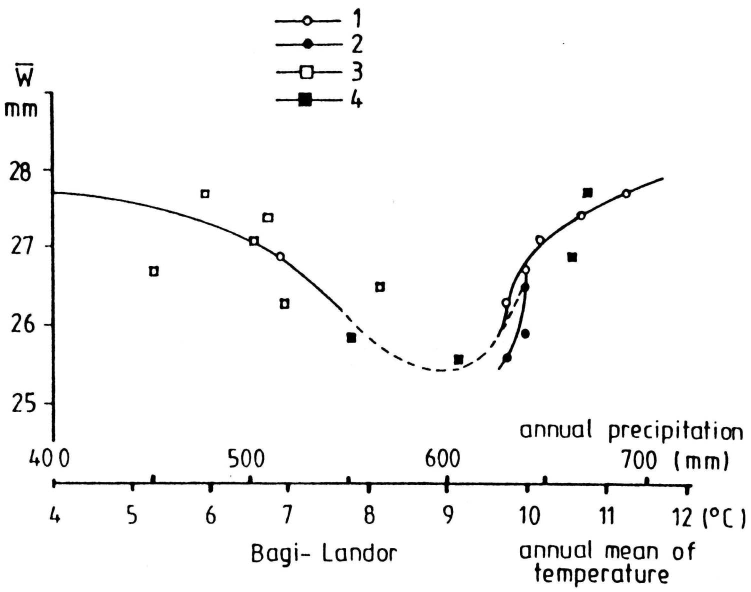


Figure 3. The dependence of average shell breadth (W) from temperatures measured in the previous year (l. Landor, Makó; 2. Bagiszeg) and from precipitation of the previous year (3. Landor, Makó; 4. Bagiszeg).

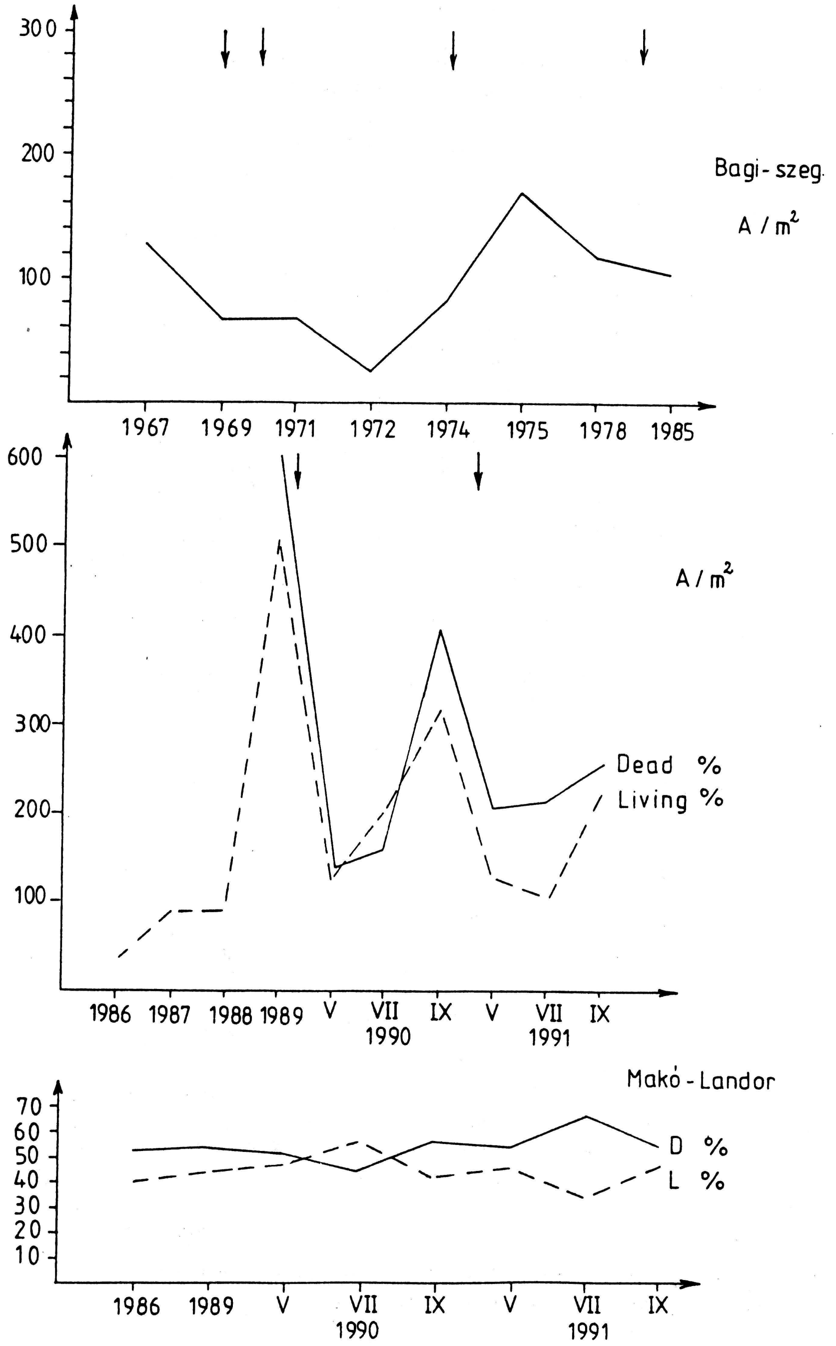


Figure 4. Abundance changes and the proportion of dead/live specimens in Bagiszeg and Makó-Landor

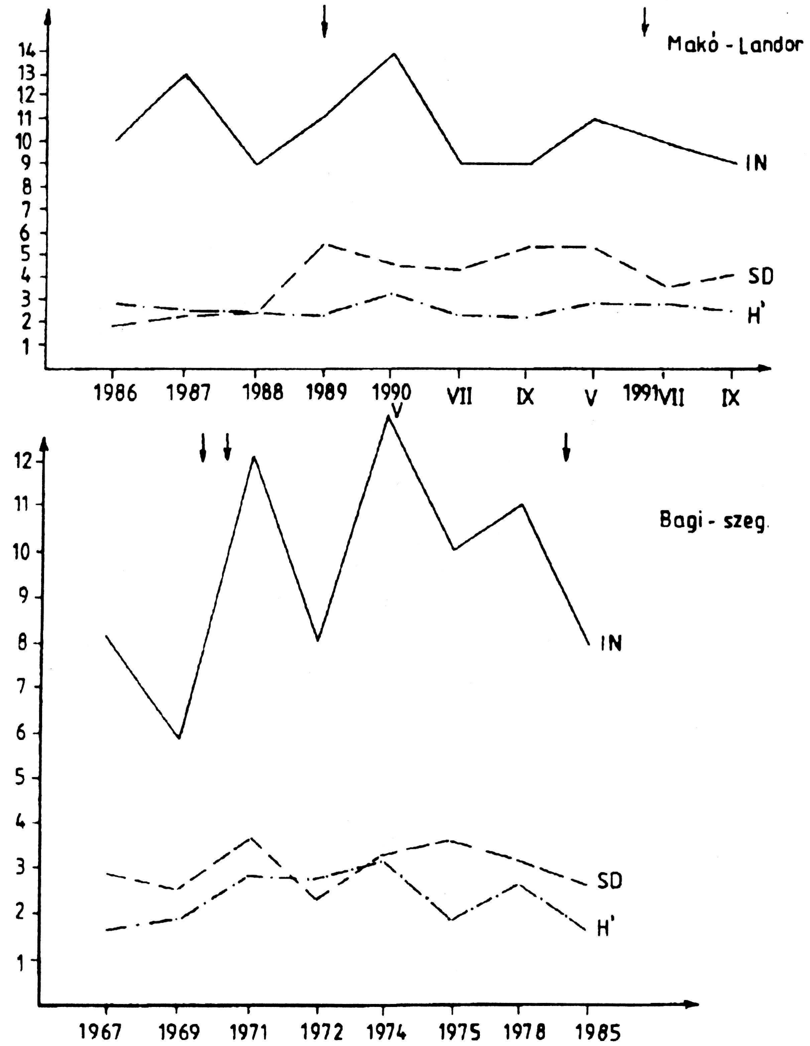


Figure 5. Species number, species density and diversity changes in Landor and Bagiszeg (IN=species number, SD=species density, H=diversity).

In Bagiszeg, the species number, species density and diversity decreased upon the natural and anthropogenic effects. The total number of species decreased from 10-13 to 6-8. The same holds true for the Landor forest after the sylvicultural intervention in 1989. The reason for the flattened curves for the Landor data is the decrease of canopy closure, which in turn led to decreased soil humidity (Fig. 6). Consequently, the dominance of major species steadily decreases between 1990-1991. Of the three dominant species, Vallonia suffered the least changes although its tolerance limits are the narrowest.

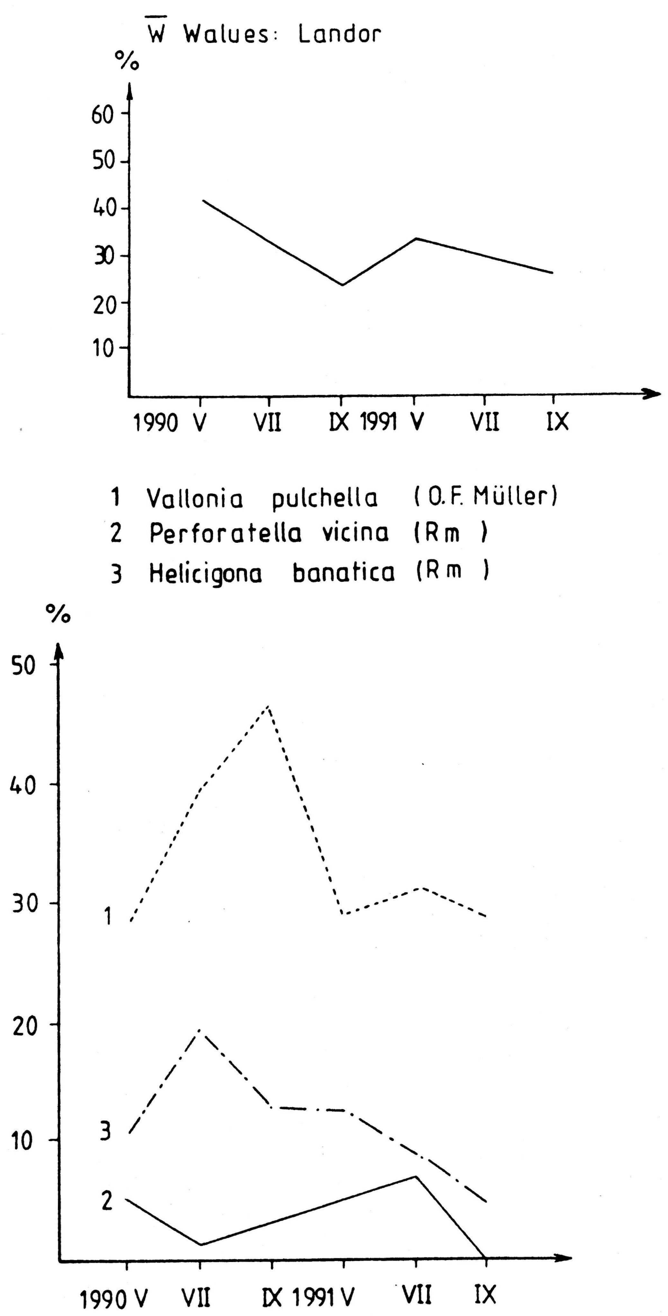


Figure 6. Changes of dominance of characteristic species and of soil humidity in the gallery forest at Landor.

Structural changes during fluctuation and oscillation

Structural changes in the two forests are different. Of the ecological species groups, complement changes of the C-A group dominate (Fig. 7). Following the renewal of shrubs after the Lymantra gradation, the shade species (group A) increase. At Landor, sylvicultural intervention is followed by the increased dominance of riparian ubiquists (E). Group E is a complement of groups A-C. Group E becomes dominant in the forest of the floodplain after disturbance, as earlier investigations suggest.

The nutritional types in the two forests also differ. In Bagiszeg, the omnivorous (O) and saprophagous (S) types are complementing, with the dominance of the first. After the Lymantria gradation, the saprophagous type becomes dominant, however (Fig. 7). At Landor, increased amounts of forest litter and debris, produced by sylvilcultural intervention, lead to the permanent dominance of the saprophagous type (Cochlodina, Vallonia, Carychium), similarly to the mown pastures, indicating terrestrial eutrophication (Fig. 8).

Table 2 shows structural changes in terms of constancy and dominance relations of the species assemblages. At Bagiszeg, Perforatella vicina and Chilostoma are constant-dominant, and Arion subfuscus is temporarily subconstant after floods. After the Lymantria gradation, when the canopy has regenerated, the increased soil moisture led to the constant-dominance of Carychium tridentatum. The sylvicultural treatment at Landor, and the steady decrease of soil moisture (Fig. 6) were favorable for mesophilous species with relatively wide tolerance ranges (Vallonia pulchella, Cochlicopa lubrica). The subconstant-dominants (Carychium minimum) and the hygrophilous species (Bradybaena, Cochlodina, Perforatella) become temporarily characteristic in the spring and autumn reproductive periods.

The results portrayed by diagrams discussed above suggest that regeneration of snail assemblages is more pronounced in moderately warm climates, both by seasons and months. In drier climates minor sylvicultural interventions (thinning) cause more changes leading to eutrophication. In more humid climates structural changes caused by external effects are more easily compensated thanks to the closeness of water in gallery forests.

Seasonal changes in Landor

Seasonal changes are depicted by cluster analysis and the mean shell breadth data of Chilostoma for 1991 (Fig. 9). After 1989, the seasonal changes are characterized by spring, summer and autmn periods. The spring aspects of different years are closer to one another than different aspects of the same year. Compared to previous investigations, such seasonal relationships develop in strongly desiccated forests and dry pastures (Bába 1993).

The clustering is confirmed by Chilostoma shell breadth measurements performed by Domokos in 1990-1991 (Bába & Domokos 1992). Fig. 9 shows data for 1991, corresponding to the gradual thickening of the apertural lip.

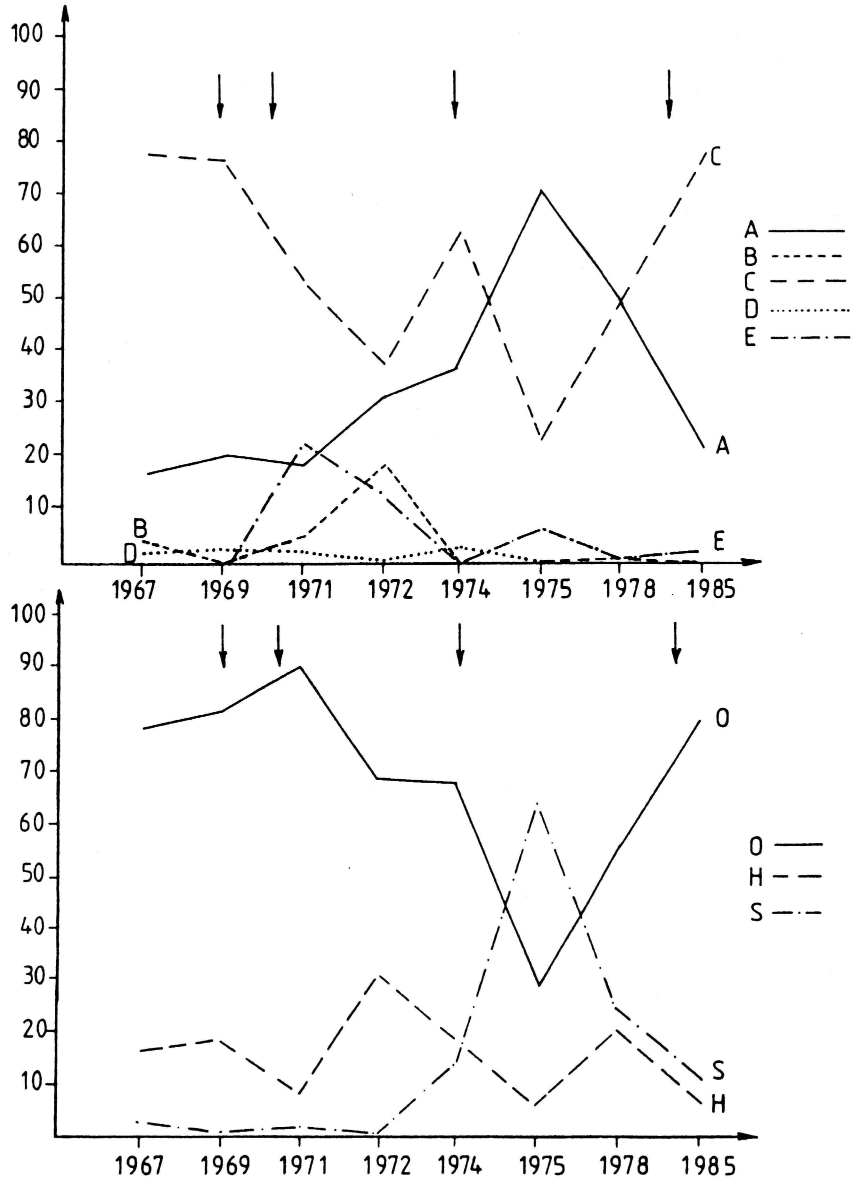


Figure 7. Percentage distribution of ecological species groups and nutritional types in Bagiszeg.

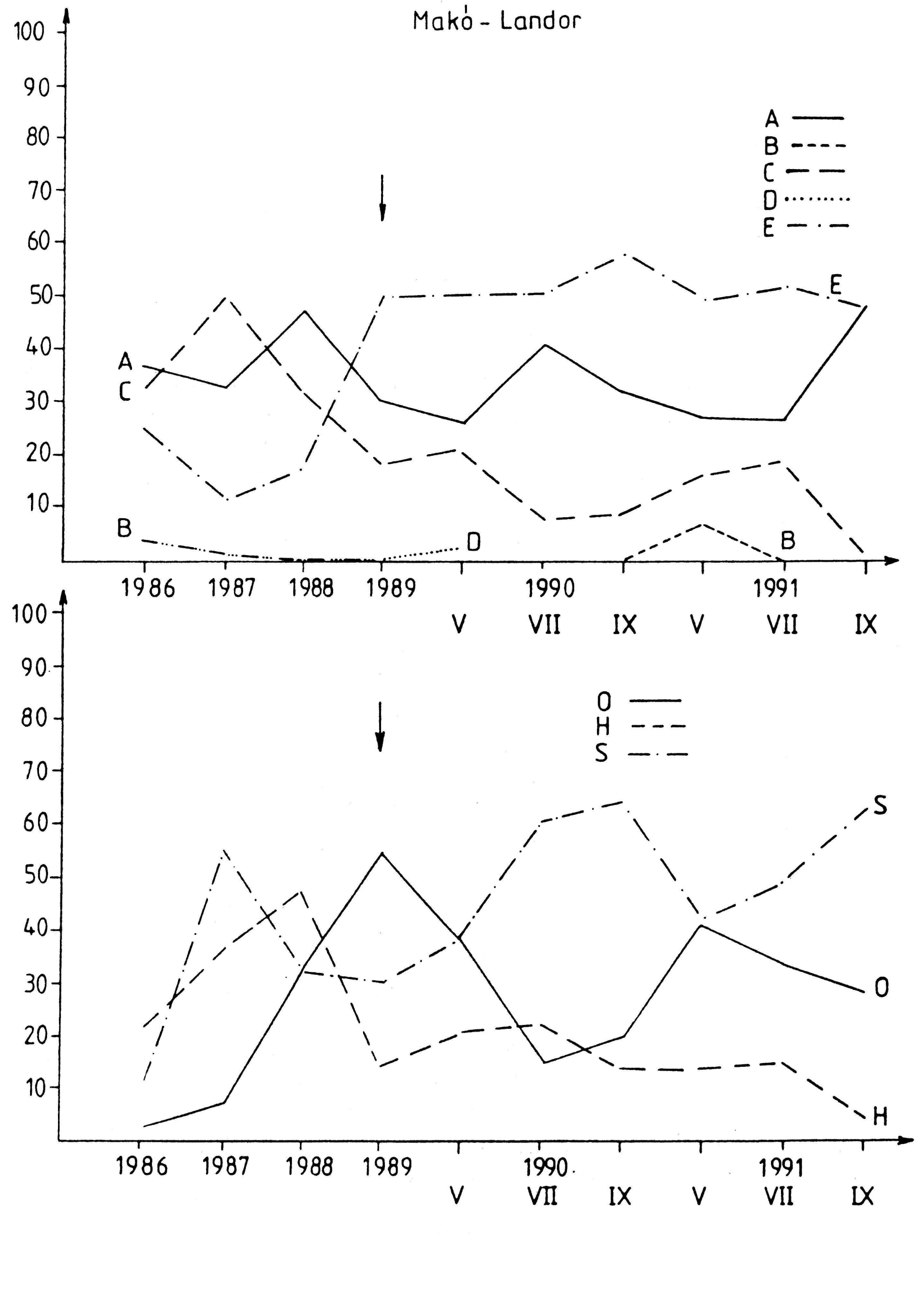
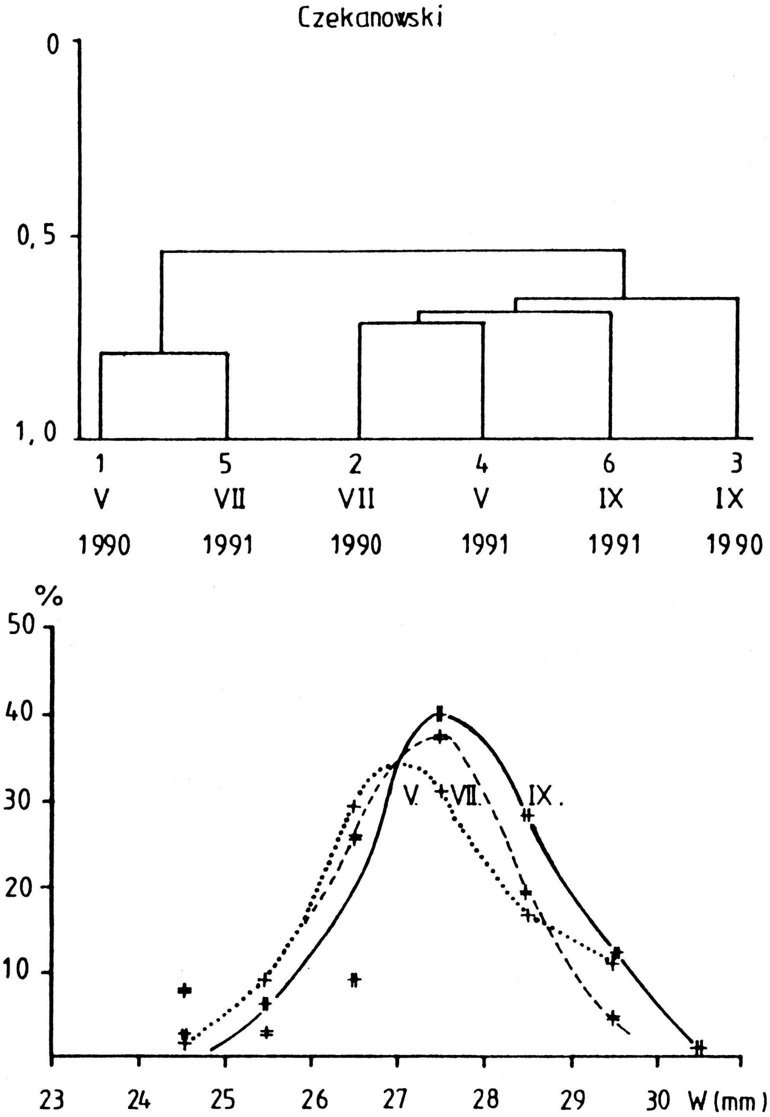


Figure 8. Percentage distribution of ecological species groups and nutritional types in the forest at Makó-Landor.



V. May	W=27.3; S=1.14;V=1.32
VII. July	W=27.2; S=1.18; V=1.38
IX. September	W=27.7; S=1.10; V=1.20

Figure 9. Seasonal distributions based on simple average clustering with the Czekanowski Index, and the mean shell breadth (W) of Chilostoma in 1991. S: standard deviation, V: variance.

Table 2. Changes of constant/dominant species in snail assemblages in Bagiszeg and Landor.

Bagi-szeg		1967		1969		1971		1972		1974		1975		1978		1985	
		D%	F%	D%	F%	D%	F%	D%	F%	D%	F%	D%	F%	D%	F%	D%	F%
Perforatella vicina	C	66.55	100	51.16	90	33.87	90	18.75	100	15.70	70	19.44	100	27.60	60	65.15	100
Helicigona banatica	A	13.31	70	16.27	60	-		26.66	40	-		-		17.60	60	-	
Bradybena fritucum	C	10.89	40	23.25	70	-		-		-		-		-		-	
Cochlodina laminata	A																
Carychium tridentatum	A	-		-		-		-		-		61.11	90	21.62	70		
Carychium minimum	A																
Arion subfuscus	C	-		-		12.90	60	-		-		-		-		-	
Vallonia pulchella	E																
Cochlicopa lubrica	E																
Helix pomatia	C																

Makó-Landor		1986		1989		1990 V		VII		IX		1991 V		VII		IX	
		D%	F%	D%	F%	D%	F%	D%	F%	D%	F%	D%	F%	D%	F%	D%	F%
Perforatella vicina	C			+		+		+		+		5.26	60	+		-	
Helicigona banatica	A	25.40	40	13.83	100	10.25	40	19.83	80	13.06	90	12.28	70	9.52	30	66.66	50
Bradybena fritucum	C			17.92	100	-		-		5.52	70	9.64	70	-			
Cochlodina laminata	A	+		+		+		+		6.53	70	+		+		+	
Carychium tridentatum	A																
Carychium minimum	A					-		16.52	60	12.56	50	13.15	50	-		-	
Arion subfuscus	C																
Vallonia pulchella	E			38.99	100	28.20	80	39.66	90	46.23	80	28.94	80	31.74	90	25.64	70
Cochlicopa lubrica	E			8.80	90	16.66	70	9.09	80	9.54	80	14.91	70	14.28	70	17.51	90
Helix pomatia	C	20.83	30														

Gallery forests of the Maros River in Romania

Based on the collected material, the relationship between willow woods and gallery forests was examined using single linkage clustering. The objects are divided into one small and two large seeds.

Cluster seed 1 includes species-poor willow-poplar stands and gallery forests strongly affected by cultural effects (localities 14,18, 28, forests at Csála, Bezdin and Makó).

Cluster seed 3 falls into three parts, the first two including forests from Bagiszeg, Csála and Landor, the latter also present in the third part.

Cluster seed 3 includes the species-poor gallery forest of Pécska (Pecica). The cluster membership and the composition of seed parts indicates that there is no big quantitative and qualitative difference between the gallery forests of the Upper Tisza and those of Hungary and Romania, notwithstanding the large geographical differences. The discrepancies are caused mainly by natural and anthropogenic effects of various origin. The differences caused by external factors are shown by structural characteristics (Fig. 11) and the scattergram of Principal coordinates analysis (Fig. 12). The species are distributed into three groups, as confirmed by the PCoA diagram. Accordingly, species of ecological group E (Succinea oblonga, Cochlicopa lubrica, Vallonia pulchella) characterize the Landor and

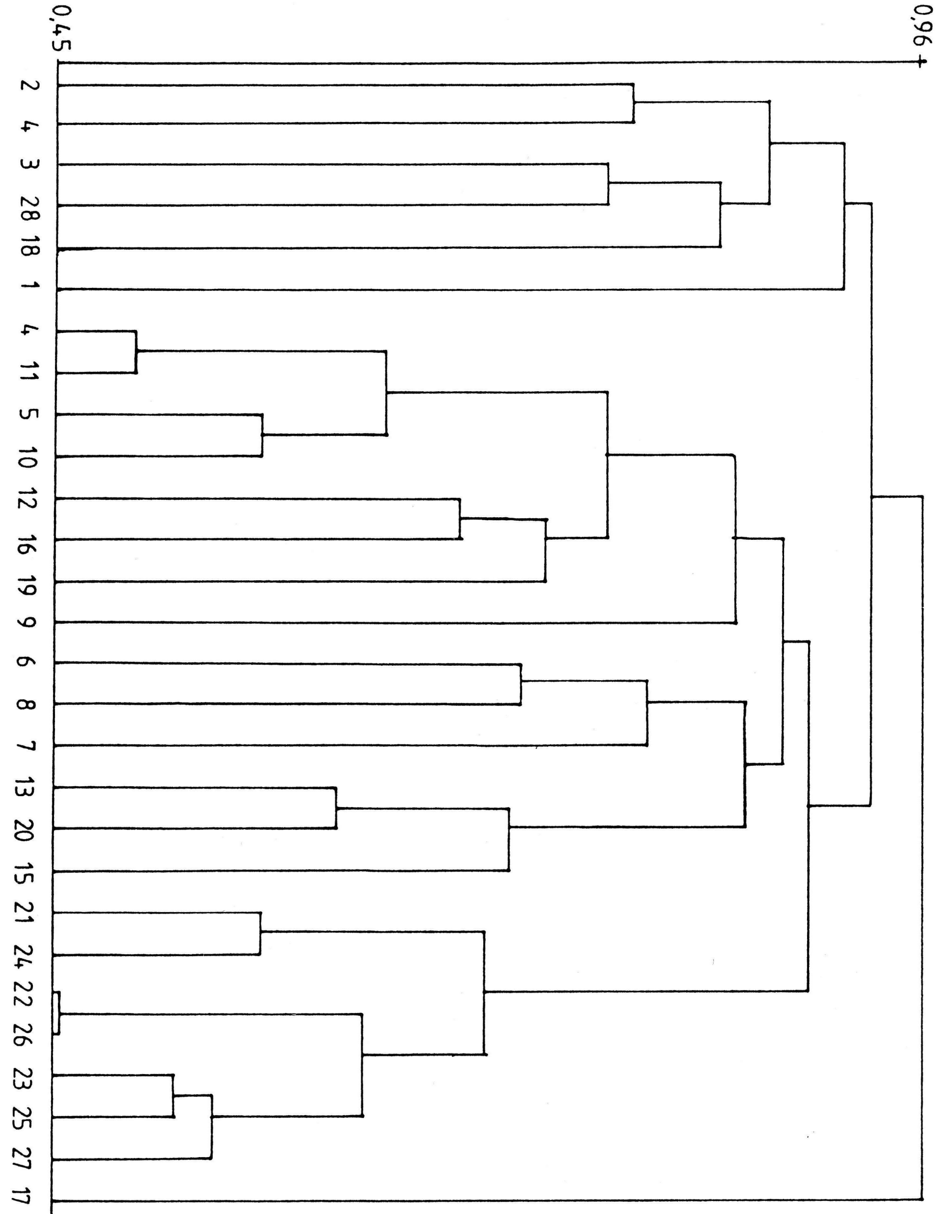


Figure 10. Simple average clustering of forests along the Maros River.

Pécska forests (Fig. 12/II). The large abundance of these species contribute to the percenage of bush forest (BW) and steppe (S) inhabitants. Especially large abundance is typical of Bradybaena fruticum, from group BW. The willow-poplar woods and the bushy Csála forest belong to group I. Low numbers of species and individuals and, as a consequence, low species density are typical. The absence of Chilostoma characterizes the willow-poplar stands. Balea and Clausilia pumila occur only in this forest type at Bezdin (site 2).

The differential species of Bagiszeg forests and the gallery forests in Romania are in group IV (Fig. 1). Limax cinereoniger and, in Romania, Euomphalia strigella join these species.

Anthropogenic effects are evident in both Hungary and Romania. The willow-poplar stands (Locations 1-3) are less disturbed. In the Lippa forest, close to the river, species of bush forests dominate. The Bezdion forests 2-3 show transition towards gallery forests via the dominance of the photophilous species group. The distribution of ecological species groups in sites 12, 13, 15 and 17 corresponds well with the Bagiszeg one. Sites 14 and 17 at Csála forest 16 at Pécska and 18 at Bezdin are strongly influenced by man. The low species density show this (Fig. 11.A), and the large dominance of bush forest and riparian species (Fig. 11.B). Especially striking is the external effect on forests 14, 17 and 18. The trees of forest 18 are mostly dead, they are included in the diagram as control. These forests are characterized by low species number, low diversity and species density. The proportion of BW, riparian and steppe species is high. The decrease of the diversity of ecological species groups and the increased dominance of groups E-C are decisive. The anthropogenic effects are similar to those after sylvicultural treatment in Landor and in the forest at Makó, leading to decreases in various characteristics (Fig. 11A,B,C, locations 18-28).

The distribution of nutritional types (Fig. 11D) is characterized by the dominance of omnivorous species in willow stands and less-disturbed forests (localities 1, 2, 3, 12, 16, and 19). In the disturbed forests, depending on the influential factor, the saprophagous (localities 13, 15, 23, and 26) or herbivorous types may dominate, especially in forests with poor herb layer (sites 14, 17, 28).

Summary

The results presented in this paper may be concluded as follows. The snail assemblages of 28 forests from 7 geographical locations are linked with an associated species group. The stability of this group is maintained by fauna transport from Transylvania through rivers. One constant-dominant species of the group is Chilostoma banatica, found in recent or subfossil state at the Upper Tisza (as arrived through the Szamos river), at the Fehér and Fekete Körös and at the Maros River.

Fluctuation and oscillation studies showed that in forests with a more humid climate and with constant influence of water) the snail assemblages regenerate from disturbed states (Bagiszeg). In dry climatic areas (continental climate), at Landor, after thinning, the ecological groups A-C are outcompeted by groups E-C. The dominance of forest dwellers,

according to investigations in Romania, may be changed upon anthropogenic effects, however, via invasion by inhabitants of bush forests, steppe communities and by riparian species.

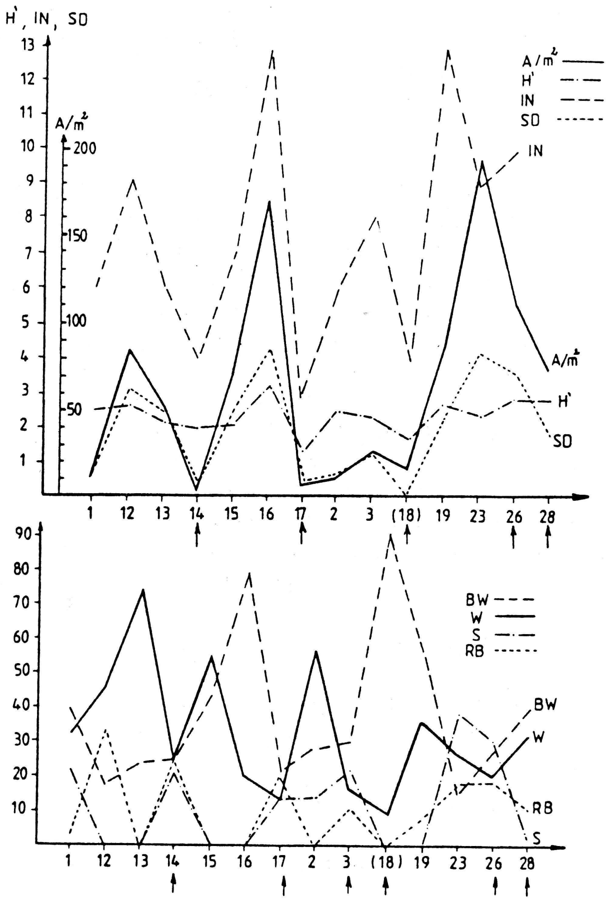


Figure 11. A, B. Structural properties of collecting sites. A (upper): A/m^2, species number (IN), species density (SD) and diversity (H'); B (lower): habitat types of Lozek.

In dry climates the dominance of omnivorous species in gallery forests is replaced by the dominance of saprophagous elements. Similarly to forests desiccated by sylvicultural intervention and to mown grasslands, the seasonal dynamics of snail assemblages is changed. This is also reflected by the monthly average shell breadth data of Chilostoma banatica.

The forests can be assigned into three groups by PCA. This grouping is influenced by differences between plant communities (Group I: willow-poplar stands) and cultural effects. After sylvicultural treatment, the forests of Landor and Makó are separated (group II). These differences are manifested in the species composition of groups as well.

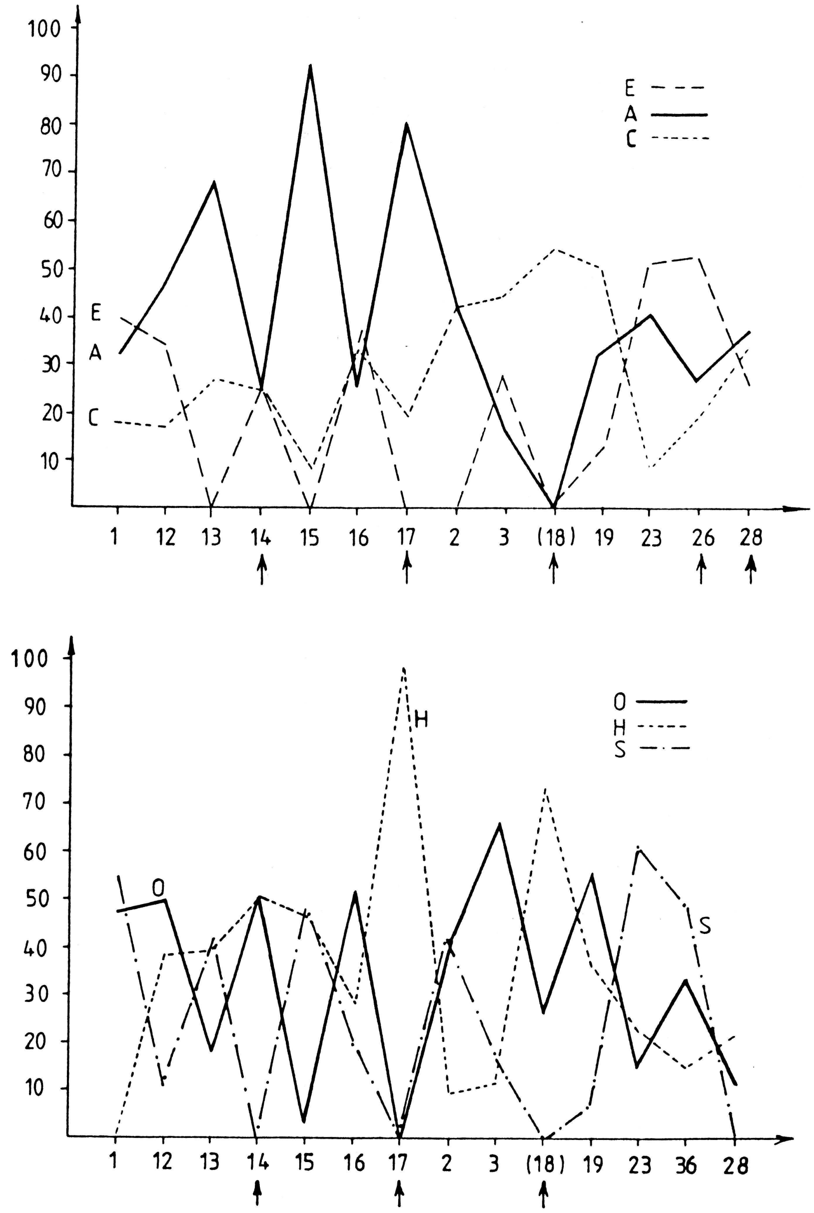


Figure 11. C, D. Structural properties of collecting sites. C (upper): Ecological species groups; D (lower): Nutritional types.

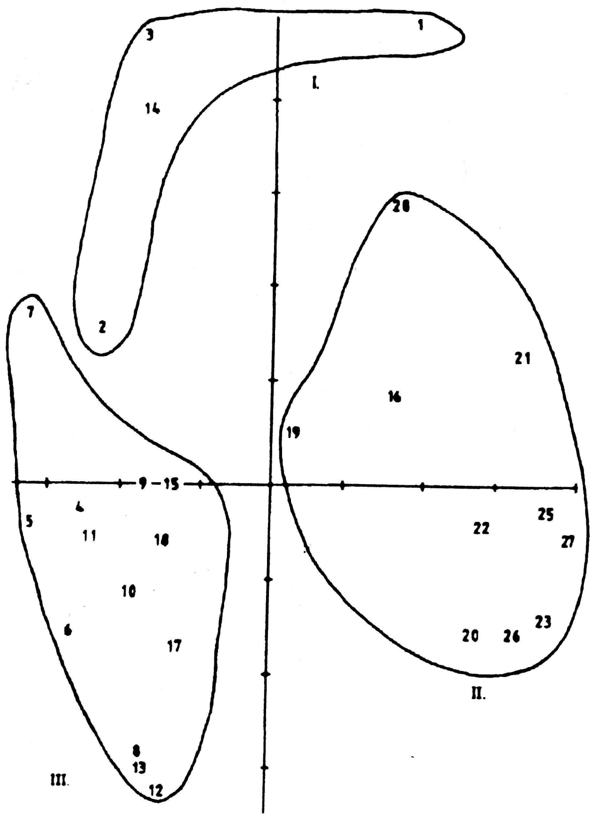


Figure 12. Principal coordinates analysis of forest types.

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FISH OF THE MUREŞ (MAROS) RIVER: SYSTEMATICS AND ECOLOGY

TEODOR T. NALBANT

A brief historical sketch of the research

The main stem of the Mureş River has more than 700 km of waterway. From its source to the confluence with the Tisza River, along its main valley, there is a natural or artificial system of marshes, pools and a network of channels. Therefore, this system maintains different biotopes with lotic or lenitic aspects with a very characteristic and a diverse fish fauna. During our field work more than 50 species were collected or observed. But before our treatment, it is necessary to pay a tribute to those that increased our knowledge concerning the fish fauna of Transylvania generally and of the Mureş River specifically.

The first information on the fish of Transylvania are due to Fridvalszky (1767). He mentions only four species: Barbones, Truttas, Mugiles and Thymallos (i.e. Barbus, Salmo, Leuciscus and Thymallus). The number of species increased to 20 in the paper of Benkõ (1778). Forty years later Leonhard (1818) mentions nearly the same species, presenting for the first time the description of the mottled barb or gray barb without naming it. Thirty-four years later, Heckel (1858) described this species as Barbus petenyi. Bielz, in three important contributions (1853, 1856 and 1888) presented a list of 39 species for all waters of the Transylvanian Basin. In his third paper (1888) he added, after Karoli (1887) and Herman (1887), contributions to the following species: Abramis brama, Gobio uranoscopus and Cobitis elongata. Heckel and Kner, in their monumental work on freshwater fish of the Austrian Monarchy, included a great number of species from the Mureş River. Other significant contributions were made by Steindachner (1863), Károlyi (1877), Simonkai (1887) and Vutskits (1918). The last named author synthesized all the data until 1913 completing them with original contributors. He added in his treatment the following species: Aspius aspius, Blicca bjoerkna, Pelecus cultratus, Acipenser schypa, Lucioperca lucioperca, Rutilus pigus virgo and Chalcalburnus vhalcoides mento. He removed Acipenser sturio, Abramis leuckardti, Salvelinus salvelinus and Cobitis elongata from the list of Transylvanian fish. Among the modern authors important contributions concerning the fish of Transylvania generally, and particularly of the Mureş River, were made by Rotarides (1944), Jászfalusi (1941, 1957), Băcescu (1947), Bănărescu (1953, 1964), Bănărescu, Müller and Nalbant (1957). A special contribution concerning the fish fauna of Transylvania was made by Bănărescu and Müller (1959). They listed 51 species with rich comments on their taxonomy and zoogeography.

Materials and methods

During the year 1991 the fish were obtained during one general collecting trip (August) and one special collecting trip (October) with an electrofishing aggregate. Altogether 42 species and more than 2100 specimens were caught.

The first cruise began August 1 and was finished August 29. A number of 18 fishing stations were made: Senetea, Faier Brook, Suseni, Joseni, Borzont, Sărmaş, Stînceni, Răstolița, Ruşii Munti, Gorneşti, Ungheni, Gura Arieşului, Sîntimbru, confluence with the Cugir River, confluence with the Beriu (Orăştie) River, confluence with the Almaş River, Pecica and Makó. A supplemental station was made in a channel at Nădlac near the frontier between Romania and Hungary. The specimens were collected with a hand net.

The second trip on the Mureş River was made especially for electro-fishing. This particular collecting cruise was relatively short in time, 18-22 October. Nine fishing stations were made: Sărmaş, Stînceni, Lunca Bradului, Răstolița, Brîncoveneşti, Gorneşti, confluence with the Cugir River, confluence with Beriu (Orăştie) River and Pecica. The specimens were fixed in a 7-8% formaldehyde solution and then transferred to a 75% ethanol solution in the scientific collection of the Department of Taxonomy and Evolution, Institute of Biological Sciences, Bucureşti. Another part of material, obtained in the October trip, was partially transported alive to the National Museum of Natural History in Madrid, Department of Zoology, for electophoretic studies, but the majority was preserved specimens (in formaldehyde 5%). The number of specimens of all species were counted. In the table the information are not presented in exact values since the fishing process represents a stochastic choice. On the other hand, the behaviour of each species (even of the different stages of development) to the net used was very diverse. Some species (Alburnoides bipunctatus, Rhodeus sericeus, Orthrias barbatulus, Cottus gobio) and early stages were obtained without difficulty. Other species (Leuciscus cephalus, Gobio uranoscopus, Zingel streber, etc.) were difficult to collect. Therefore the present evaluation was made on the basis of frequency of the specimens in each sample, for each species.

Fishing stations

Twenty fishing stations were made during two collecting trips. Most of them are the same in both trips. Only two (Lunca Bradului and Brîncoveneşti) were new and added in the October trip. However, in that cruise other stations were eliminated (Senetea, Faier Brook, Suseni, Joseni, Borzont, Ruşii Munti, Ungheni, Gura Arieşului, Sîntimbru, confluence with Almaş river and Makó), we retained only those stations most important for identifying the most oxyphilic species such as Gobio uranoscopus, Gobio kessleri, Orthrias barbatulus, Sabanejewia aurata, Sabanejewia romanica, Stizostedion lucioperca, Gymnocephalus baloni, Zingel streber and Cotus gobio.

Stations

1. Senetea (Mureş River):

width of course 6-7 m; swift current, shallow water ca 0.25-1.5 m depth; bottom mostly stone, in a few areas near the shore sand.

2. Faier Brook near its confluence with the Mureş River:

width: 1.5-3 m; depth 0.2-1.0 m; bottom: stones, gravel and sand, sometimes submerged vegetation such as Typha, Potamogeton; current: 0.25-1.0 m/sec.

3. Suseni (Mureş River):

width: 5-13 m; current: swift, 0.50-1.50 m/sec.; depth: 0.25-1.5 m; bottom: stones, gravel, coarse sand, rarely submerged vegetation (Fontinalis).

4. Joseni (Mureş River):

width: 7-15m; current: swift, 0.5-1.5 m/sec; depth: 0.20-1.20 m; bottom: stones, gravel, coarse sand, a few zones (flooded areas) with yellow-gray silty-mud.

5. Borzont (Mureş River):

width: 10-18m, current: swift, 0.75-1.65 m/sec; depth: 0.50-2.10 m; some islands not covered by vegetation; bottom: stones, coarse gravel, coarse sand, rich in emerse vegetation such as Typha.

The following four stations — Sărmaş, Stînceni, Lunca Bradului and Răstoliţa, are situated on the Mureş River and have similar features. The river crosses a volcanic chain of mountains forming a cutoff valley.

Width: 30-90 m; current: swift, 0.50-2.0 m/sec; bottom: mostly stony, sometimes with big stones (1.5-2.5 m), sometimes with islands covered by vegetation; depth: variable, from 0.25 to 1.50 m or more.

10. Brîncoveneşti (Mureş River):

generally the river has the same features as previous stations but it has a large flood-plain which crosses a hill area. The bottom is made by small stones, gravel and coarse sand in few cases, near the slope, with fine sand. The islands were covered by vegetation sometimes made by Typha.

11 and 12. Ruşii Munti and Gorneşti (Mureş River):

width: generally a large valley, 60-100 m; current: generally swift 0.50-1.0 m/sec; depth: 0.25-1.50 m or more; bottom: made by coarse gravel, coarse sand, fine sand and sometimes a fluid mud which covers the gravel.

13. Ungheni (Mureş River):

large flood-plain and the width of the main stream is very variable (50-150 m), sometimes with islands covered by vegetation; current: relatively swift, 0.30-0.75 m/sec; depth: variable, from 0.30 to 1.75 m or more.

Between Ungheni and Gura Arieşului the river has high slopes covered by vegetation, generally Salix, in a few cases some islands, a reduced current of 0.25-0.45 m/sec, and a depth from 0.50 to 2 m or more, bottom sandy or muddy. No fishing stations were made in this part of the river.

14. Gura Arieşului (Mureş River):

width: cca 30-70 mm; current: relatively swift 0.5-1.0 m/sec; depth: 0.30-1.50 m or more; bottom: stony, gravel, coarse sand and silty-mud near the slope in few cases, sometimes small islands covered by vegetation.

15. Sîntimbru (Mureş River):

generally the same features but the speed of the water in the main stream was always less than 1 m/sec.

16. Confluence with Cugir River (Mouth of the Cugir River):

width: 10-20 m; current: swift, 0.5-1.20 m/sec; depth: 0.20-0.75 m; bottom: generally stony and coarse gravel but sometimes medium and fine sand; some islands covered by vegetation (shrubs of Salix mostly).

17. Confluence with Beriu River (Mouth of the Beriu or Orăştie rivers):

width: 10-15 m; current: 0.30-0.75 m/sec; depth: 0.20-1.0 m; bottom: coarse and medium gravel generally, but in some places with coarse sand or a fluid mud covering the gravel.

18. Confluence with the Almaş River (Mouth of Almaş):

width: 5-7 m; current: swift 0.5-1.20 m/sec; depth: generally 0.25-0.75 m but more at the mouth; bottom: coarse sand generally, sometimes fine gravel.

19. Pecica (Mureş River):

width: 100-300 m; current: generally slow 0.25-0.50 m/sec; depth: very variable 0.30-1.5 m and more (5-6 m in few cases); bottom: mostly coarse and medium sand but a yellow or gray silty mud can cover large zones; large islands covered by very dense vegetation generally tree shrubs and bushes.

20 Makó (the Maros River in Hungary):

generally the same features as previous station.

Systematics and ecology of fishes

Generally there are no systemic or nomenclature problems concerning the fish of the Mureş River. However, in a few species of genera Leuciscus, Cobitis and Sabanejewia the taxonomy needs more classifications.

In the present study 56 species are treated.

1.Eudontomyzon danfordi Regan

In clean and rapid waters of the Mureş River from Senetea to Gorneşti, possibly to Ungheni.

2.Acipenser ruthenus ruthenus Linnaeus

Only in the interior part of the Mureş River from Aiud but apparently it is missing now between Aiud and Zam due to pollution. Isolated specimens were obtained by fishermen between Zam and Pecica.

3.Oncorhynchus mykis (Walbaum)

A few specimens were recorded between Sărmaş and Răstolița, they had apparently escaped from salmoniculture stations on the Gudia River.

4.Salvelinus fontinalis Mitchill

Same situation as previous species.

5.Salmo trutta fario Linnaeus

Only in tributaries of the upper Mureş (Gudia Mare, Zebrac, Răstolița etc. (see Jászfalusi, 1947)). However a few specimens were recorded in the Mureş River at the confluence with these tributaries.

6.Hucho hucho (Linnaeus)

Found in the Mureş River near Stînceni, but the specimens were obtained from Ceahlău fishculture station.

7.Thymallus thymallus (Linnaeus)

Present only in the tributaries of the upper Mureş (see also Jászfalusi, 1947): Gudia Mare, Răstolţia, Gălăoaia but a few specimens were recorded in the Mureş River near the mouths of these tributaries.

8.Esox lucius Linnaeus

A species present from Senetea to the confluence with the Tisza River in Hungary.

9.Rutilus rutilus carpathorossicus Vladykov

From Sărmaş to the confluence with the Tisza River in Hungary.

10.Leuciscus leuciscus leuciscus (Linnaeus)

A very rare species in Mureş river generally recorded from Gălăoaia and Tîrgu Mureş.

11.Leuciscus cephalus cephalus (Linnaeus)

The most common species in Mureş river, from Senetea to the confluence with the Tisza River in Hungary.

12.Leuciscus borysthenicus borysthenicus (Kessler)

The first record of this species in Mureş drainage, based on a single specimen, was in August this year in a channel of a fishculture station at Nădlac near the frontier between Romania and Hungary. The presence of this species in this area is extremely strange, since it is known only from the Danube Delta and recently was also recorded near Bucureşti.

13.Leuciscus idus idus (Linnaeus)

Known from Aiud to the Tisza River but in Mureş is a very rare species.

14.Phoxinus phoxinus phoxinus (Linnaeus)

In very clean and rapid courses of Mureş River from Senetea to Ruşii Munti.

15.Tinca tinca (Linnaeus)

A very rare species generally in the abandoned meanders (Tg. Mureş, Luduş etc.) possibly to the Tisza River in Hungary.

16.Scardinius erythrophthalmus (Linnaeus)

Same situation as previous species.

17.Aspius aspius aspius (Linnaeus)

A species known from Brîncoveneşti to the Tisza River.

18.Leucaspius delineatus delineatus Heckel

Known from Ruşii Munti to Gura Arieşului. Then in the lower part of the river.

19.Alburnus alburnus alburnus (Linnaeus)

Known from Senetea to the confluence with the Tisza River in Hungary. It is one of the most common species in the river.

20.Alburnoides bipunctatus bipunctatus (Bloch)

Same situation as Alburnus alburnus but it was found as far as the confluence with the Almaş River at Zam.

21.Blicca bjoerkna (Linnaeus)

A very rare species known from Gorneşti and the lower part of the river.

22.Abramis brama danubii (Pavlov)

Also known from the lower part of the river. An extremely rare species.

23.Abramis ballerus (Linnaeus)

Known from Tîrgu Mureş to the Tisza River.

24.Abramis sapa sapa (Linnaeus)

A very rare species known around Pecica.

25.Vimba vimba vimba

Same distribution as Abramis ballerus.

26.Pelecus cultratus (Linnaeus)

A very rare species, known from Gorneşti to Ungheni then in the lower part of the river.

27.Chondrostoma nasus nasus (Linnaeus)

One of the most common species in the river, from Suseni to the Tisza River.

28.Rhodeus sericeus amarus (Bloch)

One of the most common species from Senetea to the Tisza River.

29.Pseudorasbora parva parva Nichols

Same situation as previous species.

30.Gobio gobio obtusirontris Valenciennes

Same as above. Possibly the subspecies muresia of Jászfalusi (1951) might be a valid name only for the Mureş drainage. A comparative study of populations is necessary.

31.Gobio uranoscopus frici Vladycov

A frequent species in swift areas of the river and always associated with stones or gravel. From Suseni to Tîrgu Mureş.

32.Gobio kessleri kessleri Dybowsky

Same as above. It appears from Sărmaş and is present to the Tisza River.

33.Gobio albipinnatus vladykovi Fang

From Gorneşti to the Tisza River. Relatively common.

34.Barbus barbus barbus (Linnaeus)

A relatively common species from Tîrgu Mureş to the Tisza River, but present also from Lunca Bradului to Tîrgu Mureş.

35.Barbus peloponnesius petenyi Heckel

In very clean and rapid waters. Barbus meriodionalis from southern France and Italy differs enough from petenyi. This last named appears to be very close to the Greek species peloponnesius Valenciennes. The location of petenyi is the Mureş River (see Bănărescu, 1957:72).

36.Carassius carassius (Linnaeus)

An extremely rare species. A few specimens were caught during the year around Pecica and Nădlac channels.

37.Carassius auratus gibelia (Boch)

A relatively frequent species from Tîrgu Mureş to the Tisza River.

38.Cyprinus carpio carpio Linnaeus

Common species, especially in clean and rapid waters generally with stony bottoms, although it was collected in sandy and even muddy areas. From Senetea to Tîrgu Mureş

40.Misgurnus fossilis (Linnaeus)

A rare enough species known from Tîrgu Mureş to the confluence with the Tisza River.

41.Cobitis elongatoides Băcescu

A relatively frequent species from Sarmas to the confluence with the Tisza River.

Note: Cobitis taenia was for a long time a "catch all species". In reality, in the freshwaters (both rivers and lakes) of Europe, three lineages at least can be discerned within this genus, each having two or more species. In the Danube drainage there is a species which differs greatly from Cobitis taenia Linnaeus, 1758, from Sweden (type locality) and Central Europe, in its colour pattern and lamina circularis (Canestrini scale). Therefore, for the majority of the Danubian populations the next available name is Cobitis elongatoides Băcescu, 1962, its closest relative being Cobitis vardarensis Karaman, 1928 from Axios (Vardar) basin, Loudias, Gallikos, lower Aliakmon and Pinios rivers (Greece) and also in the rivers of northwestern Anatolia. On the other hand, in Asia, especially in Far Eastern Asia, the genus Cobitis has a great number of species, many of them being distributed from Amur drainage southward to Menam Chao Phrya in Thailand and Kapuas river in Borneo. Cobitis melanoleuca Nichols, 1925 (=granoei Rendahl, 1935, =sibirica Gladkov, 1935) has the greatest range within the genus, from the tributaries of the Pacific slope to the Don River in Eastern Europe. Apparently this species has not reached the Danube system but its presence in a few Danubian tributaries may be possible.

42.Sabanejewia romantica Băcescu

A species known to inhabit the swift waters of the southern tributaries of the Mureş River (Cugir, Beriu, Strei).

43.Sabanejewia aurata (Filippi)

Along the Mureş River this species is known by its three subspecies: radnensis (Jászfalusi, 1951), in very clean and rapid water of upper courses of the Mureş River, from Sărmaş to Gorneşti, balcanica (Karaman, 1922) in clean and relatively swift water, from Tîrgu Mureş to its confluence with the Tisza River, and bulgarica (Drensky, 1928), from Periam Port (near Pecica) to its confluence with the Tisza. Between radnesis and balcanica, between Reghin and Gura Arieşului, even Sîntimbru, there are integrades. In the lower part of the Mureş River both balcanica and bulgarica has no integrades.

44.Silurus glanis (Linnaeus)

A species now relatively rare in the lower part of the Mureş River. It can reach 80 kg in weight.

45.Ictalurus nebulosus (Le Sueur)

Very rare species found in a channel connected with the Mureş River, at Nădlac.

46.Anguilla anguilla (Linnaeus)

One specimen was caught a long time ago between Reghin and Tîrgu Mureş.

47.Lota lota (Linnaeus)

A species present in very clean and fast running water from Senetea to Gorneşti.

48.Lepomis gibbosus (Linnaeus)

Present in the river from Sărmaş to Sîntimbru, but possibly to the Tisza River.

49.Perca fluviatilis (Linnaeus)

Same situation as previous species.

50.Stizostedion lucioperca (Linnaeus)

A very rare species caught as isolated specimens near Tîrgu Mureş.

51.Gymnocephalus cernuus (Linnaeus)

A rare species, generally from Tîrgu Mureş to lower parts of the river.

52.Gymnocephalus baloni Holcik and Hensel

Found only at Pecica.

53.Gymnocephalus schraetzer (Linnaeus)

Only on sandy bottoms in the lower part of the Pecica River. A rare species.

54.Zingel zingel (Linnaeus)

Same situation as previous species. However generally this was found more seldom than Gymnocephalus schraetzer.

55.Zingel streber streber Siebold

Now a rare species in the Mureş River. Although Bănărescu and Müller (1959) found it between Tîrgu Mureş and Pecica, now the species apparently has disappeared in the lower part of the river. A few specimens were caught by fishermen near Gura Arieşului, all of the specimens were adults.

56.Cottus gobio gobio Linnaeus

Only in clean and rapid waters with stony bottoms from Senetea to Zam. At present however, this species is completely absent in the lower part of Mureş, from Tîrgu Mureş. A young specimen (65 mm total length) was collected by a fisherman in a tributary of the Mureş River near its confluence at Vărădia de Mureş and seen by one of us. The common sculpin is one of the most frequent species in the upper part of the Mureş. Many specimens have striped pelvics similar to Cottus paecilopus Linnaeus, but in the former species all rays of these fins are long.

Remarks on the distribution of the fish species along the river

Generally every place of the river is more or less densely populated by different species, the fishes being disposed in a mosaic-like pattern. This is due to the fact that optimal conditions for each species are disposed in such a way. In the fast running waters, for instance, the slopes, especially with vegetation such as Typha, Potamogeton etc, are densely populated by early stages of different species. We have obtained by hand net, but not with electofishing, early stages (4.5-9.0 mm total length) of Alburnoides bipunctatus, Rutilus rutilus, Gobio gobio obtusirostris, Rhodeus sericeus, Cobitis elongatoides and others. Other young specimens were found along the shore in crevices or under stones, etc. (Orthrias barbatulus, Sabanejewia aurata). Some Cobitis and Sabanejewia specimens that burrow in fine sand. In all these places young stages are well protected against predators and strong currents. On the other hand, adults of gregarious species as Gobio kessleri, Alburnus alburnus, Phoximus phoximus, and Alburnoides bipunctatus are permanently moving in search of food. Other adults (or subadults) are generally territorial (Salmo trutta, Leuciscus cephalus, Gobio gobio, Gobio uranoscopus, Barbus peloponnesius petenyi, Barbus barbus, Zingel zingel, Zingel streber).

Threatened species and proposals for protected areas

The Mureş River has only one (or perhaps two) endemic species: Sabanejewia aurata radnensis Jászfalusi, 1951. However, a possible second taxon described by the same author might be valid: Gobio gobio muresia. Thelocation of both taxa is the Mureş River at Stînceni. On the other hand, also the Mureş River or the drainage Mureş is the location for two other species: Barbus peloponnesius petenyi Heckel, 1858, and Eudontomyzon danfordi Regan, 1913 (Sebeş River).

In the lower part of the river there are two other interesting loaches Sabanejewia aurata balcanica and S.aurata bulgarica which are living together as two different species.

In the area between Reghin and Sîntimbru there are intergrades between S.aurata radnensis and S.aurata balcanica. Such a phenomenon is present only in the Timiş River, Banat, Romania, between S.aurata balcanica and S.aurata bulgarica.

Between the source of the Mureş River and Tîrgu Mureş there is the richest fauna in the river with one, or possibly two, endemic and extremely interesting species. I suggest this area be strictly protected against human activity, especially against pollution. I also suggest this river be protected as much as possible against pollution along its whole course. It is also necessary to protect against oil spills in the channels in the area between Pecica and Nădlac.

In the last twenty years a number of species have become rare or extremely rare. This is not an astonishing thing due to serious pollution of the river, which occurred in this time period. This is the most important reason for the loss of some species in the fauna of the Mureş River. Thus, Acipenser ruthenus, Abramis brama, Carassius carassius, Cyprinus carpio, Stizostedion lucioperca are practically considered as disappeared species. Other species, such as Vimba vimba, Abramis ballerus, Gobio albipinnatus vladykovi reached the upper part of the river. For instance, Vimba vimba is found now near Reghin, Abramis ballerus near Tîrgu Mureş and Gobio albipinnatus near Gorneşti.

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THE BIRDS OF THE MUREŞ (MAROS) RIVER

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Introduction

In 1991, we conducted a 5th survey in a 22-year period for the estimation of the avifauna of the Mureş River (see References). On the previous occasions we examined a water course of 490 and 650 km respectively; only in 1991 did we succeed in researching the entire length of the 766-km river. We took our observations by line transect, following the water course on foot or by boat. In this way, between June 13th and July 25th, we observed a water course of 719 km, from the spring (Izvorul Mureşului) to the border with Hungary. In August we reexamined the whole length of the river (766 km) by car, completing our former data by the points system.

Material and method

We divided the entire length of the river in 50-km-long sections; the last (l5th) section was longer (66 km). We numbered them starting from the spring (Izvorul Mureşului). At the 2nd and l5th courses we used the points system, while at the others we took notes continuously. The various results of the two working methods are arranged in the tables and graphs. The occuring lower values (at the 2nd and l5th courses) are the result of the points system.

Results

On the whole, we observed 123 bird species. Table 1. contains our complete notes, prospected on the 50-km sections. The last three columns include the following indices:

T = the total individual number of a species

F = the frequency of a species (= with the number of observations)

Q = the percentage of a species reported to the number of the individuals from all species(N) Q=T*100/N

Now we shall speak more widely about each species:

Ciconiformes: The order is represented by 7 species, Ardea cinerea was the most frequent and had the greatest number of individuals. We found a single breeding colony in the l4th section.The night heron (Nycticorax nycticorax) was observed begining from the 5th section, the last investigations showing a certain numerical increasing (Table 2.).

Table 1. Species composition of bird communities at different sections of Maros valley

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	T	F	Q
Phalacrocorax carbo	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	9	2	0,053
Ixobrychus minutus	-	1	-	-	5	2	-	-	-	1	-	-	-	-	-	9	9	0,053
Nycticorax nycticorax	-	-	-	-	16	2	6	2	2	15	3	3	3	2	3	57	34	0,337
Ardeola ralloides	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1	0,006
Egretta alba	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	0,006
Egretta garzetta	-	-	-	-	-	-	-	-	-	-	-	-	1	8	8	17	13	0,100
Ardea cinerea	-	-	-	1	25	-	2	36	21	29	39	59	33	44	1	290	104	1,712
Ciconia ciconia	21	1	60	4	9	4	-	10	4	2	1	1	-	3	-	120	38	0,709
Ciconia nigra	-	-	-	-	-	-	-	-	1	1	-	5	-	-	-	7	6	0,041
Anas platyrhynchos	1	-	4	33	23	-	29	29	31	5	-	3	1	9	37	205	43	1,210
Anas strepera	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	0,006
Anas querquedula	9	-	-	1	3	-	-	2	-	-	-	-	-	-	-	15	4	0,089
Milvus migrans	-	-	-	-	-	-	-	-	1	-	1	-	-	11	-	13	10	0,077
Accipiter gentilis	-	-	-	-	-	-	-	-	-	-	-	-	1	5	-	6	5	0,035
Accipiter nisus	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	2	2	0,012
Buteo buteo	5	1	3	-	-	-	-	2	3	4	5	3	2	3	-	31	28	0,183
Aquila pomarina	1	-	-	-	-	-	1	1	-	-	-	-	-	2	-	5	4	0,030
Aquila heliaca	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0,006
Circaëtus gallicus	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	1	0,006
Circus cyaneus	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0,006
Circus aeruginosus	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	2	0,012
Falco subbuteo	1	2	-	1	1	4	11	2	3	5	1	3	1	3	-	38	26	0,224
Falco vespertinus	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	5	2	0,030
Falco tinnunculus	-	-	-	-	7	4	11	19	10	1	5	6	5	4	3	75	59	0,443
Perdix perdix	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	1	0,006
Coturnix coturnix	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0,006
Phasianus colchicus	-	-	1	2	8	1	1	2	-	1	1	-	5	-	2	24	21	0,142
Crex crex	1	-	-	-	-	-	-	-	-	-	1	1	-	-	-	3	3	0,018
Gallinula chloropus	3	-	-	-	4	-	-	-	-	-	-	-	-	-	-	7	2	0,041
Charadrius dubius	-	-	3	2	-	7	6	9	1	-	-	14	39	-	-	81	43	0,478
Vanellus vanellus	-	-	-	40	53	-	8	1	2	-	-	-	-	5	-	109	12	0,644
Calidris minuta	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	5	4	0,030
Tringa totanus	-	-	-	-	-	-	1	3	-	-	-	-	4	-	-	8	3	0,047
Tringa nebularia	-	-	-	2	-	5	-	4	-	-	-	-	15	5	-	31	17	0,183
Tringa ochropus	-	-	-	-	-	-	5	3	2	-	2	-	4	6	-	22	14	0,130
Tringa glareola	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	2	0,012
Tringa hypoleucos	-	-	10	4	19	7	41	18	27	15	9	7	31	17	7	212	156	1,252
Gallinago gallinago	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0,006

Table 1. (continued)

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	T	F	Q
Larus ridibundus	-	-	1	16	39	8	5	6	46	6	-	-	146	5	271	549	42	3,242
Larus fuscus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	0,012
Larus argentatus	-	-	-	2	-	-	-	-	-	-	-	-	1	1	-	2	2	0,012
Sterna hirundo	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	1	0,012
Columba palumbus	13	-	-	-	-	-	-	-	-	10	16	11	-	8	-	58	24	0,342
Streptopelia decaocto	-	2	4	2	27	22	22	-	1	6	2	-	7	3	40	138	51	0,815
Streptopelia turtur	49	-	-	-	1	-	1	2	2	-	6	8	-	-	-	69	20	0,407
Cuculus canorus	-	-	-	6	3	2	3	2	1	1	-	1	2	5	4	30	27	0,177
Asio otus	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-	3	2	0,018
Otus scops	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	1	0,006
Strix aluco	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	0,006
Caprimulgus europaeus	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	2	2	0,012
Apus apus	-	-	-	-	-	-	-	-	-	-	-	-	-	63	-	63	2	0,372
Alcedo atthis	-	-	9	1	9	7	16	10	20	18	14	14	7	6	1	132	107	0,779
Merops apiaster	-	-		-	4	-	7	9	28	1	-	13	89	201	-	352	47	2,079
Coracias garrulus	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	2	0,012
Upupa epops	7	-	-	-	2	2	-	3	2	-	-	-	1	1	-	18	13	0,106
Picus viridis	-	-	-	-	12	3	4	1	2	-	5	-	4	1	1	33	30	0,195
Picus canus	-	-	-	-	4	-	-	-	1	1	1	3	-	-	-	10	8	0,059
Dryocopus martius	-	-	-	-	-	-	-	-	-	-	2	1	1	1	-	5	4	0,030
Dendrocopos major	-	-	-	-	2	3	-	-	-	-	1	2	-	1	2	11	8	0,065
Dendrocopos syriacus	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	3	2	0,018
Dendrocopos minor	-	-	-	-	-	-	-	-	-	1	1	2	-	-	-	4	4	0,024
Galerida cristata	-	-	-	7	-	4	-	6	-	-	-	-	1	-	-	18	9	0,106
Lullula arborea	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	1	0,012
Alauda arvensis	2	-	-	-	-	6	4	6	9	4	2	1	-	-	-	34	20	0,201
Riparia riparia	-	-	136	57	44	143	369	276	304	159	106	20	725	727	130	3196	92	18,873
Hirundo rustica	59	3	10	31	43	98	187	179	63	73	64	18	60	74	21	983	96	5,805
Delichon urbica	-	-	-	10	3	-	4	13	60	30	3	-	70	-	-	193	11	1,140
Oriolus oriolus	-	1	-	-	24	14	24	22	29	38	43	39	14	8	5	261	171	1,541
Garrulus glandarius	-	-	-	-	1	4	3	1	7	3	14	16	1	2	-	52	38	0,307
Pica pica	32	5	46	94	75	47	81	39	46	59	334	13	17	8	7	603	198	3,561
Nucifraga caryocatactes	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0,006
Corvus monedula	-	-	37	7	353	35	65	16	3	100	20	-	-	50	-	686	31	4,051
Corvus frugilegus	-	-	15	-	5	41	137	638	60	-	-	-	6	-	-	902	18	5,327
Corvus cornix	7	1	16	77	20	8	46	63	67	32	30	53	65	19	5	509	164	3,006
Corvus corax	2	2	-	-	-	2	-	4	8	2	11	2	-	-	-	33	19	0,195
Parus palustris	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	3	2	0,018

Table 1. (continued)

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	T	F	Q
Parus ater	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0,006
Parus caeruleus	-	-	3	-	-	-	-	4	2	5	8	14	1	-	2	39	21	0,230
Parus major	5	-	3	-	6	2	3	14	-	6	13	15	13	-	3	83	40	0,490
Aegithalos caudatus	-	-	1	-	-	-	-	-	-	-	-	12	-	-	-	13	3	0,077
Sitta europaea	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	4	3	0,024
Troglodytes troglodytes	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	2	2	0,012
Saxicola rubetra	21	-	1	-	-	2	2	1	1	-	-	-	-	-	-	28	11	0,165
Saxicola torquata	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	3	3	0,018
Phoenicurus ochruros	9	-	1	1	-	-	-	-	-	-	-	-	-	-	-	11	7	0,065
Erithacus rubecula	-	-	1	-	-	-	-	-	-	-	4	-	-	-	-	5	3	0,030
Luscinia megarhynchos	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	3	3	0,018
Luscinia luscinia	-	-	5	-	-	1	4	3	1	-	-	-	-	-	-	14	13	0,083
Turdus pilaris	18	1	7	-	-	-	8	-	-	-	-	-	-	-	-	34	12	0,201
Turdus merula	-	-	1	-	1	-	-	-	-	-	1	1	-	-	1	5	5	0,030
Turdus philomelos	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	3	2	0,018
Turdus viscivorus	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	6	1	0,035
Locustella luscinioides	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	3	2	0,018
Locustella fluviatilis	-	-	-	-	-	-	1	1	4	4	6	8	2	1	-	27	25	0,159
Acrocephalus palustris	1	-	10	10	8	13	12	7	-	2	-	1	-	-	-	64	46	0,378
Acrocephalus scirpaceus	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	6	4	0,035
Acrocephalus arundinaceus	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	3	3	0,018
Sylvia borin	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	0,018
Sylvia atricapilla	-	-	2	-	2	5	9	5	12	17	30	18	8	6	2	116	95	0,685
Sylvia communis	-	-	10	3	4	10	3	9	4	6	4	1	4	-	-	58	51	0,342
Sylvia curruca	-	-	-	4	2	9	10	5	7	1	-	-	-	-	-	38	36	0,224
Phylloscopus collybita	-	2	2	-	1	-	3	-	1	4	9	4	3	1	-	30	25	0,177
Muscicapa striata	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	0,006
Anthus trivialis	14	-	-	-	-	-	1	-	-	-	-	-	-	-	-	15	5	0,089
Motacilla flava	2	-	-	2	-	2	-	-	-	-	2	-	-	-	-	8	4	0,047
Motacilla cinerea	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	0,012
Motacilla alba	39	4	47	29	12	5	24	15	17	21	7	6	7	-	3	236	110	1,394
Lanius collurio	2	2	8	1	1	-	-	1	-	2	-	1	-	2	-	20	15	0,118
Lanius minor	-	-	-	-	-	-	-	1	1	1	-	-	-	-	1	4	4	0,024
Lanius excubitor	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	3	0,024
Sturnus vulgaris	2316	-	21	290	405	492	21	8	197	36	64	122	124	33	209	4338	93	25,617
Passer domesticus	4	3	2	66	40	54	22	27	13	16	6	12	36	-	-	301	37	1,777
Passer montanus	11	-	142	42	84	27	210	140	63	19	28	14	25	24	5	834	102	4,925

Table 1. (continued)

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	T	F	Q
Fringilla coelebs	3	-	3	-	-	-	1	-	8	3	2	1	-	3	-	24	19	0,142
Serinus serinus	1	1	-	-	-	-	-	-	-	-	1	-	-	-	-	3	3	0,018
Carduelis chloris	8	-	-	-	-	2	2	-	3	1	1	5	3	2	-	27	17	0,159
Carduelis carduelis	5	1	-	6	6	5	10	5	1	10	5	2	3	2	3	64	32	0,378
Carpodacus erythrinus	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	0,018
Acanthis cannabina	22	2	-	-	-	-	-	-	-	1	-	-	-	-	-	25	8	0,148
Coccothraustes coccothraustes	-	-	-	-	-	-	-	1	-	3	14	-	1	-	-	19	5	0,112
Emberiza calandra	-	-	-	-	-	1	1	-	1	-	-	-	2	-	-	5	5	0,030
Emberiza citrinella	1	-	2	-	-	1	-	-	-	1	4	3	-	-	-	12	12	0,071
Emberiza schoeniclus	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	0,012
Total individual number	2715	37	629	868	1424	1118	1452	1695	1205	786	657	570	1599	1401	778	16934		
Percentage individual number	16,0	0,2	3,7	5,1	8,4	6,6	8,6	10,0	7,1	4,6	3,9	3,4	9,4	8,3	4,6			
No. of species	46	19	37	37	49	45	51	58	52	53	53	48	50	46	28			
Relative Species Richness index (%)	37,4	15,5	30,0	30,0	39,8	36,6	41,5	47,2	42,3	43,1	43,1	39,0	40,7	37,4	22,8			

Anseriformes: Only the Anas plathyrhinchos is frequently found, occasionally with young.

Falconiformes: The most frequent species are Buteo buteo, Falco tinnunculus and Falco subbuteo. We encountered nests of the last two species, as well as of Milvus migrans and Accipiter gentilis. In the 14th section, the young of Falco vespertinus had already left their nests.

Charadriiformes: The most characteristic of the species is Tringa hypoleucos. Its coherent line distribution begins from the 3rd section. The population fluctuated in the course of years. The black-headed gull (Larus ridibundus) occured only seldom in a limited number on summer before 1975, but it could be lately observed more frequently and in larger number of individuals (Table 2.).

Table 2. Dynamics of some bird species in the Maros valley

Species	1970	1971	1978	1989	1991
Nycticorax nycticorax	17	19	4	49	57
Tringa hypoleucos	317	91	251	96	212
Larus ridibundus	-	12	18	27	549
Streptopelia decaocto	38	65	90	131	138
Streptopelia turtur	764	754	136	14	69
Alcedo atthis	7	30	26	196	132
Merops apiaster	113	181	54	116	352

Columbiformes: While the tutle dove (Streptopelia turtur) population is diminished wit 91 % in the last 22 years, that of collared turtle dove (Streptopelia decaocto) one increased 3,5 times in the same period (Table 2.).

Coraciiformes: The species of kingfisher (Alcedo atthis) and bee-eater (Merops apiaster) present line distributions; their population is fluctuated too (Table 2.). We have found 29 breeding colonies of this latter.

Piciformes: The occurrence of Dryocopus martius this year was a novelty for us, even if we have known that it had breeding grounds before in the flooded area of the 14th section. It also appeared in 1991, in the 11th and 13th sections.

Table 3. The dinamics of the species Riparia riparia on the river Maros

Year	Length of examined section	Nr. of colonies	Nr. of nests	Total number	(Q)
1970	490 km	26	1297	688	4,58
1971	650 km	77	4544	2136	15,39
1978	650 km	50	2698	1542	13,56
1989	650 km	83	11908	4924	26,50
1991	766 km	93	9236	3196	18,87

Passeriformes. The most frequent species of this order is Riparia riparia, and its changes in number are reflected by Table 3. We think it is important to mention the expansion of Locustella fluviatilis in the Mureş valley. In the last 20 years it has extended its area approximately 360 km upstream, starting from the 14th section. Carpodacus erythrinus can be found regularly in the 1st section in the last couple of years.The fieldfare (Turdus pilaris), as species in expansion coming from north, reached the Giurgeu depression in 1973, when two mature and three young individuals have been observed (Monteanu 1976). We found it for the first time nesting in 5th July 1978 near Senetea, where in a nest were four eggs. Following the flow of Mureş the first data in the succeeding localities were as follows: Joseni 5. 7. 1978 - one nest with three young, two empty nests and some fly off young; Sărmaş - 1.7.1984. foddering parents in a nest; Gălăuþaş- 13.6.1984 one nest; Reghin- 18.5.1984 fodding parents in a nest, and 2.6.1984 in the same place the parents foddered already in six places; Glodeni- 26.6.1985- four pair of birds carried the foods into the trees on the roud; Cipău- 27.6.1985 one nest with five eggs, on another nest a bird was brooding, and we found further four nests in building; Dateş - 10.6.1989 a food carrying mature bird. Based on this observations it is possible to demonstrate that the fieldfare (Tudrus pilaris) has extended this area with about 250 km in Mureş valley. Begining with the mentioned data the species breeds regularly in this area. On the occasion of our investigations of 1989 this species occured already along a section of 450 km.

Table 4. contains the species similarity indices (the Jaccard number). We compared each river section with the others on the basis of following formula: Ja = A*100/B
where A = the number of species that occur in both sections
B = the number of the species that do or do not occur in both courses.

Table 4. Quotient of Similarity (in percents) between pairs of sections

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1	14	21	17	32	28	29	24	23	26	25	28	23	28	27	
2	18	20	19	24	24	29	22	18	19	23	24	22	25		
3	35	28	34	42	36	45	39	38	41	41	41	42			
4	33	32	37	31	29	41	40	44	40	44	46				
5	45	44	46	47	44	52	52	53	52	52					
6	40	38	48	43	44	48	54	56	55						
7	39	45	58	46	46	51	66	60							
8	37	40	57	45	42	54	62								
9	38	51	72	54	54	59									
10	40	41	47	63	56										
11	40	43	47	63											
12	38	45	44												
13	50	51													
14	40														
15															

These results are like the values we have shown in prior years, alternating between 14-66%.

The graph reflects the quantity and quality dividing of species in each river section. Besides the species observed in 1991, at the four previous occasions, we met the following species:

1. Ardea purpurea
2. Aythya ferina
3. Aythya nyroca
4. Pernis apivorus
5. Aquila chrysaetos
6. Falco peregrinus
7. Pluvialis squatarola
8. Philomachus pugnax
9. Tringa erythropus
10. Larus minutus
11. Chlidonias niger
12. Chlidonias leucoterus
13. Columba oenas
14. Athene noctua
15. Jynx torquilla
16. Dendrocopos medius
17. Dendrocopos leucotos
18. Remiz pendulinus
19. Certhia familiaris
20. Cinclus cinclus
21. Oenanthe oenanthe
22. Phoenicurus phoenicurus
23. Turdus torquatus
24. Acrocephalus schoenobaenus
25. Sylvia nisoria
26. Phylloscopus sibilatrix
27. Anthuas pratensis
28. Sturnus roseus
29. Pyrrhula pyrrhula

If we take into account these species, too, based on the observations made on five occasions in the last 22 years, then we can say that the avifauna of the Mureş valley consists of 152 species.

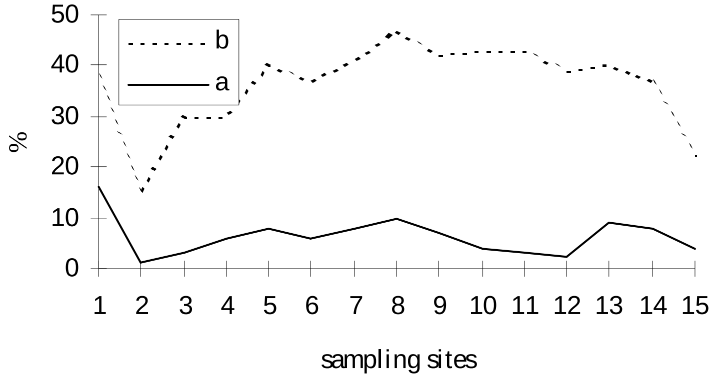

Fig. 1. The qualitative percentage division of the species (a), in each section, compared to a number of 123 species, and that of individuals (b) in each section, compared to the number of 16934.

Conclusions

The changes of the surroundings in the Mureş valley (changes in the river channel, deforestation, pollution) have influence upon the avifauna, too.

At the highest marsh course the deviation of the Mureş into a dug river bed threatens the marshes with drainage, and endangers the existence of several bird species (Gallinago gallinago). Here Carpodacus erythrinus populations nest, whose faunal importance can not be under estimated.

By the abolishment of branches, arms of the river, meanders, the places for nests will be suppressed, and these parts will be used only for rest. For example, Ardea purpurea once nested in the reed of the branch in Iernut, but now the new artificial ponds give no possibilities for birds to nest here.

The cutting of trees and bushes along the river influences also the breeding population. So, in the last years Remiz pendulinus was missing, a species that lived here before. Probably, the lack of places where they can build their nests, caused its absence. We have met this species in the last time in regions further away from the Mureş valley (Niraj valley, upstream from Reghin).

If the influence caused by water pollution cannot be seen immediatly, the avifauna is menaced by the disappearance of the inferior order of animals.

Proposals

Since not any bird reservation exist along the entire length of the river, and based on our investigations made during a period of 20 years, we propose to be declared as protected area the following:

1.The section Voşlobeni and nearly peat bog.

2. All isles of the river, as well as the protection of lines of trees and shrubs bordering there.

3. The peat bog and the flood plain forest of Bezdin - Prundu Mare, where, among others, occure not less than 171 species pf birds. From these eleven are in danger, six are rare, ten are disappeared as a result of changed living conditions and chase.

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MUSKRATS (ONDATRA ZIBETHICA L. 1766) IN THE MUREŞ(MAROS) RIVER VALLEY

SÁRKÁNY-KISS, A., KOHL, ST. and SZOMBATH, Z.

Introduction

Today muskrats are generally widespread in all the available biotopes in Romania. This species was imported in 1905 from the United States by Collorede-Mansfield and put out at the estate of Dobrisch, south of Prague (Hoffmann, 1958). It adapted to local conditions and spread speedily in Central Europe. In Romania it arrived in the basin of the Tisza River and the first three specimens were caught by a fisherman in the waters of Aranca (Nadra, 1947). It can be supposed although, that it was present previously on this territory.

Here at the lower flow of the Mureş River, the river flux is slow and the dead river branches assure excellent life conditions for the species, and it seems that this expansion became a little slower. As it is concluded by the literature, it reached approximately in 20 years the area of the Tîrnava River estuary (Teodoreanu, 1973). Its expansion followed the flow of the Mureş, and it the mid 1970s reached the city of Tîrgu-Mureş. Although Marches (1960) published a table in which there were reported four muskrat skins were donated to the wild animal skin collecting center, it could not be proven that these skins came from the neighbourhood of the town. (There was a similar case in Bucureşti, where 21 skins were donated, although the muskrat was not found in the area. No further skins were donated in subsequent years.)

At the upper flow of the Mureş River, it seems that the expansion of the species gained momentum. In 1976 it was found at Răstoliþa in the estuary of the Iod creek, in 1980 we found it at Voşlobeni, only some kilometers south from the river. Naturally the muskrat was looking for side waterflows of the river and through them settled also in the southern territories of the Cîmpia Transilvaniei. So it appeared in 1976 at lake Fărăgău, after that in the Sar creek's valley first-breeding lakes also. Beginning from 1983 we caught specimens from the Comlod creek. It can be supposed that it had existed there earlier.

Material and methods

The base of the present study is formed by 160 collected muskrat specimens. To this are added our observations in the field, and the published data dealing with the territory. Based on it we tried to estimate the expansion of the species in the Mureş River Valley. Of the most part of the collected specimens, we took the following measures: weight (with a precision to grams); total length (from the tip of the nose to the end of the tail); body length (from the tip of the nose to the base of the tail); tail length; length of the posterior leg (from the Achilles heel to the end of the longest foot-finger, without the craw); length of the ear (from the lower half of the aperture to the peak, without the tuft of hair). These measures of length were recorded in mm, in the case of the posterior leg and of the ear with a tenth mm precision. We grouped the biometrical values separately for sexes and we calculated the next parameters:

number of individuals (n)
minimum size (min)
maximum size (max)
arithmetic average ($\overline{x}$)
middle error of the $\overline{x}$
standard deviation of the arithmetic average (s)
variation coefficient (VC)

Results and discussion

Table 1 summarizes the most important collected data of specimens, marking at every place the year of the first collecting. Based on our data and on those references to the literature that deal with the Mureş valley, there can be stated the spreading of the species in the surveyed territory, and we can draw conclusions on the speed of expansion of muskrats in the watershed of the Mureş River, as it is presented also on Fig. 1.

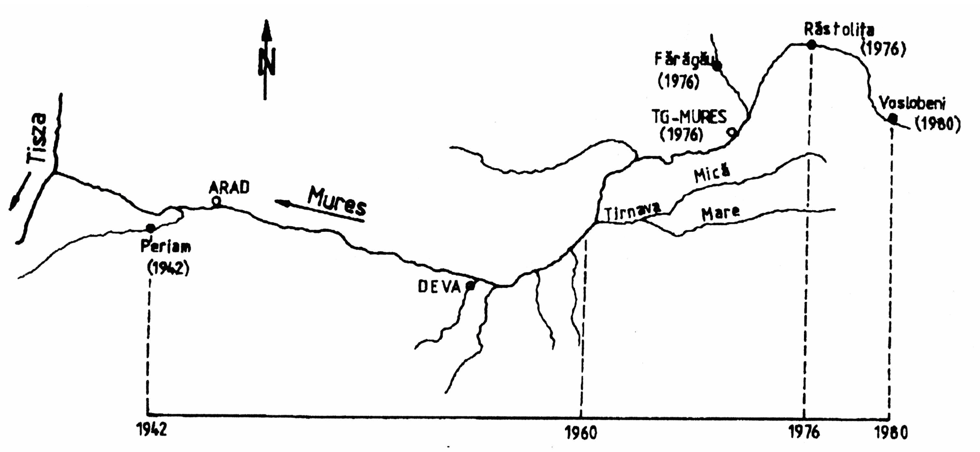

Fig. 1. The expansion of Ondathra zibethica in the Mures River valley

Teleguþ (1963) examining the appearance of muskrats in Banat, inquires the settlement of the species and evaluates that its expansion to the internal territory of the country will not be considered. Our findings do not confirm this supposition, for we found specimens in 1976 from Tîrgu Mureş, Fărăgău and Răstoliþa and in 1980 from Voşlobeni (from the riverhead of the Mureş River). In 1982 muskrats are still present in all the habitats available in the Mureş valley, in the silent-flow parts of the river (especially in the Gheorgheni basin), in dead beds, lakes, side moors. The number of individuals had been increasing explosively till 1984-85. For example, at the fish pond from Iernut, in 1981-82 and in 1983 at the time of spring breeding season, at evening observations (approx. 3 hours long) we frequently saw 10-15 individuals, but after 1985, only 3-5 were seen every evening. A similar situation has emerged at the lut brook, where a hunter shot 4-5, sometimes 6 specimens in a hunting in the years 1982-1983, but since 1985 one or two individuals have been considered a good catch. One or two years later a similar situation arose in the whole watershed of the Mureş River.

Table 1. Data on the Ondatra zibethica collected in the watershed of Mureş River in the period of 1957-1991.

	Collection Site	Year of the first collection	Number of individuals collected
1	Senetea	1980	1
2	Ciumani	1982	5
3	Joseni	1982	11
4	Răstoliþa	1976	2
5	Aluniş	1983	1
6	Brîncoveneşti	1986	4
7	Ideciu de Jos	1979	5
8	Suseni	1990	7
9	Reghin	1979	13
10	Dedrad	1980	1
11	Apalina	1981	6
12	Petelea	1978	2
13	Gorneşti	1980	1
14	Dumbraviora	1977	2
15	Viovodeni	1983	2
16	Glodeni (r.ûar)	1981	12
17	Glodeni (r. Mureş)	1983	1
18	Păingeni	1982	14
19	Băla	1982	3
20	Poarta	1982	5
21	Fărăgău	1976	20
22	Tîrgu Mureş	1976	4
23	Rîciu	1983	15
24	Berghia	1979	1
25	Cipău	1980	5
26	Iernut	1980	17
27	Ogra	1983	1
28	Arad	1957	1

Based on the biometrical data (Table 2.), there exists a difference between sexes, males are bigger, but this is not significant statistically, for the size of the body depends also on the age (the old, big individuals are rare due to over-hunting). From the individuals of our county (Teodoreanu, 1973) we do not find a marked difference. In comparison with the average weight of the North American populations (Hoffmann, 1958) our specimens are smaller (200-300 g), and it is the same situation with body length, tail length, ear and posterior leg.

In the specimens descending from dense populations, during dissection we often found intestinal liver-parasites. Unfortunately because of improper storage, the collected parasites have been damaged.

Our observations referring to the life, activity and behaviour of the individuals and on those of the populations were carried out parallel with the collection, during several years. Most parts of our results coincide with the literature data (Hoffmann, 1958; Teodoreanu, 1977), therefore we present only those which are different from them or are less known. In the summer of 1978 in a dead branch above the barrier in Tîrgu-Mureş, muskrats built 11 castles of sedge. In January we opened two such castles with a silure-saw in such a manner that we pushed one half away on the ice, and we took measures on the nest-building (Fig. 2.) At the entrance (underwater) with an iron trap we caught one individual, then we moved the trap away, and the muskrat-castle was resettled in its original position. The two muskrat-castles examined by us had only one entrance, the others being frozen; our observations were carried out at -25 ^{o}C.

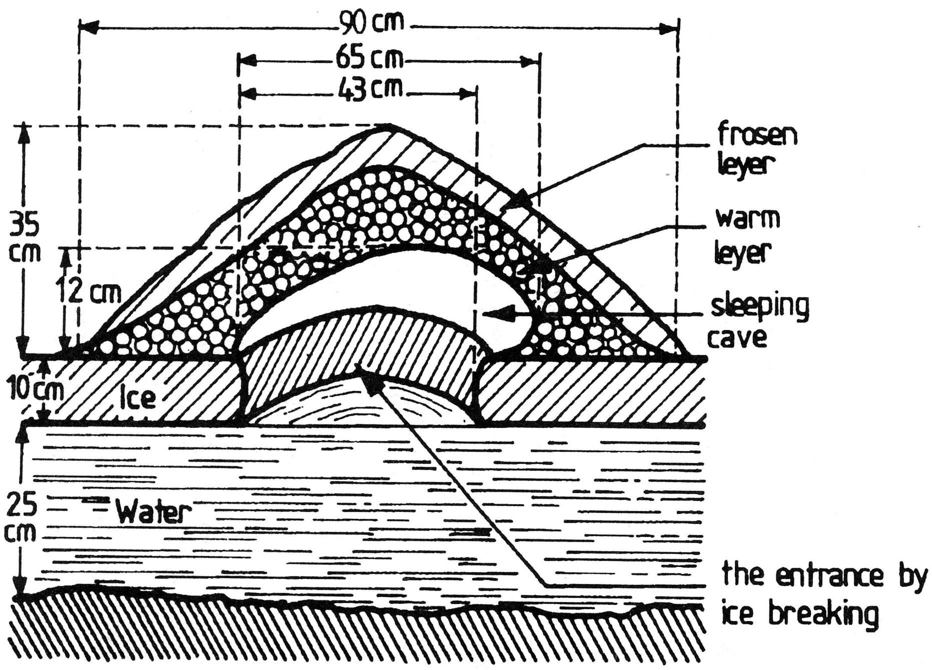

Fig. 2. The transsection of Ondathra zibethica nest building (Tg. Mures 01.17.1978)

Under the ice-crack we found 13 pairs of shells (Unionidae) of the following species composition: 8 Unio pictorum, 4 Unio tumidus, and 1 Anodonta cygnea. The species composition of the eaten mussels is highly similar to that of this habitat (Sárkány, 1977), as the muskrat eats the available food in the habitat without any selection. The shells are broken on their edges and the traces of pricks are clearly visible.

Table 2. Statistical data for some variables

Variable	Sex	n	min	$\overline{X} \pm m$	max	s	VC
Body	m	72	660	1034.96 ± 19.56	1420	165.99	16.04
weight	f	38	730	976.63 ± 21.68	1250	133.65	13.70
Total	m	47	452	526.22 ± 3.72	583	25.47	4.84
length	f	32	458	522.13 ± 5.11	566	28.89	5.53
Body	m	46	262	291.74 ± 2.35	325	15.95	5.47
length	f	31	224	287.36 ± 3.59	325	19.99	6.96
Tail	m	51	190	234.98 ± 2.04	274	14.58	6.21
length	f	33	202	234.68 ± 2.99	271	17.20	7.33
Length of	m	51	57.3	65.60 ± 0.57	84	4.07	6.20
posterior leg	f	33	58.5	64.39 ± 0.40	70	2.31	3.59
Ear-	m	50	16	20.94 ± 0.32	25.5	2.23	10.64
length	f	31	17	20.95 ± 0.34	24	1.90	9.06

Due to intensive hunting, the individuals have become cautious, most of the time they procure food while swimming underwater, and they emerge only at places covered with reed or cress.

After the importation and settling of the Chinese phytophagous fish species, the muskrat populations of these fishponds (Iernut, Cipău, Glodeni, Păingeni and Poarta) have become thin and in the majority of the cases they remained only in the chanels linking the lakes. So, the phytophagous fish despoiling the vegetation which serves as food for the muskrat, are successful concurrents with the latter ones.

In the Spring of 1988 on the shores of the fishing lakes of Iernut, our dachshund brought out a muskrat from a fox hole, the head of which had been chewed off. In our opinion, this is a sure sign of the fact that foxes consume muskrat.

Along the Mureş River as well as on the Fărăgău and Goldeni lakes, rats of passage (Rattus norvegicus) use musk galleries. Where rats appear in large numbers, the number of musks decreases considerably or they may disappear completely. Presumably rats consume young musks.

Conclusions

1. Muskrats prove to be a species with high ecological potential. In the habitats examined by us, they seem to have adapted successfully to these biocenoses, and in our opinion with little oscillations the population size will remain on the present level in the Mureş valley.

2. There was no conclusive evidence gathered to support the supposition that muskrats will spread excessively in Romania and cause great damage (Marcheş, 1960). The causes of the regression follwng the earlier population explosion are: intensive hunting, the spread of internal parasites, and the limiting action of the ancient priding fauna.

In the case of fishponds, the most important competitors for muskrats are phytophagous fish species (in other waters this concurrence need not to be taken into account since these fish can be bred only artificially).

3. The populations we examined do not present statistical deviation compared to other populations living in other areas of Romania.

4. In comparison with the North American populations, the specimens measured by us were smaller with 200-300 g, the rate of the measure of length is similar.

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APPENDIX

COUNCIL
OF EUROPE

CONSEIL
DE L'EUROPE

Parliamentary Assembly
Assemblée parlementaire

AS/Loc/Eau/Coll/Sri-a (44) 9

Committee on the environment, reQional planning and local authorities

„Freshwater Europe" Action Programme

Colloquy on
„State, local authorities, industry and water"

Strasbourg (France). Palais de 1'Europe
14 and 15 January 1993

A chance for Central-Eastern European NGO's cooperation on the environmental health of common river valleys

Tisza Klub, Szolnok (Hungary)

FRENCH MINISTRY OF THE ENVIRONMENT BAS-RHIN COUNTY COUNCIL
CITY OF STRASBOURG

A CHANCE FOR CENTRAL-EASTERN EUROPEAN NGO'S COOPERATION ON THE ENVIRONMENTAL HEALTH OF COMMON RIVER VALLEYS

Tisza Klub, Szolnok, Hungary

Resume

Every country must solve the regional environmental problems (e.g. catchment systems), in common with others.

In this respect, the Central and Eastern European NGO's far environmental protection and nature conservation can have a great part.

In the bi- or multilateral cooperations, the Tisza Klub (SZOLNOK, HUNGARY) has the following philosophy: the environment protection does not know the national boundaries, the rivers connect the countries.

The cooperation between NGO's can be feasible on the base of the principles of mutuality, publicity and freedom from politics, respecting the laws of the countries.

The Hungarian and Rumanian NGO's are successfully collaborating with each other to reveal the state of environmental health in the common river valleys and to promote the management.

All these run with some governmental responsibility, but contribute to the development of democracy.

We are of the opinion that recional problems have to be solved on regional level and on the basis of global principles. We are facing such a regional and more-countries-involved situation when we want to reveal the environmental health of a certain region and to find ,olution for them.

We think that these questions involve not the only one the experts and governmental organisations but the citizens as well.

We believe in that the citizens have the right to know the condition of their environment and to form it.

The catchment arca, and their environment are very important elements of the environmental protection, bec~iuse they have many natural values and the other hand the water is utilised and contaminated too.

Our ambition is to study the condition of the common river valleys by the cooperation of Hungary and Rumanian NGO's, to make it public and take recommendations for the interested parties.

There are many tensions between the Central-Eastern European countries which limit the official cooperation. The civil organisations play an important role in the elimination of this tension. Therefore the philosophy of the Tisza Klub Is: we must form a wide cooperation, firstly with the civil organisations and with the NGO's for environmental protection. It is made on the basis of mutuality, publicity and freedom from politics, respecting the laws of countries.

The project consist of the preparation, the forming of the database and it's application.

1. Preparation

Working up the information network , the contract with NGO's and establishing of project teams.

2. Database

Without suitable database, the NGO enterprise may become seriousless. The collection of data and the creation of database are professional work which need experts. Examinations must be carried out in lack of data, especially in case of study of the natural history. The database can be available far the interested parties in the form of discs ar booklets. The videofilm of the given theme may be important part of documentation and public relation.

3. The application of the database

There can be produced professional, popularising things and other. public relations. Information can be given on conferences, through workshops, during popularising courses through other means of the media. It is very important that the NGO's think about the citizens, the local and governmental authorities, the experts and the environmental education too.

It was proved during the projects that there are many kinds of environmental threats on different level along the rivers (fig. 1.)

Besides the propagation of environmental health the NGO's could successfully initiate the establishment of common Biosphere Reserves, furthermore the environmental and cultural heritage of regions could be part of sustainable development

We have request from the Council of Europe to suggest for endowers (for example: foundations) supporting the ambitions of regional NGO's in Central-Eastern Europe in the interes

Fig. 1. Threats and level of impact along river Maros (Romania/Hungary)

SECTION		THREATS	LEVEL OF IMPACT
UPPER	source 0	solid wastes	local
		drying up of peat bogs	local
		stone mine wastes	subregional
		sawdust load	local
MIDDLE		farm wastes	subregional
		accumulation of pollutants (barrage)	local
		communall and industrial wastes, air pollution	subregional
		heavy metals loads	transregional
		canalisation and cut out of trees, biodegradation	subregional
		eutrophication processes	subregional
LOWER		decreasing of flood plain area, melioration	subregional
		communal and agricultural contaminates	subregional
	0 mouth	load of pollutants	transregional