TISCIA monograph series

The Upper Tisa Valley

Preparatory proposal for Ramsar site designation
and an ecological background
Hungarian, Romanian, Slovakian and Ukrainian co-operation

Editors
Hamar, J. & A. Sárkány-Kiss

Szeged

1999

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Contributing Organizations

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Regional Environmental Center, Budapest, Hungary
Regional Water Works, Szolnok, Hungary

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Preface

The River Tisa catchment area is one of the most important regions in the Danube River Basin. Since 1991, we have been studying the transboundary river valleys from their headwaters to their junctions with River Tisa.

The Upper Tisza region is not just a culturally and ethnically unique territory, but also has a diverse natural and life history. Prospective social and economic changes, as a result of the transition from one economic and social system to another, now threaten this region where natural resources, forests, water, are of the greatest value to the people living there.

This book is a case-study of the Upper-Tisa Valley, where besides surveying the ecological background, we have completed a proposal for the establishment of a 400 km long (about 140 000 ha) transboundary Ramsar Wetland System. The Project has been carried through by non-governmental organisations of four countries: Hungary, Romania, Ukraine and Slovakia.

We hope our ambition can contribute to building the Pan-European Ecological Network, furthermore the natural and cultural heritage of the regions can be components of a sustainable development.

József Hamar
Tisza Klub
Szolnok, Hungary

Andrei Sárkány-Kiss
Liga Pro Europa, Environmental Group
Targu Mures, Romania

Foreword

The basic obligations of the Ramsar Convention on Wetlands are the following:

- each Contracting Party shall designate suitable wetlands within its territory for inclusion on a List of Wetlands of International Importance;
- the Contracting Parties shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List and, as much as possible, the wise use of wetlands in their territory;
- each Contracting Party shall promote the conservation of wetlands and waterfowl by establishing nature reserves in wetlands, irrespective of whether they are included in the List or not, and provide adequately for their wardening;
- the Contracting Parties shall consult with each other about implementing obligations arising from the Convention especially in the case of a wetland extending over the territories of more than one Contracting Party or where a water system is shared by CPs. They shall at the same time endeavour to coordinate and support present and future policies and regulations concerning the conservation of wetlands and their flora and fauna.

In order to streamline and focus the activities for the implementation of the treaty, a Strategic Plan for the Convention was introduced a few years ago. Within the framework of this Plan, international cooperation activities -inter-alia such related to transfrontier wetlands - have been intensified.

It was clear also that the Plan needed even greater involvement of the community of non-governmental organizations (NGOs), for instance in identifying wetlands of international importance, including those within shared catchment/river basins.

Hungary, Romania, Slovakia and Ukraine are members of the Ramsar Convention, and the NGO-s, the experts, researchers, and committed individuals of countries who compiled this book endeavoured to put into practice the fourth above obligation as well as the relevant objective of the Strategic Plan.

They collected the necessary Ramsar data, carried out surveys and research in the Upper Tisa river catchment. It is encouraging that NGOs took the initiative and intensively cooperated in order to prepare a possible future transboundary Ramsar site. It is hoped that this initiative will be followed-up by the respective governments of the four involved countries.

Data collection on the physical, ecological features, hydrological, biodiversity as well as social and cultural values and benefits of a wetland - in particular a transboundary one - is a tedious and complicated work constituting an important first step in conserving, maintaining and wisely using this habitat type.

It is well known that the success in any field depends on the willing cooperation of partners fully informed and working together to achieve shared goals. This publication significantly contributes to the revealing and better understanding of the values of the Upper Tisa region.

Therefore the efforts of the authors of this book are to be highly appreciated and commended.

Louise Lakos
Chairperson of the Standing Committee
of the Ramsar Convention on Wetlands

The Upper Tisa Valley

Preparatory proposal for Ramsar site designation
by
Ruthenia Ecoclub, Uzhgorod, Ukraine
Ecological Society of Maramures, Baia Mare, Romania
People and Water, Košice, Slovak Republic
Upper Tisza Foundation, Nyíregyháza, Hungary
and compiled by Tisza Klub, Szolnok, Hungary

Ramsar

CONVENTION ON WETLANDS
CONVENTION SUR LES ZONES HUMIDES
CONVENCIÓN SOBRE LOS HUMEDALES
(Ramsar, Iran, 1971)

Dear Reader,

The book you are keeping in your hands is the result of a work carried out with great enthusiasm by a consortium of non-governmental organizations. Tisza Klub initiated the process as early as in 1996, with the aim of bringing together people who know and love their own environment, in this particular case River Tisa.

First, the aim was to compile a study which can serve as a firm base for the establishment of a protected area in the Upper Tisa catchment, crossing borders and linking regions. This part of the work was supported financially by the Regional Environmental Centre. After an intensive period of work, people concerned came together to discuss the results achieved and further tasks. During the consultations it was realized that the most convenient tool facilitating the establishment of the desired protected area would be the Ramsar Convention, namely the designation of a transboundary Ramsar site.

All governments concerned were approached and each of them reacted positively and supported the idea. This gave a new momentum to the process because the consortium realized that it could produce a unique product. This uniqueness has two major features, one is that it involves a long stretch of a river (400 km) together with its floodplains, the second is that it will be a quadrilateral transboundary site (involving Romania, Ukraine, Slovakia and Hungary). No other similar Ramsar site has been established recently.

At the same time the Wise Use concept of the Ramsar Convention have perfectly served the aims of the consortium, because beyond the establishment of the protected area (Ramsar site), through their studies they wanted also to introduce to the area the idea of sustainable use of the river and its catchment. On the other hand, the consortium keeping an eye on recent European developments within nature conservation, especially on ecological networks, supplemented the original idea with such further goals that will end in a design of a complex riverine ecological corridor.

After winning the support from each concerned government, the consortium prepared an application to Ramsar Small Grants Fund in order to receive further funds allowing the finalization of the work which, at that stage, already appeared much more complex than had been planned at the beginnings. The application was successful and the work was continued. Not only those surveys were carried out that were demanded by the Ramsar Information Sheet, but a series of additional research, too. Consultation with people living in the area has been continuous and the final product will serve also the needs of domestic information.

The book you are keeping in your hands is not only a proposal for a transboundary Ramsar site, containing all the necessary elements, but is also a huge source of information related to the Upper Tisa region. The end-product will be useful not only for the governmental sphere which, based on it, can start the official procedure of establishment, but also for all those who have an interest in the region, concerning its nature conservation, sustainable use, ecological corridor function and cultural heritage.

I hope that everybody who in the near future or later will deal with this fantastic area will use this reference book as one of the most important references and will show enthusiasm similar to what has been shown by the contributors of this project.

Mihály Végh
wetland expert

Ukrainian section I.

Date: September 28, 1998

Country: Ukraine

Name of wetland: Upper Tisa between headwaters and Tyachiv

Geographical Coordinates: 23°30’ W - 24°30’ E - 47°04’ S - 48°20’ N

Altitude: 204-1650 m above Baltic sea level (a.s.l.)

Area: 90 000 ha

Overview: The headwaters of River Tisa, formed by the confluence of the rivers Chorna and Bila Tisa in the Transcarpathian Region (Ukrainian territory), with their picturesque landscapes, extremely wide biological diversity and original cultural features, are great natural and historical values of international importance and should be reckoned as part of the European natural heritage.

Wetland type: M, N, Ts, U, Va, W

Ramsar Criteria: 1a, c; 2a, b, d; 3b; 4a

Map of site included? see Map

Names and addresses of the compilers of this form:
Kricsfalusy V.V., Ruthenia Ecoclub, Uzhgorod, Ukraine
with M.Yu. Danilyuk, Yu.I. Krochko, V.I. Krokhtyak, A.Ye. Lugovoj , G.M. Mezõ-Kricsfalusy, A.V. Mihály, A.O. Polyanovsky, L.L. Potish, A.B. Vajnagi

General location: Ukraine, Transcarpathian Region, Tyachiv and Rahiv districts.

Physical features: The morphostructures of the region are extremely varied. In the section between Tyachiv and Dilove River Tisa and its tributaries, rivers Tereblya and Teresva, belong to the Verhovyna morphostructures. The low-mountain and middle-mountain erosional tectonic relief with peaks of 600-700 m a.s.l., which was formed on Oligocene sediments, prevails here.
The Polonyna morphostructure, the highest part of the Ukrainian Carpathians, has a high and middle-mountain relief. The morphostructure covers the Svydovets, Chornohora and Maramarosh morphostructures of lower orders. The Svydovets morphostructure is an extension of the Polonyna ridge. The Svydovets watershed line has retained marks of the Pleistocene glaciation. The inter-stream ridges have

flat tops (plains). The Chornohora morphostructure embraces the highest mountain massif of the Ukrainian Carpathians. The mountain ridge crest with rounded tops belongs to the zone of the most stable cretaceous sandstones and conglomerates. On the massif slopes there are well-preserved glacial relief forms and stone placers widely spread over them. The Maramarosh morphostructure embraces the Rahiv and Strimchak morphostructures. The former is situated on the left bank of River Tisa. The deep valleys, steep slopes, considerable altitudes, presence of rocky crests differentiate this massif from the other mountain group. The rocks are presented by crystal slates, gneisses and marble limestones.

In the area of the region various soil types are distributed: meadow and bog soils on alluvium, sod-podzolic soils on alluvium, as well as mountain meadow brown soils and sod brown soils. The characteristics of the first type of soils were given in the Ramsar sheet II. The sod-podzolic soils on the alluvium of low terraces are spread in the Pritisyanska Plain with the relief showing low hills, ridges and low lands. Shallow arrangement of ground waters provides gleization of the lower part of the profile. The humic alluvial horizon is not deep (does not exceed 20 cm), clearly grey, structureless and dispersed. The alluvial horizon is distinctly separated, strongly leached out, porous, 10 to 15 cm thick. Soil acidity is high, the pH of the soil extract is 3.9 to 4.8. The soils do not provide favourable conditions for plant growth due to their high acidity, structurelessness of the upper horizons and gleization of the lower ones. Brown mountain forest soils developed on the slopes within the forest belt from the foots of the mountains to 1100-1500 m a.s.l. Their mother rock is the aluvium-deluvium of the crystal rock flysch and magmatic deposits. Depending on the thickness and presence of rock debris there are deep (116 to 120 cm), middle-deep (60 to 75 cm) and shallow (40 to 50 cm) soils, as well as slightly and highly stony ones. The soils of this type are acidic (pH is about 4.0), not saturated by bases, considerably enriched by mobile aluminium, poor in mobile phosphorus and potassium. Mountain-meadow brown soils occur in the subalpine and alpine belts on the altitudes of 1100 to 1600 m. They were formed under the meadow and shrub vegetation. Their characteristic feature is the presence of peat turf or peat 10 to 12 cm thick. Under this there is the humic horizon (15 to 20 cm) with its markedly granular structure. The soils have a high actual acidity (pH 3.5-4.5), are well supplied with nitrogen, but are poor in phosphorus and potassium. The sod brown soils occur in all vertical belts of the mountain zone on forest-free plots used as natural fodder-producing areas. They developed as a result of the superimposment of the sod layer on the brown earths in the process of soil formation. They differ from the brown forest soils by the presence of darkish brown horizon of 20 to 30 cm thickness. There is a transitory greyish-brown horizon, 60 to 80 cm deep with nut-structure, which turns into the eluvium of bedrock (sandstone, slate, flysch). The soils have a medium supply of mobile forms of nitrogen and potassium, somewhat less of phosphorus, and a comparatively high acidity (pH 4.5- 5.0).

Hydrological values: River Tisa is the main water artery of Transcarpathia. It is formed by the confluence of rivers Chorna Tisa and Bila Tisa, four kilometres behind Rahiv.

River Chorna Tisa rises in the north-west slope of the Svydovets ridge on the altitude of 1400 m a.s.l. Its length is 49 km, the catchment area is 567 km2. This is a typical mountain river with high banks and a deep, slightly sinuous valley. Its channel width varies from 10 to 25-30 m. Its depth in the drought period being 0.2-0.5 m becomes 4 to 6 m in the period of floods. Cutting across the highest part of the Polonyna ridge, the river flows to south-west to River Bila Tisa.

River Bila Tisa rises in the south-west slope of the Chornohora on the altitude of 1650 m a.s.l. and flows in the latitudinal direction from east to west. Before the town of Velyky Bychkiv the river flows along a narrow valley with steep slopes and has a marked mountain character. In this section its tributaries (rivers Kosivska and Shopurka) from the right side, and River Visheu from the Romanian side drain into River Tisa. The average speed of the current is 2-4 m/sec. River Shopurka is formed by the confluence of Mala Shopurka and Serednya Rika, its length is 13 km (41 km together with Mala Shopurka), the catchment area is 283 km2. It is a river of the mountain type with the stream gradient of 26 m/km. Its current speed in the drought periods is 2-3 m/sec.

Behind Velyky Bychkiv and up to Tyachiv the valley of River Tisa widens, and near the town of Bushtyno it reaches 3 to 5 km. The river here is of the piedmont character, its bed is 40-80 m wide. The lowest registered minimum water level in the observed section near Tyachiv was 54 cm, the highest maximum one was 694 cm, the amplitude of water levels is 748 cm. In this section its largest East-Transcarpathian right-side tributary, River Teresva, with a length of 56 km and a catchment area of 1220 km2, flows into River Tisa. Before the village of Dilove River Teresva flows in a deep and narrow valley having a bottom width of 100-400 m. The width of the riverbed is 20 to 40 m, its depth is 0.5-1.0 m. Behind the village of Dubove the valley widens to 1-2 km. The riverbed is winding, branched with numerous isles, its width is 30-60 m, the depth of the river is 0.5-2 m.

The hydrological conditions of River Tisa is characterised by the abrupt changes of levels, instability of the flow and unstable ice formations on the river.

The most important determiner of the river flow is the characteristics of precipitation distribution. The highest amount of precipitation falls in the headwater area and can reach 1500 mm per annum, while in the piedmont areas this can reduce to 600-700 mm per annum. The daily amount of precipitation can reach 100 to 130mm and exceeds the average monthly standards. In the warm periods of year rains are responsible for flood runoff formation, and drastic thaws cause winter floods. It should be noted that winter floods sometimes have large scales.

The hydrochemical description of the waters of River Tisa is presented in Table 1 (Appendix).

The spring high water formation in the mountain section of River Tisa is essentially influenced by the conditions of runoff development in the prevernal period.

Taking into account the marked gradient of the riverbed in its mountain section (15.5 m/km near Rahiv, 12.7 m/km near Dilove), the level rise during the flood is very drastic, the abatement of high waters is slow, with numerous peaks caused by rainfalls.

The extreme values of water levels in River Tisa in the area of Rahiv-Tyachiv for the period of a series of years are given in Table 2 (Appendix).

The average water flow rate, according to observations made for River Tisa - Rahiv during a number of years, is 23.9 m3/sec, the average yearly specific discharge is 22.3 l/sec × km2, for River Tisa - Dilove it is 34.1 m3/sec and 28.7 l/sec × km2, respectively.

From Dilove to below Tyachiv River Tisa flows along the state border with Romania, so some hydrological observation data are incomplete or are not available.

Ecological features: The Region is characterized by an extremely high diversity of biotopes. Forest, meadow, waterside and anthropogenic biotopes prevail here, as well as ones of rocks, stone fields, bogs and ecotones. The zonalitz of vegetation cover is pronounced, it is represented by the piedmont, mountain (upper, lower) and highland (subalpine, alpine) belts. In terms of phytogeography there are 6 floristic areas: the Khust-Solotvino (Maramarosh) depression, the inter-stream area between rivers Tereblya and Teresva, the Maramarosh Alps, the Chornohora, the Svydovets, the Horhans.

The principal plant types are represented by forest (Vaccinio-Piceetea, Querco-Fagetea, Quercetea robori-petraeae, Alneteca glutinosae, Salicetea purpureae), meadow (Molinio-Arrhenatheretea, Nardo-Callunetea, Festuco- Brometea, Salicetea herbaceae, Caricetea curvulae, Elyno-Seslerietea), shrub and undershrub (Betulo-Adenostyletea, Loiseleurio-Vaccinietea, Vaccinio- Juniperetea), waterside and wetland (Phragmito-Magnocaricetea, Montio- Cardaminetea, Scheuchzerio-Caricetea fuscae) and pioneer communities (Asplemnietea rupestris, Thlaspietea rotundifolii). Segetal communities - Plantaginetea, Galio-Urticetea - also have local distribution.

Noteworthy flora: The flora of the region is very rich and diverse. It reckons over 1000 vascular plant species. These include particularly endemic (94), rare taxa, as well as those included in the Red Data Book of Ukraine (118). A total of 366 vascular plant species of the region need protection.

For the annotated list of vascular plants and plant communities of the River Tisa basin, which include all of Transcarpathia, see the Appendix.

Noteworthy fauna: The fauna of the River Tisa headwaters and its valley is heterogeneous and varies with the hydrological and landscape-botanical features of the localities. Generally one can speak of two aspects of the fauna: the first is associated with the most mountaneous part of River Tisa (from the rivers Chorna and Bila Tisa approximately as far as their confluence behind Rahiv.); the second is from Rahiv down the river as far as Tyachiv. Of course, this is only a conventional boundary between the two sections. Nevertheless, in the first section the following characteristic species prevail, see the Appendix.

Social and cultural values: The human population of the Upper Tisa have passed a complicated path of the historic development. The Hutsul ethnic group had formed here, which, along with the general Ukrainian and East Slavic features, has some specific traits of culture and mode of life. The Hutsuls, unlike other Transcarpathian ethnic groups, have the grazing type of cattle breeding as their main occupation. Crop farming is of minor importance, and woodwork has been an auxiliary occupation there for a long time. The cultural-historic processes in the lives of the Upper Tisa people developed in close relationship with the Carpathian regional development at large. They reached the highest rise in the Hallstatt period - the decisive one in the Thracian culture (8th-7th centuries B.C.). The monuments of this culture are connected with salt- and iron-works. Later on, after the tribes from the Forest Steppe had penetrated into Transcarpathia and assimilated with the South Thrakian tribes, the Kushtanovitsa culture formed there. The culture of the Celts, or La Tene culture, exerted its influence there around the 5th-2nd centuries B.C. After the decline of Celtic dominance, at the beginning of Anno Domini, the Getae-Thracian, or Getae-Dacian culture formed in the Carpathian region. This is one of the few cultures which had a true highland character. The late Roman period is famous for its original culture of Carpathian burial mounds, which was created by the Getae-Thracian tribes, and partly by the Slavs. This culture was likely to unite the Carpes - an old population of the region in the 2nd-4th centuries. The flourishing of the early Middle Age culture of the Slavs (Prague, Penkovo cultures) took place in the 6th-7th centuries. At the doorstep of the 10th century the culture of Luka-Raikovetska developed; at that time the Slavic tribes of the Carpathian Croatians formed their first unions: the principalities. There are numerous monuments of the above cultures displayed in the region.

In the Hutsul land economy cattle breeding, and first of all sheep breeding, was always the key branch. These domestic animals were of the greasing type (with seasonal herding) and were managed on the basis of collective ownership. Other kinds of farm animals like goats, cows, horses were also on grazing. The population have performed woodwork, logging and transportation of timber long since. Wood materials were used for construction, making tools and utensils, charcoal, pitch; they were used as fuel, etc. Important auxiliary occupations of the Hutsuls have been also apiculture, hunting, fishing, gathering mushrooms, berries and medicinal plants.

Land tenure/ownership:

Tyachiv district rada, Tyachiv district state administration

Bushtyno settlement rada, Tyachiv town rada, Bedevlya village rada, Teresva settlement rada, Hrushovo village rada, Dibrova village rada, Solotvino settlement rada.

Rahiv district rada, Rahiv district state administration

Bila Tserkva village rada, Veliky Bychkiv settlement rada, Luzhanska village rada, Dilove village rada, Kostylivo village rada, Rahiv town rada, Bilinska village rada, Kvasy village rada, Yasinya settlement rada, Chorna Tysa village Rada, Roztoka village rada, Vidrychanska village rada, Bohdan village rada, Luhy village rada.

Current land use: The main territories are piedmont and mountain zones used for agricultural purposes (livestock, crop farming), for forestry and recreation. The Rahiv and Tyachiv districts have a state border with Romania. Their socio-economic specificity differs from that of other districts in the complicated conditions of living and in economic activity, particularly in agricultural work, because of the shortage of arable lands. A substantial part of the land is situated on slopes which make farming hard. The high density of the population living mainly in the River Tisa basin, sharpens the problems of employment. In both districts there are some useful minerals, the greatest attention is attached to the exploitation of marble and salt. As to the branches of industry, the most developed are forestry and wood-processing industry. In agriculture meat production, dairy live-stock farming and gardening are the principal fields. The population‘s supply with land in the Rahiv and Tyachiv districts is the poorest in the region: there is 0.1 ha and 0.3 ha of arable land per one resident of the district, respectively.

Among the promising lines of land management there is the development of ecological (green) tourism and agricultural tourism. These lines are planned to be developed on the international level.

Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:

Floods are frequent phenomena in the region. Some of them have caused considerable material damage to the objects of national economy and private possessions, they also were responsible for ecological catastrophes.

The floods affected most badly the Rahiv and Tyachiv districts in October 1992 and December 1993. During these floods the sewage disposal structures were damaged in Tyachiv, the Teresva wood works, Solotvino and Bushtyno. Highways of local and state importance were seriously damaged, too. Specially serious detriment was caused to the forest paths and forest engineering structures. The deficit of budget means less assistance for speedy recovery.

Conservation measures taken: In the Tyachiv and Rahiv districts over 80 valuable objects of "natural reserve stock" (NRS) as well as areas of different categories of reservation have been drawn under protection. In addition, in these districts over 90 mineral sources are registered. The largest among the natural reserve objects is the Carpathian Biosphere Reserve (CBR) occupying ane area of 57.800 ha. As the territory of CBR was expanded in 1997, over 13 objects and areas of NRS were incorporated into it. Since these objects are numerous, in 1998 the State Department of Eco-safety carried through and co-ordinated the work on compiling their inventory.

Along the stream of River Tisa the following objects and areas of natural reserve stock are situated:

«Apshinetsky» - a hydrological reservation of state level; its area is 105 ha, Yasynya State Forest and Hunting Organization. The coniferous virgin forest and a dense network of water sources, giving rise to mountain streams which drain into River Chorna Tisa, are under protection.

«Radyansky Karpaty» - a forest reservation of local level. Its total area is 648.9 ha. It is a highly productive beech virgin forest with a considerable admixture of field maple, sycamore and other tree species. It is a gene pool for obtaining a stable forest tree seed base. It is of scientific and economic importance.

«Stanislav» - a botanical reservation of local level. Its area is 5.3 ha, Yasynya State Forest and Hunting Organization. Rare plants having been entered the Red Data Book of Ukraine are protected.

«Andromeda» - a botanical natural monument of local level. Its area is 6.0 ha, Chorna Tysa village, «Markovets» natural landmark. The sphagnum bog and a number of rare plant species are protected.

«Chorna Tysa» - an ichtyological reservation of local level. Its extent is 39.3 km2, Yasynya State Forest and Hunting Organization, Svydovets and Stanislav forestries. Rare valuable fish species are under protection.

Conservation measures proposed but not yet implemented: The present natural reserve stock of the River Tisa headwaters requires a certain degree of optimization. First of all, it is necessary to expand the territory of the Carpathian Biosphere Reserve (CBR) in the vertical gradient, to include subalpine and alpine vegetation types. It is worthwhile also to expand the present reserve massifs. A new reserve massif should be organized in the Svydovets, where now only a few small reservations are scattered in the area. As the last stage, it seems necessary to unite the CBR massifs, today isolated, into a single functional structure through the system of ecological corridors.

Current scientific research and facilities: The scientific research in the region concerns mainly biodiversity studies in the Carpathian Biosphere Reserve (CBR) and a series of other projects, which, to a certain extent, embrace the Upper Tisa Region. Among these there are the following which seem to be the most important:

1. Conservation of Carpathian biodiversity (Global Ecological Fund, 1994-1996). Performers: CBR; Institutes of Botany and Zoology, NAS, Ukraine; Institute of Carpathian Ecology, NAS, Ukraine; Universities of Lviv, Uzhgorod, Chernivtsi.
2. Red Data List of Transcarpathia: threatened plant species and communities (Systematic Association of Great Britain, 1995-1997). Performers: V. V. Kricsfalusy, G. B. Budnikov, A. V. Mihály.
3. Ramsar Wetland Area in the Upper Tisa Region (Ramsar Small Grants Fund, 1998). Performers: Ruthenia Carpathian Ecological Club.

Current conservation education: Ecological education has become especially active recently. Among the most important actions there are those carried on by the «Ruthenia» Carpathian EcoClub, the «Eco-Eks» non-governmental organization and the «Karpaty» EcoClub.

The «Ruthenia» Carpathian EcoClub (V. V. Kricsfalusy, A. Ye. Lugovoj, V. I. Sabadosh), together with the Regional Forest Department, organized a series of educational seminars for the workers of 4 forestries (about 300 people) of this region, and published a manual titled «Forests of Transcarpathia» (1997). This activity became possible through the help of the Carpathian Euroregion Development Fund. At the same time practical lessons were organized, as well as the mobile exhibition «Fauna of Transcarpathia and its conservation» (A. Ye. Lugovoj, L. A. Potish) which were sponsored by the ISAR Fund.

In addition, in the regional press (Kárpáti Igaz Szó, Novyny Zakarpattya, Yedinstvo-Plus, Rio-Inform) materials of eco-educational character are being published like, for example, the last series of articles under the general heading «Looking through the pages of the Red Data Book». Seven articles have already been published under that heading: «Beetles», «Butterflies», «Fish», «Amphibians», etc. (author: A. Ye. Lugovoj). Though the articles Transcarpathian nature conservation is addressed at large, at the same time they directly concern River Tisa and its valley.

The «Eco-Eks» NGO organizes All-Ukrainian ecological camps for schoolchildren in the CBR every year. Members of the EcoClub «Karpaty» take part in the work.

Current recreation and tourism: The Upper Tisa - Hutsul Land - is the most popular place for tourism in Transcarpathia, due to the diverse relief of the locality, wonderful mountain landscapes with picturesque lakes, slopes of different steepness and length for skiing, interesting walking and water routes, etc. There are a lot of tourist centres and shelters in Hutsul land. In Rahiv there is the «Tisza» tourist center (its shelter in the mountains is named «Perelisok»), in the village of Kobyletska Polyana one can find the «Trembita» tourist centre, in Yasinya there is «Edelveis» with two branches («Hoverla» and «Drahobrat»), and the «Moldova». The construction of two tourist hotels has been launched in Kvasy and Yasinya. The programme of recreation at these centres includes excursions by bus and on foot, skiing in the mountains, etc.

Jurisdiction:

Administrative structures of district level:
Rahiv district rada and Rahiv District State Administration
295800 Rahiv, 1 Miru Str.
Tyachiv district rada and Tyachiv District State Administration
295710 Tyachiv, 30 Nezalezhnosti Sq.
Administrative structures of regional level:
Regional Rada and Regional State Administration
294008 Uzhgorod, 4 Narodna Sq.
Regional Forest Department
294008 Uzhgorod, 4 Narodna Sq.
Regional Department of Agriculture and Food Products
294008 Uzhgorod, 2A Kotsubinsky Str.
State Department of Eco-safety in Transcarpathian Region
294008 Uzhgorod, 4 Narodna Sq.

Management authority: The objects and areas of the natural reserve stock belong to the following administrative structures:

- the Carpathian Biosphere Reserve is under the Ministry of Natural Environment and Nuclear Safety of Ukraine;
- the other objects - forest reservations and natural monuments - are under the protection of forest enterprises forming a part of the State Forest Committee;
- mineral sources outside the state forests are under the protection of agricultural enterprises and village radas.

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Appendix

Hydrological values:

Table 1.
Chemical characteristics of the water of River Tisa

Components(мg/l)	Site of samples			
	Rahiv 1 Км up	Rahiv 1 Км down	V.Bychkiv	Tyachiv
Biological Oxygen Demand	1.7–3.6	2.3–7.6	1.6–6.6	1.6–5.8
Ammonium	0.0–0.17	0.0–0.9	0.0–0.7	0.0–0.7
Nitrite	0.000–0.014	0.000–0.017	0.000–0.040	0.000–0.060
Nitrate	0.80–6.00	1.00–7.00	1.00–5.65	1.00–6.60
SSAS	0.000–0.017	0.000–0.080	0.000–0.040	0.000–0.004
Chloride	7.1–14.5	7.1–14.2	6.2–17.7	10.3–56.8
Sulphate	16.0–31.3	16.0–29.5	11.7–36.0	11.7–32.0
Iron	0.10–0.22	0.20–0.90	0.20–1.10	0.10–0.55
Phosphates	0.21–0.58	0.32–0.80	0.11–0.50	0.19–0.50

Table 2.
Water level changes

Place of observation	Water levels		Amplitude of water level changes
	lowest minimum	highest maximum	
1. River Tisa - Rahiv	13 см	255 см	268 см
2. River Tisa - Dilove	27 см	400 см	427 см
3. River Tisa - V.Bychkiv	30 см	448 см	478 см
4. River Tisa - Tyachiv	54 см	694 см	748 см

Annotated list of vascular plants

Aceraceae

Acer campestre L.
A. platanoides L.
A. pseudoplatanus L.
A. tataricum L.

Adoxaceae

Adoxa moschatellina L.

Alismataceae

Alisma lanceolatum With.
A. plantago-aquatica L.
Sagittaria sagittifolia L.

Amaranthaceae

Amaranthus hybridus L.
A. retroflexus L.
A. lividus L.

Amaryllidaceae

Galanthus nivalis L.
Leucojum aestivum L.
Leucojum vernum L.
Narcissus angustifolius Curt.

Apiaceae

Aegopodium podagraria L.
Aethusa cynapium L.
Angelica sylvestris L.
Anthriscus nitida Garcke.
A. sylvestris (L.) Hoffm.
Astrantia major L.
Bupleum longifolium L.
B. ranunculoides L.
Carum carvi L.
Chaerophyllum aromaticum L.
Ch. bulbosum L.
Ch. cicutaria Vill.
Ch. temulum L.
Cnidium dubium (Schkuhr) Thell.
Conium maculatum L.
Eryngium campestre L.
E. planum L.
Ferulago sylvatica (Bess.) Reichb.
Heracleum carpaticum Porc.
H. palmatum Baumg.
H. sphondylium L.
Laser trilobum (L.) Borkh.
Laserpitium alpinum Waldst. et Kit.
L. latifolium L.
L. pruthenicum L.
Libanotis montana Crantz.
Ligusticum mutellina (L.) Crantz.
Oenanthe aquatica (L.) Poir.
O. banatica Heuff.
O. silaifolia Bieb.
Peucedanum carvifolia Vill.
P. cervaria (L.) Lapeyr.
P. oreoselinum (L.) Moench
P. palustre L.
Pimpinella major (L.) Huds.
P. saxifraga L.
Pleurospermum austriacum (L.) Hoffm.
Sanicula europaea L.
Selinum carvifolia (L.) L.

Apocynaceae

Vinca minor L.

Araceae

Arum intermedium Schur
A. maculatum L.
Calla palustris L.

Araliaceae

Hedera helix L.

Aristolochiaceae

Aristolochia clematitis L.
Asarum europaeum L.

Asclepiadaceae

Vincetoxicum hirundinaria Medik.

Aspleniaceae

Asplenium adiantum-nigrum L.
A. cuneifolium Viv.
A. ruta-muraria L.
A. septentrionale (L.) Hoffm.
A. trichomanes L.
A. viride Huds.
Phyllitis scolopendrium (L.) Newm.

Asteraceae

Achillea carpatica Blocki ex Dubovik
A. distans Waldst. et Kit.
A. millefolium L.
A. setacea Waldst. et. Kit.
A. stricta Schleich.
A. schurii Sch. Bip.
Achyrophorus maculatus (L.) Scop.
A. uniflorus (Vill.) Bluff.
Adenostyles alliare (Gouan) Kern.
Ambrosia artemisiifolia L.
Antennaria dioica (L.) Gaertn.
A. carpatica (Wahlenb.)R. Br.
Anthemis arvensis L.
A. carpatica Waldst. et Kit.
A. cotula L.
A. subtinctoria Dobrocz.
Aposeris foetida (L.) Less.
Arctium lappa L.
A.minus Bernh.
A. tomentosum Mill.
Arnica montana L.
Artemisia absinthium L.
A. annua L.
A. scoparia Waldst. et Kit.
A. vulgaris L.
Aster alpinus L.
A. amellus L.
Barkhausia rhoeadifolia Bieb.
B. setosa DC.
Bellis perennis L.
Bidens cernuus L.
B. radiata Thiull.
B. tripartita L.
Carduus biscolorifolius Klok.
C. collinus Waldst. et Kit.
C. crispus L.
C. kerneri Simk.
C. fortior Klok.
Carlina acaulis L.
C. bibersteinii Bernh.
Carpesium cernuum L.
Centaurea carpatica (Porc.) Porc.
C. cyanus L.
C. diffusa Lam.
C. jacea L.
C. kotschyana Heuff.
C. marmarosiensis (Jav.) Czer.
C. mollis Waldst. et Kit.
C. pannonica (Heuff.) Hayek.
C. phrygia L.
C. rhenana Boreau.
C. scabiosa L.
C. stricta Waldst. et Kit.
Chondrilla juncea L.
Cichorium intybus L.
Cirsium arvense (L.) Scop.
C. canum (L.) All.
C. erisithales (Jacq.) Scop.
C. oleraceum Scop.
C. palustre (L.) Scop.
C. setosum Bieb.
C. vulgare (Savi) Ten.
C. waldsteinii Rouy
Crepis biennis L.
C. capillaris (L.) Wallr.
C. conyzifolia (Gouan) Dalla Torre
C. paludosa (L.) Moench
C. tectorum L.
C. tristis Klok.
Cyclachaena xanthiifolia (Nutt.) Fresen.
Doronicum austriacum Jacq
D. carpaticum (Griseb et Schenk.) Nym.
D. clusii (All.) Tausch.
D. longifolium Griseb et Schenk.
D. hungaricum (Sadl.) Reichenb.
Echinops exaltatus Schrad.
E. sphaerocephalus L.
Erechtites hieracifolius (L.) Rafin
Erigeron acer L.
E. alpinus L.
E. canadensis L.
Eupatorium cannabinum L.
Filago arvensis L.
F. germanica L.
F. minima Fries
Galinsoga ciliata (Raf.) Blake
G. parviflora Cav.
Gnaphalium luteo-album L.
G. norvegium Gunn.
G. supinum L.
G. sylvaticum L.
G. uliginosum L.
Helichrysum arenarium (L.) DC.
Hieracium acutisquamum Naeg. et Peter

H. alpinum L.
H. amaureuilema (Naeg. et Peter) Juxip
H. apatelium Naeg. et Peter
H. apiculatum Tausch
H. atrellum (Zahn) Juxip.
H. aurantiacum L.
H. auricula Lam. et DC.
H. aquilonare (Naeg. et Peter) Juxip.
H. bupleurifolioides)Zahn) Juxip.
H. bupleurifolium Tausch
H. colliniforme (Naeg. et Peter) Juxip
H. conium Arv.-Touv.
H. decipiens Tausch
H. festinum Jord.
H. fritzei F.Schultz
H. floribundum Wimm. et Grab.
H. galbanum (Dahlst.) Norrl.
H. gentile Jord.
H. glaucescens Bess.
H. gymnogenum (Zahn.)Juxip.
H. knaffi (Èelak) Juxip
H. krasanii Woloszcz.
H. laevigatum Willd.
H. lomnicense Woloszcz.
H. marginale (Varp. Et Peter.) Juxip.
H. megalomastix (Naeg. et Peter) Juxip.
H. melanocephalum Tausch
H. mukacevense Juxip.
H. nigrescens Juxip.
H. onegense (Norrl.) Norre.
H. pellucidum Laest.
H. pilosella L.
H. pocuticum Woloszcz.
H. plicatulum (Zahn) Juxip
H. praecurrens Vukot.
H. rehmanii (Naeg. et Peter) Juxip.
H. regiomontanum Naeg. et Peter
H. rigidum C. Hartm.
H. rohascense Kit.
H. rojowskii Rehm.
H. roxolanicum Rehm.
H. rubricymigerum Naeg. et Peter
H. scabiosum (Surde) Juxip.
H. serratifolium Jord.
H. spathopyllum Naeg. et Peter
H. sterromastix (Naeg. et Peter) Juxip.
H. subnigrescens (Fries) Juxip.
H. sudetorum (Naeg. et Peter) Juxip.
H. tatrense (Naeg. et Peter) Juxip.
H. transsilvanicum (Heuff.) Juxip.
H. tricheilem (Naeg. et Peter) Juxip.
H. umbellatum L.
H. umbelliferum Naeg. et Peter
H. vagum Jord.
H. villosum Jacq.
H. virgultorum Jord.
H. volhynicum Naeg. et Peter
H. wimmeri Uechtr.
Homogyna alpina (L.) Cass.
Hypachoeris glabra L.
H. radicata L.
Inula brittanica L.
I. ensifolia L.
I. helenium L.
I. hirta L.
I. salicina L.
I. vulgaris (Lam.) Trevisari
Lactuca serriola Torner
L. stricta Waldst. et Kit.
Lapsana communis L.
Leontodon autumnalis L.
L. croceus Haenke
L. danubialis Jacq.
L. gutzulorum V.Vassil.
L. pseudotaraxaci Schur
L. repens Schur
L. schischkinii V.Vassil.
Leontopodium alpinum L.
Leucanthemum vulgare Lam.
Linosyris vulgaris Cass.
Matricaria matricarioides (Less.) Porter ex Britt.
M. recutita L.
Mycelis muralis (L.) Reichb.
Onopordon acanthium L.
Petasites albus (L.) Gaertn.
P. hybridus (L.) Gaertn.
P. kablikianus Tausch.
Picris hieracioides L.
Ptarmica lingulata DC.
P. vulgaris Chornaw. ex DC.
Pulicaria vulgaris Gaertn.
Pyrethrum clusii Fisch. ex Reichb.
P. corymbosum (L.) Schrank
Saussurea alpina (L.) DC.
S. discolor (Willd.) DC.
S. porcii Degen
Scariola viminea (L.) J. et C. Presl.
Scorzonera humilis L.
S. rosea Waldst. et Kit.
Senecio aquaticus Huds.
S. barbareifolium Krock.
S. capitatus (Wahlb.) Steud.
S. carniolicus Willd.
S. carpaticus Herbich.
S. erucifolius L.

S. fluviatilis Wallb.
S. fuchsii Gmel.
S. jacobaea L.
S. nemorensis L.
S. paludosus L.
S. paluster (L.) DC.
S. papposus (Reichb.) Less.
S. pratensis (Hoppe) DC.
S. rivularis (Waldst. et Kit.) DC.
S. subalpinus Koch
S. sylvaticus L.
S. vernalis Waldst. et Kit.
S. viscosus L.
S. vulgaris L.
Serratula intermis Gilib.
Solidago alpestris Waldst. et Kit.
S. canadensis L.
S. virgaurea L.
Sonchus arvensis L.
S. asper (L.) Hill.
S. oleraceus L.
S. palustris L.
Stenactis annua (L.) Nees.
Tanacetum vulgare L.
Taraxacum alpinum (Hoppe) Hegetschw. et Heer.
T. fontanum Hand-Mazz.
T. nigricans (Kit.) Reichb.
T. officinale Web. et Wigg.
Telekia speciosa (Schreb.) Baumg.
Tragopogon dubius Scop.
T. transcarpaticus Klok.
Tripleospermum inodorum (L.) Sch. Bip.
Tussilago farfara L.
Xanthium albinum (Widder) H.Scholz
X. spinosum L.
X. strumarium L.

Athyriaceae

Athyrium filix-femina (L.) Roth.
A. distentifolium Tausch ex Opiz
Cystopteris fragilis (L.) Bernh.
C. montana (Lam.) Desv.
C. regia (L.) Desv.
C. sudetica A. Br. et Milde.

Balsaminaceae

Impatiens noli-tangere L.
I. parviflora DC.

Berberidaceae

Berberis vulgaris L.

Betulaceae

Alnus glutinosa (L.) Gaertn.
A. incana (L.) Willd.
Betula pendula Roth.
Carpinus betulus L.
Corylus avellana L.

Blechnaceae

Blechnum spicant (L.) Roth.

Boraginaceae

Anchusa barrelieri (All.) Vitm.
A. italica Retz.
A. officinalis L.
A. pseudochroleuca Shost.
Asperugo procumbens L.
Cerinthe minor L.
Cynoglossum officinale L.
Echium vulgareL.
Lappula myosotis Moench
Lithospermum arvense L.
L. officinale L.
L. purpureo-coeruleum L.
Lycopsis arvensis L.
Myosotis alpestris F.W.Schmidt
M. arvensis (L.) Hill
M. caespitosa K.F.Schultz
M. discolor Pers.
M. nemorosa Bess.
M. ramosissima Rochel ex Schult.
M. stricta Link ex Roem. et Schult.
M. strigulosa Reichb.
M. sylvatica (Ehrh.) Hoffm.
Omphalodes scorpioides (Haenke) Schrank
Pulmonaria filarszkyana Jav.
P. mollissima A.Kerner
P. obscura Dum.
P. rubra Schott.
Stophiostoma sparsiflorum (Mikan) Turcz.
Symphytum besseri Zaverucha
S. cordatum Waldst. et Kit.
S. officinale L.
S. popovii Dobrocz.

S. tanaicense Stev.

Brassicaceae

Alliaria petiolata (Bieb.) Cavara et Grande
Alyssum desertorum Stapf.
A. hirsutum Bieb.
Arabidopsis thaliana (L.) Heynh.
Arabis alpina L.
A. hirsuta (L.) Scop.
Barbarea stricta Andrz.
B. verna (Miller) Ascherson
B. vulgaris R. Br.
Biscutella laevigata L.
Berteroa incana (L.) DC.
Brassica campestris L.
Bunias erucago L.
B. orientalis L.
Camelina alyssum (Mill.) Thell.
C. albiflora Kotschy
Capsella bursa-pastoris L.
Cardamine amara L.
C. graeca L.
C. dentata Schulz
C. flexuosa With.
C. hirsuta L.
C. impatiens L.
C. matthiolii Moretti
C. opizii Presl.
C. palustris Peterm.
C. parviflora L.
C. pratensis L.
C. rivularis Schur
C. trifolia L.
Cardaminopsis arenosa (L.) Hayek
C. halleri (L.) Hayek
C. neglecta (Schult.) Hayek
C. ovirensis (Wulfen) Thell. ex Jáv.
C. petraea (L.) Hiit.
Conringia orientalis (L.) Andrz.
Dentaria bulbifera L.
D. glandulosa Waldst. et Kit.
Descurainia sophia (L.) Schur
Draba aizoides L.
D. carinthiaca Hoppe
Erophila krockeri Andrz.
E. verna (L.) Bess.
Eruca sativa Mill.
Erysimum cheiranthoides L.
E. cuspidatum (Bieb.) DC
Hesperis candida Kit.
H. matronalis L.
Lepidium campestre (L.) R.Br.
L. densiflorum Schrad.
L. draba L.
L. perfoliatum L.
L. ruderale L.
Lunaria rediviva L.
Nasturtium officinale (L.) R.Br.
Neslea paniculata (L.) Desv.
Psilolema calycinum (L.) C.A.Mey.
Raphanus raphanistrum L.
R. sativum L.
Rorippa amphibia (L.) Bess.
R. palustris L.
R. prostrata (Desv.) Schinz.
R. pyrenaica (Lam.) Reich.
R. sylvestris (L.) Bess.
Sinapis arvensis L.
Sisymbrium altissimum L.
S. loeselii L.
S. officinalis (L.) Scop.
S. orientale L.
S. strictissimum L.
Thlaspi alliaceum L.
T. arvense L.
T. daccium Heuff.
Turritis glabra L.

Butomaceae

Butomus umbellatus L.

Callitrichaceae

Callitriche cophocarpha Sendtner.

Campanulaceae

Adenophora liliifolia (L.) Bess.
Campanula abietina Griseb. et Schenk.
C. alpina Jacq.
C. bononiensis L.
C. carpatica Jacq.
C. cervicaria L.
C. glomerata L.
C. kladniana (Schur) Witasek
C. latifolia L.
C. patula L.
C. persicifolia L.
C. polymorpha Witasek
C. rapunculoides L.
C. sarrata (Kit.) Hendrych.
C. trachelium L.
Jasione montana L.

Phyteuma orbiculare l.
Ph. spicatum L.
Ph. tetramerum Schur
Ph. vagneri Kern.

Cannabaceae

Humulus lupulus L.

Caprifoliaceae

Linnaea borealis L.
Lonicera caerulea L.
L. nigra L.
L. xylosteum L.
Sambucus ebulus L.
S. nigra L.
S. racemosa L.
Viburnum opulus L.

Caryophyllaceae

Agrostemma githago L.
Arenaria brevifolia Gilib.
Cerastium arvense L.
C. caespitosum Gilib.
C. cerastoides (L.) Britt.
C. dubium (Bast.) Guepin
C. fontanum Baumg.
C. glomeratum Thuill.
C. lanatum Lam.
C. pumilum Curt.
C. sylvaticum Waldst. et Kit.
C. tauricum Spreng.
Coronaria flos cuculi (L.) A.Br.
Cucubalus baccifer L.
Dianthus armeria L.
D. carthusianorum L.
D. carpaticus Woloszcz.
D. commutatus (Zapal.) Klok.
D. compactus Kit.
D. deltoides L.
D. glabriusculus (Kit.) Borb.
D. pseudobarbatus Bess.
Elisanthe noctiflora (L.) Rupr.
E. zawadskii (Herbich) Klok.
Eremogone micradenia (P. Smirn) Ikonn.
Gypsophila muralis L.
G. paniculata L.
Heliosperma carpaticum (Zapal.) Klok.
Holosteum umbellatumL.
Kohlrauschia prolifera Kunth
Melandrium album (Mill.) Garcke
M. dioicum (L.) Coss. et Germ.
M. nemorale (Heuff.) A.Br.
Minuartia oxypetala (Woloszcz.) Kulcz.
M. zarencznyi (Zapal.) Klok.
Moehringia muscosa L.
M. trinervia (L.) Clairv.
Myosoton aquaticum (L.) Moench
Sagina nodosa (L.) Fenzl.
S. procumbens L.
S. saginoides (L.) Karst.
S. subulata (Sw.) Presl.
Saponaria officinalis L.
Scleranthus annuus L.
S. perennis L.
S. unicatus Schur
Silene anglica L.
S. carpatica (Zapal.) Czopik.
S. dichotoma Ehrh.
S. dubia Herbich
S. fabaria (L.) Sibth et Smith
S. jundzilli Zapal.
S. nemoralis Waldst. et Kit.
S. nutans L.
S. vulgaris (Moench) Garcke
Spergula vulgaris Boenn.
Spergularia campestris (L.) Aschers.
S. marina (L.) Griseb.
Stellaria alsine Grimm
S. barthiana Schur
S. diffusa Willd.
S. graminea L.
S. holostea L.
S. media (L.) Vill.
S. nemorum L.
S. palustris Retz.
Viscaria vulgaris Bernh.

Celastraceae

Euonymus europapeae L.

Ceratophyllaceae

Ceratophyllum demersum L.
C. submersum L.

Chenopodiaceae

Atriplex nitens Schk.
A. oblongifolia Waldst. et Kit.
A. patula L.

Chenopodium album L.
Ch. bonus-henricus L.
Ch. botrys L.
Ch. foliosum Aschers.
Ch. hybridum L.
Ch. glaucum L.
Ch. murale L.
Ch. polyspermum L.
Ch. urbicum L.
Ch. viride L.
Polycnemum heuffelli Lang.
Salsola pestifera Nels.

Cistaceae

Helianthemum grandiflorum (Scop.) Lam. et DC.

Convolvulaceae

Calystegia sepium (L.) R. Br.
Convolvulus arvensis L.

Cornaceae

Cornus mas L.
Swida sanguinea (L.) Opiz

Crassulaceae

Sedum acre L.
S. alpestre Vill.
S. annuum L.
S. atratum L.
S. carpaticum G. Reuss
S. sexangulare L.
Sempervirum montanum L.
Jovibarba preissiana (Domin) Omelcz. et Czopik
Rodiola rosea L.

Cucurbitaceae

Bryonia alba L.
B. dioica Jacq.
Echinocystis lobata (Michx.) Torr.
Sicyos angulata L.

Cupressaceae

Juniperus communis L.
J. excelsa Bieb.
J. sabina L.
J. sibirica Burgsd.

Cuscutaceae

Cuscuta campestris Yunck.
C. epilinum Weiche
C. epithymum Murr.
C. europaea L.
C. lupuliformis Koch.
C. viciae Koch.

Cyperaceae

Blysmus compressus (L.) Panz. ex Link.
Bulboschoenus maritimus (L.) Palla
Carex acuta Good.
C. acutiformis Ehrh..
C. brizoides L.
C. buekii Wimm.
C. caespitosa L.
C. canescens L.
C. contiqua Hoppe
C. digitata L.
C. divulsa Stokes
C. echinata Murr.
C. flacca Schreb.
C. flava L.
C. hirta L.
C. inflata Huds.
C. lasiocarpa Ehrh.
C. leporina L.
C. muricata L.
C. otrubae Podp.
C. pallescens L.
C. panicea L.
C. pilosa Scop.
C. praecox Schreb.
C. pseudocyperus L.
C. remota L.
C. riparia Curt.
C. sylvatica Huds.
C. tomentosa L.
C. umbrosa Host.
C. vaginata Tausch.
C. verna Chaix.
C. vesicaria L.
C. vulgares Fries.
C. vulpina L.
Cyperus flavescens (L.) Beauv. ex Reicht.
Eleocharis acicularis (L.) R. Br.
E. carniolica Koch

E. intersita Zinserl.
E. palustris (L.) R.Br. s str.
E. uniglumis (Link.) Schult.
Pycreus flavescens (L.) Beauv. ex Reichb.
Schoenoplectus lacustris (L.) Palla
Schoenus ferrugineus L.

Dipsacaceae

Dipsacus laciniatus L.
D. pilosus L.
D. sylvestris Huds.
Knautia arvensis (L.) Coult.
K. dipsacifolia (Host) Gren. et Godr.
Scabiosa columbaroa L.
S. ochroleuca L.
S. opaca Klok.
Succisa pratensis Moench
Succisella inflexa (Klok.) G. Beck.

Droseraceae

Drosera rotundifolia L.

Dryopteridaceae

Dryopteris assimilis S.Walker
D. carthusiana (Vill.) H.P. Fuchs
D. cristata (L.) A. Gray
D. filix-mas (L.) Schott.
D. lanceolato-cristata (Hoffm.) Asson
Gymnocarpium dryopretis (L.) Newm.
G. robertianum (Hoffm.) Newm.
Phegopteris connectilis (Michx.) Watt.
Polystichum aculeatum (L.) Roth.
P. braunii (Spenn.) Fée
P. lonchitis (L.) Roth

Elatinaceae

Elatine alsinastrum L.
E. ambigua Wight.
E. hydropiper L.

Empetraceae

Empetrum nigrum L.

Equisetaceae

Equisetum arvense L.
E. fluviatile L.
E. hiemale L.
E. telmateia Ehrh.
E. palustre L.
E. pratense Ehrh.
E. ramosissimum Desf.
E. sylvaticum L.

Ericaceae

Andromeda polifolia L.
Calluna vulgaris (L.) Hill.
Ledum palustre L.
Loiseleuria procumbens (L.) Desv.
Rhododendron kotschy Simonk.

Euphorbiaceae

Euphorbia amygdaloides L.
E. angulata Jacq.
E. carniolica Jacq.
E. carpatica Woloszcz.
E. cyparissias L.
E. helioscopia L.
E. lingulata Heuff.
E. lucida Waldst. et Kit.
E. palustris L.
E. peplus L.
E. platyphyllos L.
E. purpurata Thuill.
E. serrulata Thuill.
E. sojakii (Chrtek. et Køisa) Dubovik
E. tristis Bieb. ex Bess.
E. villosa Waldst. et Kit.
E. virgata Waldst. et Kit.
Mercurialis perennis L.

Fabaceae

Anthyllis affinis Brittinger
A. alpestris Reichb.
Astragalus cicer L.
A. glycyphyllos L.
A. krajinae Domin
Coronilla elegans Panc.
C. varia L.
Dorycnium herbaceum Vill.
D. suffruticosum Vill.
Hedyzarum hedyzaroides (L.) Schinz et Thell.
Genista elata (Moench) Wench.

G. germanica L.
G. oligosperma (Andre) Simk.
G. tinctoria L.
Lathyrus hirsutus L.
L. laevigatus (Waldscht. et. Kit.) Gren.
L. niger (L.) Bernh.
L. pratensis L.
L. sylvestris L.
L. transsilvanicus (Spreng.) Reichb.
L. tuberosus L.
L. vernus (L.) Bernh.
Lembotropis nigricans (L.) Griesb.
Lens cullinaris Medic.
Lotus corniculatus L.
L. tenuis waldscht. et Kit.
Medicago falcata L.
M. lupulina L.
Melilotus albus Medik.
M. officinalis (L.) Pall.
Ononis arvensis L.
Oxytropis carpatica Uechtr.
Sarothamnus scoparius (L.) Koch.
Trifolium alpestre L.
T. arvense L.
T. aureum Poll.
T. campestris Schreb.
T. dubium Sibth.
T. montanum L.
T. medium L.
T. ochroleucum Huds.
T. pannonicum Jacq.
T. pratense L.
T. repens L.
T. rubens L.
T. spadicetum L.
Vicia angustifolia L.
V. cassubicus L.
V. cracca L.
V. dumetorum L.
V. hirsuta (L.) S.F. Gray
V. lathyroides L.
V. pannonica Crantz.
V. sordida Waldst. et Kit.
V. sylvatica L.
V. tetrasperma (L.) Moench
V. villosa Roth.

Fagaceae

Fagus sylvatica L.
Quercus cerris L.
Q. dalechampii Ten.
Q. petraea (Mattuschka) Liebl.
Q. polycarpa Schur
Q. robur L.

Gentianaceae

Centaurium pulchellum (Swartz) Druce
Gentiana asclepiadea L.
G. axillaria (F.M.Schmid) Murb.
G. carpatica Wettst.
G. ciliata L.
G. cruciata L.
G. excisa C.Presl.
G. lacciniata Kit.
G. lingulata C.A.Agardh.
G. lutea L.
G. pneumonanthe L.
G. praecox A. et J.Kerner
G. punctata L.
G. verna L.
Menyanthes trifolia L.
Swertia alpestris Baumg.
S. punctata Baumg.

Geraniaceae

Erodium cicutarium (L.) L'Herit
Geranium alpestre Schur
G. columbinum L.
G. dissectum L.
G. macrorrhizum L.
G. molle L.
G. palustre L.
G. phaeum L.
G. pratense L.
G. pusillum L.
G. pyrenaicum Burm
G. robertianum L.
G. sanguineum L.
G. sylvaticum L.

Halorrhagidaceae

Myriophyllum spicatum L.
M. verticillatum L.

Hippuridaceae

Hippuris vulgaris L.

Huperziaceae

Huperzia selago (L.) Bernh. ex Schrank et Mart.

Hydrocaryaceae

Trapa natans L.

Hydrocharitaceae

Hydrocharis morsus-ranae L.
Stratiotes aloides L.

Hypericaceaea

Hypericum alpigenum Kit.
H. hirsutum L.
H. maculatum Crantz
H. montanum L.
H. perforatum L.
H. tetrapterum Fries.

Hypolepidaceae

Pteridium aquilinum (L.) Kuhn.

Iridaceae

Crocus banaticus J. Gay
C. heuffelianus Herb.
Iris germanica L.
I. hungarica Waldst. et Kit
I. pseudacorus L.
I. graminea L.
I. pseudocyperus Schur
I. sibirica L.
Sisyrinchium angustifolium Mill.

Juncaceae

Juncus articulatus L.
J. atratus Krock.
J. bufonius L.
J. bulbosus L.
J. castaneus Smith.
J. compressus Jacq.
J. effusus L.
J. fuscoater Schreb.
J. gerardii Loisel.
J. inflexus L.
J. macer S.F.Gray
J. obtisulflorus Ehrh. ex Hoffm.
J. trifidus L.
J. triglumis L.
Luzula flavescens (Host.) Gaudin
L. luzuloides (Lam.) Dandy et Wilm.
L. multiflora (Ehrh.) Lejeune
L. pallescens (Wahlb.) Bess.
L. pilosa (L.) Willd.
L. spicata DC.
L. subpillosa (Gilib.) V.Krecz.
L. sudetica (Willd.) DC.
L. sylvatica (Huds.) Gaudin

Juncaginaceae

Scheuchzeria palustris L.
Triglochin palustres L.

Lamiaceae

Acinos baumgartenii (Simk.) Klok.
A. thymoides Moench
Ajuga genevensis L.
A. reptans L.
Ballota nigra L.
Betonica officinalis L.
Chaiturus marrubiastrum (L.) Reichb.
Clinopodium vulgare L.
Elsholtzia ciliata (Thunb.) Hyl.
Galeobdolon luteum Huds.
Galeopsis bifida Boenn.
G. pubescens Bess.
G. speciosa Mill.
G. tetrahit Mill.
Glechoma hederacea L.
G. hirsuta Waldst. et Kit.
Lamium album L.
L. laevigatum L.
L. purpureum L.
Leonurus cardiaca L.
L. quinquelobatus Gilib.
Lycopus europaeus L.
Melittis mellissophyllum L.
Mentha aquatica L.
M. arvensis L.
M. longifolia (L.) L.
M. pulegium L.
M. verticillata L.
Nepeta cataria L.
Origanum vulgare L.
Prunella grandiflora (L.) Scholl.
P. laciniata (L.) L.
P. vulgaris L.
Salvia glutinosa L.
S. pratensis L.
S. verticillata L.

Scutellaria galericulata L.
S. hastifolia L.
Stachys alpina L.
S. annua (L.) L.
S. germanica L.
S. palustris L.
S. recta L.
S. sylvatica L.
Teucrium chamaedrys L.
Thymus alternans Klok.
Th. cyrcumcinctus Klok.
Th. enervius Klok.
Th. subalpestris Klok.
Th. ucrainicus (Klok. et Shost.) Klok.

Lemnaceae

Lemna gibba L.
L. minor L.
L. trisulca L.

Lentibulariaceae

Pinguicula alpina L.
P. vulgaris L.
Utricularia bremii Heer.
U. vulgaris L.

Liliaceae

Allium angulosum L.
A. montanum F.W.Schmidt
A. oleraceum L.
A. scorodoprasum L.
A. sibiricum L.
A. ursinum L.
A. victorialis L.
A. vineale L.
Anthericum ramosum L.
Asparagus tenuifolius Lam.
Colchicum autumnale L.
Convallaria majalis L.
Erythronium dens-canis L.
Fritillaria meleagris L.
Gagea lutea (L.) Ker. - Gawl.
G. minima (L.) Ker. - Gawl.
G. pratensis (Pars.) Dum.
G. spathacea (Hayne) Salisb.
G. vileosa (Bieb.) Duby
Leopoldia comosa (L.) Parl.
Lilium bulbiferum L.
L. martagon L.
Lloydia serotina (L.) Reichb.
Majanthemum bifolium (L.) F.W.Schmidt
Muscari racemosum L.
M. transsilvanicum Schur
Ornithogalum boucheanum (Knuth.) Aschers.
O. gussonei Ten.
O. umbellatum L.
Paris quadrifolia L.
Polygonatum multiflorum (L.) All.
P. officinale (L.) All.
P. verticillatum (L.) All.
Scilla subtriphylla (Schur) Dom.
Streptopus amplexifolius (L.) DC.
Veratrum album L.

Linaceae

Linum catharticum L.
L. extraaxillare Kit.
L. trigynum L.

Loranthaceae

Loranthus europaeus Jacq.
Viscum album L.

Lycopodiaceae

Diphasium alpinum (L.) Rothm.
Lycopodium annotinum L.
L. clavatum L.

Lythraceae

Lythrum hyssopifolia L.
L. salicaria L.
L. virgatum L.
Peplis portula L.

Malvaceae

Abutilon teophrasti Medik.
Althaea officinalis L.
Hibiscus trionum L.
Lavatera trimestris L.
Malva crispa (L.) L.
M. excisa Reichb.
M. mauritania L.
M. neglecta Wallr.
M. rotundifolia L.

Marsileaceae

Marsilea quadrifolia L.

Monotropaceae

Hypopithys monotropa Crantz

Nymphaeaceae

Nuphar luteum (L.) Sm.
Nymphaea alba L.
N. candida Presl.

Onocleaceae

Matteuccia struthiopteris (L.) Tod.

Oleaceae

Fraxinus angustifolia Vahl.
F. excelsior L.
F. ornus L.
Ligustrum vulgare L.

Onagraceae

Chamerion angustifolium (L.) Scop.
C. dodenaei (Vill.) Wimm.
Circaea alpina L.
C. intermedia Ehrh.
C. lutetiana L.
Epilobium alpestre (Jacq.) Krock.
E. anagallidifolium Lam.
E. collinum C.C.Gmel.
E. dominii M.Pop.
E. hirsutum L.
E. montanum L.
E. nutans F.W. Schmidt
E. palustre L.
E. roseum Schreb.
E. tetragonum L.
Ludwigia palustris (L.) Ell.
Oenothera biennis L.
Oe. parviflora L.
Oe. rubricaulis Klebahn.

Ophioglossaceae

Botrychium lunaria (L.) Sw.
B. matricariifolium A.Br. ex Koch

Orchidaceae

Cephalanthera rubra (L.) Rich.
Epipactis atrorubens (Hoffm.) Schult.
E. helleborine (L.) Crantz.
Listera ovata R.Br.
Neottia nidus-avis (L.) Rich.
Orchis incarnata L.
O. maculata L.
O. majalis Reichb.
O. militaris L.
O. morio L.
O. palustris Jacq.
O. sambucina L.
O. ustulata L.
Platanthera bifolia (L.) Rich.
P. chlorantha (Cust.) Reichb.
Traunsteinera globosa (L.) Reichb.

Orobanchaceae

Orobanche alba Steph.
O. reticulata Wallr.
O. flava Mart.

Oxalidaceae

Oxalis acetosella L.
O. europaea Jord.

Papaveraceae

Chelidonium majus L.
Corydalis bulboza (L.) DC.
C. intermedia (L.) Merat
C. solida (L.) Swartz.
Fumaria officinalis L.
F. schleicheri Soy-Willem.
Papaver rhoeas L.
P. somniferum L.

Pinaceae

Abies alba Mill.
Larix polonica Racib.
Picea abies (L.) Karst.
P. montana Schur
Pinus cembra L.
P. mugo Turra

Plantaginaceae

Plantago alpina L.
P. altissima L.
P. aristata Michx
P. atrara Hoppe
P. indica L.
P. intermedia Gilib.
P. lanceolata L.
P. major L.
P. media L.
P. stepposa Rupr.

Poaceae

Agropyron pectinatum (Bieb.) Beauv.
Agrostis alpina Scop.
A. canina L.
A. gigantea Roth.
A. rupestris All.
A. stolonifera L.
A. tenuis Sibth.
Alopecurusaequalis Sobol.
A. geniculatus L.
A. pratensis L.
Anisantha sterilis (L.) Nevski.
A. tectorum (L.) Nevski.
Anthoxanthum odoratum L.
Apera spica-venti (L.) Beauv.
Arrhenatherum elatius (L.) J. et C.Presl.
Bellardiahloa violacea (Bell.) Chiov.
Beckmannia eruciformis Host
Botryochloa ischaemum (L.) Keng.
Brachypodium pinnatum (L.) Beauv.
B. sylvaticum (Huds.) Beauv.
Briza media L.
Bromus arvensis L.
B. commutatus Schrad.
B. japonicus Thunb.
B. mollis L.
B. secalinus L.
Calamagrostis arundinacea (L.) Roth
C. canescens (Web.) Roth
C. epigeios (L.) Roth
C. pseudophragmites (Hall.) Koel.
C. villosa (Chaix) J.F.Gmell.
Cynodon dactylon (L.) Pers.
Cynosurus cristatus L.
Dactylis glomerata L.
D. polygama Horvát
Danthonia alpina Vest.
Deschampsia flavescenss (L.) Beauv.
D. caespitosa (L.) Beauv.
Digitaria ischaemum (Schreb.) Muehl.
D. pectiniformis (Herard) Tzvel.
D. sanguinalis (L.) Scop.
Echinochloa crus-galli (L.) Beauv.
Elytrigia intermedia (Host) Nevski
E. repens (L.) Desv. ex Nevski
Eragrostis minor Host
E. pilosa (L.) Beauv.
Festuca altissima All.
F. amethystina L.
F. arundinacea Schreb.
F. carpatica Dietr.
F. drymeja Mert. et Koch
F. duriuscula L.
F. fallax Thuill.
F. gigantea (L.) Vill.
F. heterophylla Lam.
F. orientalis (Hack.) V. Krecz. et Borb.
F. ovina L.
F. picta Kit.
F. porcii Hack.
F. pratensis Huds.
F. rubra L.
F. saxatilis Schur
F. supina Schur
F. tenuifolia Sibth.
F. varia Haenke
Glyceria fluitans (L.) R. Br.
G. maxima (C. Hartm.) Holub
G. nemoralis Uechtr. et Koern.
G. plicata Fries
Helictotrichon alpinum (Schmith) Henrard.
H. planiculme (Schrad.) Pilg.
H. pubescens (Huds.) Pilg.
H. versicolor (Vill.) Pilg.
Holcus lanatus L.
H. mollis L.
Hordelymus europaeus (L.) Harz.
Hordeum leporinum Link
H. murinum L.
Koeleria pyramidata (Lam.) Beauv.
Leersia oryzoides (L.) Swartz.
Lerchenfeldia flexuosa (L.) Schur
Lolium perenne L.
Melica nutans L.
M. picta C.Koch
M. transsilvanica Schur
M. uniflora Retz.
Milium effusum L.
Molinia coerulea (L.) Moench
Nardus stricta L.
Oreochloa disticha (Wulf.) Link
Panicum implicatum Scribn.

Phleum alpinum L.
Ph. hirsutum Honck.
Ph. phleoides (L.) Karst.
Ph. pratense L.
Ph. montanum C.Koch
Phragmites communis Trin.
Poa alpina L.
P. angustifolia L.
P. annua L.
P. balfourii Parn.
P. bulbosa L.
P. chaixii Vill.
P. granitica Br.-Bl.
P. media Schur
P. nemoralis L.
P. palustris L.
P. pratensis L.
P. remnannii Aschers. et Graebn.
P. remota Forsell.
P. trivialis L.
P. turfosa Litw.
Puccinellia distans (L.) Parl.
Roegneria canina (L.) Nevski
Sclerochloa dura (L.) Beauv.
Scolochloa festucacea (Willd.) Link.
Sesleria coerulans Friv,
S. heufleriana Schur
Setaria glauca (L.) Beauv.
S. verticillata (L.) Beauv.
S. viridis (L.) Beauv.
Sieglingia decumbens (L.) Bernh.
Stipa pulcherrima C.Koch
Trisetum alpestre (Host) Beauv.
T. ciliare (Kit.) Domin
T. flavescens (L.) Beauv.
Ventenata dubia (Leers) Schultz.
Vulpia myuros (L.) C.C.Gmell.
Zerna aspera (Murr.) Panz.
Z. erecta (Huds.) S.F.Gray
Z. intermis (Leyss.) Lindm.
Z. ramosa (Huds.) Lindm.

Polygalaceae

Polygala comosa Schkuhr.
P. subamata Fritsch
P. vulgaris L.

Polygonaceae

Oxyria digyna (L.) Hill.
Polygonum aviculare L.
P. bistorta L.
P. convolvulus L.
P. dumetorum L.
P. hydropiper L.
P. incanum (F.W.)Schmidt.
P. minus Huds.
P. mite Schrank
P. nodosum Pers.
P. persicaria L.
P. vivparum L.
Rumex acetosa L.
R. acetosella L.
R. alpinus L.
R. carpaticus Zapal.
R. conglomeratus Murr.
R. crispus L.
R. maritimus L.
R. sanquineus L.
R. scutatus L.
R. stenophyllus Ledeb.
R. sylvestris (Lam.) Wallr.
R. thyrsiflorus Fingehr.

Polypodiaceae

Polypodium vulgare L.

Potamogetonaceae

Potamogeton acutifolius Link.
P. berchtoldii Fieb.
P. compressus L.
P. crispus L.
P. gramines L.
P. lucens L.
P. natans L.
P. obtusifolius Mert et Koch
P. pectinatus L.
P. perfoliatus L.
P. praelongus Wulf.
P. pusillus L.
Zannichellia palustris L.

Primulaceae

Anagallis arvensis L.
Hottonia palustris L.
Lysimachia nemorum L.
L. nummularia L.
L. punctata L.
L. vulgaris L.
Primula elatior (L.) Hill

P. farinosa L.
P. halleri J.F.Gmell.
P. minima L.
P. poloniensis (Domin) Fed.
P. vulgaris Huds.
Soldanella hungarica Simonk.
S. montana Willd.
Trientalis europaea L.

Pyrolaceae

Moneses uniflora (L.) Gray
Orthilia secunda (L.) House
Pyrola carpatica Holub et Krisa
P. minor L.
P. rotundifolia L.

Ranunculaceae

Aconitum bucoviense Zapal.
A. firmum Reichb.
A. hosteanum Schur
A. jacquinii Reichb.
A. moldavicum Hacq.
A. nanum Baumg.
A. paniculatum Lam.
A. paniculatum Reichb.
Actaea spicata L.
Anemone narcissiflora L.
A. nemorosa L.
A. ranunculoides L.
A. sylvestris L.
Aquilegia nigricans Baumg.
A. vulgaris L.
Atragene alpina L.
Batrachium aquatile (L.) Dum.
B. foeniculareum (Gilib.) V. Krecz.
B. gilibertii V.Krecz.
Caltha cornuta Schott, Nym. et Kotschy
C. laeta Schott, Nym. et Kotschy
C. palustris L.
Cinicifugs europaea N. Schipcz.
Clematis integrifolia L.
C. recta L.
C. vitalba L.
Consolida orientalis (J. Gay) Schroed.
C. paniculata (Host) Schur
C. regalis S.F. Gray
Ficaria verna Huds.
Helleborus purpurascens Waldst. et Kit.
Hepatica nobilis Mill.
Isopyrum thalictroides L.
Myosurus minimus L.
Nigella arvensis L.
Ranunculus acris L.
R. arvensis L.
R. auricomus L.
R. breyninus Crantz
R. bulbosus L.
R. carparicus Herb.
R. cassubicus L.
R. flammula L.
R. hornschuchii Hoppe
R. illyricus L.
R. kladnii Schur
R. lanuginosus L.
R. lateriflorus DC.
R. lingua L.
R. montanus Willd.
R. platanifolius L.
R. polyanthemos L.
R. polyphyllus Kit.
R. pseudobulbosus Schur
R. repens L.
R. sardous Crantz
R. sceleratus L.
R. stevenii Andrz.
R. tatrae Borb.
Thalictrum aquilegifolium L.
T. flavum L.
T. lucidum L.
T. minus L.
T. simplex L.
Trollius europaeus L.

Resedaceae

Reseda lutea L.
R. luteola L.

Rhamnaceae

Frangula alnus Mill.
Rhamnus catharica L.

Rosaceae

Agrimonia eupatoria L.
Alchemilla acutiloba Opiz
A. alpestris F.W. Schmidt
A. czwczynensis Pawl.
A. flabellata Bus.
A. gracilis Opiz
A. incisa Bus.
A. monticola Opiz
A. obtusa Bus.

A. subcrenata Bus.
A. szaferi Pawl.
A. turkulensis Pawl.
A. zapalowiczii Pawl.
A. xanthochloa Rothm.
Aremonia agrimonoides (L.) DC.
Aruncus vulgaris Raf.
Cerasus avium (L.) Moench
Comarum palustre L.
Cotoneaster integerrimus Medik
C. melanocarpus Lodd.
Crataegus calycina Peterm.
C. curvisepala Lindm.
C. laevigata (Poir.) DC.
C. lipskyi Klok.
C. pseudokyrtostyla Klok.
Dryas octopetala L.
Filipendula vulgaris Moench
F. ulmaria (Z.) Mixim.
Fragaria moschata Duch.
F. vesca L.
F. viridis Duch.
Geum allepicum Jacq.
G. rivale L.
G. urbanum L.
Malus sylvestris Mill.
Padus avium Mill.
Parageum montanum (L.) Hara
Pentaphylloides fruticosa (L.) Duham.
Potentilla anserina L.
P. argentea L.
P. aurea L.
P. canescens Bess.
P. crantzii (Crantz) Beck.
P. erecta (L.) Hampe
P. impolita Wahlenb.
P. leucotricha Borb.
P. norvegica L.
P. obscura Willd.
P. reptans L.
Poterium polygamum Waldst. et Kit.
P. sanguisorba L.
Prunus spinosa L.
Pyrus communis l.
Rosa agrestis Savi
R. canina L.
R. corymbifera Borkh.
R. crenatula Chrshan.
R. czackiana Bess.
R. dumalis Bechst.
R. eglanteria L.
R. elliptica Tausch
R. jundzillii Bess.
R. lazarenkoi Chrshan.
R. micrantha Smith
R. minimalis Chrshan.
R. mucatscheviensis Chrshan.
R. pendulina L.
R. schmalhauseniana Chrshan.
R. slobodjanii (Chrshan.) Dubovik
R. subafzeliana Chrshan.
R. tomentosa Smith
R. transsilvanica Schur
R. uncinella Bess.
Rubus caesius L.
R. candicans Weihe
R. discolor Weihe et Nees
R. hirtus Waldst. et Kit.
R. idaeus L.
R. nessensis W. Hall.
R. plicatus Weihe et Nees
R. saxatilis L.
R. serpens Weihe
R. sulcatus Vest ex Tratt.
R. villicaulis Koehler ex Weihe et Nees
Sanguisorba officinalis L.
Sorbaria sorbifolia (L.) A.Br. ????
Sorbus aria (L.) Crantz
S. aucuparia L.
S. torminalis (L.) Krantz
Spiraea crenata L.
S. ulmifolia Scop.

Rubiaceae

Asperula campanulata (Vill.) Klok.
A. cincinnata Klok.
A. cynanchica L.
A. odorata L.
A. rivalis Sibth. Et Smith
Galium aparine L.
G. bellatulum Klok.
G. boreale L.
G. carpaticum Klok.
G. cruciata (L.) Scop.
G. glabratum Klok.
G. hercynicum Weig.
G. intermedium Schult.
G. kerneranum Klok.
G. maximum G. Moris
G. mollugo L. s. str.
G. palustre L.
G. pseudoaristatum Schur
G. pseudomollugo Klok.
G. pumilum Murr.
G. rubioides L.

G. suberectum Klok.
G. tricornutum Dandy
G. uliginosum L.
G. vaillantii DC.
G. vernum Scop.
G. verum L.

Salicaceae

Populus alba L.
P. canescens Smith
P. nigra L.
P. tremula L.
Salix alba L.
S. alpina Scop.
S. aurita L.
S. caprea L.
S. cinerea L.
S. daphnoides Will.
S. eleagnos Scop.
S. fragilis L.
S. hastata L.
S. herbacea L.
S. kitaibeliana Willd.
S. lapponum L.
S. pentandra L.
S. phylicifolia L.
S. purpurea L.
S. reticulata L.
S. retusa L.
S. silesiaca Willd.
S. triandra L.
S. viminalis L.

Salviniaceae

Salvinia natans (L.) All.

Santalaceae

Thesium alpinum L.
Th. linophyllon L.

Saxifragaceae

Chrysosplenium alpinum Schur
Ch. alternifolium L.
Grossularia reclinata (L.) Mill.
Parnassia palustris L.
Ribes alpinum L.
R. carpaticum Schult.
Saxifraga adscendens L.
S. aizoides L.
S. androsacea L.
S. bryoides L.
S. bulbifera L.
S. carpatica Reichb.
S. cymosa Waldst. et Kit.
S. luteoviridis Schott et Kotschy
S. oppositifolia L.
S. paniculata Mill.
S. stellaris L.

Scrophulariaceae

Antirrhinum oronthium L.
Bartsia alpina L.
Chaenorrhinum minus (L.) Lange
Digitalis grandiflora Mill.
Euphrasia brevipila Burn. et Gremli
E. coerulea Hoppe ex Fuernhohr
E. kerneri Wettst.
E. montana Jord.
E. parviflora Schagerstrom
E. picta Wimm.
E. rostkoviana Hayne.
E. salisburgensis Funk.
E. stricta D. Wolff ex J.E. Lehm
E. tatrae Wettst.
E. tenuis (Brenn.) Wettst.
Gratiola officinalis L.
Kickxia elatine (L.) Dum.
Lathraea squamaria L.
Linaria genistifolia (L.) Mill.
L. vulgaris Mill.
Lindernia procumbens (Krock.) Borb.
Melampyrum arvense L.
M. harbichii Woloszcz.
M. laciniatum Koschew. et Zing.
M. nemorosum L.
M. pratense L.
M. saxosum Baung.
M. vulgatum Pers.
Pedicularis hacquettii Graff.
P. oederi Vahl.
P. palustris L.
P. sylvatica L.
P. verticilata L.
Rhinanthus aestivalis (Zing.) Schischk. et Serg.
Rh. aestivalis (Zing.) Schischk. et Serg.
Rh. alectorolophus (Scop.) Pol.
Rh. alpinus Baumg.
Rh. angustifolius Gmel.
Rh. minor L.
Rh. nigricans Meinsh.

Rh. serotinus (Schoenh.) Oborny
Rh. vernalis (Zing.) Schischk et Serg.
Scrophularia nodosa L.
S. scopolii Hoppe ex Pers.
Tozzia carpathica Woloszcz.
Verbascum blattaria L.
V. densiflorum Bertol.
V. lanatum Schrad.
V. lychnitis L.
V. nigrum L.
V. phlomoidesL.
Veronica alpina L.
V. anagallis-aquatica L.
V. aphylla L.
V. austriaca L.
V. bachofenii Heuff.
V. baumgartenii Roem. et Schult
V. beccabunga L.
V. bellidoides L.
V. chamaedrys L.
V. dentata F.W.Schmidt.
V. fruticans Jacq.
V. fruticulosa L.
V. gentianoides Vahl.
V. montana L.
V. officinalis L.
V. paniculata L.
V. persica Poir.
V. scutellata L.
V. serpyllifolia L.
V. spicata L.
V. teucrium L.
V. urticifolia Jacq.
V. verna L.

Selaginellaceae

Selaginella selaginoides (L.) link.
S. helvetica Link.

Solanaceae

Atropa belladonna L.
Datura stramonium L.
Hyoscyamus niger L.
Physalis alkekengi L.
Scopolia carniolica Jacq.
Solanum dulcamara L.
S. nigrum L.

Sparganiaceae

Sparganium erectum L.
S. minimum Wallr.
S. simplex Huds.

Staphyleaceae

Staphylea pinnata L.

Tamaricaceae

Myricaria germanica (L.) Desv.

Taxaceae

Taxus baccata L.

Thelypteridaceae

Oreopteris limbosperma (All.) Holub

Thymelaeaceae

Daphne mezereum L.

Tiliaceae

Tilia argentea Desf. ex DC.
T. cordata Mill.
T. platyphyllos Scop.

Typhaceae

Typha angustifolia L.
T. latifolia L.
T. shuttlewortii Koch et Sond.

Ulmaceae

Ulmus elliptica C.Koch
U. glabra Huds.
U. laevis Pall.
U. minor Mill.
U. suberosa Moench

Urticaceae

Parietaria erecta Mert. et Koch
Urtica dioica L.
U. kioviensis Rogov.
U. urens L.

Vacciniaceae

Oxycoccus microcarpus Turcz. ex Rupr.
O. palustris Pers.
Rhodococcum vitis-idaea (L.) Avror.
Vaccinium uliginosum L.
V. vitis-idaea L.

Valerianaceae

Valeriana angustifolia Tausch.
V. dentata (L.) Poll.
V. dioica L.
V. exalta Mikan
V. nitida Kreyer
V. sambucifolia Mikan
V. simplicifolia (Reichb.) Kabath.
V. stolonifera Czern.
V. tripteris L.

Verbenaceae
Verbena officinalis L.

Violaceae

Viola alba Bess.
V. ambigua Waldst. et Kit.
V. arenaria DC.
V. arvensis Murr.
V. biflora L.
V. canina (L.) Reichb.
V. dacica Borb.
V. declinata Waldscht. et Kit.
V. hirta L.
V. matutina Klok.
V. mirabilis L.
V. montana L.
V. odorata L.
V. palustris L.
V. pumila Chaix
V. reichenbachiana Jord. ex Boreau
V. riviniana Reichb.
V. saxatilis F.W. Schmidt
V. stagnina Kit.
V. suavis Bieb.
V. uliginosa Bess.

Vitaceae

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Annotated list of plant communities
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Noteworthy fauna

Annotated list of animals

Fish: - Salmo trutta m. fario L., Gobio uranoscopus carpatorossicus Vladykov, Cottus poecilopus Heckel.; amphibians: - Triturus montandoni Boul, T. alpestris Laur., Bufo bufo L.; reptiles: - Lacerta vivipara Jacquin; nesting birds - Cinclus cinclus L. and Motacilla cinerea Tunst.; mammals: - Sorex alpinus Schinz. At the same time, down the river, behind Rahiv, such species are more typical as Thymalus thymalus L., Gobio albipinnatus Fang., Cobitis aurata montana Vladykov, Cottus gobio gobio Heck. The density of the above mentioned species decreased drastically, however, and Triturus vulgaris L., T. cristatus Laur., Bufo viridis Laur. appear. Lacerta vivipara Jacquin is replaced by Lacerta agilis. Cinclus cinclus L. does not nest along the central section of the stream any longer. Great numbers of the birds winter there, the density of Motacilla cinerea Tunst. declines conspicuously, while the number of Motacilla alba L. increases.

It should be noted that in the past there were artificial water basins in the very head of River Tisa, which were used for organizing timber rafting. These basins played an important role as spawning places for amphibians, including Red Data Book species, as well as sites for a series of hydrophilic birds - Podiceps spp., Ardea cinerea L., Charadrius spp., etc. Such basins should be reconstructed, since there are no natural lakes in the area of the Tisa headwaters.

In the forests which are near the polonynas (alpine meadows) there are species interesting for the European fauna such as Elaphe longissima Laur., Aegolius funereus L., Glaucidium passerinum L., Ursus arctos L., Lynx lynx L., Cervus elaphus montanus Bot. which have survived here.

Finally, the River Tisa valley is an important route for the seasonal migrations of birds, the Jablonets mountain pass with River Chorna Tisa being the most marked migration line.

The mammal fauna of the Upper Tisa is rather rich and diverse. Insectivorous mammals are represented by 9 species; very notable among them are Sorex alpinus Schinz and Neomys anomalus Cabera, which have entered the Red Data Book of Ukraine. Erinaceus europaeus occurs only sporadically in the studied area.

The bat fauna, though it is a numerous group of mammals in the region, is not diverse in the River Tisa plain. Practically, only Myotis daubentoni Kuhl., Plecotus austriacus Fischer, Nyctalus noctula Schreb. and Pipistrellus pipistrellus Schreb. were found there. Other species very rarely fly to the river plain for hunting. All bats are very useful animals, they and their habitats should be protected.

Predators are represented by 13 species: Martes martes L. and M. foina Erxleb., Mustela putorius L., M. lutreola L., M. nivalis L., M. erminea L., Meles meles L., Lutra lutra L., Ursus arctos L., Canis lupus L., Vulpes vulpes L., Felis sylvestris Schreb., and Lynx lynx L. Among these the mink, the stoat, the badger, the otter, the European wild cat and the lynx have entered the Red Data Book of Ukraine. Small predators and Lutra lutra L. live in the river plain more or less permanently. For the others the river plain is only hunting place. Some species, like the wolf, rarely the bear and the lynx, may sometimes cause a conspicuous detriment to the hoofed livestock and domestic animals while the otter can reduce the amount of fish. The other species are mainly useful, since they consume a considerable amount of mice. Practically, all these species are valuable game, but, due to their small numbers, hunting for some of them is forbidden, for the others it is restricted.

Artiodactyles. There are 3 species - Sus scrofa L., Capreolus capreolus L., and Cervus elaphus L.. In the river plain they do not stay for long, they come here only for watering and resting. All the three species are game, their shooting is restricted. They are valued for their meat and hunting trophies.

Leporids are represented by Lepus europaeus Pall. It comes to the river plain to have a rest and take up fat.

The most numerous and representative group of mammals in the River Tisa plain are the rodents. There are about 15 rodent species, namely: Sciurus vulgaris L., Glis glis L. and Muscardinus avellanarius L., Rattus norvegicus Bark., Mus musculus L., Apodemus agrarius Pall., A. sylvaticus L., A. flavicollis Melch., Clethrionomys glareolus Schreb., Arvicola sherman Shaw., Microtus arvalis Pall., M. subterraneus De Selys Longchamps. Glis glis, Microtus arvalis, Clethrionomys glareolus, and M. subterraneus occur only in places where the forest is close to the riverbed. Rattus norvegicus and Mus musculus, however, can be seen near human settlements. The occurance of the muskrat is not impossible in this area. Mice settle in the river plain reluctantly, since the frequent floods cause great damage to their populations.

Romanian section

Date: August 30 , 1996

Country: Romania

Name of the Wetland: Upper Tisa

Geographical coordinates:
-at the upper (entrance) end: Valea Vişeului situated on the Romanian - Ukrainian border:
47^0 55' N, 24^0 10' E
-at its exit: downstream Piatra, on the Romanian - Ukrainian border:
48^0 15' N, 23^0 33' E

Altitude: The altitude of the Upper section of River Tisa at its entrance to Romania upstream Valea Vişeului is 337 m, and at the point of leaving the country downstream Piatra it is 190 m above Black Sea level.

Area:: 3710 ha

Commune	Protected areas	Areas with minimal activities	Buffer areas	Regene-rated areas	Total
1. Remeţi	184	96	530	-	810
2. Săpânţa	123	73	485	-	681
3. Câmpulung la Tisa	51	42	515	8	616
4. Sarasău	68	35	227	-	330
5. Sighetu Marmaţiei	74	51	130	-	225
6. Bocicoiu Mare	107	140	460	-	707
7. Rona de Sus	23	-	120	-	143
8. Bistra	36	15	117	-	168
Total	**666**	**452**	**2584**	**8**	**3710**

Overview: the studied area belongs to the Maramuresh Depression crossed by the rivers Săpânţa, Iza, Vişeu (all being River Tisa's affluents), and by the Upper Tisa.
The land is made up of low terraces, alluvial meadows, terraces with clogged backwaters, or water, swamps, ponds, and is partly covered by forest vegetation or agricultural crops.
River Tisa represents the type of Carpathian mountain river form which is characterized in this area by an upper stream nature, steep banks with high-velocity courses, quite large water volume due to the frequent rainfalls in the

area, categorized as oligothrophic water with an important transport of solid material.
This river belongs to the category of less polluted rivers. As to the mineral and oxygen contents, River Tisa belongs to the first rank water quality (class I), consequently its water can be used for salmoniculture and for drinking water supplies, if properly treated.

Wetland Type: M,N,O,P,W,X,Z

Ramsar Criteria: 1.c, 2.b, 2c

Map of site included: yes

Name and adress of the compiler of this form:
Filip Moisei, Ecological Society of Maramures, non governmental organization, Baia Mare, Romania
with Marta Beres, Iosif Beres, Florin Borz, Ioan Pop, Martin Pop

Justification of the criteria selected under *Ramsar Criteria:* The protected areas under study fulfil the international criteria established by the Ramsar Convention and the indications from the Montreux Conference, July 1990, in the followings:
-The Romanian Upper Tisa region, measuring an area of 666 hectares, plays an important hydrological, biological and ecological role in a system of wetlands with adjoining similar areas in Ukraine, Hungary and Slovakia.
1.C criterium.
-By enlisting this wetland, the following objectives will be achieved:
-The protection of the unique ichthyofauna, especially of the Huchen (*Hucho hucho*), through an international cooperation meant to stop pollution, to rationalize and control fishing. Should there be dams built, the characteristics of the biocenosis must remain unchanged, pond draining and deforestation must be discontinued.
-The avifauna and especially bird migrations are very characteristic and are of international importance, mainly because of the repeated predsence of rare species such as the Osprey (*Pandion haliaetos*), the Arctic Loon (*Gavia arctica*), the Red-crested Pochard (*Netta rufia*), the Shoveler (*Anas clypeata*), the Common Scoter (*Melaintta nigra*), etc. At migration time thousands of birds traveling from Eastern Europe and the northeast towards Western Europe and the southwest. Species such as the Bean Goose (*Anser fabalis*), the Greylag Goose (*Anser anser*), the Mallard (*Anas platyrhynchos*) and the Green-winged Teal (*Anas crecca*) pass over and rest here in masses of thousands.
Hundreds of thousands of Rooks (*Corvus frugilegus*) pass over these wetlands in October during the migration period when the populations from the eastern part of the continent fly over the valley of River Tisa towards the west.
Around the end of August and early September White storks (*Ciconia ciconia*) migrate in large flocks numbering hundreds of individuals from the west towards the east. They cross over the valley of River Tisa and fly up to the confluence

with River Iza where the valley turns to the northeast and the storks to the southeast.
The waters of the Upper Tisa system never get frozen completely during wintertime, a fact that allows many waterfowls to winter in the area, out of which the most predominant is the Mallard (*Anas platyrhynchos*), with its numbers often exceeding several thousands. The Green-winged Teal (*Anas crecca*) is also important, but other species such as Mute swans (*Cygnus olor*), Goosanders (*Mergus merganser*) or Goldeneyes (*Bucephala clangula*) and Tufted Ducks (*Aythya fuligula*), etc. also appear here.
Regions adjacent to the suggested "Upper Tisa" protected area play a significant role in assuring necessary food supply during the migration of these bird populations.

General location: The Upper Tisa collects its water from the south-western parts of the Carpathians from Tatra Mountain up to Rodna Mountain, in a geographic area situated on the territories of Romania, Slovakia, Ukraine and Hungary. The Romanian area of the Upper Tisa is situated in north-northwestern Romania, entirely within Maramuresh County. The Upper Tisa borders Romania and Ukraine along a length of 62 km, directed from east to west, with the width of its upper flood plain varying between 50-150 m and the lower flood plain between 150-700 m. Settlements situated along the Upper Tisa on Romanian territory, from its entrance to the country to its exit, are as follows:

Name of settlement	Distance from River Tisa (m)
1. Valea Vişeului - village, (Bistra commune)	50
2. Lunca la Tisa - village, (Bocicoiu Mare commune)	50
3. Bocicoiu Mare - commune residence	50
4. Crăciuneşti - village, (Bocicoiu Mare commune)	300
5. Tisa - village, (Bocicoiu Mare commune)	800
6. Sighetu Marmației - municipality	50
7. Sarasău - commune	300
8. Câmpulung la Tisa - commune	500
9. Săpânța - commune	900
10.Remeți - commune residence	100
11.Teceu Mic - village, (Remeți commune)	50
12.Piatra - village, (Remeți commune)	700

All the places mentioned above are situated at the border of the proposed wetland and have direct influence upon it through human activities taking place there.
By their nature, the protected areas are mostly lands on which human activities cannot be carried out, except for occasional usage; oxbow lakes, areas of ponds covered by forest vegetation on gravel grounds, banks, alluvial gravel grounds, etc.

Physical features: within the boundaries of the hydrographic basin of the Upper Tisa, there is a varied relief belonging to major geomorphological units appertaining to:

- mountain zones
- hills, plateaus and piedmonts
- depressions with meadows and terraces.

In the north-west of the Maramuresh Mountains, one of its branches (Muncelul: 1318 m) looks over the confluence or River Vişeu and River Tisa, dating back to the upper cretaceous (grit stones, limestones, diorite sands, pudding stones).

The straits River Tisa crosses between Valea Vişeului and Lunca la Tisa, are marked on the Romanian side by Măgura Obcina (the Obcina Hill) and Măgura Voloseanca (the Voloseanca Hill), that constitute the cretaceous-oligocene piedmont. Leaving the mountain zone and coming out from the straits, River Tisa enters the Maramuresh Depression in whose structure we will find, besides other depressions, the Sighet Depression extending from Lunca la Tisa to Săpânța, and the Săpânța-Teceu Depression, the lowest part of which is the bank of River Tisa. Along this depressional route we can find varied relief forms grouped in high hills, depressions, valley passages, small basins and piemonts having a complex origin: tectonic, sedimentary and differential erosive.

The Upper Tisa collects all its tributary streams from the western part of the Maramuresh Mountains, from the north of the Rodna Mountains, and also from the numerous northern and eastern streams arriving from the volcanic mountains Oas, Ignis, Gutâi and Țibles.

The important tributary streams of the Upper Tisa are:

- River Vişeu. The area of its hydrographic basin is 1580 km^2, its length is 79 km. Its altitude is 2303 m (upstream at Pietrosul Rodnei Peak), and 330 m (at the confluence with River Tisa). The density of the Vişeu drainage basin has values of 0.7-1 km/km^2, due to the high amount of precipitation measuring over 1,000 mm a year. River Vişeu and its affluents cross montane regions with very steep slope falls (20-50 m/km).

Characteristic flow measurements at the Bistra hydrometric station are as follows:

- the highest flow with 1% probability is 1120 m^3/s;
- the multiannual medium flow is 32.l4 m^3/s
- the minimum flow with 95% probability is 5.5 m^3/s.

There are no hydroelectric power plants in the Vişeu system.

- River Iza. The area of its hydrographic basin is of 1303 km^2, the length of the river is 83 km. Its altitude is 1839 m (upstream at Țibles Peak), and 268 m (downstream at the confluence with River Tisa, westward from Sighetu Marmației). River Iza crosses regions made up of eocene and oligocene deposits, and passes through deposits of the tortonian age, consisting of salt mountains.

Characteristic flow measurements at the Vad hydrometric station are as follows:

- the highest flow with 1% probability is 790 m^3/s;
- the multiannual medium flow is 16.8 m^3/s
- the minimum flow with 95% probability is 0.62 m^3/s.

- River Săpânța. The area of its hydrographic basin is of 135 km^2, the length of the river is 20 km. Its altitude is 1240 m (upstream at Rotundu Peak), and 228 m

(downstream at the confluence with River Tisa). In the montane region the sloping reaches 80-90 m per km.
River Săpânța has an impressive multiannual flow of 3.41 m^3/s, owing to a climate with high humidity and annual precipitation exceeding 1300 mm. These conditions have favoured marsh formation on the upper reaches. Here there are over 20 of eutrophic and oligotrophic mountain marshes ("tinoave") where the prevailing vegetation is peat moss (*Sphagnum*). The so-called "tinoave" are true live museums preserving numerous glacial relict species and they represent an ecological and fitohistorical importance.
In their natural conditions, most of the rivers that flow into the Upper Tisa have very favourable hydrochemical parameters. These stream waters are generally pollution-free with some exceptions on the lower parts of the rivers Mara, Cosău, Rona and Iza, which recieve salty water originating from the Ocna Şugatag and Costiui salt pits. The water quality of the rivers is also affected by the mining enterprises situated on the upper part of the Vişeu hydrographic basin, and by wastewaters dumped directly into them.
The water quality of River Tisa has been studied by means of laboratory analyses performed by specialized Romanian organizations which possess a data base of over 30 years. Also, international research and measurement programmes were also carried out for the study of the water quality of River Tisa at low flows, in which specialists from Romania, Ukraine and Hungary took part. The results obtained can be found in Appendix 1 where one can see the evolution of oxygen-content and dissolved CCO-Mn, CBO_5 values obtained on the analysed rivers belonging to the Upper Tisa basin.
In these control areas a good correlation among the values obtained for O_2,, COD-Mn, BOD_5 can be observed, owing to the load of organic substances from dumped domestic wastewaters.
River Tisa presents very high values along the entire analysed section.
The evaluation of the values of inorganic nitrogen (NH_4^+, NO_2 and NO_3) on River Tisa shows that the high values of the NH_4 and NO_3 ions are evident in the Teceu section (area), owing to the evacuated wastewaters of the Sighetu Marmației filter station and to the fact that they belong to the main inorganic constituents of domestic pollution.
As for the level of toxicity, River Tisa is degraded. Metal ions that lead to this phenomenon come from the River Vişeu (Baia Borsa and Repedea) and from River Iza in which water from the S. C. Mecanica Sighetu Marmației Galvanizing Section is evacuated (Zn, Cu, Pb, Cd, As, Fe, Mn). The loading of River Tisa with such metals at low flows favours the emergence and development of algal colonies.
From data in Table and from materials mentioned in the bibliography it follows that River Tisa (which is a less polluted river) can be framed between the following categories of quality
- between the Vişeului Valley and Sighetu Marmației (30 km): degraded
- between Sighetu Marmației and Teceu (32 km): category 2

Water chemical investigation of the River Tisa and its some tributaries [1](September, 1992)

Sampling sites	rkm	O_2diss.	COD_{Mn}	BOD_5	Cond.	Total residual	NH_4	NO_2	NO_3	As	Zn	Cu	Pb	Cd	Fe total	Mn
		mg/l	mg/l	mg/l	uS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Someş at -Ulmeni	163	12,40	9,1	7,9	380	681	0,32	0,260	6,40	0,002	0,036	0,018	0,017	0,000	1,10	0,27
-Cicârlău	123	10,50	7,1	4,9	255	558	0,32	0,110	3,30	0,358	1,500	1,594	0,318	0,008	7,30	1,24
-Satu Mare	68	7,30	15,0	3,5	811	568	2,67	0,180	4,57	0,128	1,018	0,565	0,121	0,005	6,03	1,96
-Oar	55	7,10	7,4	4,0	730	545	3,75	0,730	7,29	0,008	0,881	0,407	0,106	0,006	5,32	1,87
-Csenger	48	9,12	8,2	7,4	506	380	0,54	0,153	7,17	0,013	0,253	0,056	0,014	0,001	1,60	0,96
-Tunyogmatolcs	3	13,19	9,5	8,3	500	370	0,58	0,114	6,35	0,014	0,258	0,006	0,018	0,002	2,34	0,87
Lăpuş at -Buşag		10,70	10,4	9,88	130	431	0,33	0,090	3,50	0,420	3,370	2,200	0,383	0,018	13,95	2,09
Săsar at -Baia Mare		11,60	13,9	10,8	500	388	1,10	0,160	5,80	0,403	2,775	1,660	0,915	0,019	14,83	3,68
Vişeu at -Bistra		11,10	5,9	5,1	200	235	0,10	0,003	2,90	0,024	1,080	0,184	0,203	0,007	4,18	0,27
Iza at -Sighetu M.		10,40	6,1	5,1	295	304	0,10	0,01	2,60	0,112	0,341	0,143	0,156	0,002	12,20	0,32
Tisa at -Rachiv, above	882	14,30	3,1	1,6	223	193	0,32	0,030	3,10	0,000	0,180	0,008	0,005	0,001	2,55	0,16
-Rachiv, below	868	13,08	5,1	3,5	214	190	0,32	0,020	3,00	0,000	0,125	0,004	0,003	0,000	0,83	0,10
-Bocicoiu	855	12,40	6,0	4,5	205	176	0,60	0,020	2,80	0,027	0,340	0,106	0,087	0,001	12,85	0,53
-Sighetu M.	844	10,50	5,7	5,0	303	275	0,20	0,030	2,40	0,075	0,988	0,297	0,066	0,005	12,20	0,50
-Teceu Mic	810	11,70	4,8	1,1	208	171	0,60	0,028	7,40	0,024	0,269	0,095	0,075	0,002	24,10	0,78
-Hust	785	11,96	3,4	1,7	231	199	0,70	0,040	5,60	0,000	1,840	0,010	0,007	0,002	2,18	0,58
-Vilok	751	11,10	3,7	1,5	209	178	0,80	0,025	6,20	0,000	0,144	0,027	0,020	0,000	3,25	0,14
-Tiszabecs	744	9,45	1,4	1,0	250	188	0,25	0,107	5,03	0,000	0,055	0,003	0,002	0,000	0,53	0,49
-Borzhava, above	725	10,40	0,9	0,7	268	180	0,12	0,049	3,43	0,000	0,051	0,003	0,000	0,000	0,38	0,06
-Jánd	693	10,95	3,8	1,4	205	148	0,46	0,063	5,85	0,000	0,579	0,012	0,010	0,004	1,79	1,24
-Vásárosnamény	684	10,90	4,6	1,6	211	148	0,58	0,059	5,88	0,002	0,204	0,013	0,009	0,000	1,85	0,58
-Aranyosapáti	670	9,69	6,2	2,7	371	286	0,59	0,114	4,27	0,010	0,275	0,062	0,017	0,001	2,69	0,51
-Záhony	628	9,69	7,8	5,2	417	298	0,79	0,153	5,23	0,009	0,283	0,047	0,004	0,002	3,49	0,57
-Tuzsér	620	9,75	7,4	4,1	412	286	1,01	0,163	7,06	0,008	0,210	0,039	0,016	0,001	2,82	0,45
-Dombrád	593	10,20	5,8	3,7	428	286	0,94	0,176	6,52	0,004	0,140	0,017	0,007	0,001	1,69	0,17
-Tiszabercel	569	9,99	5,0	4,0	434	308	0,33	0,187	6,89	0,003	0,124	0,018	0,006	0,001	1,45	0,13
-Balsa	553	9,03	3,2	2,7	434	332	0,32	0,164	5,74	0,004	0,127	0,014	0,006	0,002	0,78	0,11
-Tokaj, above	543	9,62	5,9	6,2	418	272	0,06	0,170	6,40	0,003	0,062	0,013	0,004	0,001	0,59	0,08
-Tokaj, below	542	7,90	5,0	3,4	388	254	0,12	0,140	6,40	0,004	0,050	0,012	0,006	0,000	0,63	0,10
-Tiszalök	525	7,50	5,5	4,0	372	272	0,28	0,150	6,90	0,002	0,082	0,012	0,004	0,001	0,059	0,11
-Tiszadob	508	7,10	4,5	3,5	3,27	248	0,20	0,140	5,40	0,002	0,060	0,009	0,003	0,001	0,40	0,09

1. By Laboratory of the Environmental Authority, Nyíregyháza, Hungary

The depth of River Tisa is 1.8 - 2.5 m on average, at the fords it is only 0.5-0.8 m, and at high floods it reaches 5-15 m. More important floods were recorded in 1888, 1925, 1933, 1949, 1953, 1960, 1970 (maximum) and in 1974.
The temperature of River Tisa varies between $+4^0$C and $+18^0$C, in accordance with the succession of seasons.
Freezing time extends over December, January and February with all the winter phenomena included: bank ice, ice bridges, floating ice, sometimes even with thaws.
Meadows in the River Tisa area are strewn with many ponds originating from dead arms of the river, some of them with permanent water and significant depths, others existing only in clogging time. Most of them stretch over 5-10 hectares.
Permanent ponds are at Drăghicioaia, Piatra, Teceu, Remeți, Săpânța, Câmpulung la Tisa, Sarasău (Ciarda) and Tisa-Teplița (an artificial recreation area on the geothermic River Teplița);
Abandoned arms (dead backwater branches) with occasional water are at Teceu Mic, Remeți, Săpânța, Câmpulung la Tisa, Sarasău and Crăciuneşti.

Main soil types
The pedographic soil substratum is made up of sedimentary rocks. Soils are extremely varied; as a result of the effect of vegetation, different degrees of podzol and genetic soil types occur.
Gleic soils are to be found in the meadows of the River Tisa area, on small terraces. They are represented by clay and various clay types that are weakly drained, leading to the formation of marshes.
Marsh soils established where there was excess water originating either from the phreatic water level or from depressed or plain surface. Gleic soils are used as arable lands or hayfields depending on their degree of drainage, especially in rainy years.
-Alluvial soils and alluvial deposits are found in the easily flooded meadows of River Tisa. Alluvial deposits are very poorly developed coarse deposits with little nutritive contents. Alluvial soils with structured substratum and high nutritive contents have good biological, chemical and physical qualities: among fertile soils fine sands are dominant, while argillaceous soils and clays are represented in a smaller proportion. On these soils potato, barley, wheat, etc. are grown.
The climate is of a moderate temperate continental type. The climate of this section of River Tisa is similar to that characteristic of the Maramuresh Depression (the north area), having a protected topoclimate, but comparatively cold and wet:
-medium annual temperatures of $+8.5^0$C
-in January -5^0C and -3^0C
-in July $+16^0$C and $+18^0$C
-medium rainfalls 800-1000 mm
- 75-120 snowy days.

Hydrological values: From a biophysical point of view, the importance of River Tisa lies in its considerably high water output, the average flow being 85% = 6.5-7 m^3/sec. During the spring high floods evoked by snow melting and rains, the output can reach 2500-3000 m^3/sec.

One major importance of this river is its hydropower potential; hydroelectric power stations with an output of about 12-18 MW/h could be built here.

The biophysical conditions of River Tisa offer the possibility to preserve the **huchen** and **salmonids**, and to use the water for domestic purposes.

The subsoil waters in the River Tisa Meadow are captured, in order to supply Sighetu Marmației with industrial and drinking water.

Ecological features: On the wetlands of the Upper Tisa (meadows) being subject to natural influences as well as subsequent anthropogenic activities, the following habitats can be differentiated:

-riverside meadows where the local vegetation still survives with venerable trees, and where human influence is minimal;

-at some places these riverside meadows of gallery type are interrupted by patches invaded by adventitious plants (Appendix, Charts 7 and 8), creating thick thickets that are hardly crossable;

- some rather important areas are covered by shrubs which, based on their origins, can be classified into two sub-units:

a) shrubs of the original riverside meadows from where tall trees have been cleared out

b) shrubs also consisting of local species, invading the gravel grounds;

-hygrophilic pastures, which are periodically covered with water; these areas are used as pastures and grazing fields, and important areas are turned into farming lands used for growing different crops: corn, barley, potato, cabbage, vegetables and other plants whose products are consumed locally. These farmlands along the River Tisa meadows keep extending against natural regions;

-ponds originating from drained dead arms: these constitute habitats for aquatic and hydrophilic plants, and are extremely important habitats for many other living organisms.

-in the place known as "Livada" ("the orchard", Săpânța commune), a wooded islet has remained on the second terrace of River Tisa, covering 21 hectares and containing aged oak-trees, with a phytogenesis characteristic of oak groves. In this place the Forest Enterprise from Sighetu Marmației organized a dendrological park with 39 species of trees, out of which we mention Common Pine (*Pinus silvestris*), Black Pine (*Pinus nigra*), Larch (*Larix decidua*), Common Spruce (*Picea abies*), Black Walnut (*Juglans regia*), *Thuja orientalis*, Mountain Ash (*Sorbus aucuparia*), American Bird Cherry (*Padus serotina*), etc.

-on the second terrace of River Tisa in the village Tisa (Bocicoiu Mare commune), there are some species of exotic trees in the school park, surviving from the park founded by the former owner. Such are, for example: Tulip Tree (*Liriodendron tulipifera*), Black Walnut (*Juglans nigra*), etc.

-in the River Tisa strait where the river crosses the Măgura ("Hills") region, the mountain slope streaching down the river bank was once covered by beech

forests. Today these forests are intersected by pastures and grazing lands. The forest offers, besides wood, a series of secondary products (forest fruits, mushrooms, herbs, etc.). The woods in the Upper Tisa basin were put under forest jurisdiction in 1730 by "Regia Cameralis", the administration supervising a limited level of forest operations and providing wood material for transportation rafts carrying salt coming from the salt pits in Costiu and Ocna Sugatag.
The types of shrubs growing in the Upper Tisa basin, adjacent to the wetland, are:
-oak forests located at altitudes of 200-800 m;
-beech forests at altitudes between 500-1300 m, which sometimes, on northern slopes, grow even as low as at 300 m and can stretch on the southern slopes up to 1600 m.
-spruce-fir forests are found at altitudes of 1000-1700 m, and in some regions as down as 400 m.
Alpine pastures are on the upper region of the mountains and they can be:
-low alpine sub-zones between 1600-2000 m, also characterized by the presence of forestry vegetation;
-upper alpine sub-zones between 2000-2300 m, containing special open-zone plants and rare forest species.

Noteworthy flora: The vegetation of the Upper Tisa between Miceu, the Piatra village, and the village Valea Vişeului is varied, specific to the areas with streams, hill and mountain rivers. It is populated with plants ranging from inferior plants growing in the floodplains, some species attached to the substratum, others floating freely (filamentous green algae), to ligneus superior plants that form meadows and hardly crossable thickets woven thick by Weil associations.
Based on their biological forms most of the Macromicetes are lignicolous, while based on their ecological forms they are lignicolous saproparasitical and lignicolous saprophytic fungi. We can mention the preponderant presence of *Polysporus* and *Agrocybe*, and, among the species belonging to ground forms, the most frequent species are members of the genera *Coprinus*, *Stropharia*, *Panaeohus*, *Pluteus*.
Out of the hygrophytic plant populations we can mention various moss species (*Polytrichum sp*., *Strium sp*., etc.), ferns (e.g. *Dryopteris thelypteris*), Wood Horsetail (*Equisetum sylvaticum*), Yellow Marigold (*Caltha lueta*), Yellow Iris (*Iris pseudacorus*), Water Mint (*Mentha aquatica*), Spring Snowflake (*Leucojum vernum*), various species of sedge (*Carex sp*.).
Along the dead branches of River Tisa, in the pond waters we meet associations of hygrophytic plants including Ivy-leaved Duckweed (*Lenmna trisulca*), Broad-leaved Pondweed (*Potamogeton natans*), Common Water Plantain (*Alisma plantago-aquatica*), Bogbean (*Menyanthes trifoliata*), Common Water Crowfoot (*Ranunculus aquatilis*); (*Batrachium fluitans*), (*Scirpus lacustris*), Flowering Rush (*Butomus umbellatus*). Such associations border the ponds together with willows and alders.
The undisturbed natural meadows consist of the following most common species: White Willow (*Salix alba*), Osier Willow (*Salix viminalis*), Red Willow (*Salix purpurea*), Black Poplar (*Populus nigra*), White Poplar (*Populus alba*), Alder

(*Alnus glutinosa*), Hornbeam (*Carpinus betulus*), Bird Cherry (*Padus racemosa*), etc.

The shrub layer is also rich in species, out of which the most common are: Guelder Rose (*Viburnum opulus*), Common Elder (*Sambucus nigra*), Privet (*Ligustrum vulgare*), Dog Berry (*Cornus sanguinea*), Hazel (*Corylus avellana*), Rose (*Rosa sp.*), etc.

The weil associations climb up till they interweave with the crowns of the trees. In such associations climbers such as the Wild Hop (*Humulus lupulus*), the Traveller's Joy (*Clematis vitalba*) or the Woodland Grape (*Vitis silvestris*) can be present, and the willow bushes, locations with osier are overgrown by *Sicyos angulatus*, Hedge Bindweed (*Calystegia sepium*), Wild Cucumber (*Echinocystis lobata*: an adventitious plant).

Locations cleared of trees are invaded by thick associations made up of Jerusalem Artichoke (*Helianthus tuberosus*) and an adventitious plant originating from Japan: *Polygonum cuspidatum*.

In lighter places, both in riverside coppices and their borders, among the weeds we can find Meadowsweet (*Filipendula ulmaria*), Dropwort (*Filipendula vulgaris*), Moth Mullein (*Verbascum blattaria*), Common Tansy (*Chrysanthemum vulgare*), Self-heal (*Prunella vulgaris*), Hedge Bedstraw (*Gallium mollugo*), Purple Loosestrife (*Lythrum salicaria*) and Marsh Wounwdort (*Stachys palustris*).

In natural hayfields and at the edges of fields, herbaceous associations are made up of colourful flowers such as sage and clary species (*Salvia nemorosa, Salvia pratensis*), Small-flowered Catchfly (*Silene gallica*), False London Rocket (*Sisymbrium loeselii*), White Amaranth (*Amaranthus albus*), Ragweed (*Ambrosia artemisifolia*), Alkanet (*Anchusa officinalis*) and Common Meadow-rue (*Thalictrum flavum*).

In the River Tisa strait the vegetation is inlaid. It consists of beech forests interspersed with hayfields and, in the form of a narrow line on the bank, by osier plots. Out of the most common species we can mention the Beech (*Fagus sylvatica*), the Sycamore Maple (*Acer pseudoplatanus*), the Hornbeam (*Carpenus betulus*), the Common Ash (*Fraxinus excelsior*), under which Hazel (*Corylus avellana*), Blackthorn (*Prunus spinosa*) and hawthorn (*Crataegus sp.*), enter the forest associations. In the grassy bed there are: Dog's-tooth Violet (*Erythronium dens-canis*), Transsylvanian Hepatica (*Hepatica transylvanica*), European Ginger (*Asarum europaeum*), Wild Strawberry (*Fragaria vesa*), Alpine Squill (*Scilla bifolia*), Large Yellow Ox-eye (*Telekia speciosa*), Comfrey (*Symphytum officinale*), Corydalis (*Corydalis*), Toothwort (*Dentaria bulbifera*), etc.

Herbaceous plants are listed in Appendix, Chart No. 7, and ligneous plants (trees, shrubs and bushes) from the Upper Tisa land appear in Appendix, Chart No. 8.

In the Upper Tisa area there are a number of herbaceous and ligneous plants protected by Romanian law: Appendix, Chart No. 9.

Noteworthy fauna: The Upper Tisa Wetlands constitute good habitats for many vertebrate species living in forest and water environments.

As to the fishes, 33 species have been found in River Tisa among which even rare species, endemical species and natural monuments such as the Huchen (*Hucho hucho*) are found, as well as ice-age relic species with a limited area such as the Strömer (*Leuciscus soufia agassizi*). In this comparatively small area of River Tisa, rheophilic species characteristic of mountain rivers, such as the Common River Trout (*Salmo trutta fario*), the Grayling (Thymallus thymallus), the Bullhead (*Cottus gobio*), etc. occur together with species characteristic of slow-flowing waters of lower river sections, such as the Pike (*Esox lucius*), the Carp (*Cyprinus carpio*), even the Sheatfish or Catfish (*Silurus glanis*), and, lately in large numbers, the Bream (*Abramis brama*). This ichthyofauna can be maintained by preserving the biophysical quality of the waters of River Tisa. The updated list of confirmed species is shown in Appendix, Chart No. 1.

Out of the amphibians the Carpathian Newt (*Triturus montadoni*) is worth mentioning, occurring at altitudes of 300 m on the River Tisa terraces near Sighetu Marmației. These locations are the westernmost and lowest occurrences of this endemic species of the Eastern Carpathians. For the amphibians the River Tisa meadows with ponds formed in deserted riverbeds are also places of reproduction. For example, thousands of Common Toads (*Bufo bufo*) have been reported to occur in the lakes near Câmpulung la Tisa (Appendix, Chart No. 2).

Out of the reptiles the European Pond Terrapin (*Emys orbicularis*) in Maramuresh County founds a favourable habitat only in the River Tisa ponds. The suppression of these habitats brings about the disappearance of the species from this region (Appendix, Chart No. 3).

It is believed that over 90 bird populations nest near River Tisa and the above mentioned ponds, as well as in the well outlined meadows (that, at places, take a jungle aspect owing to climbing species such as the Traveller's Joy (*Clematis vitalba*) creating Weil associations), out of which 23 are closely linked to aquatic or wetland environments, and 67 to forests: Lesser Spotted Eagle (*Aquila pomarina*), Goshawk (*Accipiter gentilis*), Hobby (*Falco subbuteo*), etc.

In Appendix, Chart No. 4 bird species associated with wet and aquatic environment are listed, such as the Little Grebe (*Podiceps ruficollis*), the Little Bittern (*Ixobrychus minutus*), the Mallard (*Anas platyhrynchos*), etc. Appendix, Chart No. 5 conains the list of bird species that are not directly linked to aquatic environment, yet the favourable meadow biocenoses permits the nesting of several bird species in far greater density than in other bush or forest biocenoses. The particular density of the Fieldfare (*Turdus pilaris*) in the River Tisa meadows is worth mentioning The Fieldfare is a species noticed as a nesting bird of the Carpathians first in 1972.

The Tisa Valley is of utmost importance, even at international level, from the aspect of bird migration and the winter residence of northern species. The Carpathian native populations, mainly the passerines, simply fly downstream along the side valleys towards the River Tisa Valley leaving which they follow westwards through the Maramuresh depression, towards the Pannonian Plain. In autumn the migration of Rooks (*Corvus frugilegus*) and Jackdaws (*Corvus monedula*), is quite spectacular with hundred of thousands of birds flying above to rest in the River Tisa Valley. In autumn large flocks (thousands of birds) fly over: Greylag Goose (*Anser anser*), Bean Goose (*Anser fabalis*) and duck species. It is only the growing number of birds that proves that northern populations also arrive here. In spring the direction is opposite, from southwest towards northeast. During the passage a number of rare species can be seen such as the Osprey (*Pandion haliaetus*), the Red-throated Diver (*Gavia stellata*), the Shoveler (*Anas clypeata*), the Red-crested Pochard (*Netta rufina*), the Common Scoter (*Melanitta nigra*), etc.

As far as the mammals are concerned, they lack scientific list, but we can notice that most mammals confirmed to exist in Maramuresh County exist here too, and we have conclusive proofs concerning big mammals such as the Carpathian Red Deer (*Cervus elaphus carpathicus*), the Roedeer (*Capreolus capreolus*), the Wild Boar (*Sus scrofa*), the Red Fox (*Vulpes vulpes*), the Hare (*Lepus europaeus*), etc.

We must also mention that through the River Tisa Valley the Muskrat (*Ondathra zibethica*) entered the fauna of the Maramuresh Depression, and the Mink (*Mustela lutreola*) survived in the River Tisa region.

As a conclusion we can notice that the River Tisa Valley (the River and the meadows) has a very rich vertebrate fauna in the examined area. Over 60% of the vertebrates confirmed in Maramuresh County exist within an area of only 2% of the whole depression. The occurrences of the above mentioned species are strongly confirmed, and the most uncommon species are mentioned in documents in the Maramuresh Museum.

Research work must be continued and intensified, on the basis of which we can complete the information on the faunal composition of this marvellous region. River Tisa and the River Tisa meadows deserve a better sustained protection which could be achieved by means of international cooperation.

Social and cultural values: The culture and civilisation of this area root deeply in the past. Manastirea la Peri, a site on the right bank of River Tisa, and Sarasau have been religious centres as much as centres for spreading the Romanian alphabet in the area.

Human activities here began with animal keeping, agriculture and forest work, "în butini", wood processing and domestic handicrafts. The followings are traditional products and activities characteristic of this region: gates carved with Maramuresh motifs and symbols (rope, sun, arbor vitae), wooden houses, churches with specific architecture (with entrance hall), home objects with artistic patterns (spindle, cradle, weaving loom, woollen rugs, bags, carpets dyed in vivid colours), etc. The traditional peasant wear in the Maramuresh County is characterized by its temperance, chromatic sense and well-chosen motifs: anthropic, zoomorphic and floral.

The pastoral, agricultural life of the people living here has multiple spiritual values, being tightly related to a large number of customs and archaic rituals such as "Sâmbra oilor", "Ruptul sterpelor", "St. John's Day", "Tânjaua" (the celebration of the beginning of spring farming activities), etc.

During the winter holidays (Christmas, New Year's Eve, Epiphany) carol singers go from house to house wishing the hosts happiness, rich crops for the coming New Year.

Lasting until the end of December there is a Winter Traditional Festival at Sighetu Marmației for which thousands of people come from Romania and abroad.

Land tenure/ownership:

The Upper Tisa basin in Maramuresh county has an area of 334000 hectares, with the following distribution:
-farming lands 150000 ha 44,99%
- lands with forestry vegetation 162000 ha 48, 50%
-other lands 22000 ha 6,51%

Out of this area National Parks extend over 4403 ha, with a perspective of further extension, as declared and approved by decision No. 37/1994 of the Maramuresh County Council. Among National Parks we can mention "Pietrosul Rodnei" (3300 ha), "Cornu Nedeii - Ciungii Bălăsinii" (800 ha), and others.

Seventy percent of the farming lands in this region are private, and the remaining 30% are lands belonging to state possession (mainly public estates): primarily grazing fields and pastures under the administration of the mayoralty and Agricultural Commercial Enterprises with state capital (SC Agricole SA). Out of the lands covered with forestry vegetation over 95% are state properties (public estates) administered by the Regia Autonoma ROMSILVA and the Forest Enterprises both of which put into practice the policy of forest protection legislated by the Legea Codului Silvic (The Forest Code Law) No. 26/1996.

After putting the Land Property Law (No. 18/1991) into operation, each forest land owner was given a hectare of forest to be managed under forest policy.

The protected lands, proposed in Article 9 to be administrative centres and extending over an area of about 666 hectares, are state properties (public estate), administered by the mayoralty and R.A. ROMSILVA S.A., but there are also areas on which ownership has not been specified yet, especially those next to the former border strip.

Adjacent areas that are neither cultivated nor grazed are used for domestic activities.

Current land use: Areas adjacent to River Tisa make up a total of 54370 hectares. Land use structure is as follows (data also comprise the neighbouring zones that administratively belong to these places) :
-farming lands 7380 ha = 13.57%
-orchards 1309 ha = 4.25%
-hayfields and grazing lands17761 ha = 32.67%
-forestry vegetation23078 ha = 42.45%
-other uses 3842 ha = 7.06%

The high share of farming lands is represented by pastures and hayfields. This imposes on the local population a certain activity, namely animal breeding. The main activity of the rural population is plant cultivation and animal breeding and the processing of these primary argicultural products. The main activities include the breeding of sheep, cattle, horse and poultry, together with bee-keeping, which all ensure the people an important income, mainly through homemade goods and wool manufacturing. The most famous wool manufacturers are to be found in Săpânța.

The vast areas covered with forests provide the inhabitants with other important sources of income: workplaces in forestry enterprises and in timber and wool processing factories in Sighetu Marmației and Câmpulung la Tisa.

The presence of wood is also reflected in the physical appearance of dwellings and home dependencies that consist of a great amount of wood processed by famous craftsmen.

Farmlands, most of them being private properties, are cultivated by individual land owners whose products are consumed in their own farms.

Fruit growing extends over a comparatively small area of about 4,25% of the total, in the form of intensivly cultivated orchards possessed by the Agricultural Enterprises - S.C. Agricole S.A. (with a perspective to being turned into private properties), and private traditional orchards, too (that partly extend over the territory under). Fruits grown here are: apple, plum, pear, etc.

Hunting in the frontier region of the River Tisa basin is forbidden, while fishing is practised by organized amateurs with licences or permits released by the qualified authorities.

On a local scale different kinds of stone are still being exploited in the quarries, and the ballast-pit products in the Upper Tisa bed are also being turned to account. Sediments are sorted in the sorting stations at Sighetu Marmației.

Material removal from the ballast-pit resources is achieved occasionally by direct excavation from the floodplain and the product is used mainly for civil and industrial building.

The water of River Tisa is, in general, not used as industrial water supply for enterprises (except for the Câmpulung la Tisa Timber Factory), and it is not used for irrigation either.

There are no organized dumpsites along the Upper Tisa bed. In an unorganized way, though, people still deposit domestic waste in the proximity of almost every settlement along the main flood plain.

Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects: From Miceu-Piatra up to Valea Vişeului large areas along River Tisa, covered by poplars (*Populus* sp.) and willows (*Salix* sp.), were cleared between 1980-1993. Most of these lands have been turned into farmlands; habitats of various living organisms have been diminished.

In the River Tisa meadow (the first terrace) draining operations took place until 1989: some swamps and ponds were subjected to agricultural management.

Due to clearing and uprooting, the banks of River Tisa became exposed to erosion during high floods. Although paving and consolidating has been done along the course of River Tisa, the water course did alter.

Works of consolidation were no longer maintained after the high floods, which fact determined the fate of many deserted channels, ponds and swamps: they became clogged and no longer provided shelter for waterfowl.

The last Grey Heron (*Ardea cinerea*) colony in the River Tisa meadow (village Tisa) was destroyed due to the wrong conception of the 1950s. It was feared that the birds might transfer ichthyophagous pests, and even the trees good for nesting were all cut down.

In the meadow exotic species or ones found in adjacent areas were planted, such as: Common Spruce (*Picea abies*), White Fir (*Abies alba*), Duglas Fir (*Pseudotsuga toxifolia*), American Bird Cherry (*Padus serotina*), Green Maple (*Acer negundo*), Catalpa (*Catalpa bignonioides*) and others.

The risk of damaging water quality is conveyed by some enterprises, such as the Borsa Mining Enterprise, the Sighet Mechanic Commercial S.A., the Vişeu Therapy S.A., the Hospitals in Borsa, Vişeu and Sighetu Marmației, in case their filter stations do not work. After heavy rains pollution can also occur from the dump heaps related to the graphite schist prospects at Repedea. In such cases these heaps are washed away by torrents the way it happened in 1973, when after a downpour the polluting alluvial deposits of the graphite schists caused great damage to the ichthyofauna down to the River Vişeu - River Tisa confluence.

High floods provoked by downpours and lasting rains threaten Sighetu Marmației and keep on flooding Remeți and Teceu Mic.

The degradation of these wet habitats had a direct influence on the diminution of the variety and numbers of vertebrates characteristic of this area. For example, pollution to River Tisa had a negative impact on the huchen and other salmonid species as well as other fishes preferring oxygenated clear water.

Pond clogging and draining had negative impacts not only on certain fishes, but also on other vertebrates such as the European Pond Terrapin (*Emys orbicularis*), waterfowls nesting in these habitats such as the Little Grebe (*Podiceps ruficollis*), the Little Bittern (*Ixobrychus minutus*), the Mallard (*Anas platyrhynchos*), the Gallinule (*Gallinula chloropus*), etc., and especially on mirgatory birds that make a halt in large numbers near these ponds. Among these there are even very rare species such as the Arctic Loon (*Gavia arctica*), the Red-throated Diver (*Gavia stellata*) and other duck species.

The habitat of numerous mammal species living here e.g. the Muskrat (*Ondatra zibethica*), have been disturbed.

Massive clearing activities in the meadows have been felt even in the diminution of the nesting species in this very favourable habitat, such as the Lesser Spotted Eagle (*Aquila pomarina*), other birds of prey, and other bird species, too.

Environmental damaging through the whole Upper Tisa Basin by massive clearing, by polluting rivers with different substances and overflown wastes, etc. induce direct as well as indirect damages to the water quality of River Tisa and to the habitat of different living organisms in the wetlands of the region and in the flood plain.

The problem of Huchen (*Hucho hucho*) protection is not adequately resolved. The lack of piscicultural guarding by well-trained staff is being felt. There are no

patrols; some areas should be closed, and fishing should be forbidden in places that are known as spawning and breeding sites of huchens.
There are some hydroelectric power projects for River Tisa, including mine hydropower stations. In the first stage the Teceu and Săpânța hydropower stations will be built. The Teceu dam is meant to be built across the river, as part of an international route, allowing the passage of vessels. The following enterprises seem to be interested in these projects: the Ministry of Waters, Forests and Environmental Protection, the Autonomous Administration of Romanian Waters, the Ministry of Industry (Electric Power Department), and others.

Conservastion measures taken: The Upper Tisa Wetland under study is situated along the Romanian-Ukrainian border where public access is restricted, which is a measure favouring the partial protection of the area.
-Hunting is forbidden in the frontier area and fishing can be practised only with a permit;
-Fishing can be practiced by the members of the Associatiation of Hunters and Fishermen of Romania, with an exception for the **Huchen** (*Hucho hucho*) which is considered by law to be a natural monument (Law on Environment Protection No. 137/1995, County Council Decision No. 37/1994 providing precautionary and preserving measures for National Parks and natural monuments to be found in the Maramuresh County area).
-Decision No. 37/1994, among other things, stipulated in its annexes the protection of the "timoave", by declaring them to be National Parks. Such are "Mlastina Poiana Brazilor" (Fir Clearing Swamp), "Tăul Mororenilor", "Mlastina Oligotrofă Vlăsinescu" (Vlăsinescu Oligotrophic Swamp), "Mlastina Iezerul Mare" (Great Pond Swamp), "Mlastina Oligotrofă Tăul lui Dumitru" (Dumitru's Pool Oligotrophic Swamp), "Poiana Săpânței" and „Vrăticel".
-The Maramuresh Ecological Society, with its headquarters in Baia Mare, and The Sighetu Marmației Ecological Society contributed to drawing up Decision No. 37/1994 and to designating new protected areas that are to be declared National Parks.
-Trees in the "Livada" (Orchard), Săpânța commune, are protected, for they belong to the Dendrological Park area which is to be declared forestry park.
-Lands covered with forestry are administered by Regia Autonoma Romsilva, in accordance with Law No. 26/1996. By applying forestry management the protected areas fit within the forests belonging to 1st rank protection.

Conservation measures proposed but not yet implemented:: Conservation measures of such nature have not been taken officially in the Upper Tisa Wetland. The exception is the declaration of the **Huchen** (*Hucho hucho*) a natural monument, although in the frontier area it is being fished.
Generally speaking, all National Parks and Natural monuments included in the annexes to the Maramuresh County Council Decision No. 37/1994 are ordered to the administration of the Regia Autonoma Romsilva and to the local councils that possess the lands on which these natural values are situated.

- Scientists (researchers, museum specialists) have had permanent preoccupations regarding the protection of the flora and the fauna of the area. In their scientific papers published in different specialized reviews, and in those presented on the occasion of scientific sessions organized for example by the Cluj Napoca Department of the Romanian Academy, they presented the problems of the protection of the Upper Tisa area and of the living organisms of the place (**Huchen**, migratory birds, local nesting birds, exotic species, etc.).
"Observations and proposals regarding the ancient trees in the natural ecosystems and dendrological parks of the Maramuresh Depression". Scientific Session of the Romanian Academy, Department of Cluj-Napoca, 22-23 April, 1982.
"Contributions to the knowledge about the avifauna of the Upper Tisa (on Romanian territory)". Scientific Session of the Hungarian Ornitological Society, Nyíregyháza, 20-22 October, 1995,
and others.

Current scientific research and facilities: Due to its geomorphological features, to its flora, fauna, social, cultural and ethno-geographical values, the Upper Tisa Land is under permanent research work conducted by Romanian and foreign specialists.
Research is made in the fields of microbiology, zoology (aquifauna, ichthyofauna), forest and spontaneous flora, by specialists from the Maramuresh Museum from Sighetu Marmației, the Maramuresh County Museum, the Bucharest Forest Research Institute, the Cluj-Napoca Department of the National Institute for Hydrological Measurements, the Cluj-Napoca Department of the Romanian Academy, etc.
There are proposals for the future to supplement the research with new data concerning mainly the fauna and the flora that develops in time. In the River Tisa Wetland it is necessary to parcel out the areas subjected to protection. This must be done so as to obtain lots and sublots of a wetland area in each place and entrust these to the owners for managing and for careful administration, in accordance with the Ramsar Convention.

Current conservation education: In Sighetu Marmației there is the Maramuresh Museum. The staff of the museum, together with teachers from the primary and secondary schools, popularize towards the visitors the importance of environmental protection. The establishment of the Ecological Societies in Baia Mare and Sighetu Marmației has had an important impact on people's education, via publishing several articles dealing with the protection of the local flora and fauna, in the local and specialized media. Also, through thematic conferences followed by slide shows or video projecting, the sense of taking part in the maintenance and restoration of the order of our living environment is cultivated.
The two above mentioned societies contribute to carrying out ecological education, by means of camps organised for groups of young people.
In the proposed wetland sustained propaganda will be necessary, probably by pronouncing ecological basic rules and releasing posters with the species of fauna and flora to be protected.

Current recreation recreation and tourism: The protected areas, the buffer zones and bordering lands of the the Upper Tisa Basin offer possibility for extensive recreative tourism.

In the protected areas and along the rivers Săpânța, Iza and Vişeu, sport fishing is being practised. The Teplițe recreation area at Tisa, eastward of Sighetu Marmației is used for practising aquatic sports and as an area of recreation for the inhabitants of nearby settlements.

The Livada dendrological park in Săpânța, the Grădina Morii (Mill Garden) in Sighetu Marmației, the exotic trees in Tisa and some others, are excellent places for recreative tourism and for enriching the visitors' ecological knowledge.

Anthropological sights of international touristic importance in areas bordering the analysed region are:

- Săpânța lying on the left bank of River Tisa, on the National Road No. 19 connecting Maramuresh County with Oas County. The most important sights are:

"Cimitirul vesel" (Merry Cemetery), a unique place in the world, made by folk artist Stan Ion Pătras, with its painted, engraved and carved crosses, together with epitaphs containing pieces of folk poems in connection with the former activity of the deceased.

The Trout Station where visitors can fish a trout, together with a mineral water spring, can be considered interesting sights. In the commune home handicraft industry has developed: processing wool and manufacturing rugs, coloured carpets, knapsacks, wallets, etc.

- Sighetu Marmației lies upstream from the junction between the rivers Iza and Tisa. Based on a document dating back to 1329, it is considered an old cultural centre. The "Diplomele Maramureshene" (Maramuresh Diplomas) were printed here by Dr. Ioan Mihaly de Apsa. The most important sights to be visited in Sighetu Marmației are:

-The Maramuresh Museum with its departments of ethnography, natural sciences, history, and art gallery.

-The Open Air Museum of the Maramuresh Village, on the Dobăies Hill;

-The Sighet Prison, where great Romanian politicians such as Iuliu Maniu, I. C. Brătianu, Cardinal Iuliu Hossu and others, were exterminated.

-The Orthodox, Catholic and Protestant churches

-The "Grădina Morii" Park, a recreative area with many ancient and exotic trees having been declared to be natural monuments.

-The Solovan Hill, from where you have a gorgeous view of the Maramuresh Depression and the course of River Tisa.

In places along the Vişeu, Iza and Mara Valleys tourists can admire the wooden churches with their high steeples rising up above towards the sky, together with the Maramuresh wooden gates which are real masterpieces of carved wood.

Jurisdiction: The studied area proposed as a protected land is meant to enter under the Ramsar Convention, with an area of 666 hectares. As mentioned in article 9, the communes will have to exercise the authority right.

-the mayoralties of Remeți, Săpânța, Câmpulung la Tisa, Sarasău, Bocicoiu Mare, Rona de Sus, Bistra and Sighetu Marmației will look after this area according to corresponding regulations;

-the Maramuresh County Council is involved on the level of regional legislation (e.g. decision "The Protected Areas");

- the Cluj-Napoca Department of the Romanian Academy will have to decide upon scientific research in the wetland;

-the Ministry of Waters, Forests and Environmental Protection requested and decided the enlisting of the Upper Tisa as a habitat for waterfowls (Law No. 5, 25 January, 1991);

-the Baia Mare University, the Sighetu Marmației Museum, the Ecological Societies of Baia Mare and Sighetu Marmației will be executors of research and studies regarding the regional fauna and flora.

Management authority: The responsibility for the Wetland will be established after it is registered on the wetland list.

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Appendix
List of Vertebrates Confirmed Along River Tisa and the meadows

Chart 1.
Fishes (Pisciformes)
Lampetra danfordi Regan 1911 - **Danube Lamprey**
Salmo trutta fario (L.) 1759 - **Common River Trout**
Salmo gaidneri irideus Gibb. 1855 - **Rainbow Trout**
Hucho hucho (L.) 1758 - **Huchen**
Thymallus tymallus (L.) 1758 - **Grayling**
Esox lucius (L.) 1758 - **Pike**
Rutilus rutilus carpathorossicus (Vladycov) 1930 - **Carpathian Roach**
Leuciscus soufia agassizi (Valenciennes) 1844 - **Strömer**
Leuciscus leuciscus leuciscus (L.) 1758 - **Dace**
Leuciscus cephalus cephalus (L.) 1758 - **Chub**
Phoxinus phoxinus phoxinus (L.) 1758 - **Minnow**
Aspius aspius aspius (L.) 1758 - **Asp**
Alburnus alburnus alburnus (L.) 1758 - **Bleak**
Alburnus bipunctatus bipunctatus (Bloch) 1782 - **Rifle Minnow**
Vimba vimba carinata (Palas) 1811 - **Azov Vimba**
Chondrostoma nasus nasus (L.) 1758 - **Undermouth**
Gobio gobio carpathicus (Vladycov) 1930 - **Gudgeon**
Gobio uranoscopus frici (Vladycov) 1925 - **Long-whiskered Gudgeon**
Barbus barbus barbus (L.) 1758) - **Barbel**
Barbus meridionalis petenyi Heckel 1847 - **Petényi's Barbel**
Cyprinus carpio carpio (L.) 1758 - **Carp**
Noemachilus barbatulus barbatulus (L.) 1758 - **Stone Loach**
Cobitis aurata balcanica Krraman 1822 - **Balcan Loach**
Silurus glanis (L.) 1758) - **Sheatfish**
Lota lota (L.) 1758) - **Burbot**
Perca fluviatis fluviatilis (L.) 1758 - **Perch**
Aspro streber Siebild 1863) - **Streber**
Aspro zingel zingel (L.) 1758) - **Zingel**
Stizostedion lucioperca (L.) 1758 - **Pike-perch**
Cottus gobio gobio (L.) 1758 - **Bullhead**
Cottus poecilopus poecilopus Heck. 1836 - **Alpine Bullhead**
Acerina schaester (L.) 1758 - **Acerine**
Acipenser ruthenus (L.) 1758 - **Sterlet**

Chart 2.
Amphibians (Amphibia)
Triturus montandoni (Boulenger) 1881 - **Carpathian Newt**
Triturus cristatus (Laur) 1768 - **Crested Newt**
Triturus vulgaris (L.) 1758 - **Smooth Newt**
Bombina variegata (L.) 1758 - **Yellow-bellied Toad**
Bufo bufo (L.) 1758 - **Common Toad**
Bufo viridis Laur. 1768 - **Green Toad**
Hyla arborea (L.) 1758 - **Common Tree Frog**

Rana ridibunda Pall. 1771 - **Marsh Frog**
Rana esculenta (L.) 1758 - **Green Frog**
Rana dalmatina Bonaparte 1839 - **Agile Frog**
Rana temporaria (L.) 1758 - **Common Frog**

Chart 3.
Reptiles (Reptilia)
Emys orbicularis (L.) 1758 - **European Pond Terrapin**
Lacerta agilis (L.) 1758 - **Sand Lizard**
Natrix natrix (L.) 1758 - **Grass Snake**

Chart 4.
Nesting Birds
Podiceps ruficollis (Pall.) 1764 - **Little Grebe**
Ixobrychus minutus minutus (L.) 1758 - **Little Bittern**
Ciconia ciconia ciconia (L.) 1758 - **White Stork**
Anas platyrhynchos platyrhynchos (L.) 1758 - **Mallard**
Rallus aquaticus aquaticus (L.) 1758 - **Water Rail**
Anas querquedula (L.) 1758 - **Garganey**
Porzana porzana (L.) 1758 - **Spotted Crake**
Porzana parva (Scop.) 1769 - **Little Crake**
Crex crex (L.) 1758 - **Corncrake**
Gallinula chloropus (L.) 1758 - **Moorhen**
Charadrius dubius curonicus Gml. 1789 - **Little Ringed Plover**
Vanellus vanellus (L.) 1758 - **Lapwing**
Tringa hypoleucos (L.) 1758 - **Common Sandpiper**
Sterna hirundo hirundo (L.) 1758 - **Common Tern**
Alcedo atthis ispida (L.) 1758 - **Kingfisher**
Riparia riparia riparia (L.) 1758 - **Sand Martin**
Cinclus cinclus aquaticus (Bechst.) 1789 - **Dipper**
Acrocephalus schoenobaenus (L.) 1758 - **Sedge Warbler**
Acrocephalus palustris (Bechst.) 1789 - **Marsh Warbler**
Acrocephalus scirpaceus scirpaceus (Herm.) 1804 - **Reed Warbler**
Acrocephalus arundinaceus arundinaceus (L.) 1758 - **Great Reed Warbler**
Motacilla cinerea cinerea Tunst. 1771 - **Grey Wagtail**
Motacilla alba alba (L.) 1758 - **White Wagtail**

Chart 5.
Nesting Birds in the meadow areas of River Tisa
Accipiter gentilis gentilis (L.) 1758 - **Goshawk**
Aquila pomarina pomarina (C. L. BREHM) 1831 - **Lesser Spotted Eagle**
Falco subbuteo subbuteo (L.) 1758) - **Hobby**
Falco tinnunculus tinnunculus (L.) 1758 - **Kestrel**
Perdix perdix perdix (L.) 1758 - **Grey Partridge**
Coturnix coturnix coturnix (L.) 1758 - **Quail**
Phasianus colchicus (L.) 1758 - **Ring-necked Pheasant**
Columba oenas (L.) 1758 - **Stock Dove**

Columba palumbus palumbus (L.) 1758 - **Wood Pigeon**
Streptopelia decaocto decaocto (L.) 1758 - **Collared Turtle Dove**
Streptopelia turtur (L.) 1758 - **Turtle dove**
Cuculus canorus canorus (L.) 1758 - **Cuckoo**
Asio otus otus (L.) 1758 - **Long-eared Owl**
Athene noctua noctua (Scop.) 1769 - **Little Owl**
Strix aluco aluco (L.) 1758 - **Tawny Owl**
Upopa epops epops (L.) 1758 - **Hoopoe**
Jynx torquilla torquilla (L.) 1758 - **Wryneck**
Picus viridis viridis (L.) 1758 - **Green Woodpecker**
Dendrocopos major pinetorum (L. Brehm.) 1831 - **Great Spotted Woodpecker**
Dendrocopos syriacus (Hempr. Et Ehrenb) 1833 - **Syrian Woodpecker**
Dendrocopos medius medius (L.) 1758 - **Middle Spotted Woodpecker**
Galerida cristata cristata (L.) 1758 - **Crested Lark**
Alauda arvensis arvensis (L.) 1758 - **Skylark**
Garrulus glandarius glandarius (L.) 1758 - **Jay**
Oriolus oriolus oriolus (L.) 1758 - **Golden Oriole**
Pica pica pica (L.) 1758 - **Magpie**
Corvus monedula soemmerringii (Fisch.) 1811 - **Jackdaw**
Corvus frugilegus frugilegus (L.) 1758 - **Rook**
Corvus corone cornix (L.) 1758 - **Carrion Crow**
Corvus corax corax (L.) 1758) - **Raven**
Parus palustris palustris (L.) 1758 - **Marsh** Tit
Parus caeruleus caeruleus (L.) 1758 **- Blue tit**
Parus major major (L.) 1758 - **Great Tit**
Aegithalos caudatus caudatus (L.) 1758 - **Long-tailed Tit**
Sitta europaea caesia Wolf. 1810 - **Nuthatch**
Certhia familiaris familiaris (L.) 1758 - **Tree Creeper**
Troglodytes troglodytes troglodytes (L.) 1758 - **Wren**
Saxicola rubetra (L.) 1758 - **Whinchat**
Saxicola torquata (L.) 1766 - **Stonechat**
Oenanthe oenanthe oenanthe (L.) 1758 - **Wheatear**
Phoenicurus ochruros gibraltariensis (Gml.) 1789 - **Black Redstart**
Phoenicurus phoenicurus phoenicurus (L.) 1758 - **Redstart**
Erithacus rubecula rubecula (L.) 1758 - **Robin**
Luscinia luscinia (L.) 1758 - **Thrush Nightingale**
Turdus pilaris (L.) 1758 - **Fieldfare**
Turdus merula merula (L.) 1758 - **Blackbird**
Turdus philomelos philomelos C. L. Brehm.)1831 - **Song Thrush**
Hippolais icterina (Vieill) 1817 - **Icterine Warbler**
Sylvia borin borin (Bodd.) 1783 - **Garden Warbler**
Sylvia atricapilla aticapilla (L.) 1758 - **Blackcap**
Sylvia curruca curruca (L.) 1758 - **Lesser Whitethroat**
Phylloscopus collybita collybita (Vieill.)1817 - **Chiffchaff**
Phylloscopus trochilus fitis Bechst. 1793 - **Willow Warbler**
Muscicapa striata striata (Pall.) 1764 - **Spotted Flycatcher**
Prunella modularis modularis (L.) 1758 - **Hedge Sparrow**
Lanius collurio collurio (L.) 1758 - **Red-backed Shrike**

Lanius minor minor Gml. 1788 - **Lesser Shrike**
Lanius excubitor excubitor (L.) 1758 - **Great Grey Shrike**
Sturnus vulgaris vulgaris (L.) 1758 - **Starling**
Passer montanus montanus (L.) 1758 - **Tree Sparrow**
Passer domesticus domesticus (L.) 1758 - **House Sparrow**
Carduelis chloris chloris (L.) 1758 - **Greenfinch**
Carduelis carduelis carduelis (L.) 1758 - **European Goldfinch**
Fringilla coelebs coelebs (L.) 1758 - **Chaffinch**
Serinus serinus (L.) 1758 - **Serin**
Acanthis cannabina cannabina (L.) 1758 - **Linnet**
Emberiza citrinella citrinella (L.) 1758 - **Yellowhammer**

Chart 6.
Winter Guest Migratory Birds
Gavia stellata (Pont) 1763 - **Red-throated Diver**
Gavia arctica arctica (L.) 1758 - **Black-throated Diver**
Podiceps auritus auritus (L.) 1758 - **Slavonian Grebe**
Podiceps griseigena griseigena (Bodd.) 1733 - **Red-necked Grebe**
Podiceps cristatus cristatus (L.) 1758 - **Great Crested Grebe**
Botaurus stellaris stellaris (L.) 1758 - **Bittern**
Nycticorax nycticorax nycticorax (L.) 1758 - **Night Heron**
Ardea cinerea cinerea (L.) 1758 - **Grey Heron**
Ardeola ralloides (Scop.) 1769 - **Squacco Heron**
Ardea purpurea purpurea (L.) 1758 - **Purple Heron**
Ciconia nigra nigra (L.) 1758 - **Black stork**
Anser anser (L.) 1758 - **Greylag Goose**
Anser albifrons albifrons (Scop.) 1769 - **White-fronted Goose**
Anser fabalis brachyrhynchus Baillon 1811 - **Bean Goose**
Cygnus olor (Gm.) 1789 - **Mute Swan**
Anas crecca crecca (L.) 1758 - **Green-winged Teal**
Anas penelope (L.) 1758 - **European Widgeon**
Anas acuta acuta (L.) 1758 - **Pintail**
Anas clypeata (L.) 1758 - **Shoveler**
Netta rufina (Pall.) 1773 - **Red-crested Pochard**
Aythya ferina (L.) 1758 - **Pochard**
Aythya nyroca (Guldenst.) 1770 - **Ferruginous Duck**
Aythya fuligula (L.) 1758 - **Tufted Duck**
Aythya marila (L.) 1758 - **Greater Scaup**
Bucephala clangula clangula (L.) 1758 - **Goldeneye**
Mergus serrator (L.) 1758 - **Red-Breasted Merganser**
Mergus merganser merganser (L.) 1758 - **Goosander**
Haliaetus albicilla (L.) 1758 - **White-tailed Eagle**
Circus pygargus (L.) 1758 - **Montagu's Harrier**
Circus cyaneus cyeneus (L.) 1758 - **Hen Harrier**
Pandion haliaetus haliaetus (L.) 1758 - **Osprey**
Grus grus grus (L.) 1758 - **Crane**
Fulica atra atra (L.) 1758 - **Coot**
Pluvialis apricaria altifrons (C. L. Brehm.) 1831 - **Golden plover**

Calidris minuta (Leisl.) 1812 - **Little Stint**
Philomachus pugnax (L.) 1758 - **Ruff**
Tringa totanus totanus (L.) 1758 - **Redshank**
Tringa nebularia (Gunn.) 1767 - **Greenshank**
Tringa ochropus (L.) 1758 - **Green Sandpiper**
Tringa glareola (L.) 1758 - **Wood Sandpiper**
Gallinago gallinago gallinago (L.) 1758 - **Common Snipe**
Larus ridibundus (L.) 1758 - **Black-headed Gull**
Larus argentatus (L.) 1758 - **Herring Gull**
Chlidonias niger niger (L.) 1758 - **Black Tern**
Hydroprogne tschegrava (Lepechin) 1770 - **Caspian Tern**
Asio flammeus flammeus (Pontopp.) 1763 - **Short-eared Owl**
Motacilla flava flava (L.) 1758 - **Yellow Wagtail**
Emberiza schoeniculus schoeniculus (L.) 1758 - **Reed Bunting**

Chart 7.
Herbaceous Plants from the Upper Tisa Land
Equisetum arvense - **Field Horsetail**
Humulus lupulus - **Wild Hop**
Urtica dioica- **Common Nettle**
Polygonum aviculare - **Knotgrass**
Polygonum amphibium - **Amphibious Bistort**
Polygonum multiflorum
Stellaria nemorum - **Wood Stitchwort**
Silene vulgaris - **Bladder Campion**
Saponaria officinalis - **Soapwort**
Mercurialis perennis -**Dog's Mercury**
Trollius europaeus - **Globe Flower**
Hepatica transsylvanica - **Transsylvanian Hepatica**
Dentaria bulbifera - **Toothwort**
Ranunculus platanifolius - **Large Whie Buttercup**
Asarum europaeum - **European Ginger**
Corydalis solida - **Bulbous Corydalis**
Viola alba - **White Violet**
Viola tricolor - **Wild Pansy**
Hypericum perforatum - **Perforate St John's Wort**
Fragaria vesca - W**ild Strawberry**
Medicago falcata - **Yellow Lucerne**
Capsella bursa-pastoris - **Sheperd's Purse**
Trifolium pratense - **Red Clover**
Lotus corniculatus - **Birdsfoot Trefoil**
Malva sylvestris -**Common Mallow**
Oxalis acetosella - **Wood-sorrel**
Geranium phaeum - **Dusky Cranesbill**
Geranium robertianum - **Herb Robert**
Angelica silvestris - **Angelica**
Primula officinalis - **Primrose**
Pulmonaria officinalis - **Lungwort**

Convolvulus arvensis - **Field Bindweed**
Symphytum cordatum - **Comfrey**
Verbascum phlomoides - **Orange Mullein**
Prunella vulgaris - **Self-heal**
Laminum maculatum - **Spotted Dead-nettle**
Thymus serpyllum - **Wild Thyme**
Inula helenium - **Elecampane**
Achillea millefolium - **Yarrow**
Platango lanceolata - **Ribwort Plantain**
Menyanthes trifoliata - **Bogbean**
Campanula patula -**Spreading Bellflower**
Chrysanthemum corymbosum -**Crown Daisy**
Tussilago farfara - **Coltsfoot**
Taraxacum officinale - **Dandelion**
Arctium lappa - **Greater Burdock**
Centaurea cyanus - **Cornflower**
Typha angustifolia -**Lesser Bulrush**
Phragmites communis - **Common Reed**
Colchicum autumnale - **Meadow Saffron**
Leucojum vernum - **Spring Snowflake**
Schoenoplectus lacustris
Carex canescens
Carex sylvatica - **Wood Sedge**
Festuca gigantea -**Giant Fescue**
Festuca rubra - **Red Fescue**
Festuca heterophyla - **Various-leaved Fescue**
Poa pratensis - **Smooth Meadow-Grass**
Agropyrum repens - **Common Couch**
Dryopteris thelypteris - **Fern sp.**
Caltha lactia - **Marigold sp.**
Myosotis palustris - **Marsh Forget-me-not**
Iris pseudacorus - **Yellow Iris**
Mentha aquatica - **Water Mint**
Lemna minor - **Common Duckweed**
Potamogeton matans - **Broad-leaved Pondweed**
Alisma plantago-aquatica - **Common Water Plantain**
Juncus effuscus - **Soft Rush**
Scirpus lanstris - **Common Bulrush**
Butamus beltamus - **Rush sp.**
Clematis vitalba - **Traveller's Joy**
Vitis silvestris - **Woodland Grape**
Sicyos angulatus - **Bur Cucumber**
Calystegia arvensis - **Bindweed sp.**
Helianthus tuberosus - **Jerusalem Artichoke**
Filipendula ulmaria - **Meadowsweet**
Filipendula hexapetala - **Dropwort**
Prunella vulgaris - **Self-heal**
Gallium verum - **Lady's Bedstraw**

Chart 8.

Ligneous Plants from the Upper Tisa Land (Trees, Shrubs, Bushes)

Abies alba - **White Fir**
Pseudotsuga toxifolia -
Picea excelsa - **Common Spruce**
Larix decidua - **Larch**
Pinus silvestris - **Common Pine**
Pinus nigra - **Black Pine**
Thuja orientalis
Thuja occidentalis
Populus alba - **White Poplar**
Plopulus tremula - **Trembling Poplar**
Populus nigra - **Black Poplar**
Salix alba - **White Willow**
Salix caprea - **Goat Willow**
Salix viminalis - **Osier Willow**
Salix incana - **Hoary Willow**
Salix purpurea - **Red Willow**
Juglans regia - **Walnut**
Betula verrucosa - **Silver Birch**
Alnus glutinosa - **Common Alder**
Alnus incana - **White Alder**
Carpinus betulus - **Hornbeam**
Corylus avellana - **Hazel**
Fagus sylvatica - **Beech**
Quercus sessiliflora - **Sessile Oak**
Quercus robur - **Common Oak**
Ulmus campestris - **Elm**
Ulmus montana - **Mountain Elm**
Morus alba - **Mulberry**
Viscum album - **Mistletoe**
Loranthus europaeus - **Yellow-berried Mistletoe**
Magnolia acuminta - **Magnolia**
Ribes grossularia - **Gooseberry**
Ribes nigrum - **Black Currant**
Platanus occidentalis - **Plane**
Crataegus monogyna - **Hawthorn**
Sorbus aucuparia - **Mountain Ash**
Malus silvestris - **Wild Crab**
Rubus idaeus - **Raspberry**
Rubus caesius - **Dewberry**
Rubus hirtus - **Blackberry**
Rosa canina - **Dog Rose**
Prunus spinosa - **Blackthorn**
Prunus avium (Cerasus avium) - **Wild Cherry**
Prunus padus - **Bird Cherry**
Padus serotina - **American Bird Cherry**

Gleditschia triacanthos -
Sarothamnus scoparius - **Scotch Broom**
Robinia pseudacacia - **Locust Tree**
Acer platanoides - **Norway Maple**
Acer campestre - **Common Maple**
Acer pseudoplatanus - **Sycamore Maple**
Acer negundo - **American Maple**
Aesculus hippocastanum - **Horse Chestnut**
Vitis silvestris - **Woodland Grape**
Tilia cordata (parvifolia) - **Small-leaved Lime**
Tilia platyphyllos - **Large-leaved Lime**
Elaeagnus angustifolia - **Oleaster**
Hedera helix - **Ivy**
Cornus mascula
Cornus mas - **Cornel**
Vaccinium myrtillus - **Bilberry**
Vaccinium vitis-idaea - **Cowberry**
Fraxinus excelsior - **Common Ash**
Syringa vulgaris - **Common Lilac**
Ligustrum vulgare - **Privet**
Catalpa bignonioides - **Catalpa**
Sambucus nigra - **Common Elder**
Sambucus racemosa - **Red-berried Elder**
Viburnum opulus - **Guelder Rose**
Chart 9.
Herbaceous and Ligneous Plants Under Protection
Herbaceous Plants
Scopolia carniolica
Melittis melissophyllene - **Bastard Balm**
Cypripedium calceolus - **Lady's Slipper**
Narcissus angustifolius - **Wild Daffodil**
Vaccinium oxycoccos - **Cranberry**

Ligneous Plants
Taxus baccata - **Yew** (Sighetu Marmației)
Quercus sessiliflora - **Sessile Oak** (Sighetu Marmației)
Tsuga canadensis (Tisa-Bocicoiu Mare)
Populus nigra - **Black Poplar** (Sighetu Marmației)
Platanus occidentalis - **Plane** (Sighetu Marmației)
Liriodendron tulipifera **Tulip Tree** (Sighetu Marmației)
Juglans nigra - **Black Walnut (**Tisa-Bocicoiu Mare)
Magnolia acumita - **Magnolia** (Tisa-Bocicoiu Mare)

Ukrainian section II.

Date: September 23, 1996

Country: Ukraine

Name of wetland: Upper Tisa between Tyachiv and Vilok

Geographical coordinates: 22° 10’ W - 23° 30’ E, 47° 04’ S - 48 ° 07’ N

Altitude: 113-204 m above Baltic Sea level (a.s.l.)

Area: 36 000 ha

Overview: The floodplain territories of the upper basin part of River Tisa, the largest tributary of River Danube within the Transcarpathian Region of Ukraine, with their remains of unique primary ecosystems (meadow, forest and water-marsh complexes), uncommon flora and fauna, original history and culture of the local population, are of great value on the European scale and can be objects of international environmental concern within the framework of the operating Ramsar Convention.

Wetland type: M, T, U, X

Ramsar Criteria: 1.a, c; 2.b, c, d, 3 b

Map of site included? see Map

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General location: Ukraine, Transcarpathian Region, Uzhgorod district, Tyachiv district, Hust district, Vinogradiv district, Beregova district.

Physical features: In terms of tectonic zoning, this region is situated in several zones. From the village Dilove River Tisa begins to flow in the Central zone of Transcarpathian inter-mountain depression. The sediments of Neogene spread have a flat pitch there, with slightly expressed synclinal structure in the peripheral parts of the zone. A chain of salt domes and brachyanticlinal folds stretch in the middle belt of the zone. Then, in the area of the Hust Gate River Tisa flows along the territory of the Vyhorlat-Huta volcano massif, where bed deposits are basalts and andesites.

In the northwest the Central zone and Vyhorlat-Huta massif join the Pannonian fault zone. The zone is morphologically expressed by the Beregova hills, with various effusive and intrusive Neogene volcano structures attached to it, part of which contains ores. This zone has a horst-like characteristic of the pre-Miocene basement, and the faults surrounding it are of long development and ancient origin.

From the geomorphological aspect, the River Tisa area is surrounded by low Holocene and medium level upper and medium Pleistocene terraces. From the Hust Gate River Tisa begins to flow along the territory of the Pannonian morphostructure which is a part of the large Pannonian middle massif situated principally further to the south (Hungary), and only its northwest districts are within the territory of the Transcarpathian Region. The massif emerged in the place of the upper Mesosoic fold zone. From the Transcarpathian intermountain depression the massif is separated by the zone of faults. Thus, the proposed object is situated in two geomorphological areas i.e. the Transcarpathian lowland and the Pannonian regions.

There are three principal soil features occuring in the territory of the region: meadow and bog soils on alluvium, sodic soils in high floodplain areas and sodic soils on the present-day alluvium (see Appendix). Meadow and bog soils on the alluvium occur in the floodplain areas of River Tisa and its tributaries. They have been formed on alluvial and alluvial-deluvial deposits. The meadow-bog soils on alluvium occur in lowlands where ground waters are at the depth of 40 to 50 cm. There is a bluish grey humus horizon from the surface down to 10-12 cm. The transitory horizon is about 25 cm thick, moderately humified, greyish-blue, with rusty stains, wet, swampy. The soils are highly acidic, pH is 4.0-4.5. The sodic soils on the high floodplain areas have been formed in the terrace of River Tisa and its tributaries, which is situated above the floodplain area within the Transcarpathian lowland and consists mainly of clay and loam alluvium. The humus horizon of brownish grey colour reaches 20 to 25 cm in depth. Its structure is granular and clotty. The eluvial horizon is not marked distinctly, it is of a dusty and clotty structure, its capacity is 10 to 12 cm. The illuvial horizon reaches 110 to 130 cm, has a tough prizmatic nut-shaped structure, markedly gleyed. The pH of the soil varies within the range of 4.0-4.7. The sodic soils on the present-day alluvium have been formed in the floodplain area of River Tisa on sand and loamy sand, sometimes on slight loamy alluvial sediments. The humus horizon of 20 to 30 cm in depth has brownish grey colour, is markedly clotty-granular, mellow, porous, permeable to water. The transitory horizon is still humified enough, mainly stratified, it gradually comes into the parent rock of lighter mechanical composition, it is mostly sand which lays on shingle beds. Its actual acidity is not very high, sometimes it is close to neutral (pH is 4.7 to 6.3).

River Tisa is formed by the confluence of the rivers Chorna and Bila Tisa 4 km upstream from Rahiv. The river's general length is 966 km, its drainage area is 153,000 km^2 (within the boundaries of the Transcarpathian Region: 201 km and 11,300 km^2, respectively). In the section between the town Tyachiv and the village Badalovo, River Tisa flows along the valley which is 3 to 5 km wide within the area of Tyachiv and 8 to 9 km wide in the area down from Vinogradiv.

Down from the town of Hust River Tisa flows through the Hust Gate along a very narrow valley (1.5 km wide). Down from Vilok the river valley is not pronounced. The riverbed is winding, very branched, islands can be found there in high numbers (down to Vilok), while down below Vilok the riverbed is essentially not branched. Along the entire section between Tyachiv and Chop the river is in fact an alternation of deeps and shallows. The length of the shallows is essentially 50 to 200 m, some of them reach 2 km, the length of the deeps is 200-400 m to 1 km, down below Vilok it is up to some kilometres. The width of the river varies from 40-50 m to 80-140 m. The depth of the shallows in the upper part of the section is about 0.5-1 m (the shallowest ones are 0.2-0.3 m), that of the deeps is 1.5 to 4 m; in the lower part of the section the depth of the shallows varies from 0.5-1.2 m to 2.0-2.5 m, that of the deeps from 3 to 6 m, at some places up to 10 m (see Appendix). The velocity of the current at the deeps is 0.2 to0.6 m/sec, while at the shallows it is 0.7 to 2.5 m/sec.
The hydrochemical regime of waters of River Tisa is formed under the influence of both natural (mountain relief with widely spread flysch rocks poor in salts, high humidity, etc.) and anthropogenic factors, and varies within a wide range along the river length, depending on seasonal factors. The river water has important hydrocarbonate-calcium composition and is characterized by low values of mineralization. During floods the degree of water mineralization and hardness vary within the range of 0.2 g/l and 0.8-1.5 mg-eq/l. During the intermediate periods these values rise to 0.4 g/l and 3.8 mg-eq/l. The average turbidity of the river water is 80-85 g/m3, with considerable annual variations, depening on the time and place of observations. The content of ammonium nitrogen in River Tisa water varies from 0.0 to 1.61 mg/l; that of nitrates: from 2.1 to 11.4 mg/l; sulphates: from 19.7 to 51.3 mg/l; chlorides: from 8.52 to 43.2 mg/l; phosphates: from 0.1 to 1.57 mg/l.
Hydrological values: The hydrological regime of River Tisa is formed amidst the complex conditions of the region and embraces piedmont, mountain and plain areas. The water capacity of the river varies essentially during the year and is characterized by a complex discharge hydrograph with many peaks. The spring high water is formed due to thawing snow with simultaneous raining, and consists mainly of several peaks in succession. The highest values are reached mostly in early March or in the middle of March, but may persist till the middle of April to early May. The height of the highest level varies along the river length and amounts 1-5.3 m in the case of an ordinary flood, while it can be 2.5-8.6 m in the case of a high flood. The warm period of the year is characterized by frequent and heavy precipitation which causes 6 to 12 rain floods each persisting 1 to 6 days and characterized by intensive water level raising and delayed abatement. In certain years the height of these floods exceeds the spring flood maximum. Autumn rains cause considerable rising of the level in October-November. The winter floods are caused by intensive snow melting at the times of persistent thaws, and are accompanied by pouring rains. Floods are often of extraordinary character in their amount and intensity and turn into overflows that cause considerable damage to the national economy and threaten human lives. During the last 30 years seven catastrophic floods have been recorded in the region. The

spring discharge makes up 40% of the annual value, the summer-autumn discharge amounts cca. 30%, while the winter discharge makes 30%. During the past years a trend has been noted as to the annual discharge redistribution, the floods making up about 70% of the total annual amount.

The processes taking place in the mountain sections of the riverbed concern mainly down-cutting, while in the piedmont and plain sections lateral erosion types predominate. Maximal solid sediment saturation of waters is observed in the piedmont sections. As a result of reduced velocity of the current when the river comes out of the mountains, a proportion of the sediments deposits, which causes the riverbeds to be unstable, often disfigured and branched. To protect the populated areas and fertile soils from floods, some dikes have been constructed along the river down from the village Velyka Kopanya. Besides, some ring-shaped and oval dikes have been built to shield certain populated areas (Tyachiv, Vyshkovo, down from the village of Kryva). The dikes are reinforced at some places with concrete slabs and stones. Work is carried on to fortify the coastline and to stabilize the riverbed.

Ecological features: Meadow and forest biotopes, wetland biotopes (stagnant basins, riverbanks, etc.) ecotones (shrubs, boundaries, gorges, etc.) and anthropogenic biotopes are mostly spread in this area. The zonality of vegetation is slightly marked, all communities are attached to two altitude belts: those of the Transcarpathian lowland, and of the piedmont.

The main vegetation types are represented by meadow (Molinio-Arrhenarheretea, Festuco-Brometea), forest (Salicetea purpureae, Alnetea glutinosae, Querco-Fagetea, etc.) as well as by water (Lemnetea, Potametea) and wetland (Isoto-Nanojuncetea, Phragmito-Magnocaricetea, Scheuchzerio-Caricetea fuscae) communities. Segetal communities (Bidentetea tripartitae, Galio-Urticetea, Plantaginetea majoris) are also spread to some extent (see Appendix).

Noteworthy flora: The Transcarpathian Lowland is the northeastern part of the Middle Danube Plain, their floras bearing similar features, and the same can be said about the region in question. At present natural vegetation cover has remained here in small patches and occupies only about 30% of the total area, while forest vegetation makes up only 10%. In the flora composition of this region about 1000 aboriginic vascular plant species can be differentiated. The most rich families are Asteraceae, Poaceae, Cyperaceae, Brassicaceae, Caryophyllaceae, Rosaceae, Fabaceae, Ranunculaceae, Apiaceae etc. (see Appendix). They are associated with meadows (flooded, meadow-steppe, boggy, peat), forests (fresh, humid, moist oak groves) and hydrophilic floristic complexes. In the flora of this region more than 50 taxa of endemic, endangered (rare, disappearing) and relic plants occur; 20 syntaxa requiring protection grow there (see Appendix). Most of these species are registered in the Red Data Book of Ukraine (1980), some of them appear on the International Red List (1976).

Noteworthy fauna: The section of River Tisa within the Transcarpathian Region of Ukraine, consisting of a flooded deep and plains with the dead lakes, flooded island forests and basins attached to them, (lakes, dead lakes, etc.) is a place for the concentration of many species of the fauna (see Appendix). The waters of River Tisa and its right-bank tributaries, their flooded parts are inhabited by species registered in the Ukrainian Red Data Book (1994), such as Eudontomyzon danfordi, Leuciscus souffia agassizi, Acipenser ruthenus, Hucho hucho, Umbra krameri, Zingel zingel, Z. streber streber, Gymnocephalus schraester. There are such birds as Sterna hirundo, S. albifrons, Riparia riparia, Merops apiaster, Alcedo atthis, Ciconia nigra, Aythya nyroca, Hieraaetus pennatus. Probably (further field observations are to be made) Falco naumanni and Acrocephalus paludicola also nest there. Besides the above mentioned bird species registered in the Red Data Book, such bird species rarely occuring in the region as Podiceps cristatus, P. griseigena, P. nigricollis, Nycticorax nycticorax, Botaurus stellaris, Ixobrychus minutus, Aythya ferina, Chlidonias nigra, Ch. hybrida, Remiz pendulinus, Motacilla feldegg, etc. nest only there. Before the Transcarpathian passage to the north, hundreds and thousands of geese, ducks, gulls (Anser, Anas, Larus), some species of Charadriiformes, etc. concentrate there. Phalacrocorax carbo also occurs there, as well as various species of herons (Egreta alba, E. garzetta). These places are interesting in the mammalogical aspect as well. Such species registered in the Red Data Book as Myotis nattereri, Mustela erminea, Mustela (Putorius) eversmani, Felis silvestris live there. Invertebrates are represented by the characteristic species Hirundo medicinalis, Leucanus cervus, Papilio machaon, Cerambyx cerdo cerdo, etc.

Social and cultural values: This region is of a great socio-economic importance as regards people having inhabited it for thousands of years. It belongs to the plain-piedmont zone of Transcarpathia, where about 70% of the total population of the region live. The natural resources of the region are used mainly in agriculture, forestry, for fishing and hunting sports, apiculture, recreation, etc.

In the area there are the most ancient archaeological relics of Ukraine, e.g. a site of the earlier palaeoolithic period near the village Korolevo, Vinogradiv district. On an ancient terrace of River Tisa the remains of a human settlement, aged more than one million years, were found. A number of sites revealing evidences of peoples belonging to the middle palaeoolithic period (Mousterian period), mesolithic and neolithic periods have been found. As early as in the first stage of the neolithic period, objects of the Körös type, of painted and incised ware already existed. In the late neolithic period Polgár culture was formed there. In the aeneolithic epoch the culture of corded ware spread widely. In the early Bronze age in the Upper Tisa area Nyírség agriculture and Ottoman bronze culture existed. One of the principal cultures of the middle Bronze age, the Felseshevts culture followed. Then the culture of Thracian Hallstatt civilization started to predominate with the development of iron metallurgy. In the region some outstanding relics of the La Téne culture of the Celts have remained, as well as some of the Getae-Thracian culture. In the Late Roman period there existed an original culture of Carpathian burial mounds. The evidence of Slavic complexes of the early Middle ages is the “Prague” culture of the 6th-7th centuries. The Slavic culture of “Luka Raikovetska” is richly represented in the region.

Land tenure/ownership of:

Authorities	Authorities
Vinogradiv district administration	Beregova district administration
Korolevo village council	Chetovo village council
Velyka Kopanya village council	Dobroselye village council
Rokosovo village council	Borzhava village council
Sasovo village council	Varievo village council
Fanchikovo village council	Badalovo village council
Petrovo village council	Halabor village council
Bobove village council	Tyachiv district administration
Nove Selo village council	Bushtyno village council
Vilok village council	Uzhgorod district administration
Shalanky village council	Solovka village council
Hust district administration	Esen village council
Steblivka village council	Tisaashvan village council
Sokyrnits village council	Chop city council
Vyshkovo village council	
Velyatyno village council	

Current land use: The main territory is the lands of the Transcarpathian lowland and the foothills, which are used for purposes of agriculture, animal breeding, forestry and recreation. Objects of nature protection are found in adjacent territories: there are "Chorna Hora" (747 ha), "Yulivska Hora" (176 ha), "Narcissus Valley" (256.5 ha), "Bihanska Hora" (5 ha), "Beregivske Horbohirya" (33 ha) can be found there, which are protected by the state.

Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:
In recent times a number of catastrophic floods were noted in Transcarpathia (in 1992, 1993, 1995). As a result of the flood during the period between 25-30 October 1992 the central water supply structures were put out of order in Hust, and some dikes were destroyed. In the Hust District 2.7 ha of arable soil were taken off. The next catastrophic flood in the River Tisa basin took place in between 21-24 December, 1993. As a result of the rising water of River Tisa (605 cm at the control range, Tyachiv), considerable damage was caused to the regional economy. In the Tyachiv District, for example, the sewage disposal structures of Bushtyno were flooded. In the Hust region dikes near the villages of Kryva and Vyshkovo were ruined by the water, a considerable part of Hust adjacent to River Tisa was flooded. The central water supply structures and the town sewage disposal station were put out of order. Some sections of the highways between Rokosovo and Hust, Hust and Sokyrnitsa were ruined by the water. 1660 m of dikes, 26 bridges, 32.2 km of highways were ruined as a result

of that flood. A furniture factory in the Vinogradiv District, the sewage disposal structures of the Vilok woodworking factory, and considerable areas of agricultural crops were flooded. In the Hust and Vinogradiv Districts only the damage was estimated at 42.4 billion karbovanets (in 1993 prices). The last flood was on 27-28 April, 1995. In the Hust District a newly built dike was ruined between the villages of Rokosovo and Kryva. Agricultural areas were flooded, a bridge near the village Dragovo was damaged. A "Complex Programme for taking flood-preventing measures in the Transcarpathian Region for 1994-2000" has been developed with the aim to take preventing measures against floods in the territory of the region, to reduce the enormous expenditures for covering the damage to economy, caused by the elements. The Programme includes primary (1994-1995) and long-term (until 2000) measures to save the territory of the region from floods. These measures encompass both administrative actions on district and interdistrict levels, and, specifically, professional work.

Conservation measures taken: There are 3 objects of natural reserve in the suggested territory, and 9 mineral water sources. They include (see Appendix):
"Atak" natural landmark, its area is 52 ha, it is a natural monument of state level; an object located in the territory of Beregova State Forestry; it was established to protect the places of highly productive oak and ash-tree stands in the River Borzhava floodplain area.
"Borzhava" protected natural landmark. Oak and ash-tree forests of artificial origin grow there. Its area is 205 ha. The main part of the territory is a floodplain area.
"Velyky Lis" (Big Forest) natural monument of local level, its area is 1.5 ha, located in the territory of Vinogradiv State Forestry. It was established to protect the sites of ivy occurrence in the oak stands. The territory is a floodplain area.

Conservation measures proposed but not yet implemented: In the suggested territory new objects of nature protection are planned to be established. Those are:
Environs of the village Yablunivka, Tyachiv district. It is a group of isles along the channel line of River Tisa from where the state boundary with Romania stretches to the south of the river, to the place of the confluence with River Teresva. Colonies of the mallard are located there, nestings of the little ringed plover and Chorna stork occurrence were also noted there.
Environs of the villages of Sokyrnitsa and Steblivka. There are the Boronyava lakes belonging to the fish-breeding farm, and a boggy lake in the right side floodplain area of River Tisa. Botarus stellaris, Podiceps cristatus, Aythya nyroca, etc. occur there.
A section of River Tisa between Hust and the village of Kryva. Forests are located there, situated just at the left bank of River Tisa. Chorna stork and bank swallow occur there.
Environs of the villages of Drotyntsi and Hetynya. There are a group of isles along the channel line of River Tisa as well as a deep between the anti-flood

dikes. A colony of the little ringed plover, bank swallows, gulls, great and little Bila herons are found here.

"Trosnyk" (100 ha). The area consists of flooded forests and lakes with rare flora and fauna.

"Variyivsky Lis" (Variyivo Forest) (800 ha). There are flooded oak and ash-tree forests there with rare flora and fauna.

Current scientific research and facilities: For the last five years the region has drawn special attention of naturalists. Among the most important research projects some principal ones can be noted:

1. Structure and functional characteristics of River Tisa water ecosystems (Transcarpathian Ecocentre of Transcarpathian Regional State Administration, 1992). Performers: Institute of Hydrobiology NAS of Ukraine, Uzhgorod State University).
2. Ecological optimization of natural ecosystems management in the plain part of Transcarpathia (Ministry of Higher Education of Ukraine, 1993-1994). Performer: Uzhgorod State University.
3. Inventory of endangered plant species and plant communities of River Tisa lowland (Ministry of Higher Education of Ukraine, 1995). Performer: Uzhgorod State University.
4. Combined studies of zoocenoses of typical natural ecosystems in the Transcarpathian Plain and development of their present-day ecomanagement and protection (Ukrainian State Committee on Science and Technology, 1994-1996). Performer: Uzhgorod State University.
5. NGO's proposals on establishing a Transboundary Nature Conservation Area in the Upper Tisa Region (Regional Environmental Centre, 1995-1996). Performer: Carpathian Ecological Club, Ruthenia.

Current conservation education: Within the framework of ecological education of the inhabitants of the region, staff of the Uzhgorod State University and the Carpathian Ecological Club carried out a campaign in 1995-1996, popularising of the ideas of biodiversity conservation, during which 5 articles were published in regional newspapers in Ukrainian, Hungarian and Russian, two radio programmes were made on these materials. An international-regional conference was held in which scientific, non-governmental, administrative organizations and institutions took part. The conference was devoted to the sustainable development of Transcarpathia and, in particular, the region where the bulk of the regional agricultural production is concentrated. The proceedings of the conference have been published ("Sustainable agricultural development and biodiversity conservation" edited by V. Kricsfalusy In: »Proceedings of international-regional conference«. - Uzhgorod, Patent, 1996.- 130 p.), and the regional press gave some publications about the conference.

Another aspect of ecological education is the activity practised by the Uzhgorod club of ornithologists who, for already 5 years now, have organized summer ornithological camps for schoolchildren in June. The theme "Birds of flooded areas of the Transcarpathian Lowland" has been included in the camp work programme, in accordance with which camp members from the main centre located in the piedmont, visit the flooded area of River Latoritsa where they study the specific composition of waterfowl and waders. In the upper Tisa areas ecological camps are also organized annually (in August) by the Transcarpathian ecological naturalist centre for youth. Young people can, there, learn about the diversity of biocenoses in the areas surrounding River Tisa, the problems of their conservation and protection. This practice has been popularised by TV, in newspapers and magazines. A booklet has been published on the methods of the ornithological camp work: A. Lugovoy, A. Gerevich: “Organization and work of school ornithological camp in Transcarpathia” Uzhgorod, 1993, 13p.

Current recreation and tourism: The picturesque plain landscapes and surface waters of rivers, lakes, artificial basins are the basic recreational resources of this region. These waters are used for swimming, water tourism (rafting, catamarans, etc.), and other sports. The main recreation centres are the environs of Chop (River Tisa), Beregova (River Borzhava), Vinogradiv (River Tisa), Hust (River Tisa, River Rika) and Tyachiv (River Tisa). However, the level of organized tourism is rather low. Tourist centre is present only in Hust, called “Nartsis”, which offers one-day floating tour on rafts down River Tisa, and a bus tour “Along River Tisa”.

Jurisdiction: The protected natural objects of the Carpathian Biosphere Reserve are subordinated to the Ministry of Natural Environment Protection, other protected nature objects are subordinated to the administration of forestry and to local councils. There are private and collective agricultural farms subordinated to the Regional Department of Agriculture. The suggested objects located in River Tisa mouth will be subordinated to the “Zakarpattyameliovodhosp” production association and to the local Councils of People’s Deputies.

Management authority: The main administrative structures of this area are the state bodies of power:

Tyachiv District state administration - 295710, Tyachiv, Lenin Str. 22;
Hust District state administration - 295600, Hust, Pyatdesyatiricha Zhovtnya Str. 27;
Vinogradiv District state administration - 295540, Vinogradiv, Lenin Sq. 5;
Beregova District state administration - 295510, Beregova, Mukachivska Str. 3;
Uzhgorod District state administration.- 294000, Uzhgorod, Fizkulturna Str.;
Regional administration for agriculture and food production - 294000, Uzhgorod, Kotsubinskoho Str. 2 “a”;
Regional administration of forestry - 294008, Uzhgorod, Narodna Sq. 4;
State Department of Nature Protection in Transcarpathia - 294008, Uzhgorod, Narodna Sq. 4;
Production association “Zakarpattyameliovodhosp” - 294017, Uzhgorod, Zahorska Str. 61 “a”.

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Appendix

Physical features

Place of observation	Water levels		Water level fluctation Amplitude
	lowest	highest	
1. Tyachiv	- 54 cm 12.12.1973	694 cm 30.12.1947	748 cm
2. Hust	- 25 cm 08.08.1995	426 cm 14.05.1970	451 cm
3. Vilok	- 242 cm 11.09.1984	696 cm 14.05.1970	938 cm

Table 2. Concentrations of polluting substances in River Tisa

№	Place of sample taking	Suspended substances mg/l	Chlorides mg/l	Sulphates mg/l	Biological requirement of oxygen mg/l	Synthetic superficially active substances mg/l	Ammonia nitrogen mg/l	Nitrate nitrogen mg/l	Nitrite nitrogen mg/l	Phosphates mg/l
1	Tyachiv	3.00	35.90	21.60	2.29	0.032	0.06	2.60	0.024	-
		35.75	26.40	21.10	3.80	0.025	0.35	5.20	0.053	0.50
		25.08	26.67	31.23	2.32	0.035	0.89	3.44	0.027	0.02
2	1 km downward from Hust	2.30	25.70	18.00	1.98	0.010	-	0.625	0.030	-
		103.00	10.25	19.45	3.71	0.020	0.50	5.55	0.020	0.40
		28.70	12.35	28.80	2.80	0.011	1.33	2.175	0.006	0.066
3	Vilok	26.25	38.15	21.44	2.93	0.024	0.19	5.46	0.070	0.32
		9.90	17.09	19.92	3.23	0.011	0.25	6.30	0.045	0.41
		29.19	25.97	30.79	2.41	0.026	1.55	6.21	0.006	0.096

Table 3. Physical and chemical characteristics of principal soil types

Soil type	Depth of horizon (cm)	Humus (%)	pH KCl	Absorbed cations (mg-equiv. per 100 g soil)		Exchange acidity (mg-equiv. per 100 g soil)	
				Ca^{2+}	Mg^{2+}	H^{+}	Al^{3+}
Meadow soddy-gley	0-3	5.8	3.7	7.3	5.2	5.51	31.50
	3-13	3.6	3.7	7.0	4.8	5.34	29.79
	13-33	2.3	3.8	6.4	3.8	4.73	27.36
	33-83	1.1	3.8	5.2	3.0	4.21	29.27
Meadow soddy	0-3	4.7	4.5	7.8	4.8	5.68	31.27
	3-18	2.4	4.6	8.6	5.6	5.14	30.18
	18-88	2.1	4.8	9.0	6.1	4.98	28.12
	88-106	1.4	4.1	9.3	6.5	4.90	20.16

Noteworthy fauna

Annotated list of vertebrate fauna

Pisces

Acipenseridae		
	Acipenser ruthenus L.	
Salmonidae		
	Salmo trutta morpha fario L.	*S. irideus* G.
	Hucho hucho L.	
Thymallidae		
	Thymallus thymallus L.	
Esocidae		
	Esox lucius L.	
Umbridae		
	Umbra crameri W.	
Cyprinidae		
	Carassius carassius L.	*Cyprinus carpio* L.
	Barbus barbus L.	*Alburnus alburnus* L.
	B. meridionalis petenyi H.	*A. bipunctatus* Bloch
	Gobio gobio Flem.	*Scardinius erythrophtalmus* L.
	G. frici Vlad.	*Ruthilus ruthilus* L.
	G. uranoscopus Ag.	*Vimba vimba* L.
	Leuciscus cephalus L.	*Abramis brama* L.
	L. idus L.	*A. sapa* Pall.
	L. leuciscus L.	*Plecotus cultratus* L.
	L. agassizi Heck.	*Chondrostoma nasus* L.
	Tinca tinca L.	*Aspius aspius* L.
	Rhodeus sericeus Pall.	*Blicca bjoerkna* L.
	Phoxinus phoxinus L.	
Misgurnidae		
	Cobitis taenia L.	*Nemachilus barbatutus* L.
	C. montana Vlad.	*Misgurus fossilis* L.
Siluridae		
	Silurus glanis L.	
Amiuridae		
	Ameiurus nebulosus L.	
Percidae		
	Perca fluviatilis L.	*Lucioperca lucioperca* L.
	Zingel zingel L.	*Acerina cernua* L.
	Z. streber St.	*A. schraetser* L.
Cobitidae		
	Cottus gobio L.	*C. poecilopus* Heck.
Gadidae		
	Lota lota L.	
Anguillidae		
	Anguilla anguilla L.	

Petromyzonidae

Lampetra danfordi R.	*L. fluviatilis* L.

Amphibia

Salamandridae

Triturus alpestris Laur.	*T. cristatus* Laur.
T. montandoni Boul.	*T. vulgaris* L.
Salamandra salamandra L.	

Discoglossidae

Bombina variegata L.	*B. bombina* L.

Pelobatidae

Pelobatus fuscus Laur.

Bufonidae

Bufo viridis Laur.	*B. bufo* L.

Hylidae

Hyla arborea L.

Ranidae

Rana ridibunda Pall.	*R. lessonae* Cam.
R. arvalis Nilss.	*R. dalmatina* Bonop.
R. temporaria L.	

Reptilia

Emydidae

Emys orbicularis L.

Anguidae

Anguis fragilis L.

Lacertidae

Lacerta agilis L.	*L. viridis* Laur.
L. vivipara Jack.	

Colubridae

Natrix natrix L.	*Vipera berus* L.
N. tessellata La.	*Elaphe longissima* Laur.
Coronella austriaca Laur.	

Aves

Podiceps griseigena Bodd.	*Athene noctua* Scop.
P. cristatus L.	*Alcedo atthis* L.
Ardea cinerea L.	*Upupa epops* L.
Egretta alba L.	*Picus viridis* L.
Nycticorax nycticorax L.	*Dendrocopos major* L.
Ixobrychus minutus L.	*D. minor* L.
Ciconia ciconia L.	*Riparia riparia* L.
C. nigra L.	*Hirundo rustica* L.
Platalea leucorodia L.	*Delichon urbica* L.
Cygnus olor Gm.	*Oriolus oriolus* L.
Anser anser L.	*Garrulus glandarius* L.

A. albifrons Scop.
A. fabalis Lath.
Anas platyrhynchos L.
A. crecca L.
A. acuta L.
A. querquedula L.
Aythia ferina Pall.
A. nyroca Gould.
A. fuligula L.
Bucephala clangula L.
Mergus merganser L.
Aquila pomarina Brehm
Hieraeetus pennatus Gm.
Circus aeruginosus L.
Milvus migrans L.
Buteo buteo L.
B. lagopus Pontopp.
Accipiter gentilis L.
A. nisus L.
Falco tinnunculus L.
F. subbuteo L.
Perdix perdix L.
Coturnix coturnix L.
Phasianus colchicus L.
Grus grus L.
Crex crex L.
Fulica atra L.
Gallinula chloropus L.
Charadrius dubius Scop.
Vanellus vanellus L.
Tringa ochropus L.
T. glareola L.
T. nebularia Gunn.
T. erythropus Pall.
T. totanus L.
Calidris alpina L.
Scolopax rusticola L.
Larus canus L.
L. argentatus Pontopp.
L. ridibundus L.
Chlidonias nigra L.
Sterna hirundo L.
S. albifrons Pall.
Columba palumbus L.
Streptopelia turtur L.
S. decaocto Frivald.
Cuculus canorus L.
Asio otus L.
Pica pica L.
Corvus corax L.
C. corone cornix L.
C. frugilegus L.
C. monedula L.
Remiz pendulinus L.
Parus major L.
P. coeruleus L.
P. atricapillus L.
Sitta europaea L.
Cinclus cinclus L.
Troglodytes troglodytes L.
Saxicola torquata L.
Phoenicurus ochruros Gm.
Luscinius luscinius L.
L. megarhynchos Brehm
Turdus iliacus L.
T. viscivorus L.
T. pilaris L.
T. merula L.
Phylloscopus collybita Vieill.
Ph. sibilatrix Bechst.
Acrocephalus scirpaceus Herm.
A. arundinaceus L.
A. palustris Bechst.
A. schoenobaenus L.
Locustella fluviatilis Wolf.
Sylvia borin Bodd.
S. atricapilla L.
S. communis Lath.
Regulus regulus L.
Prunella modularis L.
Motacilla cinerea Tunst.
M. flava L.
M. alba L.
Lanius collurio L.
L. excubitor L.
Sturnus vulgaris L.
Emberiza citrinella L.
E. schoeniclus L.
Passer domesticus L.
P. montanus L.
Fringilla coelebs L.
F. montifringilla L.
Cannabina cannabina L.
Carduelis carduelis L.
Carduelis chloris L.
Pyrrhula pyrrhula L.

Mammalia

Erinaceidae		
	Erinaceus europaeus L.	
Talpidae		
	Talpa europaea L.	
Soricidae		
	Sorex araneus L.	*Neomys fodiens* Pena
	S. minutus L.	*N. anomalus* Cab.
	S. alpinus Schin.	*Crocidura suaveolens* Pall.
		C. leucodon Herm.
Rhinolophidae		
	Rhinolophus ferrumequinum L.	*Rh. hipposideros* Bechs
Vespertilionidae		
	Myotis blythi L.	*Nyctalus noctula* Sh.
	M. myotis Borkh.	*Vespertilio serotinus* Schreb.
	M. daubentoni Kuhl	*Plecotus auritus* L.
	Pipistrellus pipistrellus Schreb.	*P. austriacus* Fish
Lepidae		
	Lepus europaeus Pall.	
Sciuridae		
	Sciurus vulgaris L.	
Gliridae		
	Glis glis L.	*Muscardinus avellanarius* L.
	Pryomes nitedula Pall.	
Muridae		
	Apodemus agrarius Pall.	*Mus musculus* L.
	A. sylvaticus L.	*Micromys minutus* Pall.
	A. flavicollis Melch.	*Rattus norvegicus* Berk.
Cricetidae		
	Cricetus cricetus L.	*Ondatra zibethica* L.
	Arvicola terrestris L.	*Microtus arvalis* Pall.
Canidae		
	Canis lupus L.	*Vulpes vulpes* L.
Mustelidae		
	Mustela nivalis L.	*Mustela lutreola* L.
	Martes martes L.	*Lutra lutra* L.
	Meles meles L.	
Felidae		
	Felis sylvestris L.	
Artiodactyla		
	Sus scrofa L.	*Capreolus capreolus* L.
	Cervus elaphus L.	

Conservation measures

Characteristics of existing natural reserve objects

1) The “Atak” reserve is a botanical natural monument of state level. Its total area is 52 ha. It was established in accordance with the decision by the Executive Committee at the Regional Council of People’s Deputies, on 16 November 1969. Situated on a conventional island between the rivers Velyka Borzhava and Mala Borzhava, it is virtually a remaining section of lowland oakeries. The yearly aggcounciltions with fertile brown soil contribute to the formation of productive mixed groves of the nitratophilous type. Fresh, moist hornbeam groves, moist and wet ash-tree groves and elm groves are common there. In the undergrowth there is hazel, European euonymus, water elder, Tatarian maple, English and single-seed hawthorn, alder buckthorn. Grass cover is represented mainly by the megatrophic and hydrophylous species. Ivy is common everywhere in this place, forming continuous thickets. The main value here is the natural occurrence of the narrow-leaved ash in the ash grove communities. This is a mediterranean species which rarely occurs in the plains of Transcarpathia.

2) The “Borzhava” reserve is of local importance. Its total area is 205 ha. It was established in accordance with the decision of the Executive Committee at the Regional Council of People’s Deputies, reg. # 270, 18 October 1983. The reserve is situated along River Borzhava and consists of planted oak stands with admixtures of the narrow-leaved ash, aged 120-140 years. In the grass cover ramson and other rare plant species grow. The wide distribution of the ivy is characteristic of this place. The main value here are the planted stands which are equal to natural woods and are of great importance for seed selection.

Current scientific research and facilities

The Upper Tisa Project

1993
First draft

The goal is to ecologically optimise the natural ecosystem management in the lowlands of Transcarpathia, aiming at establishing the “Upper Tisa” International Park.

The project has been backed by the:

EEB - European Environmental Bureau of the European Community of Central and Eastern Europe
WWF - World Wild Fund for Nature
REC - Regional Environmental Centre for Central and Eastern Europe
CEE WEB - Working Group for Enhancement of Biodiversity for Central and Eastern Europe

EPCE - Environmental Partnership for Central Europe
ECOLOGICAL BRICKS - Initiative for Common House of Europe
FNNPE - Federation of Nature and National Parks of Europe
DNR - Deutscher Naturschutzring Bundesverband fur Umweltschutz (Germany)
VERONICA - Ecological Centre SOP (Czech Republik)
IEC - Independent Ecological Centre (Hungary)
REFLEX - Environment Protection Society (Hungary)
SZOPK - Slovak Union of Nature and Landscape Protectors (Slovakia)
TISZA KLUB - for Environment and Netware (Hungary)

1993-1995

Fostering international co-operation, developing the joint Upper Tisa project with Hungarian, Slovak and Roumanian NGOs

The project becomes member of the International Carpathian Bridge (ICB), the association of NGOs of the Carpathian Euroregion

1995-1996

Second draft

NGOs proposals were released on establishing a Transboundary Nature Conservation Area in the Upper Tisa Region, in Hungarian-Romanian- Slovak-Ukrainian co-operation (Regional Environmental Center, Earmarked Grant Program).

Presentations of the Project

International conference: The East Carpathians' Fauna: its present state and prospects of preservation (Uzhgorod, Ukraine: September, 1993).

Deutscher Naturshutzring Seminar (Galati, Romania: October, 1993).

A Magyar Tudományos Akadémia Szabolcs-Szatmár-Bereg Megyei Tudományos Testületének ülése (Nyíregyháza, Hungary, November, 1994).

1st International-regional conference on environmental development (Nyíregyháza, Hungary, April, 1996).

Publications on the Project

Kricsfalusy V. - Melika G.: About the necessity of establishing International Park "Upper Tisza" in the Central-East Europe- The 41th Working Session of the Special Commitee of National Parks and Protected Areas of IUCN: Abstracts.- Beijing (China), 1993, p. 78. [In English].

Melika G. - Kricsfalusy V.: The necessity of protecting natural ecosystems of the Transcarpathian lowland as unique ecosystems of Europe - Szegedi ökológiai napok. 24 Tiszakutató ankét.- Szeged (Hungary), 1993, old. 17. [In English].

Melika G. - Kricsfalusy V. - Krochko Yu. et al.: Unique natural ecosystems of the Transcarpathian lowlands and the necessity of their protection - The East Carpathians' fauna: its present state and prospects of preservation: Proceed. Inter. Conf.- Uzhgorod (Ukraine), 1993, p. 33-42. [In Ukrainian].

Melika G. - Kricsfalusy V. - Krochko J. et al.: The necessity of protecting Transcarpathian oak forests as unique ecosystems of Europe - The East

Carpathians' fauna: its present state and prospects of preservation: Abstr. Inter. Conf..- Uzhgorod, 1993, p. 36. [In English].
Kricsfalusy V. - Melika G. (1993): Ecological optimization of management of natural ecosystems in the Transcarpathian lowland.- Rakhiv (Ukraine), p. 41-43. [In Ukrainian].
Melika G. - Kricsfalusy V. - Krochko J. et al.: Ecological optimization of natural ecosystems management in the lowlands of Transcarpathia and the prospects of establishment of a Trilateral International Park "Upper Tisa"- CERECO'94. The 1st Conference on Carpathian Euroregion. Ecology.- Uzhgorod, 1994, p. 59. [In English].
Melika G. - Kricsfalusy V. - Krochko J. et al.: The necessity of preserving the Transcarpathian Lowland oak forests - Materials of the 46 scientific-technical conference of the Ukrainian State Forestry University.- Lviv (Ukraine), 1994, p. 153-155. [In Ukrainian].
Kricsfalusy V. - Melika G.: About the necessity of establishing the International Park "Upper Tisza" in Central-Eastern Europe- Anthropization and environment of rural settlements. Flora and vegetation: Proceedings of International Conference.- Sátoraljaujhely (Hungary), 1994, p. 58-66. [In English].
Kricsfalusy V. – Mezõ-Kricsfalusy G.: International nature conservation area "Upper Tisza": modern state and perspective for future.- 1st International-regional conference on environmental development: Abstracts.- Nyíregyháza, 1996, p. 15. [In English and Hungarian].

Information about the Project

European Environmental Bureau Newsletter No. 5, July-August, 1993. [In English].
Kricsfalusy V. - Melika G. - Lugovoj O.: Bieszczady Region. Ecological Bricks N.10 - In: H. Roth. Update of Ecological Bricks for Our Common House of Europe.- Vienna: GCN, 1994, p. 33-35. [In English].
Borbely A. M.: Tisza: NGOs show the way - Danube watch (The newsletter of the environmental programme for the Danube river basin), 1995, vol. 1, No.5. [In English].
Balogh I.: A folyók nem ismernek határokat... (Rivers do not know of borders) - Beregi Hírlap, 1995, augusztus 31. [In Hungarian]
Balogh I. International expedition on River Tisa: investigations in Transcarpathia- Visnyk Berehivschyny, 1995, august 31. [In Ukrainian].
Common interest of four states - Kelet-Magyarország (LIII évf., 75 sz.), 1996, March 29. [In Hungarian].
The Záhony locality was discussed - Kelet-Magyarország (LIII évf., 76 sz.), 1996, March 30. [In Hungarian].
Mihály A.: Nature does not know of borders - Sribna Zeml'a-fest, 1996, May 9-15. [In Ukrainian].
Kricsfalusy V. Four states - one aim - Novyny Zakarpattya, 1996, June 9. [In Ukrainian].

Hungarian section I.

Date: October 12, 1996

Country: Hungary

Name of Wetland: Upper Tisa[1] between Vásárosnamény and Tiszabecs

Geographical Coordinates: 48° 06’ 08’’ N 22° 35’ 20’’ E (center of the site)

Altitude: 115.9 m at Tiszabecs and 102.3 m at Vásárosnamény (average: 109.1 m), as compared to the level of the Baltic Sea

Area: 5 500 ha

Overview: The wetland is a typical floodplain between dikes which were built during the end of the 19th and the first half of the 20th centuries. The highly natural and near-natural habitats consist of large patches of soft wood gallery forests (Salicetum albae-fragilis) and hard wood gallery forests (Querqo-Ulmetum), oxbow lakes, filled-up meanders with rich natural flora and fauna, wild or near-wild orchards and plough-lands. The wetland is natural, without significant disturbance by human activities and it has an important role as an extended “green corridor” in the movement and migration of many plant and animal groups in the region.

Wetland Type: M, T, X

Ramsar Criteria: 1.c; 2.b; 2.c

Map of site included?: see Map

Name and address of the compiler of this form:
Tibor Szép, Upper Tisza Foundation, Nyíregyháza, Hungary
with Zoltán Dobány, Kocsis Gáborné, András Légány, Zsolt Nagy, Ágnes Szomolya, Miklós Tóth

General Location: Located in the floodplain along River Tisa between the Hungarian-Ukrainian border (744.8 river km) and the confluence with River Szamos (686 river km). The site is located in Szabolcs-Szatmár-Bereg county, with the nearest towns being Fehérgyarmat and Vásárosnamény.

[1] The Hungarian name of the river is Tisza

Physical features: The site is a basin of recent subsidence, made up of fluvial plains. The soil types are mixtures of Holocene fluvial sediments such as fluvial sand, gravel, floodplain mud, freshwater lime mud. The river carries fine gravel with sand in the reach between Tiszabecs and Tivadar. The river has strong meandering and incision characteristics, with a large number of undercut steep banks. Climatically it is a moderately warm region with insufficient precipitation in the growing season, and with moderately dry, cold winters. The average number of hours with sunshine is 1950-2000 per year, the average temperature is 9.5-10 Co, and the average annual rainfall is 600-700 mm. The size of the catchment area is 13,173 km2. The average difference between high and low water levels of the river is 8 m. The most intensive flood times are April (snow melting), occasionally June ("green flood" caused by heavy spring rainfall) and between December and January. The lowest water level occurs between August and September.

Hydrological values: There are regular and heavy floods, mainly in April, following snow-melting in the catchmentarea, and the occurrence of heavy floods in June-July and late autumn, caused by intensive precipitation, is not rare either. The average difference between high and low water levels is 485 cm with a maximum of 930 cm. Because of the high risk of flooding, a huge dike system has been constructed in the middle of the 19th century.

The frequency and intensity of floods has an important impact on the condition of oxbow lakes in the flooded area. During the past few decades, there have been dry periods with the water level being lower than the average, and the "washing out" function of the flood could not work properly in the oxbows. As a consequence, eutrophication has been becoming more intense.

Ecological Features: The types of habitats and vegetation are closely related to the typical riparian land. Because of river regulations, the size and distribution of these habitats have decreased significantly during the last hundred years. However, in the present situation the remaining fragments of these habitats are able to keep their basic features.

Soft-wood riparian forest (Salicetum albae-fragilis): consists of the species Salix alba, Salix fragilis, Populus alba, and P. nigra. This habitat is common in this wetland and the number, size and distribution of this habitat have an important role in the general ecological function of the wetland. The following internationally and nationally important typical bird species breed in this habitat: Egretta garzetta, Ardeola ralloides, Nycticorax nycticorax, Ardea cinerea, Ciconia nigra, Milvus migrans, Luscinia luscinia.

Willow bushes (Salicetum triandre): consist of Salix triandra, S. purpurea, S. fragilis, S. viminalis.

Hard wood riverside forests (Querqo-Ulmetum), oxbow lakes, filled-up meanders with rich natural flora and fauna, wild or near-wild orchards.

Noteworthy flora: The most important values in the flora are natural soft-wood forests (Salicetum albae-fragilis) and hard-wood (Querceto Fraxineto-Ulmetum) riparian forests, whose size and numbers provide ample opportunity for the survival of its original flora and fauna and for the natural re-colonization of the surrounding artificially altered areas in the flood zone.

Protected plant species in the area:
Salix eleagnos
Iris pseudacorus
Leucojum aestivum
Leucanthemum serotinum
Nymphaea alba
Salvia natans
Nymphoides peltata

Noteworthy fauna: Because of the lack of extensive biological investigation in this area, we presently have proper data for the avifauna only.
Crex crex, 2-10 pairs in the grassland habitats
Ciconia nigra, 2-5 pairs
Pernis apivorus, 2-5 pairs
Milvus migrans, 1-2 pairs
Ardea ralloides, 3-5 pairs
Egretta garzetta, 15-30 pairs
Nycticorax nycticorax, 45-50 pairs
Coracias garrulus, 4-5 pairs
Luscinia luscinia, 6-8 pairs
Columba oenas, 4-5 pairs
Alcedo atthis, 30-40 pairs
Riparia riparia, 200-500 pairs
Corvus corax, 10-20 pairs

Social and cultural values: The fish fauna is rich, providing opportunity for traditional fishing. Because of the natural conditions, the area provides a unique opportunity to study both the structure and function of a riverside ecosystem and the ecological and behavioural characteristics of both the populations and the communities of animals and plants in an undisturbed setting.
The area has great importance for environmental education. Because of the presence of large and diverse habitats, there are many options for the hands-on presentation of the structure and function of the ecosystems both to the students and others, using proper methodology and, thus, without causing almost any damage.

Land Tenure / ownership:
(a) The ownership structure of the proposed sites is a mixture of state, private and co-operative possessions.
(b) Similarly, the ownership structures of the surrounding areas are state, private and co-operative.

Current Land Use:
Site:
Forestry, unfortunately with extended plantation of hybrid poplar.

Agriculture, mainly with fast-growing plants because of the intensive and common flooding.
Orchards for which soil and climate are adequate.
Grazing and harvesting of hay
Tourism, canoe trips along the river, sandy beach resorts and related businesses, development of concentrated guest-house areas and village tourism
Hunting (mainly for wild boar, pheasant, ducks and hare)
Fishing

Surrounding / catchment:
Forestry, with extended plantation of hybrid poplar.
Agriculture, mainly with fast-growing plants because of the intensive and common flooding.
Orchards for which the soil and climate are adequate.
Grazing and harvesting of hay
Tourism, village tourism
Hunting (mainly for wild boar, pheasant, ducks and hare)
Fishing

Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:
The uncontrolled development of guest-houses, beaches and related activities threaten most significantly the previously untouched areas.
The intensity of forest felling has increased since 1990. As a result, the fragmentation of the riverside forest habitats is getting close to a dangerous level for the species living in those habitats.
The proportion of areas with hybrid poplar plantation as compared to naturally growing riverside forests is increasing, resulting in effects similar to those of deforestation.
The increasing volume of treated sewage water and the nutrients it carries pose a potential risk for the river and its streams and oxbows.
Uncontrolled fishing activities in the oxbows, introduction of non-native fish species, overloading, littering and disturbance by anglers.
Growing and uncontrolled tourism along the river and on the beaches result in significant littering and disturbance in the formerly silent and clean habitats.
Areas between the dikes need unique conservation-oriented land management policy in order to achieve effective protection.
Unresolved communal garbage management; no proper dumpsites.
Uncontrolled land management; there are no local and regional development plans with special attention to the requirements of nature conservation.

Conservation measures taken: The Szatmár-Bereg Landscape Protection Area, which covers some part of the proposed area between Nagyar and Olcsvaapáti was established in 1982. Now it is evident that the size and distribution of the areas presently protected are not adequate for the effective conservation of riverside habitats. The current protection presents little opportunity for limiting and regulating agricultural, forestry and developmental activities. The Landscape Protection Area is supervised by the Hortobágy National Park.

Conservation measures proposed but not yet implemented: The “Alföld Program” of the Hungarian Government has implemented a special sub-program for River Tisza. This originates from the recognition of the essential role of the river in the structure and function of the Hungarian Lowlands and from an understanding of the high ecological values of the river and habitats along it. This program has identified the most important sites along the river with the aim of controlling further developments.

Current scientific research and facilities: Currently, there is a scientific research investigation in progress, focusing on the “Environmental changes and evolutionary responses of the migrating birds” by Tibor Szép, Hungarian Ornithological Society (Hungarian Scientific Research Fund (OTKA) # F17709, 1995-1998).
Some studies on Odonata are being conducted by NGOs (Kossuth Lajos University, Debrecen).
HNP management planning for the Szatmár-Bereg LPA

Current conservation education: Szabolcs-Szatmár-Bereg county holds a leading role in nature protection education in Hungary. However, in this part of the county there is no significant environmental education. There is no visitor center, nor are there publications and hides related to River Tisa and its habitats, flora and fauna. Although the Szatmár-Bereg Landscape Protection Area has its own visitor center in Fehérgyarmat, in its exhibition it does not focus on the river.

Current recreation and tourism: At present, there is very intensive and unfortunately uncontrolled canoe tourism during the summer period crowded, uncontrolled beach tourism in Tivadar and Vásárosnamény, and increasing tourism in various villages developing, but low level village tourism along the river in the summer period

Jurisdiction: Hortobágy National Park, 4024 Debrecen, Sumen u. 2.,

Management authority: Upper-Tisa Water Management Authority, 4400 Nyíregyháza, Széchenyi u. 19.

References

Legány, A., Kónya, J., Vértes, I. Data on the Avifauna of the Tisa region in Szatmár-Bereg. Tiscia (1977): 12:131-139.

Szép, T. (1991): A Tisza magyarországi szakaszán fészkelõ partifecske (Riparia riparia (L.), 1758) állomány eloszlása és egyedszáma. (Number and Distribution of the Hungarian Sand Martin Population Breeding along the Hungarian Reaches of the River Tisza) Aquila, 98: 111-124.

Hungarian section II.

Date: October 20, 1996

Country: Hungary

Name of wetland: Upper Tisa[1] between Záhony and Vásárosnamény

Geographical coordinates: 48° 14' 36'' N 22° 16' 52'' E (center of the site)

Altitude: 97.3 m at Záhony and 102.3 m at Vásárosnamény (as compared to the level of the Baltic Sea)

Area: 3 200 ha

Overview: The wetland is a typical and much wider flood plain than that along the upper part of the river, between the dikes which were built during the end of the 19th and the first half of the 20th centuries. The highly natural and near-natural habitats consist of the largest patches of soft wood riparian forests (*Salicetum albae-fragilis*) to be found along the Upper Tisa. Hard wood riparian forests (*Querqo-Ulmetum*) do not exist here. There are oxbow lakes, filled-up meanders with rich natural flora and fauna, and plough-lands. The wetland is natural, without significant disturbance by human activities and it has an important role as an extended "green corridor" in the movement and migration of many plant and animal groups in the region.

Wetland type: M, T, X

Ramsar criteria: 1.c; 2.b, 2.c

Map of site included? see Map

Name and address of compiler:
Tibor Szép, Upper Tisza Foundation, Nyíregyháza, Hungary
with Zoltán Dobány, Kocsis Gáborné, András Légány, Zsolt Nagy, Ágnes Szomolya, Miklós Tóth

General Location: Located in the floodplain along River Tisa between Záhony (628 river km) and the confluence with River Szamos (686 river km). The site is located in Szabolcs-Szatmár-Bereg county, with the nearest towns being Vásárosnamény, Kisvárda and Záhony.

[1] The Hungarian name of the river is Tisza

Physical features: The site is a basin of recent subsidence, made up of fluvial plains. The soil types are mixtures of Holocene fluvial sediments such as fluvial sand, floodplain mud, freshwater lime mud. The river has strong meandering and incision characteristics, with a large number of undercut steep banks. Climatically it is a moderately warm region with insufficient precipitation in the growing season, and with moderately dry, cold winters. The average number of hours with sunshine is 1950-2000 per year, the average temperature is 9.5-10 C^o, and the average annual rainfall is 650-700 mm. The size of the catchment area is 29,057 km^2. The average difference between high and low water levels of the river is 11 m. The most intensive flood occurs in April (snow melting), and in June there are occasional floods ("green flood" caused by heavy spring rainfall) and there is a flood between December and January. The lowest water level occurs between August and September.

Hydrological values: There are regular and heavy floods mainly in April following snow-melting in the catchment area, and the occurrence of heavy floods in June-July and late autumn, due to intensive precipitation, is not rare either. The difference between high and low water levels is 11 m as maximum. Because of the high risk of flooding, a huge dike system was created in the middle of the 19th century.The frequency and intensity of floods has an important impact on the condition of oxbow lakes in the flooded area. During the past few decades, there have been dry periods with the water level being lower than the average, and the "washing out" function of the flood could not work properly in the oxbows. As a consequence, eutrophication has been becoming more intense.

Ecological features: The types of habitats and vegetation are closely related to typical riparian land. Because of the regulation of the river course, the size and distribution of these habitats have decreased significantly during the last hundred years. However, in the present situation the remaining fragments of these habitats are able to keep their basic features. — Soft-wood riparian forest (*Salicetum albae-fragilis*): consists of the following major tree species: *Salix alba*, *Salix fragilis*, *Populus alba*, *P. nigra*. This habitat is common in this wetland and the number, size and distribution of these habitats have an important role in the general ecological function of the wetland. The following internationally and nationally important typical bird species breed in this habitat: *Ciconia nigra*, *Milvus migrans*, *Luscinia luscinia*. — Willow bushes (*Salicetum triandre*): consist of *Salix triandra*, *S. purpurea*, S. fragilis, S. viminalis. — Flood plain meadows *(Agrostetum albae, Alopecurum pratensis)*. Because of the regular organic pollution delivered by River Szamos at Vásárosnamény, the water quality is worse than in the upper stretch of the river.

Noteworthy flora: The most important values in the flora are the natural soft-wood (Salicetum albae-fragilis) riparian forests, whose size and numbers allow the survival of its original flora and fauna and natural recolonization in the surrounding artificially altered areas in the flood zone. Protected plant species in the area:

Salix eleagnos
Iris pseudacorus
Leucojum aestivum
Leucanthemum serotinum
Nymphaea alba
Salvia natans
Nymphoides peltata

Noteworthy fauna: Because of the lack of extensive biological investigation in this area, we presently have proper data for the avifauna only.
Ciconia nigra, 2-5 pairs
Milvus migrans, 1-2 pairs
Corvus corax, 2-10 pairs
Merops apiaster, 5-10 pairs
Alcedo atthis, 30-40 pairs
Riparia riparia, 200-500 pair

Mollusca:
Helicigona banatica, the only occurrence in Hungary

Social and Cultural values: The fish fauna is less rich than in the higher section, because of the high organic pollution delivered by River Szamos. Because of the natural conditions, the area provides a unique opportunity to study both the structure and function of a riverside ecosystem and the ecological and behavioural characteristics of both the populations and the communities of animals and plants in an undisturbed setting.The area has a great importance for the subject of environmental education. Because of the presence of extensive and various habitats, there are many options to present, using proper methodology, the structure and function of the ecosystems both to the students and to the public without significant harm to the environment.

Land tenure / ownership:
(a) The ownership structure of the proposed site is a mixture of state, private and co-operative possessions.
(b) Similarly, the ownership structures of the surrounding areas are state, private and co-operative.

Current land use:
Site:
(a) Forestry, unfortunately with extended plantation of hybrid poplar.
Agriculture, mainly with fast-growing plants because of the intensive and common flooding.
Grazing and harvesting of hay
Tourism, canoe trips along the river, village tourism
Hunting (mainly for wild boar, pheasant, ducks and hare)
Fishing

(b) Surrounding / catchment:
Forestry, with extended plantation of hybrid poplar.
Agriculture, mainly with fast-growing plants because of the intensive and common flooding.
Orchards for which the soil and climate are adequate.
Grazing and harvesting of hay
Tourism, village tourism
Hunting (mainly for wild boar, pheasant, ducks and hare)
Fishing

Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:
(a) The intensity of forest felling has increased since 1990. As a result, the fragmentation of the riparian forest habitats is approaching a dangerous level for the species living in that kind of habitat.
The proportion of areas with hybrid poplar plantation as compared to naturally growing riverside forests is increasing, resulting in effects similar to those of deforestation.
The increasing volume of treated sewage water and the nutrients it carries pose a potential risk for the river and its streams and oxbows.
Uncontrolled fishing activities in the oxbows, introduction of non-native fish species, overloading, littering and disturbance by anglers.
Growing and uncontrolled tourism along the river results in significant littering and disturbance in the formerly silent and clean habitats.
Areas between the dikes need unique conservation-based land management policy in order to achieve effective protection.

(b) Unresolved communal garbage management; there are no proper dumpsites.
Uncontrolled land management; there are no local and regional development plans with special attention to the requirements of nature conservation.

Conservation measures taken: There is no protected area along this part of the river. This is quite dangerous given the fact that the area has the largest natural riparian forest that suffers the least from the disturbance of tourism. Of special importance is the fact that there is no regular supervision of development and land usage by any nature conservation authoritiy.

Conservation measures proposed but not yet implemented: The "Alföld Program" of the Hungarian Government has implemented a special sub-program for River Tisa. This originates from the recognition of the essential role of the river in the structure and function of the Hungarian Lowlands and from an understanding of the high ecological values of the river and habitats along it. This program has identified the most important sites along the river with the aim of controlling further developments.

Current scientific research and facilities: Currently, there is a scientific research investigation in progress, focusing on the Environmental changes and evolutionary responses of migrating birds by Tibor Szép, Hungarian Ornithological Society (Hungarian Scientific Research Fund (OTKA) # F17709, 1995-1998).
Some studies are being run in an NGO framework, related to Odonata (Kossuth Lajos University, Debrecen).

Current conservation education: Szabolcs-Szatmár-Bereg county holds a leading role in nature protection education in Hungary. However, in this part of the county there is no significant environmental education. There is no visitor center, nor are there publications and hides related to River Tisa and its habitats, flora and fauna.

Current recreation and tourism: At present, there is very intensive and unfortunately uncontrolled canoe tourism during the summer period developing, but low level village tourism along the river in the summer period

Jurisdiction: Hortobágy National Park, 4024 Debrecen, Sumen u. 2.,

Management authority: Upper-Tisa Water Management Authority, 4400 Nyíregyháza, Széchenyi u. 19.

References

Legány, A., Kónya, J., Vértes, I. (1977): Data on the Avifauna of the Tisza region in Szatmár-Bereg. -Tiscia, 12:131-139.
Szép, T. (1991): A Tisza magyarországi szakaszán fészkelõ partifecske (Riparia riparia (L.), 1758) állomány eloszlása és egyedszáma. (Number and Distribution of the Hungarian Sand Martin Population Breeding along the Hungarian Reaches of the River Tisza) -Aquila, 98: 111-124.

Slovakian section I.

Date: October 15, 1996

Country: Slovak Republic

Name of wetland: Wetland between Upper Tisa and River Latorica

Geographical coordinates: 48º 28´ 47´´ N, 22º 08´ 39´´ E

Altitude: Minimum is 99 m, the maximum is 103 m, with an average of 100 m above Baltic see level

Area: 500 ha

Overview: The site represents the old arm of the previously meandering River Tisa and the surrounding area which is separated from the living river system by dikes (the interdike area is the Latorica Ramsar site). Most of these valuable natural wetlands have been damaged by the construction of drainage channels and other projects, with only a small area still remaining (as natural reserve).

Wetland type: W, T, 3,4,9

Ramsar criteria: 1a, 2b

Map of site included? see Map

Name and address of the compiler of this form:
Jaroslav Tešliar, People and Water, non governmental organisation,Košice, Slovak Republic
with Ján Hronsky, Michal Kravcik, Jaroslava Pajtinkova, Zuzana Tešliarova

General location: The proposed River Tisa Ramsar site is located in the southern part of Eastern Slovakia, specifically in the subregion of the East Slovakian Lowlands. It has a natural border with the present Latorica Ramsar site (which is a 4,358 ha, 22 km long interdike area of River Latorica between the Ukrainian border and the confluence with River Laborec). It is located within the county city of Trebišov and the nearest town is Královský Chlmec.

Physical features: The existing geological substrate forms rocks of the Upper Miocene up to Pliocene, represented mostly by marl, mica and sandy clay. Soil types are typical clays and sandy dunes. Potential evapo-transpiration is 750 mm but yearly precipitation is 620 mm and specific water outflow from the area is 130 mm. The extreme shortage of rain precipitation is 260 mm. This area is represented by subcontinental climate, hot summers and cold winters, with average temperatures of 9,5 C^{o}. Water quality is poor with pollution occurring from nearby villages (without treatment of wastewater) but mainly from agricultural lands (i.e., artificial nutrients, pesticides, etc.). In the current situation there is no proper hydrological connection between the old riverbed system and the channelized water within the interdike area. This lack of connection results in the disappearance of the water.

Hydrological values: In addition to the problems with floods and inhabitants, the natural environment is experiencing a shortage of water during the summer months and in this area there is usually drought in the summertime. There is a loss of connection between the present altered river system and the previous riverbed system. During this time, local governments and state authorities are preparing revitalization projects for the entire River Tisa area (these projects are especially focused on the changes in the hydrological regime of the old riverbed system of River Tisa).

Ecological features: The most important phenomenon in the River Tisa area is the remaining part of the old Tisa riverbed (natural reserves) which is slowly being filled up with sediments, resulting from intensive agricultural activities in the surrounding areas. About 35 associations are reported, and about 45 taxa of threatened plants and their communities - *Hydrochari-stratoitetum*, *Nupharo lutei-Nymphaetum albae*, *Trapetum natantis* and various littoral communities. The most dominant willow shrubs include: *Salix cinerea*, *Salix fragilis*, *Salix purpurea*.

Noteworthy flora: *Nymphaea alba*, *Nuphar luteum*, *Stratiotes aloides*, *Trapa natans*, *Aldrovanda vesiculosa*, *Beckmannia eruciformis*, *Batrachium baudotii*, *Elatine alsinastrum*, *Ranunculus lateriflorus*, *Leucojum aestivum*, *Solanum dulcamara*, and *Glechoma hederacea*.

Noteworthy fauna: Insects: *Mantis religiosa*, Odonata, *Aorida hungarica*.
Birds: Ardea purpurea, Ciconia nigra, Porzana porzana, Rallus aquaticus, Perdix perdix, Anas platyrhynchos, Circus aeruginosus, Falco naumannni, Luscinia svecica, Locustella luscinioides, Merops apiaster, Mammals: Sus scrofa, Capreolus capreolus, Lepus europaeus.

Social and cultural values: Citizens in this area have lost their identity and connection to the land, because the natural environment has been transformed. Fish and game production have also decreased. This area includes very important archeological sites in the villages Zemplin and Leles. The majority of the population in this area are of Hungarian nationality.

Land tenure/ownership of:

(a) Specific site: It is still not clear who the owners are. The re-privatization process has not been finished yet. The greatest part of the area belongs to private owners and local communities.

(b) Surrounding area: On the north side is the Latorica Ramsar area that is divided by dikes. The rest of the surrounding areas are agricultural lands with intensive farming.

Current land use:

a) Site: The main economic activity in this area is farming. People use these sites mostly as arable lands, pastures and vineyards. The largest proportion of this land has been channelized (long system of ditches) for draining the land.

(b) Surrounding/catchment: Same as above (a).

Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:

(a) At the site: The completed water channels and changes in water regime have negatively affected the ecological stability of the wetland and entire area is now very dry, especially during the summer.

(b) In the surrounding/catchment: Air pollution (industrial dust and SO) from the Vojany Power Plant, drainage so as to lower water levels in agricultural lands, and a rapid decrease of forest lands.

Conservation measures taken: The whole proposed Ramsar site is a part of the Medzibodrožie (inter-river space between River Latorica and River Tisa) where the natural environment has been protected in the form of natural reserves: Zatény, Debnárske, Veľké jazero. The largest part of this area was channelized and drained for intensive agricultural purposes and the sandy hills were used for vineyards. Most of the human activities in the area are not restricted.

Conservation measures proposed but not yet implemented: To this date, no special proposals or measures have been prepared, except for the existing natural reserves.

Current scientific research and facilities: Research has been performed in this area mostly by experts from Slovakian scientific institutes, universities and NGOs. Research is currently being conducted but it will be necessary to harmonize its goals and implements.

Current conservation education: This region does not have a special focus on environmental education, but throughout the area a well-organized campaign for the protection of wetlands has been launched. We would like to initiate also the reconstruction of the old riverbed of River Tisa. It will be a unique example to show the principles of sustainable development.

Current recreation and tourism: The site does not belong to the important recreational areas of Slovakia, but there is a potential for closer co-operation in tourism and recreation between Ukraine and Hungary when the borders will be more permeable.

Jurisdiction: Slovak Environmental Agency - branch Košice, Zvonárska 22,040 01 Košice

Management authority: The management of this wetland has been cared for by an association of surrounding villages in the Medzibodrožie area. This association is currently preparing a revitalization project.

References

Surveys and research have been conducted, however, their results are not available.

Slovakian section II.

Date: September 30, 1998

Country: Slovak Republic

Name of wetland: Upper Tisa and its backwater area

Geographical coordinates: 48º 53´ 60 - 65´´ N, 22º 45´ 83 - 86´´ E

Altitude: Minimum is 100 m, the maximum is 107 m, with an average of 103 m above Baltic Sea level

Area: 1130 ha

Overview: The site represents the right bank of River Tisa, the plain permanently and periodicaly flooded 5 km of the Slovak part of River Tisa). The site is made up of the alluvium of River Tisa, which is represented by fragments of alluvial forests and shrubs, by the old arm of the previously meandering River Tisa (a backwater) and by agricultural lands.

Wetland type: M, W, X

Ramsar criteria: 1a,c, 2b,

Map of site included? see Map

Name and address of the compiler of this form:
Jaroslav Tešliar, People and Water, non governmental organisation,Košice, Slovak Republic
with János Bogoly, Ján Hronsky, Michal Kravcik, Jaroslava Pajtinkova, Zuzana Tešliarova

General location: The proposed River Tisa Ramsar site is located in the southern part of Eastern Slovakia, specifically in the subregion of the East Slovakian Lowlands on the borders with Ukraine and Hungary. It is located within the region of Košice, county Trebišov, and the nearest town is Královský Chlmec. The area belongs to the tand-register of the villages Velké Trakany and Malé Trakany.

Physical features: The existing geological substrate forms rocks of the Upper Miocene up to Pliocene, represented mostly by alluvial sediments motleyed by sand sediments from the last glacial period. Soil types are typical alluvial soils enriched by clays.
At this part of the river the average outflow is 379 m3/s and the whole inundation area is periodically flooded.

The amount of yearly precipitation is 550 mm. This area is represented by subcontinental climate, hot summers and cold winters, with average temperatures of 9,3 Co.

Water quality of River Tisa is good (class II.) but in the backwaters there is a high degree of eutrophication with pollution occurring from nearby agricultural lands (e.g. pesticides, etc.). In the current situation there is no proper hydrological connection between the old riverbed system and the channelized areas.

Hydrological and biophysical values: The natural environment during the summer months in this area is mostly with evapotranspiration; dew is very important. It increases the humidity of the air .

Ecological features:

River: The most important phenomenon in the River Tisa area is the clean water with high oxigen capacity, which is indicated by the presence of the fish species Acipenser ruthenus and Ephemeropterans Ephemera vulgata, Cloen dipterum, Isogerus nubecula, Isoperla obscura.

On the riverbank Salicion albae association is present with euro-american poplars, and associations in the backwaters can be Lemnea, Potametea, Littorelletea, Isoeto-Nanojuncetea.

Noteworthy flora: Lemna gibba, Stratoides aloides, Hydrocharis morsus-ranae, Salvia natans, Hottonia palustris, Potamogeton gramineus, Butomus umbellatus, Symphytum tanaicense, Dichostylis micheliana, Armoracia macrocarpa, Lindrernia aquatica, Ranunculus lateriflorus, Leucanthemella serotina

Noteworthy fauna: Birds: Podiceps cristatus, Ardea cinerea, Ardeola ralloides, Egretta garzetta, Ciconia nigra, Platalea leucorodia, Milvus migrans, Buteo buteo, Accipiter gentilis, Coturnix coturnix, Vanellus vanellus, Tringa glaerola, T. totanus, Larus ridibundus, Chlidonias niger, Alcedo atthis, Luscinia luscinia, Remiz pendulinus, Riparia riparia, Sitta europaea, Oriolus oriolus. Reptiles: Emys orbicularis. Fish: Acipenser ruthenus, Rutilus pigus, Abramis sapa, Pelecus cultratus.

Amphibians: Triturus cristatus dobrogicus, Pelobates fuscus, Rana arvalis, R. dalmatina

Social and cultural values: Citizens in this area lost their identity and connection to the land because the natural environment has been transformed. Fish and game production have also decreased. The site is important for its landscape values, for traditional fishing, regulated recreation, etc.

Land tenure/ownership of:

The largest proportion of the area belongs to state and private owners and local communities.

Current land use:

(a) Site: The main economic activity in this area is extensive agricultural production, meadow and pasture use, vegetable growing and orchards. A proportion of these areas has been ameliorated. Lowland forests are not properly maintained.

(b) Surrounding/catchment: Intensive agricultural production.

Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:

Besides the existence of "black dumps" (i.e. illegal dumpsites), it is unregulated recreation without infrastructure, illegal felling, the intensification of agriculture, and angling that can can cause trouble.

Also, there is always a possibility that polluted water arrives from Ukraine.

Conservation measures taken: In 1975, on the basis of the resolution of county authority in Trebišov, the evaluated site was given certain degree of protection (category "C"), with with a perspective to developing its protection. On this basis during 1991-1996 the removal of buildings without permission was carried out, recreation activies were limited, and the mouth of the channel of the waste water treatment plant in Cierna nad Tisou was improved.

Conservation measures proposed but not yet implemented: For the more advanced protection of the site is necessary to regulate recreation during summertime (there is no infrastructure there), to prevent illegal felling, to eliminate illegal dumpsites and to modify present land use plans with the emphasis transposed onto meadow, pasture and orchard forms of farming. For the protection of this site as a nature reserve it is necessary to carry through the preparation phase in accordance with the regulations of the Act on Nature and Landscape Protection 287/1994.

Current scientific research and facilities:

It appears that there are no recognised research projects under way.

Current conservation education: This region does not have a special focus on environmental education but, throughout the area, a well- organized campaign for the protection of wetlands has been launched.

Current recreation and tourism: The site is suitable for summer tourism because river banks are sandy and supplied with the shadow of trees. The water is clean and suitable for angling. There is a potential for closer co-operation in tourism and recreation between Ukraine and Hungary when the borders will be more permeable.

Jurisdiction: Water Management Authority for Bodrog and Hornád, Košice.

Management authority: The management of this site is fulfilled by the Water Management Authority for Bodrog and Hornád, in Košice.

References:

BOGOLY, J.: Királyhelmec (Prírodopis a dejiny Královského Chlmca a Horného Medzibodrozia), Madách, Bratislava , 1992.

SESZTÁK, J. et al. : Zdruzenie pre reguláciu Tisy v Medzibodrozí. Košice, 1996

ŠPÁNIKOVÁ, A. et al.:Acta Botanica Slovaca, Ser. A, 8. VEDA, Bratislava 1985

VOSKÁR, J. - RENCÍK, J.: IX. Východoslovenský tábor ochrancov prírody , Borša, 1985 - Prehlad odborných výsledkov, Trebišov, 1985.

Hungarian section III.

Date: October 22, 1996

Country: Hungary

Name of wetland: Upper Tisa[1] between Tokaj and Záhony

Geographical coordinates: 48° 13’ 25’’ N 21° 48’ 07’’ E (center of the site)

Altitude: 94.1 m at Tokaj and 97.3 m at Záhony (as compared to the level of the Baltic Sea)

Area: 8 900 ha

Overview: The wetland is a typical flood plain between dikes which were built during the end of the 19th and the first half of the 20th centuries. The highly natural and near-natural habitats consist of large patches of soft wood riparian forests (Salicetum albae-fragilis) and hard wood riparian forests (Querqo-Ulmetum) in small patches, oxbow lakes, filled-up meanders with rich natural flora and fauna, wild or near-wild orchards and plough-lands. The wetland is natural, without significant disturbance by human activities and it has an important role as an extended “green corridor” in the movement and migration of many plant and animal groups in the region.

Wetland type: M, T, X

Ramsar Criteria: 1.c; 2.b, 2.c; 3.c

Map of site included? see Map

Name and address of compiler:
Tibor Szép, Upper Tisza Foundation, Nyíregyháza, Hungary
with Zoltán Dobány, Kocsis Gáborné, András Légány, Zsolt Nagy, Ágnes Szomolya, Miklós Tóth

General location: Located in the flood-plain along River Tisa, between Tokaj (544 river km) and the Hungarian-Ukrainian-Slovakian border (627 river km), in Szabolcs-Szatmár-Bereg county. The nearest towns are Záhony, Kisvárda, Nagyhalász, Ibrány, Nyíregyháza and Tokaj.

Physical features: The site is a basin of recent subsidence, made up of fluvial plains. The soil types are mixtures of Holocene fluvial sediments such as fluvial sand, floodplain mud, freshwater lime mud. The river has strong meandering and

[1] The Hungarian name of the river is Tisza

incision characteristics, with a large number of undercut steep banks. Climaticallz it is a moderately warm region with insufficient precipitation in the growing season, and with moderately dry, cold winters. The average number of hours with sunshine is 1950-2000 per year, the average temperature is 9.5-10 ºC, and the average annual rainfall is 550-650 mm. The size of the catchment area is 32,782 km^2. The average difference between high and low water levels of the river is 10.25 m. The most intensive flood occurs in April (snow melting), and in June there are occasional floods "green flood" caused by heavy spring rainfall) and there is a flood between December and January. The lowest water level occurs between August and September.

Hydrological values: There are regular and heavy floods mainly in April, following snow-melting in the catchment area, and the occurrence of heavy floods in June-July and late autumn, due to intensive precipitation, is not rare either. The difference between high and low water levels is 1025 cm as maximum. Because of the high risk of flooding, a huge dike system was created in the middle of the 19th century.

The frequency and intensity of floods has an important impact on the condition of oxbow lakes in the flooded area. During the past few decades, there have been dry periods with the water level being lower than the average, and the "washing out" function of the flood could not work properly in the oxbows. As a consequence, eutrophication has been becoming more intense.

Ecological features: The types of habitats and vegetation are closely related to typical riparian land. Because of the regulation of the river course, the size and distribution of these habitats have decreased significantly during the last hundred years. However in the present situation the remaining fragments of these habitats are able to keep their basic features.

Soft-wood riparian forest (Salicetum albae-fragilis) consist of the following major tree species: Salix alba, Salix fragilis, Populus alba, P. nigra. This habitat is common in this wetland and the number, size and distribution of these habitats have an important role in the general ecological function of the wetland. The following internationally and nationally important, typical bird species breed in this habitat: Ardea cinerea, Ciconia nigra, Milvus migrans, Luscinia luscinia.

Willow bushes (Salicetum triandre): consist of Salix triandra, S. purpurea, S. fragilis, S. viminalis

Hard wood riparian forests (Querqo-Ulmetum), oxbow lakes, filled in meanders with rich natural flora and fauna, wild or near-wild orchards

Flood plain meadows (Agrostetum albae, Alopecurum pratensis)

Oxbows

Noteworthy flora: The most important values in the flora are the natural soft-wood forests (Salicetum albae-fragilis) and small patches of hard-wood (Querceto Fraxineto-Ulmetum) riparian forests, whose size and numbers allow the survival of their original flora and fauna and natural recolonization in the surrounding artificially altered areas in the flood zone. It is important to underline the numerous, large and regularly developing perpendicular riverbanks which provide a natural breeding habitat for the largest Riparia riparia population in Europe, for mayflies (Palingenia longicaudata), and for many dragonfly species.

Protected plant species in the area:

Salix eleagnos
Iris pseudacorus
Leucojum aestivum
Leucanthemum serotinum
Nymphaea alba
Salvia natans
Nymphoides peltata

Noteworthy fauna: Because of the lack of extensive biological investigation in this area, presently we have proper data for the avifauna only.

Crex crex, 2-10 pairs in the grassland habitats
Ciconia nigra, 2-5 pairs
Aquila pomarina, 1 pair
Riparia riparia, 10,000-15,000 pairs (which make 15-25 % of the entire population in the Carpathian Basin!)
Luscinia luscinia, 6-8 pairs
Milvus migrans, 1-2 pairs
Coracias garrulus, 4-5 pairs
Merops apiaster, 10-20 pairs
Alcedo atthis, 30-40 pairs
Corvus corax, 10-15 pairs
Ardea cinerea, 100-150 pairs

Social and cultural values: The fish fauna is rich and ensures opportunity for traditional fishing. Because of the natural conditions, the area provides a unique opportunity to study both the structure and function of a riparian ecosystem, and the ecological and behavioral characteristics of both the populations and the communities of animals and plants in an undisturbed setting.

The area has a great importance in environmental education. Because of the presence of extensive and various habitats, there are many options to present, using proper methodology, the structure and function of the ecosystems both to the students and to the public without significant harm to the environment.

Land tenure / ownership:

Site:

(a) The ownership structure of the proposed site is a mixture of state, private and co-operative possessions.

Surrounding / catchment:

(b) Similarly, the ownership structures of the surrounding areas are state, private and cooperative.

Current land use:

(a) site:

Forestry, unfortunately with extended plantation of hybrid poplar.

Agriculture, mainly with fast-growing plants because of the intensive and common flooding.
Grazing and harvesting of hay
Tourism, canoe trips along the river, sand-beaches and related businesses, the creation of concentrated guest house areas, village tourism
Hunting (mainly for wild boar, pheasant, ducks and hare)
Fishing
(b) Surrounding / catchment:
Forestry, with extended plantation of hybrid poplar.
Agriculture, mainly with fast-growing plants because of the intensive and common flooding.
Grazing and harvesting of hay
Tourism, village tourism
Hunting, (mainly for wild boar, pheasant, ducks and hare)
Fishing

Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:
(a) The uncontrolled development of rest-housing, beaches and related activities threaten significantly the previously untouched areas.
The intensity of forest felling has increased since 1990. As a result, the fragmentation of the riparian forest habitats is approaching a dangerous level for the species living in that kind of habitat.
The proportion of areas with hybrid poplar plantation as compared to naturally growing riparian forests is increasing, resulting in effects similar to those of deforestation.
The increasing volume of treated sewage water and the nutrients it carries pose a potential risk for the river and its streams and oxbows.
Uncontrolled fishing activities in the oxbows; introduction of non-native fish species, overloading, littering and disturbance by anglers.
Growing and uncontrolled tourism along the river and at the beaches results in significant littering and disturbance in the formerly silent and clean habitats.
Areas between the dikes need unique conservation-based land management policy in order to achieve effective protection.
(b) Unresolved communal garbage management; there are no proper dumpsites.
Uncontrolled land management, there are no local and regional development plans with special attention to the requirements of nature conservation.

Conservation measures taken: The Tiszabercel-Tiszatelek protected area was established in 1978, and the Tokaj-Bodrogzug Landscape Protection Area (Ramsar site) in 1986. By now it has become obvious that the size and the distribution of the existing protected areas and Landscape Protection areas are not proper for the effective nature conservation of riparian habitats. Current protection measures have little possibility to limit and regulate agricultural, forestry and developmental activities. The Tiszabercel-Tiszatelek protected area is supervised by the Hortobágy National Park, and the Bodrogzug Landscape

Protection Area by the Bükk National Park, being the authority for the Landscape Protection Area.

Conservation measures proposed but not yet implemented: The "Alföld Program" of the Hungarian Government has implemented a special sub-program for River Tisa. This originates from the recognition of the essential role of the river in the structure and function of the Hungarian Lowlands and from an understanding of the high ecological values of the river and habitats along it. This program has identified the most important sites along the river with the aim of controlling further developments.

Current scientific research and facilities: Currently, there is a scientific research investigation in progress, focusing on the "Environmental changes and evolutionary responses of migrating birds" by Tibor Szép, Hungarian Ornithological Society (Hungarian Scientific Research Fund (OTKA) # F17709, (1995-1998).
Some studies are being run in an NGO framework, related to Odonata (Kossuth Lajos University, Debrecen).

Current conservation education: Szabolcs-Szatmár-Bereg county holds a leading role in nature protection education in Hungary. However in this part of the county there is no significant environmental education. There is no visitor center, nor are there publications and hides related to River Tisa and its habitats, flora and fauna. Only the Upper Tisa Foundation has a research base at Tiszabercel which can provide limited service by handing out leaflets to interested visitor groups.

Current recreation and tourism: At the present, there is very intensive and unfortunately uncontrolled canoe tourism during the summer period crowded and uncontrolled beach tourism in Dombrád, Tiszatelek, Ibrány and Gávavencsellõ, and at an increasing number of villages developing, but low-level village tourism along the river in the summer period

Jurisdiction: Hortobágy National Park, 4024 Debrecen, Sumen u. 2.

Mangement authority: Upper Tisa Water Management Authority, 4400 Nyíregyháza, Széchenyi u. 19.

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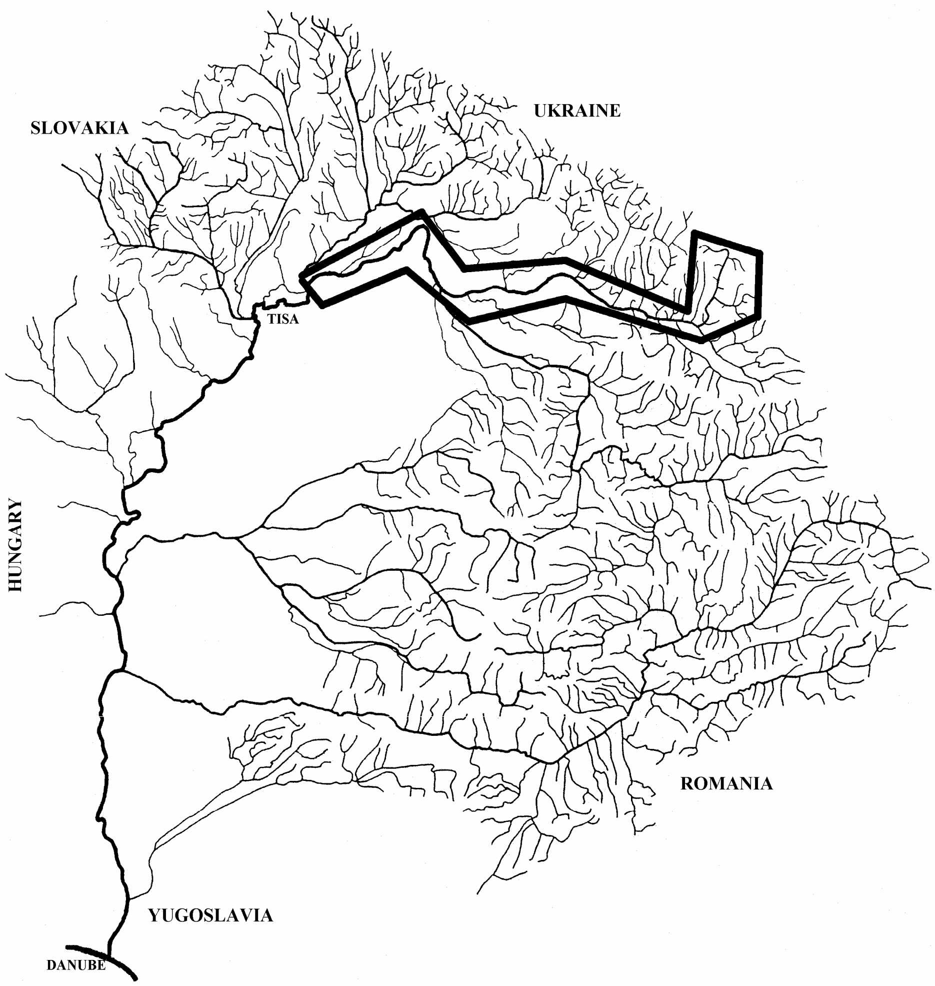
Legány, A., Kónya, J., Vértes, I. (1977): Data on the Avifauna of the Tisa region in Szatmár-Bereg. -Tiscia, 12:131-139.

Szép, T. (1991): A Tisza magyarországi szakaszán fészkelõ partifecske (Riparia riparia (L.), 1758) állomány eloszlása és egyedszáma. (Number and Distribution of the Hungarian Sand Martin Population Breeding along the Hungarian Reaches of River Tisa) -Aquila, 98: 111-124.

The Upper Tisa Valley

Ecological background



Description of sampling sites along the Upper Tisa

Andrei Sárkány-Kiss, József Hamar & Nicolae Mihăilescu

Introduction

The research was done on the upper section of River Tisa from its two sources (rivers Bila Tisa and Chorna Tisa) in the territory of Carpathian Ukraine down to the confluence with River Szamos in Hungary (Fig. l: map). The research was carried out between 1-22 August 1995 within a single expedition.

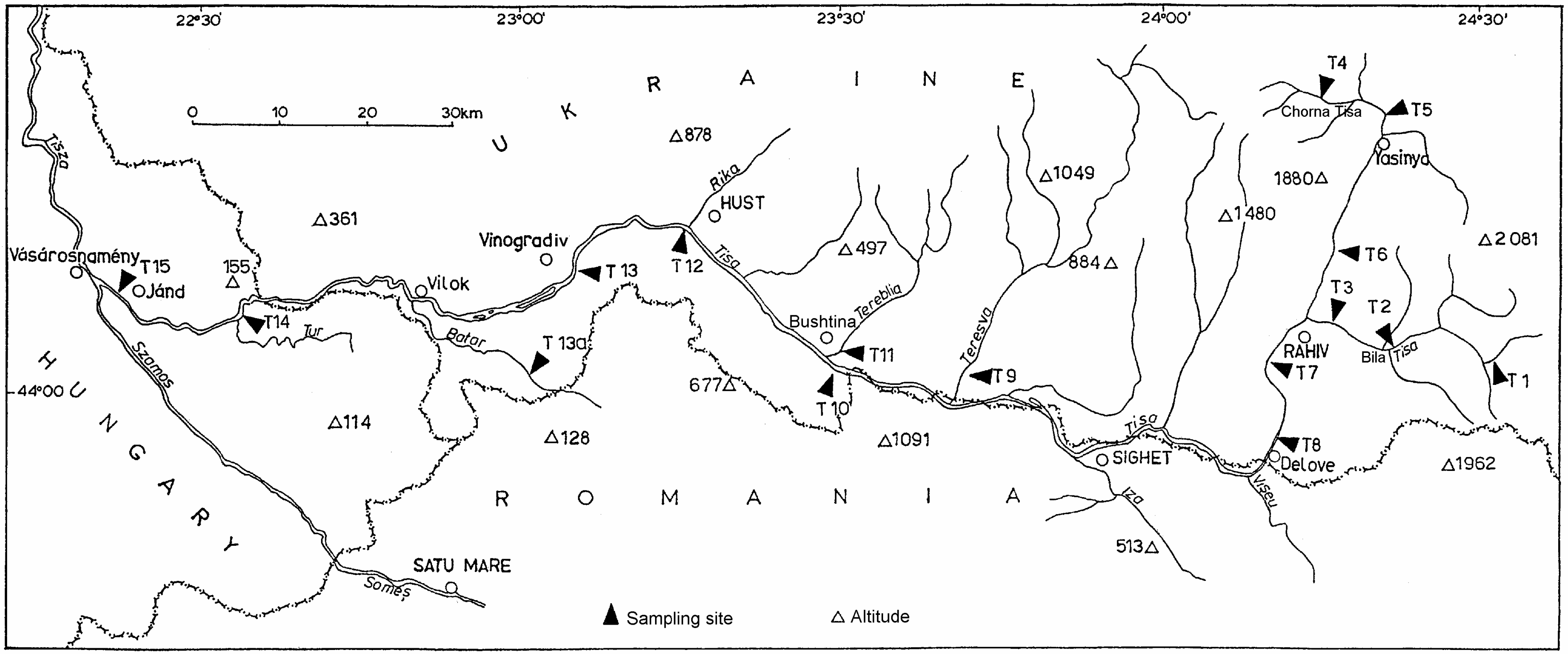
Considering the influence of the tributaries of River Tisa on its water-quality, we extended our research onto the rivers Tereblia, Teresva and Batar.

The biological samples were collected at 16 sampling stations. A thorough description of these stations is given below, as we consider it to be important to interpret the presence or absence of certain species.

Description of sampling sites

Site 1

Situated on River Bila Tisa, 100 m downstream from its confluence with White brook. Here, 5-6 km downstream from its spring, River Bila Tisa looks like a mountain brook, with its riverbed consisting of boulders and rocks. The velocity of the stream is 1 m/sec and its depth is a maximum of 70 cm. There is also rough sand and even finer sediment among the boulders in the zones of slow flow. The boulders of the riverbed are covered with algae which retain fine particles suspended in the water. Thus, muddy sediment settles among algal filaments. The water carries a great amount of allochthonous fragments: leaves, branches and other vegetal fragments. The river valley is covered with coniferous forests, which protect against high floods. However, we can find signs of bank erosion, which refers to the existence of floods. The rough sand which accumulates among boulders, and the presence of muddy sediment leads us to the conclusion that this stream carries sediment even at low water level (Table 1.). The whitish colour of the water, especially in the White brook, is a result of the erosion of the calcareous rocks. The coat of fine sediment on the boulders is not prosperous for the fixation of benthic organisms.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Rika
HUST
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Tisa
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Bushtina
Tereblia
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Teresva
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1049
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SIGHET
Iza
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1880
Chorna Tisa
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T5
Yasinya
T6
T3
T2
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Bila Tisa
T7
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Delove
Viseu
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Sampling site
Altitude

Figure 1

Site 2

Situated on River Bila Tisa, upstream from Breboja, about 20-25 km from its spring. River Bila Tisa gathers many tributaries up to this point and takes the appearance of a mountain river. The riverbed consists of boulders and pebbles, but there is also a great amount of fine sediment (Figure 2) on the bank. The velocity of the stream is 70-80 cm/sec. Boulders are covered with a layer of algae, which holds fine detritus particles. Some times, boulders are overlaid with a greyish-whitish muddy coat.

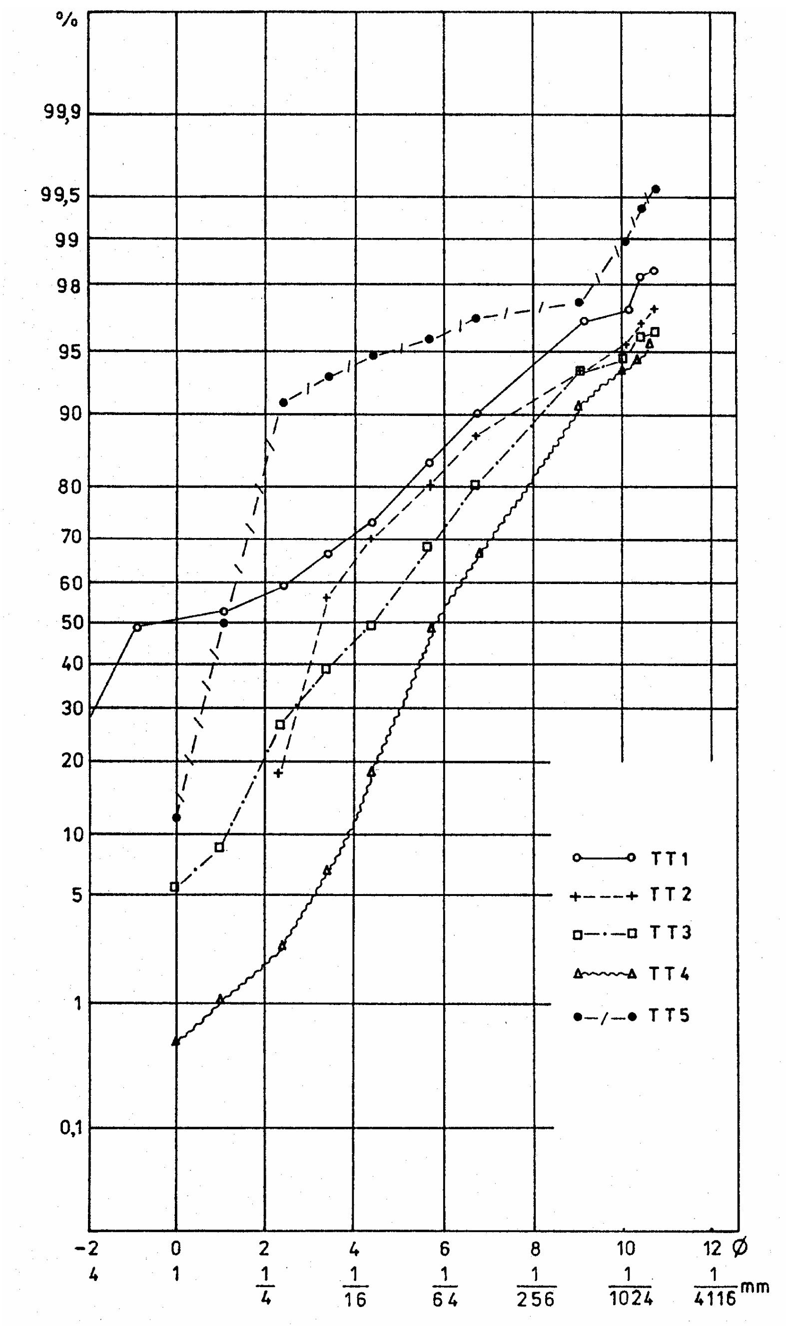


Figure 2.

Site 3

Situated on River Bila Tisa, upstream from Roztoki. The riverbed consists of big and very big boulders, without course sand among them. The water current is extremely stong: l-1,2 m/sec.

Site 4

River Chorna Tisa, 5-6 km downstream from its spring. It looks like a small mountain brook, with a bouldery bed and rapid flow of 0,7-0,8 m/sec. The valley is narrow, wooded. The abundant vegetation on the banks shades the water.

Site 5

River Chorna Tisa, upstream from Yasinya, near the entrance of the natural reserve. The riverbed consists of big boulders and rocks covered with an algal layer holding fine sediment (Figure 2.). The character of the stream is that of a mountain river, with a velocity of 1 m/sec.

Site 6

River Chorna Tisa, downstream from Jasinya. The riverbed consists of boulders and big fragments of rocks. There are great amounts of muddy and sandy sediments on the banks in the zones of slow flow (Figure 3., Table 1.). The velocity of the stream is 0,7 m/sec.

Site 7

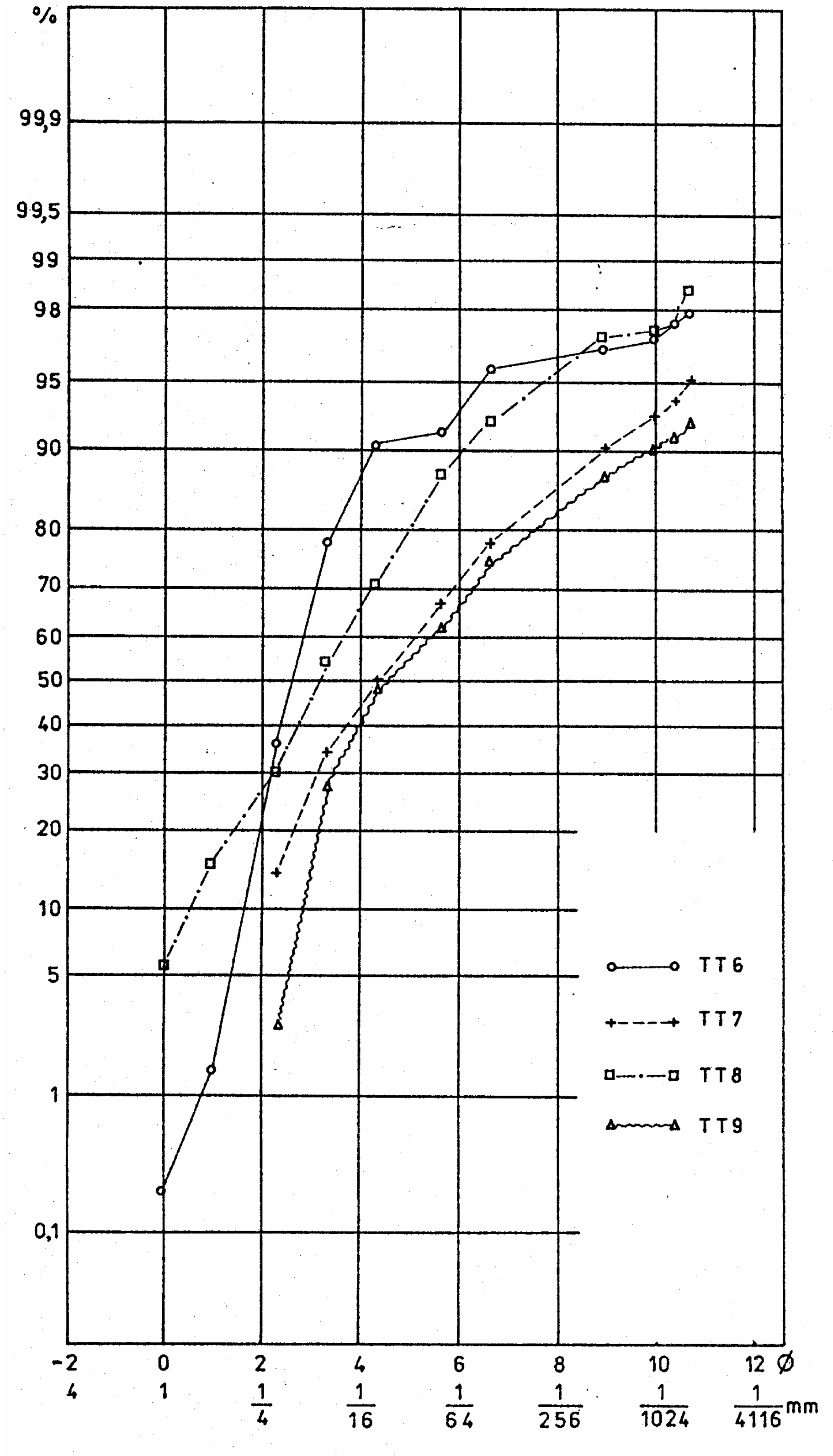
River Tisa (formed by the union of rivers Bila Tisa and Chorna Tisa), 2 km downstream from Rahiv. The riverbed consists of big boulders and rocks here and there. The boulders and the rocks are covered with a rich algal coat, which is loaded with very fine sediment. The rest of the fine sediment is deposited near the banks, among boulders (Figure 3., Table 1.).

Site 8

Tisa, upstream from Dilove . The bed consists of big boulders and big fragments of rocks. The boulders are not rolled by the stream and are rounded by the effects of high floods. At low water level, the rocks stick out and form small islands. Water output is higher at this station and the water depth reaches l,5 m in some places. Rapid flow (0,6-0,7 m/sec) alternates with slow flow. There is much muddy sediment which is unstable and, thus, carried away by high floods. The organic load of these sediments is obvious. It arrives from upstream localities (especially from Rahiv).

Site 9

Tributary Teresva, 1,5 km upstream from the river mouth. Access to the river was prohibited by frontier guards (the river represents the state border between Ukraine and Romania). Therefore, we were not able to work at this section. The riverbed consists of big boulders carried by high floods. These boulders divide the river into branches. Apparently, the water is clear, but there are suspended particles formed by fragments of the rich algal coat found on boulders.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TT6
TT7
TT8
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Figure 3

Table 1. Median grain size of sediment in the Tisa river-bad

Sites	C	P5	P16	P25	M	P75	P84	P95	gravel	sand	silt	clay	sediment
	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø					
1				2.1	1	4.7	5.8	8.5	36	24	24	6	medium sand
2				2.5	3.25	5.1	6.4	10		64	26.5	9.5	very fine sand
3		0	1.6	2.3	4.5	6.4	7.9	10.2		44	43	13	coarse silt
4	1	3.05	4.2	4.75	5.8	7.45	8.25	10.6		12	70	18	medium silt
5			0.2	0.5	1.1	1.7	2	5.6		93.5	3.2	3.3	medium sand
6	0.8	1.4	1.85	2.1	2.65	3.3	3.8			85	10	4	fine sand
7			2.5	3	4.4	6.3	7.8	10.6		43	42	15	fine silt
8		5.3	1.1	2	3.2	4.7	5.4	7.8		66	28.5	4.5	coarse silt
9		2.5	3.1	3.3	4.6	7	8.2			40	42	18	very fine silt

Site 10

River Tisa, upstream from the river mouth of the tributary Tereblia, at Bustina. The riverbed consists of big boulders. There are great amounts of unstable sediment on both banks. Big boulders often lie on a bed of course sand. Boulders deposited by high floods divide the river into branches which often change their direction.

Site 11

On the tributary Tereblia, at its confluence with River Tisa. The riverbed is bouldery. Deposits of boulders, gathered by high floods, form a dam at the river-mouth. Water often disappears beneath the accumulated boulders. The water is clear but rich in mineral nutrients. These mineral nutrients probably originate from chemical fertilizers used on nearby mountain pasture lands and hayfields. The great amount of filamentous algae in the reaches of slow flow is a result of the above mentioned phenomenon.

Site 12

River Tisa at Hust. The riverbed consists of big boulders. Pebbles form islands which divide the river into secondary branches. Fine sediment is unstable in places of slow flow. The velocity of the stream varies from 0,5 to 0,70 m/sec.

Site 13

River Tisa at Vinogradiv. The riverbed consists of pebbles, fixed well by matrix of course sand. There are thick layers of mud in places of slow flow. These layers are carried away by high floods. Places of rapid water discharge alternate with places of slow flow, especially around the islands formed by sediments. These sedimental islands divide the river into branches.

Site 13/a

The tributary Batar (Vájás) (on the left side of River Tisa), near Chepa (Csepe). The flow is slower because of the gentle slope. Sediment consists of sand and mud.

Site 14

River Tisa at Tivadar (Hungarian territory). The bed is spacious and the river flows slowly. Sediment varies from pebbles to rough sand in accordance with the velocity of the stream. There are small muddy areas near the banks.

Site 15

River Tisa, downstream from Jánd and upstream from the mouth of River Szamos. The bed consists of rough sand. There are extenxive muddy areas which are stable and prosperous for the existence of bivalves.

Upper Tisa is a river with particular properties. It flows along woody mountains. Its velocity is fast and its high level often occurs. Because of the bouldery riverbed and the lack of muddy sediment, pelophilic fauna is rather poor.

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Hydrogeographical features of the Upper Tisa river-system

Mihály Andó

Introduction

Along its 964 km length, River Tisa is environed by a 157,180 sq. km catchment area. The river rises in the north-east of its catchment area and reaches its recipient, River Danube at Titel.

The drainage basins of River Tisa and its tributaries are excessively different from one another not only as far as their shape, situation, size, hydrography and sloping are concerned, but with regards to their soil composition too. With the shape of an arching semi-circle, the towering ridge of the Carpathians is the boundary of the catchment area. The southwestern-western watershed is comparatively low, in some places its surface shape is in fact even. The catchment area is divided in the middle by the Munții Apuseni, east of which lies the 400-600 m high plateau-like Transylvanian Basin, and to the west lies the Great Plain.

Based on the hydrogeographical data the catchment area of River Tisa is divided into three characteristic sections: the mountainous Upper Tisa, the Middle-Tisa, receiving most of the waters of the drainage basin, and bound by the confluences of the two main tributaries, River Szamos/Someş and River Maros/Mureş, which drain the Transylvanian Basin, and lastly the Lower-Tisa extending from its confluence with River Maros to its confluence with River Danube.

The present study gives a detailed account of the Upper Tisa river-system, the section of River Tisa down to its confluence with River Szamos. However, there will also be a brief account of the drainage basins of River Szamos and River Bodrog, because both may play a major role in shaping the water resources of River Tisa. Therefore this section of the river is extended as far down as the town Tokaj (Figure 1).

Keywords: hydrogeology, Upper Tisa catchment

The relief, structure and geological features of the catchment area of the Upper Tisa

The river-system of the Upper Tisa in the Northwestern Carpathians can be divided into structurally distinctive and tectonically connected parts. Within these parts isoclinal structure and exfoliation can be detected. The distribution of the reliefs of the river-system is in many respects similar to the structure of the West Carpathian

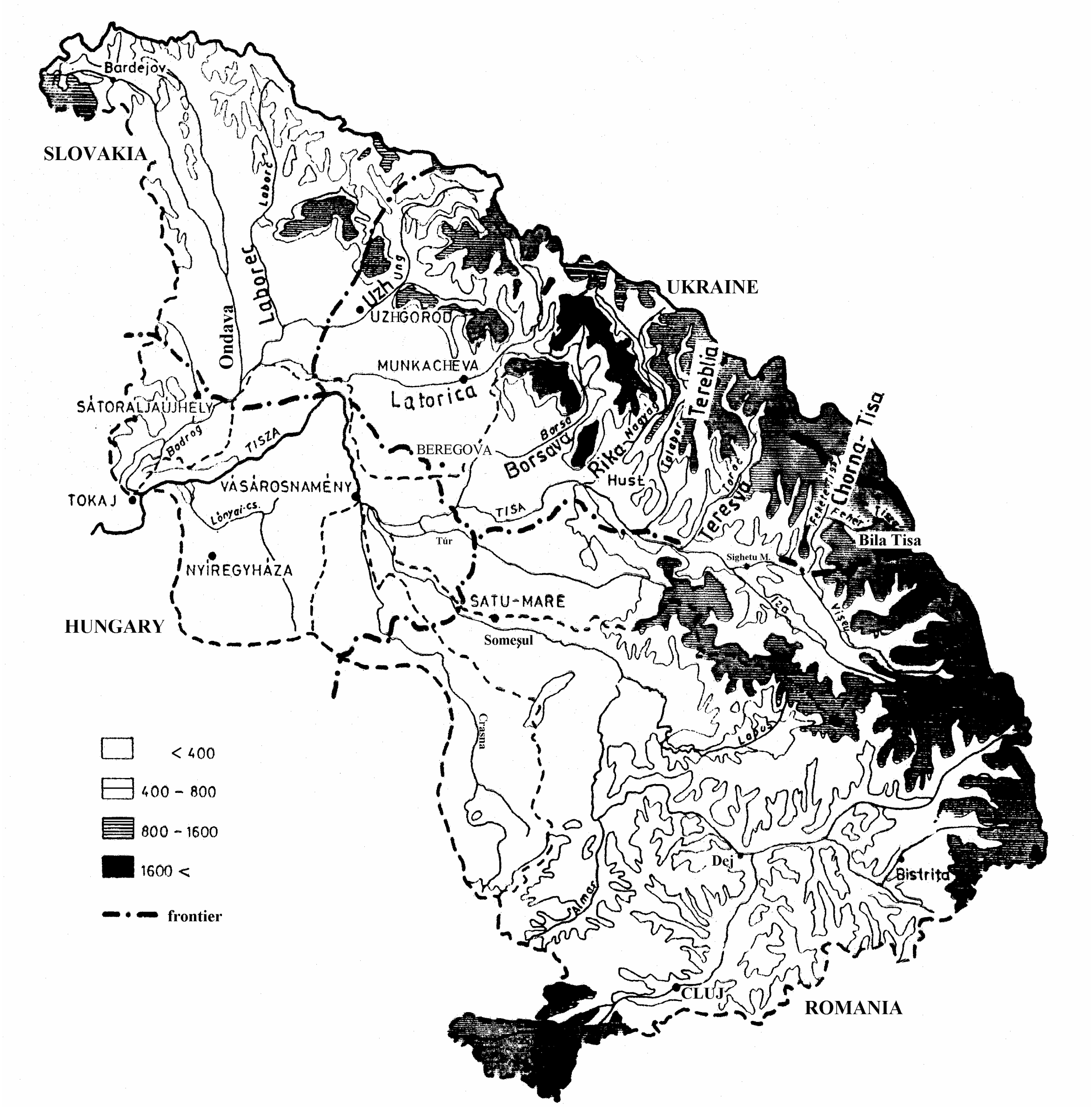

Figure 1 Relief of the Upper Tisa, after VITUKI

region, because the bulk of these mountains also consist mainly of Eocene and Cretaceous formations. It is similar structurally as well, because on the outer side of the Carpathian arc there is sandstone ('flis'), which is geologically comparable to the fairly narrow sandstone zone lining the Alps. In the Northeastern Carpathian region, regarding the Eastern Beskyds and the Maramureshian Alps, besides sandstone limestone comes to play a minor role as well in the rock composition. Furthermore, crystalline rock, in the form of 'cliffs', can be found in traces in the inner side if the sandstone zone. Crystalline rock does not form a morphological zone in the catchment area, only the environs of Pop-Ivan bear a large stretch of surface crystalline ancient mountain formation.

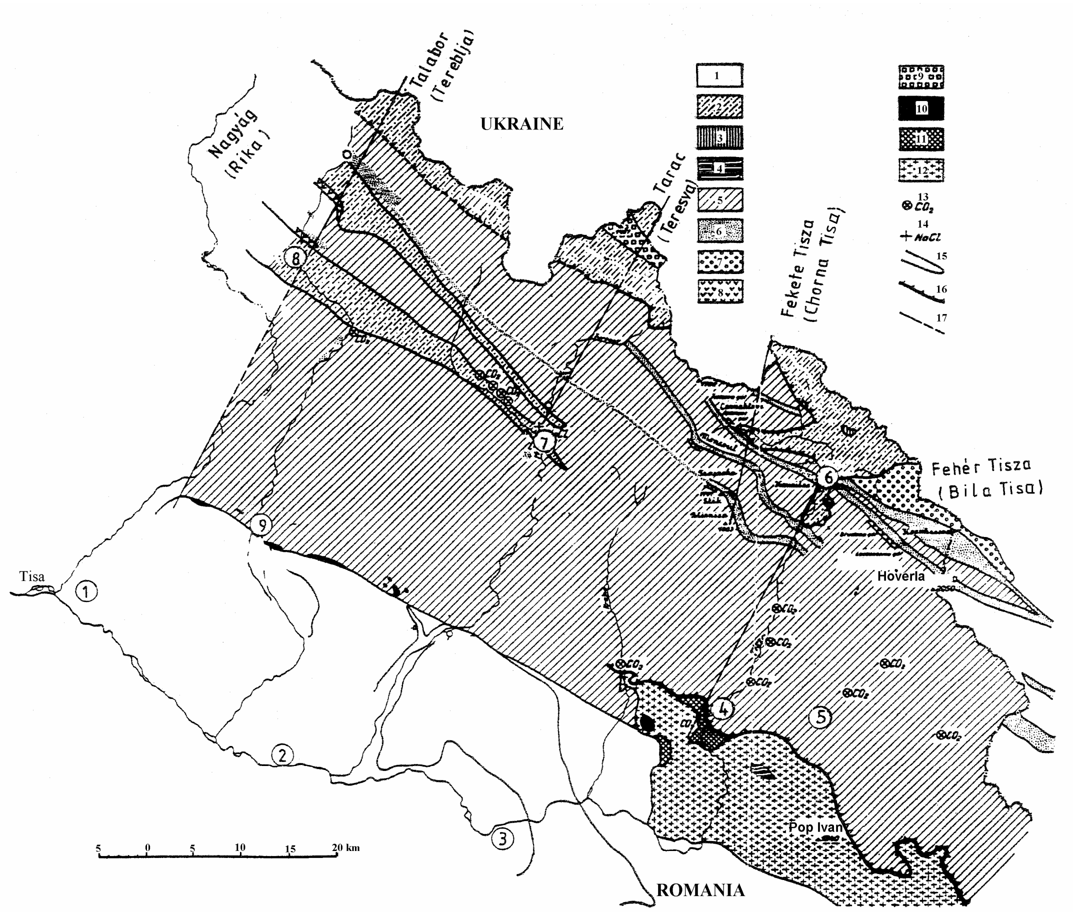

Figure 2 A schematic geological map of the area between River Black Tisa and River Tereblia. After Szalai T.

Legend: 1 Mediterranean 2 Middle Oligocene 3 Lower Oligocene (shale) 4 Upper Eocene (clay-marl) 5 Eocene (MAGURA belt) 6 Upper Cretaceous, Lower Eocene (clay) 7 Upper Cretaceous, Lower Eocene (sandstone) 8 Upper Cretaceous, Lower Eocene (shale) 9 Cretaceous, Eocene 10 Cliffs 11 Triassic 12 Mica schist, gneiss 13 Aereated springs 14 Salt springs 15 Tectonic window 16 Overthrustings 17 Segments

The high mountains here are crystalline masses emerging in isolation from the significantly folded Permian-Mesozoic strata. They were probably already parts of the structure of the former Variscian mountains. The Mesozoic strata - together with their shell that today encloses them in a common frame - were involved in the Cretaceous folding, but their present mountainous character is still partly due to the faults that took place in the Tertiary (Figure 2).

In our homeland only few of the 'Tisia'-massif ancient mountain range have stayed on the surface. At other locations the Tisia sank so deep that it has been covered by thick Tertiary formations. The volcanic mountains also belong to Tertiary formations. They are traces left by lava eruptions from the tectonic rift of the western foothills of the sandstone mountain ranges and the fissure marking the subsidence of the Plain (Figure 3).

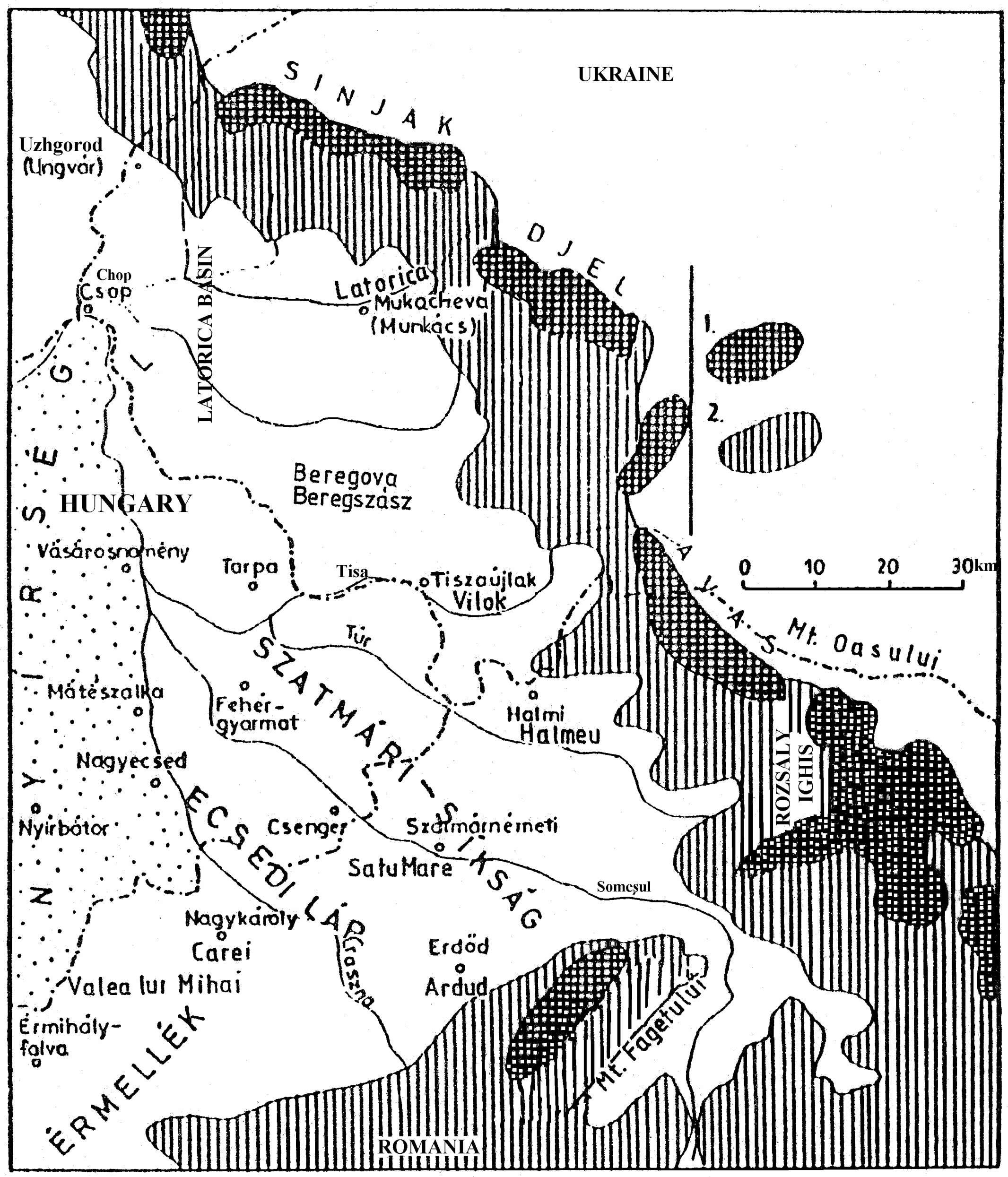

Figure 3 The Szatmári Plain and the Latorcai Basin

Caption 1 Mountains2 Regions at the foot of mountains

To sum up, what is dealt with here is mountains with very simple structure, because apart from the rudimentary cliff belt they only consist of a volcanic belt within a sandstone belt. Parts of the volcanic belt are the Vihorlat, the Sinjak, the Diel, the Vinovgradiv Mountains and the Oaş-Ighiş-Gutâi Mountains range.

Between the Oaş-Ighiş-Gutâi Mountains volcanic mountains on one side and the sandstone belt of the Maramuresh Alps together with the mountain range in Pop-Ivan consisting of emerging crystalline rocks on the other side, lies the Maramuresh

Basin filled with Tertiary layers. Finally, we must also mention that along an imaginary curved line connecting the southern part of the Eperjes-Tokaj Mountains (Zemplén Mt.) with approximately the middle of the Vihorlat-Gutâi (M. Gutâiului) range, there are some individual small mountains emerging from under the Quaternary strata of the northeastern bay of the Great Plain.

Intense volcanic activity in the Tertiary was an outgrowth of the fragmentation of the Tisia. There was significant volcanic activity along the main faults, especially at the edges of the massively subsided large basins along the Great Plain. Volcanic ash cemented into tuff and lava alternately accumulated one layer on top of the other, thus volcanic mountains came into existence. That was a long and resurgent process, so it partially settled on sediments already from the Tertiary. Volcanic masses covered by the youngest Tertiary strata were multiply traversed by faults. The bulk of the eruptions took place in the first part of the Upper Tertiary, the Miocene; their product is mainly andesite, whereas it is chiefly rhyolite in the east.

In some places volcanism created fairly shapely mountains, most of which, however, are now in ruins having been the victims of eroding forces. Only the highest tops reach above 1000 m, the average altitude is about 800-900 m. The forms are subdued and gentle, their mildness or sharpness depends on the rock composition, the alternation of soft tuff and hard lava.

The first member of the range is the 1074 m high Vihorlat between the Uzh Valley and the Laborec Valley. It is separated from the Eperjes-Tokaj volcanic range by the wide valley entrance of the rivers Ondava and Laborc. In the collapsed, therefore caldera-like hollow of the volcanic cone is Szinnai Lake, at an altitude of 619 m. The Uzh Valley and the Latorica Valley embrace the mass of the Sinjak (1014 m); the Latorica Valley and the Borzhava Valley enclose the mass of Veliki-Diel (1068 m). Its tuff slope in the southwest spreads widely towards Beregova. The volcanic range of the Vinovgradiv Mountains (Salanki Mt., 372 m; Chorna Gora 568 m; Tupij Mt. 878 m) extends as far as the valley of River Tisa. With it the volcanic range leaves behind the sandstone belt, and at the southwestern edge of the Maramuresh Basin, on the left of the Tisa valley its next members emerge: the 805 m high Oaş and the 1307 m high Ighiş. Its further extension is the shapely, 1447 m high Gutâi with the final member of the range being the 1842 m high cone of the Ţibles. Its southern slopes dip as far as the Transylvanian Basin.

The present-day mountain range of the Upper Tisa river system also belongs partly to the ancient mountain belt. Its mountainous character is due to Tertiary faults, or more precisely to the circumstance that its environs subsided deeper along the faults.

The parts with greater subsidence - basins of various sizes - were flooded by the Tertiary sea. In some of them we can find sediments of the Lower Tertiary, whereas in the Great Plain only that of the Upper Tertiary, exclusively at the edges and in faults.

In the Northeastern Carpathian system the sandstone belt is the widest, but not the highest. For instance, in the northwest the width of the sandstone belt reaches 50 km and in the northeast it even exceeds 100 km.

Since the multi-stage event of folding, the intensely eroding sandstone belt has experienced crust movements many times: some of its clods broken into large pieces

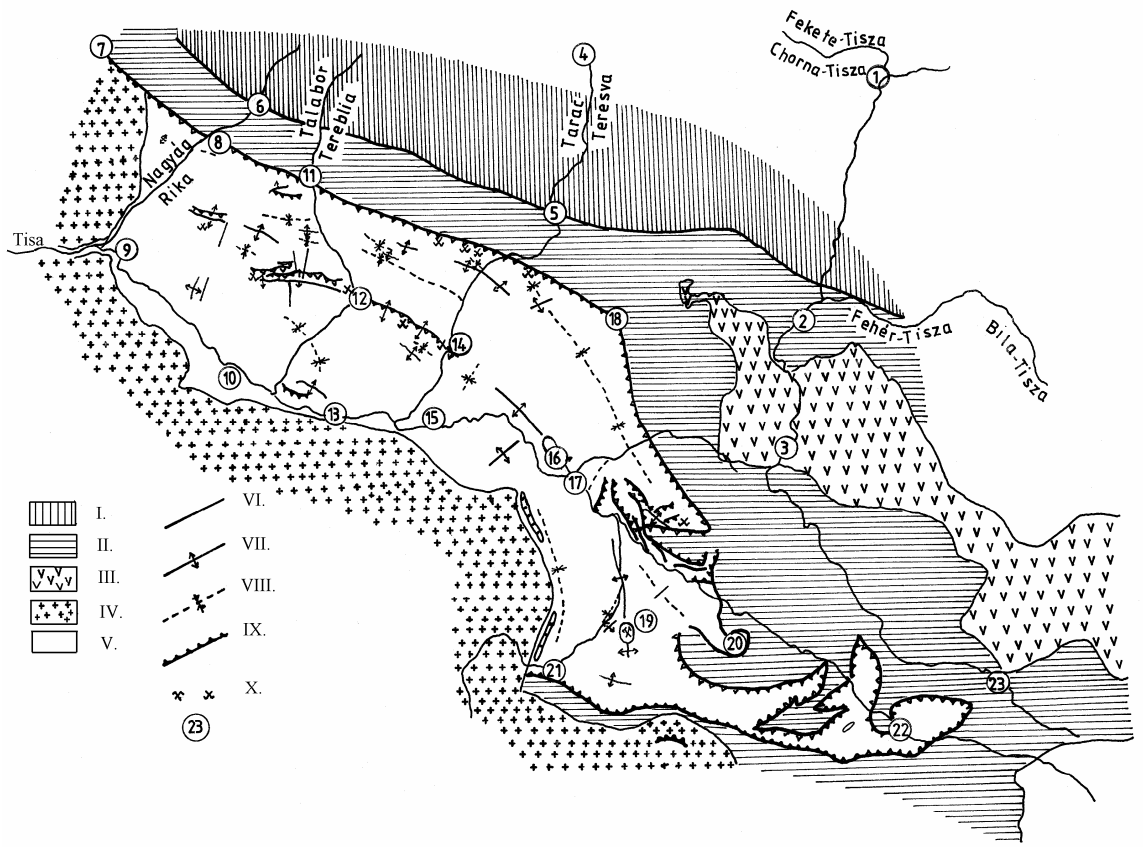

Figure 4. Sketch of the mountain structure at the basin of the Upper Tisa, after Szentes F.

I Outer flis belt — II Inner flis belt — III Crystalline shales — IV Andesites — V Miocene basin — VI Structural fault — VII Anticline — VIII Syncline — IX Normal fault — X Salt mines — 23 towns/villages

emerged obliquely. The surfaced edges and the main ridges are in the inner side, so the narrower, steeper slopes face the basin. The folded layers are intersected by the present surface: the emersions of the harder layers were formed into the shape of long ridges. The Eastern Beskyds reached significant altitude, second only to that of the Maramuresh Alps. It is also evident in the altitudes of mountain passes. The Uzhecki Pass leading from the Uzh Valley to the San Valley is 889 m, the Serednoverecki Pass leading from the Latorica Valley to the Stryj Valley is 841 m, and the Yasina Pass (also called Jablunicki Pass) leading from the Chorna Tisa Valley to the Prut Valley is 931 m high. Already in the Eastern Beskyds peaks exceeding 1300-1400 m and in the Maramuresh Alps peaks exceeding 1500-1800 m can be found, while Hoverla is exactly 2061 m high.

In the Northeastern Carpathians the main ridge has been etched only to a minor extent by the rivers. That is the reason for the comparatively slight difference between the heights of the passes and the peaks. Here, within the main ridge we are able to identify an inner range which is more intersected by rivers.

Where the sandstone belt is represented by higher mountains, the valleys are apparently deeper, the peaks towering from them are magnificent, but only as far as their mass is concerned, because they, too, have a subdued shape.

Compared with the vast stretch of the sandstone belt, the sequence of limestone cliffs in the inner edge of the belt appears to be merely insignificant patches. Still, they are very conspicuous parts of the landscape: from the environment consisting of softer rocks and - as viewed from the distance - having a mild contour, they emerge steeply, in places with bare faces.

The raised sandstone blocks look monotonous in the landscape. The forest-covered, uninhabited recesses of the ribs line in dull monotony. Even in the high Maramuresh Alps glacial formations do not lessen monotony, because due to mild glaciation even in the 2061 m high Hoverla, there are only a few little 'firn' fields left.

Within the main ridge we can easily distinguish parts of an inner ridge, too, intersected by river valleys. Covered by forests and alpine pastures this is the ridge of the Polonina Runa (1482 m) - Stoj (1679 m), called Verchovina. It is separated from the main ridge by a structural depression, which has sporadically been widened by the upper sections of the rivers Uzh, Latorica, Rika, Tereblia and Teresva running in it, creating basin-like formations in the process. There are steep slopes climbing from the depression up to the main ridge (Chorna Repa 1836, Popadia 1742, Pop Ivan 2022, Petros 2020, Hoverla 2061 m).

Between the sandstone and the volcanic ranges in a NW-SE direction is the wide Tertiary Maramuresh Basin stretching in the valleys of the rivers Tisa, Vişeu and Iza. The rivers have etched terraced valleys into its surface. It gradually widens and dips toward the 'Gate of Hust', where it joins the Pleistocene depression area of the Great Plain. The basin covers almost unexploitable deposits of rock salt (Solotvina, Coştiui, Ocna Şuhatag). Apart from rock salt there are traces of crude oil in the basin as well (Săcel, Dragomireşti).

Climatic and hydrogeographic features of the drainage basin of the Upper Tisa

The catchment area of the Upper Tisa section down to its confluence with River Szamos is 13,500 sq. km, the section itself is 2,080 km long. The area per unit river length is 6.36 sq. km/km. The greater part of the drainage basin is in Ukrainian territory, a smaller part is in Romanian territory. A very small piece of the catchment area belongs to plain terrain (1444 sq. km).

The drainage basin is bordered by the Maramuresh Alps in the northeast and by the Rodna Alps (Munții Rodnei) in the south.

The catchment area of the Upper Tisa is morphologically rather unfavourable because the region is comparatively short and it stretches wide. Mountain slopes are steep indeed, mountain streams of high dip reach the river valley after covering a relatively short course. Down in the valley pouring waters amass. The mean dip of the surface in the drainage basin reach 550 m/km. On the other hand, dip ranges from 80-200 m/km in the hilly area and 5-60 m/km in the Great Plain. The total dip of the Upper Tisa is 1577 m (Figures 5, 6).

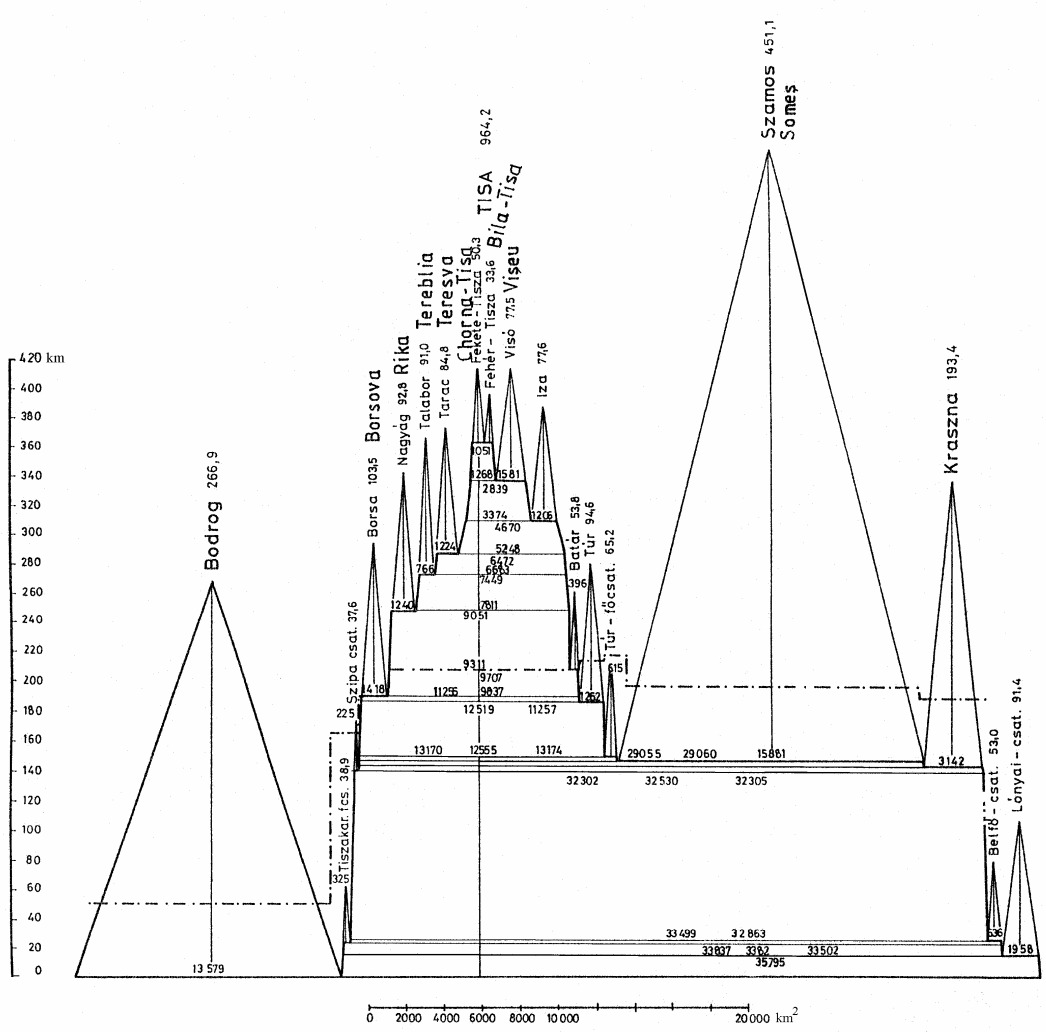

Figure 5 General map of the catchment area of the Upper Tisa, after VITUKI

The relief of the surface determines the distribution of water resources in the region to an extremely great extent, with a considerable proportion of the water resources accumulating in the form of snow. (Table 1.)

Table 1.

Catchment area	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
A./ Regional averages of surface input, mm													
Upper Tisa	22	42	122	124	101	122	118	116	91	94	73	45	1070
River Szamos	21	39	79	72	81	102	91	86	60	64	51	40	786
River Bodrog	27	46	87	70	75	98	95	98	71	75	66	47	855
B./ Regional averages of snow-broth, mm													
Upper Tisa	20	40	10	71	12	0	0	0	2	11	25	29	316
River Szamos	18	34	59	19	2	0	0	0	0	4	14	22	172
River Bodrog	21	40	62	16	1	0	0	0	0	4	15	25	184
C./ Contribution of snow-broth to surface input, %													
Upper Tisa	91	95	87	57	12	0	0	0	2	12	34	65	30
River Szamos	86	88	75	26	2	0	0	0	0	6	28	55	22
River Bodrog	78	87	71	23	1	0	0	0	0	5	23	53	22

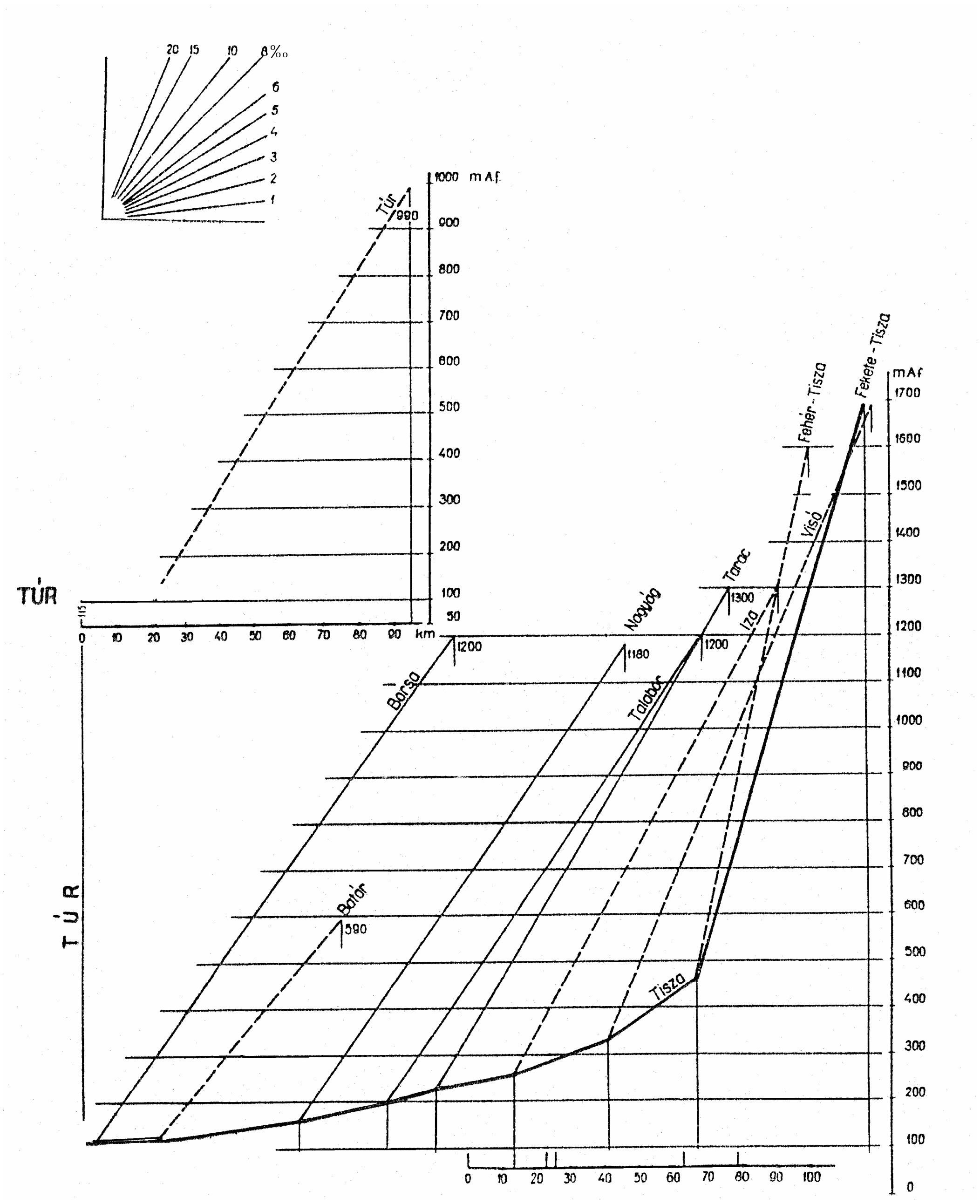

Figure 6. Schematic valley length segments of the Upper Tisa, after VITUKI

In this respect, triggered by winds and as a result of avalanches, snow may accumulate in large quantities in the glacial valleys of the alpine zones. In the hilly areas and in the plains snow driven by winds accumulates in hollows and concave surface formations (in shower-stream valleys, loess dips and old formations hollowed by erosion). It is these concave surface formations where the most prominent failure of flowage during the melting of snow and the most intense flowage during rainfalls can be observed.

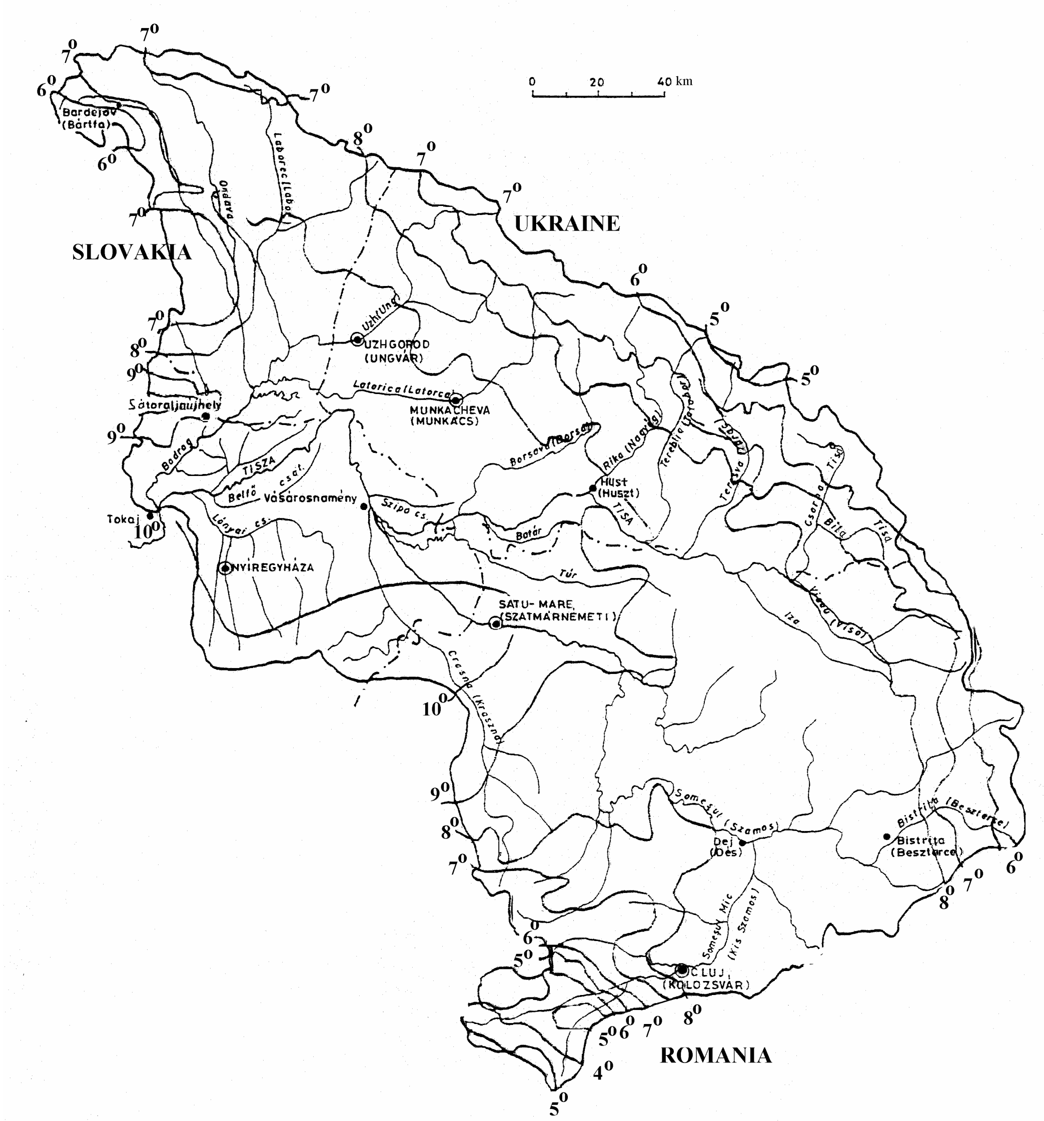

Figure 7. Distribution of annual mean temperatures in the catchment area of the Upper Tisa on the basis of an average over 40 years

As the highest ridge of the Carpathians most often stops the wet air currents coming from the southwest, most of the precipitation occurs here. Its annual average reaches 1400 mm, 80% of which comes from the Atlantic and the Mediterranean, and the remaining 20% is created by local circulation.

The Northeastern Carpathian region has a distinctive distribution of temperature and precipitation as it is situated in a transitional climatic belt. It is by far the continental nature of the climate that is prominent here. Mean temperature in January is between -2 and -4 degrees Celsius, so the figure of average annual fluctuation slightly surpasses the minimum of that of the continental type. Reversed thermal conditions are a common phenomenon in the basins of various sizes and in the deep valleys situated in the mountain ranges (Figure 7). Annual precipitation is greatly variable, usually at high altitudes it is 1200 mm, at low ones 800-1000 mm; and the lower basins are poor in precipitation (under 600 mm). In the Carpathians, mountain

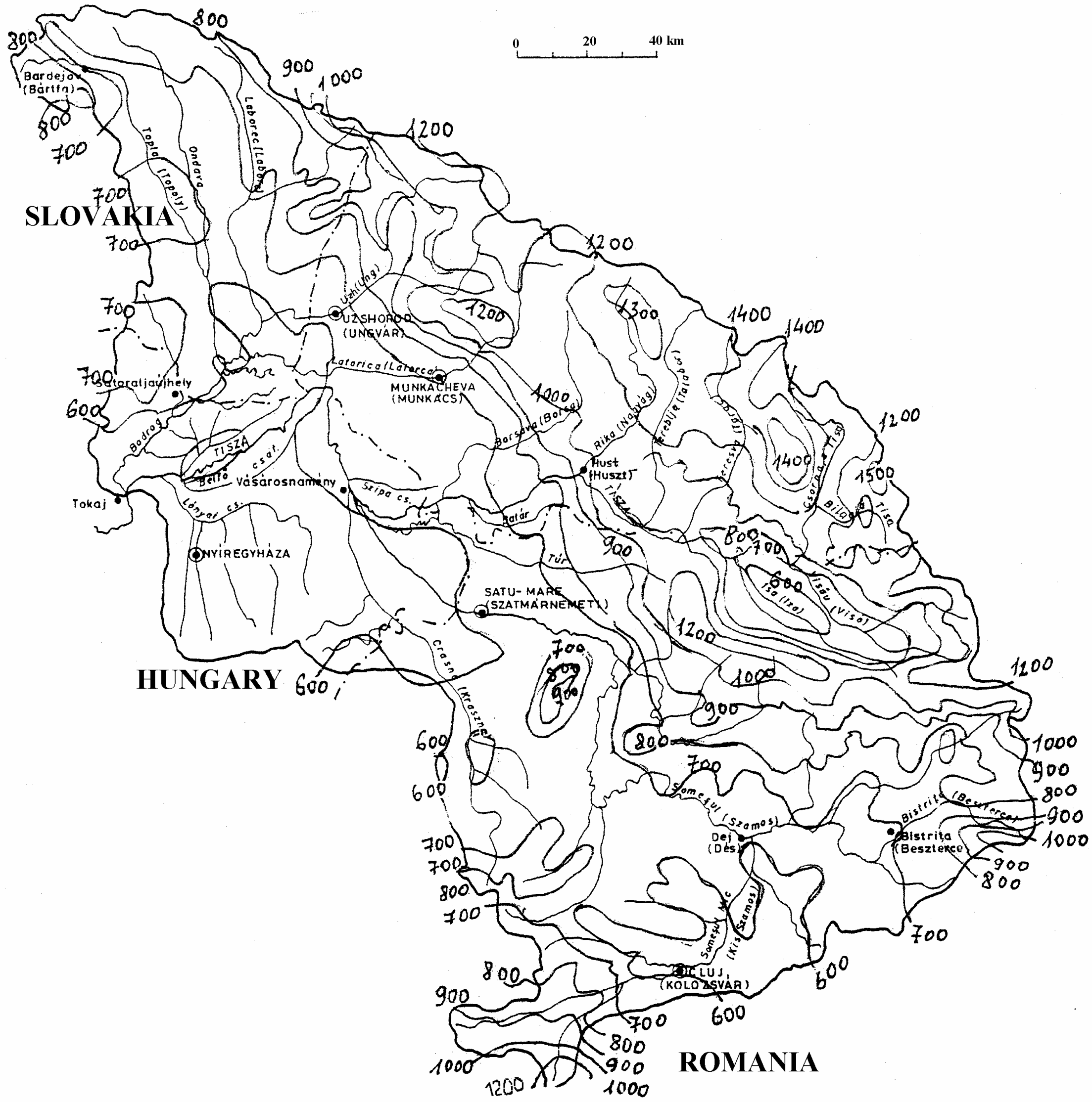

Figure 8. Distribution of precipitation in mm in the catchment area of the Upper Tisa on the basis of an average over 40 years

slopes predominantly rich in precipitation are the ones that lie in a right angle to the winds carrying precipitation. Such mountain ranges are in NW-SE and N-S directions (Figure 8).

The change in the extent of wetness within a year essentially determines the flow of the rivers. Surface water input determining the flow of the rivers and the seasonal changes occurring in the catchment area cause significant regional differences (Figures 9-12).

In the Northeastern Carpathians, surface water in the winter months (December, January, February) is mainly from snowfall. Snow accumulation increases with altitude and, regarding the distribution of water input, it causes maximal activity of precipitation in December in the catchment area. Orographical factors exert considerable influence on quantitative changes, as in the above mountainous area lower than 15 mm of water-input distribution can be observed at altitudes above 1600 m.

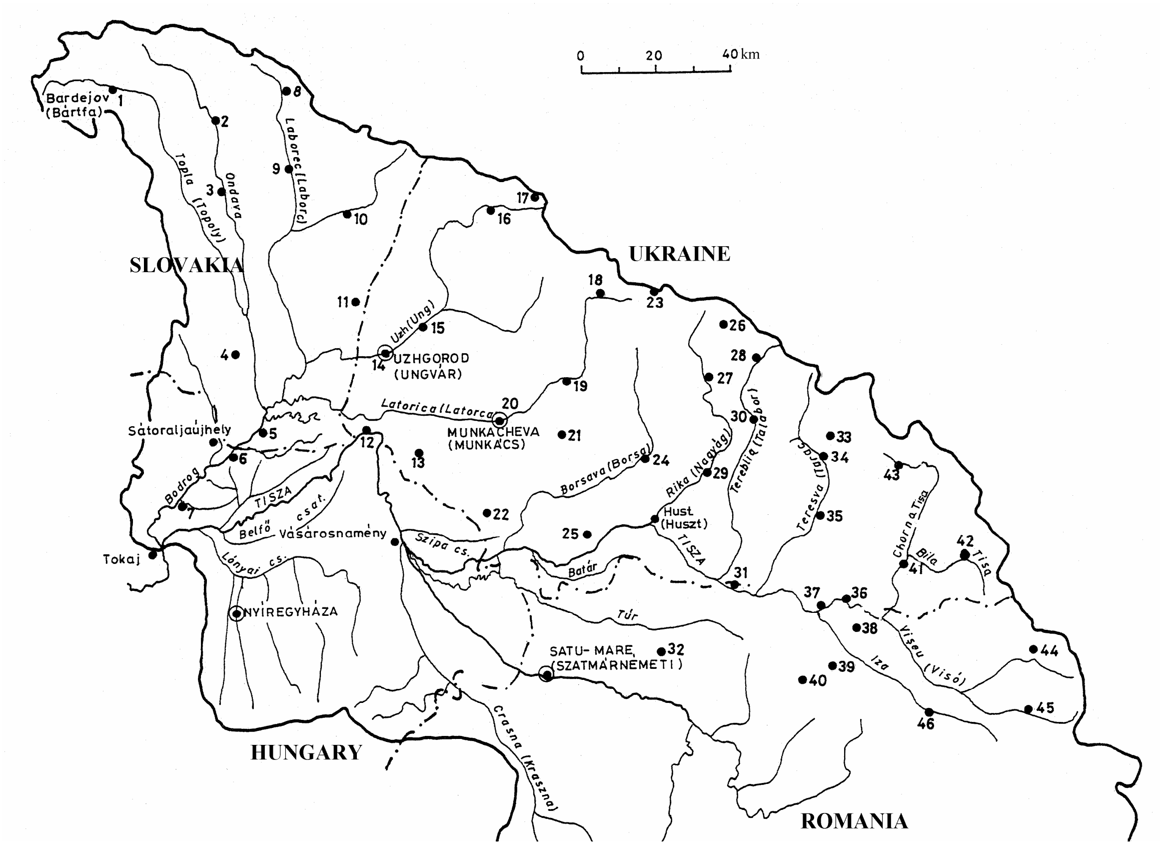

Figure 9. Locations of pluviometric stations in the catchment area of the Upper Tisa and River Bodrog, having data over 20 years

In January the regional distribution of precipitation is similar to that of December. At altitudes above 1000-1500 m monthly data show less than 15 mm as well, at altitudes above 2000 m we practically cannot speak of surface water-input due to sub-zero temperatures. In the wetter southwestern slopes of the drainage basin, due to mild winters, we can normally expect monthly figures to be about 30 mm. In the last month of winter (February) frequent melting that causes considerable increase in the flowage of water resources from certain areas is the only change in the monthly averages of surface water. In mountainous regions reaching altitudes higher than 2000 m we can reckon water input mainly at 15 mm, while 30 mm can only be observed in areas at altitudes lower than 1000 m.

Surface water-flow of the spring season (March, April, May) shows a dynamic picture. Snow-melting in spring triggers a significant increase in the surface water input from March to April. In March, for example, in most of the catchment area thaw peaks and the figure of surface water input increase considerably compared with the preceding months. In areas between altitudes of 500 m and 1500 m the average monthly figure can generally be set at about 100 mm. Figures of the leanest water input are experienced in the Great Plain and in some regional basins, where monthly averages are merely about 15 mm. Regions situated 2000 m or higher above sea level are considered unfavourable areas, where there is still a process of snow accumulation

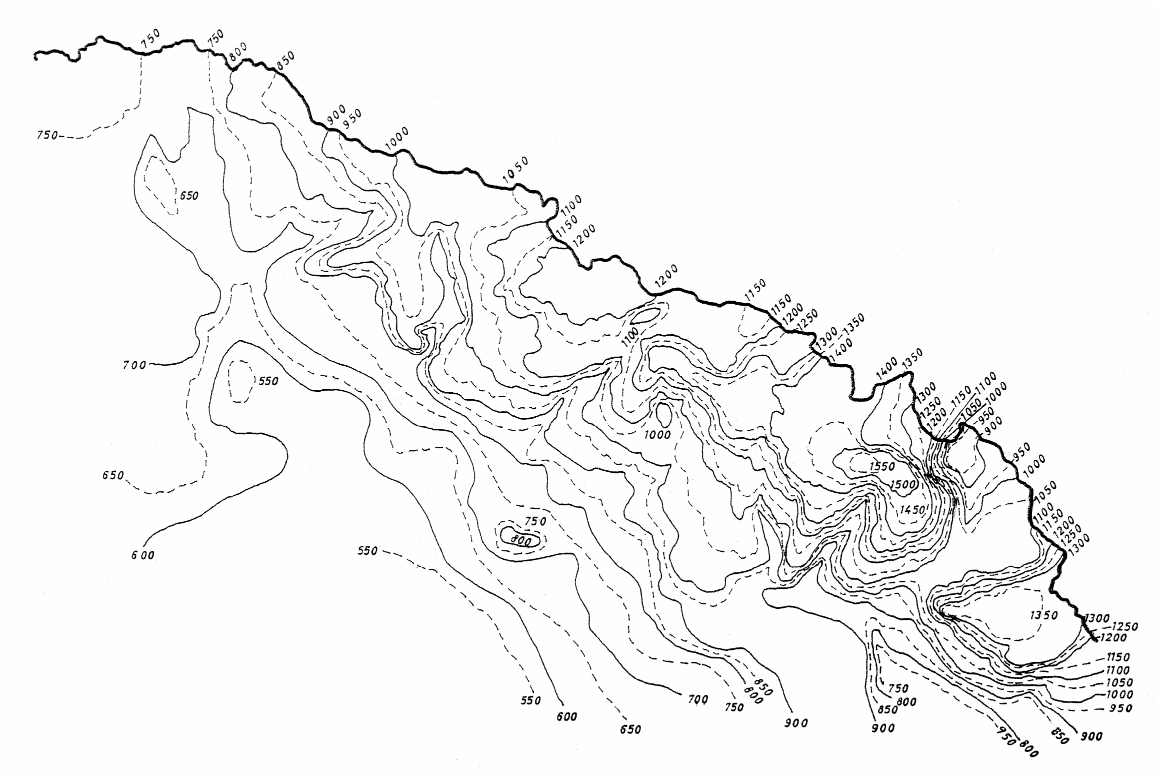

Figure 10 Annual mean values of precipitation in mm in the catchment area of the Upper Tisa and River Bodrog on the basis of 20 years of survey data (see figure 9)

at this time of year rather than thaw. Intensive increase of surface water-input in the highest regions start only in April. At that time figures of around 100-300 mm are common in the Northwestern Carpathian region. In plain and hilly areas amounting to the bulk of the drainage basin it is rainfall that provides the sole source of surface water input in April. In the catchment area system there are sharp differences between basins, dry valleys and mountainous areas. In May this extreme condition lessens to a great extent: rainfall accounts for the entire surface water input in the region. In higher areas of the mountain ranges the considerable melt and rainfall result in a significant increase in the water input. At altitudes higher than 2000 m, for instance, there are figures exceeding 200 mm.

In the summer months (June, July, August) it is rainfall that provides surface water input everywhere, except in the regions above the snow line. Very high values result (600-700 mm). In the catchment area most of the rainfall is received by the northwestern and northern slopes. In the catchment area system monthly average exceeds even 200 mm, while in the area of the intermediate basins, on the surface of the plain, figures are only about 50 mm. With the comparatively dry weather conditions of July and August, water input of the drainage basin does not decrease here.

On the western slopes of the Northeastern Carpathians figures reach even 100-150 mm, in most of the Great Plain, however, figures under 50 mm are observed. Due to the continental effect in August, sources of water input significantly diminish in the whole area.

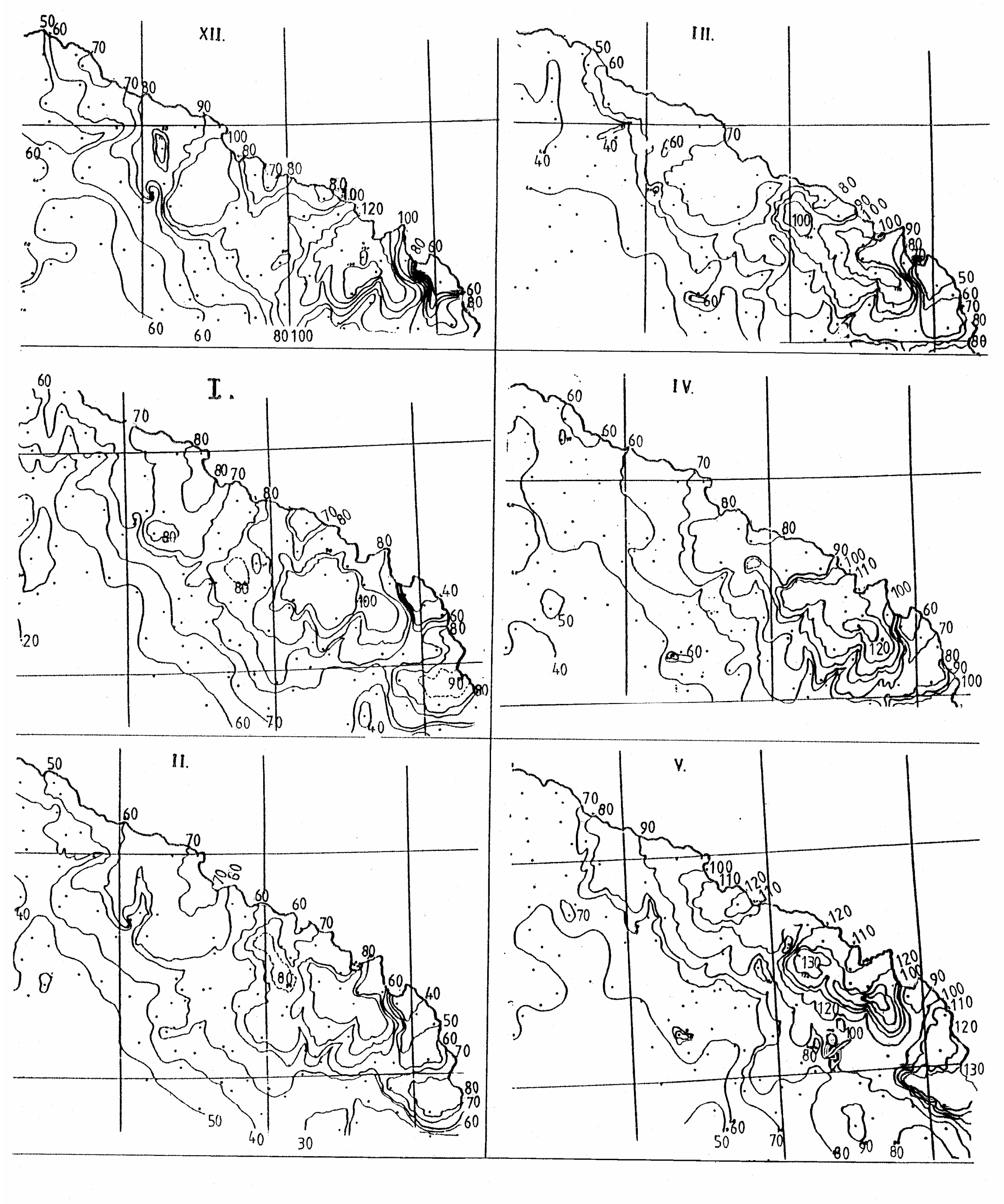

Figure 11 Monthly mean values of precipitation in mm during the winter and the spring months (see figure 9)

Regional changes of surface water input in the autumn months (September, October, November) are brought primarily by Mediterranean climate impacts. At this time of the year surface water input decreases significantly in both the drainage basins of the mountain ranges and in plain areas. In October, for example, snow accumulation commences at altitudes above 2000 m, and these regions do not count as far as contribution to water flowage is concerned. As early as in November water input

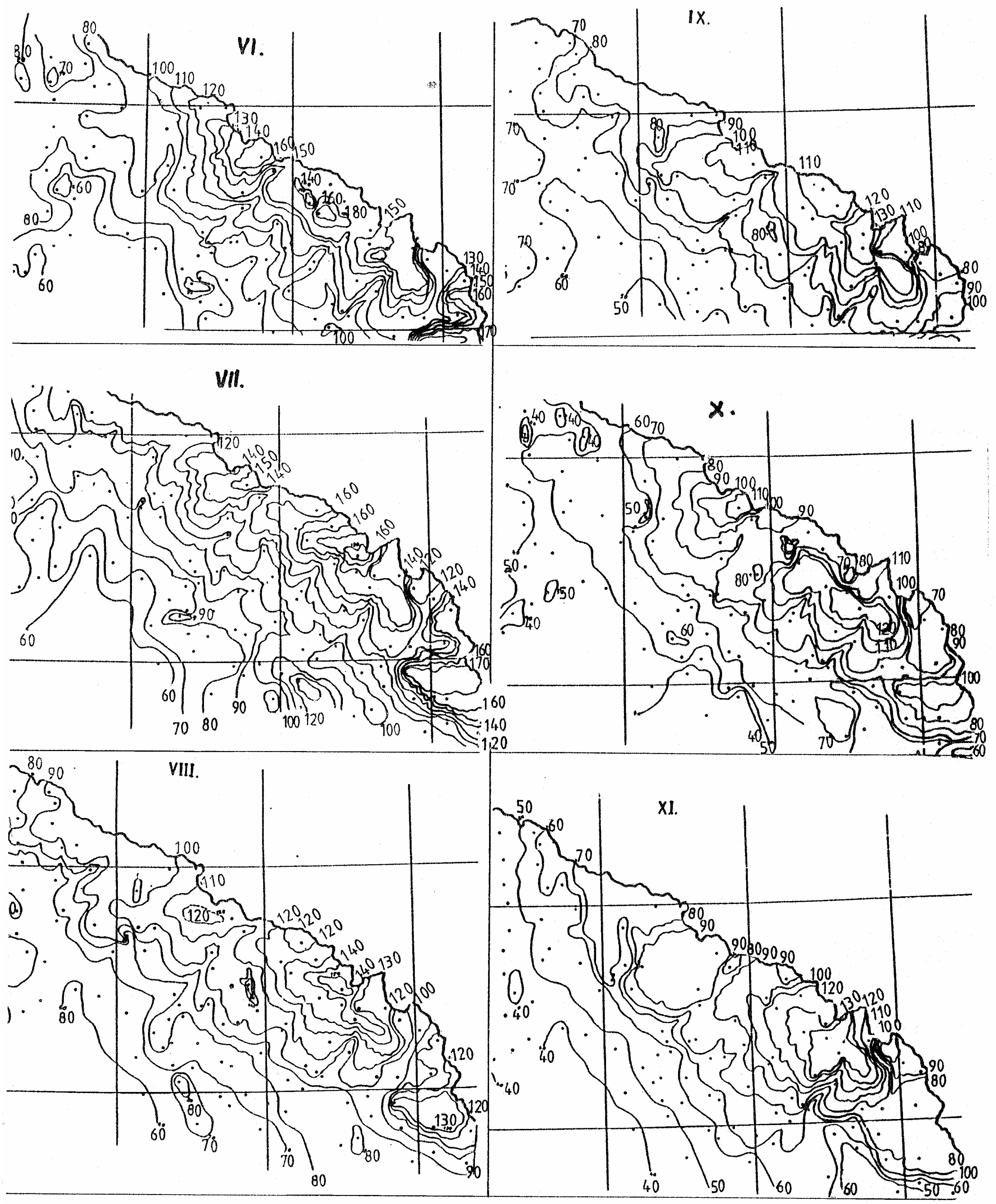

Figure 12 Monthly mean values of precipitation in mm during the summer and the autumn months (see figure 9)

mainly show characteristics of winter months. Snow accumulation occurs even at altitudes above 1500 m, while in the Great Plain and in areas of certain basins belonging to the more enclosed ones there are water inputs of about 30 mm. The highest monthly totals - as it has already been mentioned before - are possible in catchment areas under the influence of Adriatic cyclones, as a result of the Mediterranean climate impact.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
A	16,2	11,4	9,4	7,0	7,8	12,3	18,8	18,8	23,0	15,5	14,0	15,8	14,1
Ac	13,2	13,1	14,5	12,0	10,6	4,3	2,9	6,8	13,0	21,3	22,7	16,8	12,6
Am	10,0	8,8	8,1	8,3	8,4	17,3	25,5	20,0	11,7	8,7	9,0	8,4	12,1
An	9,0	10,0	9,7	8,3	13,2	8,3	5,5	9,7	9,0	10,8	9,3	9,7	9,4
Cm	8,7	9,9	11,6	11,7	8,7	6,3	4,3	5,5	6,3	7,4	10,7	9,0	8,3
AB	4,5	7,5	6,1	6,3	5,5	10,7	8,1	7,7	7,3	4,8	4,3	2,9	6,3
As	6,3	5,3	6,4	5,7	5,2	6,7	6,2	5,5	5,0	6,5	4,0	6,1	5,7
Cmm	9,4	8,2	7,8	9,3	6,1	2,3	1,4	1,3	4,3	6,5	7,3	9,3	6,1
NY	3,8	4,9	4,5	8,3	8,3	6,3	6,4	6,6	5,3	4,0	3,7	4,1	5,5

Table 2. Annual and monthly frequency of macrosynoptic conditions in the Carpathian Basin (in percentage points)

Key to the table:
"A"= The centre of the anticyclone is over the Carpathian Basin. It is a common phenomenon in summer, the direction of wind is indefinite, and prolonged dryness prevails. — "Ac"= The centre of the anticyclone is east of the Carpathian Basin. Southerly and southeasterly winds blow, there is relatively dry weather, a small amount of precipitation is possible. — "Am"= Azorean anticyclone from the west most often with northwesterly winds causing cool, windy and wet summers and mild winters. — "An"= The centre of the anticyclone is north of the Carpathian Basin. Northerly and northeasterly winds prevail; chances of precipitation are indeterminable. — "Cm"= There is a cyclonic condition over the Carpathian Basin. This is a common phenomenon most often before a cold frontal passage. It causes wet weather in winter and weather without precipitation in summer with southerly and southwesterly winds. — "AB"= The core of the anticyclone is over either the British Isles or the North Sea. It is variable in the Carpathian Basin. It causes wet weather with northly-northwesterly winds. — "CMm"= It represents strong Mediterranean cyclonic activity with southerly and southeasterly winds. In summer in the southern and western parts of the Carpathian Basin precipitation of more than 50 mm/day may occur. In winter it causes ample precipitation in the north and east of the basin. — "As"= The centre of the anticyclone is south of the Carpathian Basin. Weather with meagre precipitation prevails with southerly and southwesterly winds. — "Ny"= 'Saddle' condition with changing directions of wind; mainly bright and dry weather prevails.

The mountain climate of the Northeastern Carpathians includes characteristics of the climate of enclosed basins, too. Comparatively low precipitation and significant fluctuation of temperature together with its extreme nature are disadvantages of the enclosed basins. Advantages include the fact that the ring of mountains softens the blow of winds and the fact that the proportion of sunshine is much favourable. Annual temperature peaks in July, and the lowest point is in January. Mild winters and cool summers are quite common, and the weather, though not always extreme, is very changeable. Winter is mild when temperate air from the sea penetrates the area, but it is piercingly cold when northeasterly winds carry cold air masses from the middle of the continent. The snow blanket already there may increase the degree of cold. The highest precipitation values are observed here (1300-1400 mm/year).

Precipitation minima and maxima, respectively, occur synchronously in the catchment area system. This phenomenon, when it coincides with regular weather, causes a well-known process of flooding in our rivers. Severe weather conditions often involve excessive differences in the regional distribution of precipitation, which, in turn, may cause inestimable flooding. Considering the possible extremes of precipitation of each month in the region (on the basis of the absolute peaks and lows registered so far) we can come to the conclusion that both the minimum and the maximum figures indicate the rather unbalanced hydro-meteorological nature of the river system. The main reason for this is that the river system is geographically situated in a temperate zone where air masses of different type (continental, oceanic, Mediterranean, Arctic) often interact actively with each other (Table 2).

Atmospheric advection stretching all over the Carpathian Basin usually distributes precipitation unevenly. Yielding and intense precipitative activities are restricted only to smaller areas. Surface relief provides an explanation to this. The most important inner factors of orographical precipitation are the position, shape and height of the mountains, the steepness of their slopes and the vegetation covering the surface. For example, ridges with N-S direction in the Maramuresh Alps serve as "precipitation blocks" when northwesterly, westerly and southwesterly winds blow.

The heaviest rainfalls occur here when intensified activity of the cyclone of the Atlantic Ocean and the centre of its air pressure lows are located over the Polish Plain and Ukraine. In this case a rapid ascent of the air current may result in intense precipitation over the slopes facing the winds. There are similar additional orographic features aside from the above mentioned in several locations in the river system, for the quantity of precipitation increases with altitude. It is therefore evident that both the map of the distribution of precipitation and the map of flowage reflect the relief of the surface. At the highest points of the catchment area of River Tisa mean annual water output exceeds 1000-1200 mm. The flowage factor in the Great Plain decreases below 0.1, in high mountains it exceeds 0.8. Mean annual water output (MQ) depends not only on the size of the drainage basin, but on its altitudinal location, wetness, slopingness, etc. The order of importance of the tributaries, concerning their water output, is fundamentally different from that of the catchment areas according to their size.

Of course, the tributaries of the Upper Tisa are relatively the most important, as, regarding their water output, they are close to their recipient. The water output of River Tisa is nearly doubled by River Vişeu (more precisely it adds 84% to it), even River Szamos increases it 1.5 times (by 57%). Moreover, both River Iza and River Teresva with their relative weight precede River Maros which has a much greater water output.

Annual water output varies extremely, primarily according to the weather. Thus, the annual water discharge of River Tisa may go down as low as half of the annual average, but in a wet year it may exceed even the double of the annual average. Generally speaking, spring months are the most abundant in water in the catchment area of River Tisa.

In drainage basins of relatively great size, accumulation of water from melting is often prolonged, with April taking the lead.

In the Upper Tisa, because of the characteristics of precipitation distribution, the greatest floods occur in the spring and winter months. Winter precipitation, which, compared to other seasons, is less here, too, melts quite quickly, so at the beginning of spring warm weather and rainfall cause huge amounts of water to pour on the Middle- and the Lower Tisa region. The melting process usually starts at the beginning of March when snow melts in the plains and is followed by melting in the mountainous

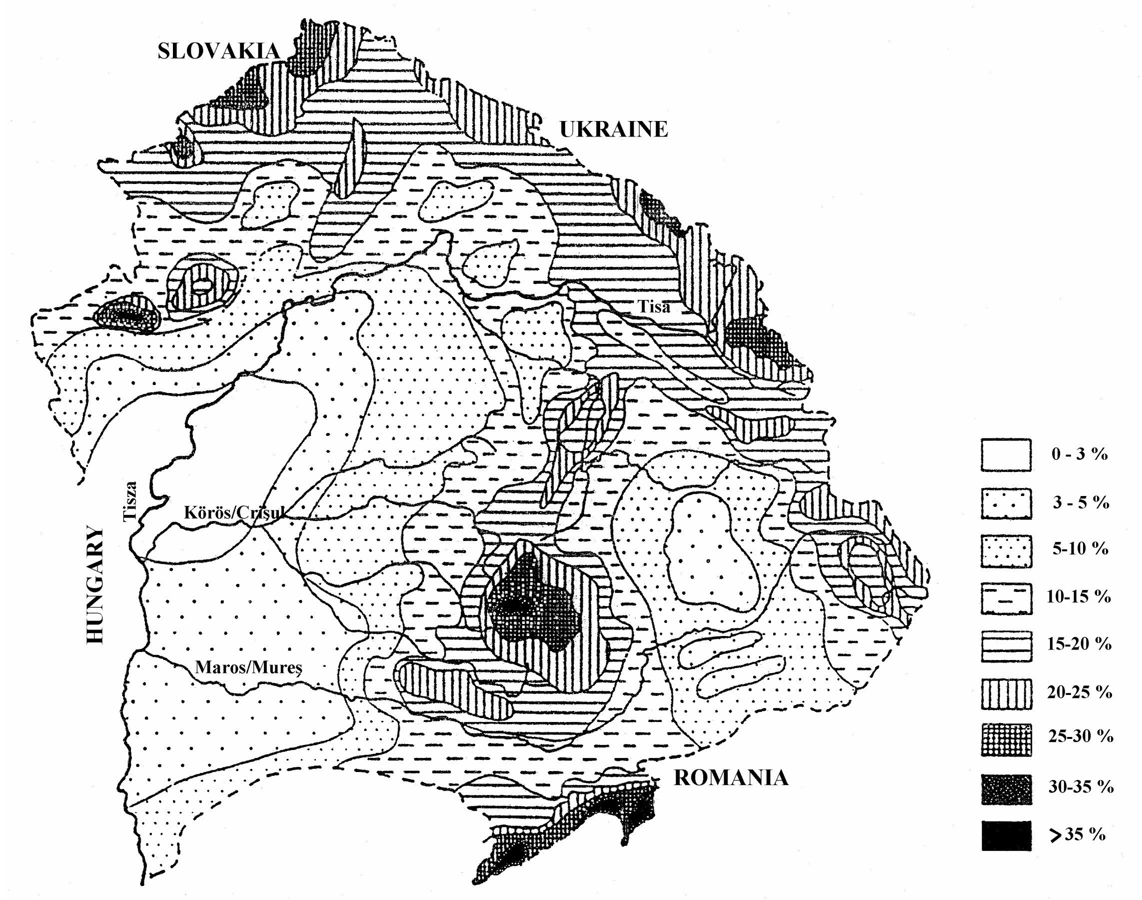

Figure 13. Mosaic map of flowage coefficients of the catchment area of River Tisa

areas at the end of March and the beginning of April. In April snow remains only on high peaks and in hollows of cold locations, and only in small amounts. Every year three major flood waves set off from the Upper Tisa. The first is caused by the melting of snow, and it rarely reaches record heights, it is rather a sequence of several smaller flood waves. The second, taking place at the end of spring and at the beginning of summer, is called the "green flood", which is particularly noteworthy if it finds a riverbed already filled by winter floods. The third is the autumn flood wave, which is remarkable only at times of major autumn rainfall, and then mainly in the right tributaries, to the north of River Tisa. The flood waves mentioned do not occur every year, they may often fail to come about.

Out of the three flood waves of the Upper Tisa only the spring and the summer floods are significant in the Middle-River Tisa section. These floods are substantially prolonged because of the floods in the tributaries. The difference between the water mass at low water mark and at high-water mark constantly decreases. At Vásárosnamény, below the confluence with River Szamos the lowest water output (average of many years) is 38 m^3/sec, the highest is 3300 m^3/sec (i.e. 87 times the lowest). The abatement of the flood wave here still cannot be observed because of the joint effect of the rivers Tisa and Szamos, but below Tokaj the lowest water output is 54 m^3/sec, the highest is 4000 m3/sec, (i.e. 74 times the lowest).

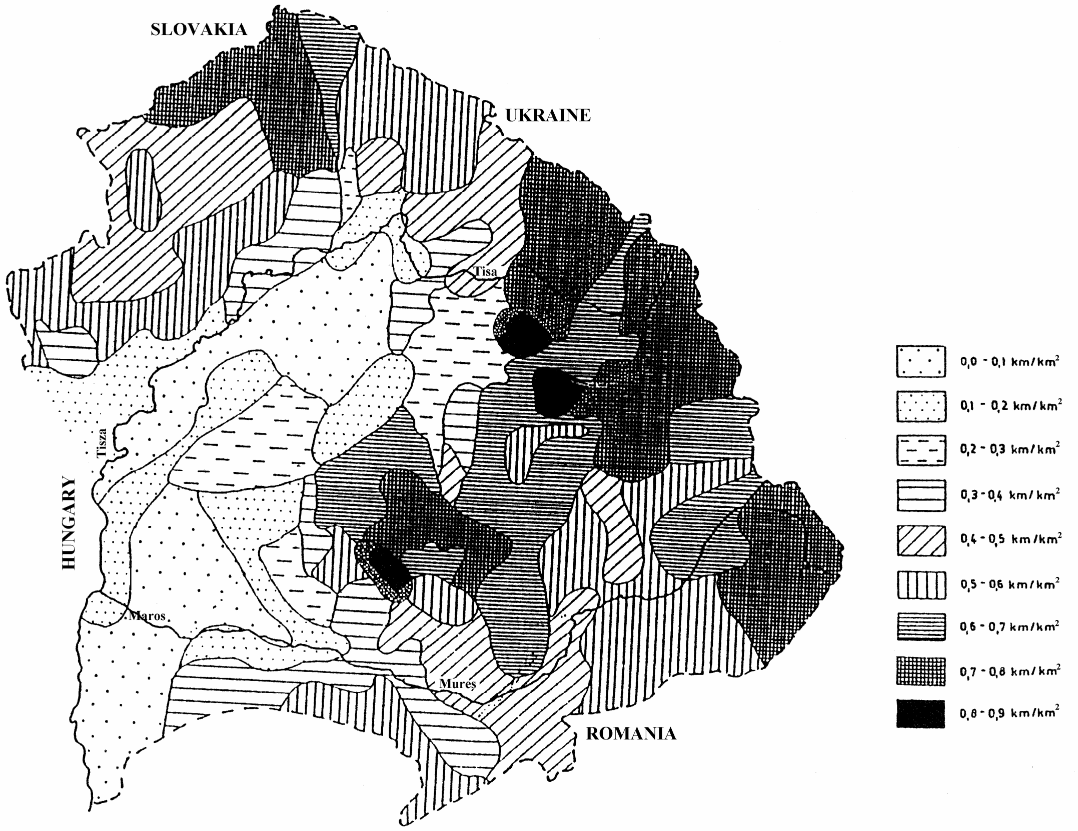

Figure 14. A map of the density of natural watercourses in the catchment area of River Tisa

Volumes of flowage in the catchment area hugely depend on the features of the surface relief (angle of slope, exposure, perviousness, proportion of area covered by plants, etc.). One of the most essential factors influencing the density of the watercourses and the dynamics of surface erosion (stage of valley formation) is the relief energy of the region, which primarily exerts its influence in the river system in a way that the higher the figure is, meaning the more marked the features of relief are and the higher the slopingness is, the denser and richer the river system taking shape will be.

The mountain ranges of the Carpathians have a powerful and complex effect on the distribution of atmospheric movements. 1500-2000 m high relief formations constitute real obstacles to air masses coming towards them. Mountain ranges significantly alter the direction of cyclones as well as their natural formation. Passing cyclones moving over the ridges often separate to meet again later in less turbulent zones.

Within air masses forced into an ascending course, intense adiabatic cooling occurs, which, in turn, results in the creation of precipitative activities in the mountainous areas, even in the case of air masses that have proved to be absolutely inactive and dry over the Great Plain.

The ridge of the Carpathians blocks most frequently the humid air masses coming from the west and the southwest, and, as a result, some of the humidity of these clouds falls on the drainage basins of the tributaries flowing into River Tisa from the right, i.e. rivers Teresva, Tereblia, Rika and Borzhava. Although the rain fronts arriving from various directions play a part in the creation of precipitation, the dominant direction of air currents are of crucial importance in the formation of annual precipitation totals. For example, annual average precipitation reaches its peak, 1720 mm, on the southern slopes of the Svidovec Mountains, in the valley of the Sopurka Stream; the maximum figure registered here was 2432 mm. In the area of the river-heads of River Tisa's tributaries flowing from the right, annual precipitation is 1200-1400 mm. Elsewhere, in about 60% of the catchment area of the Upper Tisa, there is more than 1000 mm of precipitation, and in a fairly small area, namely a section of the Iza Valley, there is a figure under 700 mm, while precipitation below 600 mm is recorded at only one station.

Westward the amount of precipitation gradually decreases. Accordingly, the 40-year average still exceeds 1400 mm at the wettest spot of the Teresva Valley, in Usty Chorna; in the Tereblia Valley it is already below that (around 1356 mm), in the Rika Valley it is only about 1250 mm (Berezova 1253 mm) and it is around the same figure in the Borzhava Valley (Rika 1290 mm).

East of the wettest region the figure of precipitation rapidly decreases. Barely 10 km eastward, in the valley of the Chorna Tisa, the annual amount is already below 1100 mm. Moreover, near Yasina the annual total of precipitation does not even reach 900 mm. This region, which is sheltered from rain by the above-mentioned wet Svidovec, is the driest in the Maramuresh Alps. Elsewhere, precipitation as little as here can only be found in the south, in the low-lying areas of the Maramuresh Basin, and in the valleys of the rivers Vişeu and Iza.

West of the 'Gate of Hust' the amount of precipitation decreases evenly and relatively precipitously from 1000 mm to 600 mm, the latter figure being characteristic at the surroundings of the confluence of River Szamos and River Tisa. From other wet regions it is only rivers Borzhava and Túr that carry water of remarkable amount. The upper section of River Borzhava is in the wet area of the Maramuresh Alps, whereas River Túr rises on the southwestern slope of the Oaş Mountains, another area where precipitation exceeds 1000 mm.

The distribution of the annual amount of precipitation can be explained by the orographical structure of the region: the arc of the Carpathian Mountains runs from NW to SE. Arriving in the Carpathian Basin mainly from the southwest or the west, however, air masses carrying precipitation change their course northeastward because the frontier mountains bounding Transylvania in the west constitute an obstacle. As a result, these air masses are forced to bank up, and ascended they precipitate some of their humidity because of dynamic cooling. Precipitation is also enhanced by the channel effect: the area tends to narrow northeastward. Here we deal with the wettest region of not only River Tisa Valley but the whole Carpathian Basin. An increase in precipitation can be detected in our country as close as only 60-80 km from the foot of the mountains. Obviously, the southeastern slopes of the mountain ranges receive the most precipitation, so there is a great deal of precipitation even on the southwestern slopes of the Oaş-Ighnis. Behind them, in the Maramuresh Alps intense ascent of the

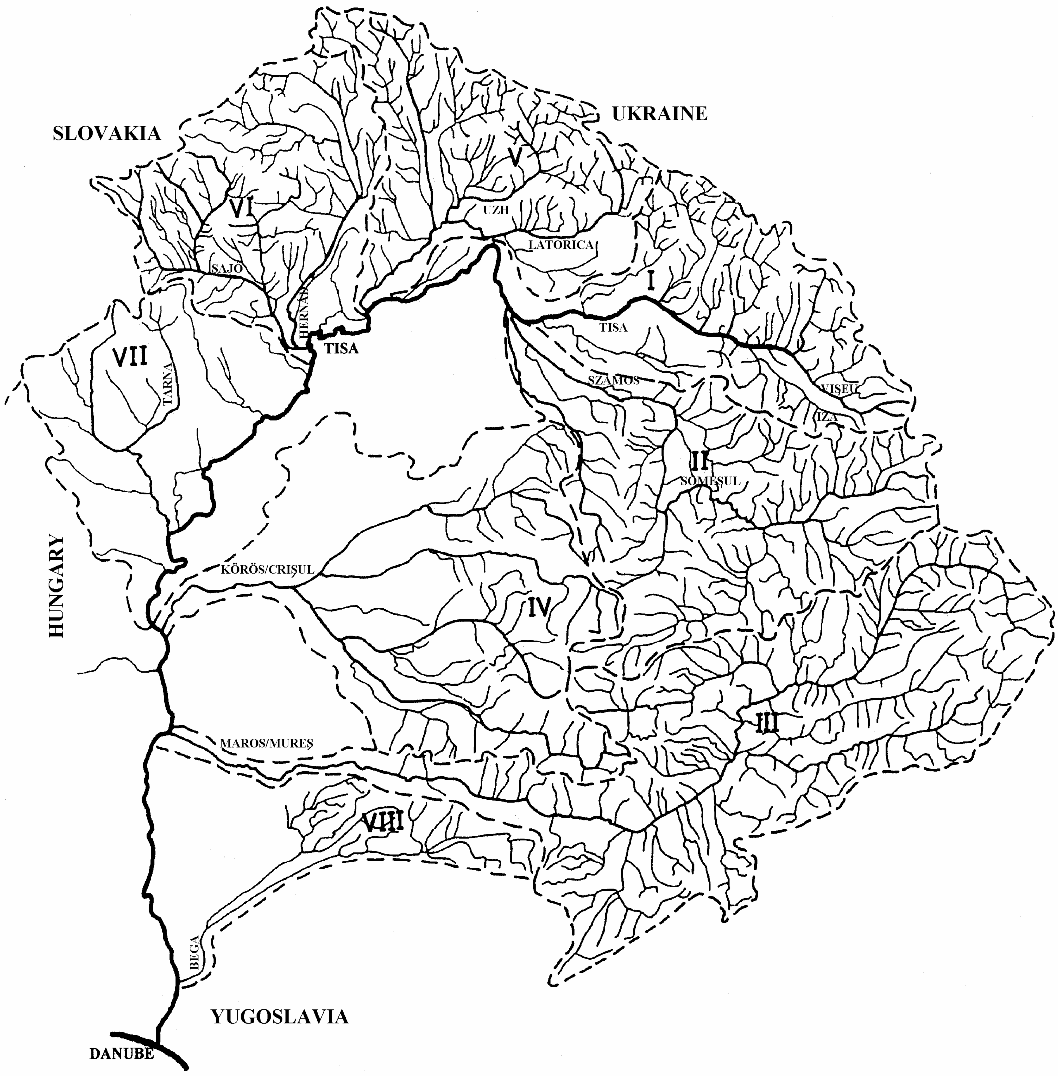

Figure 15 The catchment area of River Tisa and its tributaries with the major sub-catchment areas indicated

I The sub-catchment area of the Upper Tisa; — II The sub-catchment area of River Bodrog; — III The sub-catchment area of River Sajó and River Hernád; — IV The sub-catchment area of River Zagyva and River Tarna; — V The sub-catchment area of River Szamos; — VI The sub-catchment area of the Körös rivers; — VII The sub-catchment area of River Maros; — VIII The sub-catchment area of River Bega

air commences because there is no side outlet at lower altitudes. As a result, there is even more precipitation here than in the previous mountain range. Naturally, the Maramuresh Basin sheltered from rain by the Gutâi Mountains is drier, but the river-head area of the Chorna Tisa behind the highest ridge is also rainless.

The drainage system of River Szamos is at a lower altitude and is much bigger than that of the Upper Tisa. In most of the region there are low and medium height mountains, which are covered by Tertiary argillaceous and marly strata, therefore the sloping of the mountains is not as great as in the water system of River Tisa.

The high-lying areas from where the drainage basin gets water are the southern slopes of the Rodna Alps, the northern side of the Calimani Alps (M. Calimani) and the eastern half of the Gilău Alps. At its lower section River Szamos drains also the watercourses on the southwestern slopes of the Cibles and Gutâi and the watercourses of the (Szatmári) Bükk. Its catchment area lies lower than that of the Upper Tisa, which already explains partly why the water output of River Szamos lags behind that of the Upper Tisa in spite of the drainage basin of the former being 1.5 times bigger than the latter.

Usually precipitation is also less here than in the Upper Tisa system (6-700 mm). Spring and summer floods of the river generally come along at the same time as those of River Tisa. In autumn, however, heavy rainfall is a rare occurrence in the Transylvanian Basin, so the flood waves of River Tisa in autumn (October) and the high waters of River Szamos do not cause floods. The catchment area is 15,882 sq. km, the length of the river is 1,696 km, the area per unit river length is 7.80 sq. km/km.

The drainage basin of River Bodrog concerning its size is roughly the same as the catchment area of the Upper Tisa (13,579 sq. km). River Bodrog drains the waters of the western parts of the Northeastern Carpathians, and as the amount of precipitation diminishes in the Maramuresh Alps westward, this decrease continues in the drainage basin of River Bodrog, therefore the river carries much less water than the Upper Tisa. The average annual rainfall exceeds 1000 mm only in the region of the eastern source streams Latorica and Uzh. In the river-head area of the Laborec, at the watershed, the figure is about 800 mm, near the springs of the western source streams Topla and Ondava, it reaches only 700 mm. In the region of the streams Latorica and Uzh most of the precipitation does not fall on the main ridge of the Carpathians, but on the area of the Sinjak lying southwest in front of it.

The eastern half of the catchment area of River Bodrog gains its ample precipitation because of the same reasons as the Upper Tisa region, only that the amount of precipitation is slightly lower. What may play a part in this is the fact that the height of the ridge of the Carpathians decreases westward, so cooling off and the precipitation of humidity of the air masses passing over it is also less. Along the upper section of the streams Ondava and Topla the situation is different: this area is out of the way of the air masses advancing from the southwest, hence the comparatively small amount of precipitation, whereas - because of the low ridge - northwestern and northern air currents also play a role in precipitation.

Hydrographic features and the conditions of flowage in the catchment area

Since the Cretaceous period up to the present day some of the high mountains of the river system of the Upper Tisa region have not been covered by sea, other parts surfaced during the Tertiary, or at the end of it as latest. During the long period of time, crust movements and changes in climate have modified the surface-shapings of the elemental forces many times. Vertical crust movements are common in the

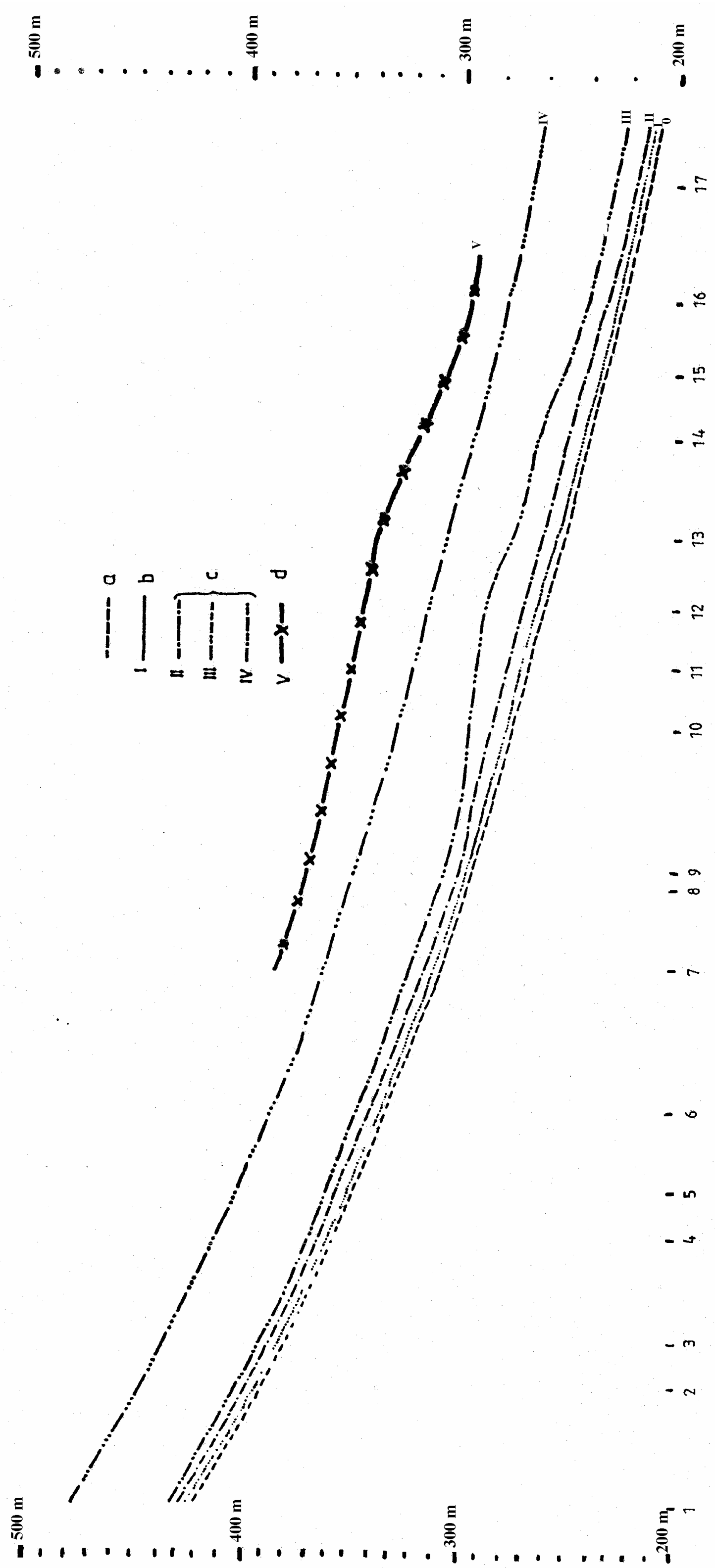

Figure 16 Terraces of the mountain-tract tributaries of the Upper Tisa
Key a=present level of River Tisa b=Holocene (alluvium) c=Pleistocene d=Pliocene

mountainous area. With their dip heightened, the rivers, or certain sections of them may have repeatedly etched their valley plain, so in their valleys terraces cut into one another recur in a stepped way. It is mainly the valleys of the major rivers that are terraced. Climate changes of the Pleistocene period as well as the alternation of cool-and-dry ice ages and wet-and-warm interglacial periods led to similar results via the changes in the amount of water or the rubble.

Universal elevation was one of the reasons why the sea covering the Tertiary basins was isolated, freshened and then disappeared. Faulting, and through that, relative differences in altitude altered the dip of the rivers, their potential energy and their surface-forming activity, of all of which visible indications are the terraces.

Since the Pliocene up to the present day rivers of the Northeastern Carpathians have formed six terraces in the process of etching. Terraces in the river valley are not parts of a uniform group, what is more, the eroding force of the rivers made the older terraces disappear. Where there is a gorge along the riverbed only fragments of the youngest terraces remained. Appendix I gives useful information of the etching of the rivers, though determining the exact age of the terraces is very difficult. Where the valley of River Tisa widens, more remains of the terraces survived. So there was a unique terrace formation in the Maramuresh Basin, too. This section of the basin played the role of a filter indeed. River Tisa and its tributaries running down from the high mountainous areas have their first sudden slowdown here. As a result, River Tisa becomes shoaly and a pre-plain-tract river, with its alluvial deposit settling in the past and in the present.

Terrace 1 is 2.25 m above the level of River Tisa. This is the youngest terrace, its facies is often shapely. The gravel composition is completely the same as the one belonging to 'flis'.

Terrace 2 is the youngest among the glacial terraces, it is a prominent, well-developed terrace, it belongs to the most common terraces of the upper section. It is situated 6-10 m above the level of River Tisa. Its composition is gravel, which is always loose because of the lack of cementing substance. Conglomeration cannot be observed anywhere.

Terrace 3 is one of the commonest among terraces of medium level. It is 14-16 m above the level of River Tisa. Regarding its morphology it is cohesive and its gravel content is also quite fresh, there are no decayed parts in it. Gravel accumulation may have happened in the middle of the ice-age.

Fragments of terrace 4 are quite rare, but still enough to form a cohesive terrace system. It is 50-55 m above the level of River Tisa. This being the oldest glacial terrace is relatively intact, decayed pieces can hardly be found.

Terrace 5 belongs to the older, Pliocene terraces that still remain. It is 75-80 m above the level of River Tisa. This is the last terrace that can be traced back to a cohesive terrace level with the help of its remains. Its gravelly rock composition reflects the erosion through time. Certain compounds of the pebbles are greatly decayed.

Terrace 6: They are very conspicuous levels above terrace 5, but it is risky to establish a connection between them. Resembling the terraces of River Tisa there are terraces of the above mentioned types along its tributaries, too. They can primarily be found in isolated pieces in the valley of River Teresva.

Anyhow, terraces are important components of the landscape, and they are also important from the people's point of view: on the lower ones, protected from floods and having a plain surface, there are a number of villages with their arable lands, and the roads are also here. Some patches of the higher, therefore older and, as a result, more eroded terraces proved to be suitable for building castles.

V-section valleys created by rivers are the prevailing formations in the Northeastern Carpathians. There is a great deal of variety in the details. The density of the valley network and characteristics of minor surface formations depend on the size and height of the mountainous area on the one hand, and on its composition and the qualities of rocks in its structure on the other.

Minor rivers and streams rising in the inner side of the mountain ranges of the sandstone belt flow together in groups before they break through the volcanic belt in the relatively narrow valley. To the central trough of River Tisa in the Maramuresh Basin six torrent river valleys are attached, stretching from Sighetu Marmației to Hust: rivers Rika, Tereblia, Teresva, Chorna Tisa, Bila Tisa, Vişeu and Iza. (Table 3.)

Watercourse	Name of section	Location	Catchment area	Water output, m^3/sec		
		rkm	sq. km	low eater	average	high water
Vişeu	Petrova	8,5	1586	3,6	29,2	1020
Túr	Turulung	56,1	723	0,14	8,8	300
Teresva	Dubove	34,2	240	3,57	8,4	663
Tereblia	Kolotsava	57,7	149	141,8	4,05	356
Rika	Hust	1	781	4,14	27	1667
Iza	Vadu Izei	9,7	1130	0,58	15,9	660
Borzhava	Dovge	69	407	0,66	10,1	399

Table 3. Regime data referring to some sections of the tributaries of the Upper Tisa

If the surfacial unity of this huge region is seen, which takes shape in a 100 km long trough and its narrow southern as well as its 40 km wide northern mountainous slope, including the perfect enclosure of these two slopes by the Rodna Alps (Munții Rodnei), then what we see here is a big indivisible hydrographical unit whose water supplies constitute the water bases of River Tisa.

The huge trough of the Maramuresh dominates so much over the mountain tributaries that their independence is overcome by its attraction. The fact that the valleys of Maramuresh are formations by simple slope rivers also contribute to that. As a result they do not furcate, do not branch. They are narrow ditches on which human settlement spreads, and each joins the big trough of River Tisa separately.

The dip of the rivers already in the basin or just reaching the bays of the plains is much lower. Their potential energy may be only as much as or just less than what is needed to carry their sediments. In the former case the river is a valley-tract, meandering river; with its prominent bends it creates a wide valley plain. In the latter case it is a mountain-tract, branching, shoaly river filling its valley with its sediment.

Evaluating the hydrogeographical features in detail, on the basis of the valley structure and the characteristics of the surface morphology, the catchment area can be divided into three parts: mountainous, hilly, and plain areas. River Chorna Tisa rising north, about 50 m under the ridge of the Okula-Aklos and later joined by River Bila Tisa flowing from the east, flows mainly southward, then at its confluence with River Vişeu, takes its course westward and keeps this direction as far as Tjachiv. The drainage area of the Upper Tisa above Tjachiv is about 7000 sq. km, which can hydrogeographically be divided into two characteristic sections. From the spring of River Tisa the real mountain-tract section spreads roughly from Rahiv to Luh. Here River Tisa is a real mountain river, a real "wild river"; its speed reaches 3-4 m/sec at several places. In the narrow valley it runs deep in a bed interspersed by big, in places 1 m^3 large cuestas, races and faults, roughly as far as the confluence with the stream Kasovska.

The hilly section spreads from the village of Luh, from the confluence with the stream Kasovska, to the village near Tjacsiv. Below Luh the "embrace" of the mountains suddenly ends and River Tisa flows out into the hilly region. However, because of the sloping of the terrain, it does not lose much of its speed. 3-4 km below the village V. Bochkiv, there is a fall at the bend between the La Ciube Mountain and the village of Tisa (Romania). Further down as far as Sighetu Marmației there is an alternation of small and big islands. It is here, approximately between Sighetu Marmației and Solotvina that River Tisa first pours out its "bundle", its mass of water, to which River Iza contributes to a great extent. The first big levee beginning here impairs the flowage conditions throughout a 25 km length or so with a number of branches, bends, falls and shallows. Below the confluence with River Teresva, River Tisa runs down at such a speed that along an approximately 7 km stretch as far as Tjachiv no considerable island is formed. We first encounter major islands and falls only near the Tjachiv bridge. Another major levee begins only below the ravine between Tjachiv and the Papasztag Mountain. The section of the river ends at the edge of the Maramuresh Basin, where the mountain pass of Hust (or the 'Hust Gate') can be found. The following section of River Tisa is between Hust and Vinogradiv in a region of low hills consisting of volcanic rocks.

The mountainous area surrounding the Great Plain elevated differently in the Quaternary, and the basin of the plain did not subside uniformly either: sub-basins of different size were formed, so different kinds of rock from the mountains filled up the different parts of the basin. From Vinogradiv to Vilok River Tisa is a mountain-tract river. From its spring it travels 200 km with an average dip of 8 m/km and arrives at the edge of the Great Plain carrying an enormous amount of gravel. From that point to the confluence with River Szamos and River Kraszna its dip decreases fortyfold, the average barely reaching 20 cm/km. Because of the abrupt loss of dip it deposits most of the large pieces of its sediment here, at the edge of the Great Plain, it branches and wanders around the 40-50 km wide plain covering it with multiple layers of gravel. Keeping west near Vásárosnamény it runs into the elevated "island" of Nyírség, and it takes a sharp turn north from here. Below the turn it receives River Szamos and River Kraszna flowing from Transylvania, from the south. River Szamos is a longer river: by the confluence it has covered 370 km as against the 200 km of River Tisa (Figure 17).

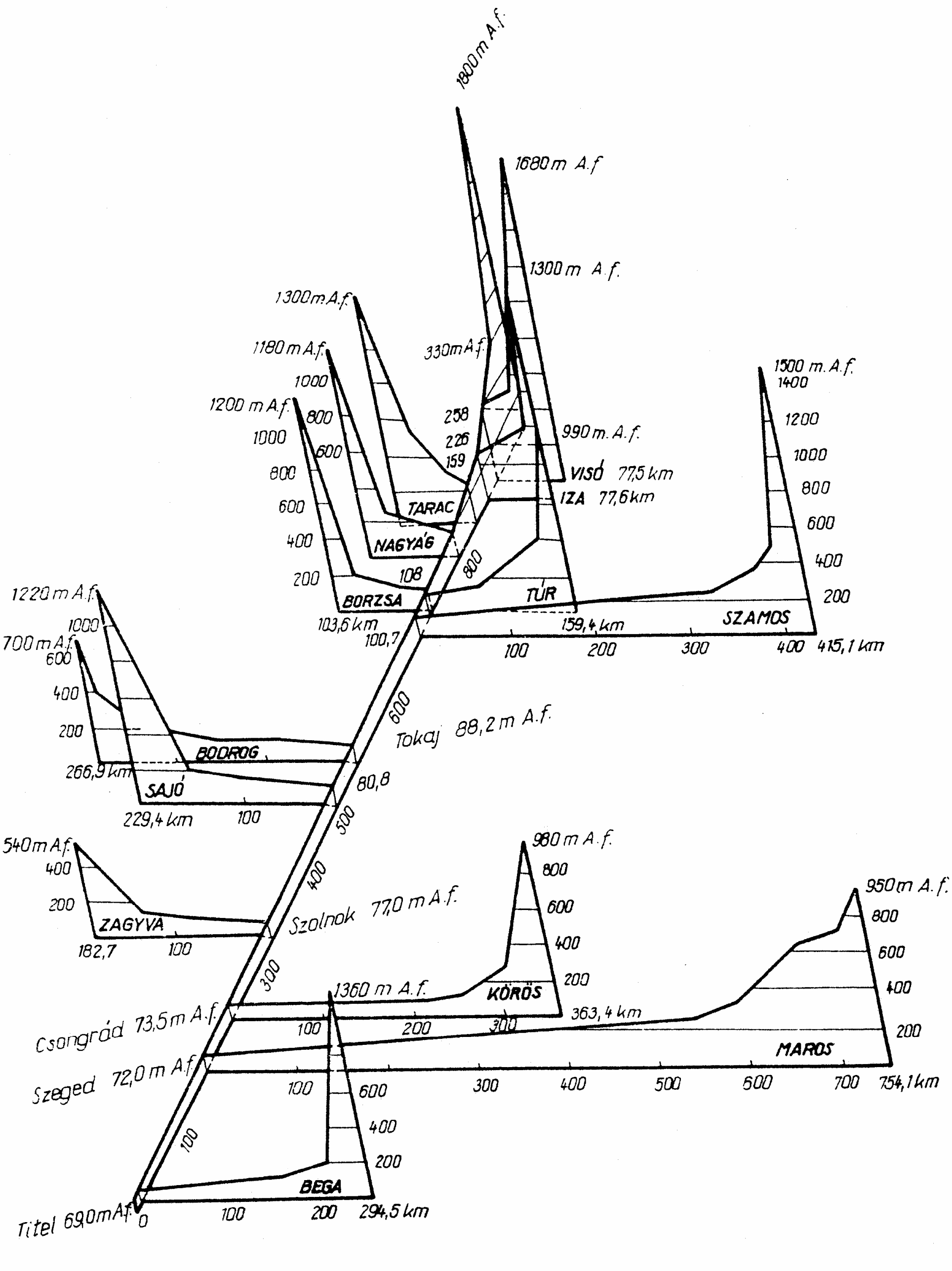

Figure 17 A schematic delineation of the conditions of bed gradient of River Tisa and its tributaries

The water output of River Tisa is higher, 224 m^3/sec, that the average 126 m^3/sec of River Szamos. It is due to River Tisa's tributaries of great water discharge. River Szamos comes from the rather dry region of North Transylvania. Well beyond its confluence with River Tisa, River Szamos loses its dip and begins its large-scale deposition of gravel up near Szatmárnémedi. The vast gravel field of the Szatmári Plain has been built by the three major rivers, (Szamos, Kraszna and Túr) together with their affluents. This catchment area (Tisa-Szamos region) is a plain area indeed, where the great bend of Vásárosnamény came into existence in the last third of the

Pleistocene. River Tisa, in accordance with its original course, turned south, united with River Szamos, and flowed toward the Berettyó in what is now called Ér Valley. The change was caused by the elevation of Nyírség. Nowadays in the 60 km section from Vásárosnamény to Chop River Tisa, as a plain-tract river, dips only 4 m, or 7 cm/km. From Chop downwards its dip and its speed increase. Its dip is 10 cm/km as far as Tokaj which is 86 km away. But the neck of the Tokaj Gate swells it again. At this gate River Tisa is joined by River Bodrog, which enters Bodrogköz together with its several tributaries and deposits a great deal of gravel on the flood plain between the two rivers.

River Tisa becomes a typical plain-tract river below the Tokaj Gate. The plain opens wide here. Leaving the marginal little basins the river arrives in the main basin. Its great left-side flood plain, the Hortobágy, is 20-25 km wide. The dip of the river before it arrives in the Szatmár Plain at Tiszaújlak (Vilok), along a 160 km stretch, is 8.2 m/km on average. From the edge of the Szatmár Plain to Tokaj, a 210 km distance, the average dip is 30 cm/km, while from Tokaj to Szeged, on a length of 480 km, it is merely 4 cm/km.

The annual average water output of River Tisa is 200 m^3/sec at Tiszaújlak (Vilok), 450 m^3/sec at Tokaj and 790 m^3/sec at Szeged. River Tisa, enlarged by the mountain streams, is a significant river when it arrives in the Great Plain. Although it does not receive many tributaries on the Great Plain its average water output increases fourfold down to its confluence with River Danube, because it drains the ground water as well, to a great extent. This phenomenon plays an important role in the water movement of the layers 10-20 m under the surface.

Regarding their hydrological parameters, mountain rivers differ to a great extent. What is more or less a common feature, however, is that all of the mountain rivers rise on the inner slope of the Carpathian sandstone mountain range.

In our evaluation we account for the river-heads and the immediate environs of River Tisa and its tributaries.

River Chorna Tisa rises at the foot of the Svidovec, 1680 m above sea level. It drains the waters of 567 sq. km, its length is 50.3 km, the direction of its course is first W-E, then N-S.

Its spring is on the northern slope of the NE-SE mountain range of the Svidovec Mountains. It becomes a rapid mountain stream from the confluence of several mountain rivulets in its environment. The valley is first wide, but it soon narrows, then another wide section ensues, where it unites with the stream Apsinec in the dense fir forests. On it there was formerly a mountain lake that held 200,000 m3 of water. It ceased to exist, and now the mountain stream has only a 15-20 m wide bed, which was etched into the side of the Ocola Mountain. Here, in the mountainous surroundings we can already see several high elevations: the Bratkivska, the Chorna-Kleva, the range of the Svidovec southward, while eastward in the distance the towering mass of the Hoverla. From the valley a narrow path leads to the spring of River Chorna Tisa, where the crystal clear water stream trickles. In the upper section of River Chorna Tisa the Yasina Basin takes central stage. The Yasina lies 12 km long in the valleys of River Chorna Tisa and the Lazeschina. The longest measure of the basin is 14 km, its width is 8 km. Concerning surface morphology, the area is a 200 m high hilly region. Its rock composition is shaley sandstone and micaceous sandstone saturated with crude oil to a certain extent.

The valley of River Chorna Tisa is 44.6 km long, the riverbed section down to its confluence with River Bila Tisa is 50.3 km. The highest point of the drainage area is 1788 m above sea level. The upper extremity of the riverbed section is at an altitude of 1680 m, the lower one is at 460 m. The catchment area is 564.4 sq. km, the total dip of the riverbed section is 1220 m, average dip is 24.2 m/km. The average dip of the whole valley section is 27.4 m/km

River Bila Tisa has two springs. It is fed from the Hoverla setting off at an altitude of 1600 m. It gathers the waters of an area of 489 sq. km along a length of 34 km. North of Rahiv the two branches of River Tisa unite. The bigger branch, River Chorna Tisa retains its previous NNE direction. River Bila Tisa forms an E-W direction river valley. Its river-head area is on the western slope of the Chorna Gora alpine mountain range. From the confluence with River Bila Tisa the distance is 27 air km in a W-E direction to the peak of the Chorna Gora, 21 air km in a N-S direction to the Petros Mountains, while it is 25 air km to the peak of Pop Ivan. The peaks of the northeastern watershed provide a real alpine landscape (Konecz 1517 m, Sesul 1728 m, Petros 1784 m, Hoverla 2061 m, Chorna Gora 2020 m).

Especially noteworthy is the Chorna Gora range, which has several peaks higher than 2000 m (Hoverla 2061 m, Danec 1822 m, Turkul 1933 m, Tomnatek 2018 m, Chorna Gora 2020 m). At the southeastern edge of the alpine range another range begins (the Gora Vaskul 1737 m, Vihid 1471 m, Stig 1650 m), which constitutes the river-head area of the stream Tisora. Among the great watershed peaks we should also mention the Pop Ivan, the Magura peak (1489 m), and the Menchil (1880 m). Relief features provide a significant water basis to the affluents of River Bila Tisa. Some of the remarkable affluents are the streams Pavlik, Bogdan, Hoverla (White) on the right, and Balcatul, Kvasnivchik, Schaul and Stohovec on the left. There are several additional rivulets feeding River Bila Tisa.

River Bila Tisa down to its confluence with River Chorna Tisa counts as a minor mountain river, although some of its parameters are higher than those of River Chorna Tisa. The length of the riverbed is 33.6 km, the length of the valley is 31.8 km. The highest point of the drainage basin is 2035 m.

At the upper extremity of the riverbed the banks are at an altitude of 1600 m, at the lower one they are at 460 m. The total dip of the riverbed section is 1140 m, average dip is 33.9 m/km. The average dip of the valley section is 35.8 m/km, and the catchment area is 486.9 sq. km.

River Vişeu rises at the easternmost part of the Maramuresh and flows into River Tisa at Valea Vişeului. The catchment area is 1606 sq. km, the source of its 80 km-long riverbed is in the Rodna Alps, at the foot of the 2305 m high Pietrosul Rodnei at an altitude of 1693 m. At low-water mark usual water output is 3.6 m3/sec, the average is 29.4 m3/sec, and at high-water mark it is 1020 m3/sec. The river flows in a romantic region, in a narrow valley, down to the village Bistre. Between Bistre and Ruscova, however, there is a widened valley plain. The river is surrounded by various rocks and crystalline shales. Among them there are some kinds of lime deposit of various size, such as limestone shale and solid or breccia-like limestone. On both sides of the crystalline shales Carpathian sandstone can be found, which consists of

Cretaceous, Eocene and Oligocene rocks. The right tributaries of River Vişeu are the streams Borşa, Vaser and Ruscova, the watercourse of the Bistra, and various other less important ones, of which the streams Bistra and Crasna may be mentioned. Except for the first stream all rise from the mountain mass of the Pop Ivan. None of the left watercourses of River Vişeu are significant.

River Iza rises in the Rodna Alps. Its catchment area is 1303 sq. km, its length is 83 km. It is the left tributary of River Tisa flowing along the fault structure of the valley of the Lăpus (M. Țiblesului) and the M. Gutâi, whose SE-NW direction is also followed by River Tisa. Its usual water output is 1.58 m^3/sec at low-water mark, the average is 15.9 m^3/sec, at high-water mark it is 660 m3/sec.

Below the confluence of River Iza and River Tisa, between the M. Oaş and the Vinogradiv mountains at the so-called 'Hust Gate', where the river valley widens, River Tisa first receives its northern tributaries:

- River Teresva which rises on the southwestern slopes of the Maramuresh Alps. The 1836 m high Syvula and the 1742 m high Popdja can be found in its river-head area. The catchment area of the river is 1224 sq. km, its length is 85 km. Usual water output at low-water mark is 3.57 m^3/sec, the average is 8.4 m^3/sec, at high-water mark it is 663 m^3/sec.
- River Tereblia, whose catchment area is 766 sq. km. Its length is 91 km, usual water output at low-water mark is 40.5 m^3/sec, the average is 4.18 m^3/sec, at high-water mark 356 m^3/sec. It rises on the southwestern slope of the Maramuresh Alps.
- River Rika. The highest point of its 1240 sq. km drainage basin is only 1288 m high. The length of the river is 93 km, its usual water output is 4.14 m^3/sec at low-water mark, the average is 27.0 m^3/sec, and 1667 m^3/sec at high-water mark.

From the right River Tisa receives two more major tributaries between Korolevo and its confluence with River Szamos:

- - River Borzhava, the catchment area of which is 1418 sq. km, and its length is 104 km. The river rises at the foot of the 1681 m high Stoj, its water output is 1.66 m3/sec at low-water mark, its average water output is 8.8 m3/sec, at high-water mark 399 m3/sec.
- - River Túr (Tur), which flows into River Tisa in Hungarian territory already. The drainage basin is 1262 sq. km, the length of the river is 95 km, water output is 0.14 m3/sec at low-water mark, the average water output is 8.8 m3/sec, and 300 m3/sec at high-water mark.

Down to its confluence with River Szamos the catchment area of River Tisa is 13.173 sq. km, whereas the altitude of the river valley decreases to 103 m at the lower edge of its 258 km long area, thus the dip of the Upper Tisa is 1577 m.

The mountain streams mentioned above have consistent courses in all cases, their river-head areas are mainly in the Maramuresh Alps.

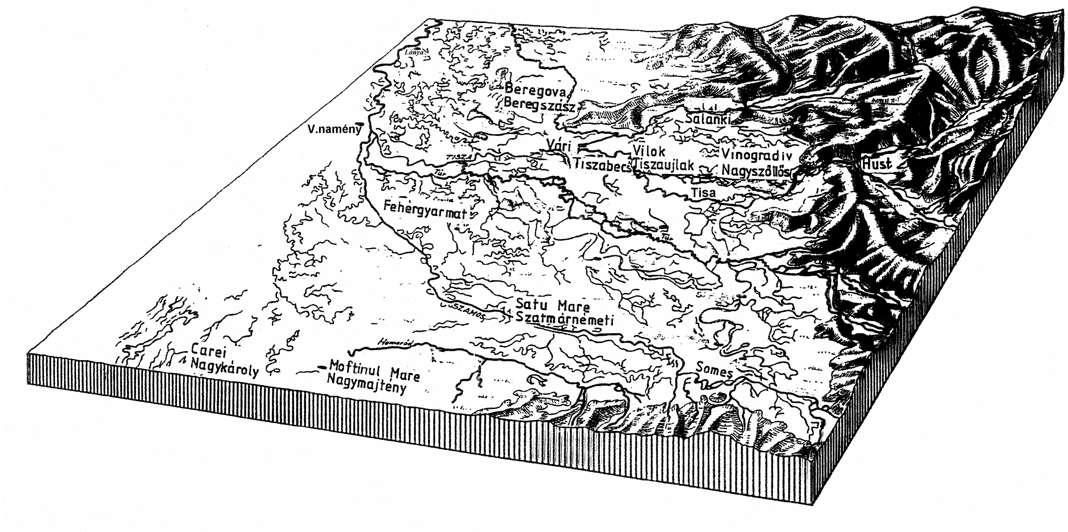

Figure 18 Changes of the beds of River Tisa and River Szamos in the Bereg-Szatmár Plain (after Borsy Z.)

The watercourses rise below the main ridge which serves as the watershed, and all run toward the centre of the Carpathian Basin. All of them are received by River Tisa. The present picture of the river system was created after the folding of the volcanic deposit. The volcanic mound blocked the watercourses running down the inner slopes of the sandstone deposit. Only the eroding process of the rivers of high water output was able to keep pace with the volcanic workings. These, such as River Tisa, River Borzhava, River Latorica and River Uzh were able to keep their valleys open even during volcanic accumulation, and so-called volcanic gates were created this way (Hust, Munkacheva, Uzhgorod gates). The lively force of the smaller rivers, however, did not manage to overcome the volcanic accumulation, these rivers were mounded behind the volcanic masses, were swollen and started searching for a course towards the breakthroughs and gates of the bigger rivers. That is why certain rivers developed a river system resembling a branching treetop. The most exemplary is that of the Uzh.

The hydrography of the depressions at the foot of the mountains is chaotic and meandering everywhere, but in this respect it is the Szatmár Plain that takes the lead. Both River Szamos and River Tisa wanders across the plain while developing huge bends, branching, reuniting, flowing into each other's bed. The reason for this very indefinite flow is not only the different alluvium-carrying capacities involved in the constructing and eroding processes, but the minor mosaic-like surface movement as well, which has been under way up to the present day. The Tertiary surface under the present river sediments has a very varied relief, but the transformation of the substratum did not stop in the Pleistocene or the Holocene; on the contrary, it even intensified.

In front of the mountains the depth of the Pannon strata ranges from 400 m to 1200 m, with depressions of NW-SE direction in them. On top of the Pannon strata there is a sequence of Quaternary strata, which consists predominantly of large

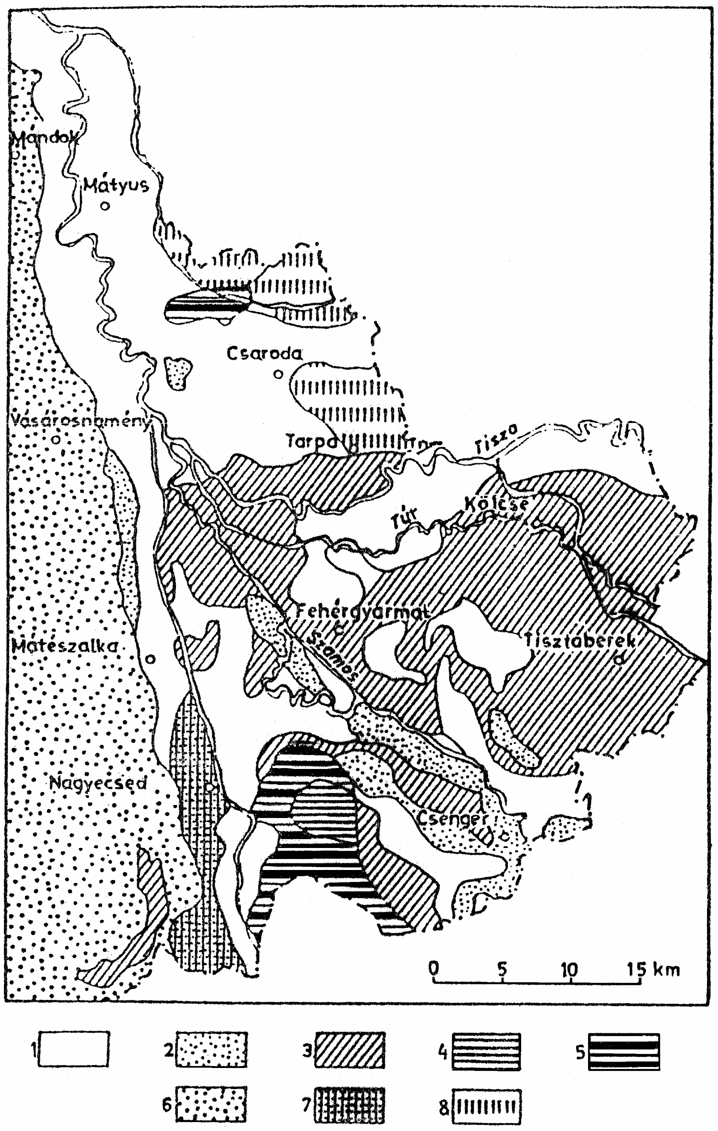

Figure 19. Near-surface deposits of the Szatmár-Bereg Plain
Caption: 1 alluvial soil; — 2 sand drift; — 3 silt; — 4 clay; — 5 mud-peat; — 6 sand drift; — 7 loessal sand; — 8 loess

sediments: gravel and gravelly sand. The depth of the sequence ranges between 50-200 m. In the plain area stretching south of River Tisa Quaternary deposits of various thickness were formed in a NW-SE direction corresponding with the courses of the rivers Kraszna, Szamos and Túr, and in an E-W direction corresponding with the courses of River Tisa and River Latorica. The Tisa-Szamos-Túr plain area was nearly filled up to the present ground level back in the periglacial Lower Pleistocene. It is covered by a comparatively thin sequence of layers formed by younger, Pleistocene and Holocene depositions. Sedimentation may already have started in the Pliocene. During the Quaternary six or seven layers of gravel accumulated in the trough at the foot of the mountain and later in the plain so formed, which indicates the periodicity of the sedimentation as well as the fact that the depression is not young.

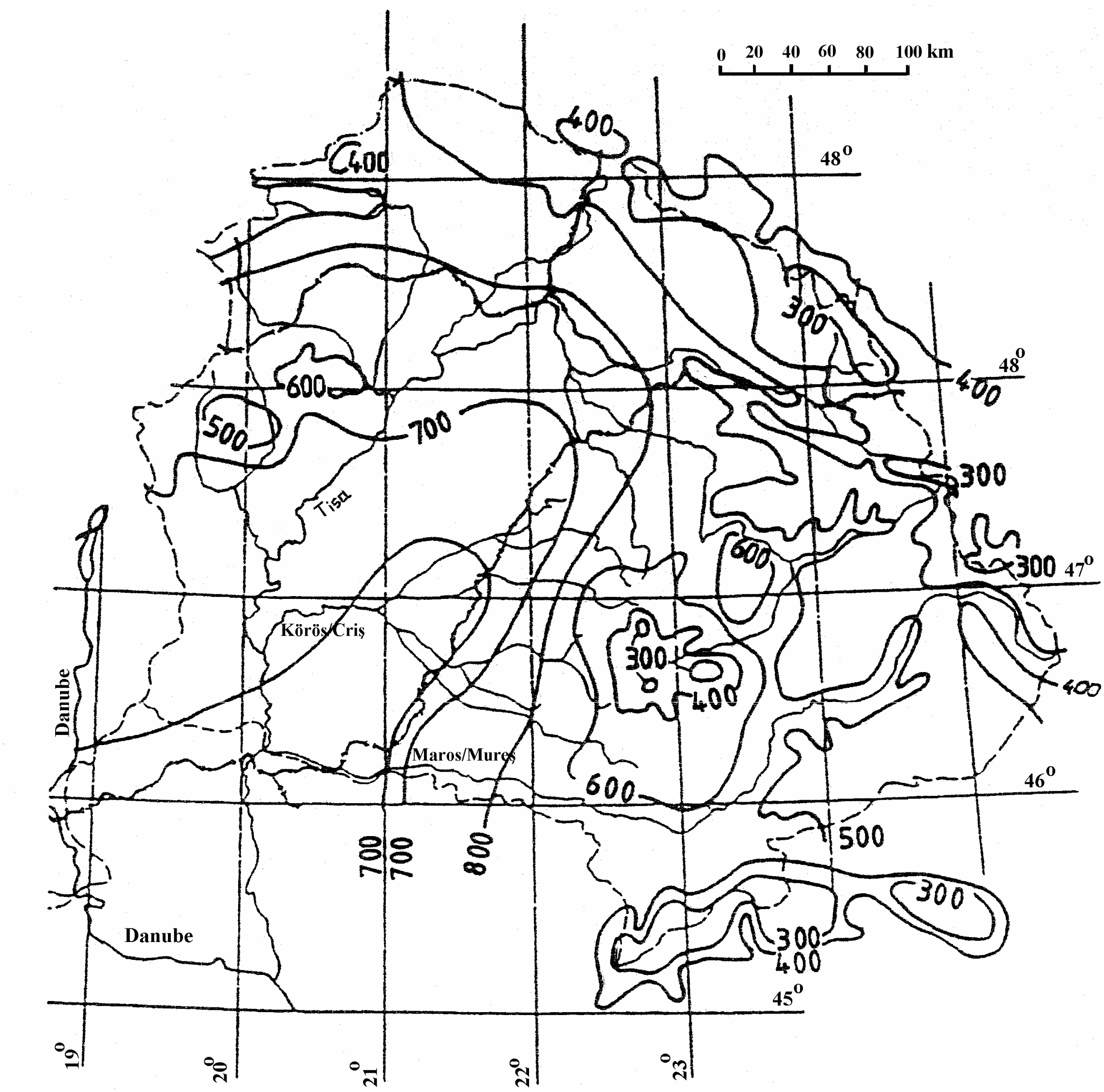

Figure 20. Average potential evapotranspiration over many years

The Holocene strata start with a layer of gravel and they become finer upwards: they turn into sand, silt and clay. Their thickness varies considerably: from some metres to 40-50 m. On their surface peat bogs have come into existence, in other places patches of alkaline soil can be seen.

Relying on the research so far we can consider it proved that the rivers flowing from the Northeastern Carpathians and Transylvania built up a uniform talus pile until the end of the Pleistocene in the northeast of the Great Plain. The talus pile unit disappeared as a result of the periodic subsidence of the Bereg-Szatmár Plain and the Bodrogköz, commencing in the Lower Holocene and as a result of the elevation of Nyírség. It can similarly be considered proven that River Szamos changed its course many times in the Holocene as a result of a gradually intensifying subsidence of the western part of the Bereg-Szatmár Plain compared with its surroundings, and that the sand-drift group of Nyírség was formed in the Holocene, with its main features created in the Hazel Age.

Natural flora of the catchment area of the Upper Tisa

In the drainage basin of River Tisa the country planning of the human society, primarily activities affecting the vegetation of the catchment areas in the mountains, have an impact on the magnitude of flowage. In this respect we give preference to the catchment areas of the mountains because it is well-known that this factor does not play an important part in the plain drainage basins having little relief energy. For example, in the plain of River Tisa where annual precipitation is 600 mm on average, and annual evaporation reaches 700 mm, there is in fact no remarkable flowage, and this fact would not be otherwise if the entire Great Plain were covered with forests. However, in the catchment areas of River Tisa in the mountains, particularly in the Northeastern Carpathians and the Transylvanian high-mountain areas, precipitation exceeds potential evaporation by 10% to even 50%. Actual figures within these extremes depend mainly on the structure of vegetation and the categories of soil composition controlled by it.

The flooding period and the water output at flood increase. Consequently, the formerly built dikes seem more and more underplanned to retain the high water output that fills up the flood plains very rapidly. Unfortunately, country planners hardly take into consideration the characteristic features of our age: the more and more intense exploitation of forests and other agricultural sources greatly increase the flowage coefficient of the catchment areas in the mountains, which can multiply peak water output and it can increase the total amount of soil and detritus washed down, mainly at the river sections well below the drainage areas. This issue is one of the gravest problems of conservation, and it definitely deserves more attention than it has been paid so far! (Table 4., Figure 21.)

Name of the drainage area	Area of forests sq. km	Proportion of the area covered by forests, %
Upper Tisa	6163	48
Szamos and Kraszna	6095	32
Bodrog	5180	39

Table 4. Stretch of forests in the catchment area of the Upper Tisa

The degree to which the drainage basins of River Tisa and its tributaries in Romanian territory were covered with forests appears as I (before branches of intensive cultivation were introduced) and it appears as II representing present time (according to Conek and Velcea). This reflects the destruction of the forest assets. Nevertheless, it is not enough to compare past and present, so our figures are relative.

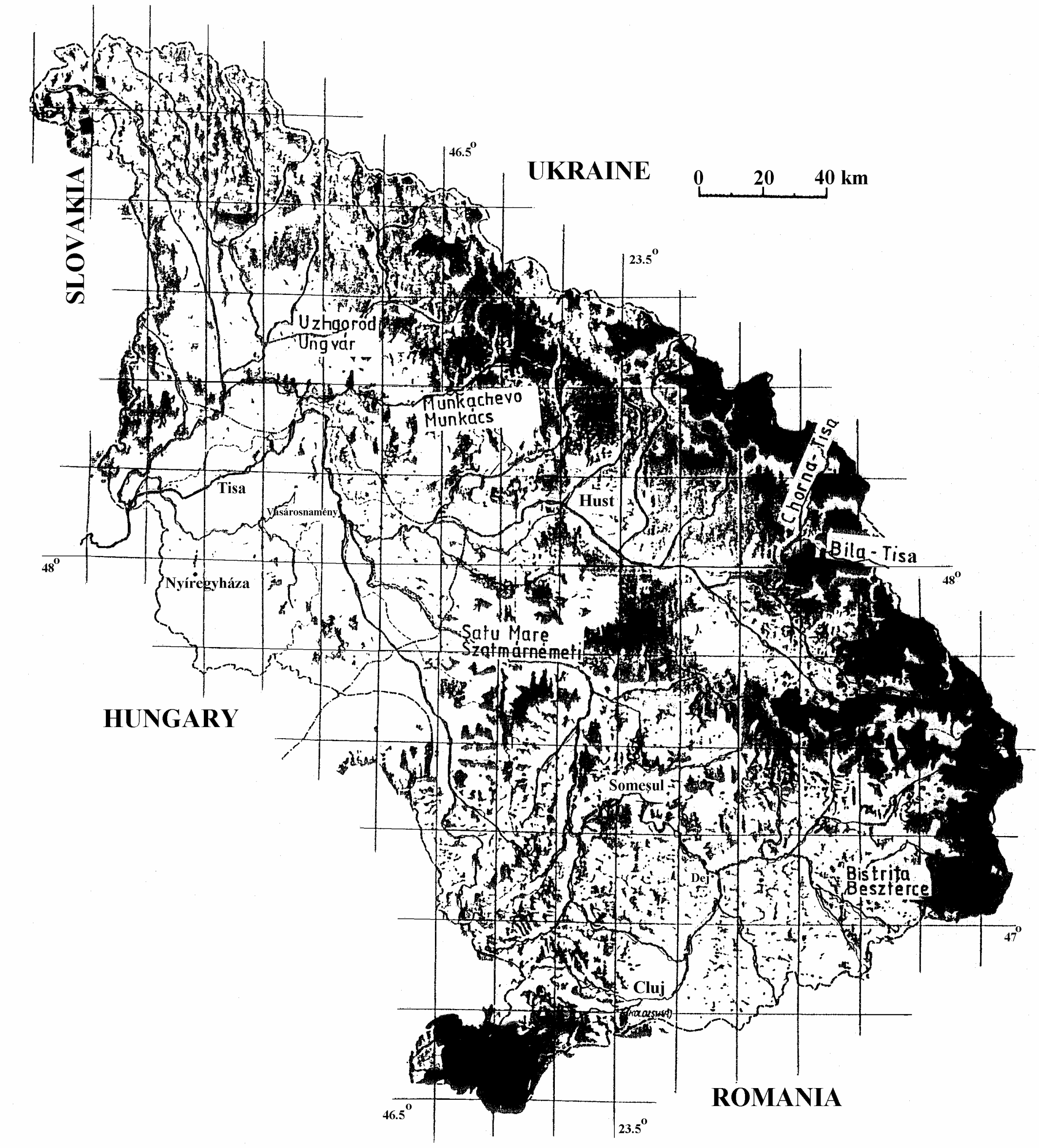

Figure 21. Forest cover of the Upper Tisa (after the hydrological atlas published in 1955 by VITUKI)

A solution would be if we only reflected the changes of the 20th century, if we had any data at all. It is known that we do not possess official figures about the widespread deforestation along River Tisa or the main changes in the branches of cultivation. The forests of the Carpathian Basin and the surrounding mountainous areas are planted forests, the trees of which should be exploited and the area reforested in a planned way, thus their natural decay cannot be permitted. Forest soil stores water, while field soil wastes water. A forest decreases water output of precipitation until the forest floor and the soil is soaked with water. After that it cannot act as a water retainer.

Before human interference, deforestation and swamp draining activities, the wooded-steppe areas of the interior of the basin system were surrounded by forests of

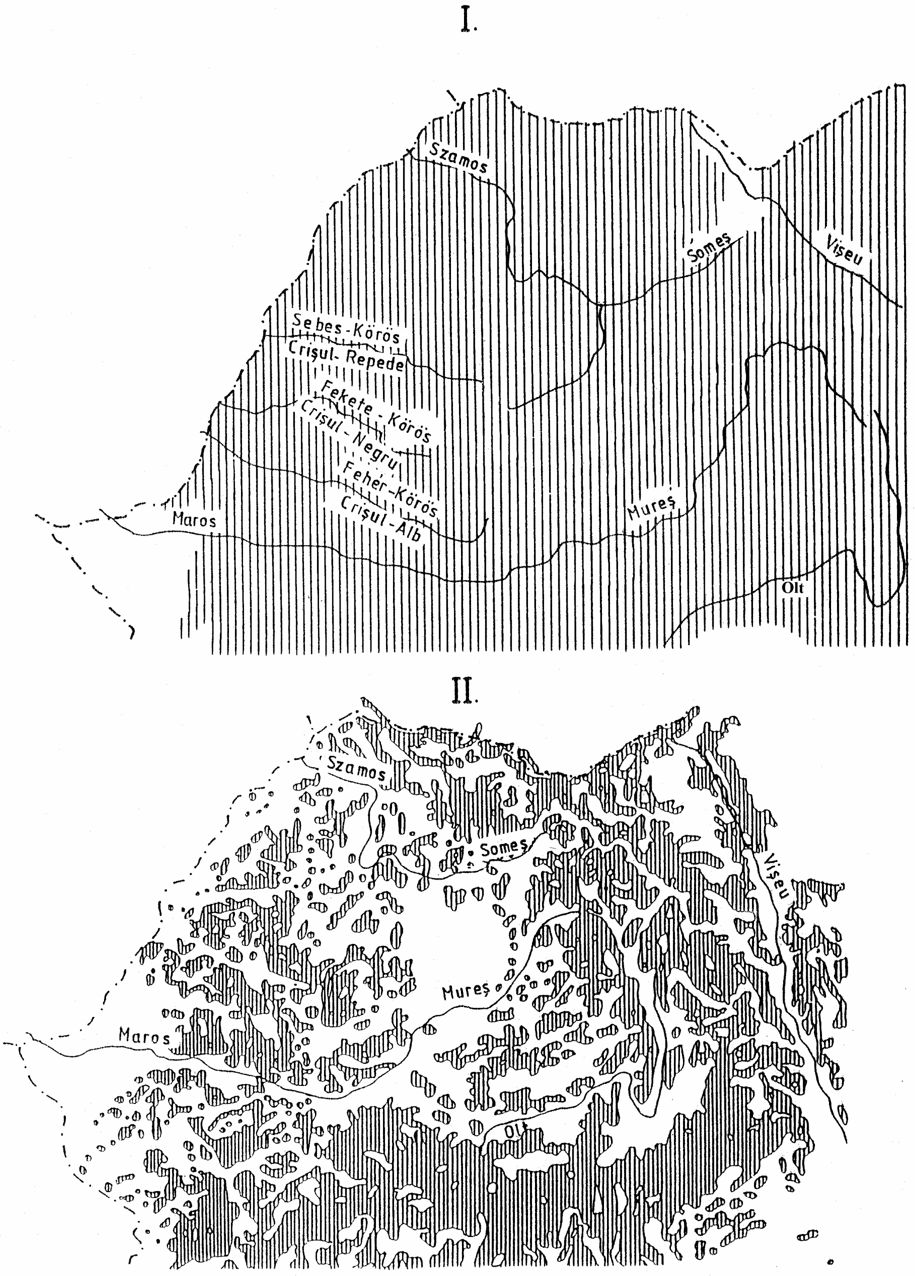

Figure 22. The proportion of area covered by forests in the catchment areas of River Tisa and its tributaries in Romanian territory, before the introduction of cultivation branches (I), and at present (II) (according to Conek and I Valcea)

altitudinal zonal distribution on the hilly and mountainous areas, both around and within Hungary. As temperature on average decreases with altitude and precipitation increases, it is evident that oak trees, which need a great deal of heat and light but only little water, are replaced at higher altitudes by beech forests which need less heat and light but more water. At higher altitude beech forests are replaced by simple pine forests, especially stocks of spruce that prefer wet and cool climate.

The floristic distribution of the vegetation of the Carpathian Basin and its mountainous environment reflects the present climate, and indirectly the relief in the cities. In the flora of the Carpathian region the northwestern and northern mountainous area differs from the Northeastern Carpathians: in the former the number of species is lower, but the number of the so-called 'Pontain' and continental species, which are common with those of the southern Russian steppes, is higher. There are even more significant differences between the distribution of the plant communities determined by climate and relief.

As neither the temperature nor the amount of precipitation, nor any other climatic factor exclusively depends on altitude, we can only approximately say that the upper boundary line of oak forests is 700 m on the Northwestern Highlands and 800 m in the east. The beech areas are between about 300-1300 m, the pine forests are between 500-1400 m in the northwest and 800-1500 m in the east. Above them we can find subalpine and alpine flora.

In the Eastern Beskyds, and even more so in the Maramuresh Alps, (more precisely in the Popadja, the Svidovec, the Hoverla and the Pop Ivan) the top of the mountain range reaches above the timber line, into the zone of the Swiss pine shrubs with sporadically scattered larch and cembra pines. In the Maramuresh Alps it extends even higher, into the region of alpine grass full of colourful flowers. In the Maramuresh Alps stocks of dwarf juniper and hellebore lead from the zone of Swiss pine alternating with green alder to the alpine grass.

There is, of course, undergrowth - grass stratum and shrub stratum - in some of the oak and beech stocks themselves. It is the richest in the often forest park-like, sparse oak stocks that, besides hornbeam, frequently grow together with lime, maple, crab, wild pear and wild cherry, and that have less close foliage. Here the presence of flowering shrubs such as cornel, thorn bush, wild rose and blackthorn is especially common. This is a "colourful forest" indeed, different from the dark beech forest with closed canopy, where the flowers of the herb layer grace flourish only in early spring. The poorest undergrowth is in the pine forests.

Obviously, the flora of very steep slopes is rather poor, because rubble cannot persist in such places. On the other hand, in many places it is the flora itself that delays the movement of rubble. For example, on the slopes of the V-section valleys intersecting our mountain ranges: if the trees are cut down the slope often becomes bare. From the rubble coming to the surface, soil is formed by chemical processes that depend on both the climate and plant physiological processes. In the area of our highest and wettest mountains, mainly covered by pine forests and to a lesser extent by beech forests, the soil is eluviated, acidic, humic, grey forest soil, which is poor in nutrients. In some places it is lithosol mixed with large pieces of rubble. In the beech region mostly brown forest soil can be found, and this leads over to the saturated, humic, dark brownish-blackish open-country soils of the centre of the basin, to the soils with higher salt content. Even on the various rocks, these soil zones which depend primarily on the features of the climate, therefore having formed as a result of a slow process, are broken by the ever-regenerated fresh alluvial soil of the river valleys, often even by the sediment fields consisting of gravel and covered only by a thin layer of silt.

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Reconstruction of flora, soil and landscape evolution, and human impact on the Bereg Plain from late-glacial up to the present, based on palaeoecological analysis

Pál Sümegi

Introduction

The Great Hungarian Plain, called "Alföld" in Hungarian, is the biggest sedimentary basin in Europe, filled with Neogene sediment of great thickness. The geological evolution of the Pannonian basin started in the Miocene. Parallel with the uplift of the Carpathian mountain arch, the inner part of the surrounded territory began to subside. The Pannonian Sea, a subsidiary of the Tethys Sea, cut through the newly developed basin. In this basin 2000-3000 m thick marine sediments (conglomerates, sandstone, marls, clays), then 1000-2000 m thick lake sediments were deposited during the Late Tertiary. At the terminal part of Tertiary the basin bottom became land surface due to the epirogenetic rise of the Carpathians. Fluvial sedimentation started in the inner part, at about the beginning of Quaternary. As a result of fluvial activity, a 600-700 m thick sedimentary series accumulated in the deepest parts of the basin (Sümeghy, 1944, Rónai, 1985).

Rivers entering the Alföld built extensive alluvial fans in the Quaternary age (Sümeghy, 1944, Borsy et al. 1969). Of the large, sand-covered alluvial fans one evolved in the northeastern part of the Alföld (called "Nyírség") (Fig.1.). Between the sand-covered surface of the Nyírség and the volcanic mountain range, which follows the Carpathians as an inner ring, there is a lowland intersected on the surface by innumerable rivers and brooks. This lowland consists of two late Pleistocene-Holocene neotectonic catchment basins ("Szatmári-sík", "Latorca-basin") and an inter-basin region ("Tiszahát") situated in the southern part of the Carpathians (Rónai, 1985, Borsy, 1990, 1995, Borsy-Félegyházi, 1983, Borsy et al. 1989).

From the point of view of evolution, the northeastern part of the Alföld is one of the most specific regions in Hungary. It is in this part of the country that the relief conditions and the network of rivers suffered the most dramatical transformations during the last (Weichselian) glacial. All the watercourses coming from the Carpathians and North Transsylvania had a role in the evolution of the alluvial fan plain. The main river, River Tisa with its tributaries used to flow across the Nyírség alluvial fan until the beginning of the Weichselian (Fig. 2.). The Nyírség depression served as catchment for the alluvial deposits of the river rising in the NE Carpathian Mountains, until approximately 30.000 BP years ago when successive tectonic events interrupted the accumulation of alluvial sediments. Then, primarily due to tectonic causes, the river flowed into the area of the present-day "Ér-valley" (Borsy, 1995), which is situated on the border zone of the Transsylvanian Mountains and the eastern part of the Great Hungarian Plain (Fig.3).

A process of subsidence, more intense than ever before, started in the Szatmár-Bereg Plain during the Late Pleistocene (Sümeghy, 1944). As a consequence of the subsidence, a completely new network of watercourses developed, which, in the course of their erosion and deposition, transformed the sinking area into floodplains. This subsidence was, for a time, counterbalanced by the aggradational work of the river. In the middle pleniglacial period River Tisa leaving the Ér-valley meandered over the area of the Szatmár-Bereg Plain from north to south (Fig.4.).

Thus, changes of the riverbeds were frequent (Borsy, 1995, Borsy and Félegyházi, 1983) in this plain (Fig.5.). In the Szatmár-Bereg Plain the levees and river channels had an important role in sediment formation as well as in the evolution of swamps and areas with bad outlet. One of the most important peat bog areas, which is a nature protection area called "Nyíres-lake", can be found in an infilled river channel at Csaroda village in the Bereg plain.

This paper presents the results of a interdisciplinary study, whose principal aims were to examine the long-term relationship between land degradation and human activity. This paper shows the evolution of a natural environment in the Csaroda region of northeastern Hungary, using various palaeo-ecological techniques, from the late-glacial to Middle Age. In conjunction with a detailed review of regional archaeological data, these results detail for the first time the long-term relationship between different prehistoric cultures, technologies and the degradation of the northeastern Hungarian landscape.

Chronological and palaeo-ecological investigation of the sedimentological sequence of "Nyíres" lake at Csaroda

Site description

The Nyíres-lake (48º 22" N and 22º 30" E) is situated in the Tiszahát region, near the margin of the Great Hungarian Plain, approximately 11 km from the Hungarian-Ukrainian border. The Tiszahát is the northeastern region of the Great Hungarian Plain, a small region occupying cca. 500 km2 of the Carpathian Basin. This lake basin is a development of the Tisa riverbed and represents an infilled oxbow lake of clay and organic matter, overlain with fluvial sand.

The present vegetation of the Nyíres-lake consists of Sphagnum bog and stands of Betula pubescens. Inwards the peat-bog the vegetation is dominated by Eriophorum vaginatum - Menyanthes trifoliata - Vaccinium oxycoccus –Drosera rotundifolia – Comarum palustre plants mixed with Sphagnum species, whilst on the edge Dryopteridi - Alnetum association with Thelypteris palustris, and Calamagrosti - Salicetum cinereae association with Betula pubescens have developed (Simon, 1960). Scripo-Phragmitetum association with Glyceria maxima encircles the Sphagnum bog. Oak-ash-elm (Quercus robur - Fraxinus excelsior – Ulmus campestris) gallery forests are found in the levee zone, which are the highest elevations of the peat-bog areas.

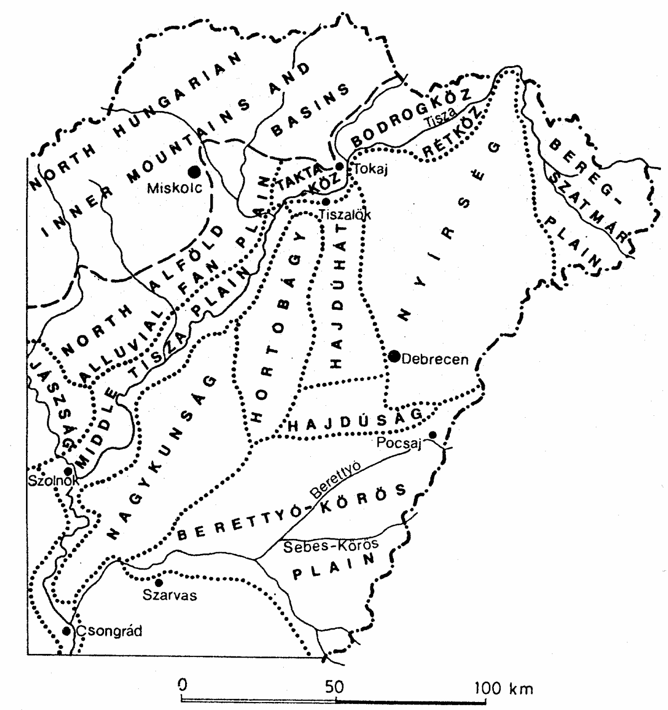

Fig.1. The geographical region within the Nyírség region of northeastern Hungary.

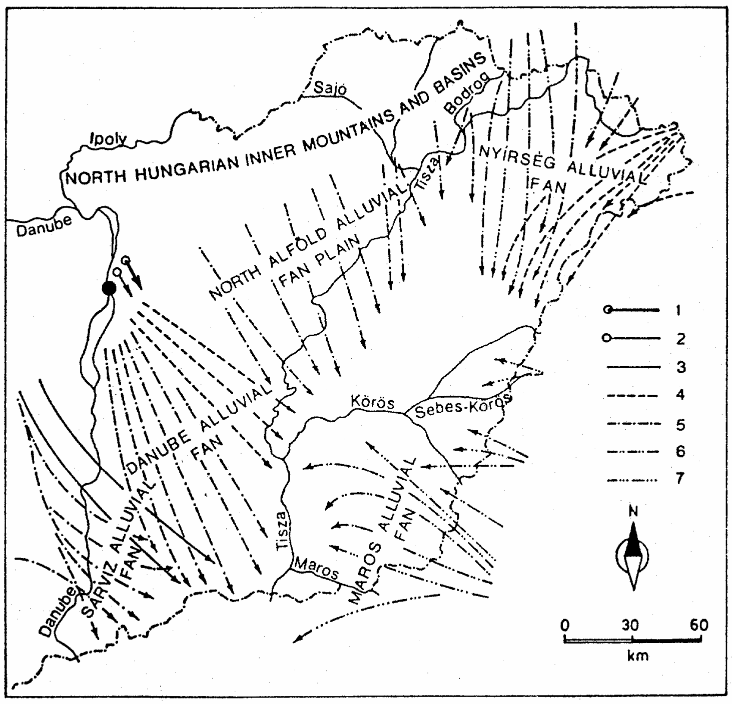

Fig.2. Tendencies of alluvial fan evolution in the Great Hungarian Plain (based on Borsy, 1995).

1. The part of Lower Pleistocen alluvial fan exposed on the surface, 2. The part of Middle Pleistocen alluvial fan exposed on the surface, 3. The alluvial fan built until the Upper Pleistocene, 4. The alluvial fan built until the begging of the Würm, 5. Alluvial fans built until the middle of the Würm, 6. The alluvial fan built until the begging of the upper periglacial period, 7. The alluvial fan built until late glacial time.

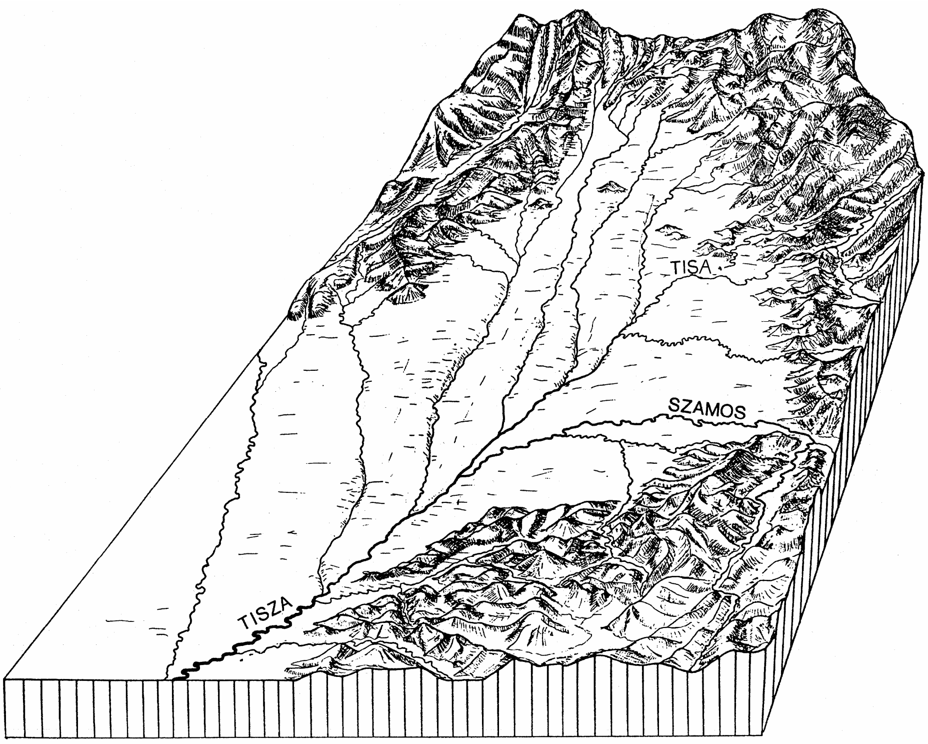

Fig.3. Network of rivers in the Early Würm (based on Borsy and Félegyházi, 1983).

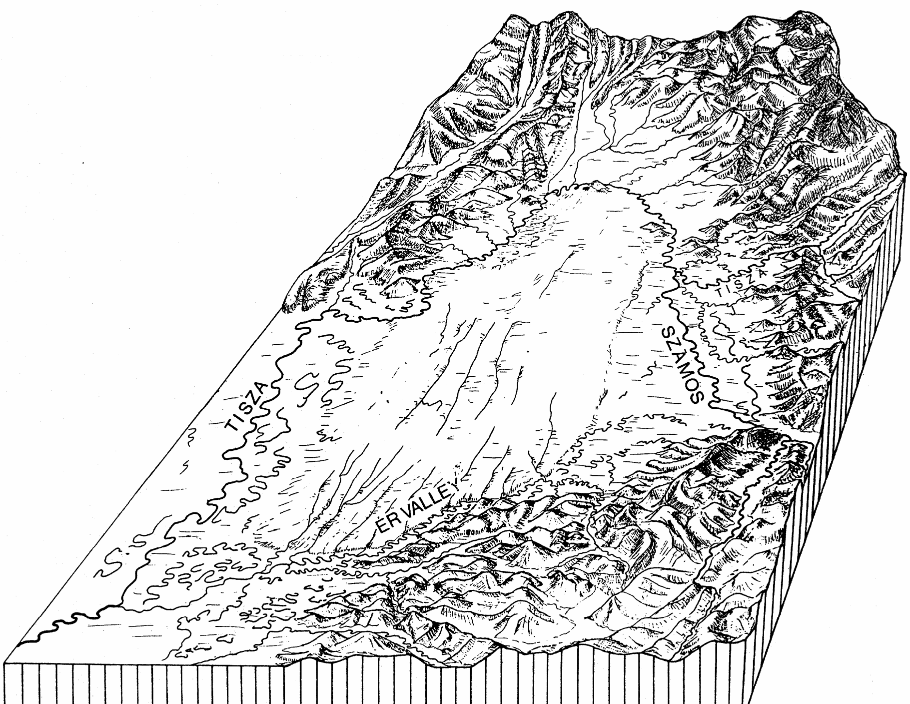

Fig.4. Network of rivers in the Upper Würm (based on Borsy and Félegyházi, 1983).

The climate in this region has a strong submontane character. This is expressed in the amount of precipitation (600-700 mm yr-1), accompanied by cooler summer and colder winter temperatures (Kakas, 1960).

Field work

Coring was carried out on a marsh in the centre of the oxbow lake (Fig.6.) on 10 January 1994, using a modified 5 cm diameter Livingstone piston corer. Core immediately was wrapped in plastic film and aluminium foil before finally being sealed in polythene sheets. The core was halved lengthways in the field. Half of the sedimentary sequence was analysed in Cambridge (UK) for pollen and AMS (Harrington, 1995), while the other half of the core in Debrecen (Hungary) for sediments, geochemistry and radiocarbon (bulk samples) dating.

Lithological analysis

Lithostratigraphic features were identified through macroscopic examination and grain-size analysis, and were described using the Troels-Smith (1955) classification.

Geochemical analysis

The core was divided into 2.5-5 cm sections. The organic and carbonate content of the core was estimated by loss-on-ignition (Dean, 1974). The inorganic weight was taken as dry weight minus organic matter and calcium carbonate weight. The elements of Na, K, Ca, Mg, Fe, Mn, Cu, Zn, S,P, Al and Cr were analysed by ICP-AES method, using a SPECTROFLAME instrument, with simultaneous and sequential measurements.

Pollen and charcoal analysis

Sediment samples of 1 cm3 were taken from the core at 4 cm intervals (starting at 150 from the top of the core) for pollen analysis, using a volumetric sampler. The lowest 13 cm represented a coarse sand layer that was not subsampled for pollen analysis. The preparation technique was a modified version of Berglund and Ralska-Jasiewiczowa’s (1986) method. Two Lycopodium spore tablets of known volume (13911 spores per tablet) were added (Harrington, 1995) to all samples to give a desirable ratio for pollen to exotic spike (Maher, 1981), to enable working out pollen concentration (Bennington, 1962). A minimum count of 300 grains per sample (excluding exotics) was made in order to ensure a statistically significant sample size (Maher, 1972). Charcoal abundances were determined using the point count method (Clark, 1982).

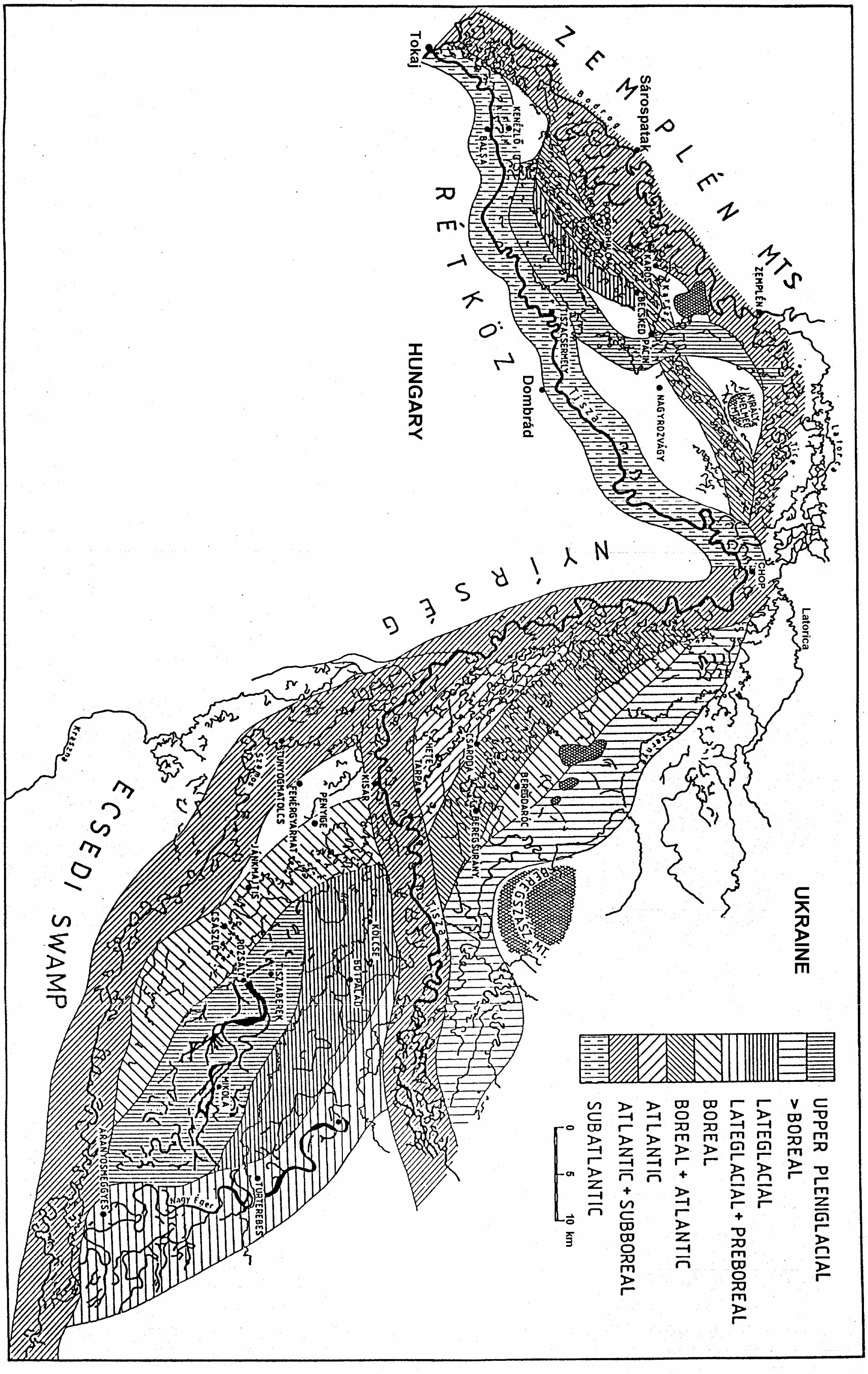

Fig.5. The age of abadoned river channels of the Tisza and Szamos in the north-eastern part of the Great Hungarian Plain (based on Borsy, 1995)

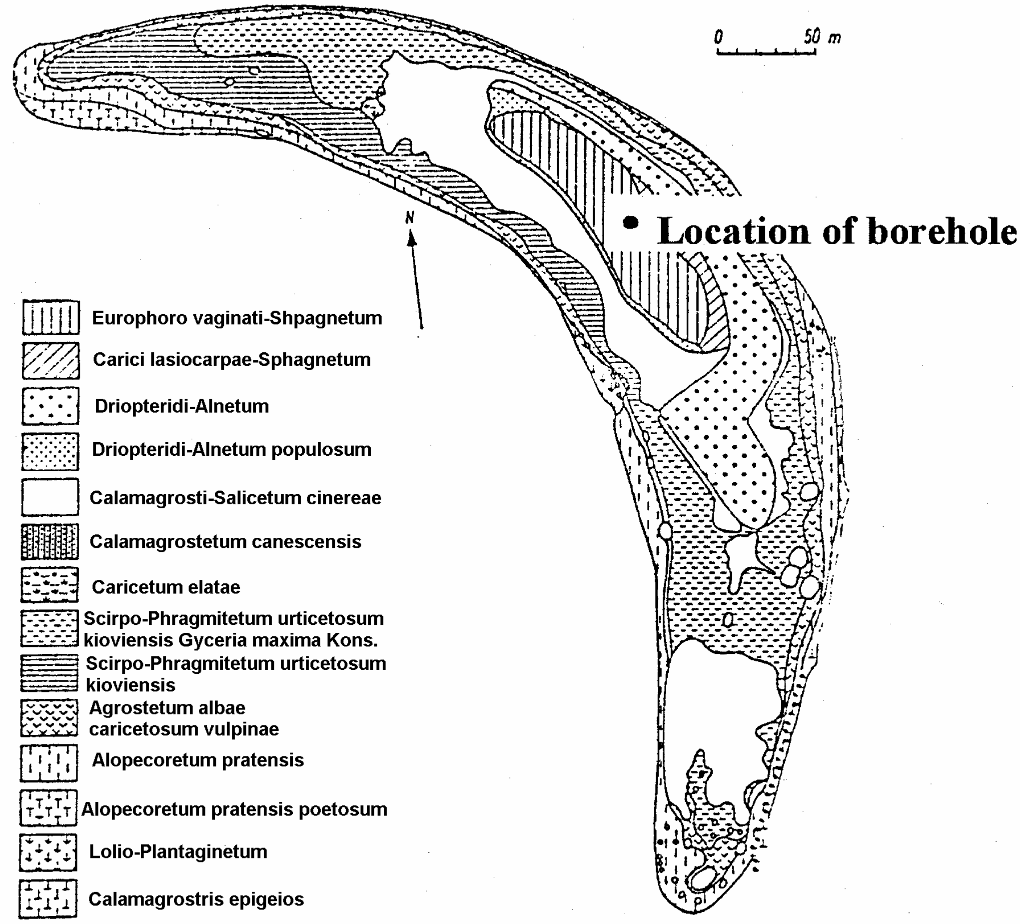

Fig.6. Location of coring site, Csaroda peat-bog.

Radiocarbon dating

Some samples were taken from core and were sent for conventional bulk radiocarbon dating to the NERC facility at East Kilbridge, but only 2 were successfully processed (between 162-158 cm and 280-278 cm). Two bulk samples were analysed for radiocarbon dating in Debrecen (between 240-245 cm and 260-265 cm). All dates are presented as calibrated BC and AD years to make them directly comparable with archaeological statements.

Geo-archaeological analysis

All the world's landscapes and ecosystems are products of natural and cultural processes. After the last glaciation, from cca. 10.000 years ago, modern climate and global environment developed but climatic variations of smaller magnitude and shorter duration have continued to evolve up to the present (Roberts, 1989). Human impact on the environment has increased progressively during the last 10 thousand years. Thus, the Holocene environment has developed under constant or periodic human effects, and some of the landscape, soil, and vegetation changes have evolved by anthropogenic impacts, therefore the regional human impact had to be reconstructed for the understanding of environmental changes.

The impact of different technologies and cultures on the landscape can be measured in a variety of ways. According to geo-archaeological hypotheses (Edwards, 1979, 1982, 1991) the charcoal, pollen, sediment and geochemical records will accord in highlighting anthropogenic effects by recording fire and erosion events, as well as changing and diversifying floristic patterns. These hypotheses are based on several assumptions e.g. that the pollen, charcoal and sedimentological, chemical signatures will respond to environmental disturbances induced by human impact. For the detection of human impact and for archaeological and geo-archaeological interpretation, a review was made of published archaeological sites covering the time period between the Mesolithic through the Late Iron Age (Roman/Barbarian Age), within a 50 km radius around the Nyíres lake at Csaroda.

Results

Lithological analysis

The core can be divided into 7 lithological units. They are described along with the results from grain-size analysis. Sediment accumulation started at about 13000 BP. The first sediment layer is 425-415 cm thick. The basal sediment is yellow-grey, non-calcareous, non-organic fine sand with coarse sand spots. The grain distribution of basal sand is typical of fluvial material, which accumulated in the water streams.

The second sediment layer is 415-395 cm thick. This sediment zone consists of grey silt with fine sand content. The grey silt contains vivianite of high dry weight value and low organic content. The base of this layer is sharply distinct from the sand below it, but there are some sandy spots and straight-crested sand ripples interbedded in the fine silty layers. This sediment layer indicates a dynamic developmental stage between lake and fluvial phases. When the fluvial phase came to its end and the lake phase started in the oxbow lake, a thick silt layer accumulated in the oxbow basin. However, the lake stage was interrupted by some flood events when inwashed sandy material accumulated in the lake basin.

The third sediment layer is of 395-368 cm. Its clay content increased gradually from base to top. The reddish brown iron-containing and bluish green vivianite-rich laminations are visible at some levels. Sediments become progressively more organic towards the top. This sediment layer indicates that the lake phase stabilised in the basin and stagnant water sediment accumulated.

The forth sediment layer is of 368-298 cm. This sediment layer consists of greenish grey, non-calcareous silt clay. Organic content is about 5 % in this layer. The amount of vivianite decreases, but some iron-rich laminations and spots can be found in the sediment.

The next sediment layer is 298-234 cm thick. This layer is inhomogeneous. There are six finely laminated and turbid clay and organic-rich sediment zones. This layer represents the highest value of carbonates in the sampled core. The laminated and turbid sediment structure indicates that a mass of eroded terrestrial material was inwashed and accumulated in the filling riverbed, thus the concentration of allogenic fraction increased.

The sixth sediment layer is 234-172 cm thick. A sharp lithological surface developed between the fifth and sixth sediment layers of Nyíres lake at Csaroda. The clay and organic content decreased, but organic components increased from the base of this sediment layer towards its top. An increase of sand content suggests that material input from floods developed in this layer.

The seventh sediment layer is of 172-150 cm. This sediment layer is characterised with high organic and clay content. The turbid sediment structure of the boundary between the 6th and 7th layers indicates that a high concentration of inwashed terrestrial sediment occurs in the lake (local catchment) basin. This peat layer with high clay and organic content developed from 172 cm up to the surface, but the part from 150 cm to the top was cut down because the layers mixed and the sediment was disturbed by postgenetic process.

Geochemical analysis

The results from geochemical and pollen analyses are plotted against depth (Fig. 7-8.). A statistical procedure was used to zone the data. All the zones are numbered from the base upwards and prefixed with following letters: NYGZ (geochemical zones), NYO-P (pollen zones).

NYGZ-1 (425-415 cm: Late-glacial)

Accumulation in the basin started in the late-glacial when a riverbed formed in the Bereg floodplain. Within the riverbed non-calcareous fine sandy coarse sand sediment was deposited with high quartz, quartzite, pyroxene and amphibole content. This sediment was predominantly inorganic and contained a high concentration of allogenic silicate minerals such as Al, K, V, Zn (Mackereth, 1966, Engstrom and Wright, 1984, Engstrom and Hansen, 1984). The arrival of these elements into the basin suggests that they represent fluvial unweathered silicate minerals. This overlying sand is considered fluviatile in origin.

NYGZ-2 (415-300 cm: Late-glacial)

The authigenic fraction shows high values of Fe and Mn and a sharply increasing Fe:Mn ratio. The similarity of the P curve to the Fe and Mn curves suggests that there is close relationship among these three elements. Such a relationship has been demonstrated to be indicative of inorganic P occurring in the sediment as an adsorbed component of amorphous iron oxide (Mackereth, 1966, Willis et al. 1997). They formed a vivianite mineral (e.g. 480-485 cm) in the sediment layer (Sümegi, 1996). The Fe, Mn content indicates that a special chemical weathering developed as a result of acidic conditions in the soil and there was an influx of these elements in large quantities. The Fe, Mn content suggest that waters at the bottom of the lake were well oxygenated and preserved these element concentrations in situ in the catchment basin (Mackereth, 1966). The iron-rich laminas probably consist of oxidised iron. On the

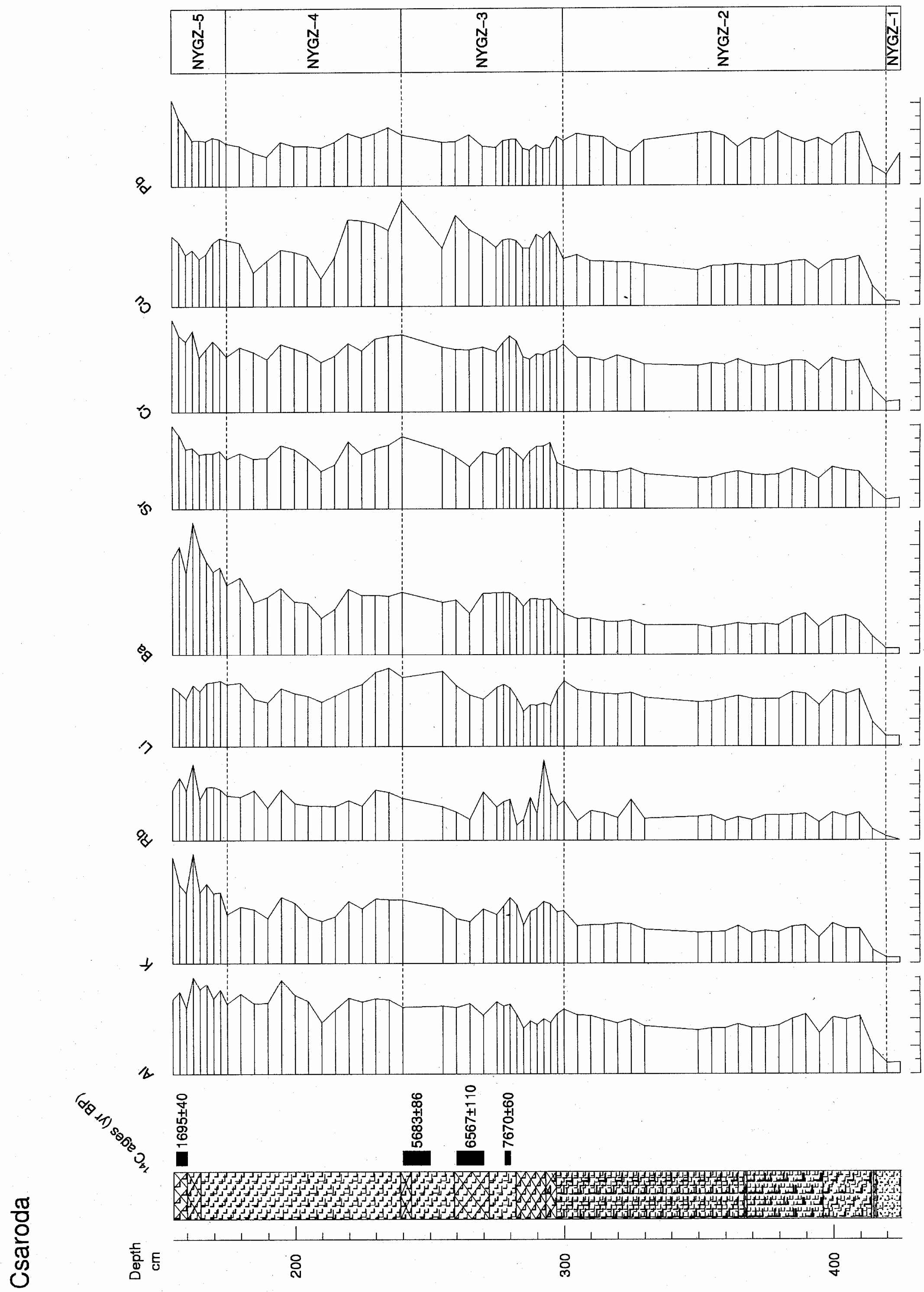

Fig.7A. Physical characteristics and elemental concentrations from the Csaroda sediment plotted against depth (based on Jakab, 1996).

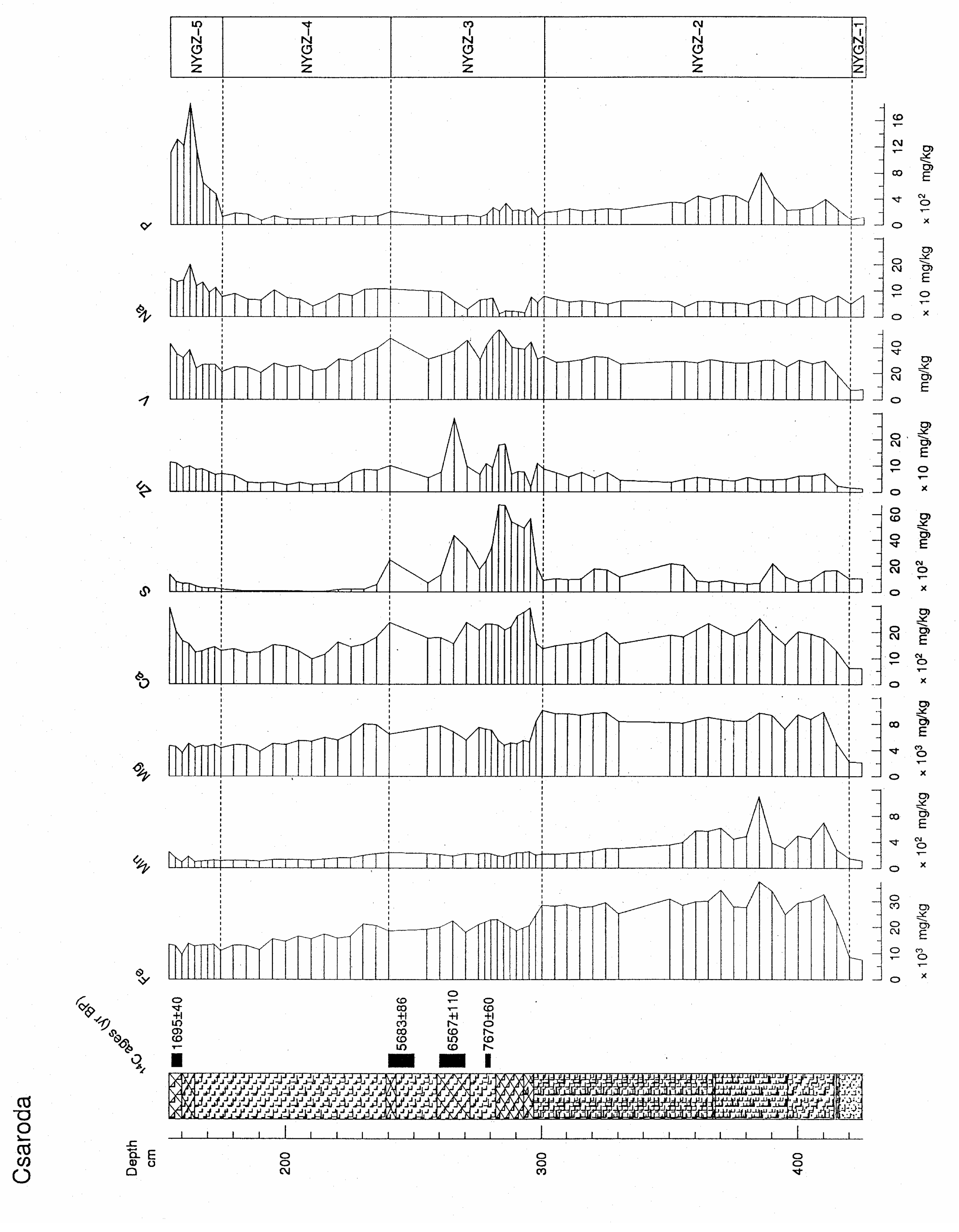

Fig.7B. Physical characteristics and elemental concentrations from the Csaroda sediment plotted against depth (based on Jakab, 1996).

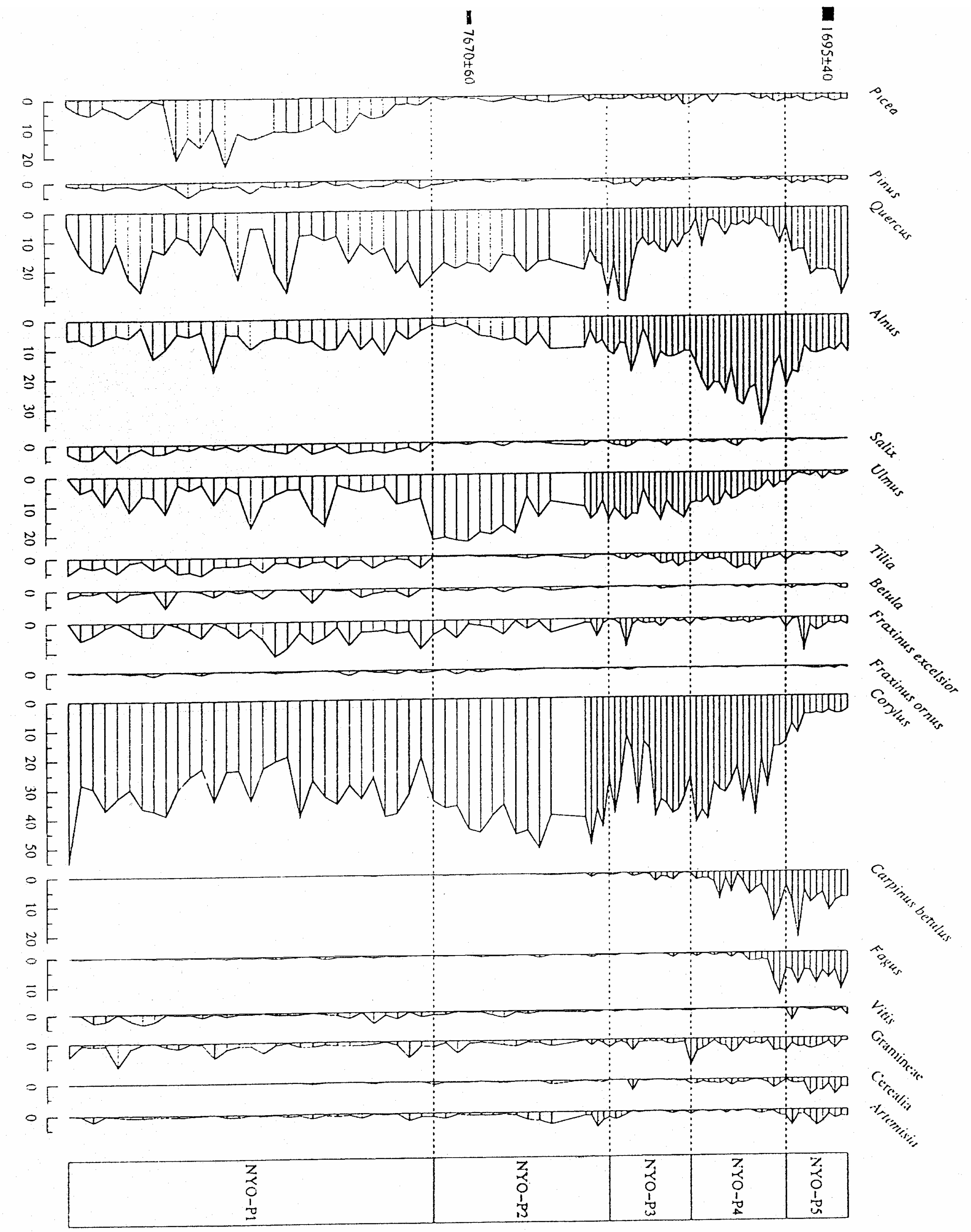

Fig.8. Percentage pollen diagram of selected taxa from Csaroda peat bog plotted against depth (based on Harrington, 1995)

other hand the low Sr:Ba ratio indicates (Qi-Zhong, 1984) that a low level of chemical weathering or a minimal surface erosion process developed around the catchment basin. These data suggest that clastic components may have entered the basin (Engstrom and Hansen, 1985). The high sand content of the sediments in the bottom layer of this zone suggests that the sediments of fluvial (flood) and stagnant waters mixed in this zone. The sand content decreased gradually parallel with increasing clay content towards the top of this zone.

NYGZ-3 (300-240 cm: cca. 9500-5000 BP)

At the late-glacial/postglacial transition all the elements representing allogenic erosion became greatly reduced as the percentage of inorganic material decreased, and there was an increase in organic content and carbonate. In the early postglacial the amount of elements associated with oxidation processes decreased. The peak of the S curve probably indicates bacterial activity and anoxic stage in the lake basin, while the higher Zn content suggests that reeds and grasses colonised and closed on the surface of the lake. Levels of calcium input prior to this increase suggest that the transformation of the vegetation continued and deciduous forest elements spread around the lake basin. This lacustrin phase differed significantly from the previous pond stage in both sediment chemistry and temperature. While the earlier Pleistocene lake environment can be characterised by sedimentation in cold water lacking Ca content and much vegetation, the early postglacial pond system can be described as being relatively rich in Ca, with carbonate content and with vegetation typical of easily warming waters. The change of chemical elements indicates that a strong erosion process around the lake and a nutrient-rich lake phase developed after the late-glacial/postglacial transition.

NYGZ-4 (240-172 cm: c. 5000-2300 BP)

The change of the sediments as of 5000 years BP possibly indicates an increased level of overland soil erosion into the catchment basin or an increased level of fluvial influence, because a number of allogenic clastic materials accumulated in the infilling riverbed. A decrease developed in the S, Zn and organic contents. This change of the chemical composition suggests that new, well-oxygenated bottom conditions formed in the basin. Probably, a mass of floodwater streamed into the basin and the water level of the lake increased. The previous early postglacial eutrophic lake stage transformed into an open watered, mesotrophic-oligotrophic lake phase. Floods could drift the mass of the silicates (sand and silt), thus clastic material became dominant in the catchment basin.

NYGZ-5 (172-150 cm: 2300-2000 BP)

The content of Zn, S, P, K elements as well as organic content increased rapidly in this layer. The increase in calcium is thought to represent throughflow from deciduous litter deposition on the one hand, and leaching Ca from the soil of the levee zone on the other. The colonised peat association absorbed the inwashed calcium the same way as with Pb, Zn, Na and Cu. The increase of P, S and organic content indicate that an eutrophic lake with less oxygenated bottom conditions then a peat bog developed in the catchment basin. These dramatic changes in the chemical composition indicate an important change in the environment of the catchment basin. According to chemical data a mass of allogenic fragments and eroded soil material accumulated in the catchment basin from 172 cm and a rapid process of eutrophication with peat formation started.

Pollen analysis

The pollen profile from Nyíres-tó extends well back into the late-glacial and presents a continuous record of vegetation dynamics around the filled riverbed until 1600 BP. With a basin diameter of approximately 200 m, the pollen catchment will be predominantly local and extralocal in origin (Jacobson and Bradshaw, 1992). Although a number of pollen grains could be deposited by streaming water in the catchment basin during flood times (Fall, 1987), because this oxbow lake was an open hydrological system which could be reached by masses of flood water from the active riverbed. According to Harrington's work (1995), the pollen percentage diagrams and the pollen concentration diagrams were zoned based on their information content (Birks and Gordon, 1985) and were assigned the prefixes NYO-P to differentiate them from the sediment zone scheme.

NYOP-1 (412-292 cm: Late-glacial – Early postglacial)

During the late-glacial (cca. 12000 BP) and up until the early postglacial (cca. 9200 BP) vegetation surrounding the Nyíres-tó basin was predominantly coniferous forest. The composition of this forest was probably similar to the present-day southern edge of the European boreal forests, with Picea, Pinus and Betula (Pastor and Mladenoff, 1992). Within the taiga forest there were other species of deciduous trees and shrubs such as Quercus, Alnus, Ulmus, Tilia, Fraxinus, Salix and Corylus. The nearest modern vegetation analogous to the composition of the pollen in this zone is the European boreal forest (Peterson, 1983, Nikolov and Helmisaari, 1992) although these forests do not contain Ulmus and Corylus. Charcoal concentration values suggest that burning was occurring during the late-glacial. This burning was probably naturally induced and in present boreal forests has been shown to be an important component of forest ecology (Payette, 1992) Probably associated with the burning, some increase in plants of the Filicales-type is shown. Generally, all arboreal taxa fluctuate throughout this zone except for Picea which peaks at 20% total pollen at 360 cm, before declining to 3% at the top of the zone (Harrington, 1995). The arboreal pollen and non arboreal pollen ratio curve shows a high degree of concordance with the concentration curve indicating particular abundance of Corylus, Ulmus, Quercus, Tilia, Fraxinus, Alnus, Betula. The presence of deciduous trees suggests that there was an important temperate refugial area for deciduous trees in this region during the last glacial.

NYOP-2 (292-232 cm: c. 9200-5000 BP)

The late-glacial/postglacial transition occurred between approximately 10.000-9200 BP. Computer simulated climatic modelling (Kutzbach and Guetter, 1986, Kutzbach et al. 1993) suggests that during this period the climate progressively became warmer. The climatic change at the late-glacial/postglacial transition resulted in some environmental changes at the Csaroda area. The percentage arboreal pollen curves in this zone are marked by high values of Corylus and Ulmus, Tilia, Quercus. Picea is present in very low quantities and Tilia, Ulmus, Corylus, Quercus taxa are virtually absent, and the pollen percentage of these species reached values at 20% (Harrington, 1995). Quercus increased in abundance to become the dominant taxon after approximately 9200 BP. The species composition of the woodland remained unchanged until approximately 7000 BP, although from cca. 8000 BP (7000 BC), there were two considerable increases in charcoal concentration and Corylus dominance. A link has often been suggested between the early increase of Corylus in the Postglacial of North and West Europe and anthropogenic activity (Smith, 1970). In particular, it has been suggested that the fire resistant shoots of Corylus enabled it to thrive in the Mesolithic (Smith, 1970), when there was deliberate landscape management using fire.

NYOP-3 (232-204 cm, c. 5000-4000 BP years)

At approximately 5000 BP the structure of the woodland transformed once again with a large reduction of the diversity of woodland, and with an increase of open ground herbaceous types, due to anthropogenic activity. This zone is marked by significant vegetation changes. Quercus rapidly declines from 30% to 10%, and reduced Fraxinus percentages and concentration are noted (Harrington, 1995). Alnus, Corylus and Ulmus all show fluctuations in percentage in this zone and concentrations of these taxa are still significantly high. Pollen concentrations decrease after 220 cm with increasing ratio of Umbelliferae, Filicales and Gramineae. The arboreal pollen and non arboreal pollen ratio generally decline throughout this zone. There was some increase in charcoal concentration, and the sediment composition changed to a brownish grey clayey layer with high inorganic content.

NYOP-4 (204-172 cm, 4000-2000 BP)

The arboreal pollen record showed an increase in Alnus, Tilia and Carpinus betulus. Junglans pollen occurred for the first time in very low quantities and Fagus rapidly increased after a charcoal peak. Corylus, Fraxinus excelsior and Ulmus all decline in concentration. An increase and consistency are noted in the Cerealia (2% dominance) and Artemisia, Gramineae curves (Harrington, 1995). Pollen concentrations are generally high but decreased after 184 cm. Charcoal concentration decreased in this pollen zone.

NYOP-5 (172-152 cm, 2000-1500 BP)

Low percentage and concentrations of Picea, Salix, Ulmus, Tilia, Corylus and Betula represent the topmost zone. The pollen dominance of Quercus, Fraxinus excelsior, Fagus and Carpinus betulus however increase, along with a consistent presence of Vitis (Harrington, 1995). Cerealia, Artemisia, Compositae, Cannabis reach their maximal abundance in this zone. A new and marked charcoal peak developed in this zone. The pollen composition, the AP:NAP ratio and an increase in grassland dominance indicate that the constant human impact developed in the environment of the analysed region. Grazing of the forest might have limited the expansion of herbaceous taxa. The increase of Cannabis pollen during this period might indicate that human communities were using the lake for rope production (Godwin, 1967). Evidence for a basin environment developing at this time is apparent in the aquatic pollen record, which indicates a change from an open water environment to a shallower water environment colonised by Typha and Nuphar.

Geo-archaeological analysis

The Mesolithic was selected as a starting point for the review because there were some archaeological evidences for the human occupation of the Csaroda region during this time (Kertész, 1996).

Age	Cultures	cal AD/BC	Archaeological findspots
Roman empire	Barbarian groups: Dacs, Celts, Vandals, Sarmatians	0-375	26
Late Iron	Celtic	300-0	31
Early Iron	Scythian	600-300	23
Early Iron	Prescythian	900-600	3
Iron / Bronze	Gáva	1250-900	32
Late Bronze	Berkesz	1450-1250	20
Middle Bronze	Füzesabony	2000-1500	15
Middle Bronze	Ottomány	2000-1500	8
Early Bronze	Nyírség	2800-2000	32
Early Bronze	Makó	2800-2000	7
Late Copper	Baden	3500-2800	22
Middle Copper	Bodrogkeresztúr	3900-3500	13
Early Copper	Tiszapolgár	4410-3760	23
Late Neolithic	Proto-tiszapolgár	4570-4270	9
Late Neolithic	Tisza-Csőszhalom-Herpály	4860-4490	5
Late Neolithic	Transitional phase of Tisza culture	5120-4710	5
Late Neolithic	Bükk-Esztár group	5260-4880	16
Middle Neolithic	Late Alföld Linear Pottery (Tiszadob)	5330-5000	11
Middle Neolithic	Alföld Linear Pottery (classical)	5330-4940	17
Early Neolithic	Körös	5950- 5400	4
Mesolithic	North Alföld Lithic Industry	Before 6000	4

Table 1. Review of the archaeological cultures, ages and numbers of inhabited sites revealed within the Carpathian Basin, inside a 50 km radius of the Csaroda region. From Mesolithic to the Dark (Migration) Age.

For an archaeological interpretation, a review was made of published archaeological sites, covering the time period from the Mesolithic through to the Roman Empire Age, within the Carpathian Basin, inside a 50 km radius around the Nyíres-tó site (Table 1). A radius of 50 km incorporates the distinctive Csaroda topographic region of fertile alluvial plain, and include some eroded volcanic hills and foothills of Carpathians.

Radiocarbon analysis

Four evenly spaced samples were taken from the core and were sent for conventional radiocarbon dating to Debrecen and East Kilbridge. The sample at 162-158 cm recorded a date of 1695 +/- 40 years BP (cca. 500 cal AD), the sample from 245-240 cm recorded a date of 5683 +/-86 years BP (4500 cal BC), the sample at 275-270 cm recorded a date of 6587 +/- 110 years BP (5400 cal BC) and the sample from 280-278 cm recorded a date of 7670 years BP (6400 cal BC). All the data are represented as calibrated BC and AD (Stuvier and Reimer, 1993) to make them directly comparable with the archaeological statements presented in this paper.

Conclusion

The lithological, geochemical and pollen profiles from Nyíres-tó extend back into the late-glacial and present a continuous record of vegetation and landscape dynamics around the basin until 1600 BP. Without any radiocarbon dating for this late-glacial sediment it is not possible to determine the age of the basal sediments although, according to earlier palaeoecological studies (Willis et al. 1995, 1997, 1998, Willis, 1997), the basal fluvial sand sediment layer may represent the transition from late-glacial (13.000-14.000 BP).

From 380 cm the coniferous pollen, especially that of Picea, increased to account for over 20% of the total pollen sum. The values of 10-20% of Picea also suggest that this taxa was one of the major components in the local vegetation (Peterson, 1983), probably present on the inside slope of the levees surrounding the oxbow lake. Modelling by Bonan (1992) suggested that soil temperatures in Picea forests with a thick forest floor and underlain with permafrost did not increase with climatic warming, unless accompanied by increses in precipitation. Spruce was an important constituent of the late-glacial north Balkan vegetation (Willis 1994) and in the eastern Carpathians (Pop, 1971).

The high value of Quercus pollen suggests that this temperate climate tree was one of the dominant taxa in the late-glacial forest around Nyíres-tó. The continuous high value of Tilia, Ulmus, Betula, Quercus, Fraxinus and Corylus with Picea pollen indicates that a mixed coniferous-hardwood forest developed in this region during the late-glacial period. The nearest modern vegetation analogous to the composition of the pollen in this zone is the European boreal forest association (Peterson, 1983, Nikolov and Helmisaari, 1992), although these forests do not contain Ulmus and Corylus (Willis et al. 1995). Thus, there is no real modern analogue for this late-glacial assemblage in Europe, only a similar recent forest type can be found in the northern part of Ukraine. A Quercus/Picea/Tilia/Ulmus/Fraxinus mixed-leaved forest with rich Corylus shrub level has been shown to have occurred around Nyíres-tó during the late-glacial time. The tree to dominate the mixed-leaved forest was Quercus, which was clearly a major component of the refugial population in this region. Nevertheless, the dominance of Tilia, Fraxinus, Ulmus suggests that the last glacial refugia of these trees developed in this region. This unusual mixture and the high amounts of Quercus, Tilia, Ulmus, Fraxinus pollen indicates that this region remained a refuge of "warm stage" deciduous tree taxa well into the most recent glacial.

According to certain pollen analytical studies (Willis et al. 1994, Tzedakis 1993, Turner-Greig, 1975) the slight and parallel fluctuation in the levels of Quercus, Tilia, Ulmus, Corylus in the sequence of Nyíres-tó before the postglacial expansion of Quercus are thought to represent late-glacial climatic oscillations. A short colder stage was represented by a slight rise in Picea values, with a parallel decrease in Quercus, Ulmus, Tilia, Corylus values between 390-340 cm. A slight decrease (10-15%) in deciduous forest elements and an associated rise (5-10 %) in Picea can represent the Younger Dryas event. Although there are no data for this event, the comparison with late-glacial vegetational changes in the pollen diagram of the nearby Bátorliget (Willis et al. 1995) leads to the conclusion that these data are representative of the Younger Dryas. However, some macrocharcoal data and lithological changes (Borsy, 1989, Borsy et al. 1981) suggest that a short and cold late-glacial climatic oscillation, which can be associated with Younger Dryas, developed in the Northeastern part of the Great Hungarian Plain.

On the other hand, it is misleading to interpret fluctuations of pollen amounts from the filling riverbed as climatic signals, since pollen diagrams may show no apparent relationship with the vegetation of a floodplain (Fall, 1987). Even the pollen found in the alluvium reflects hydrological and sedimentological influences, firstly the effect of floods or streams (Fall, 1987), since pollen types correlate significantly with sediment grain size. Consequently, the value of pollen-containing alluvium in reconstructing palaeo-vegetation and climate is limited (Fall, 1987).

The possibility of long transportation has to be ruled out for many of these types (e.g. Tilia, Ulmus, Fraxinus) because of their poor production and dispersal capabilities (Bradshaw, 1981). Therefore, persistent levels of pollen from temperate tree taxa originated from local refugial populations (Bennett et al. 1991), which were most likely located in microenvironmentally favourable areas such as south-facing slopes (Willis, 1992) and more humid ground, especially on an active flood plain.

Based on quartermalacological analyses (Sümegi-Hertelendi, 1998), the best place for refugial forest populations could be found between the foothill or sand dune and floodplain zone where warmer microclimate was accompanied with more humid microenvironment. A similar situation developed around the Nyíres-tó where a wet floodplain surrounded some small volcanic hills (e.g. Tipet hill at Barabás, Nagy hill at Tarpa). Thus, the effects of slope morphology, i. e. the altitudinal microclimatic gradients and mosaic pattern microenvironment, were favourable for the development of relict forest populations during the Pleistocene glacial times. Recent (Deli et al. 1994, 1995) and fossilic mollusc (Sümegi-Szabó, 1992) data suggest that some forest spots survived in the contamination zone of these hills and surrounding floodplains in the Pleistocene glacial phases.

Charcoal concentrations (Fig.9) indicate that fires occurred during the late-glacial (Harrington, 1995). Burning was an important component of the needle-leaved forest ecosystem, just like in present day boreal forests (Payette, 1992). Burning is thought to be related to the higher flammability levels of coniferous woodlands and

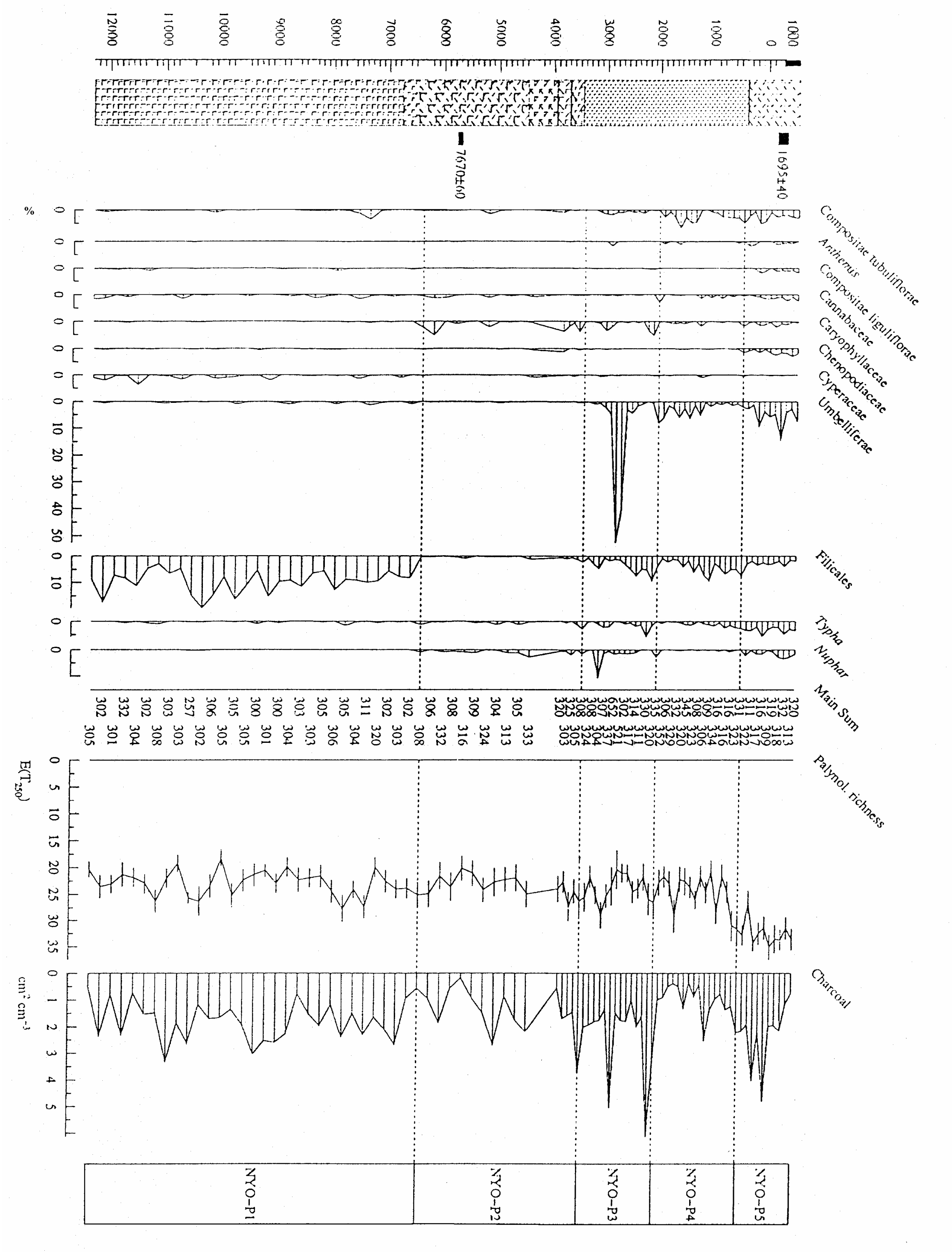

Fig.9. Percentage pollen and charcoal diagram from Csaroda peat bog plotted against depth (based on Harrington, 1995)

also to tha drier climate that was prevalent in the northeastern part of the Great Hungarian Plain during the Late Glacial (Willis et al. 1995).

The late-glacial/postglacial transition occurred between approximately 10.000-9200 years BP. Computer simulated climatic modelling (Kutzbach-Guetter, 1986, Kutzbach et al. 1993) suggest that during this period the climate became progressively warmer. This climatic change at the late-glacial/postglacial transition resulted in a gradual transformation of Nyíres-tó at Csaroda. The Picea coniferous woods declined and mixed Quercus/Ulmus/Corylus woodland became established. The early postglacial woodland, although dominated by Quercus, was still characterised by the presence of Picea. It appears that it took more than 1000 years for this tree species to disappear from the forests, only when Quercus woodland expanded and become predominant. This woodland was composed of Quercus, Corylus, Ulmus, Tilia, Fraxinus, Alnus and accounted for over 90 % of the total pollen.

Microcharcoal records (Fig. 9.) from the late-glacial/postglacial transition suggest that burnings decreased only gradually and parallel with the decrease of Picea pollen values in the Nyíres-tó. When Picea declined and Quercus/Corylus/Ulmus/Tilia hardwood forest established, a cessation of burning occurred, since broad-leaved trees are known to be less combustible than the needle-leaved Picea (Johnson, 1992), thereby the forest became less flammable.

The change at the late-glacial/postglacial transition from coniferous to deciduous woodland is unusual in central and southern Europe, because most regions experienced a change from steppe or forest steppe to deciduous forest (Bottema, 1974, Huntley-Birks, 1982, Willis, 1992, Járainé-Komlódi, 1966). Nevertheless, this type of forest-to-forest change developed in yet another region of the northeastern part of the Carpathian basin (Willis et al. 1995, 1997).

Parallel with vegetation changes, there was an increase in the level of calcium and organic material entering the basin, from about 9000 years BP. The acid nature of the bedrock and low levels of calcium input prior to this increase suggest that, again, processes other than physical weathering are responsible for this increase. Measurements of the chemical elements in leaf litter suggest that deciduous litter has higher levels of calcium than coniferous litter (Willis et al. 1997). Thus, this increase in calcium, which is associated with the transition from mixed leaved taiga forest to deciduous forest, represents throughflow from deciduous litter depositions and the leaching of Ca from the brown earth soils (Willis et al. 1997).

According to archaeological data (Fig. 9), Mesolithic human communities existed in this region (Matskevoi, 1991, Chapman, 1994, Kertész et al. 1994) where they used the habitat for hunting-fishing-gathering, yet human role in nature was already far from passive (Roberts, 1989). Palaeo-ecological data suggest that these human populations lived in the closed forest environment in this region. This conception is very different from the view of other authors (Járainé-Komlódi, 1987: p. 38, 41, Kertész, 1996: p. 18). It seems that some archaeologists and botanists did not think about the effects of mosaic pattern environments which developed equally at macro-, regional, and micro-levels in the Carpathian basin (Sümegi, 1996, Sümegi et al. 1998).

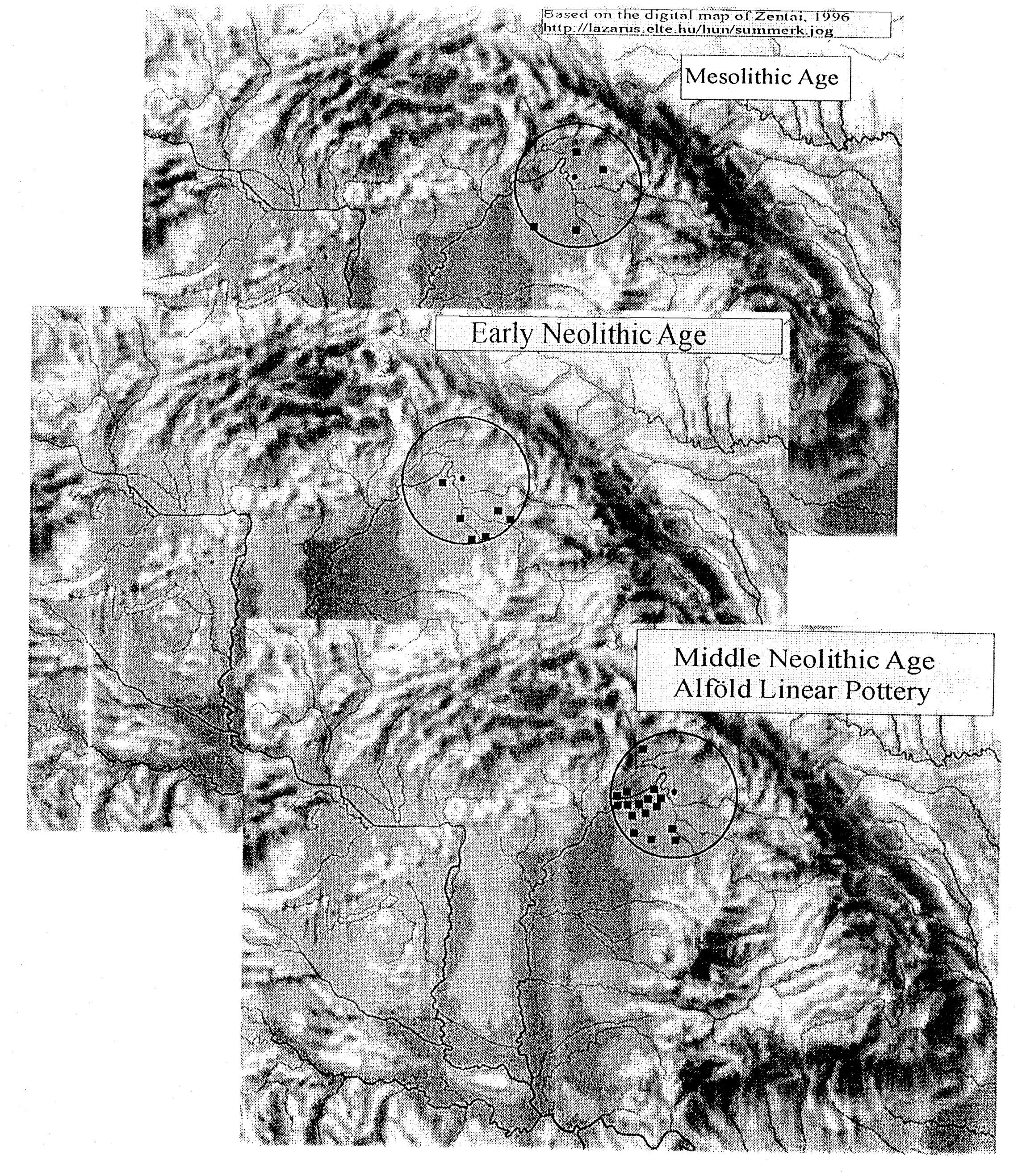

Fig.10. Archaeological findspots around the Csaroda peat bog from Mesolithic Age until Middle Neoltihic Age.

It has long been suggested that fire was an important tool of hunter-gatherers of the Mesolithic (Smith, 1970, Smith et al. 1989). In pollen and charcoal records from several Hungarian sites there is correspondance between some small peaks of hazel pollen and microcharcoal (Willis, 1997, Willis et al. 1995, 1997: Fig. 5., 1998). These data suggest that Mesolithic people may have bee responsible for bringing about the change in vegetation before 6500 cal. BC. Moreover, there is no archaeological evidence for the Neolithic occupation of the Carpathian basin before this time (Hertelendi et al. 1995, Whittle, 1996). Probably, these palaeo-ecological (Willis, 1997) and archaeological data indicate an indirect cause-effect relation in that the hunting-gathering people of the Mesolithic period used fire for changing the vegetation structure in the Carpathian basin about 7000 cal. BC.

According to Harrington's work (Harrington, 1995) there is no real charcoal evidence for human burning in the early postglacial sequence of Nyíres-tó between c. 7000 and 8000 cal. BC. However, there is an unusually high concentration of hazel pollen, which developed parallel with the decline of Picea pollen values, and a small and slight peak of charcoal concentration between 6500-7000 cal. BC. Some known localities of the Mesolithic culture are found close to the location of the analysed core sequence (Fig. 10), thus these data suggest that Mesolithic communities in this region started the transition to Neolithic agriculture and entered the substitution phase (Zvelebil and Rowley-Conwy, 1986) about 7000 cal. BC.

A considerable increase of the charcoal and hazel pollen concentration without an evidence of strong change in tree composition indicates that a new but not too strong human effect could develop in this region from cca. 5700 cal. BC. Some early Neolithic sites (Kalicz-Makkay, 1976, 1977) can be found around the analyzed sequence (Fig. 10), but it seems that early Neolithic people continued the late Mesolithic way of life. Namely, they hunted, fished and gathered and only slightly disturbed the composition of the postglacial woodland in this region. Probably, this ancient and primitive economic strategy was more useful on the acidic bedded soil surface with closed forest cover than what the real transition to Neolithic way of life could have offered. This effect is called "green corridor impact" (Sümegi-Kertész, 1998). It is possible that the land use of the Körös and then the Linear Pottery culture rooted in the Mesolithic subsistence (Chapman, 1994), thus environmental effects and palinological response would be small.

According to palaeo-ecological data this region was a background of the gathering, hunting, fishing economy during the Neolithic Age where real pasture lands or arable lands were not formed. This can be stated in spite of the fact that a number of Middle Neolithic and Late Neolithic settlements (Bóna, 1986, Kalicz-Makkay, 1977, Nagy, 1998, Raczky, 1983, Kosse, 1979, Kurucz, 1989, Kalicz, 1994) can be found within the 50 km radius of the Nyíres-tó at Csaroda (Table 1.).

The first real anthropogenic impact began to develop at the end of the Late Neolithic Age (about 4500-4600 cal. BC), for which an increase in copper values was detected. Although the gradual increase in copper amounts is independent of other geochemical signatures, the sediment structure does not indicate soil erosion or an increase of organic content in the catchment basin. Archaeological evidence suggests that extensive copper mining occurred in the Carpathian Basin from approximately 6000 years BP (Kalicz, 1982, Sherratt, 1982a, b) when various Late Neolithic and

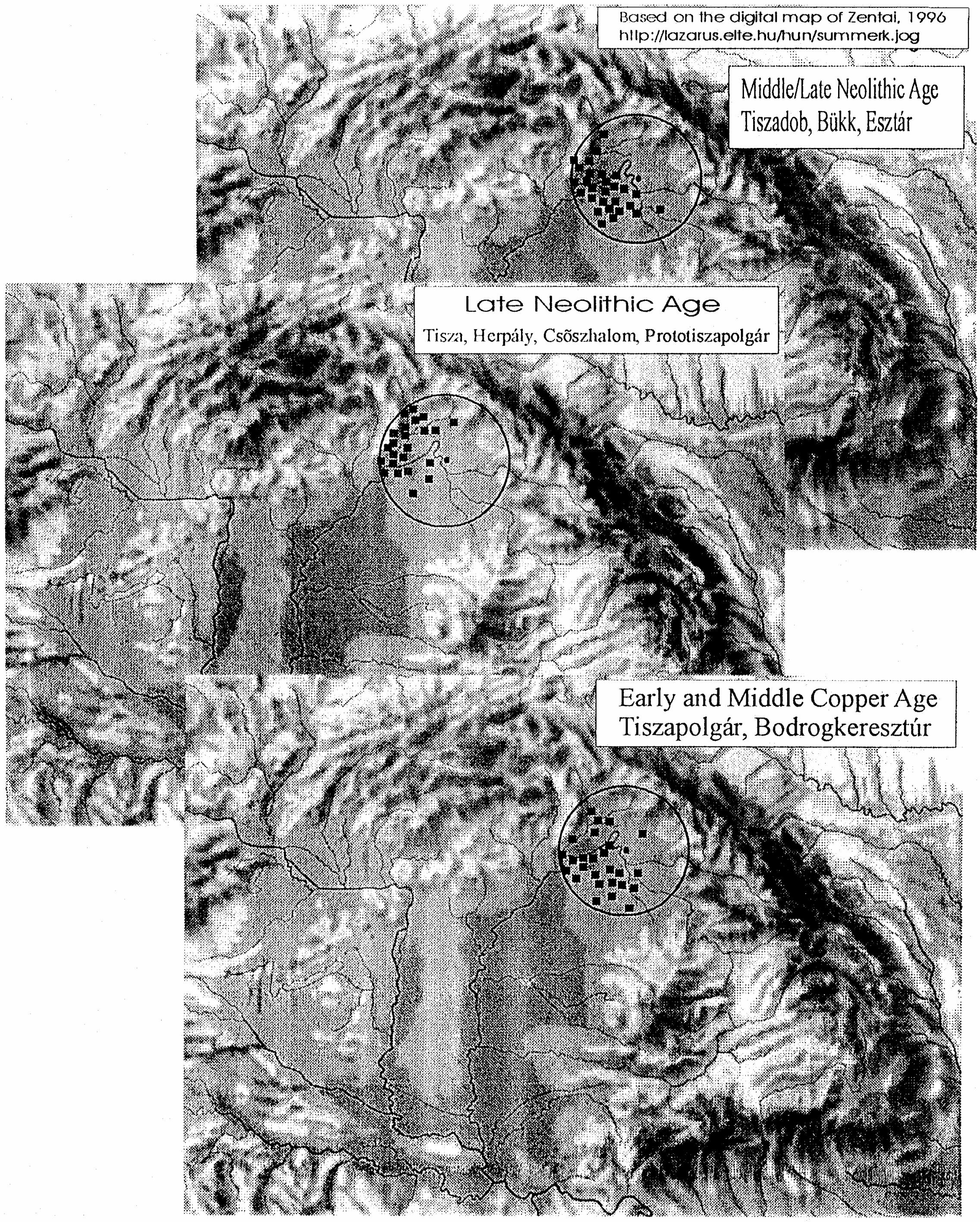

Fig.11. Archaeological findspots around the Csaroda peat bog from Late Neoltihic Age until Middle Copper Age.

Copper Age cultures (Figs. 11, 12) settled in the Csaroda region (Bognár-Kutzián, 1963, 1966, 1972, Kalicz, 1994, Kalicz-Raczky, 1984, 1987, Korek, 1989). This activity must have released Cu particles into the atmosphere, which could be carried into the basin by rainwater (Willis et al. 1995). Copper data from Nyíres-tó, together with earlier geochemical records from an other catchment basin at Bátorliget (Willis et al. 1995) suggest that copper mining and melting started in the northeastern part of Carpathian Basin in the Late Neolithic Age.

Parallel with the rise of copper contents, vegetation was still predominantly wooded but suffered disturbances by fire which caused stress in the forest (Harrington, 1995). The composition of the forest was similar to the previous woodland phase but Ulmus (elm) was gradually declining in abundance. In many areas of northwest Europe the decline of elm coincided broadly with the first signs of human activity between about 5300 and 5000 BP (Bell-Walker, 1992). Some researchers argued that elm decline was caused by the advent of the new Neolithic agricultural economy (Troels-Smith, 1960, Mitchell, 1956, Rackham, 1980, 1986), while recent ecological data suggest that a disease could be the cause of the Ulmus decline (Rackham, 1980, 1986). Thus, the exact cause of elm decrease commencing in this region in the Late Neolithic/Early Copper Age is unknown.

At approximately 3500 cal. BC the structure of the woodland transformed once again with a large reduction in the diversity of the woodland and with an increase of open ground herbaceous (e.g. Umbelliferae, Compositae) types usually associated with anthropogenic activity. Woodland instability manifests in the declines of Quercus, Ulmus, Corylus (Harrington, 1995) which may be attributable to anthropogenic disturbance (Aaby, 1986), to a form of arboriculture of building (Huttunen et al. 1992). Wood from oak and hazel, for example, are particularly processible as building material (Rackham, 1980). The general rise in Non Arbor Pollen taxa correlates with some charcoal peaks. Charcoal concentration increased to a maximum at this time suggesting that anthropogenic activity was occurring in the form of clearance by burning and exterminating natural vegetation. According to archaeological data a peak of settlement number and an occupation maximum formed around Nyíres-tó (Table 1, Figs. 11, 12) from the Late Copper Age to the Middle Bronze Age. The lack of evidence for soil erosion during this period indicates that either these activities were not occurring in the catchment basin or the nature of anthropogenic activities was such that they did not cause soil degradation. Possible forest clearance may have aimed at increasing the hunting potential on ungulates or at ensuring better possibilities for the grazing of domestic animals (Simmons, 1969). This region, firstly the backswamp areas which can be found behind the levees of the infilled river channel, may have provided vast open grounds for animal husbandry including horse breeding, from the Early Bronze Age. However, there is still no evidence for large-scale cereal cultivation or large open lands for animal keeping, as opposed to other diagrams in central and southern Europe of this time (Willis, 1994, 1996, Willis-Bennett, 1994).

From the Middle Bronze Age the composition of the woodland changed and a considerable increase of Alnus, Carpinus betulus and Fagus is detected. The expansion of these tree taxa indicate that high degree of clearing activity and human disturbance (Bjorkman-Bradshaw, 1996) started on the low floodplains (Behre, 1988, Willis, 1992). Some authors argued that the rise of these taxa can be correlated with human

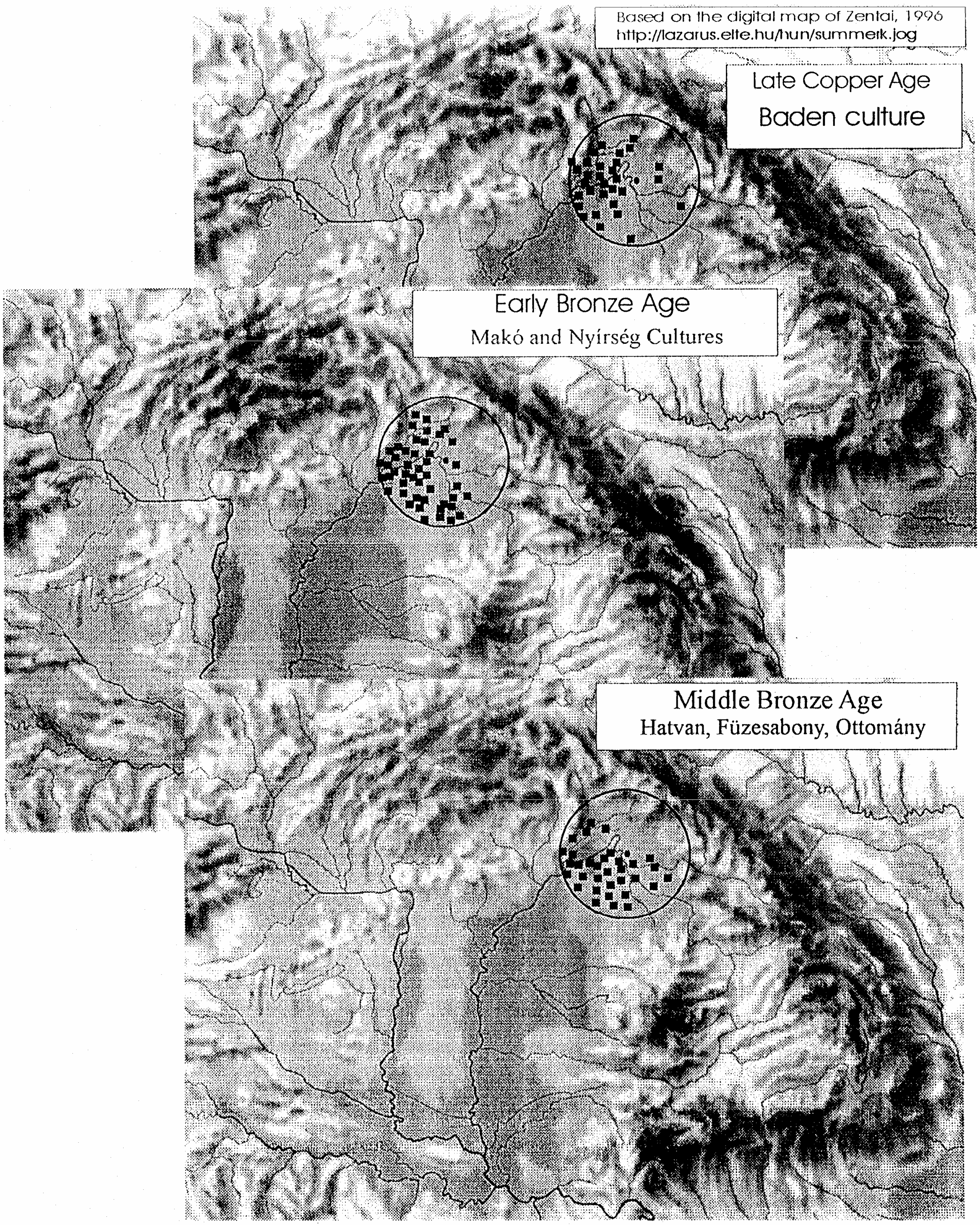

Fig.12. Fig.10. Archaeological findspots around the Csaroda peat bog from Late Copper Age until Middle Bronze Age.

impact (Tzedakis, 1993). The presence of Juglans in the pollen diagram from Middle Bronze Age clearly signifies cultivation by local human communities (Kremenetski, 1995), and it could represent the migration of this plant from the south caused by anthropogenic influence (Bottema, 1983). The final period of impact coincides with the Late Iron and Roman Ages during which time Scythian and Celtic groups then some different Barbarian groups occupied the Csaroda region (Trogmayer, 1980, Bóna, 1993). The Late Iron Age groups brought about a technical revolution in the production of high quality iron tools (Szabó, 1971). Geochemical records suggest that a threshold of irreversibility was crossed, and that soil erosion was thereafter continuous. The high increase of Cannabis (hemp) pollen during this period might indicate that Barbarian groups were using the Nyíres-tó lake for rope production (Godwin, 1967). The basin of the lake, however, was shallow and supported the growth of aquatic species such as Typha, Potamogeton, Myriophyllum and Nuphar (Harrington, 1995). Probably, one part of this lake was cleared for the procedure of hemp retting, which process unintentionally introduced large quantities of Cannabis pollen into the lake. A similar lake-clearing procedure is known to have occurred in the Roman Age on the Nagy-Mohos lake at Kelemér, which can be found 150 km to the northwest. Parallel with the increase of the hemp pollen values, charcoal concentration increased, probably indicating that a clearance of land for Cannabis cultivation started. Oak, beech, lime and elm trees also re-established, although a marked increase of grasses and open-ground herbaceous types and continuing soil erosion suggest that an unstable open landscape was developing upon human impact.

Summary

The sequence from Nyíres-tó provides an important record of environmental changes in the northeastern of Carpathian Basin from the late-glacial to times of Holocene anthropogenic disturbance.

At the beginning of the late-glacial the catchment basin of Nyíres-tó was an infilled river channel which was cut off from the riparian system. According to palinological work, pollen in the alluvium reflects hydrological and sedimentological influences, firstly the effect of floods or streams, because pollen types correlate significantly with sediment grain size. Consequently, the possibilities to use pollen-containing alluvium with special pollen taphonomy in the reconstruction of palaeo-vegetation and climate are limited.

During the late-glacial highly mixed communities (Quercus Picea/Ulmus/ Tilia/Corylus forest) were present, which have no analogue in the modern flora. The occurrence and dominance of deciduous tree populations suggest that this region, with its close proximity to the Carpathian mountain range, was an important Pleistocene refugial area for Tilia, Quercus, Ulmus and Corylus. The transition from late-glacial to postglacial took 1000-1500 years for the cold-stage forest taxa to decline gradually and the warm-period forest taxa to gain dominance. Thus, the high diversity of

Quercus/Ulmus/Corylus/Tilia/Fraxinus gallery forests and the forest-to-forest type change developed around the analysed region in the early postglacial phase.

A number of Early and Middle Neolithic sites can be found around the analyzed sequence, but according to palaeo-ecological data there are no real marks of anthropogenic disturbance, soil erosion or changes in the composition of vegetation. It is possible that the land use of the Körös and then the Linear Pottery cultures rooted in the Mesolithic subsistence, thus environmental effects and palinological response would be small.

After the Late Neolithic Age continuous but small-scale anthropogenic impact can be detected around the analysed region. During the Late Iron Age the impact upon the vegetation around the Nyíres-tó basin became intense with widespread open grounds for animal husbandry. From the beginning of the Roman Age a peak of human effects developed in this region which was used for manufacturing hemp ropes. Clearing the woodlands and burnings resulted in a reduction of woodlands, with an increase in grasses and scattered oaks. During the Roman Empire Age a Carpinus-Fagus-Quercus woodland developed around the palaeo-ecological site and the formation of the peat bog started in the basin of Nyíres-tó.

Acknowledgments

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Appeal to the participants of the Second World Congress PRO SILVA, 1996

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As a result of the anthropogenic factor during the agricultural era, the forest area of the Ukrainian Carpathians has become half or even one third as large as before. In the plain and piedmont territories the proportion of woodland areas has decreased to 20.2 %, in the mountain territories to 53.5 %, the average being 37 %. Negative transformations have taken place in the highlands, where the boundaries of the upper forest zone has descended by 100-200 m.

In Uzhgorod (Ukraine) an international seminar of experts in the problem field of upper forest boundary recovery was held in April 1996.

At the seminar in which experts from Ukraine, Russia, Slovakia, Hungary and Romania took part, a conception and an ecological-economic strategy were developed for the intensification of the protective, primarily water-regulating functions of the Transcarpathian forests.

Based on the European and world practice in forecasting and preventing destructive floods, mud flows, avalanches and other natural disasters, as well as on the experience in eliminating their negative outcomes, seminar participants stressed the peculiarity of the Transcarpathian region as a zone of constant risk of excessive flood formation on River Tisa and its tributaries. The economic and ecological detriment from the outcomes of the floods can be strongly felt along the whole basin of River Tisa, and further along River Danube.

In order to protect the nature of the Transcarpathian mountain system and the adjacent plain territories of Ukraine, Hungary, Slovakia, Romania, and other countries River Danube touches, as well as the river basin itself, from the results of ecological misbalance, the experts suggested that the water-protecting and water-regulating functions of the forest ecosystems in the Carpathian highlands should be restored.

Restoring the forests and shrubs that have been degraded as a result of natural catastrophes and anthropogenic effects in the Transcarpathian highlands (Ukraine) in an area of about 4,500 ha has been recognised to be the most important among the whole series of preventive measures. The water-protecting function of these forest ecosystems intended to be created on the upper forest boundary would be equal in their mature age to the ecological function of 100,000 ha of forests located in the lower altitude zones. To fulfil this plan a sum of 4.5 million USD is needed. This is a huge amount, but it is only one tenth as large as the sum that has been spent annually and can be spent further on the elimination of the destructive outcomes of flood disasters. We are appealing to all the Seminar participants with the hope that they will support our initiative to restore the upper forest boundary, first in the Transcarpathian Region, and then in the whole Carpathian mountain system. We hope for the assistance of world forestland ecological sciences, ecological and environmental foundations, for earmarking the finances for designing and surveying work as well as for material and technical support of the project on the upper forest boundary recovery.

We hope that the problem of upper forest boundary recovery in the Carpathians will be recognised among the universal problems of balanced approach to global environment, and that it will find scientific and financial support.

On behalf of the Seminar participants:

Head of the working group of the International Seminar of experts on the expedience of upper forest boundary recovery in the Carpathians.

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Conception for the regeneration of the upper forest boundary and for the optimisation of hydrological regimes in the Ukrainian Carpathians, 1997

Problem outlines

River Tisa is the longest left-side tributary of River Danube, the second longest river in Hungary. It is of great importance for water transportation, its water is used for the irrigation of agricultural lands in Hungary and Yugoslavia, and as a water source for navigable channels. The total length of River Tisa is 966 km, its length within the boundaries of the region is 223 km. Its total drainage area is l56.400 km2, out of which 12.760 km2 (about 8.1%) are within the region. However, 30.6% of the main drainage volume originates from this area, which is approximately 8 km3, or 625 mm, per year. The formation of one third of the total drainage in only 8% of the drainage area proves that the water conservation function of the river is of great importance. This feature of the drainage area is caused by its hilly relief and the considerable amount of precipitation in the mountains. (If the average amount of precipitation in the piedmont is 600 to 800 mm, in the mountains it is 1000 to 1600 mm per year).

According to data reported by M. A.Golubets (1988), the woodedness of the Carpathian drainage area before human interference started was 95% or even more. This was the main condition for theregularity of the river drainage, and for the balanced water regime of the mountain slopes. At present, woodedness in the Transcarpathian region amounts 51.6%. Careless forest management (both felling and reforestation) has resulted in decreasing biological stability and water regulating functions of the forest drainage area ecosystems, which was displayed in outbreaks of mass pest invasion and fungal diseases, in windfalls, floods and avalanches, and in the alluviation of rivers due to soil erosion. From 1877 to 1933 there were 4 disastrous floods, with the average period between them being 18 years, while from 1933 to 1964 they began to repeat every 3-4 years. At present floods disturb us every other year, if not every year. Human casualties, of course, are a price which can no way be compensated.

The general weakening of forest ecosystems is aggravated by the global industrial atmospheric pollution. In addition to the tangible decrease of woodedness, ecological problems also originate from the age structure shift of woods in the direction towards rejuvenation, from the increase of secondary tree stand ratio, the general decrease of the density of mature and maturing stands, the considerable descent of the upper forest boundary, and the destruction of highland shrub vegetation.

Thus, we suggest that the main cause of the crisis situation is the critical decrease of the level of woodedness, the misbalance of the forest stand age structure, the composition, variety and the extension of forests in relation to the size of the river network and to the Carpathian mountain system as a whole, which all have been caused by careless forest management (intensive fellings and directive forest regeneration, disregarding natural conditions) and the extensification of agricultural production (excessive ploughing on slopes and strip-grazing in areas adjacent to "polonynas") in the recent years.

The problem has a multilateral character; however, it is necessary to begin with the steps that have immediate results.

Our purposes

The gradual rising of the upper forest boundary and the regeneration of the shrub cover of "polonynas" are promising. The increase of precipitation in the spruce forest belt is 28% greater than in the beech woods. The increase of precipitation in the highlands is far more calculable than that in the spruce forest belt. By raising the upper forest boundary we first of all form a larger area of condensation surfaces, which causes a considerable increase in condensative precipitation. The same is true with the creeping shrub thickets. According to data by Krecmer (1970), the amount of condensative precipitation beginning from 604 m a.s.l. exceeds the amount of other precipitation captured by the forest cover, and within the upper forest boundary zone it is 84% of the total precipitation amount (O. V. Chubaty, 1968). The air masses, as they ascend along the slope, cool down and condense into moisture. The forest activates this process. As evaporation greatly decreases in the ascent, the main part of horizontal precipitation becomes drainage-forming. Moisture which still evaporates as a result of constant air movement, condenses or falls as vertical precipitation. In the highlands where it is much colder and evaporation is weaker, the infiltration power of the soil is smaller and the drainage modulus is the highest. The woods of the drainage area are the principal regulators of drainage. Consequently, the deforestation of the upper part of drainage area systems where river sources are formed, is of the greatest importance.

The creation of the forest plantation area to access ecological stability would require considerable expenditures, work, and first of all time which will take for these plantations to become able to carry out their protective function.

Thus, the most expedient and effective step in this situation is the creation of forest plantations in the upper forest boundary (around the "polonynas"), where, as a result of sheep breeding activity, the forest boundary has lowered by 100-300 m during this century. Under these conditions with excessive amount of precipitation, low temperatures, slow evaporation and considerable condensation of humidity in the air, forest plantations are able to carry out important water regulating and protecting functions as early as in their young age.

According to our scientists' data, 1 ha forest plantation on its upper boundary equals in water-protecting properties with the drainage formation of 5-6 hectares of plantation in the piedmont zone.

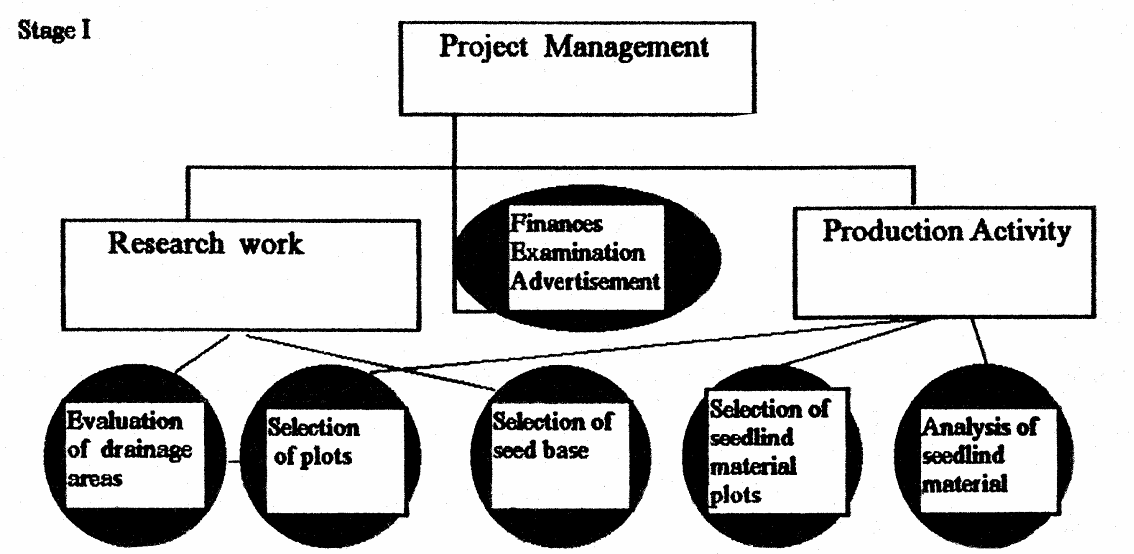
Grounds for Application

The crisis-ridden ecological situation cannot be resolved by the forest workers of the region because of the lack of budget financing as a result of the ineffectivity of reforming the old planned economy and other negative processes of the political transition. At the same time, there is a great deal of backlog in forest-planting due to the large-scale felling forced by continuing spruce withering (especially in forests of protective significance). The cleared glades should be forested as soon as possible, and the forest enterprises should devote sufficient amounts for it. Additional work related to the fulfilment of the project cannot be financed by them, let alone project research work which is absolutely beyond their plans. They are indebted to their workers even in paying the wages.

We consider that the main duty of the project is to mobilise finances from different sources; a foundation can be created. We hope that this project would find financial support from our Government. This would give us a real opportunity to get assistance from international charity foundations. It is expedient to co-operate with partners from the interested countries in the fulfilment of the joint project. Participation in the project can be registered at any of the three stages in any element of the scheme by simple individual contracts.

An important stimulus in the preparation of the project was the International Seminar of experts on the regeneration of the upper forest boundary (Uzhgorod, 1996). Scientists and specialists from Ukraine, Hungary, Slovakia, Russia, Romania adopted the resolution in which the expediency of these measures was confirmed.

The final result of the project is planned to be the reforestation of the ecologically most critical areas in the zones adjacent to “polonynas”. Forest cultures are suggested to be planted in 5.000 hectares. The supposed expenditures are around 5 million USD. The period of fulfilment is 20 years. The stages of project fulfilment can be illustrated by the following scheme:


Stage I
Project Management
Research work
Finances
Examination
Advertisement
Production Activity
Evaluation of drainage areas
Selection of plots
Selection of seed base
Selection of seedlind material plots
Analysis of seedlind material

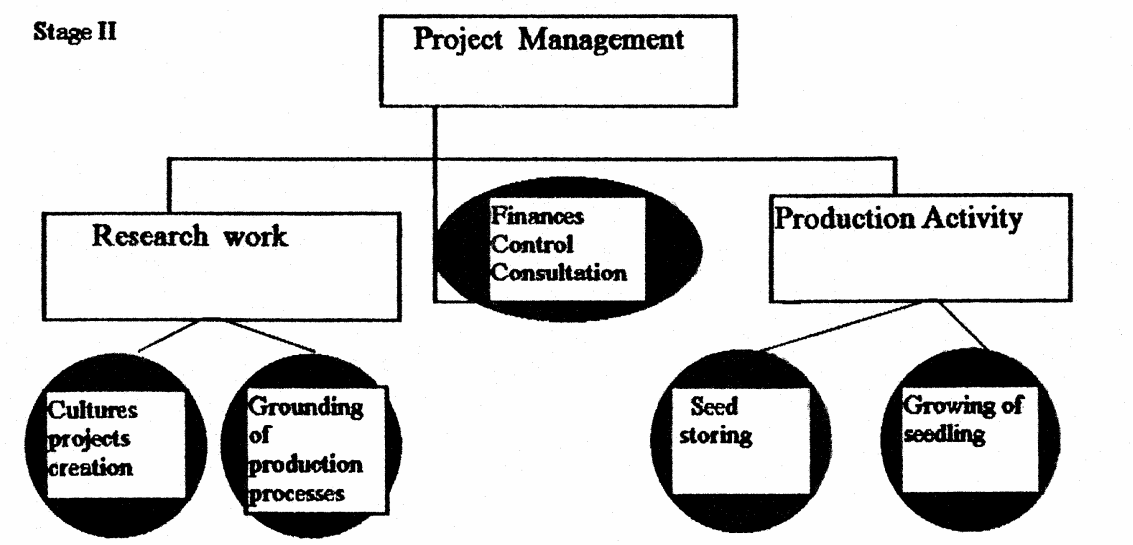
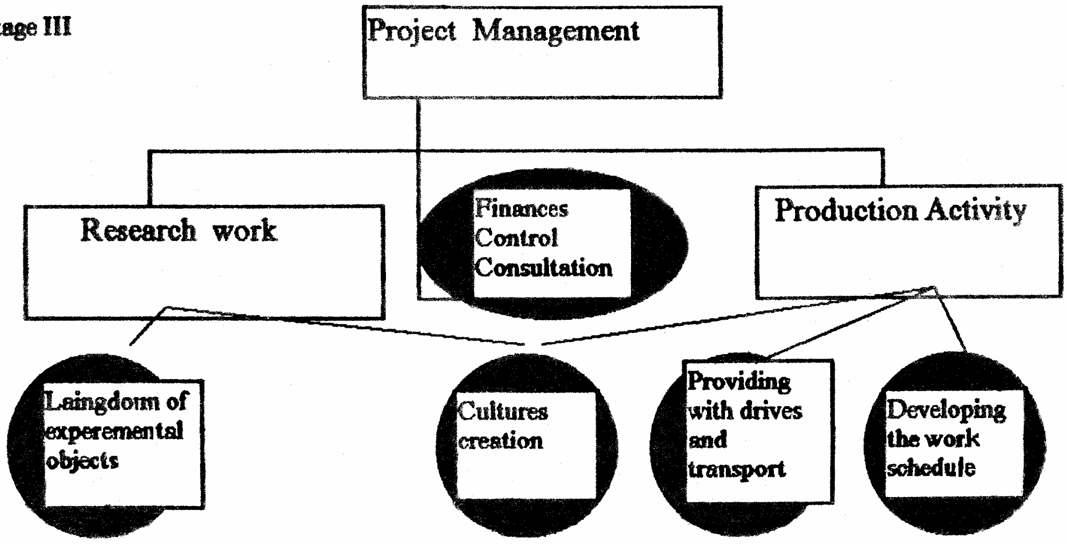

Stage II
Project Management
Research work
Finances
Control
Consultation
Production Activity
Cultures projects creation
Grounding of production processes
Seed storing
Growing of seedling

Table 1.

Stage III



Stage IV

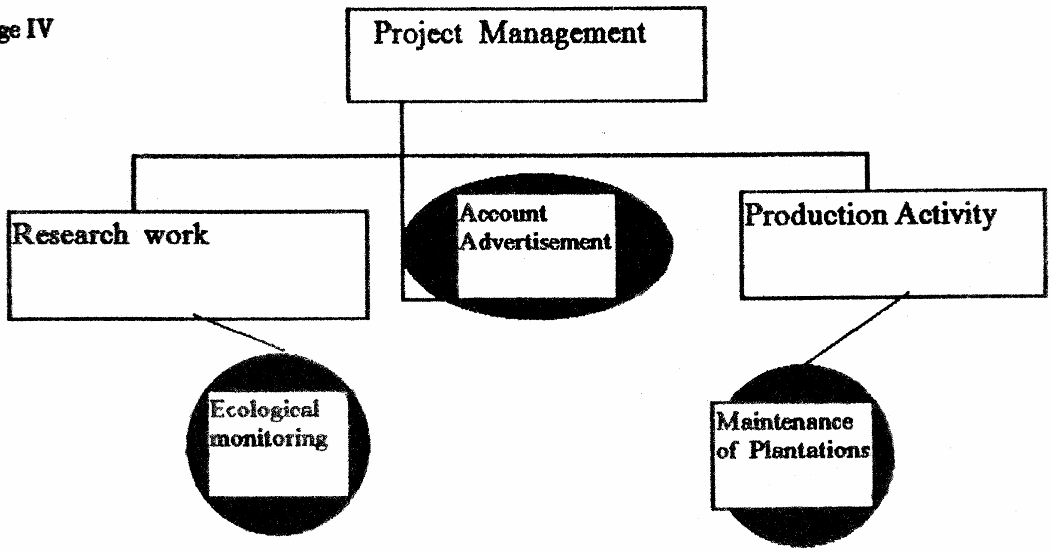


Table 2.

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Wetland flora and vegetation of the Upper Tisa river valley

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Introduction

This work presents a characterization of the flora and vegetation of the Upper Tisa (upper section of River Tisa) and an enumeration of the hydrophilous, hygrophilous and hygromesophilous species and phytocenoses. In the text we use following abbreviations: lifeforms: Ph = phanerophyte (Mph. = MM.: megaphanerophyte, mPh = M.: mesophanerophyte, nPh = N.: nanophanerophyte), Ch.: chamaephyte, H.: hemicryptophyte, G.: geophyte, T.: therophyte (Th.: annual therophyte, TH.: biannual therophyte), Hh. = HH.: helohydatophyte = hydato-helophyte.

Floristic elements. Adv.: Adventive, Afr.: African, Alp.: Alpine, Amphiatl.: Amphiatlantic, Asia (S-~, E-~ = Southern-~, Eastern-~ etc.): Asian, Atl.: Atlantic, B. = Balc.: Balcanic, Bor.: Boreal, Cauc.: Caucasian, Carp.: Carpathian, Cp.: Circumpolar = Circumboreal, C. = Cont. Continental, Cosm.: Cosmopolitan, D.: Dacic, End.: Endemism, Eua. (S-~, M-~ etc. = Southern~, Middle-~ etc.): Eurasian, Eu. (S-~, Ec = M-~ etc. = Southern~, Central or Middle~ etc.): European, Eurosib.: Eurosiberian, M. = Medit.: Mediterranean, Mp. = Ponto-medit.: Pontic-Mediterranean, Palaetrop.: palaetropical, Pn. = Pannon: Pannonic, P. = Ponto-: pontic, Sarmata: Sarmathian, Submedit.: Submediterranean, Subtr.: Subtropical, and combinations of the above mentioned elements.[Mont.: mountainous].

Waterway segments: BT - the Chorna Tisa, WT - the Bila Tisa, MT - the united (joined) mountainous section of River Tisa, JT - the joined Romanian-Ukrainian section of River Tisa, UT - the hilly Ukrainian section of River Tisa, HT - the Hungarian Upper Tisa.

The mark (!) indicates that the plant or association was observed by foreign authors.

Keywords: wetland flora and vegetation, Upper Tisa (upper section of River Tisa)

Methods

The flora and vegetation indices and their accompanying observations are based on our field research in summer 1995, on bibliographical information and data from the Carpathian Biosphere Reserve Herbarium in Rahiv (Ukraina). In the species enumeration, we indicated for each plants the river section at which the plant grows, the work that quotes it, the bio-form (lifeform), the floristic element and the cenotaxons in which it occurs. In the presentation of the hydrophilous, hygrophilous and hygro-mesophilous vegetal associations only the river sections in which the cenotaxon is spread is specified. The categorisation of bio-forms (life forms), floristic elements and the classification of the plant associations are done following V. Sanda et al. (1980, 1983), R. Soó (1964-1980), D. Dubyna et al. (1993) and our observations.

On geomorphological-climatic and national basis we divided the Upper Tisa section into six sections: the Chorna Tisa (CT), the Bila Tisa (BT), the united mountainous section of River Tisa (MT), the joined Romanian-Ukrainian section of River Tisa (JT), the hilly Ukrainian section of River Tisa (UT) and the Hungarian Upper Tisa section (HT).

Rivers Chorna and Bila Tisa are the alpine-subalpine-mountainous river sections extending between 2061 m a.s.l. (above Baltic sea level) and 450-500 m a.s.l. (the confluence of the two branches is upstream from Rahiv). Yearly average temperature is between 0 °C and 5 °C, and yearly average precipitation is between 1000 - 1400 mm.

The united mountainous section of River Tisa represents the section between the confluence of rivers Chorna and Bila Tisa and the locality of Dilove (about 350 m a.s.l.) at the Romanian-Ukrainian border. Annual mean temperature is around 5 °C - 6 °C and yearly precipitation is around 800 -1000 mm.

In the joined Romanian-Ukrainian section of River Tisa, from Dilove to Tyachiv (about 210 m a.s.l.) yearly mean temperature is 6 °C - 7 °C, and yearly precipitation is 700 -900 mm.

In the hilly Ukrainian section of River Tisa, between Tyachiv and Vylok (about 120 m a.s.l.), annual mean temperature is 7 °C - 9 °C and annual precipitation diminishes to 600 - 700 mm.

In the Hungarian Upper Tisa section, from Vylok to the confluence with the River Szamos (about 100 m a.s.l.) annual average temperature is 9 °C - 10 °C, and precipitation is around 600 mm/year.

Under these climatic conditions both flora and vegetation have a more and more thermophilous and xerophilous character from River Tisa's springs towards its confluence with River Szamos.

Results

Part 1.

The flora and vegetation of the Romainan and Ukrainan section of the River Tisa valley

Concerning the flora of the Upper Tisa region, two interesting remarks should be made: on the one hand, a great number of adventive species are advancing upstream, and on the other the number of some boreal species decreases towards lower altitudes. Thus, in the Upper Tisa region almost 30 species of adventive plants were identified: Amaranthus crispus, A. deflexus, Oxalis europaea, Oenothera biennis, Parthenocissus inserta, Eschscholtzia ciliata, Veronica persica, Ambrosia artemisifolia, Erigeron canadensis, Xanthium italicum, X. riparium, X. spinosum, Galinsoga ciliata, Solidago canadensis, S. gigantea, Rudbeckia laciniata, Juncus tenuis a.o. Some adventive species ascend nearly as up as the confluence of river Chorna Tisa with River Bila Tisa at Rahiv (e. g. Impatiens parviflora, Echinocystis lobata), and others spread even upper along these two rivers (e.g. Polygonum cuspidatum, Epilobium adenocaulum, Impatiens glandulifera, Erigeron annuus, Helianthus decapetalus, Galinsoga parviflora, Sisyrinchium angustifolium).

Among the species of boreal plants which descend to low altitudes we note Vaccinium vitis-idaea, V. myrtillus, V. oxycoccus, Andromeda polifolia, Eriophorum vaginatum, Carex pauciflora which reach the altitude of 800 m (in the peat bog Chorne Bahno on river Chorna Tisa), Parnassia palustris, Trollius europaeus, Moneses uniflora which reach the altitude 500-550 m on River Bila Tisa, Carex vesicaria, C. rostrata, C. nigra, C. flava, C. canescens, Scirpus sylvaticus a.o. which occur on the hilly Ukrainian River Tisa section at about 200 m a.s.l. We point out, too, that Picea abies constitutes woods by River Chorna Tisa at 800-850 m a.s.l. and isolatedly reaches 600 m a.s.l. by River Bila Tisa. Campanula carpatica may be seen at Rahiv at 430 m a.s.l., at Kuzij at about the same altitude. Duschekia viridis grows at Uhorski at River Bila Tisa only at 960 m a.s.l.

The neoadventive species Heracleum caucasicum ssp. sosnovskyi (not pointed out yet in Romania, but surely present on the right riverside of River Tisa) advenced upwards along River Tisa from Hungary to Dilove, being relatively frequent between Vynogradiv and Uzhgorod.

The flora of the Upper Tisa flora is seen as rich, if we take into account the latitude at which this river flows and the research which is in an incipient stage. From the sources of River Tisa to the confluence with River Szamos 1224 species of cormophytae have been identified so far. In the followings we enumerate only the aquatic and paludic species, respectively the hydrophytae, hygrophytae, and hygro-mesophytae ones, representing a total of 289 species. These grow in the water of River

Tisa, especially in the dead branches of the river, in the swamps and marshes, peat bogs and springs in the immediate proximity of the Upper Tisa.

From the 1224 species which were identified from the sources of River Tisa to its confluence with River Szamos, approximatively 750 species grow in the Carpathian sector and 830 grow in the extra-Carpathian one (about 350 species are common to both). Hoiwever, we point out the fact that for the Carpathian sector there all discovered and identified species in the River Tisa basin were taken into account, while for the extra-Carpathian sector species only from the river meadow and the first terrace of River Tisa were counted.

We note, as especially interesting spots of phytogeographical significance, the peat bog Ciorne Bahno at the village Chorna Tisa, the Kuzij natural reservation, and the Narcissum-meadows at Kiresi (257 ha) and at Bustino. In the latter a very special cenosis of Molinia coerulea with much Spiraea salicifolia, a rare species in the Ukrainian flora, is found.

Along the Upper Tisa, from its sources to the confluence with River Szamos, the flora and vegetation is distributed in accordance with levels, due to geomorphological relief characteristics and to the climatic features.

Thus, on the subalpine and alpine levels (1600 - 2061 m a.s.l.) typical phytocenoses of rocky regions occur, with weeds and lawns belonging to the following vegetal associations: Juncetum trifidi with fac. cetrariosum, Oreochloo-Juncetum trifidi, Polytrichetum sexangularis, Luzuletum alpino- pilosae, Festucetum pictae, Poaetum deylii, Diantho tenuifolii-Festucetum amethystinae, (Seslerio heuflerianae)-Caricetum sempervirentis, Primulo-Caricetum curvulae, Festucetum sudeticae with subass. nardetosum and vaccinietosum and fac. gnaphaliosum, (Seslerio)- Festucetum versicoloris, Diantho compacti-Festucetum porcii, Seslerietum coerulantis, Hyperico grisebachii-Calamagrostietum villosae, Rumicii-Deschampsietum caespitosae, Adenostylo-Doronicetum austriacii a.o. Among subalpine and alpine shrubs we note: Vaccinio-Pinetum mugi with subass. calamagrostietosum villosae, rumicetosum carpaticae and sphagnetosum and fac. athyriosum and cetrariosum, Vaccinio-Juniperetum nanae with fac. deschampsiosum and calamagrostidosum, Rhododendro-Vaccinietum, Pulmonario filarszkyanae- Alnetum viridis with fac. athyriosum, Cetrario-Vaccinietum myrtilli, Cetrario- Vaccinietum gaultherioidis, Loiseleurietum procumbentis, Salicetum herbaceae, Soldanello hungaricae-Salicetum kitaibelianae.

At the mountain level (400 - 600 m a.s.l.) forests are dominant; they are replaced, on relatively small surfaces, by secondary lawns. These forests are: beech forests between (400) 500-1000 (1100) m a.s.l., mixed forests of deciduous (leafy) and resinous trees between 800 m-1300 m a.s.l., and spruce firs between (1000) 1100-1600 (1665) m a.s.l. The most extensive forest types belong to the following associations: Symphyto cordati-Fagetum with subass. asperuletosum and mercurialetosum and fac. dentariosum, Phyllitidi-Fagetum, Abieti-Fagetum with fac. oxalidosum, athyriosum and galeobdolosum, Leucanthemo waldsteinii- Piceo-Fagetum with subass. mercurialetosum, asperuletosum and fac. petasitosum and stellariosum nemori, Hieracio rotundati- Piceetum, Luzulo silvaticae-Piceetum, Oxalo-Piceetum, Vaccinio myrtilli-Piceetum with fac. muscosum and Sphagno-Piceetum. To these, shrubs belonging the associations Coryletum avellanae, Spiraeetum ulmifoliae, Sambucetum nigrae, Salici capreae-Sambucetum racemosae are added. The lawns, used especially as hay fields, belong to the associations Agrostio-Festucetum rubrae, Nardo-Festucetum rubrae, Alchemillo-Festucetum rubrae, Trifolio- Cynosuretum, Anthoxantho-Agrostietum tenuis a.o.

On the levels of hills and plains (about 100-400m a.s.l.), from the exit of River Tisa from the Carpathian sector to its confluence with River Szamos, forests diminish more and more, their place being taken by agrocenoses, lawns, weeds and built-up areas. The woody and bushy vegetation belong to the associations Carpino-Quercetum petraeae, Querco robori-Carpinetum, Querco robori-Caricetum brizoidis, Fraxino pannonicae-Ulmetum, Bromo sterili-Robinietum and Pruno-Crataegetum. The observed lawn phytocenoses join the associations Agrostio-Festucetum rubrae, Anthoxantho-Agrostietum tenuis, Festucetum rupicolae, Phleetum pratensis, Holcetum lanati, Alopecuretum pratensis, Cynodonto-Po‰tum angustifoliae, Artemisio-Festucetum pseudovinae a.o. In these sections of River Tisa an extremely high number of weeds belonging to the associations Amarantho-Chenopodietum albi, Hordeetum murini, Atriplicetum tataricae, Malvaetum neglectae, Descurainetumsophiae, Agropyretum repentis, Cirsietum arvensi- lanceolati, Onopordetum acanthii, Carduetum acanthoidis, Ambrosietum artemisiifoliae, Setario- Galinsogetum, Tanaceto- Artemisietum vulgaris, Conietum maculati, Sambucetum ebuli, Arctio-Ballotetum nigrae, Urticetum dioicae, Chaerophylletum bulbosi, Tussilaginetum farfarae, Rudbeckio- Solidaginetum, Polygonetum cuspidati, Helianthetum decapetali, Heracleetum sosnovskyii, Bidentetum tripartiti, Echinochloo-Polygonetum lapathifolii, Xanthietum italici, Lolio-Plantaginetum majoris, Polygonetum avicularis, Dauco-Matricarietum inodorae, Lolio-Potentilletum anserinae a.o. are scattered.

In this review of the vegetal associations of the Upper Tisa region we did not mention the aquatic and paludic ones, because, like for the hydro-and hygrophilous flora, they will be presented in the followings, as classified based on alliances, orders and classes, with the river section in which the association was identified specified in each case.

The hydrophilous, hygrophilous and hygromesophilous flora

Equisetaceae

1. Equisetum fluviatile L. (E. limosum L.); BT,MT (32), JT (7), UT (11), HT (!); Hh, Cp (bor); Magnocaricion, Phragmitetea
2. Equisetum palustre L.; CT (!),BT(32), JT (22,!), UT (32,!), HT (6,!); G, Cp (bor); Molinietalia
3. Equisetum telmateia Ehrh.; MT (32,!); G, Cp (bor); Alno-Padion, Filipendulo-Petasition
4. Equisetum variegatum Schleich.; CT, BT (32); G, Cp (bor); Caricetalia nigrae
5. Equisetum ramosissimum Desf.;UT (11); G, Cosm; Festucion vaginatae

Thelypteridiaceae

6. Thelypteris palustris Schott; UT (32), HT(6); Hh, Cp (bor); Alnion glutinosae, Alno-Padion, Magnocaricion

Marsileaceae
7. Marsilea quadrifolia L.; UT (5, 15), HT (6,25); Hh, Eua (M); Nanocyperion

Salicaceae
8. Salix alba L.; JT (!), UT (28,32, 11, !), HT (6,!); MPh-mPh, Eua; Salicion albae, Alno-Padion
9. Salix aurita L.; UT (32); mPh, E; Alnion, (Caricetalia nigrae)
10. Salix cinerea L.; CT (32), JT, UT (11,28,!); mPh, Eua; Alnetea, Alno-Padion
11. Salix daphnoides Vill.; UT (32); mPh, E; Salicion eleagni
12. Salix eleagnos Scop.; JT (7), UT (11,32,!), HT (6,27,!); mPh, Ec; Salicion eleagni
13. Salix fragilis L.; JT (!), UT(28,32,!); mPh-MPh, Eua; Salicion albae, Salicion triandrae, Alno-Padion
14. Salix purpurea L.; CT, BT (32,!), JT, MT(!), UT (32,!); mPh, Eua; Salicetalia purpureae
15. Salix triandra L.; BT (32,!), JT (!), UT (11,32,!); mPh, Eua; Salicion triandrae
16. Salix viminalis L.; MT, JT (!), UT (28,32,!), HT (6,!); mPh, Eua; Salicion triandrae
17. Populus alba L.;UT (11), HT (!); Mph, Eua; Salicetalia purpureae
18. Populus nigra L.; JT (7), UT (11,32,!); Mph, Eua; Salici-Populetum

Betulaceae
19. Alnus glutinosa (L.) Gaerthn.; MT, JT (!), UT (11,28,32,!), HT (6,!); MPh-mPh, Eua; Alnion glutinosae, Alno-Padion
20. Alnus incana (L.) Moench.;BT(32,!), CT,MT,JT (!); MPh-mPh,Eua; Alno-Padion, Salicion albae

Urticaceae
21. Urtica kioviensis Rogow.; HT (6); H(G), P; Phragmition (Alnetea)

Polygonaceae
22. Polygonum amphibium L.;UT(32, 5); G-Hh, Cosm; Phragmitetea, Alnetea, Salicetea
23. Polygonum bistorta L.; BT (32,!), UT (28,32); H, Eua; Molinietalia, Calthion
24. Polygonum hydropiper L.; CT (32); JT (!), UT (32,!), HT (!); Th, Eua(M); Bidention, Populetalia, Alnetea
25. Polygonum lapathifolium L.; CT (32); UT (32,!); Th, Cosm; Bidentetalia, Polygono- Chenopodion
26. Polygonum minus Hudson; UT (11,32); Th, Eua; Bidention
27. Polygonum mite Schrank; UT (32); Th, Eua; Bidentetalia
28. Polygonum persicaria L.; JT (!), UT (32,!), HT (!); Th, Eua; Populetalia, Phragmitetea
29. Rumex conglomeratus Murray; UT (11), HT (!); H, Cp; Bidention, Agropyro-Rumicion
30. Rumex sanguineus L.; BT (32), JT (!), UT (32,!), HT (!); H, E; Alno-Padion

Caryophyllaceae
31. Stellaria alsine Grimm.; BT,MT (32); H, Cp (bor); Cardamini-Montion
32. Stellaria longifolia Muhl.; BT, MT (32). H, Cp(bor); Caricion rostratae, Magnocaricetalia
33. Stellaria palustris Retz; CT, BT (!); var. laxmanni (Fisch.) Simk.; BT (32); H, Eua; Agrostion stoloniferae, Magnocaricion, Caricetalia nigrae, Alnetea
34. Cucubalus baccifer L.;UT (11,!); H, Eua; Senecion fluviatilis, Calystegion
35. Myosoton aquaticum (l.) Moench.; JT, UT (32,!); Th-TH, Eua(M); Alno-Padion, Populetalia, Senecion fluviatilis

36. Sagina nodosa (L.) Fenzl.; BT(32); H, Atl(bor); Caricetalia davallianae Nanocyperion
37. Lychnis flos-cuculi L.; CT, BT (!), JT (22), UT(28,32); H, Eua Molinietalia, Magnocaricion
38. Saponaria officinalis L.;UT (!); H, Eua; Senecion fluviatilis, Calystegion

Chenopodiaceae
39. Chenopodium botrys L.;UT (11); TH, Cosm; Sisymbrion, Chenopodietea

Ceratophyllaceae
40. Ceratophyllum demersum L.; UT (5), HT (!); Hh, Cosm; Potametea

Ranunculaceae
41. Caltha palustris L.; CT (!), BT (32,!), MT, JT (!), UT (28), H, Cp(bor); ssp. laeta (S.,N. et Ky.) Hegi; CT (!), BT (32), JT (!); ssp. cornuta (S., N. et Ky) Hegi; HT(6); Calthion, Molinietalia, Magnocaricetalia, Alno-Padion
42. Ranunculus flammula L.; UT (28,!), HT(6); H, Eua; Agrostion stoloniferae, Magnocaricion, Caricion canescenti-nigrae
43. Ranunculus polyphyllus W. et K.; HT (6); Hh-H, Eua; Glycerietum
44. Ranunculus repens L.; JT, UT, HT (!); H, Eua(M); Molinio-Arrhenatheretea, Phragmitetea, Salicetea, Alno-Padion, Calystegion, Agropyro-Rumicion
45. Ranunculus sceleratus L.; UT (32,!); Th, Cp; Bidention
46. Ranunculus trichophyllus Chaix.; HT (6,27); Hh, E; Potamion
47. Thalictrum flavum L.; UT (32,!),HT(6); H, Eua; Molinietalia(-Magnocaricion Filipendulo-Petasition
48. Thalictrum lucidum L.; UT (28,!), HT (6,27); H, Ec; Molinietalia, Salicetalia, Alnetea, Filipendulo-Petasition
49. Trollius europaeus L.; CT (14), BT (32,!), MT (32); ssp. transsilvanicus (Schur) Jáv.; BT (32); H, E(bor); Molinietalia, Calthion

Brassicaceae
50. Cardamine amara L.; CT (!),BT,MT (32,!); H, Eua (M);Cardamini-Montion, Alno-Padion
51. Cardamine opizii J. et C. Presl.; CT(!),BT (32,!); H, Ec, Cardaminetum opizii
52. Cardamine pratensis L.; CT, BT, MT (32,!); JT (22,!), UT(28), HT(6,27); H, Cp (bor); Molinio-Arrhenatheretea; ssp. dentata(Schult.) Neilr.; MT(32), HT(6)
53. Cardamine palustris(Wimm. et Grab.) Peterm.; BT, MT (32); H, E; Molinio-Arrhenatheretea
54. Cardamine matthiolii Moretti; BT (32); H, Ec; Caricetalia nigrae
55. Cardamine rivularis Schur; CT, BT (32); H, Alp-Carp-B; Caricetalia nigrae
56. Cardamine x rohleana (pratensis x matthiolii); HT (6); Molinio-Arrhenatheretea
57. Rorippa amphibia (L.) Badder; Mt (5,32,!), JT (!), HT (6); Hh, Eua; Phragmitetea, Alnetea, Populetalia
58. Rorippa palustris (R. islandica (Oeder) Borb.); BT, MT (32), HT (6,27,!); Th-TH, Cosm; Bidentetea

Droseraceae
59. Drosera rotundifolia L.; CT (!); H, Cp (bor); Oxycocco-Sphagnetea

Saxifragaceae
60. Saxifraga aizoides L.; MT (32); Ch, Eua (Arct-alp); Saxifragetum aizoidis, Cratoneurion

61. Saxifraga stellaris L.; BT (32); Ch (H), Eua (Arct-alp); Philonotido-Saxifragetum stellaris, Montio-Cardaminetea

Parnassiaceae

62. Parnassia palustris L.; CT, BT (16,32,!), MT (32); H,Cp (bor); Caricetalia davallianae, Molinion, Tofieldetalia

Rosaceae

63. Filipendula ulmaria (L.) Maxim; CT (!), BT, MT (32,!), JT (22,!), HT (6,!); H, Eua; Filipendulo-Petasition, Alno-Padion, Molinietalia; ssp. denudata (J. et C. Presl.) Hayek; MT (32)
64. Geum rivale L.; CT, BT (32,!), MT (32); H, Cp(bor); Calthion, Filipendulo-Petasition, Adenostylion
65. Potentilla anserina L.; CT (!), BT,MT (32,!), JT, UT (!); H, Cosm; Plantaginetea, Bidentetalia, Nanocyperetalia, Molinietalia
66. Potentilla palustris (Comarum palustre L.); UT (32,!); Hh(Ch), Cp (bor); Alnetea, Caricetalia nigrae
67. Spiraea salicifolia L.; UT (!); mPh, Eua (C); Alno-Padion (-Salicion)

Fabaceae

68. Galega officinalis L.; UT (21,!), HT (6,12,!); H, P-M; Bidention-Calystegion, Molinietalia
69. Glycyrrhiza echinata L.; HT (6); H, P-M; Calystegion, Phragmitetea, Salicetea
70. Lathyrus palustris L.; HT (6); H, Cp(bor); Molinio-Juncetea, Molinietalia
71. Medicago lupulina L.;UT (11); Th, Eua; Cynosurion, Thero-Airion, Panico-Setarion
72. Medicago sativa L.;UT (11); H, Eua; Caucalidion, Panico-Setarion
73. Melilotus officinalis (L.) Pall.;UT (11,!); Th, Eua; Arction, Thero-Airion

Geraniaceae

74. Geranium palustre L.; MT (32); H, Eua(C); Filipendulo-Petasition

Euphorbiaceae

75. Euphorbia lucida W. et. K.; HT (6); H, E(C); Filipendulo-Petasition- Molinion
76. Euphorbia palustris L.; MT, JT (32,!); H-Hh, E; Magnocaricion-Agrostion stoloniferae, Convolvuletalia, Filipendulo-Petasition
77. Euphorbia serrulata Thuill. (E. stricta L.); MT, JT (11,32,!); Th, E(C); Alno-Padion- Calystegion, Senecion fluviatilis

Violaceae

78. Viola elatior Fries; HT (6); H, Eua; Alno-Padion, Molinietalia
79. Viola stagnina Kit.; UT (28,32); HT (6,25); H, Eua; Molinio-Juncetea
80. Viola biflora L.; CT BT (32,!); H, Cp, Adenostylion

Elatinaceae

81. Elatine hydropiper L.; UT (5,32); Hh(Th), Cp(bor); Nanocyperion
82. Elatine macropoda; HT (6,12); Hh(Th), Eua(M); Nanocyperion
83. Elatine triandra Schkuhr; HT (6); Hh (Th), Cosm; Oryzion

Lythraceae

84. Lythrum hyssopifolia L.; UT (32), HT (6); Th, Cosm; Nanocyperion
85. Lythrum salicaria L.; CT (32); MT, JT (!), UT (5,32,!), HT (12,!); H-Hh, Cosm; Phragmitetea, Molinio-Juncetea, Salicetea, Alnetea, Filipendulo-Petasition

86. Lythrum virgatum L.; UT (32); HT (6,!); H-Hh, Eua(C); Agrostion-Beckmannion
87. Peplis portula L.; JT (!), UT (11,32), HT (6); Th, Atl-M; Nanocyperion, Beckmannion

Trapaceae
88. Trapa natans L., UT (16), HT (!); Hh, Eua(M); Nymphaeion

Onagraceae
89. Epilobium adenocaulon Hausskn; BT (32); MT, JT (!); H, Adv; Phragmitetea, Filipendulo-Petasition, Molinietalia
90. Epilobium alsinifolium Vill.; BT, MT (11,32); H, Eua(arct-alp); Montio-Cardaminetea
91. Epilobium anagallidifolium Lam.; CT (32); H, Cp (arct-alp); Cardamino-Montion
92. Epilobium dodonaei Vill.; CT(!), BT,MT (32), UT (11,!), HT (6); H, Ec; Epilobion fleischeri
93. Epilobium hirsutum L.; UT (32,!); H (Hh), Eua(M); Phragmitetea, Filipendulo-Petasition
94. Epilobium nutans F. W. Schmidt; CT, BT (32); H, E(alp); Cardamino- Montion
95. Epilobium obscurum Schreber; BT, MT (32;) H, Alt-M; Glycerio-Sparganion, Cardamino-Montion
96. Epilobium palustre L.; CT (!), BT, MT (32); H, Cp(bor); Caricetalia nigrae-Magnocaricion, Calthion
97. Epilobium parviflorum Schreber; BT, MT (32); H, E; Phragmitetea-Molinietalia, Glycerio-Sparganion
98. Epilobium x persicinum Rchb. (parviflorum x roseum); JT (7); Glycerio-Sparganion
99. Epilobium roseum Schreber; BT, MT (32,!), JT (!); H, Eua; Glycerio-Sparganion
100. Circaea lutetiana L.; UT (29,!); G, Eua; Alno-Padion

Haloragaceae
101. Myriophyllum spicatum L.; UT (5,32,!), HT (!); Hh, Cp (bor); Potamion, Nymphaeion

Balsaminaceae
102. Impatiens parviflora DC.;UT (!); Th, Adv; Arction, Alliarion

Apiaceae
103. Chaerophyllum hirsutum L.; CT(!), BT, MT (32,!); H, Ec; Filipendulo-Petasition
104. Sium latifolium L.; HT (!); Hh, Eua; Phragmitetea
105. Oenanthe aquatica (L.) Poir.; UT (5,32); Hh, Eua; Phragmitetalia
106. Oenanthe banatica Heuff.; UT (32, HT (6,25); H, D-B-Pn; Alno-Padion
107. Oenanthe silaifolia Bieb.; HT (27); H, M; Agrostion stonoliferae
108. Angelica archangelica L.; CT (!), MT (32); TH-H, Eua(bor); Filipendulo-Petasition, Adenostyletea
109. Angelica x mixta Nyár. (archangelica x silvestris); CT (!); Adenostylion
110. Angelica silvestris L.; CT, BT (!), MT (32,!), UT (!), HT (6,!); H, Eua; Alno-Padion, Molinietalia
111. Cnidium dubium (Schkuhr) Thell.; UT (32); TH(H), Eua; Molinion
112. Cicuta virosa L.; HT (25); Hh, Eua; Magnocaricion
113. Peucedanum palustre (L.) Moench.; UT (11,5,32), HT (6); H, Eua; Phragmitetea, Molinio-Juncetea, Magnocaricion-Alnion

Ericaceae

114. Andromeda polifolia L.;CT (!); Ch(nPh),Cp(bor); Sphagnetalia fusci
115. Vaccinium oxycoccos L.; CT(!); Ch, Cp(bor); Oxycocco-Sphagnetea, Sphagnion medii

Pyrolaceae
116. Pyrola rotundifolia L.;CT (14); H, C (bor); Vaccinio-Piceion

Primulaceae
117. Hottonia palustris L.; UT (5,32); Hh, E; Potamion
118. Lysimachia nummularia L.;CT (!), BT, MT, JT (32,!); Ch, E; Calthion, Alno-Padion, Filipendulo-Petasition, Phragmitetea, Molinio-Juncetea, Alnetea
119. Lysimachia vulgaris L.; JT, UT (5,32,!); H-Hh, Eua; Phragmitetea,Molinio-Juncetea, Scheuchzerio-Caricetea, Alnetea, Populetalia

Oleaceae
120. Fraxinus angustifolia Vahl.; HT (6,!); Mph, P-Pn; Alno-Padion, Alnetea

Gentianaceae
121. Centaurium pulchellum (Swartz) Druce; JT (7), UT (32), HT (6); Th, Eua; Isoëto-Nanojuncetea
122. Centaurium littorale (D. Turner) Gilmour; ssp. uliginosum (W. et K.) Melderis; HT (6); Th-TH, Eua; Molinietalia
123. Gentiana pneumonanthe L.; UT (!); H, Eua(M); Molinion
124. Sweertia perennis L.; BT, MT (32); H; Eua; var. alpestris (Baumg.) Sag. et Schn.; CT, BT (32); Deschampsion caespitosae, Scheuchzerio- Caricetea nigrae, Caricion davallianae

Menyanthaceae
125. Menyanthes trifoliata L.; CT, BT, UT (32;) Hh, Cp(bor); Magnocaricion, Caricetalia nigrae

Rubiaceae
126. Galium palustre L.; BT (32), UT (32,!), HT (6,26); H, Cp; Molinio-Juncetea, Magnocaricion
127. Galium uliginosum L.; JT (2), HT (6); H, Eua; Molinio-Juncetea, Magnocaricion, Calthion

Convolvulaceae
128. Calystegia sepium (L.) R. Br.;UT (11); H, Eua; Calystegion, Salicion

Boraginaceae
129. Symphytum officinale L. ssp. officinale; BT (32), JT, UT (28,32,!); HT (6,!); ssp. uliginosum (A. Kern.) Nyman; HT (6,!); H, Eua; Molinio-Juncetea, Phragmitetea, Alno-Padion
130. Myosotis scorpioides L.; CT, BT, MT, JT (!), UT (32,!), HT (6,!); var. strigulosa (Rchb.) Mert. et Koch; CT, BT, MT (32); H-Hh, Eua; Phragmitetea, Molinio-Juncetea, Calthion, Populetalia, Alnetea
131. Myosotis caespitosa K. F. Schltz; UT (32); Th-TH(H), Cp; Magnocaricion, Phragmition

Verbenaceae
132. Verbena officinalis L.;UT (29,!);Th-H, Cosm; Agropyro-Rumicion, Arction

Callitrichaceae

133. Callitriche cophocarpa Sendt.; JT, UT (5,7,32,!); HT (6,!); Hh, Eua; Nanocyperion, Potamion
134. Callitriche hermaphroditica L.; BT (32); Hh; Cosm; Potamion
135. Callitriche palustris L.; BT, UT (32); Hh, Eua(M); Potamion, Nanocyperion

Lamiaceae

136. Galeopsis ladanum L.;UT (!); Th, Eua; Caucalidion, Sisymbrion, Trifolion medii
137. Lycopus europaeus L.; BT (!), UT (32,!); Hh, Eua; Phragmitetea, Alnetea, Populetalia, Bidentetea
138. Mentha aquatica L.; JT, UT (5), HT (!); var. riparia Schreb.; JT (2);Hh-H, Eua; Phragmitetea, Alnetea, Salicion, Molinio-Arrhenatheretea
139. Mentha arvensis L.;CT(!), BT (14), MT (32,!); H-G, Cp (bor); Phragmitetea, Molinietalia, Calthion; ssp. parietariaefolia Beck., var. salicetorum Borb.;JT (2)
140. Mentha longifolia (L.) Huds.; CT (!), BT, MT, JT, UT (32,!); HT (!); H(G), Eua(M); Glycerio-Sparganion, Filipendulo-Petasition, Bidentetea, Agropyro-Rumicion, Molinietalia
141. Mentha pulegium L.; MT (32,!);, JT (2,!), UT, HT (!); H, Eua (M); Nanocyperion, Agrostion stoloniferae, Bidentetea, Puccinellietalia
142. Mentha verticillata L.; JT(!); var. hylodes Top.; JT (2); H, E; Phragmitetea, Molinietalia
143. Scutellaria galericulata L.; CT, BT (!), MT, UT (32,!); H, Cp (bor);Phragmitetea, Molinietalia, Magnocaricion
144. Scutellaria hastifolia L.; MT (32); H,Ec; Molinietalia, Calystegion
145. Stachys palustris L.; UT (32,!); H (G), Cp(bor); Phragmitetea, Alnetea, Agrostion stoloniferae, Filipendulo- Petasition

Solanaceae

146. Solanum dulcamara L.; BT (32), UT (11,32,!), HT (!); Ch (nPh), Eua (M); Phragmition, Alnetea, Calystegion, Senecion fluviatilis, Alno-Padion

Scrophulariaceae

147. Verbascum densiflorum Bertol.;UT (11); TH, E; Onopordion
148. Verbascum phlomoides L.;UT (11); TH, E; Onopordion, Aphanion
149. Gratiola officinalis L.; UT (32,!); H, Eua; Phragmitetea (-Nanocyperion), Molinion- Magnocaricion
150. Lindernia procumbens (Krocker) Philcox; UT (16, 21), HT (6,27); TH, Eua (M); Nanocyperion
151. Limosella aquatica L.; UT (16, 21), HT (6); Th, Cosm; Nanocyperetalia
152. Veronica anagallis-aquatica L.; JT (2), UT (11,32,!); H-Hh, Cp(bor); Phragmitetea, Glycerio-Sparganion, Bidentetea
153. Veronica anagalloides Guss.; HT (6); H-Hh, Eua; Phragmitetea, Bidentetea, Isoëto- Nanojuncetea
154. Veronica beccabunga L.; BT, MT,JT, UT(11,32,!),HT(6,25,!); H-Hh, Eua; Glycerio- Sparganion, Bidentetea, Populetalia
155. Veronica scutellata L.; BT, MT (32); H-Hh, Cp; Magnocaricion-Agrostion, Caricion canescenti-nigrae

Lentibulariaceae

156. Utricularia australis R. Br.; HT (6,27); Hh, Atl-M; Nymphaeion,Lemnion
157. Utricularia vulgaris L.; UT (5,32); Hh, Cp (bor); Lemnetea, Nymphaeion

Caprifoliaceae

158. Sambucus ebulus L.;UT (11); H, Eua; Arction

Valerianaceae

159. Valeriana officinalis L.; UT (!); H, Eua (M); Magnocaricion, Molinietalia, Alno-Padion, Filipendulo-Petasition
160. Valeriana simplicifolia (Reichb.) Kobath; CT (32); H, Ec; Scheuchzerio-Caricetea nigrae, Caricion davallianae, Eriophorion latifolii

Dipsacaceae

161. Succisa pratensis Moench.; JT (2), UT (32,!), HT (6,12); H, Eua; Molinio-Juncetea, Molinion

Asteraceae

162. Eupatorium cannabinum L.; CT (!), BT, MT, (32. !), JT, UT (!); H, Eua(M); Populetalia, Alnion glutinosae, Phragmitetea, Filipendulo-Petasition
163. Solidago canadensis L.; HT (!); H, Adv; Calystegion
164. Solidago gigantea Aiton; JT, UT, HT (!);H, Adv; Alno-Padion, Salicetea, Calystegion
165. Aster salignus Willd.; UT (32); H, Adv; Alno-Padion, Salicetea, Convolvuletalia
166. Filago minima Fries.;UT (11); Th, Eua; Thero-Airion
167. Gnaphalium uliginosum L.; CT, BT (!), UT (11,28,32); Th, Eua; Nanocyperion
168. Telekia speciosa (Schreber) Baumg.; CT (!), BT, MT JT (32,!), HT (6); H, Carp-B-Cauc; Filipendulo-Petasition, Alnion incanae
169. Rudbeckia laciniata L.; HT (25); H, Adv;Calystegion, Senecion fluviatilis
170. Xanthium strumarium L.;UT (11,!); Th, Eua; Sisymbrion, Onopordion
171. Bidens cernua L.; UT (11,32,!); Th, Eua; Bidention
172. Bidens tripartita L.; JT, UT (32,!); Th , Eua; Bidentetea, Nanocyperion
173. Leucanthemum serotinum L.; HT (6); H, P-Pn; Phragmition-Alnetea
174. Petasites albus (L.) Gaertn.; BT, MT (11,32,!), JT, UT (!); G(H); Eua; Alno-Padion
175. Petasites hybridus (L;) Gaertn.; CT (!); BT, MT JT (32,!), UT (!); G(H), Eua; Filipendulo- Petasition, Alno-Padion, Adenostyletalia
176. Senecio rivularis (W. et K.)DC.; MT (32); H, Ec; Filipendulo-Petasition, Calthion- Adenostylion
177. Echinops exaltatus Schrad.;UT (11,29); H, Alp-Carp-Balc; Alno-Padion
178. Carduus personata (L;) Jacq.; CT (!), BT, MT (32,!); H, Ec(mont); Filipendulo-Petasition, Adenostylion, Alno-Padion
179. Cirsium canum (L.) All.; UT, HT (!); G, Eua(C); Molinio-Juncetea, Magnocaricion, Alno- Padion
180. Cirsium oleraceum (L.) Scop.; CT(!), BT, MT, JT (32,!); H, Eua; Molinio-Juncetea, Filipendulo- Petasition., Calthion , Alno-Padion
181. Cirsium palustre (L.) Scop.; BT (32,!), JT (14); TH, Eua (M); Phragmitetea, Molinio- Juncetea (-Alnetea)
182. Cirsium rivulare (Jacq.) All.; MT, JT (32,!), UT (28); H, Ec; Molinio-Juncetea, Magnocaricion, Alno-Padion, Molinion, Calthion
183. Cirsium waldsteinii Rouy;BT (14); H, Alp-Carp-Balc; Adenostylion, Filipendulo-Petasition
184. Chondrilla juncea L.;UT (11); H, Eua; Festucion rupicolae
185. Serratula tinctoria L.; UT (32,!), HT (!); var. dissecta Wallr.; HT (!); H, Eua; Molinion
186. Crepis paludosa (L.) Moench.; BT (32,!); MT (32); H, E; Montio-Cardaminetea, Adenostyletea, Alnetea, Calthion

Alismataceae
187. Alisma lanceolatum With.; UT (29,!); Hh, Eua; Phragmitetalia
188. Alisma plantago-aquatica L.; CT (29), BT (!), MT, JT, UT (5,29,32,!) Hh, Cosm; Phragmitetea

Butomaceae
189. Sagittaria sagittifolia L.; UT(5,13,32), HT (!); Hh, Eua(M); Phragmition, Sagittario- Sparganietum; var. vallisneriifolia f. vallisneriifolia; HT (6)
190. Butomus umbellatus L.; UT (5), HT (!); Hh, Eua (M); Phragmitetea

Hydrocharitaceae
191. Hydrocharis morsus-ranae L.; UT (5,!), HT (6,!); Hh, Eua; Hydrocharition, Lemnion
192. Stratiotes aloides L.; UT (5), HT (6); Hh, Eua; Hydrocharition, Lemnion

Juncaginaceae
193. Triglochin palustris L.; CT (!), HT (6); H, Cp (bor); Molinio-Juncetea, Scheuchzerio- Caricetea nigrae

Potamogetonaceae
194. Potamogeton crispus L.; UT (5,32,!); Hh, Cosm; Potametalia
195. Potamogeton x angustifolius J. S. Presl. (gramineus x lucens); HT (6,27); Potamion
196. Potamogeton lucens L.; UT (5,32); Hh, Eua(M); Potamion
197. Potamogeton natans L.; CT (!), UT (5,32,!), HT (!); Hh, Cosm; Potamion,
198. Potamogeton nodosus Poir.; UT (5,!), HT (6,!); Hh, Cp(bor); Potametalia, Batrachion fluviatilis
199. Potamogeton pusillus L.; JT, UT (5,!); var. tenuissimus Mert. et Koch; JT(2,7); Hh, Cosm; Potamion

Liliaceae
200. Allium angulosum L.; HT (6); G, Eua(C); Molinio-Juncetea
201. Allium schoenoprasum L. ssp. sibiricum (L.) Hayek- Markgraf; CT, BT (32,!); G, Cp(bor); Scheuchzerio- Caricetea nigrae
202. Erythronium dens-canis L.;JT, UT (1); G, Eua; Quercion robori-petraeae, Prunion spinosae

Melanthiaceae
203. Colchicum autumnale L.;CT, UT (14,18,!); G, E; Agrostion stoloniferae

Amaryllidaceae
204. Leucojum aestivum L.; HT (6); G, Alt-M; Salicion albae, Agrostion stoloniferae, Calthion
205. Leucojum vernum L.;MT, JT, UT (1); G, Euc; Carpinion
206. Narcissus poëticus L. ssp. stellaris (Haw.) Dost.; UT (1,28,32,!); G, Ec; Molinietalia

Iridaceae
207. Crocus banaticus J. Gay;UT (1,18,19,!); G, Dac-Balc; Fagion, Carpinion
208. Crocus heuffelianus Herb.; CT, BT, MT, JT, UT (1,4,17,!); G, Carp-Balc; Potentillo- Nardion, Fagion, Triseto-Polygonion
209. Iris pseudacorus L.; JT (22), UT (5,28,32,!); G-Hh, E; Phragmitetea, Populetalia, Alnetea

210. Iris sibirica L.; UT (28,32); G, Eua (C); Molinion
211. Gladiolus imbricatus L.; UT (28,32), HT (6); G, Eua(C); Alno-Padion

Juncaceae

212. Juncus alpinus Vill.; CT, BT (32); H, Cp(bor); Scheuchzerio- Caricetea nigrae
213. Juncus articulatus L.; CT (!), BT; MT, JT (32,!); H, Cp (bor); Calthion, Nanocyperion, Agropyro- Rumicion
214. Juncus atratus Krocker; UT (32); H, Eua(C); Agrostion stoloniferae
215. Juncus bufonius L.; CT (!), BT, MT, JT (32,!), HT (!); H, E; Nanocyperetalia
216. Juncus castaneus Sm.; BT (32); G, Cp(arct-alp); Scheuchzerio- Caricetea nigrae
217. Juncus compressus Jacq.; UT (32); G, Eua; Agrostion stoloniferae, Nanocyperion, Agropyro-Rumicion
218. Juncus conglomeratus L.; JT (!), UT (32,!); H, Eua; Molinietalia, Caricion nigrae
219. Juncus effusus L.; CT (!), BT, MT, JT, UT (32,!), HT (!); H, Cosm; Molinietalia, Caricion nigrae
220. Juncus triglumis L .; CT (32); H, Cp(arct-alp); Scheuchzerio-Caricetea nigrae

Poaceae

221. Digitaria ischaemum (Schreb.) Muehl.;UT (11); Th, Cosm; Polygono-Chenopodion
222. Poa palustris L.; BT (32), UT (32,!), HT (6,25,!);H, Cp(bor); Magnocaricion, Calthion, Alnion, Phragmition
223. Beckmannia eruciformis (L.) Host; UT (5), HT (6); H, Cp; Beckmannion
224. Glyceria maxima (Hartm.) Holm.; JT (2,!), UT (11,5,32,!); Hh-H, Cp; Phragmition
225. Glyceria fluitans (L.) R. Br.; CT, BT, MT, UT (5,32,!); Hh-H, Cosm; Glycerio-Sparganion
226. Glyceria plicata (Fries) Fries; BT (32), MT (14), UT (5,32,!); Hh, Eua; Glycerio-Sparganion
227. Deschampsia caespitosa (L.) Beauv.; CT, BT, MT (32,!), JT (22,!), UT (28,!); H, Cosm; Molinio-Juncetea, Deschampsion caespitosae
228. Agrostis canina L.; CT (!), BT, MT (32); H, Eua; Molinio-Juncetea, Caricion canescenti- nigrae
229. Agrostis gigantea Roth; (A. stolonifera ssp. gigantea (Roth) Beldie); MT (32); H, Eua; Calthion, Phragmitetalia
230. Agrostis stolonifera L.; CT,BT (32,!), MT, JT, UT, HT (!); H, Cp(bor); Agrostion stoloniferae, Agropyro-Rumicion
231. Calamagrostis pseudophragmites (Haller fil.) Koeler; BT (32), MT, UT (32,!), HT (!); H, Eua(C); Salicion elaeagni
232. Alopecurus aequalis Sobol; UT (5,32) HT (6,!); H; Cp(bor); Nanocyperion, Bidentetalia
233. Alopecurus geniculatus L.; UT (32); H, E(bor); Agrostion stoloniferae, Agropyro- Rumicion
234. Phalaris arundinacea L.; JT, MT (!), UT (5,32,!), HT (6); Hh-H, Cp(bor); Caricion gracilis, Agrostion stoloniferae
235. Phragmites australis (Cav.) Trin. et Stendel; JT (!), UT (5,32,!), HT (!); Hh, Cosm; Phragmition
236. Cynodon dactylon (L.) Pers.; UT (11); G (H), Cosm; Polygonion avicularis
237. Molinia coerulea (L.) Moench.; JT (22), UT (32,!); H, Eua; Molinion
238. Leersia oryzoides (L.) Swartz; UT (11,32), HT (6,25); Hh, Cp(bor); Glycerio-Sparganion, Bidentetea
239. Vulpia myuros (L.) C. C. Gmel.;UT (11); Th, Eua; Thero-Airion

Araceae
240. Acorus calamus L.; HT (6); Hh(G), Adv; Phragmition

Lemnaceae
241. Lemna minor L.; JT, UT (5,!); Hh, Cosm; Lemnion
242. Spirodela polyrrhiza (L.) Schleich.; UT (5), HT(!); Hh, Cosm; Lemnion

Sparganiaceae
243. Sparganium emersum Rehm.; UT (5,32); Hh, Eua; Phragmition, Batrachion fluviatilis
244. Sparganium erectum L. ssp. neglectum (Beeby) Schinz et Thell.; CT (!), UT (5,32,!); Hh, Eua; Phragmition, Glycerio-Sparganion; ssp. microcarpum (Neum.) Rother;UT (5,11); Hh, Eua; Glycerio-Sparganion

Typhaceae
245. Typha angustifolia L.; CT (!), UT (5,32,!), HT (!); Hh, Cosm; Phragmition
246. Typha latifolia L.; CT (!), UT (5,32,!), HT (!);Hh, Cosm; Phragmition

Cyperaceae
247. Scirpus sylvaticus L.; CT (!), BT, MT, JT, UT (28,29,32,!); Hh-G, Cp (bor); Phragmitetea, Molinio-Juncetea, Calthion, Alno-Padion
248. Schoenoplectus lacustris (L.) Palla; UT (5,29), HT (!); Hh-G, Cosm; Phragmition
249. Schoenoplectus supinus (L.) Palla (Isolepis supina (L.) R. Br.); HT (6,25); Th(Hh), Cosm; Nanocyperion
250. Schoenoplectus tabernaemontani (Gmel.) Palla; JT (2); Hh-G, Eua; Phragmition
251. Bolboschoenus maritimus (L.) Palla; UT (11,5), HT (!); Hh, Cosm; Bolboschoenion maritimi
252. Eriophorum angustifolium Honckeny; BT, MT (32), UT (14); G, Cp(bor); Molinio- Juncetea, Scheuchzerio-Caricetea nigrae
253. Eriophorum latifolium Hoppe; BT (14), MT (32); H, Eua; Scheuchzerio-Caricetea nigrae
254. Eriophorum vaginatum L.; CT (!), BT (32,!); H, Cp(bor); Sphagnion fusci
255. Eleocharis acicularis (L.) Roem. et Schult.; UT (5,29), HT (6,25); Th, Cp(bor); Nanocyperion
256. Eleocharis ovata (Roth) Roem. et Schult.; UT (16,!), HT (6); Th, Cp(bor); Nanocyperion
257. Eleocharis palustris (L.) Roem. et Schult.; BT (32), MT, JT, UT (5,32,!), HT (!); G-Hh, Cosm; Phragmitetea, Nanocyperetalia, Molinio-Juncetea; ssp. mamillata (Lindb. f.) Beauv.; HT (6)
258. Dichostylis micheliana (L.) Nees; HT (6); Th, Eua(M); Nanocyperion
259. Carex acutiformis Ehrh.; UT (5,32); Hh, Eua(M); Magnocaricion, Caricion gracilis
260. Carex appropinquata Schumacher; UT (32); Hh, Eua; Magnocaricion, Molinio-Juncetea
261. Carex bohemica Schreber; HT (6,25); H, Eua; Nanocyperion
262. Carex buekii Wimmer; BT, UT (32);Hh, P-Pn; Magnocaricion, Caricion rostratae, Glycerio-Sparganion
263. Carex buxbaumii Wahlenb.; BT (32), UT (28,32); G, Cosm; Magnocaricion, Caricion rostratae, Molinietalia
264. Carex caespitosa L.; UT (32); Hh, Eua; Calthion
265. Carex canescens L.; CT (32,!), BT (32), UT (28); H, Cp(bor); Caricion canescenti-nigrae

266. Carex davalliana Sm.; BT (32,!); H, Ec; Caricion davallianae, Eriophorion latifolii
267. Carex dioica L.; BT (32); G, Cp(bor); Eriophorion latifolii, Tofieldetalia, Caricion davallianae
268. Carex echinata Murray (C. stellulata Good.); CT (!), BT, MT (32,!), JT (7); Cp(bor); Caricion canescenti-nigrae, Calthion, Magnocaricion
269. Carex elongata L.;UT (32, HT (6); H, Eua(bor); Alnetea, Alnion glutinosae
270. Carex flacca Schreber; JT, UT (32,!). var. claviformis (Hoppe) Boeck.; JT (2); G, Eua; Magnocaricion, Molinietalia
271. Carex flava L.; BT (32,!), UT (28,32,!); H, Cp(bor); Caricetalia davallianae, Tofieldetalia, Calthion
272. Carex gracilis Curt.; CT (!), MT (32,!), JT (22); Hh-G, Eua; Magnocaricion, Caricion gracilis,Calthion, Alno-Padion
273. Carex leporina L.; BT (32), MT, JT, UT (32,!); H, Eua(bor); Molinio-Juncetea,Caricion canescenti-nigrae
274. Carex limosa L.; BT (32); H, Cp(bor); Rhynchosporion
275. Carex melanostachya Bieb.; HT (6); Hh, Eua(C); Magnocaricion, Caricion gracilis, Agrostion stoloniferae
276. Carex nigra (L.) Reichard; CT (32,!), BT, MT(32), UT (28); G, Cp(bor); Caricetalia nigrae, Caricetalia davallianae, Calthion
277. Carex panicea L.; JT (22), UT (28, 32); H(G), Eua; Molinio-Arrhenatheretea, Magnocaricion, Caricetalia nigrae
278. Carex paniculata L.; BT (32), UT (5,28); Hh, Ec; Magnocaricion.
279. Carex pauciflora Lightf.; CT (32,!); H, Cp(bor); Sphagnion fusci, Oxycocco-Sphagnetea
280. Carex pseudocyperus L.; UT (5,16), HT (6); Hh, Cp(bor); Magnocaricion, Alnetea
281. Carex remota L.; BT, UT (32), HT (6,!); H, E; Alno-Padion
282. Carex riparia Curt.; UT (5,32,!); Hh, Eua(M); Magnocaricion, Caricion gracilis
283. Carex rostrata Stokes; CT (!); BT, (32,!), UT (5,28,32); Hh, Cp(bor); Magnocaricion, Caricion rostratae
284. Carex serotina Merat; CT, BT (32); H, Eua(M); Molinietalia, Scheuchzerio-Caricetea nigrae, Nanocyperion
285. Carex vesicaria L.; BT (32. !), UT(5,28); Hh, Cp(bor); Magnocaricion, Caricion gracilis
286. Carex vulpina L.; BT, UT (5,28,32,!), JT (22), HT (!); Hh-H, Eua(M); Magnocaricion, Caricion gracilis, Phragmition, Agropyro-Rumicion
287. Cyperus fuscus L.; UT, HT (!); Th, Eua(M); Cyperetalia
288. Pycreus flavescens (L.) Reichb.; UT (11), HT (!); Th, Cosm; Nanocyperion

Orchidaceae

289. Epipactis palustris (L.) Crantz; MT (32), JT (7); G, Eua; Caricetalia davallianae, Molinietalia

The hydrophilous, hygrophilous and hygromesophilous vegetation

Lemnetea W, Koch Et Tx. 1954
Lemnetalia W. Koch Et Tx. 1954
Lemnion minoris W. Koch et Tx. 1954
1. Lemnetum minoris (Oberd. 1957)Müller et Görs 1960; UT,HT (!)

2. Spirodeletum polyrrhizae W. Koch 1954; HT (!)

Hydrocharetalia Rübel 1933
Hydrocharition Rübel1933
3. Ceratophylleto-Hydrocaretum I. Pop 1962; HT (!)
Ceratophyllion Den Hartog et Segal 1964
4. Ceratophylletum demersi (Soó 1927) Hild. 1965; UT, HT (!)

Potametea Tx. Et Prsg. 1942
Potametalia W. Koch 1926
Ranunculion aquatilis Pass. 1964 (Batrachion fluitantis Neuh. 1959)
5. Callitrichetum cophocarpae-palustris Drg. 1989; UT (!)
6. Potametum nodosi Soó (1928) 1960; Segal 1964; UT (!)
Potamion W. Koch 1926 emend. Oberd. 1957
7. Myriophylletum spicati Soó 1927; UT, HT (!)
8. Potametum crispi Soó 1927; UT(!)
9. Potametum pusilli Soó 1927; UT (!)
Nymphaeion Oberd. 1957 emend. Neuhäusl 1926
10. Potametum natantis Soó 1927, Eggler 1933; CT, UT, HT(!)
11. Polygonetum natantis Soó 1927; UT(!)
12. Trapetum natantis Müller et Görs 1960; HT(!)

Phragmitetea Tx. Et Prag. 1942
Phragmitetalia W. Koch 1926 emend. Pign. 1953
Phragmition W. Koch 1926 emend. Soó 1947
13. Phragmitetum australis (All. 1922) Pign. 1953; UT, HT(!)
14. Typhetum angustifoliae (All. 1922)Pign. 1943; CT, JT, UT, HT(!)
15. Typhetum latifoliae Soó 1927; CT, BT, JT, UT, HT(!)
16. Schoenoplectetum lacustris Eggler 1933; UT, HT(!)
17. Glycerietum maximae Hueck 1931; JT, UT(!)
18. Iridetum pseudacori Eggler 1933; UT(!)
Bolboschoenion maritimi Soó (1945) 1947 emend. Borhidi 1970
19. Bolboschoenetum maritimi Soó (1927)1957; UT, HT(!)
20. Eleocharidetum palustris Schennikow 1919; Soó 1933; MT, JT(!)

Nasturtio-glycerietalia Pign. 1953
Glycerio-Sparganion Br. -Bl. et Sising ex Boer 1942
21. Sparganio-Glycerietum fluitantis Br. -Bl. 1925; CT, UT(!)
22. Glycerietum plicatae Oberd. (1952) 1957; UT(!)
Eleocharido-Sagittarion Pass. 1964
23. Sagittario-Sparganietum Tx. 1955; HT(!)
Phalarido-Glycerion Pass. 1964
24. Equisetetum fluviatilis Soó (1927) 1947; HT(!)

Magnocaricetalia Pign. 1953
Magnocaricion W. Koch 1926
25. Caricetum rostratae Rübel 1912; CT(!)
26. Phalaridetum arundinaceae Libb. 1931; JT, UT(!)
27. Caricetum gracilis Almquist 1929; Tx. 1937; CT, MT(!)
28. Caricetum acutiformis-ripariae Soó (1927) 1930; UT(!)
29. Caricetum vesicariae Br. -Bl. et Denis 1926; Zólyomi 1931; BT(28,!)
30. Caricetum vulpinae Soó 1927; UT (!)

Isoëto-nanojuncetea Br. -Bl. et Tx. 1943
Nanocyperetalia Klika 1935
Nanocyperion W. Koch 1926
31. Cyperetum flavescenti-fusci W. Koch 1926 em. Philippi 1968; UT(!)
32. Juncetum bufonii Morariu 1956; Philippi 1968; CT, BT, MT(!)
-juncosum articulati fac. nov.; CT(!)
Verbenion supinae Slavnic 1951
33. Pulicario-Menthetum pulegii Slavnic 1951; UT,HT(!)

Montio-cardaminetea Br. -Bl. et tx. 1943
Montio-cardaminetalia Pawl. 1928
Cardamino-Montion Br. -Bl. 1925
34. Philonotido-Saxifragetum stellaris Horv. 1949; CT(!), BT(28,!)
35. Cardaminetum opizii Szafer, Pawl. et Kulcz. 1923; CT(!), BT(28,!)
-philonotidosum; BT(28)
36. Cardaminetum amarae (Rübel 1912) Br. -Bl. 1926 s. str.; CT, MT(!)
37. Calthaetum laetae Krajina 1933; CT, BT, MT(!)
Cratoneurion commutati W. Koch 1928
38. Doronico carpatici- Saxifragetum aizoidis Coldea 1990; BT (28,!)
- cratoneurosum commutati; BT (28)
39. Cratoneuretum filicino-commutati (Kuhn 1937) Oberd. 1977; BT(!)

Scheuchzerio-caricetea Nigrae Nordh. 1936
Scheuchzerio-caricetalia Nigrae (W. Koch 1926) Görs et Müller ex Oberd. 1967
Caricion canescenti-nigrae (W. Koch 1926) Nordh. 1936
40. Carici stellulatae - Sphagnetum Soó (1934) 1954; CT, BT(!)
-nardetosum strictae Lup;a 1971; BT (!)
41. Carici rostratae-Sphagnetum Zólyomi 1931; BT(28,!)
42. Caricetum nigrae Br. -Bl. 1915; CT(!)

Tofieldetalia Prsg. apud Oberd. 1949
Eriophorion latifolii Br. -Bl. et Tx. 1943
43 Carici flavae-Eriophoretum Soó 1944; BT(!)

Oxycocco-sphagnetea Br. -Bl. et Tx. 1943
Sphagnetalia Pawl. 1928
Sphagnion fusci Br. -Bl. 1920
44. Sphagnetum acutifolii Pusçaru et all. 1956; BT (28,!)
45. Eriophoro vaginato-Sphagnetum recurvi-magellanici (Weber 1902) Soó (1927) 1954; CT (!), BT (28,!)
-oxycocco-empetrosum; CT (!), BT (28)
-andromedosum fac. nov.; CT(!)

Molinio-arrhenatheretea Tx. 1937
46. Caricetum davallianae W. Koch 1928; BT (!)

Molinietalia W. Koch1926
Agrostion stoloniferae Soó (1933)1971
47. Agrostidetum stoloniferae (Ujvárosi 1947) Burduja et all. 1956; CT,BT, MT, JT, UT, HT (!)
48. Agrostio-Deschampsietum caespitosae Ujvárosi 1947; UT (!)
49 Deschampsio-Alopecuretum pratensis Soó 1947; HT (!)
50. Lythro salicariae-Juncetum effusi-inflexi Todor et all. 1971; CT, BT, UT, HT(!)

Molinion coeruleae W. Koch 1926
51. Junco-Molinietum Prsg. 1951; UT (!)
-spiraeosum salicifoliae fac. nov.; UT(!)
-ranunculetosum acris (Resm. 1974) comb. nov.; JT (11)
Calthion palustris Tx. 1937
52. Scirpetum sylvatici Schwick. 1944; CT, MT(!), BT(28,!)
-juncosum effusi Serb. 1939, Reclaru et Barbu 1959; BT(28)
53. Epilobio palustri-Juncetum effusi Oberd. 1957; CT(!)
54. Cirsietum cani Tx. 1951; UT, HT(!)
Filipendulo-Petasition Br. -Bl. 1947
55. Petasitetum hybridi (Dost. 1933) Soó 1940; CT, BT, MT, JT, UT(!)
56. Filipenduletum ulmariae W. Koch 1926; CT, BT, MT, JT(!)
57. Angelico-Cirsietum oleracei Tx. 1937 s. l.; Soó 1969; CT(!)

Bidentetea Tripartiti Tx., Lohm. et Prsg. 1950
Bidentetalia Tripartiti Br. -Bl. et Tx. 1943
Bidention tripartiti Nordh. 1940
58. Bidentetum tripartiti (W. Koch 1926) Libbert 1932; UT, HT (!)
-polygonetosum hydropiperi Tx. 1937; CT, MT, UT(!)
-polygonetosum lapathifolii Felföldy 1943; CT(!)
Chenopodion fluviatile Tx. 1960
59. Echinochloo-Polygonetum lapathifolii (Ujvárosi 1940) Soó et Csürös (1944) 1947; UT, HT(!)

Plantaginetea Majoris Tx. et Prsg. 1950
Plantaginetalia Majoris Tx. (1947) 1950
Agropyro-Rumicion Nordh. 1940
60. Ranunculetum repentis Knapp 1946 emend. Oberd. 1957; JT, UT(!)
61. Juncetum effusi Soó (1931) 1949; CT, JT, UT, HT(!)
62. Junco-Menthetum longifoliae Lohm. 1953; CT, BT, UT(!)

Epilobietea Angustifolii Tx. et Prsg. 1950
Petasiteto-chaerophylletalia Morariu 1967
Telekion Morariu 1967 n. n.
63. Telekio speciosae-Petasitetum albae Beldie 1967; CT, BT MT(!)

Salicetea Purpureae Moor 1958
Salicetalia Purpureae Moor 1958
Salicion albae (Soó 1930 n. n.) Müller et Görs 1958
64. Salici-Populetum (Tx. 1931) Mejer Drees 1936; UT, HT(!)
Salicion triandrae Müller et. Görs 1958
65. Salicetum triandrae Malcuit 1929; BT, MT, JT, UT(!)
-salicetosum viminalis Soó 1958; MT, JT, UT(!)
-rubosum Pázmany 1966; UT(!)
66. Salicetum purpureae (Soó 1934 n. n.) Wendelbg. -Zelinka; CT, BT, MT, JT(!)

Alnetea Glutinosae Br. -Bl. et Tx. 1943 em. Müller et Görs 1958
Alnetalia Glutinosae Tx. 1937, Vlieger 1937 em. Müller et Görs 1958
Alnion glutinosae (Malcuit 1929) Mejer Drees 1936
67. Alnetum glutinosae Mejer-Drees 1936; UT(!)

Salicetalia Auritae Doing 1962 em. Westh. 1969
Salicion cinereae Müller et Görs 1958

68. Frangulo-Salicetum cinereae Malcuit 1929; CT(!)
69. Rubo-Salicetum cinereae Somsak 1963; UT, HT(!)

Querco-fagetea Br. -Bl. et Vlieger 1937 em . Soó 1964
Fagetalia Silvaticae (Pawl. 1928) Tx. et Diem. 1936
Alno-Padion Knapp 1942 em. Medwecka-Kornas 1957
70. Alnetum incanae (Brockman 1907) Aichinger et Siegrist 1930; CT, BT, MT(!)
-matteucetosum Soó 1962; Lungu 1971; CT, BT(!)
-piceetosum Lungu 1971; CT, BT(!)
-salicosum Lungu 1971; CT, BT, MT(!)
-petasitosum; CT, BT(!)

Part 2.

The flora and vegetation of the Hungarian section of the River Tisa valley, from Tiszabecs to Tokaj

This part contains, in separation, the vascular flora & vegetation the Hungarian section of the River Tisa valley from Tiszabecs (Ukrainian - Hungarian Border) to the Tokaj region.

The reasons for the separation are:

1. – Drăgulescu, C. and A. Mihály used a different taxonomy-system from what we use. We followed the Soó system with their species-numbering. Moreover, separating these two parts from each other seems to be reasonable for another reason: the Upper Tisa section has more natural flora & vegetation while the Hungarian section has a richer one with weeds and introduced species in abundance.

2. - For this reason we made a classification of the flora of this section following Simon (1988, 1991, 1992). The table shows the Nature Conservation ranks of the vascular flora of the Hungarian section of the River Tisa valley from Tiszabecs to Tokaj.

Nature conservation ranks of the vascular flora of the Hungarian section of the River Tisa Valley from Tiszabecs to Tokaj

I. Species indicating the naturalness of habitats

		N of species	%
V.	Species protected in Hungary by Law	45	5,92
E.	Natural species predominating in plant communities	39	5,13
K.	Main components in communities	296	38,95
TP.	Natural pioneer elements	34	4,47
Total:		414	54,47

II. Species indicating the level of degradation of habitats

		N of species	%
TZ.	Native species that tolerate disturbance	123	16,18
A.	Introduced species	17	2,24
G.	Cultivated plants	10	1,32
GY.	Cosmopolitan weeds	196	25,79
Total:		346	45,53
Total:		760	100,00

The hydropholius, hygrophilous and hygromesophilous flora

PTERIDOPHYTA
Equisetaceae

(P. 8.) Equisetum arvense L. 1753, HT(6), G., Cp., Secalietea, Nanocyperion, Salicion. GY.
(P.10.) Equisetum fluviatile L. 1753, em. Ehr. 1787, HT(6), HH., Cp., Phragmitetea - Magnocaricion. K.
(P.11.) Equisetum palustre L. 1753, HT(6), G., Cp., Magnocaricion, Cypero-Juncetum, Salicetum albae-fragilis, Fraxino pannonicae-Ulmetum pannonicum, Molinio-Juncetea. K.
(P.13.) Equisetum moorei 1854, HT(in print 6/A), G., Cp. x Submed. -Cont., Fraxino pannonicae - Ulmetum pannonicum. K.
(P.14.) Equisetum ramosissimum Desf. 1800, HT(6), Submed-Cont., G., Salicetum triandrae, Salicetum albae-fragilis, Setario-Digitarietum, Robinietum. K.

Ophioglossaceae
(P.20.) Ophioglossum vulgatum L. 1753, HT(6), G., Cp., Fraxino pannonicae - Ulmetum pannonicum. V.

Pteridiaceae
(P.22.) Pteridium aquilinum (L. 1753 sub Pteride) Kuhn 1879, G., HT(6), Cp., Querco-robori - Carpinetum hungaricum. K.

Polypodiaceae
(P. 25.) Polypodium vulgare L. 1753, HT(6), Cp., G., Fagetalia. E.

Thelypteridaceae
(P. 37.) Thelypteris palustris (= Lastrea thelypteris Bory 1826), HT(6), G. -HH., Cp. - Cosm., Fraxino pannonicae - Ulmetum pannonicum, - Magnocaricion. K.
(P.38.) Gymnocarpium dryopteris (L. sub. Polypodio 1753) Neowman 1851, HT(6), G., Cp., Fraxino pannonicae - Ulmetum pannonicum. K.
(P.41.) Athyrium filix-femina (L. sub. Polypodio 1753) Roth 1800, HT(6), H., Cp. - Cosm., Fraxino pannonicae - Ulmetum pannonicum. K.
(P. 50.) Dryopteris filix-mas (L. 1753 sub Polypodio) Schott 1834, HT(6), H., Cp., Fraxino pannonicae - Ulmetum pannonicum, Querco-Fagetea. K.
(P. 52.) Dryopteris carthusiana (Vill. 1786, pro Polypodio), P. Fuchs 1959, HT(6), Cp., H., Fraxino pannonicae - Ulmetum pannonicum, Querco-Fagetea. V.
(. . .) Dryopteris tavelii Rothm. 1945, (Tarpa), HT(6), H., Atl. -medit, Fagion. V.

Marsileaceae
(P. 56.) Marsilea quadrifolia L. 1753, (sic !), HT(6), HH., Eua. (Cont.), Schoenoplectetum supini - Eleocharetosum acicularis, Myriophyllo - Potametum, Nanocyperion. V.

Salviniaceae
(P. 57.) Salvinia natans (L. sub. Marsilea 1753) All. 1785, HT(6), HH., Cont. and submedit. (Eua), Salvinio-Spirodeletum, Lemno-Utricularietum, Nymphaeion, Hydrocharition. V.

Azollaceae
(P. 58.) Azolla caroliniana Willd. 1810, HT(6), adv., HH., Cont. and submedit. (Eua), Salvinio-Spirodeletum, Lemno-Utricularietum, Nymphaeion, Hydrocharition. A.

DICOTYLEDONOPSIDA
Helleboraceae

(3) Caltha palustris L. 1753, s. l. - ssp. cornuta (Sch., Nym. et Ky. 1854 p. sp.) Hegi 1912, Borb. 1879 p. var. HT(6), Cp, H., Salicetum albae-fragilis, Fraxino pannonicae -Ulmetum pannonicum, Salicetea-Calthion. K.

(9) Nigella arvensis L. 1753, HT(6), Ponto-medit., Th., Consolido orientali - Stachyetum annuae, Vicio - Eragrostetum poaeoidis, Secalietea. GY.

(11) Actaea spicata L. 1753, (A. sp. nigra L. 1753), HT(6), H., Eua., Querco robori - Carpinetum hungaricum, Fagetalia. K.

(14) Consolida regalis S. F. Gray 1821, ssp. regalis (= arvensis Soó, 1922) et ssp. paniculata (Host) Soó 1922, HT(6), Medit., Th., Ponto-medit. (= ssp. pann.), Consolido orientali - Stachyetum annuae, Vicio - Eragrostetum poaeoidis, Secalietea. GY.

(15) Consolida orientalis (J. Gray in Desmoulins 1840 sub Delphinio) Schrödinger 1909, HT(6), medit., Th., Consolido orientali - Stachyetum annuae, Vicio - Eragrostetum poaeoidis, Secalietea. GY.

(27) Anemone nemorosa L. 1753, HT(6), Eu., G., Fraxino pannonicae - Ulmetum pannonicum, Fagetalia. K.

(28) Anemone ranunculoides L. 1753, HT(6), Eu., G., Fraxino pannonicae - Ulmetum pannonicum. K.

(31) Clematis vitalba L. 1753, HT(6), N. -E., M-Eu-submedit., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, etc., -Prunetalia. K.

(32) Clematis integrifolia L. 1753, HT(6), H., Eua. -(Cont.), Alopecuretum pratensis, Molinio - Arrhenatheretea. V.

(34) Myosurus minimus L. 1753, HT(6), Th., Cp., Pulicaria vulgaris - Mentha pulegium ass., Nanocyperion. TP.

(36) Batrachium aquatile (L. 1753 sub Ranunculo) Dum. 1827, HT(6), HH., Eua. (-medit.), Eu., Subatl. -submed., Potamion, vel Nymphaeion. K.

(39) Ranunculus peltatus (Koch in Sturm 1840 sub Ranunculo) F. Schultz 1844, sec. Cook B. peltatum (Schrk. 1789 sub Ranunculo) Bercht. et Presl 1823, HT(6), HH., M-Eu., Nanocyperion. K.

(40) Batrachium trichophyllum (Chaix in Vill. 1786, nom. nud. sub Ranunculo, em. Freyn 1888) V. D. Bosch 1850, HT(6), HH., Cp, Batrachio-Callitrichetum, Lemno-Utricularietum, Salvinio - Spirodeletum, Eleochari (aciculari) - Shoenoplectetum supini, Scirpo-Phragmitetum, Salicetum albae-fragilis, Potametalia. K.

(41) Batrachium circinatum (SiCTh. 1792 sub Ranunculo) Spach 1838, HT(6), HH., Eua., Myriophyllo - Potametum, Scirpo-Phragmitetum, Potamion. K.

(43) Ranunculus ficaria L. 1753, HT(6), Eu., H. -G., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis. K.

(44) Ranunculus polyphyllus W. et K. 1800, in Willd. 1799, HT(6), HH. -H., Eua. (-cont.), Batrachio aquatili - Ranunculetum polyphylli, - Beckmannion. K.

(45) Ranunculus flammula L. 1753, HT(6), H., Cp., - ssp. flammula mostly Eu., Nanocyperion, Magnocaricion-Agrostion. V.

(46) Ranunculus lingua L. 1753, HT(6), HH., Eua., Scirpo - Phragmitetum, Phragmition. V.

(47) Ranunculus sceleratus L. 1753, HT(6), Th., Cp., Bidentetum, Chenopodion fluviatile, Scirpo - Phragmitetum, Eleochari (aciculari) - Schoenoplectetum supini, Salicetum triandrae, Myriophyllo - Potametum etc. - Bidention. Gy.

(48) Ranunculus repens L. 1753, HT(6), H., Eua. (-medit.), Scirpo - Phragmitetum, Fraxino pannonicae - Ulmetum pannonicum, Nanocyperion etc., Phragmitetea, Salicetea, Bidentetalia, Calystegion etc. TZ.

(49) Ranunculus bulbosus L. 1753, HT(6), H. -G., Eu., Fraxino pannonicae - Ulmetum pannonicum. GY.

(50) Ranunculus sardous Cr. 1763, HT(6), Th. (TH.,H.), D-Eua., Bidentetea, (Echinochloo - Polygonetum lapathifolii), Eleochari (aciculari) - Schoenoplectetum supini, Pulicaria vulgaris - Mentha pulegium ass., Nanocyperion, Secalietea. GY.
(51) Ranunculus polyanthemos L. 1753, HT(6), H., Eua., Quercetea. TZ.
(53) Ranunculus acris (acer) L. 1753, HT(6), H., Eua. (-medit.), Fraxino pannonicae - Ulmetum pannonicum, Bidentetea, Echinochloo - Polygonetum lapathifolii, Alopecuretum pratensis. TZ.
(55) Ranunculus auricomus L. 1753, emend. Korsh., HT(6), H., Eua., Fraxino pannonicae - Ulmetum pannonicum, Alopecuretum pratensis, - Querco-Fagetea. K.
R. a. - ssp. transtibiscensis Soó 1964
- ssp. pannonicus Soó 1964.
- ssp. binatus Kit. ex Rchb. 1832 (R. vertumnalis D. Schwarz 1919)
- ssp. kitaibelii Soó 1964.
- ssp. pseudobinatus Schur 1866.
- ssp. acriformis Soó 1964.
- ssp. beregensis Soó 1964.
- ssp. auricomiformis Soó 1964.
- ssp. gayeri 1964.
- ssp. hungaricus Soó 1964.
- ssp. schurianus Soó 1964.
(56) Ranunculus arvensis L. 1753, HT(6), Th., Eua., (S-Eua. - medit), Salicetum triandrae, Secalietea. Gy.
(57) Ranunculus lateriflorus DC 1818, HT(6), Th., Eua., seu ponto-medit., Beckmannion et Nanocyperion. K.
(61) Thalictrum aquilegiifolium L. 1753, HT(6), H., Eu., Quercetalia. K.
(64) Thalictrum simplex L. 1753, HT(6), H., Eua., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis, Molinietalia. K.
(65) Thalictrum flavum L. 1753, HT(6), H., Eua., Alopecuretum pratensis, Salicetum albae-fragilis, Molinietalia. K.
(66) Thalictrum lucidum L. 1753, HT(6), H., M-Eu. (-Cont.), Alopecuretum pratensis, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, Molinietalia, Salicetea, Alnetea. K.
(69) Adonis flammea Jacq. 1776, HT(6), Th., Ponto-medit., Secalietea. GY.
(70) Adonis aestivalis L. 1762, HT(6), Th., Eu. (-medit.), Secalietea. GY.

Nymphaeaceae
(71) Nymphaea alba L. 1753, HT(6), HH., Eua. (-medit.), Nymphaeion. V.
(72) Nuphar luteum (lutea) (L. 1753 sub Nymphaea) Sm. in SiCTh. et Sm. 1808, HT(6), HH., Eua. (-medit.), Nymphaeion. K.
(73) Ceratophyllum submersum L. 1753, HT(6), HH., Eua. (-medit.), Hydrocharition, Potametalia-Potamion. K.
(74) Ceratophyllum demersum L. 1753, HT(6), HH., Cp. (-cosm. ?), Potametea, Potametalia-Potamion. K.

Aristolochiaceae
(75) Asarum europaeum L. 1753, HT(6), H. (G.), Eua., Fraxino pannonicae - Ulmetum pannonicum, Fagetalia. K.
(76) Aristolochia clematitis L. 1753, HT(6), H. (G.), Eua., Fraxino pannonicae - Ulmetum pannonicum, Calystegion. GY.

Rosaceae
(83) Pyrus achras Gärtn. 1791, HT(6), M., Eu. (-medit.), Fraxino pannonicae - Ulmetum pannonicum, Quercetea. K.

(86) Malus sylvestris (L. 1753) Mill. 1768, HT(6), MM. -M., Eu. (-submedit.), Fraxino pannonicae - Ulmetum pannonicum, Quercetea. K.
(88) Sorbus aucuparia L. 1753, HT(6), M. -MM., Eurosib., Fraxino pannonicae - Ulmetum pannonicum, Querco-Fagetea. K.
(92) Sorbus torminalis (L. 1753 sub Crataego) Cr. 1763, HT(6), MM., M-Eu. - submedit - Asia, Fraxino pannonicae - Ulmetum pannonicum, Quercetea et Querco-Fagetea, Quercetalia. K.
(94) Crataegus oxyacantha L. 1753, HT(6), M., M-Eu., Fraxino pannonicae - Ulmetum pannonicum, Quercetea, Querco-Fagetea chf. K.
(95) Crataegus monogyna Jacq. 1775, agg. HT(6), M., Eu., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis, Quercetea et Querco-Fagetea, Prunion sp., Prunetalia chf. K.
(98) Rubus idaeus L. 1752, HT(6), N., Eua. (Eurosib.), Fagetalia, Epilobietalia chf. TZ.
(99) Rubus caesius L. 1753, HT(6), H. (N.)., Eua. (-medit.), Fraxino pannonicae - Ulmetum pannonicum, Fagetalia, Salicetea. TZ.
(170) Rubus hirtus W. et K. 1805. - ssp. hirtus (R. euhirtus Focke 1877), HT(6), H. (N.)., M-Eu., (Fraxino pannonicae - Ulmetum). K.
(171) Fragaria vesca L. 1753, HT(6), H., Cp., Arrhenatheretea, Alopecuretum pratensis, Epilobietea, Querco-Fagetea, Quercetea, Fragarion vescae chf. K.
(173) Fragaria viridis Duch. 1766, HT(6), H., Eua. (-medit.) +cont., Arrhenatheretea, Festucetum pratensis,(-Quercetalia). K.
(178) Potentilla supina L. 1753, HT(6), Th. -H., Eua. (-medit.), (Cypero-Juncetum, Eleochari /aciculari/ - Schoenoplectetum supini, Pulicaria vulgaris - Mentha pulegium ass. etc) Bidentetea, Echinochloo - Polygonetum, Nanocyperion et Bidention, Cyperetalia chf. GY.
(179) Potentilla anserina L. 1753, HT(6), H., Eua., Plantaginetalia, Bidentetalia, Nanocyperetalia etc. GY.
(180) Potentilla erecta (L. 1753) sub Tormentille) Räuschel 1797, HT(6), H., Eua., Alopecuretum pratensis, etc. K.
(181) Potentilla reptans L. 1753, HT(6), H., medit., Fraxino pannonicae - Ulmetum pannonicum, Molinio - Arrhenatheretea, Plantaginetea, Bidentetalia. TZ.
(182) Potentilla argentea L. 1753, - ssp. tenuiloba (Jord. 1852, 1852 p. sp.) Jáv., 1924 (A. F. Schwarz 1899 p. var.), HT(6), H., Eua. (-medit.), Alopecuretum pratensis. TZ.
(196) Geum urbanum L. 1753, HT(6), H., Eua. (-medit.), Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Cuscuto - Calystagietum, - Querco-Fagetea chf. K.
(198) Filipendula ulmaria (L. sub. Spiraea 1753) Maxim. 1879, HT(6), H., Eurosib., Fraxino pannonicae - Ulmetum pannonicum, Molinietalia chf. K.
(199) Filipendula vulgaris Mönch 1794, HT(6), H., Eua. (-medit.), Alopecuretum pratensis, (-Quercetea) chf. K.
(200) Agrimonia eupatoria L. 1753, HT(6), H., Eu., Fraxino pannonicae - Ulmetum pannonicum, Quercetea. TZ.
(203) Sanguisorba officinalis L. 1753, HT(6), H., Eua. (-medit.), Festucetum pratense, Arrhenatheretea, Molinietalia chf. K.
(205) Aphanes arvensis L. 1753, HT(6), Th., Submedit., Aphanion. GY.
(229) Rosa canina L. 1753, HT(6), M., Eu. (-medit.), S. latiss. : Fraxino pannonicae - Ulmetum pannonicum, Prunetalia, Alopecuretum pratense. TZ.
(230) Rosa corymbifera Borkh. 1790 (= R. dumetorum Thuill. 1798) HT(6), M., Eua. (-medit.), Fraxino pannonicae - Ulmetum pannonicum, Alopecuretum pratense, Prunetalia, TZ.

(231) Rosa afzeliana = dumalis Bechst. 1810, HT(6), M., Eu., Fraxino pannonicae – Ulmetum pannonicum, Querco-Fagetea. TZ.
(232) Rosa caesia Sm. ex Sow. 1812 (= R. coriifolia Fr. 1814), HT(6), M., Eu., Fraxino pannonicae - Ulmetum pannonicum, Prunetalia, Quercetea. TZ.
(233) Padus avium Mill. 1768, HT(6), MM., Eua., Fraxino pannonicae - Ulmetum pannonicum. K.
(237) Cerasus avium (L. 1733) Mönch 1794, - ssp. avium, HT(6), M. -MM., M-Eu., submedit., Fraxino pannonicae-Umetum pannonicum. K.
(. . .) Prunus domestica L. 1753, agg. - ssp. institítia (Jusl. 1755. p. sp.), HT(6), M., Fraxino pannonicae - Ulmetum pannonicum. -
(239) Prunus spinosa L. 1753, HT(6), M., Eu. -medit. Prunetum. TZ.
(246) Sedum acre L. 1753, HT(6), Eu. (-medit.), Ch., Festuco-Brometea, Festuco-Sedetalia chf. K.
(248) Sedum sexangulare L. 1753, HT(6), Middle-SE-Eu. (-medit.), Ch., Cuscuto - Calystegietum, Setario - Digitarietum, Festuco-Sedetalia chf. K.

Saxifragaceae
(254) Saxifraga bulbifera L. 1753, HT(6), Middle-medit. -SE-Eu., H., Arrhenatheretea (Quercetalia). K.
(258) Chrysosplenium alternifolium L. 1753, HT(6), Eua., H., Fraxino-pannonicae – Ulmetum pannonicum, Fagetalia. K.

Fabaceae
(268) Genista tinctoria L. 1753, HT(6), Eu., Ch-N., Molinio-Arrhenatheretea, Molinion chf. K.
(268/a) Genista elata (Moench) Wenderoth 1840 rectius quam Eu., Ch. -N., G. tinctoria subsp. elatior (Koch) Simk. HT(6), Quercetea, Molinion chf. K.
(283) Ononis spinosa L. 1753, HT(6), Eu. (-medit.), H. (Ch.), Festuco-Brometea. GY.
(284) Ononis arvensis L. 1759, HT(6), Eua. (cont.), H. (Ch.), Arrhenatheretea, Cynodonti - Poëtum angustifoliae, Molinio-Arrhenatheretea, Cirsio-Brachypodion chf. TZ.
(285) Ononis spinosiformis Simk. 1877, (- ssp. semihircina /Simk. 1879/ Soó 1970), HT(6), Balc. -Cauc., H. (Ch.), Alopecuretum pratensis, Molinio-Arrhenatheretea. TZ.
(289) Medicago lupulina L. 1753, HT(6), Eua. (-medit.), Th. -TH. -H., Molinio-Arrhenatheretea, Secalietea, Chenopodietea, Plantaginetea, Festuco-Brometea etc. GY.<F"Symbol">®<F255>
(294) Medicago minima (L.) Grufbg. 1754, HT(6), Eua. (-submedit.), Th., Festuco-Brometea, Sedo-Scleranthetea chf. TP.
(300) Melilotus officinalis (L.) Lam. 1778, Desr. ap. Lam. 1796, Medic. 1787 nom. nud., HT(6), Eua. (medit.), TH. (Th.,H.), Meliloto-Echietum, Chenopodietea-Secalietea, Artemisietea chf. TZ.
(301) Melilotus albus Desr. in Lam. 1796, Medik. 1787 nom. nud. HT(6), Eua., TH. (Th.,H.), Chenopodietea, Artemisietea chf. GY.
(303) Trifolium aureum Poll. 1777, HT(6), Eua. (-medit.), Th. -TH., Festuco-Brometea (Quercetea), Festuco-Sedetalia chf. K.
(305) Trifolium dubium SiCTh. 1794, HT(6), Eu. (-medit.), Th. -TH., Arrhenatheretea, Arrhenatherion chf. K.
(307) Trifolium montanum L. 1753, HT(6), Eua. (-medit.), ill. Eu-W-sib. (= Cont.), H., Quercetalia, Festuco-Brometea, Brometalia. TZ.
(308) Trifolium hybridum L. 1753, HT(6), (Medit.) Eu., H., Molinietalia, Calthion chf. K.

(309) Trifolium repens L. 1753, HT(6), Eua. Cosm., H., Molinio-Arrhenatheretea, Beckmannion, Secalietea, Plantaginetea etc. Cynosurion chf. TZ.
(313) Trifolium fragiferum L. 1753, HT(6), Eua., ~ Ponto-medit., H., Alopecuretum pratensis, Pulicaria vulgaris - Mentha pulegium ass., Cypero - Juncetum, Eleochari - Schoenoplectetum, etc. Agrostion-Beckmannion (Plantaginetea). TZ.
(325) Trifolium pratense L. 1753, HT(6), Eua. (-medit.), TH-H., Molinio-Arrhenatheretea (chf.), Secalietea et Plantaginetea. TZ.
(327) Trifolium arvense L. 1753, HT(6), Eua. (-medit.), Th., Corynephoretea, Secalietea, Arrhenatheretea etc., Sedo-Scleranthetea chf. GY.
(333) Lotus angustissimus L. 1753, HT(6), Ponto-medit., Th., Peucedano - Asteretum. K.
(335) Lotus corniculatus L. 1753, HT(6), S-Eua. (medit. - E-Afr.), H., Molinio-Arrhenatheretea, Secalietea, Plantaginetea. TZ.
(337) Amorpha fruticosa L. 1753, HT(6), Adv., M., Echinochloo - Polygonetum lapatihifolii, Bidention, Salicetum albae-fragilis, Salicetum triandrae, (Glycyrrhizetum echinatae). G.
(338) Galega officinalis L. 1753, HT(6), SE-E-Asia, Ponto-medit., H., Alopecuretum-pratensis, Salicetum albae-fragilis, Salicetum triandrae. TZ.
(339) Robinia pseudo-acacia L. 1753, HT(6), Adv. MM. Robinietum. GY.
(341) Astragalus contortuplicatus L. 1753, HT(6), Eua. -Cont., Th., Echinochloo - Polygonetum lapathifolii - Heleochloëtosum alopecuroidis, Chenopodion fluviatile. V.
(343) Astragalus glycyphyllos L. 1753, HT(6), Eurosib. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum, Alopecuretum pratensis, Quercetea. K.
(353) Glycyrrhiza echinata L. 1753, HT(6), Ponto-medit., H., Glycyrrhizetum echinatae, Salicetum albae-fragilis, Salicetum triandrae, Alopecuretum pratensis, Bidention, Echinochloo - Polygonetum, Xanthietum etc. - Calystegion. TZ.
(356) Coronilla varia L. 1753, HT(6), M-Eu. (-medit.), H., Arrhenatheretea, Festucetum pratensis hungaricum. K.
(361) Onobrychis viciifolia Scop. 1772, HT(6), Submed. -Medit., H., Arrhenatheretea. A.
(362) Onobrychis arenaria Kit. in Willd. (1813 sub. Hedysaro), Ser. in. DC. 1825, HT(6), Cont., H., Chenopodion fluviatile (rubri). K.
(364) Vicia tetrasperma (L. 1753 sub. Ervo) Schreb. 1771, Mönch 1794, HT(6), Eua. (-medit.), Th., Consolido orientali - Stachyetum annuae, Fraxino pannonicae - Ulmetum pannonicum - Secalietea. TZ.
(366) Vicia dumetorum L. 1753, HT(6), M-Eu. (-medit.), H., Querco-Fagetea. K.
(371) Vicia villosa Roth 1879, HT(6), S-Eua. (-medit.), Th. -TH. (H.), - Secalietea. GY.
(372) Vicia cracca L. 1753, HT(6), Cp., H., Alopecuretum pratensis, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, - Molinio - Arrhenatheretea. TZ.
(375) Vicia sepium L. 1753, HT(6), Eua. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum, Arrhenatheretea - Quercetea. K.
(376) Vicia lathyroides L. 1753, HT(6), Atl-med. (-M-Eu.), Th., Arrhenatheretea. TP.
(379) Vicia sativa L. 1753, HT(6), Medit., Th., - Secalietea. GY.
(384) Lathyrus niger (L. 1753 sub. Orobo) Bernh. 1800, HT(6), M-Eu. (-medit.), H., Querco-Fagetea, Quercetea. K.
(392) Lathyrus pratensis L. 1753, HT(6), Eua. (medit.), H., Alopecuretum pratensis, Fraxino pannonicae - Ulmetum, Salicetum albae-fragilis. TZ.
(394) Lathyrus nissolia L. 1753, HT(6), Atl. -submedit., Th., Alopecuretum pratensis, Agrostion ? K.

(395) Lathyrus tuberosus L. 1753, HT(6), Eua. (-medit.), H. (-G.), Salicetum albae-fragilis, Salicetum triandrae - Echinochloo - Polygonatum lapathifolii, Cuscuto - Calystegietum sepium, Alopecuretum pratensis, etc. - Secalietea. GY.

Lythraceae

(407) Peplis portula L. 1753, HT(6), Subatl. (-medit.), Th., Nanocyperion & Beckmannion. GY.

(410) Lythrum hyssopifola L. 1753, HT(6), Cosm., Th., Cypero-Juncetum, Heliotropio - Verbenetum supinae, Pulicaria vulgaris - Mentha pulegium ass., - Nanocyperion. GY.

(412) Lythrum virgatum L. 1753, HT(6), Eua. -Cont., H. -HH., Alopecuretum pratensis, Salicetum albae-fragilis, Salicetum triandrae, Bidention etc. - Agrostion albae. K.

(413) Lythrum salicaria L. 1753, HT(6), Cp., (Eua.), H. -HH., Phragmitetea, Salicetea. K.

Onagraceae

(415) Epilobium hirsutum L. 1753, HT(6), Eua. (-medit.), H. (HH.), Bidention, Cuscuto-Calystegion sepium, Salicetum albae-fragilis, Phragmitetea. K.

(416) Epilobium parviflorum (Schreb. 1771 sub Chamaenerio) Wither. 1776, DC. 1828, HT(6), S-Eua., H., Alopecuretum pratensis, Fraxino pannonicae - Ulmetum pannonicum, Cypero-Juncetum, Bidention, Echinochloo-Polygonetum lapathifolii etc. - Phragmitetea-Molinietalia. K.

(421) Epilobium palustre L. 1753, HT(6), Eu. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum, Epilobietea. K.

(423) Epilobium tetragonum L. 1753 em. Leyss 1761, HT(6), Eua. (-Medit.), H., Alopecuretum pratensis, Cypero-Juncetum, Pulicaria vulgaris - Mentha pulegium ass., Bidention, Echinochloo-Polygonetum lapathifolii, - Agrostion (Magnocaricion) - Bidentetalia. K.

(424) Epilobium lamyi F. Schultz 1844, HT(6), Eu. (-Atl. -medit.), H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. K.

(425) Epilobium angustifolium L. 1753 seu Chamaerion a. Holub 1972 (Chamaenerion a.), HT(6), Cp., H., Epilobietea. TZ.

(427) Oenothera biennis L. 1753, HT(6), Eu., TH., Brom. t., Bidention, Echinochloo-Polygonetum lapathifolii, Cuscuto-Calystegietum sepium, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, - Chenopodietea. GY.

(428) Oenothera suaveolens Desf. 1804, HT(6), Medit., TH., Bidention, Echinochloo-Polygonetum lapathifolii, Cuscuto-Calystegietum sepium, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, - Chenopodietea. A.

(429/a) Oenothera salicifolia Desf. ex Schlecht. em. G. Don 1832 (Oe. depressa Greene 1891, muricata auct.), HT(6), Adv., TH., Bidention, Echinochloo-Polygonetum lapathifolii, Cuscuto-Calystegietum sepium, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, - Chenopodietea, Onopordetalia. A.

(430) Circaea lutetiana L. 1753, HT(6), Eua. (-medit.), G., Salicetum albae-fragilis, - Fagetalia. K.

Trapaceae

(432) Trapa natans L. 1753, HT(6), Medit., HH., Trapetum, Lemno-Utricularietum, Myriophyllo - Potametum, -Nymphaeion. V.

Haloragaceae

(433) Myriophyllum verticillatum L. 1753, HT(6), Cp., HH., Myriophyllo-Potametum, Lemno-Utricularietum etc. - Potamion. K.

(434) Myriophyllum spicatum L. 1753, HT(6), Cp., HH., Myriophyllo-Potametum, Lemno-Utricularietum etc. - Potamion. K.

Hippuridaceae

(435) Hippuris vulgaris L. 1753, HT(6), Cp., HH., Myriophyllo-Potametum, Nymphaeetum albo-luteae, -Phragmition-Potamion. K.

Polygalaceae

(439) Polygala comosa Schkuhr 1796, HT(6), Eu., H. (Ch.), Molinio-Arrhenatheretea. K.

Aceraceae

(445) Acer tataricum L. 1753, HT(6), Ponto-pannon (-E-medit.), M., Fraxino pannonicae - Ulmetum pannonicum, - Quercetea. K.

(446) Acer pseudo-platanus L. 1753, HT(6) M-Eu. (-medit.), MM., Fraxino pannonicae -Ulmetum pannonicum, -Querco-Fagetea. K.

(447) Acer platanoides L. 1753, HT(6), Eu., MM., Fraxino pannonicae - Ulmetum pannonicum, Querco-Fagetea. K.

(448) Acer campestre L. 1753, HT(6), Eu., M. -MM., Fraxino pannonicae - Ulmetum pannonicum, Querco-Fagetea. K.

(449) Acer negundo L. 1753, HT(6), Adv., MM., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Bidention etc. TZ.

Balsaminaceae

(450) Impatiens noli-tangere L. 1753, HT(6), Eua., Th., Fraxino pannonicae - Ulmetum pannonicum, - Fagetalia. K.

(451) Impatiens parviflora DC. 1824, HT(6), Asia, Th., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Cuscuto - Calystegion sepium etc. - Arction. A.

(452) Impatiens glandulifera Royle 1835, HT(6), Adv., Th., Salicetum albae-fragilis, Cuscuto - Calystegion sepium. A.

Celastraceae

(454) Euonymus verrucosus Scop. 1772, HT(6), Submedit. or E-Eu., M., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, - Quercetea-Querco-Fagetea. K.

(455) Euonymus europaeus L. 1753, HT(6), Eu. (-medit.), M., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Quercetea-Querco-Fagetea. K.

Rhamnaceae

(457) Rhamnus catarthicus L. 1753, HT(6), Eua. (-medit.), M., Fraxino pannonicae - Ulmetum pannonicum, - Querco-Fagetea. K.

(459) Frangula alnus Mill. 1768, HT(6), Eua. (-medit.), M., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, - Querco-Fagetea. K.

Vitaceae

(460) Vitis silvestris Gmelin 1806, HT(6), Ponto-medit., M-E., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, - Salicion albae. V.

(462) Vitis riparia Michx. 1803, Adv., M. -E., Salicetum albae-fragilis. A.

(463) Parthenocissus inserta (Kern. 1887 sub Viti) Fritsch 1922, HT(6), M. -E., Adv., Cuscuto - Calistegietum sepium. A.
Araliaceae
(464) Hedera helix L. 1753, HT(6), Atl. -medit., E. -M., Fraxino pannonicae - Ulmetum pannonicum. K.

Cornaceae
(466) Cornus sanguinea L. 1753, HT(6), Submedit., M., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Cuscuto-Calystegietum sepium etc. - Quercetea - Querco - Fagetea. K.

Umbelliferae
(468) Sanicula europaea L. 1753, HT(6) , Palaeotrop., H., Fraxino pannonicae - Ulmetum pannonicum, - Fagetalia. K.
(470) Eryngium campestre L. 1753, HT(6), Cont., H., Arrhenatheretea, Schlerochloo - Polygonetum avicularis etc. - Festuco-Brometea. TZ.
(471) Eryngium planum L. 1753, HT(6), Eua., H., Alopecuretum pratensis, Salicetum albae-fragilis. K.
(473) Chaerophyllum aromaticum L. 1753, HT(6), Cont., H., Cuscuto-Calystegietum sepium, Fagetalia. K.
(477) Chaerophyllum bulbosum L. 1753, HT(6), Eua., TH. -H., Chaerophylletum bulbosi, Cuscuto-Calystegietum sepium, Fraxino pannonicae - Ulmetum pannonicum, - Calystegion. GY.
(479) Anthriscus cerefolium (L. 1753 sub Scandice) Hoffm. 1814, HT(6), Ponto-med., Th., Arction. TZ.
(480) Anthriscus sylvestris (L. 1753 sub Chaerophyllo) Hoffm. 1814, HT(6), Eua. (-medit.), H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum etc., Arrhenatheretea, Salicetea. TZ.
(483) Torilis arvensis (Huds. 1762 sub Caucalidi) Link 1821, HT(6), Submedit., Th., Salicetum albae-fragilis, - Onopordion. GY.
(484) Torilis japonica (Houtt. 1773 sub Caucalidi 1773) DC. 1830, + ssp. j. -f. roseiflora, + ssp. ucranica, HT(6), Eua. (-medit.), Th. -TH., Fraxino pannonicae - Ulmetum pannonicum, - Querco-Fagetea, Epilobietea, Arction etc. TZ.
(488) Bifora radians M. B. 1819, HT(6), Eu., Th., Consolido - Eragrostion, Secalietea, GY.
(491) Conium maculatum L. 1753, HT(6), Eua. (-medit.), Th-TH., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Bidention, Echinochloo-Polygonetum lapathifolii, Cuscuto-Calystegietum sepium etc. - Arction. GY.
(503) Cicuta virosa L. 1753, HT(6), Eua., HH., Echinochloo-Polygonetum lapathifolii, - Magnocaricion. V.
(504) Falcaria vulgaris Bern. 1800, HT(6), Eua. (-medit), Th. -TH., Secalietea - Onopordetalia, Chenopodietea. GY.
(508) Aegopodium podagraria L. 1753, HT(6), Eua., H. (G.), Fraxino pannonicae - Ulmetum pannonicum, Chaerophylletosum bulbosi, Cuscuto-Calystegietum sepium, - Fagetalia. K.
(510) Sium latifolium L. 1753, HT(6), Eua., HH., Scirpo-Phragmitetum, Caricetum elatae, Alopecuretum pratensis, Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Bidention, Lemno-Utricularietum etc. - Phragmitetalia. K.
(518) Oenanthe aquatica (L. 1753 sub Phellandrio) Poir. in Lam. 1797, HT(6), Eua. (-medit.), HH., Scirpo-Phragmitetum, Salicetum albae-fragilis, Salicetum triandrae, Echinochloo-Polygonetum lapathifolii etc. - Phragmitetalia. K.
(519) Oenanthe fistulosa L. 1753, HT(6), Eua., HH., - Fraxino pannonicae - Ulmetum pannonicum, - Magnocaricion. K.

(520) Oenanthe silaifolia M. B. 1819, HT(6), Submedit., H., Agrostion albae. K.
(521) Oenanthe banatica Heuff. 1854, HT(6), Balc. - Pannon, H., Fraxino pannonicae - Ulmetum pannonicum. K.
(523) Anethum graveolens L. 1753, HT(6), S-Asia, Th., Bidention, Echinochloo-Polygonetum lapathifolii etc. - Chenopodietea. G.
(527) Selinum carvifolia L. (1753) 1762, HT(6), Eua., H., Alopecuretum pratensis, Arrhenatheretea, Fraxino pannonicae - Ulmetum pannonicum, - Molinio-Juncetea. K.
(529) Angelica sylvestris L. 1753, HT(6), Eua., H., Salicetum albae-fragilis, Salicetum triandrae, - Molinio-Juncetea. K.
(532) Peucedanum palustre (L. 1753 sub Selino) Mönch 1794, HT(6), Eua., H., Scirpo-Phragmitetum, Fraxino pannonicae - Ulmetum pannonicum, - Phragmitetea. K.
(537) Peucedanum officinale L. 1753, HT(6), Eu. (-medit.), H., Mesobromion. V.
(540) Heracleum sphondylium L. 1753 - H. s. ssp. sph., H. s. ssp. Trachycarpum, (Soják 1963 p. sp.) Holub 1964, H. s. ssp. chloranthum, (Borb. 1884 p. sp.) Neumayer 1923, Jáv. 1924, Soó 1937, K. Malý 1919 p. var., HT(6.), Eua (-medit.), H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Arrhenatheretea etc - Querco-Fagetea. K.
(—) Heracleum caucasicum (Sosnovskyi) var. subcarpaticum Fodor, HT(6), Adv., H., Salicetum albae-fragilis, Salicetum triandrae et syvae cult. Leg. : Fintha-Szabó, 1991, det. Fodor 1992 et Simon ex Terpó 1994. -
(545) Daucus carota L. 1753, HT(6), Eua. (-medit.), TH, Th, H., Festucetum pratense, Alopecuretum pratensis, Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum etc. - Molinio - Arrhenatheretea. TZ.

Rubiaceae
(553) Cruciata glabra (L. sub Valantia /1763/ Ehrend. 1958, HT(6), Eua. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum, - Querco - Fagetea. K.
(555) Galium boreale L. 1753 et G. b. ssp. pseudorubioides (Schur 1866 p. var.) Jáv. 1925, Nyár. 1943 p. sp, HT(6), Eua., H., Fraxino pannonicae - Ulmetum pannonicum, - Molinio - Juncetea. V.
(556) Galium rubioides L. 1762, HT(6), M-Eu., H., Alopecuretum pratensis - Fraxino pannonicae - Ulmetum pannonicum, - Agrostion. K.
(558) Galium odoratum (L. 1753 sub Asperula) Scop. 1772, Eua., HT(6), G., Fraxino pannonicae - Ulmetum pannonicum, - Fagetalia. K.
(560) Galium aparine L. 1753, HT(6), Cp. (-medit.), Th., mainly Robinietum. GY.
(562) Galium tricornutum Dandy 1957, HT(6), S-Eua., Th., - Secalietea. GY.
(566) Galium uliginosum L. 1753, HT(6), Eua., H., Salicetum triandrae, - Molinio-Juncetea & Magnocaricion. K.
(567) Galium palustre L. 1753, HT(6), Cp., H., Scirpo-Phragmitetum, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, Bidentetea, Echinochloo-Polygonetum lapathifolii etc., - Magnocaricion Molinio - Juncetea. K.
(567/a) Galium elongatum Prese 1822 (Lange 1870 p. subsp.), Cp., HT(6), H., Scirpo-Phragmitetum, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae – Ulmetum pannonicum, Bidentetea, Echinochloo-Polygonetum lapathifolii etc. – Magnocaricion, Molinio - Juncetea. K.
(569) Galium schultesii Vest 1821, HT(6), Sarmata, G., - Querco – Fagetea, - Quercetea. K.
(571) Galium verum L. 1753, HT(6), Eua. (-medit.), H., - Festuco – Brometea, - Festuco - Sedetalia. K.

(573) Galium mollugo L. 1753 et. G. m. ssp. elatum HT(6), Cp., (-medit.), H., - Arrhenatherion. K.
(577) Rubia tinctorum L. 1753, HT(6), Medit., H. ?, A.

Caprifoliaceae
(578) Sambucus ebulus L. 1753, HT(6), Submedit., H., Sambucetum ebuli, Salicetum albae-fragilis, - Arction - Epilobetea. GY.
(579) Sambucus nigra L. 1753, HT(6), Eu. (-medit.), MM. -M., Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, Robinietum etc. GY.
(581) Viburnum opulus L. 1753, HT(6), Cp. (-medit.), M., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, etc. - Querco-Fagetea. K.

Valerianaceae
(588) Valerianella dentata (L.) Poll. 1776 = V. mixta (L.) Dufr. 1811, HT(6), Eu., Th. Consolido - Eragrostion poaeoidis, Chenopodietea. GY.
(589) Valerianella rimosa Bast. in Desv. 1813, HT(6), Submedit., Th., - Secalietea, Chenopodietea. GY.
(591) Valerianella locusta (L. 1753 sub Valeriana) Latterade 1821, Betcke 1826, HT(6), Submedit., Th., Rorippo-Agropyretum repentis, Chenopodietea. TP.
(594) Valeriana officinalis L. 1753 s. str. HT(6), Eua. (-medit.), H. Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, - Magnocaricion, etc. K.

Dipsacaceae
(598) Dipsacus laciniatus L. 1753, HT(6), Eua. (-medit.), TH., - Agropyro - Rumicion crispi. GY.
(599) Dipsacus fullonum L. 1753 s. str., HT(6), Submedit. (M-Eu.), TH., Bidentetalia, Onopordion, Fraxino pannonicae - Ulmetum pannonicum, - Agropyro-Rumicion crispi Onopordetalia. GY.
(600) Virga pilosa (L. 1753) sub Dipsaco Hill. 1868, HT(6), M-Eu., TH., Fraxino pannonicae - Ulmetum pannonicum, Arctietum nemorosi, - Alno-Padion. TZ.
(602) Succisa pratensis Mönch 1794, HT(6), Eua. (-medit.), H., Alopecuretum pratensis, Arrhenatheretea, - Molinio - Juncetea. K.
(603) Succisella inflexa (Kluk sub Scabiosa 1788) Beck 1892, HT(6), M, Eu., H., Arrhenatheretea, Fraxino pannonicae - Ulmetum pannonicum, - Molinio - Juncetea. K.
(604) Knautia arvensis (L. 1753 sub Scabiosa) Coult. 1824, HT(6), Eua., H., Arrhenatheretea. K.
(609) Scabiosa ochroleuca L. 1753, HT(6), Eua. -Cont., H., Festuco-Brometea (-Quercetea). TZ.

Tiliaceae
(612) Tilia argentea Desf. in DC. 1813, HT(6), Balc. -Pann., MM., Fraxino pannonicae -Ulmetum pannonicum. K.
(614) Tilia cordata Mill. 1759, HT(6), Eu. (-medit.), MM., Fraxino pannonicae - Ulmetum pannonicum, - Carpinion. K.

Malvaceae
(615) Abutilon theophrasti Medik. 1787, HT(6), Submedit., Th., Chenopodietea. GY.

(616) Lavatera thuringiaca L. 1753, HT(6), Eua. (-medit.), H., Chenopodietea. K.

(619) Althaea officinalis L. 1753, HT(6), Eua. (-medit.), H., Scirpo-Phragmitetum, Alopecuretum pratensis, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum. TZ.
(622) Malva sylvestris L. 1753, HT(6), S-Eua., Th., TH., H., Chenopodietea-Secalietea. GY.
(623) Malva neglecta Wallr. 1824, HT(6), M-Eua. (-medit.), H., Chenopodietea-Secalietea. GY.
(624) Malva pusilla Sm. 1795, With. 1796, HT(6), Eua. (-medit.), Th.,TH.,H., Chenopodietea-Secalietea. GY.
(625) Hibiscus trionum L. 1753, HT(6), Eua. (-medit.), TH., Hibisco-Eragrostetum, - Consolido - Eragrostion, Secalietea. GY.

Linaceae
(627) Linum catharticum L. 1753, HT(6), Eu. (-medit.), TH. (H.), Molinio-Juncetea, Arrhenatheretea. K.

Oxalidaceae
(636) Oxalis fontana Bunge 1833, HT(6), Eu. (-medit.), Th. (H.,G.), Secalietea - Chenopodietea. G

Geraniaceae
(639) Geranium robertianum L. 1753, HT(6), Eua. (-medit), Th., Fraxino pannonicae - Ulmetum pannonicum, - Fagetalia. K.
(646) Geranium dissectum Jusl. 1755, HT(6), S-Eua., Th., Chenopodietea. GY.
(648) Geranium pusillum Burman f. 1759, HT(6), Eu. (-medit.), Th., Chenopodietea. GY.
(656) Erodium cicutarium (L. 1753 sub Geranio) L'Hérit. in Ait. 1789, HT(6), S-Eua. (-medit.), Festuco-Sedetalia Polygono - Chenopodietea. GY.

Euphorbiaceae
(665) Euphorbia palustris L. 1753, HT(6), Eu., H-HH., Eleochari-Schoenoplectetum, Alopecuretum pratensis, Salicetum triandrae, - Magnocaricion - Agrostion. K.
(666) Euphorbia villosa W. et K. in Willd. 1800, 1802, HT(6), Ponto-medit, H., Festucetum pratensis, Fraxino pannonicae - Ulmetum pannonicum, Molinio-Juncetea. K.
(672) Euphorbia stricta L. 1759, HT(6), Submedit., Th., Fraxino pannonicae - Ulmetum pannonicum, -Calystegion. GY.
(674) Euphorbia amygdaloides L. 1753, HT(6), M-Eu., Ch., Fraxino pannonicae - Ulmetum pannonicum, Fagetalia (Quercetea). K.
(675) Euphorbia salicifolia Host 1797, HT(6), Ponto-Pann., H., Chenopodietea. TZ.
(676) Euphorbia cyparissias L. 1753, HT(6), Eua. (-medit.), H. (G.), Chenopodietea, Alopecuretum pratensis. GY.
(677) Euphorbia esula L. 1753, incl ssp. pinifolia (Lam. 1768, p. sp. A. et G. 1898,Wierzb. in Roch. 1838, Boiss, 1862 p. var., HT(6), Eu., H., - Molinion - Arction. GY.
(678) Euphorbia lucida W. et K. 1801, HT(6), Eu. -Cont., H., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis, Alopecuretum pratensis etc. - Molinion. K.
(679) Euphorbia virgata W. et K. 1803 (non Desf. 1804), Eua. (Eurosib), Cont., H., Alopecuretum pratensis, Arrhenatheretea, - Secalietea, Chenopodietea, Agrostion etc. TZ.
(685) Euphorbia exigua L. 1753, HT(6), Submedit., Th., Bidention, - Secalietea. GY.

Callitrichaceae

(686) Callitriche palustris L. 1753 em. Druce, HT(6), Cp., HH., Scirpo-Phragmitetum, Eleochari (aciculari) - Schoenoplectetum supini, - Potamion-Nanocyperion. K.

(687) Callitriche cophocarpa Sendtn. 1854, HT(6), Eua., HH., Potamion - Nanocyperion. K.

Oleaceae

(690) Fraxinus angustifolia Vahl. 1804 ssp. pannonica Soó et Simon 1960, HT(6), SE-Eu., MM., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis, Alopecuretum pratensis etc., (Alnetea). E.

(—) Fraxinus pennsylvanica Marsh. 1785, Adv., MM. -

(692) Ligustrum vulgare L. 1753, HT(6), Eu., M., Salicetum albae-fragilis, Fraxino pannonicae – Ulmetum pannonicum, Querco-Fagetea-Quercetea. E.

Gentianaceae

(693) Centaurium littorale (Turner sub Chironia 1805) Gilmour 1937, ssp uliginosum (W. et K. 1812) Rothm. ex Melderis 1972, HT(6), Eu., Th. -TH., Molinietalia. K.

(694) Centaurium erythraea Rafn. 1800, HT(6), Eua. (-medit.), Th., Alopecuretum pratensis, - Molinio-Arrhenatheretum, Epilobietalia. K.

(695) Centaurium pulchellum (Sw. 1783 sub Gentiana) Druce 1897, HT(6), Eua. (-medit.), Th., Nanocyperion. K.

(700) Gentiana pneumonanthe L. 1753, HT(6), Eua. (-medit.), H., Molinio-Juncetea. V.

(704) Nymphoides peltata (Gmel. sub Limnanthemo 1770), Ktze. 1891, HT(6), Eua. (-medit.), HH., Nymphaeion. V.

Asclepiadaceae

(705) Asclepias syriaca L. 1753, HT(6), Adv., H., Fraxino pannonicae - Ulmetum pannonicum, Epilobietalia ?. GY.

(706) Vincetoxicum hirundinaria Medik. 1790, [Cynanchum v. (L.) Pers.], HT(6), Eu. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum. TZ.

(707) Vinca minor L. 1753, HT(6), Submedit. (-M-Eu.), Ch., Fraxino pannonicae - Ulmetum pannonicum, - Fagetalia Carpinion. K.

Convolvulaceae

(709) Cuscuta lupuliformis Krock. 1787, HT(6), Eua. -Cont., Th., ~ H., Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, Bidentetea, - Calistegion (Salicetea). K.

(—) Cuscuta europaea L. 1753, HT(6), Eua. (-medit.), Th., Calystegion. GY.

(711) Cuscuta epithymum (L. 1753 p. var. C. europaea) Nath. 1756, Murr. 1774, HT(6), Eua. (-medit.), Th. -H., Alopecuretum pratensis. GY.

(712) Cuscuta trifolii Bab. 1844, HT(6), Medit., Th. -H., Trifolio-Medicaginion. GY.

(714) Cuscuta campestris Yuncker 1932, HT(6), Adv., Th., Trifolio-Medicaginion. GY.

(716) Convolvulus arvensis L. 1753, HT(6), Cp., H. -G., Chenopodio-Scleranthea etc. GY.

(718) Calystegia sepium (L. 1753 sub Convolvulo) R. Br. 1810, HT(6), Eua. (-medit.), H., Calystegion. K.

Boraginaceae

(720) Heliotropium europaeum L. 1753, HT(6), Submedit., Th., Secalietea. GY.

(723) Cynoglossum officinale L. 1753, HT(6), Eua. -Cont., TH., Onopordion. GY.

(728) Asperugo procumbens L. 1753, HT(6), Eua. -Cont., Th., Chenopodietea. GY.

(730) Symphytum officinale L. 1753. incl. S. off. ssp. off; S. off. ssp. bohemicum (F. W. Schm. 1794 p. sp.) Èelak. 1890, Schwarz 1949, Pers. 1805 p. var.; S. off. ssp. uliginosum (Kern. 1863 p. sp.) Nym. 1883, Ktze. 1867 p. var., HT(6), Eu., H., The ssp. ulig. = Ponto-Pannon, the ssp. bohemicum, M-Eu., Molinio-Juncetea & Phragmitetea. K.
(732) Anchusa officinalis L. 1753, HT(6), Eu. (-medit.), TH. -H., Chenopodietea vel Onopordetalia. GY.
(739) Pulmonaria officinalis L. 1753. incl. P. o. ssp. obscura (Dum. 1865) Murb. 1891, HT(6), M. -Eu., H., Fraxino pannonicae - Ulmetum pannonicum, Querco-Fagea. K.
(740) Pulmonaria mollissima Kern. 1878, HT(6), Eua. (-Cont.), H., Fraxino pannonicae -Ulmetum pannonicum. K.
(741) Myosotis sparsiflora Mikan in Hoppe 1807, HT(6), Eua. (-Cont.), Th., Fraxino pannonicae - Ulmetum pannonicum. K.
(743) Myosotis palustris (L.) Nath. 1756 em Rchb. 1822, HT(6), Eua. (-medit.), H., Scirpo-Phragmitetum, Arrhenatheretea, Festucetum pratensis, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, Cuscuto - Calistegietum sepium etc. - Phragmitetea - Molinio-Juncetea. K.
(746) Myosotis arvensis (L. 1753 p. var. M. scorpioidis) Hill 1764, HT(6), Eua., TH., Arrhenatheretea. GY.
(747) Myosotis ramosissima Roch. ex Schult. 1814 (= M. hispida), HT(6), Eu. (-medit.), Th., Secalietea-Onopordion. TZ.
(748) Myosotis stricta Link in R. et Sch. 1819 (= M. micrantha Pall. in Lehm. 1817 ?), HT(6), Eua. (-medit.), Th., - Corynephoretea. TP.
(750) Lithospermum officinale L. 1753, HT(6), Eua. (Eurosib.), H., Fraxino pannonicae - Ulmetum pannonicum, - Quercetea. K.
(752) Lithospermum arvense L. 1753, HT(6), S-Eua., Th. -TH., Secalietea, Chenopodietea. TP.
(756) Cerinthe minor L. 1753, HT(6), Ponto-medit., TH. (H.,Th.), Onopordion. GY.
(759) Echium vulgare L. 1753, HT(6), Medit., TH., Sedo-Scleranthetea & Chenopodietea. TP.

Verbenaceae

(760) Verbena officinalis L. 1753, HT(6), Medit., Th.,-H., Chenopodietea-Plantaginetea. GY.

Labiatae (Lamiaceae)

(762) Ajuga chamaepitys (L. sub Teucrio 1753) Schreb. 1794, HT(6), Submedit., Th. Secalietea. GY.
(764) Ajuga reptans L. 1753, Eu. (-medit.), HT(6), H. -Ch., Fraxino pannonicae - Ulmetum pannonicum, Querco-Fagea. TZ.
(765) Ajuga genevensis L. 1753, HT(6), Eu. (-Cont.), H., Arrhenatheretea, Quercetea etc. TZ.
(770) Teucrium scordium L. 1753, HT(6), Eua. (-medit.), H., Magnocaricion. K.
(771) Scutellaria hastifolia L. 1753, HT(6), Eu., H., Molinietalia, Calystegion. K.
(772) Scutellaria galericulata L. 1753, HT(6), Cp., H. Phragmitetea & Molinietalia. K.
(775) Marrubium vulgare L. 1753, HT(6), Eua., H. (Ch.), Chenopodietea. GY.
(776/a) Marrubium x paniculatum Desr. ex Lam. 1789, HT(6), Eua., H. (Ch.), Onopordion. GY.
(779) Nepeta cataria L. 1753, HT(6), Eua. (-medit.), H. (Ch.), Chenopodietea, Arction. GY.
(780) Glechoma hederacea L. 1753, HT(6), Eua., H. (Ch. -G.), Querco-Fagea, Molinio-Arrhenatheretea etc. K.

(784) Prunella vulgaris L. 1753, HT(6), Cp., H., Molinio-Arrhenatheretea, Querco-Fagea etc. TZ.
(789) Galeopsis ladanum L. 1753, HT(6), Eua., Th., Secalietea, Caucalidion & Sisymbrion. GY.
(790) Galeopsis speciosa Mill. 1768, HT(6), Eua., Th., Alno-Padion & Epilobietea, Alliarion etc. TZ.
(791) Galeopsis pubescens Bess. 1809, HT(6), M-Eu., Th., Querco-Fagea, Fraxino pannonicae - Ulmetum pannonicum, Secalietea etc. TZ.
(792) Galeopsis tetrahit L. 1753, HT(6), Eu., Th., Epilobietea. GY.
(793) Galeopsis bifida Boenn. 1824, HT(6), Eua., Th., Epilobietea-Calystegion. TZ.
(794) Galeobdolon luteum Huds. 1798, HT(6), M-Eu. (-medit.), H. (Ch.), Fraxino pannonicae - Ulmetum pannonicum. K.
(796) Lamium amplexicaule L. 1753, HT(6), Eua. (-medit.) Th., Chenepodio-Scleranthea. GY.
(797) Lamium purpureum L. 1753, HT(6), Eua., Th. (H.), Fraxino pannonicae – Ulmetum pannonicum, - Secalietea. GY.
(798) Lamium album L. 1753, HT(6), Eua. (-medit.), H., Arction-"Alliarion" (-Fraxino pannonicae - Ulmetum pannonicum). GY.
(799) Lamium maculatum (L. 1753, p. var. L. albi) L. 1762, HT(6), Eu. (-medit.), H. (Ch.), Fagetalia, Fraxino pannonicae - Ulmetum pannonicum. TZ.
(800) Leonurus cardiaca L. 1753, HT(6), Eua. (-medit.), H., Chenopodietea (Arction). GY.
(801) Leonurus marrubiastrum L. 1753, HT(6.), Eua. (Cont), Th. -TH., Chenopodietea, Bidentetea. GY.
(802) Ballota nigra L. 1753, HT(6), Submedit. -Eu., H. (Ch.), Chenopodietea, Arction. GY.
(803) Betonica officinalis L. 1753, HT(6), Eua. (-medit.), H., Fraxino pannonicae – Ulmetum pannonicum, Arrhenatheretea, Festucetum pratensis, - Quercetea & Molin<F"Times New Roman CE"P9>io- Arrhenatheretea. K.
(804) Stachys annua (L. 1753 sub Betonica) L. 1762, HT(6), Eu. (-Submedit.), Th., Secalietea, Consolido- Eragrostion. GY.
(806) Stachys sylvatica L. 1753, HT(6), Eua., H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Fagetalia. K.
(807) Stachys palustris L. 1753, HT(6), Cp., H. (G.), Phragmitetea. K.
(809) Stachys germanica L. 1753, HT(6), Ponto-medit., H. (TH.), Onopordio etc. GY.
(811) Salvia verticillata L. 1753, HT(6), Eua. (-medit.), H., Chenopodietea-Plantaginetea, Onopordion. K.
(815) Salvia nemorosa L. 1753, HT(6), Eu., H., Festuco-Brometea, Chenopodietea. K.
(816) Salvia pratensis L. 1753, HT(6), Eu. (-medit.), H., Onopordion etc. K.
(822) Origanum vulgare L. 1753, HT(6), Eua. (-medit.), H. Quercetea. K.
(827-828) Thymus glabrescens Willd. 1811, HT(6), Ponto-Pann., Ch., Onopordion. K.
(834) Lycopus europaeus L. 1753, HT(6), Eua. (-medit.), HH., Phragmitetea. K.
(835) Lycopus exaltatus L. f. 1781, HT(6), Eua. Cont., HH., Phragmitetea. K.
(836) Mentha pulegium L. 1753, HT(6), Eua., H., Nanocyperion, Bidenteea, Chenopodietea etc. TZ.
(837) Mentha longifolia (L. 1753 pro var. M. spicatae) Nath. 1756, HT(6), Eua. (-medit.), H. (G.), Glycerio-Sparganion, Bidentetea etc. K.
(842) Mentha aquatica L. 1753, HT(6), Eu. (-medit.), H. (HH.), Phragmitetea. K.
(843) Mentha arvensis L. 1753, HT(6), Cp., H. (G.), Phragmitetea, Molinietalia. K.

Solanaceae
(847) Lycium barbarum L. 1753 p. maj. p. HT(6), Medit., M., Arction. GY.

(851) Hyoscyamus niger L. 1753, HT(6), Eua. (-medit.), H. (Th. -TH.), Chenopodietea, Onopordion. GY.
(852) Physalis alkekengi L. 1753, HT(6), Submedit., H., Fraxino pannonicae – Ulmetum pannonicum. K.
(853) Solanum dulcamara L. 1753, HT(6), Eua. (-medit.), Ch. (N.), Phragmition, Populetalia, Bidentetea, Calystegion etc. TZ.
(854) Solanum nigrum L. 1753, s. str. HT(6), Medit., Th., Chenopodio-Scleranthea. GY.
(857) Datura stramonium L. 1753, HT(6), Adv., Th. Chenopodietea (-Bidentetea). GY.

Scrophulariaceae
(858) Verbascum phoeniceum L. 1753, HT(6), Eua., H., (Cynodonti-Poëtum angustifoliae). TZ.
(859) Verbascum blattaria L. 1753, HT(6), Eua. (-medit.), H., Molinio-Juncetea & Arrhenatheretea. TZ.
(862) Verbascum phlomoides L. 1753, HT(6), Eu. (-medit.), TH., Chenopodietea, Onopordion. TZ.
(863) Verbascum lychnitis L. 1753, HT(6.), Eu. (-medit.), TH., Onopordion etc. (Quercetea). K.
(866) Verbascum austriacum Schott in R. et Sch. 1819, HT(6), Submedit., TH. -H., Quercetea. TZ.
(867) Verbascum nigrum L. 1753, HT(6), Eua., TH. -H., Quercetea,-Epilobietalia. TZ.
(869) Kickxia spuria (L. 1753 sub Antirrhino) Dum. 1827. HT(6), Submedit., Th., Nanocyperetalia, Echinochloeto-Polygonetum lapathifolii. GY.
(870) Kickxia elatine (L. 1753 sub Antirrhino) Dum. 1827, HT(6), Submedit. (-M-Eu.) Th., Echinochloeto-Polygonetum lapathifolii. GY.
(873) Linaria vulgaris Mill. 1768, HT(6), Eua. (-medit.), H. (TH.), Chenopodio-Scleranthea, Epilobietea etc. TZ.
(876) Misopates orontium (L. 1753 sub Antirrhino) Raf. 1850, HT(6), Submedit., Th., Secalietea. GY.
(877) Chaenorrhinum minus (L. 1753 sub Antirrhino) Lange in Willk. et Lange 1870, HT(6), Submedit., Th., Secalietea. GY.
(879) Scrophularia scopolii Hoppe 1803 (S. glandulosa W. et K. 1806.), HT(6), Medit., H., Calystegietalia. V.
(880) Scrophularia nodosa L. 1753, HT(6), Eua., H., Fagetalia. TZ.
(882) Gratiola officinalis L. 1753, HT(6), Eua., H., Agrostion, Beckmannion, Phragmitetea. K.
(883) Limosella aquatica L. 1753, HT(6), Cp., Th., Eleochari (aciculari)-Schoenoplectetum supini, Cypero-Juncetum , - Nanocyperetalia. TP.
(884) Lindernia procumbens (Krock. 1790 sub Anagalloide) Borb. 1881, Philcox 1965, HT(6), Eua. (-medit.), Th., Eleochari (aciculari)-Schoenoplectetum supini, -Nanocyperion. TZ.
(885) Veronica anagallis-aquatica L. 1753, HT(6), Cp., H. -HH. Cypero-Juncetum, Salicetum triandrae, Bidentetea, Echinochloa-Polygonetum lapathifolii, - Glycerio-Sparganion- Bidentetea. K.
(886) Veronica anagalloides Guss. 1826, HT(6), Eua. (-medit.), H. -HH., Scirpo-Phragmitetum, Alopecuretum pratensis, Salicetum triandrae, Cypero-Juncetum, Bidention etc. K.
(889) Veronica beccabunga L. 1753, HT(6), Eua. (-medit.), H. -HH., Cypero-Juncetum, Salicetum triandrae, Bidention etc. - Bidentetea-Populetalia. K.
(893) Veronica chamaedrys L. 1753, HT(6), Eua. (-medit.), H. -Ch., Fraxino pannonicae - Ulmetum pannonicum. TZ.

(894) Veronica prostrata L. 1753, HT(6), Eua. (-medit.), Ch., (Alopecuretum pratensis). TZ.
(896) Veronica teucrium L. 1762, HT(6), Eua. (-medit.), H., (Quercetea). K.
(897) Pseudolysimachion spurium (L. 1753) Opiz 1852, HT(6), Eua., H., (Aceri - Quercion fragm.) Convallario-Quercetum fragm. K.
(898) Pseudolysimachion longifolium (L. 1753) Opiz 1852. HT(6), Eua., H., Alopecuretum pratensis, Fraxino pannonicae - Ulmetum pannonicum. K.
(902) Veronica serpyllifolia L. 1753, HT(6), Eua. (medit.), H., Arrhenatheretea. K.
(907) Veronica arvensis L. 1753, HT(6), Eua. (-medit.), Th., Secalietea, Arrhenatheretea etc. GY.
(913) Veronica hederifolia L. 1753, HT(6), Eua. (-medit.), Th., Fraxino pannonicae – Ulmetum pannonicum. TZ.
(–) Veronica tournefortioides (Vollm. 1914 p. var. V. politae), HT(6 in print), Eua. (-medit.), Th., Querco-Fagea. –
(920) Melampyrum nemorosum L. 1753, HT(6), Eu., Th., Fraxino pannonicae – Ulmetum pannonicum. K.
(929) Odontites vulgaris Moench 1794 (O. rubra), HT(6), Eua. (-medit.), Th., Molinietalia, Plantaginetea etc. TZ.
(930) Rhinanthus minor L. 1756, HT(6), Eu., Th., Molinio-Arrhenatheretea. K.
(931) Rhinanthus serotinus (Schönheit) Oborny 1883 em. Hyl. 1945, HT(6), Eu., Th., Molinio-Arrhenatheretea. K.
(937) Lathraea squamaria L. 1753, HT(6), S-Eua., G., Fraxino pannonicae – Ulmetum pannonicum. K.

Orobanchaceae
(945) Orobanche cernua Loefling 1758 ssp. cumana (Wallr.) Soó 1972, HT(6), Eua., Th. (G.), Secalietea. GY.

Lentibulariaceae
(961) Utricularia vulgaris L. 1753, HT(6), Cp., HH., Lemno-Potamea, Hydrochari-Lemnetea. K.
(962) Utricularia australis R. Br. 1810 (U. neglecta Lehm. 1828), HT(6), M-Eu., HH., Hydrochari-Lemnetea. K.

Plantaginaceae
(965) Plantago arenaria W. et K. 1801, HT(6), Eua. (-medit.), Th., Cypero-Juncetum. K.
(967) Plantago maritima L. 1753, HT(6), Cp., H., Cypero-Juncetum. K.
(970) Plantago lanceolata L. 1753, HT(6), Eua., H., Molinio-Arrhenathereta. TZ. (K.)
(971) Plantago altissima L. 1762, HT(6), Balk. -Pann., H., Alopecuretum pratensis, Festucetum pratensis, Salicetum albae-fragilis, Salicetum triandrae. TZ.
(973) Plantago media L. 1753, HT(6), Eua. (-medit.), H., Festuco-Brometea & Arrhenatheretea. TZ.
(974) Plantago major L. 1753, HT(6), Eua. (-medit.), H., Plantaginetea majoris. GY.

Papaveraceae
(975) Chelidonium majus L. 1753, HT(6), Eua. (-medit.), H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum etc., - Alliarion. GY.
(980) Papaver dubium L. 1753, HT(6), Submedit., Th., Secalietea. GY.
(981) Papaver rhoeas L. 1753, HT(6), Medit., Th., Secalietea. GY.

Fumariaceae

(983) Corydalis cava (L.) Schw. et Körte 1811, HT(6), M-Eu., G., Fraxino pannonicae -Ulmetum pannonicum. K.
(988) Fumaria officinalis L. 1753, HT(6), Eua. (-medit.), Th., Chenopodio-Scleranthea. GY.
(989) Fumaria schleicheri Soy. - Will. 1828, HT(6), Eua. (-medit.), Th., Chenopodio-Scleranthea. GY.

Cruciferae (Brassicaceae)

(994) Brassica nigra (L. 1753 sub Sinapi) Koch 1833, HT(6), Medit., Th., Chenopodietea. A.
(995) Brassica rapa L. 1753 em. Metzger, HT(6), Medit., mont., Th. -TH., Secalietea. G.
(999) Sinapis arvensis L. 1753, HT(6), Submedit., Th., Secalietea (-Bidentetalia). GY.
(1002) Diplotaxis muralis (L. 1753 sub Sisymbrio) DC. 1821, HT(6), Atl. -medit., H. (Ch.), Chenopodio-Scleranthea, Secalietea. GY.
(1004) Raphanus raphanistrum L. 1753, HT(6), Medit., Th., Secalietea, Chenopodietea. GY.
(1012) Lepidium perfoliatum L. 1753, HT(6), Eua., Th., Secalietea (Plantaginetalia). GY.
(1014) Lepidium ruderale L. 1753, HT(6), Eua., Th., Chenopodio-Scleranthea, Polygonion avicularis-Sisymbrion. GY.
(1018) Cardaria draba Desv. 1814, HT(6), Eua. (-medit.), H., Chenopodio-Scleranthea, Sisymbrietalia. GY.
(1023) Thlaspi arvense L. 1753, HT(6), Eua. (-medit.), Th., Chenopodio-Scleranthea. TP.
(1025) Thlaspi perfoliatum L. 1753, HT(6), Submedit., Th., (Secalietea). TP.
(1031) Capsella bursa-pastoris (L. 1753 sub Thlaspei) Medic. 1792, HT(6), Cosm., Th. -TH., Chenopodio-Scleranthea. GY.
(1045) Berteroa incana (L. 1753 sub Alysso) DC. 1821, HT(6), Eua., Th. -TH., Chenopodietea. GY.
(1050) Erophila spathulata Láng 1824, HT(6), Eua. (-medit.), Th., Festuco-Brometea, Secalietea, Festuco-Sedetalia etc. TP.
(1051) Erophila verna (L. 1753 sub Draba) Chev. 1827 (~Bess- 1822), HT(6), Eua. (-medit.), Th., Secalietea, Festuco-Sedetalia etc. TP.
(1052) Armoracia rusticana (= A. lapathifolia -) Usteri 1793, HT(6), Pontus., G. (H.), Alopecuretum pratensis, - Calystegion (-Bidentetea). G.
(1053) Armoracia macrocarpa (W. et K. 1804 sub Cochlearia) Baumg. 1816, HT(6), Pann. endem., H., Phragmition-Bidentetea. V.
(1054) Cardamine impatiens L. 1753, HT(6), Eua. (-medit.), TH. (Th.), Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. TZ.
(1059) Cardamine pratensis L. 1753, HT(6), Cp. H., C. p. ssp. dentata (Schult. 1809 p. sp.) Èelak. 1870, HT(6), Eurosib., H., Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum. K.
(1059. a) Cardamine matthioli Moretti ex Comolli 1847) Arc. (= C. hayneana Welwitsch in Rchb. 1832 p. sp.) etc., HT(6), Submedit., H., Sxirpo-Phragmitetum, Alopecuretum pratensis, Fraxino pannonicae - Ulmetum pannonicum. K.
(1064) Barbarea stricta Andrz. in Bess. 1822, HT(6), Eua., TH., Bidention, Fraxino pannonicae - Ulmetum pannonicum, - Calystegion. TZ.
(1072) Turritis glabra L. 1753, HT(6), Cp. TH., Bidention, Quercetea p. p. TZ.
(1074) Rorippa islandica (Oeder sub Sisymbrio 1768) Borb. 1900, recte: R. palustris (L.) Bess. 1822, HT(6), Cp., Th. -TH., Bidention, Salicetum albae-fragilis. GY.
(1076) Rorippa amphibia (L. 1753 sub Sisymbrio) Bess. 1822, HT(6), Eua. (-medit.), HH., Phragmitetea (Populetalia). K.

(1079) Rorippa X astylis (Rchb. 1832 sub Nasturtio) Rchb. 1838 (= R. pal. x sylv.), HT(6), Eu., H., Alopecureetum pratensis, Salicetum triandrae, Bidentetalia. K.
(1080) Rorippa X armoracioides (Tausch 1840 sub Nasturtio) Fuss 1866 (= R. austriaca x sylvestris), HT(6), Eu., H., Echinochloeto-Polygonetum lapathifolii, Glycyrrhizetum echinatae. TZ.
(1085) Erysimum cheiranthoides L. 1753, HT(6), Cp., Th., Cuscuto-Calystegietum sepium, Echinochloeto-Polygonetum lapathifolii, Salicetum albae-fragilis. TZ.
(1092) Alliaria petiolata (M. B. 1808 sub Arabide) Cavara et Grande 1913, HT(6), Eua.
(-medit.), TH. -H., Fraxino pannonicae - Ulmetum pannonicum., Alliarion-Epilobietea. TZ.
(1100) Arabidopsis thaliana (L. 1753 sub Arabide) Heynh. 1842, HT(6), Eua. (-medit.), Th. -TH., Quercetea. TP.

Resedaceae
(1105) Reseda luteola L. 1753, HT(6), Medit., TH., Onopordetalia. GY.
(1106) Reseda lutea L. 1753, HT(6), Medit., TH. -H., Scleranthо-Chenopodietea, Onopordion. GY.

Violaceae
(1116) Viola odorata L. 1753, incl. V. o. ssp. wiedemanni (Boiss. 1867 p. sp.) Kupffer 1909, HT(6), Atl. -medit., H., Fraxino pannonicae - Ulmetum pannonicum. K.
(1117) Viola suavis M. B. 1819, HT(6), Eua., H., Fraxino pannonicae - Ulmetum pannonicum. K.
(1118) Viola cyanea Čelak. 1872, HT(6), M-Eu., H., Fraxino pannonicae - Ulmetum pannonicum. K.
(1119) Viola alba Bess. 1809, HT(6), Submedit., H., Querco-Fagea. K.
(1123) Viola mirabilis L. 1753, HT(6), Eua., H., Fraxino pannonicae - Ulmetum pannonicum. K.
(1125) Viola sylvestris Lam. 1778 (p. p.) em. Rchb. 1823, Kit. in Schult. 1814, HT(6), Eu. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum. K.
(1126) Viola riviniana Rchb. 1823, HT(6), Eu. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum. K.
(1127) Viola canina L. em. Rchb. 1823, HT(6), Eua., H., Alopecuretum pratensis. K.
(1129) Viola stagnina Kit. in Schult. 1814, HT(6), Eua., H., Molinio-Juncetea. K.
(1130) Viola pumila Chaix in Vill. 1786, HT(6), Eua., H., Alopecuretum pratensis, -Molinion. K.
(1131) Viola elatior Fr. 1828, HT(6), Eua., H., Fraxino pannonicae – Ulmetum pannonicum, Molinietalia. K.
(1132) Viola tricolor L. 1753. incl. V. t. ssp. polychroma (Kern. 1882 p. sp.) J. Murr 1923 (V. incerta Blocki), HT(6), Eua., Th. -TH. -H., Alopecuretum pratensis. K.
(1133) Viola arvensis Murr. 1770, HT(6), Eua., Th., Secalietea. GY.
(1134) Viola kitaibeliana R. et Sch. 1819, HT(6), Ponto-medit., Th., Secalietea. TP.

Elatinaceae
(1135) Elatine alsinastrum L. 1753, HT(6), Eua. (-medit.), HH. (Th. -H.), Nanocyperion. V.
(1136) Elatine triandra Schkuhr 1791, HT(6), Cosm., HH. (Th.), Nanocyperion. TP.
(1137) Elatine macropoda Guss. 1827 incl. f. hungarica (Moesz) Soó 1974, HT(6), Eua. (-medit.), HH. (h.), Nanocyperion. V.
(1138) Elatine hydropiper L. 1753 em. Oeder 1764, HT(6), Cp., HH. (Th.), Nanocyperion. TP.

Cucurbitaceae

(1139) Thladiantha dubia Bunge 1835, HT(6), Adv., G., Calystegion sepium (?). A.

(1140) Bryonia alba L. 1753, HT(6), Eua., G., Calystegion sepium (Arction). GY.

(1141) Bryonia dioica Jacq. 1774, HT(6), Eua. (-medit.), H.,G., Calystegion sepium (Arction). GY.

(1144) Sicyos angulatus L. 1753, HT(6), Adv., Th., Calystegion sepium (?). – (A).

(1145) Echinocystis lobata (Michx. 1803 sub "Sicyos") Torr. et Gray 1840, HT(6), Adv., Th., Calystegion sepium. A.

Guttiferae (Hypericaceae)

(1147) Hypericum tetrapterum Fr. 1823, HT(6), Eu. (-medit.), H., Fraxino pannonicae -Ulmetum pannonicum, Bidention. K.

(1148) Hypericum perforatum L. 1753, HT(6), Eua. (-medit.), H., Onopodion, Quercetea. TZ.

(1150) Hypericum hirsutum L. 1753, HT(6), Eua. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum. K.

Pyrolaceae

(1161) Monotropa hypopitys L. 1753, HT(6), Cp., G., Fagetalia Fraxino pannonicae - Ulmetum pannonicum. K.

Campanulaceae

(1166) Campanula glomerata L. 1753, HT(6), Eua. (-medit.), H. (Quercetea). K.

(1171) Campanula rapunculoides L. 1753, HT(6), Eua. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum. TZ.

(1177) Campanula patula L. 1753, HT(6), Eu. (-medit.), TH., Alopecuretum pratensis, Fraxino pannonicae - Ulmetum pannonicum, - Arrhenatheretea. TZ.

Compositae (Asteraceae)

(1184) Eupatorium cannabinum L. 1753, HT(6), Submedit., H., Populetalia, Epilobietea, Phragmitetea. TZ.

(1187) Solidago gigantea Ait. 1789, HT(6), Adv., H., Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, - Calistegion sepium. K.

(1188) Bellis perennis L. 1753, HT(6), Atl. -medit., H., Alopecuretum pratensis - Arrhenatheretea. TZ.

(1191) Aster sedifolius L. 1753 (A. punctatus) incl. A. s. ssp. canus (W. et K. 1800 p. sp.) Soó 1925, HT(6), Eua., Carp. -Pann. -Balk. (= ssp. canus), H., Peucedano-Asteretum. V.

(1199) Stenactis annua (L. 1753 sub Astero) Nees 1833, incl. S. a. ssp. strigosa (Mühlenbg. 1803) Soó 951, HT(6), Adv., Th., Calystegion sepium (Salicetea). TZ.

(1200) Erigeron canadensis L. 1753, HT(6), Adv., Th. -TH., Chenopodion-Scleranthea, Coryneporetalia etc. GY.

(1205) Filago arvensis L. 1753, HT(6), Submedit., Th., Chenopodion fluviatile. TP.

(1208) Gnaphalium sylvaticum L. 1753, HT(6), Cp., H., Epilobietea. K.

(1209) Gnaphalium uliginosum L. 1753, HT(6), s. l. Eua., Th., Nanocyperion (-Secalietea). TP.

(1210) Gnaphalium luteo-album L. 1753, HT(6), Cosm., Th., Nanocyperion (-Secalietea). GY.

(1215) Inula salicina L. 1753, HT(6), Eua. (-medit.), H., Arrhenatheretea. K.

(1219) Inula britannica L. 1753, HT(6), Eua., TH. -H., Plantaginetea, Molinietalia. G.

(1221) Pulicaria vulgaris Gärtn. 1791, HT(6), Eua. (-medit.), Th., Nanocyperion-Plantaginetea- Bidentetea. GY.

(1222) Pulicaria dysenterica (L. 1753 sub Inula) Gärtn. 1791, HT(6), Submedit., H., Nanocyperion. GY.
(1226) Telekia speciosa (Schreb. 1766 sub Buphthalmo) Baumg. 1816, Carp. -Balk. -Cauc., H., Fraxino pannonicae - Ulmetum pannonicum. V.
(1227) Ambrosia elatior L. 1753, et A. artemisiifolia L. 1753, HT(6), Adv., Th., Chenopodio-Scleranthea, Echinochloo-Polygonetum lapathifolii, Bidentetea. GY.
(1229) Xanthium spinosum L. 1753, HT(6), Adv., Th., Chenopodietea. GY.
(1230) Xanthium strumarium L. 1753, HT(6), Eua., Th., Chenopodio-Scleranthea. GY.
(1231) Xanthium italicum Moretti 1822, HT(6), Adv., Th., Bidentetea, Chenopodion fluviatile. GY.
(1232) Rudbeckia laciniata L. 1753, HT(6), Adv., H., Calystegion sepium. G.
(1234) Helianthus annuus L. 1753, HT(6), Adv., Th., Echinochloo-Polygonetum lapathifolii, Glycyrrhizetum echinatae, Bidentetea. G.
(1235) Helianthus decapetalus L. 1753, HT(6), Adv., H., Calystegion sepium. A.
(1236) Bidens tripartita L. 1753, HT(6), Eua. (-medit.), Th., Bidentetea. TZ.
(1237) Bidens cernua L. 1753, HT(6), Eua. (-medit.), Th., Bidentetea. TZ.
(1239) Galinsoga parviflora Cav. 1794, HT(6), Adv., Th., Chenopodieto-Scleranthea, Polygono-Chenopodietalia. GY.
(1240) Galinsoga quadriradiata Ruiz et Pavon 1798, HT(6), Adv., Th., Chenopodietea-Bidentetea. A.
(1241) Anthemis cotula L. 1753, HT(6), Medit., Th., Secalietea. GY.
(1243) Anthemis austriaca Jacq. 1778, HT(6), Medit., Th., Chenopodio-Scleranthea. TP.
(1244) Anthemis arvensis L. 1753, HT(6), Medit., Th., Chenopodio-Scleranthea, Secalietea. GY.
(1245) Anthemis ruthenica M. B. 1808, HT(6), Ponto-pannon, Th., Corynephoretalia. K.
(1247) Achillea ochroleuca Ehr. 1792, W. et K. 1800, HT(6), Ponto-pannon, H., Bidentetea. K.
(1248) Achillea nobilis L. 1753, HT(6), Eua. (-medit.), H., (- Quercetea), Bidentetea. K.
(1252) Achillea millefolium L. 1753, HT(6), Eua., H., Molinio-Arrhenatherea, (Bidentetea). TZ.
(1256) Matricaria matricarioides (Less 1831 sub Artemisia) Porter in Britt. 1894 (= M. discoidea DC. 1837, = Chamomilla suaveolens (Pursh) Rydberg 1916), HT(6), Adv., Th., Plantaginetea - Bidentetea. A.
(1258) Matricaria maritima L. 1753, HT(6), Eua., Th. -TH. -H. (Ch.), Chenopodio-Scleranthea, Bidentetea. GY.
(1260) Leucanthemum vulgare Lam. 1778, HT(6), Eua., H., Molinio -Arrhenatherea. K.
(1261) Leucanthemum serotinum (L. 1753) Stankow 1949, HT(6), Ponto-pannon, H., Fraxino pannonicae - Ulmetum pannonicum, Alopecuretum pratensis. K.
(1264) Tanacetum vulgare L. 1753, HT(6), Eua. (-medit.), H., Calystegion sepium & Arction. GY.
(1265) Artemisia vulgaris L. 1753, HT(6), s. l. Cp. (-medit.), H. (Ch.), Arction-Calystegion sepium. GY.
(1266) Artemisia pontica L. 1753, HT(6), Eua. (-medit.), H. (Ch), Bidentetea. K.
(1270) Artemisia campestris L. 1753, HT(6), Cp. -Eua., Ch., Festuco-Sedetalia. K.
(1271) Artemisia scoparia W. et K. 1801, HT(6), Eua., H., Bidentetea. K.
(1272) Artemisia annua L. 1753, HT(6), Eua., Th., Chenopodio - Scleranthea, Bidentetea. GY.
(1275) Tussilago farfara L. 1753, HT(6), Eua. (-medit.), G. (H.), Arction. TZ. (TP!)

(1276) Petasites hybridus (L. 1753 sub Tussilagine) G. M. Sch. 1801, HT(6), Eu.,(-medit.), G. (H.), Salicetum albae-fragilis, Salicetum triandrae. K.
(1293) Senecio jacobaea L. 1753, HT(6), Eua. (-medit.), H., Arrhenatheretea, Quercetea. K.
(1294) Senecio erraticus Bert. 1810, HT(6), Submedit., H., Molinio-Arrhenatheretea. TZ.
(1301) Calendula officinalis L. 1753, HT(6), Medit., Th. -TH., Bidentetea. –
(1302) Echinops sphaerocephalus L. 1753, HT(6), Eua., (-medit.), H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. TZ.
(1308) Arctium tomentosum Mill. 1768, HT(6), Eua., TH., Arction. GY.
(1309) Arctium lappa L. 1753, HT(6), Eua. (-medit.), TH., Bidentetea, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, Chenopodietea etc. GY.
(1310) Arctium minus (Hill 1762 sub Lappa) Bernh. 1800, HT(6), Eu. (-medit.), TH., Chenopodietea. GY.
(1314) Carduus acanthoides L. 1753, HT(6), Eu. (-medit.), TH., Chenopodietea, Plantaginetea, - Onopordion. GY.
(1316) Carduus crispus L. 1753, HT(6), Eu. (-medit.), TH., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. K.
(1319) Cirsium vulgare (Savi 1798 sub Carduo) Ten. 1836, Petrak 1912, Airy-Shaw 1938, HT(6), Eu. (-medit.), TH., Chenopodietea, Salicetum albae-fragilis C. v. ssp. sylvaticum (Tausch 1829 p. sp.) Arènes 1947, Dost. 1950. GY.
(1322) Cirsium arvense (L. 1753 sub Serratula) Scop. 1772, HT(6), Eua. (-medit.), G., Chenopodio-Scleranthea, Populetalia, Nanocyperion, Onopordion. GY.
(1323) Cirsium brachycephalum Jur. 1857, HT(6), Pann. endem., TH. -H., Agrostion-Magnocaricion. V.
(1325) Cirsium canum (L. 1767 sub Carduo) All. 1785, HT(6), Eua. -Cont., G., Molinio-Juncetea-Magnocaricion. K.
(–) Cirsium grandiflorum Kitt. 1844, (= C. eriophorum x vulg.), HT(6), Eu., TH., Salicetum albae-fragilis. –
(1330) Onopordon acanthium L. 1753, HT(6), Eua. (-medit.), TH., Onopordion. GY.
(1332) Serratula tinctoria L. 1753, HT(6), Eu. (-medit.), H., Molinion. TZ.
(1337) Centaurea cyanus L. 1753, HT(6), Medit., Th., Secalietea. GY.
(1346) Centaurea arenaria M. B. in Willd. 1800, HT(6), Ponto-Pannon-Balc., H., Bidentetea. K.
(1356) Centaurea indurata Janka 1858, HT(6), Dacic., H., Fraxino pannonicae - Ulmetum pannonicum. K.
(1358) Cichorium intybus L. 1753, HT(6), Eua. (-medit.), H. (TH.), Arrhenatheretea, Agrostion, Polygonion avicularis etc. GY.
(1359) Lapsana communis L. 1753, HT(6), Eua. (-medit.), Th. (TH., H.), Fraxino pannonicae - Ulmetum pannonicum etc. TZ.
(1364) Leontodon autumnalis L. 1753, HT(6), Eua., H., Molinio-Arrhenatheretea. TZ.
(1365) Leontodon hispidus L. 1753, HT(6), Eu., H., Molinio-Arrhenatheretea. K.
(1367) Picris hieracioides L. 1753, HT(6), Eua. (-medit.), TH. (-H.), Festuco-Brometea, Chenopodio-Scleranthea etc. GY.
(1370) Tragopogon orientalis L. 1753, HT(6), Eua. (-medit.), TH. -H. (G.), Arrhenatheretea-Agrostion (Quercetea), Chenopodietea etc. TZ.
(1376) Podospermum canum C. A. Mey. 1831, HT(6), Ponto-Medit., H. (TH.), Daucus carota - Matricaria indora ass., Alopecuretum pratensis etc. K.
(1381) Taraxacum laevigatum (Willd. 1803 sub Leontodonte) DC. 1813, HT(6), Eua. (-medit.), H., Chenopodietea. –
(1384) Taraxacum officinale Weber in Wiggers 1780, HT(6), s. l. Eua. (-medit.), H., Molinio-Arrhenatheretea, Chenopodio-Scleranthea. GY.

(1385) Mycelis muralis (L. 1753 sub “Prenanthes”) Dum. 1827, HT(6), Eu. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum. K.
(1389) Lactuca saligna L. 1753, HT(6), Submedit., Th. -TH., Chenopodio-Scleranthea. G.
(1393) Sonchus oleraceus L. 1753 em. Gouen 1762, HT(6), Eua. (-medit.), Th., Chenopodio-Scleranthea. GY.
(1394) Sonchus asper (L. 1753 p. var.) Hill 1769, HT(6), Eua. (-medit.), Th., Chenopodio-Scleranthea. GY.
(1400) Crepis tectorum L. 1753, HT(6), Eua., Th., Secalietea, Plantaginetea; Sisymbrion. GY.
(1401) Crepis biennis L. 1753, HT(6), Eu., TH., Arrhenatheretea-Agrostion. K.
(1406) Crepis setosa Hall. f. 1797, HT(6), Submedit., Th., Chenopodio-Scleranthea. GY.
(1411) Hieracium bauhinii Schult. ex Bess. 1809, HT(6), Eu., H., Alopecuretum pratensis. K.

Loranthaceae
(1428) Loranthus europaeus Jacq. 1762, HT(6), Submedit., H., Querco-Fagea, Quercetea. GY.
(1429) Viscum album L. 1753, HT(6), Medit., N., Fraxino pannonicae – Ulmetum pannonicum, - Querco-Fagea. TZ.

Santalaceae
(1432) Thesium arvense Horvátovszky 1774, HT(6), Eua., TH. -H. Cynodonti – Poëtum angustifoliae. K.

Portulacaceae
(1437) Portulaca oleracea L. 1753, HT(6), Medit., Th., Chenopodio-Scleranthea, (Bidentetea, Cynodonti-Poëum angustifoliae, Salicetum triandrae etc.). GY.

Caryophyllaceae
(1438) Agrostemma githago L. 1753, HT(6), Medit., Th., Secalietea. V.
(1441) Lychnis flos-cuculi L. 1753, HT(6), Eua. (-medit.), H., Molino-Arrhenatherea. TZ.
(1444) Silene alba Krause in Sturm 1901 (= Melandrium album /Mill. 1768 sub Lychnide/ Garcke 1858), HT(6), Eua. (-medit.), Th. -TH. Chenopodio-Scleranthea, Populetalia etc. GY.
(1453) Silene vulgaris (Mönch 1794 sub Behen) Garcke 1869 (S. cucubalus Wibel 1799), HT(6), Eua-medit., H. (Ch.), Alopecuretum pratensis, Echinochloo-Polygonetum lapathifolii etc. K.
(1459) Cucubalus baccifer L. 1753, HT(6), Eua., H., Calystegion sepium. K.
(1460) Gypsophila muralis L. 1753, HT(6), Eua., Th., Nanocyperetalia, Bidentetea etc. TP.
(1461) Gypsophila fastigiata L. 1753, HT(6), Eua., G. (-Ch.), Chenopodion fluviatile, (Bidentetea). K.
(1462) Gypsophila paniculata L. 1753, HT(6), Eua., G. (-Ch.), Chenopodion fluviatile, (Bidentetea). K.
(1471) Dianthus deltoides L. 1753, HT(6), Eua. (-medit.), H., Arrhenatheretea, Festuco-Sedetalia. K.
(1472) Dianthus armeria L. 1753, HT(6), Eu., Th. (-TH.), Quercetea (-Arrhenatheretea). TZ.
(1476) Saponaria officinalis L. 1753, HT(6), Eua., (-medit.), H., Salicetum albae-fragilis, Salicetum triandrae, Cuscuto-Calystegietum sepium etc. TZ.

(1478) Stellaria media (L. 1753 sub Alsine) Cyr. 1784, Vill. 1789, HT(6), Cp., Th. -TH., Populetalia. GY.
(1482) Stellaria palustris Ehrh. 1789 nom. nud. in Retz. 1795, HT(6), Eua., H., Fraxino pannonicae - Ulmetum pannonicum, (-Phragmitetea). K.
(1483) Myosoton aquaticum (L. 1753 sub Cerastio) Mönch 1794, HT(6), Eua. (-medit.), Th. -TH. -Ch. (G.), Populetalia (-Phragmitetea). GY.
(1484) Cerastium dubium (Bast. 1812 sub Stellaria) Guépin 1830, Schwarz 1949, HT(6), Ponto-medit., Th., Echinochloo-Polygonetum lapathifolii. TP.
(1487) Cerastium brachypetallum Desp. in Pers. 1805, HT(6), Submed. -M. Eu., Th., Arrhenetheretea, Onopordion. TP
(1493) Holosteum umbelatum L. 1753, HT(6), Submed., Th., (! Echinochloo-Polygonetum lapathifolii, Salicetum triandrae). GY.
(1495) Sagina procumbens L. 1753, HT(6), Cp., H. (Ch.), Plantaginetea, Secalietea, Nanocyperion etc. GY.
(1507) Arenaria serpyllifolia L. 1753, HT(6), Eua. (-medit.), Th., Echinochloo-Polygonetum lapathifolii, Agropyretum repentis, Sclerochloo-Polygonetum avicularis etc. TP.
(1509) Moehringia trinervia (L. 1753 sub Arenaria) Clairv. 1811, HT(6), Eua. (-medit.), Th. -H., Fraxino pannonicae - Ulmetum pannonicum. K.
(1515) Spergularia rubra (L. 1753 sub Arenaria) Presl 1819, HT(6), Eua. (-medit.), Th. (-H.), Eleochari (aciculari) - Schoenoplectetum supini, Pulicaria vulgaris - Mentha pulegium ass., Bidentetea, Echinochloo-Polygonetum lapathifolii, - Nanocyperion, Bidentetea, Plantaginetea etc. TP.
(1518) Scleranthus polycarpos Torn. in L. 1756, HT(6), Eu. (-medit.), Th., Alopecuretum pratensis. TP.
(1520) Scleranthus annuus L. 1753 s. str., HT(6), Eua. (-medit.), Th. (TH.), Chenopodio-Scleranthea, Bidentetea, Echinochloo-Polygonetum lapathifolii etc. GY.
(1522) Herniaria glabra L. 1753, HT(6), Eua. (-medit.), Th. -TH. -H., Echinochloo-Polygonetum lapathifolii, Bidentetea. GY.

Chenopodiaceae
(1527) Polycnemum arvense L. 1753, HT(6), Eua. (-medit.), Th., Heliotropio - Verbenion supini, (Echinochloo-Polygonetum lapathifolii, Bidentetea), -Secalietea. GY.
(1528) Polycnemum majus A. Br. 1841, HT(6), Ponto-medit., Th., Secalietea. TP.
(1531) Chenopodium botrys L. 1753, HT(6), Submedit., Th., Bidentetea, Echinochloo-Polygonetum lapathifolii etc. TP.
(1534) Chenopodium polyspermum L. 1753, HT(6), Eua. (-medit.), Th., Bidentetea, Echinochloo-Polygonetum lapathifolii etc. GY.
(1536) Chenopodium hybridum L. 1753, HT(6), Eua. (-medit.), Th., Bidentetea, Echinochloo-Polygonetum lapathifolii, Echinochloo - Setarietum etc. GY.
(1537) Chenopodium murale L. 1753, HT(6), S-Eua., Th., Glycyrrhizetum echinatae, Salicetum triandrae. GY.
(1538) Chenopodium urbicum L. 1753, HT(6), Eua. (-medit.), Th., Bidentetalia, Echinochloo-Polygonetum lapathifolii, Glycyrrhizetum echinatae etc. GY.
(1539) Chenopodium rubrum L. 1753, HT(6), Cp., Th., Bidentetalia, Echinochloo-Polygonetum lapathifolii, Salicetum triandrae. GY.
(1541) Chenopodium glaucum L. 1753, HT(6), Eua., Th., Bidentetalia, Echinochloo-Polygonetum lapathifolii, Chenopodietum rubri, Onopordetalia, Glycyrrhizetum echinatae, Cypero-Juncetum, Salicetum albae-fragilis, Salicetum triandrae. GY.
(1542) Chenopodium ficifolium Sm. 1800, HT(6), S-Eua., Th., Bidentetalia, Echinochloo- Polygonetum lapathifolii, Glycyrrhizetum echinatae. GY.

(1544) Chenopodium strictum Roth 1821, HT(6), S-Eua., Th., Heliotropio - Verbenetum supinae, Salicetum triandrae, Sclerochloo-Polygonetum avicularis. GY.
(1545) Chenopodium album L. 1753, HT(6), Eua. (-medit.), Th., Chenopodio-Scleranthea. GY.
(1547) Atriplex acuminata W. et K. 1802 non M. B. 1808, HT(6), Cont., Th., Bidentetalia, Echinochloo-Polygonetum lapathifolii, Cuscuto - Calystegietum sepium. GY.
(1549) Atriplex oblongifolia W. et K. 1807, HT(6), M-Eu., Th., Echinochloo-Polygonetum lapathifolii. GY.
(1550) Atriplex patula L. 1753, HT(6), Cp., Th., Cuscuto-Calystegium sepium etc. GY.
(1551) Atriplex hastata L. 1753, = A. prostrata Boucher 1803, HT(6), Cp., Th., Bidentetalia, Echinochloo-Polygonetum lapathifolii, Chenopodietum rubri, Glycyrrhizetum echinatae, Salicetum triandrae etc. GY.
(1552) Atriplex tatarica L. 1753, HT(6), Eua. (-medit.), Th., Bidentetalia, Echinochloo- Polygonetum lapathifolii, Echinochloo - Setarietum, Chenopodietum rubri etc. GY.

Amaranthaceae
(1567) Amaranthus retroflexus L. 1753, HT(6), Adv., Th., Chenopodio-Scleranthea. GY.
(1568) Amaranthus chlorostachys Willd. 1790, HT(6), Adv., Th., Chenopodio-Scleranthea. GY.
(1572) Amaranthus albus L. 1759, HT(6), Adv., (Th.), Chenopodio-Scleranthea. GY.
(1573) Amaranthus crispus (Lespinasse et Théveneau 1859 sub Euxolo) Terrac. 1890, HT(6), Adv., Th., Chenopodietea. GY.
(1574) Amaranthus graecians L. 1753, HT(6), S-Eua., Th., Chenopodio-Scleranthea. GY.
(1576) Amaranthus lividus L. 1753 em. Thell. 1914, HT(6), Cp., Th., Bidentetalia, Echinochloo - Setarietum, Glycyrrhizetum echinatae, Onopordetalia, Xanthietum etc. GY.

Primulaceae
(1584) Hottonia palustris L. 1753, HT(6), Eu., HH., Fraxino pannonicae - Ulmetum pannonicum, - Potamion (Alnetea). V.
(1586) Lysimachia nummularia L. 1753, HT(6), Eu. (-medit.), Ch., Phragmitetea, Molinio-Juncetea, Populetalia, Bidentetea etc. K.
(1588) Lysimachia vulgaris L. 1753, HT(6), Eua. (-medit.), HH., Phragmitetea, Molinio-Juncetea, Populetalia etc. K.
(1591) Anagallis arvensis L. 1753, HT(6), Medit., Th., Chenopodio-Scleranthea. GY.
(1592) Anagallis femina Mill. 1768, HT(6), Medit., Th., Secalietea. GY.

Polygonaceae
(1597) Rumex acetosella L. 1753, MT(6), Cp., H. (G.), Festuco-Sedetalia. K.
(1598) Rumex acetosa L. 1753 s. str., HT(6), Cp., H., Molinio-Arrhenatherea (Quercetea). TZ.<F255P255>
(1605) Rumex crispus L. 1753, HT(6), Cp., H., Molinio-Arrhenatherea (-Plantaginetea, - Bidentetea). TZ.
(1606) Rumex stenophyllus Ledeb. 1830, HT(6), Eua., H., Bidentetea, Secalietea. TZ.
(1608) Rumex sanguineus L. 1753, HT(6), Eu., H., Salicetum albae-fragilis, Salicetum triandrae, Bidentetea, Echinochloo-Polygonetum lapathifolii etc. K.
(1609) Rumex hydrolapatum Huds. 1778, HT(6), M-Eu., H., Phragmitetea. TZ.

(1610) Rumex oCTusifolius L. 1753, HT(6), Eu., H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Alopecuretum pratensis, Cuscuto - Calystegietum sepium etc. TZ.
(1613) Rumex palustris Sm. 1800, HT(6), Eua. (-medit.), Th. -TH., Phragmitetea-Bidentetea. TP.
(1616) Polygonum amphibium L. 1753, HT(6), Cp., HH., Salicetea, Secalietea, Phragmitetea, Bidentetea etc. K.
(1617) Polygonum lapathifolium L. 1753, HT(6), Cp., Th., Populetalia, Phragmitetea etc. GY.
(1618) Polygonum persicaria L. 1753, HT(6), Eua. (-medit.), Th., Populetalia, Phragmitetea etc. GY.
(1619) Polygonum hydropiper L. 1753, HT(6), Eua. (-medit.), Th., Bidentetea (-Populetalia). TZ.
(1620) Polygonum mite Schrank 1789, HT(6), Eu. (-medit.), Th., Bidentetea (-Populetalia). TZ.
(1621) Polygonum minus Huds. 1762, HT(6), Eua., Th., Bidentetea. TZ.
(1622) Polygonum arenarium W. et K. 1801, HT(6), Ponto-pannon, Th., Setario - Digitarietum. TP.
(1624) Polygonum patulum M. B. 1808, HT(6), Eua. (-medit.), Th., Consolido - Eragrostion poaeoides. K.
(1625) Polygonum aviculare L. 1753, HT(6), Cp., Th., Chenopodio-Scleranthea, Plantaginetea, Nanocyperion etc. GY.
(1626) Fallopia = Bilderdykia convolvulus (L. 1753 sub Polygono) Dum. 1827, HT(6), Eua. (-medit.), Th., Bidentetea, Echinochloo-Polygonetum lapathifolii, Echinochloo - Setarietum, Onopordetalia, Glycyrrhizetum echinatae, Eleochari - Schoenoplectetum etc. GY.
(1627) Bilderdykia dumetorum (L. 1753 sub Polygono) Dum. 1827, HT(6), Eua. (-medit.), Th., Salicetum alba-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Cuscuto- Calystegietum sepium etc. GY.
(1628) Reynoutria japonica Houttuyn 1777, HT(6), Adv., G., Calystegion sepium. A.

Moraceae

(–) Morus alba L. 1753, HT(6), Adv., MM., Salicetum albae-fragilis. –
(–) Morus nigra L. 1753, HT(6), Adv., MM., Salicetum albae-fragilis. –

Cannabinaceae

(1630) Humulus lupulus L. 1753, HT(6), Cp., H., Populetalia, (Cuscuto-Calystegium sepium). TZ.

Urticaceae

(1633) Urtica dioica L. 1753, HT(6), Eua., H., Populetalia, Epilobietea. TZ.
(1634) Urtica kioviensis Rogowitsch 1843, HT(6), Ponto-pannon, H. (G.), Phragmition. V.
(1635) Urtica urens L. 1753, HT(6), Eua. (-medit.), Th., Chenopodietea. GY.

Ulmaceae

(1637) Ulmus laevis Pall. 1784, HT(6), Eu., MM., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. K.
(1638) Ulmus minor Mill. 1768, HT(6), M-Eu. (-medit.), MM. -M., Fraxino pannonicae-Ulmetum, Salicetum albae-fragilis. K.
(1640) Ulmus glabra Huds. 1762 non Mill (U. scabra Mill. 1768) HT(6), Eu., MM. -M., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis,

Salicetum triandrae, Glycyrrhizetum echinatae, Echinochloo-Polygonetum lapathifolii etc. K.

Betulaceae

(1642) Carpinus betulus L. 1753, HT(6), M-Eu., MM. -M., Fraxino pannonicae - Ulmetum pannonicum, (! Carpinion). E.

(1643) Corylus avellana L. 1753, HT(6), Eu., M., Fr. p. -U., Querco-Fage(te)a. K.

(1644) Betula pendula Roth 1788, HT(6), Eua ~ Eurosib., MM. -M., Fraxino pannonicae - Ulmetum pannonicum. E.

(1647) Alnus glutinosa (L.) Gärtn. 1791, HT(6), Eu. (-medit.), MM. -M., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis. E.

Fagaceae

(1658) Quercus robur L. 1753, HT(6), Eu. (-medit.), MM. -M., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis. E.

Juglandaceae

(1659) Juglans regia L. 1753, HT(6), Balc. -Cauc., MM., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. G.

Salicaceae

(1660) Populus tremula L. 1753, HT(6), Eua. (-medit.), MM. -M., Fraxino pannonicae -Ulmetum pannonicum. TZ.

(1661) Populus alba L. 1753, HT(6), S-Eua., MM. -M., Fraxino pannonicae - Ulmetum pannonicum, Salicetum triandrae, Salicetum albae-fragilis. E.

(1662) Populus nigra L. 1753, HT(6), S-Eua., MM. -M., Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum,Glycyrrhizetum echinatae, Cuscuto-Calystegietum sepium etc. E.

(1663) Populus x canescens (Ait. 1789 p. var. P. albae) Sm. 1803 (P. alba x tremula), HT(6), Eua., MM. -M., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis. E.

(1665) Salix fragilis L. 1753, HT(6), Eua. (-medit.), MM. -M., Salicetum albae-fragilis, Salicetum triandrae, Bidentetea, Echinochloo-Polygonetum lapathifolii, Cuscuto-Calystegion sepium. K.

(1666) Salix triandra L. 1753, HT(6), Eua., M., Salicetum triandrae, Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Bidentetea, Echinochloo-Polygonetum lapathifolii, Chenopodietum rubri, Glycyrrhizatum echinatae, Cuscuto-Calystegietum sepium etc. K.

(1667) Salix alba L. 1753, HT(6), Eua. (-medit.), MM. -M., Salicetum albae-fragilis, Salicetum triandre, Fraxino pannonicae - Ulmetum pannonicum, Bidentetea, Echinochloo-Polygonetum lapathifolii, Cuscuto-Calystegietum sepium etc. E.

(1668) Salix caprea L. 1753, HT(6), Eua., M. Fraxino pannonicae – Ulmetum pannonicum, Cuscuto-Calystegietum sepium etc. TZ.

(1670) Salix cinerea L. 1753, HT(6), Eua., (-medit.), M., Fraxino pannonicae – Ulmetum pannonicum, Alopecuretum pratensis etc. E.

(1671) Salix elaeagnos Scop. 1772, HT(6), M-Eu., M., Salicetum triandrae. V.

(1672) Salix viminalis L. 1753, HT(6), Eua., M., Salicetum triandrae, Salicetum albae-fragilis. E.

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Alismataceae

(1675) Alisma plantago-aquatica L. 1753, HT(6), Cp., HH., Phragmitetea (Lemno-Potamea). K.

(1676) Alisma lanceolatum With. 1796, Haberle 1824, Schultz 1825 p. var. Holmberg 1922 p. ssp., HT(6), S-Eua, HH., Phragmitetea (Lemno-Potamea). K.
(1679) Sagittaria sagittifolia L. 1753, HT(6), Eua. (- medit.), HH., Phragmition (Lemno-Potamea). K.

Butomaceae
(1680) Butomus umbellatus L. 1753, HT(6), Eua. (-medit.), HH., Phragmitetea (-Potametalia). K.

Hydrocharitaceae
(1683) Stratiotes aloides L. 1753, HT(6), Eua. (Eurosib.), HH., Lemno-Potamea, esp. Hydrocharition. E.
(1684) Hydrocharis morsus-ranae L. 1753, HT(6), Eua., HH., Lemno-Potamea, esp. Hydrocharition. K.
(1686) Triglochin palustris L. 1753, HT(6), Cp., H., Molinio-Juncetea. K.

Potamogetonaceae
(1687) Potamogeton natans L. 1753, HT(6), Cp. (-medit.), HH. Lemno-Potamea, esp. Nymphaeion. E.
(1688) Potamogeton nodosus Poir. ex. Lam. 1816, HT(6), Cosm. (Cp.), HH. Lemno-Potamea, esp. Batrachion fluitantis. K.
(1690) Potamogeton lucens L. 1735, HT(6), Eua. (-medit.), HH., Potamion. K.
(1691) Potamogeton x zizii Koch ex Roth 1827 (= P. angustifolius Berchtold et Presl 1821 ?), HT(6), Eua., HH., Potamion. K.
(1692) Potamogeton gramineus L. 1753, HT(6), Cp., HH., Lemno-Potamea, esp. Potamion. K.
(1693) Potamogeton perfoliatus L. 1753, HT(6), Cp., HH., Potametalia, esp. Potamion. K.
(1694) Potamogeton crispus L. 1753, HT(6), Cp., HH., Potametalia. K.
(1695) Potamogeton acutifolius Link ex R. et Sch. 1818, HT(6), Eu., HH., Potamion. K.
(1697) Potamogeton pusillus L. 1753, HT(6), Cp., HH., Potametalia, esp. Potamion. K.
(1699) Potamogeton pectinatus L. 1753, HT(6), Cp., HH., Potametalia. E

Najadaceae
(1703) Najas marina L. 1753, emend. Asch. 1864, HT(6), Cp., HH., Lemno-Potamea. K.
(1704) Najas minor All. 1785, HT(6), S-Eua. -Afr., HH., Lemno Potamea. K.

Liliaceae
(1710) Colchicum autumnale L. 1753, HT(6), M-Eu. (-Submed.), G., Molinio-Arrhenatheretea. K.
(1717) Gagea minima (L. 1753 sub Ornithogalo) Ker-Gawl. 1816, HT(6), Cont., G., Fraxino pannonicae - Ulmetum pannonicum. K.
(1718) Gagea spathacea (Hayne 1797 sub Ornithogalo) Salisb. 1806, HT(6), M-Eu., G., Fraxino pannonicae - Ulmetum pannonicum. V.
(1720) Gagea lutea (L. 1753 sub Ornithogalo p. p.) Ker-Gawl. 1809, HT(6), Eua., G., Fraxino pannonicae - Ulmetum pannonicum. K.
(1722) Allium ursinum L. 1753, HT(6), M-Eu., G., Fraxino pannonicae - Ulmetum pannonicum. K.
(1725) Allium angulosum L. 1753, HT(6), Eua., G., Alopecuretum pratensis, Fraxino pannonicae - Ulmetum hungaricum. K.

(1730) Allium oleraceum L. 1753, HT(6), Eu., G., Arrhenatheretea fragm. K.
(1736) Allium scorodoprasum L. 1753, HT(6), M-Eu., G., Fraxino pannonicae - Ulmetum pannonicum. TZ.
(1740) Fritillaria meleagris L. 1753, HT(6), Eu. (-medit.), G., Fraxino pannonicum - Ulmetum pannonicum. V.
(1742/b) Scilla kladnii Schur 1850 (= S. suCTriphylla Schur. 1866, S. bifolia ssp. suCTriphylla (Schur) Domin 1935), HT(6), M-Eu. -Submed., G., Fraxino pannonicae – Ulmetum pannonicum. V.
(1744) Ornithogalum bouchéanum (Kunth 1843 sub Myogalo) Asch. 1866., HT(6), Balc., G., Arction, Secalietea. GY.
(1749) Ornithogalum gussonei Ten. 1829, HT(6), Ponto-medit., G., Fraxino pannonicae - Ulmetum pannonicum, Alopecuretum pratensis. K.
(1750) Ornithogalum umbellatum L. 1753, HT(6), Submedit., G., Fraxino pannonicae - Ulmetum pannonicum, - Secalietea etc. TZ.
(1752) Muscari comosum (L. 1753 sub Hyacintho) Mill. 1768, HT(6), Submed. -M-Eu., G., (Festuco-Brometea) Secalietea. TZ.
(1756) Asparagus officinalis L. 1753, HT(6), Eua. (-medit.), G., Onopordetalia Quercetea. K.
(1759) Majanthemum bifolium (L. 1753 sub convallaria) F. W. Schm. 1794, HT(6), Eua., G., Fraxino pannonicae - Ulmetum pannonicum, - Fagetalia. K.
(1761) Polygonatum latifolium (Jacq. 1776 sub Convallaria) Desf. 1807, HT(6), Ponto-balc. -pannon, G., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. K.
(1762) Polygonatum odoratum (Mill. 1768 sub Convallaria) Druce 1906, HT(6), Eua. (-medit.), G., Fraxino pannonicae - Ulmetum pannonicum, Fagetalia. K.
(1763) Polygonatum multiflorum (L. 1753 sub Convallaria) All. 1785, HT(6), Eu. & S-Eua., G., Fraxino pannonicae - Ulmetum pannonicum, Fagetalia. K.
(1764) Convallaria majalis L. 1753, HT(6), Eu., G., Fraxino pannonicae - Ulmetum pannonicum. K.

Amaryllidaceae
(1766) Galanthus nivalis L. 1753, HT(6), M-SE-Eu., G., Fraxino pannonicae – Ulmetum pannonicum, Salicetum albae-fragilis. K.
(1767) Leucojum vernum L. 1753, HT(6), M-Eu., G., Fraxino pannonicae – Ulmetum pannonicum, - Carpinion. V.
(1768) Leucojum aestivum L. 1753, HT(6), Atl. -Medit., G., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. V.

Iridaceae
(1777) Gladiolus imbricatus L. 1753, HT(6), Cont., G., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis. V.
(1783) Iris pseucacorus L. 1753, HT(6), Eu. -medit., G. -HH., Phragmitetea (Populetalia). K.

Juncaceae
(1787) Juncus bufonius L. 1753, HT(6), Cosm., Th., Nanocyperetalia & Plantaginetea, Bidentetea etc. GY.
(1790) Juncus compressus Jacq. 1762, HT(6), Eurosib., G., Agrostion albae & Festuco-Pucc. (Plantaginetea), Nanocyperion. TZ.
(1792) Juncus tenuis Willd. 1799, HT(6), Adv., H., Nanocyperion; resp. Polygonion avicularis. GY.
(1794) Juncus conglomeratus L. 1753, HT(6), Eu., H., Molinietalia. TZ.

(1795) Juncus effusus L. 1753(B), 1755, HT(6), Cosm., H., Phragmitetea, Populetalia, Bidentetea etc. TZ.
(1800) Juncus atratus Krocker 1787, HT(6), Eua., H., Agrostion albae, Alopecuretum pratensis etc. K.
(1802) Juncus articulatus L. 1753, HT(6), Cp., H., Phragmitetea, Nanocyperetalia, Bidentetea, Plantaginetea etc. TZ.
(1806) Luzula campestris (L. 1753 sub Junco) Lam. et D. C. 1805, HT(6), Eu. -medit., H., Arrhenatherea, Quercetea, Junco-Molinietea etc. TZ.

Orchidaceae
(1813) Epipactis palustris (Mill. 1768 sub Serapidae) Cr. 1769, HT(6), Eua. -Eurosib., G., Fraxino pannonicae - Ulmetum pannonicum. V.
(1817) Epipactis helleborine Cr. 1769 s. str., HT(6), Eua., G., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis. V.
(1819) Listera ovata (L. 1753 sub Ophryde) R. Br. ex Ait. 1813, HT(6), Eua. -medit., G., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis. V.
(1820) Neottia nidus-avis (L. 1753 sub Ophryde) Rich. 1818, HT(6), Eurosib., G., Fraxino pannonicae - Ulmetum pannonicum. V.
(1827) Platanthera bifolia (L. 1753 sub Orchide) Rchb. 1830, HT(6), Eua., G., Fraxino pannonicae - Ulmetum pannonicum. V.
(1828) Platanthera chlorantha (Custer 1827 sub Orchide) Rchb. ex Mössler 1828, HT(6), Eua. (-medit.), G., Fraxino pannonicae - Ulmetum pannonicum, alopecuretum pratensis etc. V.
(1845) Orchis laxiflora Lam. 1778, ssp. elegans (Heuff. 1835 p. sp.) Soó 1926, A. et G. 1907 p. var., HT(6), Ponto-pannon, G., Fraxino pannonicae – Ulmetum pannonicum. etc. V.
(1851) Dactylorhiza fuchsii (Druce 1914 p. sp. Orchide) Soó 1960 1962, HT(6), Eua., G., Fraxino pannonicae - Ulmetum pannonicum. V.

Cyperaceae
(1867) Schoenoplectus supinus (L. 1753 sub Scirpo) Palla 1888 = Isolepis supina R. Br. 1810, HT(6), Cp., Th. (HH.), Nanocyperion. TP.
(1869) Eleocharis acicularis (L. 1753 sub Scirpo) R. et Sch. 1817, HT(6), Cp., H., Nanocyperion. TP.
(1871) Eleocharis ovata (Roth 1793 sub Scirpo) R. et Sch. 1817, HT(6), Cp., Th., Nanocyperion. TP.
(1872) Eleocharis carniolica Koch 1844, HT(6), Alp. -Carp. -Balc., Th., Nanocyperion. V.
(1873) Eleocharis palustris (L. 1753 sub Scirpo) R. et Sch. 1817, s. l., HT(6), Cosm., G. (-HH.), Phragmitetea, Molinio-Juncetea, Nanocyperetalia etc. K.
(1880) Cyperus fuscus L. 1753, HT(6), Eua. (-medit.), Th., Nanocyperion. TZ.
(1882) Chlorocyperus glomeratus (Torn. in L. 1756 sub Cypero) Palla 1900, HT(6), Eua. (E-medit.), HH., Nanocyperion (-Bidentetea). E.
(1885) Dichostylis micheliana (L. 1753 sub Scirpo) Nees 1835, HT(6), Eua. (-medit.), Th., Nanocyperion (Bidentetea). TP.
(1887) Pycreus flavescens (L. 1753 sub Cypero) Rchb. in Mössler 1829, HT(6), Submed., Th., Nanocyperion. GY.
(1892) Carex bohemica Schreb. 1772, HT(6), Eua., H., Nanocyperion. V.
(1893) Carex stenophylla Wahlbg. 1803, HT(6), Cp., G., Chenopodion fluviatile. E.
(1898) Carex vulpina L. 1753 s. str., HT(6), Eua. -medit., H. -HH., Magnocaricion, Phragmition. K.
(1900) Carex spicata Huds. 1762, HT(6), Eua. (-medit.), H., Fraxino pannonicae – Ulmetum pannonicum. K.

(1903) Carex praecox Schreb. 1771, HT(6), Eua. (Eurosib.), G. -H., (Quercetea). K.
(1904) Carex brizoides Jusl. ex L. 1755, HT(6), M-Eu., (G. -)H., Fraxino pannonicae - Ulmetum pannonicum, Salicetum triandrae. K.
(1905) Carex elongata L. 1753, HT(6), Eurosib., H., Alnetea glutinosae. E.
(1908) Carex leporina L. 1753, HT(6), Eurosib., H., Fraxino pannonicae – Ulmetum pannonicum. K.
(1911) Carex remota Jusl. ex L. 1755, Grufbg. ex L. 1759, HT(6), Eu. (-medit.), H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. K.
(1912) Carex nigra (L. 1753 p. var. C. acutae) Reichhard 1778, Beck 1890, HT(6), Amphiatl., G., Fraxino pannonicae - Ulmetum pannonicum. K.
(1913) Carex gracilis Curtis 1783, HT(6), Eua. -Eurosib., G. -HH., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. K.
(1920) Carex pallescens L. 1753, HT(6), Cp., H., Fraxino pannonicae - Ulmetum pannonicum. K.
(1935) Carex sylvatica Huds. 1762, HT(6), Eu. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum. K.
(1936) Carex strigosa Huds. 1778, HT(6), Atl. -M-Eu., H., Fraxino pannonicae - Ulmetum pannonicum. V.
(1939) Carex pilosa Scop. 1772, HT(6), Sarmat., H., Fraxino pannonicae - Ulmetum pannonicum. E.
(1940) Carex distans L. 1753, HT(6), Eu. -medit., H., Nanocyperion, Salicetum triandrae, Echinochloo-Polygonetum, Bidentetea. E.
(1949) Carex vesicaria L. 1753, HT(6), Cp., HH., Salicetum albae-fragilis. E.
(1950) Carex acutiformis Ehr. 1788, HT(6), Eua. (-medit.), HH., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Salicetum triandrae. E.
(1951) Carex riparia Curt. 1783, HT(6), Eua. (-medit.), HH., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum etc. E.
(1952) Carex melanostachya Willd. 1805, HT(6), Eua., HH., Fraxino pannonicae - Ulmetum pannonicum. E.
(1953) Carex lasiocarpa Ehr. 1742, HT(6), Cp., HH., Scirpo - Phragmitetum. E.
(1954) Carex hirta L. 1753, HT(6), Eu. (-medit.), G., Bidentetea, Cuscuto-Calystegietum sepium, Xanthietum, Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum etc. GY.

Gramineae (Poaceae)
(1958) Bromus inermis Leyss. 1761, HT(6), Cp., H. Alopecuretum pratensis - mainly-poëtosum, Cynodonti-Poëtum angustifoliae, Cuscuto-Calystegietum sepium, Salicetum albae-fragilis etc. K.
(1960) Bromus sterilis L. 1753, HT(6), Eua. (-medit.), Th., Bidentetea, Chenopodietea, Glycyrrhizetum echinatae, Fraxino pannonicae - Ulmetum pannonicum. GY.
(1961) Bromus tectorum L. 1753, HT(6), S-Eua., Th., Cynodonti - Poëtum angustifoliae, Cuscuto - Calystegietum sepium, Onopordetalia, Cypero-Juncetum etc. TP.
(1962) Bromus arvensis L. 1753, HT(6), Eua. (-medit.), Th. -TH., Bidentetea, Echinochloo-Polygonetum, Glycyrrhizetum echinatae, Cuscuto-Calystegietum sepium etc. GY.
(1964) Bromus commutatus Schrad. 1806, Eu. (Atl. -medit.), Th., Alopecuretum pratensis, Pulicaria vulgaris-Mentha pulegium ass., - Arrhenatheretea, Echietosum. TZ.
(1965) Bromus mollis L. 1762 = B. hordaceus L. 1753 ssp. mollis Hyl. 1945, Eu. -medit., Th., Alopecuretum pratensis, Bidentetea, Echinochloo-Polygonetum, Onopordetalia, Fraxino pannonicae - Ulmetum pannonicum etc. TZ.

(1967) Bromus japonicus Thunb. 1784, HT(6), S-Eua., Th., Nanocyperion, Echinochloo-Polygonetum lapathifolii, Bidentetea, Chenopodietea. GY.
(1968) Bromus secalinus L. 1753, HT(6), Eua. -medit., Th., Secalietea. GY.
(1971) Brachypodium sylvaticum (Huds. 1762 sub Festuca) R. et Sch. 1817, HT(6), Eua. -medit., H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. K.
(1982) Festuca rupicola Heuff. 1858, HT(6), Eua., H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. E.
(1986) Festuca gigantea (L. 1753 sub Bromo) Vill. 1787, HT(6), Eua., H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Cuscuto-Calystegietum sepium. K.
(1987) Festuca arundinacea Schreb. 1771, HT(6), Eua. -medit., H., Fraxino pannonicae - Ulmetum pannonicum. TZ.
(1988) Festuca pratensis Huds. 1762, HT(6), Eua., H., Alopecuretum pratensis, Fraxino pannonicae - Ulmetum pannonicum. E.
(1993) Glyceria maxima (Hartm. 1820 sub Molinia) Holmberg 1919, HT(6), Cp., HH., Scirpo-Phragmitetum, Fraxino pannonicae – Ulmetum pannonicum, Salicetum albae-fragilis, Phragmitetea (-Populetalia). E.
(1994) Glyceria fluitans (L. 1753 sub Festuca) R. Br. 1810, Eua. -medit., HH., Scirpo-Phragmitetum, Oenanthetum, Glycerietum maximae, Phragmitetea. K.
(1995) Glyceria plicata Fr. 1842, HT(6), Eua. -medit., HH., Bidentetea. TZ.
(2002) Poa pratensis L. 1753 s. str., HT(6), Cp., H., Alopecuretum pratensis, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum. K.
(2003) Poa angustifolia L. 1753, HT(6), Cp., H., Alopecuretum pratensis, Fraxino pannonicae - Ulmetum pannonicum. E.
(2005) Poa trivialis L. 1753, HT(6), Cp., H., Alopecuretum pratensis, Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Bidentetea, Echinochloo-Polygonetum lapathifolii, Cuscuto-Calystegietum sepium, Cypero-Juncetum etc. TZ.
(2006) Poa nemoralis L. 1753, HT(6), Eua., H., Fraxino pannonicae - Ulmetum pannonicum. TZ.
(2007) Poa palustris L. 1759, HT(6), Cp., H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Salicetum triandrae, Cuscuto-Calystegietum sepium. K.
(2009) Poa compressa L. 1753, HT(6), Eu., H., Eleochari-Schoenoplectetum supini, Salicetum triandrae, Cuscuto-Calystegietum sepium, Echinochloo-Polygonetum lapathifolii. TZ.
(2012) Poa annua L. 1753, HT(6), Eua., Th. -TH., Bidentetea, Echinochloo-Polygonetum lapathifolii, Cuscuto-Calystegietum sepium, Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum etc. GY.
(2016) Dactylis glomerata L. 1753, HT(6), Eua., H., Salicetum albae-fragilis, Salicetum triandrae, Fraxino pannonicae - Ulmetum pannonicum, Alopecuretum pratensis etc. TZ.
(2030) Lolium perenne L. 1753, HT(6), Eu. -medit., H., Alopecuretum pratensis, Pulicaria vulgaris - Mentha pulegium ass., Echinochloo-Polygonetum lapathifolii, Onopordetalia, Xanthietum strumarii, Glycyrrhizetum echinatae, Cuscuto-Calystegietum sepium, Salicetum albae-fragilis, Salicetum triandrae etc. GY.
(2036) Agropyron caninum (L. 1753 sub tritico) P. B. 1812, HT(6), Eua. (-medit.), H., Fraxino pannonicae - Ulmetum pannonicum. K.
(2037) Agropyron repens (L. 1753 sub Tritico) P. B. 1812, HT(6), Cp., G., Alopecuretum pratensis, Cypero-Juncetum, Pulicaria vulgaris - Mentha pulegium

ass., Bidentetea, Echinochloo-Polygonetum lapathifolii, Cuscuto-Calystegietum sepium, Salicetum albae-fragilis, Salicetum triandrae etc. GY.

(2047) Phragmites australis (Cavan. 1799) Trin. et Stend. 1821 (= Ph. communis Trin. 1820), HT(6), Cp., HH., Scirpo-Phragmitetum; Phragmitetea (Populetalia). E.

(2054) Deschampsia ceaspitosa (L. 1753 sub Aira) P. B. 1812, HT(6), Cp. -Cosm., H., Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum. K.

(2057) Arrhenatherum elatius (L. 1753 sub Svena) J. et C. Presl 1819, HT(6), Eua. seu Eu., H., Alopecuretum pratensis, Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Cuscuto-Calystegietum sepium. K.

(2059) Ventenata dubia (Leers 1775 sub Avena) Coss. 1856, HT(6), Submed., Th., Alopecuretum pratensis, Agrostion albae. TZ.

(2060) Avena fatua L. 1753, HT(6), Eua. (-medit.), Th., Echinochloo-Polygonetum lapathifolii, Secalietea etc. GY.

(2078) Agrostis stolonifera L. 1753 s. l., HT(6), Cp., H., Alopecuretum pratensis, Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Cypero-Junceatea, Pulicaria vulgaris - Mentha pulegium ass., Bidentetea, Xanthietum strumarii etc. E.

(2082) Calamagrostis canescens (Weber ex Wigg. 1780 sub Arundine) Roth 1789 em. Druce 1906, HT(6), Eurosib., H., Scirpo-Phragmitetum, - Phragmitetea. K.

(2083) Calamagrostis pseudophragmites (Hall. f. sub Arundine) Koel. 1802, Baumg. 1816, HT(6), Eua., H., Bidentetea, Echinochloo-Polygonetum lapathifolii, Xanthietum strumarii. K.

(2084) Calamagrostis epigeios (L. 1753 sub Arundine) Roth 1788, HT(6), Eua. (-medit.) (H. -)G., Fraxino pannonicae - Ulmetum pannonicum, Salicetum albae-fragilis, Echinochloo-Polygonetum lapathifolii, Glycyrrhizetum echinatae, - Epilobietea, Molinio-Juncetea, Populetalia. TZ.

(2088) Alopecurus pratensis L. 1753, HT(6), Eua., H. Salicetum albae-fragilis, Fraxino pannonicae - Ulmetum pannonicum, Salicetum triandrae, Cuscuto-Calystegietum sepium, Echinochloo-Polygonetum lapathifolii etc., - Alopecuretum pratensis hung. E.

(2090) Alopecurus geniculatus L. 1753, HT(6), Eu., H., Scirpo-Phragmitetum, Heliotropio-Verbenetum supini, Pulicaria vulgaris - Mentha pulicaria ass., Bidentetea, Echinochloo-Polygonetum lapathifolii etc. TZ.

(2091) Alopecurus aequalis Sobol. 1799, HT(6), Cp., H., Bidentetalia. TZ.

(2105) Anthoxanthum odoratum L. 1753, HT(6), Eua. -medit., H., Molinio-Arrhenatheretea. E.

(2107) Typhoides arundinacea (L. 1753 sub Phalaride) Mönch 1794, HT(6), Cp., HH. -H., Scirpo-Phragmitetum, Agrostion. K.

(2108) Eragrostis pilosa (L. 1753 sub Poa) P. B. 1812, HT(6), Submed., Th., Bidentetea, Echinochloo-Polygonetum lapathifolii, Salicetum triandrae etc. GY.

(2109) Eragrostis poaeoides P. B. 1812, HT(6), Medit., Th., Cypero-Juncetum, Bidentetea, Echinochloo-Setarietum, Xanthietum etc. GY.

(2112) Cynodon dactylon (L. 1753 sub Panico) Pers. 1805, HT(6), S-Eua-suCTr., G. (-H), Alopecuretum pratensis, Cypero-Juncetum, Heliotropio-Verbenetum supini, Pulicaria vulgaris - Mentha pulegium ass., Bidentetea, Echinochloo-Polygonetum lapathifolii etc. TZ.

(2115) Heleochloa alopecuroides (Piller et Mitterpacher 1783 sub Phleo) Host 1801, Schrad. 1806 sub Crypside, HT(6), S-Eua (=Medit. -Pont.), Th., Eleochari-Schoenoplectetum supini, Alopecuretum pratensis, Salicetum triandrae, Bidentetea, Echinochloo-Polygonetum lapathifolii etc. E.

(2116) Heleochloa schoenoides (L. 1753 sub Phleo) Host 1801, Lam. 1791 sub Crypside, HT(6), S-Eua., Eleochari (aciculari) - Schoenoplectetum supini, alopecuretum pratensis, Salicetum triandrae, Bidentetea, Echinochloo-Polygonetum lapathifolii etc. E.

(2118) Leersia oryzoides (L. 1753 Phalaride) Sw. 1788, HT(6), Cp., HH., Scirpo-Phragmitetum, Eleochari (aciculari) - Schoenoplectetum supini, Lemno - Utricularietum, Bidentetea, Salcietum albae-fragilis etc. E.

(2122) Digitaria sanguinalis (L. 1753 sub Panico) Scop. 1772, HT(6), Cp., Th. Secalietea - Artemisietea. GY.

(2123) Echinochloa crus-galli (L. 1753 sub Panico) P. B. 1812, HT(6), S-Eua., Th., Bidentetea, Chenopodio-Scleranthea (!Oryzion). GY.

(2127) Setaria verticillata (L. 1762 sub Panico) P. B. 1812, HT(6), S-Eua., Th., Secalietea. GY.

(2129) Setaria pumila (Poir.) R. et Sch. 1817 (= S. lutescens (Weigel 1772 sub Panico nom. illeg., ex Stuntz 1914) Huffard 1916 = S. glauca (L. 1753 p. sp.) P. B. 1812, HT(6), S-Eua., Th., Chenopodio-Scleranthea. GY.

(2130) Setaria viridis (L. 1759 sub Panico) P. B. 1812, HT(6), Eua., Th., Chenopodio-Scleranthea. GY.

Araceae

(2136) Arum orientale M. B. 1808 ssp. besseranum (Schott 1858) Holub 1977 [Arum maculatum L. 1753 em. Mill], HT(6), E-M-Eu., G., Fraxino pannonicae - Ulmetum pannonicum. K.

Lemnaceae

(2137) Lemna trisulca L. 1753, HT(6), Cp., HH., Lemno-Potamea, esp. Hydrochari-Lemnetea. K.

(2138) Lemna minor L. 1753, HT(6), Cp., HH., Lemno-Potamea, esp. Hydrochari-Lemnetea. E.

(2139) Lemna gibba L. 1753, HT(6), Cp., HH., Lemno-Utriculariaetum,-Lemnion. K.

(2140) Spirodela polyrrhiza (L. 1753 sub Lemna) Schleiden 1839, HT(6), Cp., HH., Lemno-Potamea, esp. Hydrochari-Lemnetea. K.

(2141) Wolffia arrhiza (L. 1771 sub Lemna) Wimmer 1857, HT(6), Atl. -medit., HH., - Lemnion. A.

Sparganiaceae

(2143) Sparganium emersum Rehmann 1872 and ssp. simplex (Huds. l. c.) Soó 1971, HT(6), Eua., HH., Phragmition. K.

(2144) Sparganium erectum L. 1753, HT(6), Eua. (-medit.), HH., Cypero-Phragmitetea (Lemno-Potame). K.

Typhaceae

(2147) Typha angustifolia L. 1753, HT(6), Cosm., HH., Phragmitetea. E.

(2148) Typha latifolia L. 1753, HT(6), Cp. -Afr., HH., Phragmitetea. E.

The hydropholius, hygrophilous and hygromesophilous vegetation

A/ LEMNO-POTAMEA Soó 1968

a/ Hydrochari-Lemnetea Oberd. 1967 = Lemnetea W. Koch et Tx. ex Oberd. 1957

I. Hydrocharietalia Rübel 1933 (incl. Lemnetalia W. Koch et Tx. Ex Oberd. 1957)

1. Lemnion minoris W. Koch et Tx. ex Oberd. 1957 (incl. Lemnion trisulcae Den Hartog et Segal 1964)

- Lemno-spirodeletum W. Koch 1954, Müller et Görs 1960
- Salvinio-Spirodeletum polyrrhizae Slavniæ 1956
- Lemnetum minoris Rübel 1912, Soó 1947,Oberd. 1957, Müller et Görs 1960-Riccietum fluitantis Salvniæ 1956

2. Ceratophyllion Den Hartog et Segal 1964
- Ceratophylletum demersi (Soó 1927) Hild 1956, Den Hartog et Segal 1964

3. Hydrocharition Rübel 1933
- Lemno-Utricularietum Soó 1928
- Hydrochari-Stratiotetum (Langendonck 1935) Westhoff 1942

b/ Potametea Tx et Prsg. 1942

I. Potametalia W. Koch 1926

2. Batrachion fluitantis Neuhäusl 1959
- Potametum nodosi Soó (1928) 1960, segal 1964
- Batrachio (trichophyllo) – Callitrichetum (cophocarpae) Soó (1927) 1960
- Hottonietum palustris Tx. 1937

5. Potamion W. Koch 1926 emend. Oberd. 1957
- Myriophyllo - Potametum Soó 1934
- Potametum lucentis Hueck 1931
- Parvopotameto - Zanichellietum (Baumann 1921) W. Koch 1926

6. Nymphaeion Oberd. 1956 emend. Neuhäusl 1959
- Polygonetum natantis Soó 1927
- Potametum natantis Soó 1927
- Nymphaeetum albo-luteae Nowinski 1928
- Nymphoidetum peltatae (Allorge 1922) Oberd. et Müller 1960
- Trapetum natantis Müller et Görs 1960

B/ CYPERO-PHRAMITEA Soó 1968

c/ Phragmitetea Tx. et Prsg. 1942

V. Phragmitetalia W. Koch 1926 emend. Pign. 1953

8. Phragmition communis W. Koch 1926 emend. Soó 1947
- Scirpo - Phragmitetum W. Koch 1926 medioeuropaeum Tx. 1941 p. p. emend. Soó 1971
- Glycerietum maximae Hueck 1931

VII. Magnocaricetalia Pign. 1953

11. Magnocaricion elatae W. Koch 1926
- Caricetum elatae W. Koch 1926
- Caricetum gracilis Almquist 1929, Gräbner f. et Hueck 1931, Tx. 1937
- Caricetum acutiformis - ripariae Soó (1927) 1930, 1969

d/ Isoëto - Nanojuncetea Br. -Bl. et Tx. 1943

VIII. Nanocyperetalia Klika 1935

12. Nanocyperion flavescentis W. Koch 1926
- Eleocharitetum ovatae (Hay. 23) Moor 1936
- Eleochari (Eleocharito) aciculari - Schoenoplectetum supini Soó et Ubrizsy 1948
- Dichostyli - Gnaphalietum uliginosi (Horvatiæ 1931) Soó et Timár 1947
- Cypero - Juncetum Soó et Csûrös 1944

13. Verbenion supinae Slavniæ 1951
- Heliotropio - Verbenetum supinae Slavniæ 1951
- Pulicaria vulgaris - Mentha pulegium ass. Slavniæ 1951
- Lythro - Gnaphalietum supini Pietsch ex Soó 1964

D/ MOLINIO - ARRHENATHEREA Soó 1968
i/ Molinio - Juncetea Br. -Bl. 1947
XV. Molinietalia W. Koch 1926
25. Agrostion albae Soó 1943
- Alopecuretum pratensis Regel 1925, Nowincski 1928 s. l.

j/ Arrhenatheretea Br. -Bl. 1947
XVI. Arrhenatheretalia Pawl. 1928
27. Arrhenatherion elatioris Br. -Bl. 1925, W. Koch 1926
- Arrhenatheretum elatioris Br. -Bl. 1919 s. l., Soó 1969
35. Beckmannion eruciformis Soó 1933
- Agrostio - Alopecuretum pratensis Soó 1933

XIX. Artemisio-Festucetalia pseudovinae Soó 1968
36. Festucion pseudovinae Soó 1933
- Peucedano - Asteretum punctati (Rapcs. 1927) Soó 1947

H/ CHENOPODIO - SCLERANTHEA Hadaè 1967
p/ Secalietea ("Secalinetea") Br. -Bl. 1931 emend. 1951
XXVII. Secalietalia Br. -Bl. 1931 emend. J. et R. Tx. 1960 ex Lohm. 1962
50. b. Setario-Stachyetum annuae hungaricum Horvát 1966

XXVIII. Eragrostetalia J. Tx. 1961 emend. Soó 1968
52. Consolido-Eragrostion pooidis Soó et Timár 1957
- Amarantho-Chenopodietum albi (Morariu 1943) Soó (1947) 1953, ex Timár 1947
54. Matricario-Chenopodion albi Timár 1954
- Daucus carota-Matricaria inodora ass. Pop 1968

q/ Chenopodietea Br. -Bl. 1951 emend. Lohm., J. Tx. et Tx. 1961 sensu Soó 1971
XXX. Sisymbrietalia J. Tx. 1961
56. Sisymbrion officinalis TX., Lohm. et Prsg. 1950
- Hordeetum murini Libbert 32 em. Pass. 1964
- Malvaetum pusillae Morariu 1943

XXXI. Onopordetalia Br. -Bl. et Tx. 1943 emend. Görs 1966
59. Dauco-Melilotion Görs 1966
- Echio-Melilotetum albi Tx. 1942
60. Onopordion acanthii Br. -Bl. 1926 s. str.
- Onopordetum acanthii Br. -Bl. (1923) 1936 pannonicum Slavniæ 1951
- Xanthietum spinosi Felföldy 1942

q./ Artemisietea Lohm., Prsg. et Tx. 1950
XXXII. Artemisietalia Lohm. et Tx. 1947
61. Arction lappae Tx. 37 emend. Siss. 1946
- Tanaceto-Artemisietum vulgaris (Br. -Bl. 1931) 1949 seu Artemisietum vulgaris Tx. 1942 s. l.
- Conium maculati I. Pop 1968
- Sambucetum ebuli Felföldy 1942
62. Alliarion petiolatae Oberd. 1957, 1962 emend. Hejný 1967

XXXIII. Convolvuletalia sepium Tx. 1950
63. Calystegion sepium Tx. 1947 ex Oberd. 1949
- Chaerophylletum bulbosi Tx. 1937

- Rudbeckio-Solidaginetum Tx. et Raabe 1950 emend. Soó 1961
- Calystegietum sepium (Tx. 1947) emend. Passarge 1964, corr. Soó 1957
- Cuscuto-Calystegietum pannonicum Soó 1971
- Glycyrrhizetum echinatae (Soó 1940 nom. nud., Timár 1947) Slavniæ 1951

r/ Bidentetea tripartiti Tx., Lohm. et Prsg. 1950
XXXIV. Bidentetalia tripartiti Br. -Bl. et Tx. 1943
64. Bidention tripartiti Nordhg. 1940
- Bidentetum tripartiti W. Koch 1926
- Xanthio strumario-Chenopodietum "Timár" in Pop 1968
65. Chenopodion fluviatile (rubri) Tx. 1960
- Chenopodietum rubri Timár 1947
- Echinochloo-Polygonetum lapathifolii (Ujvárosi 1940) Soó et Csûrös (1944) 1947

s/ Plantaginetea majoris Tx. et Prsg. 1950
XXXV. Plantaginetalia majoris Tx. (1947) 1950
66. Polygonion avicularis Br. -Bl. 1931 emend. Tx. 1950

I/ QUERCO-FAGEA Jakucs 1967
u/ Salicetea purpureae Moor 1958
XXXVIII. Salicetalia purpureae Moor 1958
72. Salicion triandrae Müller et Görs 1958
- Salicetum triandrae Malcuit 1929, I. Kárpáti 1970
73. Salicion albae (Soó 1930 nom. nud., 1940 p. p.) Müller et Görs 1958
(- Salicetum albae-fragilis Issler 1926 emend. Soó 1957, Simon 1957 etc.)

W/ Carpino-fagetea Jakucs 1960 (Querco-Fagetea Br. -Bl. et Vlieger 1937 p. p.
XLI Fagetalia sylvaticae Paw³. 1928
76. A. Ulmion Oberd. 1953
- Fraxino pannonicae-Ulmetum Soó 1960 s. str. (Fraxino pannonicae-Ulmetum pannonicum Soó 1963)

XLV. Prunetalia Tx. 1952
85. Prunion spinosae Soó (1930 nom. nud.) 1940 s. str., Klika 1955 1955 p. subfoed.
- Pruno spinosae-Crataegetum (Soó 1927, 1931) Hueck 1931, Soó 1969

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Flora and vegetation of the Ukrainian Upper Tisa Basin: Aspects of biodiversity conservation

Vladimir Kricsfalusy

Abstract

Results of the flora and vegetation studies in the Upper Tisa basin within Ukraine are presented. The bicentennial history of the vegetation cover studies of Transcarpathia and the Maramarosh region in particular is considered.

Special attention is focused on the problem of biodiversity conservation in the Upper Tisa Region. Lists of the threatened vascular plants (366 taxa) of the region are presented, which were developed on the basis of the surveyed studies. The peculiarities of the distribution of rare and endemic species are stated.

Keywords: flora, vegetation, biodiversity, conservation, Upper Tisa

Introduction

The studies dealing with the vegetation cover of Transcarpathia (Ukraine) whose historical name is known as Ruthenia or Subcarpathia Rus, cover more than 200 years, which can be divided into three periods: Austro-Hungarian (1796-1918), Czecho-Slovakian (1918-1945) and Soviet-Ukrainian (from 1945).

The beginning of vegetation cover studies in Transcarpathia is connected with the names of P. Kitaibel and F. Waldstein who from 1796 undertook a series of expeditions in different parts of the region. They studied most extensively the flora of Maramarosh county where exactly the upper part of the basin of River Tisa is located. During these expeditions over 1000 plant species were collected; as a result of these studies dozens of taxa new for science were described (Kitabel 1863).

A substantial contribution to the vegetation cover studies of Transcarpathia was made by local botanist L. Vágner (L. Wagner) who studied mainly the flora of Maramarosh. His studies done for many years are generalised in a separate work (Vágner, 1876) which has not lost its importance even by present time.

Among the researchers of that period, the names of those who actively studied the flora of Maramarosh should be mentioned. They are: B. Müller (1863), V. Borbás (1877, 1878), K. Siegmeth (1881–1884 a, b; etc.), L. Biró (1885), F. Pax (1898–1908;

etc.), H. Zapalowicz (1889; etc.), J. Bezdék (1905), J. Tuzson (1919), A. Boros (1938, 1944; etc.), A. Pénzes (1939), G. Andreánsky (1940; etc.), B. Zólyomi, J. Ujhelyi (1942), R. Soó (1933, 1944; etc.). Rich information about the vegetation cover of Transcarpathia can be also found in works by L. Fekete, Gy. Gáyer, F. Haszlinsky, V. Janka, S. Mágocsy-Dietz, L. Szücs, L. Thaisz, G. Ubrizsy, Z. Zisák and a number of other researches. The greatest achievement of this period was the publication of the plant identification handbook of Hungary (Jávorka, 1925), which contained lasting conclusions concerning the Hungarian - and particularly the Transcarpathian - flora studies.

Special attention is deserved by local botanist A. Margittai (A. Margittaj), whose activity dates back to the end of the first period and the second period of studies. A series of his works is devoted to the flora studies of Maramarosh (Margittai 1930, 1933, 1935; etc.) and Transcarpathia (Margittai 1911, 1923, 1927, 1936; etc.).

In the following period the vegetation cover of Transcarpathia was studied by Czechoslovakian botanists. There is valuable information about the flora of Maramarosh in the works by I. Nevole (1925), K. Domin (1929 a, 1930 a; etc.), Fr. Maloch (1932, 1933), M. Deyl (1935 a, b; 1936, 1940; etc.), J. Klásterský (1935, 1936), V. Krist (1935), A. Zlatnik (1934-1935; etc.), M. Pulchart (1937, etc.). A great contribution to the studies of flora and vegetation in Transcarpathia is associated with the names of J. Buček, V. Drahný, A. Hilitzer, K. Hroch, J. Hruby, R. Jirasek, A. Láska, M. Maloch, J. Nádvornik, A. Pilat, K. Šiman, J. Suza and some other botanists. This period is characterized by the development of works of the general kind such as the plant identification handbook of Czechoslovakia (Polivka et al., 1928) which included also the flora of Transcarpathia, as well as the cycles of floristic works by K. Domin (1929 b, 1929–1931) and J. Kláštерský (1929–1931), which were essential contributions to the information about the flora of the region.

When Transcarpathia joined Ukraine, intensive studies on vegetation cover developed in the region. They were crowned by the publication of the large general works in which Transcarpathian flora studies were included: Flora SSSR (1934-1964), Flora URSR (1936-1965), Flora Evropejskoj chasti SSSR (1974-1995), Vyznachnyk roslyn Ukrainy (1950, 1964, 1987), Vyznachnyk roslyn Ukrainskykh Karpat (1977), etc. Some major works on systematics, geography, plant ecology of different systematic groups were devoted to the vegetation cover analysis in the region (Popov 1949; Roslynnist 1954; Makarevych 1963; Fodor 1974; Zerov, Partyka 1975; Chopyk 1976; Malynovsky 1980; Malinovsky et al. 1991; etc.).

In this period some works appeared that were devoted to the studies of flora and vegetation of the natural reserve objects of the Ukrainian Carpathians and Transcarpathia, the major part of which is concentrated in the Upper Tisa basin (Stojko 1977; Stojko et al. 1991; Okhorona pryrody ..., 1980; Flora i roslynnist ..., 1982; Bioriznomanittja ..., 1997; etc.). In many works data are given on the flora of the south-eastern part of Transcarpathia, which is within the former Maramarosh county (Fodor 1956, 1960, 1984; Kotov, Chopik 1960; etc.).

For the last decades dozens of other works have been published, which substantially supplemented the information on the vegetation of the region and made it more accurate, but, for shortage of place, we cannot dwell upon them. Thus, today the flora and vegetation of Transcarpathia have been studied comparatively well. The annotated list of vascular plants and plant communities is given in the Upper Tisa Ramsar Sheet (Kricsfalusy et al. 1998b) which is dealt with in the present monograph.

Thanks to the efforts of several generations of botanists it has been stated that the region is a prominent depository of the gene pool of the flora, since in its area which is only 2% of Ukraine's territory, almost 50% of the vascular plants and communities are concentrated. In this context the extended studies of the vegetation biodiversity of Transcarpathia and its effective conservation acquire prior importance.

A considerable contribution to the cause of the conservation of vegetation cover in Transcarpathia was made by A. Zlatnik, S.M. Stojko, V.I. Chopyk, K.A. Malynovsky, V.I. Komendar, S.S. Fodor and some other researchers. They initiated the compilation of the Red Data List of vascular plant species and plant communities, and, on the basis of their studies, targets of nature conservation, existing in various statuses, were set. A series of monographs, devoted to rare and disappearing species of the flora, including those of Transcarpathia, was published (Chopyk 1970; Kricsfalusy, Komendar 1990; etc.).

Today 145 species of the flora of Transcarpathia (7.3%) have entered the Red Data Book of Ukraine (Chervona Knyha ..., 1996), while the Green Data Book of Ukraine (Zelenaja Kniga ..., 1986) includes 56 plant communities. However, as the studies have shown, 485 plant species (24,4 %) need protection on the regional level in Transcarpathia (Kricsfalusy et al. 1998).

Materials and Methods

The whole river system of Transcarpathia belongs to the basin of River Tisa. Its upper part extends from the headwaters to the town of Hust where River Tisa, breaking through the volcanic ridge, enters the Transcarpathian Plain.

Accordingly, when giving the characteristics of flora and vegetation of the Upper Tisa basin, we mean the territory located east of River Rika (Figure1.).

It is interesting to note that its outlines in the phytogeographic terms distinctly coincide with the boundaries of six floristic districts of the Ukrainian Carpathians: Svydovets, Chornohora, Maramarosh Alps, Horhans, Maramarosh depression, the area between the rivers Rika and Teresva.

The list of threatened plant species of the region is compiled on the basis of earlier works (Kricsfalusy et al. 1998 a). All taxa names have been collated with those given in S. K. Cherepanov's (1995) check list, with the supplements used in works on the flora of the adjacent regions and the Carpathian mountain system (Flora Polska 1919-1968; Flora României 1952-1976; Flora Slovenska 1966-1998; Soó 1964-1980).

We accepted and applied the categories of rarity (I-V) used in most recent publications on these problems (IUCN Red List categories, 1994). The following abbreviations were used: E - endemic (EC - East Carpathian, SEC - South - East Carpathian, PE - Pan Carpathian), RRL - Regional Red List, RBU - Red Book of Ukraine, ERL - European Red List.

Figure1. Map of studied area

Results and Discussion

On the basis of the general information on flora and vegetation of the Upper Tisa as well as based on our sozological analysis it was stated that 366 vascular plant species and 35 plant communities of the region needed protection.

All plant species in the highest conservation status entered the suggested list. In particular, they are included in the European Red List (1991) and the Red Data Book of Ukraine (Chervona Knyha ..., 1996), some are endemic, represents of specific gene pools. However, it should be noted that some of these species grow in comparatively large areas, have rather stable population structures and there is actually no danger to their existence today.

We found that the European Red List and the Red Data Book of Ukraine, respectively, included 9 and 118 plant species of the studied region. For some reason, 6 species appearing in the European Red List, which grow in this territory, are not included in the Red Data Book of Ukraine.

Of great interest are the categories of rarity. According to their sozological status, the endangered plants are divided as follows: I (extinct) - 8 species, II (endangered) - 83, III (vulnerable) - 131, IV (rare) - 102, V (lower risk) - 42.

The highest indices of the flora's richness in endangered species, including the Red Data Book ones, are noted for the Svydovets and Chornohora. As regards the presence of different categories of rarity, it is the Maramarosh Alps that occupy an intermediate position between the aforementioned two massifs and the Horhans. The number of endangered species is the lowest in the anthropogenically most affected floristic districts i.e. the area between the rivers Rika and Teresva and the Maramarosh depression, despite that these areas are not the smallest ones in size (Figure 2.).

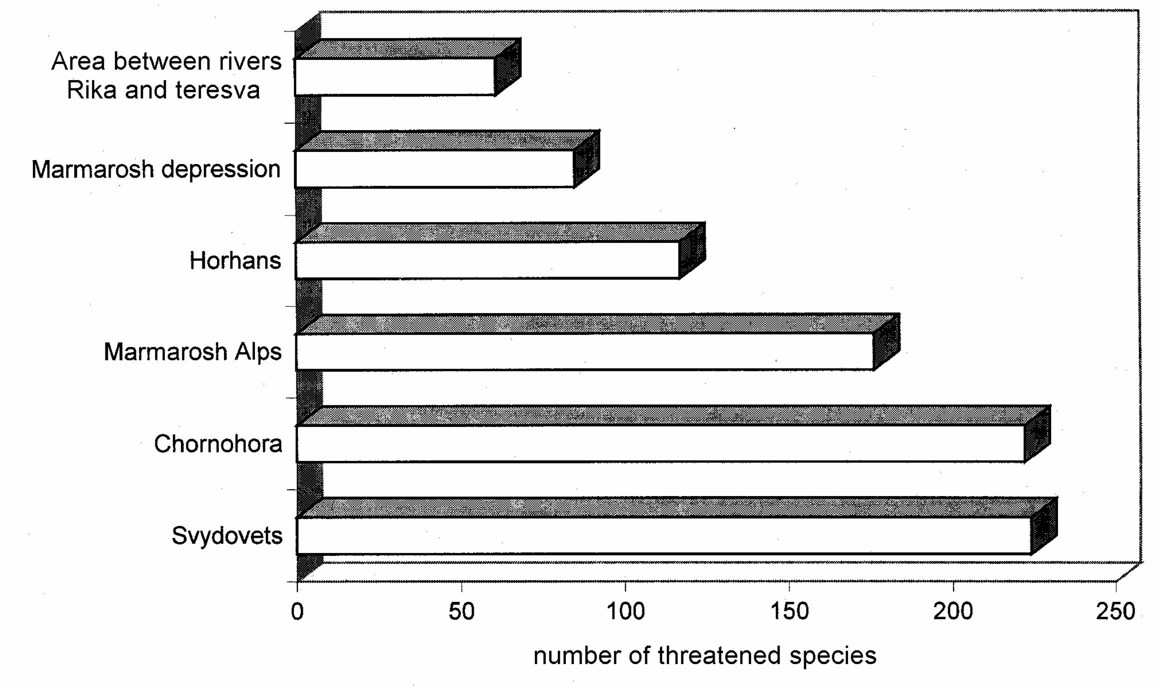

Figure 2. Distribution spectrum of threatened vascular plants in different floristic areas

A remarkable part of the flora composition of the studied region is made up by endemic plants. They number 94 species, of which 37 are East Carpathian, 26 are South-East Carpathian and 34 are Pancarpathian endemisms. Their densest concentration can be observed in the Chornohora, Svydovets and the Maramarosh

Alps. This index is twice as low for the Horhans, while in the other districts the number of endemic species drops markedly (Figure 3.).

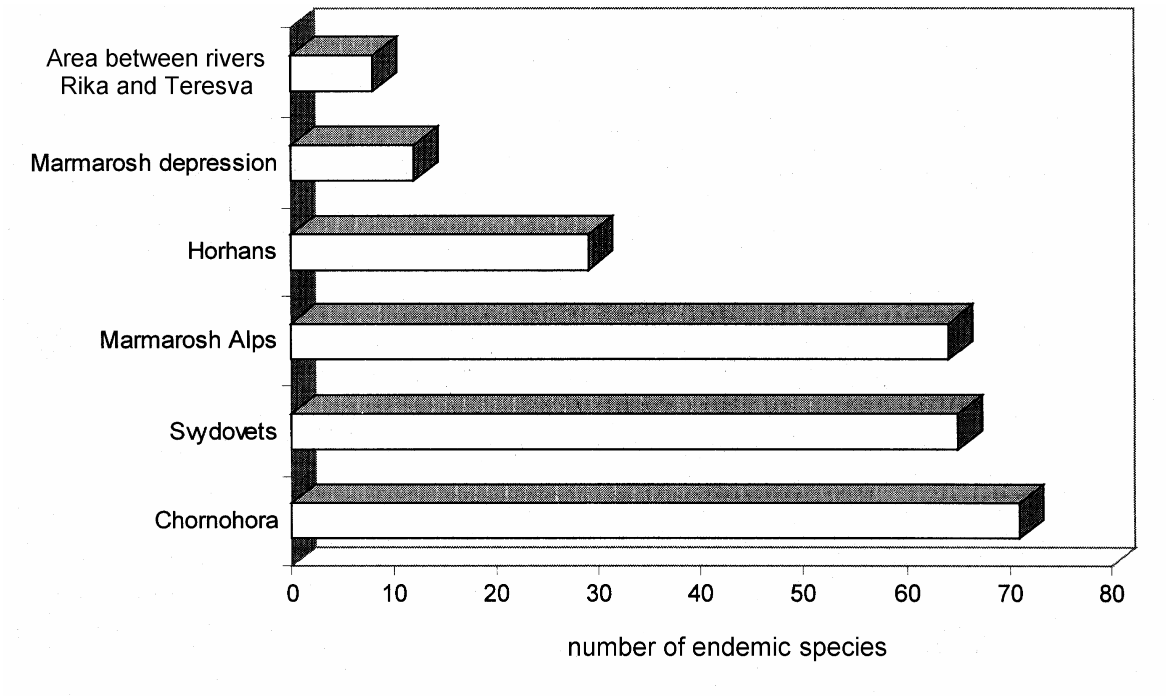

Figure 3. Distribution spectrum of endemic vascular plants in different floristic areas

The majority of endemic species occur in various highland areas. They grow mostly in woodlands, on the upper edge of forests and in tall-grass lands. At the same time there are a number of endemic plants attached only to a single district. There are 9 species that grow solely in the Chornohora, 6 in the Maramarosh Alps, 5 in the Svydovets, 1 in the Horhans and 1 in the area between the rivers Rika and Teresva. As a rule, these species, too, occur on the exposed rocky sites, and to a less extent in the tall-grass cenoses and forests.

It should be specially noted that a substantial proportion of species included in the regional Red List belong to the groups of valuable medicinal, decorative, or food plants which are laid in and used by pharmaceutics and food industry and in greenbelt setting.

Consequently, it is necessary to achieve the control of their populations and the regulation of economic load on them.

Threatened vascular plants of the area

Achillea carpatica - E (EC), RRL (IV)

Acinos baumgartenii (A. alpinus subsp. baumgartenii, A. alpinus, Melissa baumgartenii) - RRL (III)

Aconitum bucoviense (R.callibotryon subsp. bucoviense, A. firmum subsp. bucoviense) - E (EC), RRL (IV)
A. degenii (A. paniculatum subsp. degenii) - E (EC), RRL (II)
A. firmum (A. firmum subsp. firmum, A. napellus subsp. firmum) - RRL (IV)
A. gracile (R. variegatum subsp. gracile) - RRL (IV)
A. hosteanum (A. moldavicum subsp. hosteanum) - E (SEC), RRL (III)
A. jacquinii (A. anthora subsp. jacquinii) - E (SEC), RRL (II), RBU
A. nanum (A. tauricum subsp. nanum) - E (SEC), RRL (III)
A. paniculatum - RRL (IV)
A. variegatum (A. rostratum) - RRL (IV)
Agrostis rupestris subsp. rupestris - RRL (III)
Alchemilla babiogorensis - E (EC), RRL (II)
A. cymatophylla (A. strigosula) - III
A. deylii - E (EC), RRL (II)
A. firma (A. glaberrima subsp. firma, A. pyrenaica) - RRL (II)
A. flabellata (A. truncata, A. pubescens) - RRL (IV)
A. hoverlensis - E (EC), RRL (II)
A. incisa (A. gracilis, A. vallesiaca) - RRL (II)
A. obtusa (A. obsoleta) - RRL (II)
A. pseudoincisa - E (EC), RRL (III)
A. reniformis (A. sudetica) - RRL (II)
A. szaferi - E (EC), RRL (IV)
A. turkulensis - E (EC), RRL (IV)
Allium angulosum - RRL (III)
A. ursinum (A. ucrainicum) - RRL (IV), RBU
Alopecurus laguriformis (A. pratensis subsp. laguriformis) - E (SEC), RRL (III)
Andromeda polifolia - RRL (II)
Anemonastrum narcissiflorum (Anemone narcissiflora) - RRL (IV)
Antennaria carpatica - E (PC), RRL (III), RBU
Anthemis carpatica (A. cretica subsp. carpatica) - RRL (III)
Anthyllis alpestris (A. vulneraria subsp. alpestris) - RRL (IV)
Aquilegia nigricans - RRL (II), RBU
Arnica montana - RRL (IV), RBU
Arum alpinum (A. maculatum) - RRL (III)
Asplenium adiantum-nigrum (A. adiantum-nigrum subsp. nigrum) - RRL (II), RBU
Aster alpinus subsp. subvillosus - RRL (II), RBU
Astragalus krajinae (A. australis subsp. krajinae) - E (EC), RRL (II), RBU, ERL
Astrantia major subsp. major - RRL (V), RBU
Atropa bella-donna - RRL (IV), RBU
Bartsia alpina L. - RRL (III)
Bellardiochloa violacea (Poa violacea) - RRL (IV)
Biscutella austriaca subsp. hungarica (B. alpestris subsp. austriaca) - RRL (II)
Bistorta vivipara (Polygonum viviparum) - RRL (IV)
Blechnum spicant subsp. spicant - RRL (IV)
Botrychium lunaria - RRL (IV), RBU
B. matricariifolium (B. ramosum) - RRL (III)
B. multifidum (Sceptridium multifidum) - RRL (II)

B. virginianum (B. virginianum subsp. europaeum, Botrypus virginianus subsp. europaeus) - RRL (II)
B. longifolium subsp.vapincense - RRL (III)
Bupleurum ranunculoides subsp. orbiculatum - RRL (II)
B. tenuissimum - RRL (III)
Calla palustris - RRL (II)
Callianthemum coriandrifolium (Ranunculus rutifolius) - RRL (II)
Callitriche stagnalis - RRL (IV)
Calluna vulgaris - RRL (II)
Campanula carpatica - E (PC), RRL (III), RBU
C. polymorpha (C. kladniana, C. kladniana subsp. polymorpha, C. rotundifolia subsp. polymorpha, C. tatrae) - E (PC), RRL (IV)
C. serrata (C. napuligera, C. pseudolanceolata, Thesium serratum) - E (PC)
C. subcapitata (C. glomerata subsp. elliptica f. subcapitata) - E (EC), RRL (II)
Cardaminopsis ovirensis (C. halleri subsp. ovirensis, Arabis ovirensis) - RRL (III)
C. neglecta (A. neglecta) - E (PC), (III)
Carduus bicolorifolius (C. personata, C. personata subsp. albidus) - E (EC), RRL (IV)
C. kerneri (C. transsilvanicus) - RRL (V)
Carex bicolor - RRL (I)
C. buxbaumii - RRL (II), RBU
C. davalliana (C. scabra) - RRL (II), RBU
C. disticha (C. disticha subsp. grossheimii, C. grossheimii, C. intermedia) - RRL (II)
C. fuliginosa subsp. fuliginosa - RRL (II)
C. hartmanii (C. buxbaumii subsp. hartmanii) - RRL (II)
C. humilis (C. buschiorum) - RRL (III)
C. limosa - RRL (III)
C. pauciflora - RRL (IV), RBU
C. rupestris - RRL (II), RBU
C. umbrosa subsp. umbrosa - RRL (V), RBU
Centaurea carpatica (C. phrygia subsp. carpatica, Jacea carpatica, J. phrygia subsp. carpatica) - E (SEC), RRL (V), RBU
C. Maramaroshiensis (C. mollis subsp. Maramaroshiensis, Cyanus Maramaroshiensis, C. montanus subsp. Maramaroshiensis) - E (EC), RRL (IV)
C. melanocalathia (C. nigriceps, C. phrygia subsp. melanocalathia, C. phrygia subsp. nigriceps, J. phrygia subsp. nigriceps) - E (EC), RRL (V)
Centaurium pulchellum - RRL (III)
Cephalanthera damasonium (C. grandiflora, C. alba) - RRL (III), RBU
C. longifolia (C. ensifolia) - RRL (V), RBU
C. rubra - RRL (IV), RBU
Cerastium lanatum (C. alpinum subsp. lanatum) - RRL (IV)
Chamaecytisus elongatus (Ch. ratisbonensis subsp. elongatus) - RRL (II)
Chimaphila umbellata - RRL (III)
Chrysaspis badia (Trifolium badium) - RRL (IV)
Chrysosplenium alpinum - E (SEC), RRL (IV)
Cimicifuga foetida - RRL (IV)
Coeloglossum viride (C. bracteatum) - RRL (IV), RBU
Colchicum autumnale - RRL (IV), RBU
Comarum palustre - RRL (II)

Conioselinum tataricum (C. boreale, C. vaginatum) - RRL (IV)
Corallorhiza trifida (C. innata) - RRL (III), RBU
Cortusa matthioli - RRL (III)
Cotoneaster integerrimus - RRL (IV)
Crataegus lipskyi - RRL (IV)
Crocus banaticus - RRL (IV), RBU
C. heuffelianus (C. vernus subsp. vernus) - RRL (V), RBU
Cynoglottis barrelieri (Anchusa barrelieri) - RRL (IV)
Cypripedium calceolus - RRL (I), RBU, ERL
Cystopteris regia (C. alpina) - RRL (I)
Dactylis slovenica (D. glomerata subsp. slovenica) - E (EC), RRL (IV)
Dactylorhiza cordigera (Orchis cordigera) - RRL (IV), RBU
D. fuchsii (D. longebracteata subsp. longebracteata, O. fuchsii) - RRL (V), RBU
D. incarnata subsp. incarnata (O. incarnata, O. strictifolia) - RRL (V), RBU
D. longebracteata subsp. soóiana - E (P), RRL (III)
D. maculata subsp. maculata - RRL (IV), RBU
D. majalis (O. latifolia, O. majalis) - RRL (V), RBU
D. sambucina (O. sambucina) - RRL (V), RBU
D. transsilvanica (D. maculata subsp. O. transsilvanica) - E (PC), RRL (IV)
Daphne mezereum - RRL (V)
Delphinium elatum subsp. elatum (D. atropupureum, D. intermedium) - RRL (II), RBU
Dianthus carpaticus (D. carthusianorum subsp. saxigenus) - E (SEC), RRL (IV)
Dichodon cerastoides (Cerastium cerastoides) - RRL (III)
Diphasiastrum alpinum (Diphasium alpinum, Lycopodium alpinum) - RRL (III)
Doronicum carpaticum (D. columnae) - RRL (IV)
D. clusii (D. styriacum, Arnica styriaca, A. glacialis, Aronicum clusii) - RRL (III), RBU
D. hungaricum (D. longifolium) - RRL (II), RBU
Draba aizoides subsp. aizoides - RRL (III)
D. carinthiaca - RRL (IV)
Drosera rotundifolia - RRL (IV)
Dryas octopetala subsp. subinciza (D. octopetala) - RRL (II), RBU
Echinops exaltatus (E. commutatus) - RRL (III)
Elatine alsinastrum - RRL (V), ERL
E. hungarica (E. schkuhriana) - RRL (III)
Eleocharis austriaca (E leptostylopodiata, E. mamillata subsp. austriaca) - RRL (III)
E. carniolica - RRL (IV), ERL
Epipactis atrorubens (E. atropurpurea, E. rubiginosa) - RRL (IV), RBU
E. helleborine subsp. helleborine (E. latifolia) - RRL (V), RBU
E. palustris (E. longifolia) - RRL (IV), RBU
Epipogium aphyllum - RRL (II), RBU
Equisetum hyemale (Hippochaete hyemalis) - RRL (III)
E. telmateia (E. majus, E. maximum) - RRL (IV)
Erigeron alpinus - RRL (III)
Erythronium dens-canis subsp. dens-canis - RRL (III), RBU
E. dens-canis subsp. albiflorum - RRL (III)
Euphorbia carpatica (Tithymalus carpaticus) - E (EC), RRL (V)
E. salisburgensis (E. carpatica) - RRL (II)
Festuca carpatica (F. dimorpha) - E (PC), RRL (IV)

F.drymeja (F. montana) - RRL (IV)
F. filiformis (F. capillata, F. ovina subsp. tenuifolia, F. tenuifolia) - RRL (III)
F. inarmata (F. amethystina subsp. inarmata, F. amethystina subsp. orientalis) - RRL (IV)
F. porcii - E (SEC), RRL (II), RBU
F. pseudodalmatica (F. dalmatica subsp. pseudodalmatica, F. valesiaca subsp. pseudodalmatica) - RRL (III)
F. saxatilis (F. rupicola subsp. saxatilis, F. sulcata subsp. saxatilis, F. valesiaca subsp. saxatilis) - RRL (II)
Filago minima (Logfia minima) - RRL (IV)
F. oxycarpa (F. angustifolia subsp. oxycarpa, F. excelsior subsp. oxycarpa) - RRL (IV)
Gagea minima - RRL (IV)
Galanthus nivalis - RRL (V), RBU
Galium bellatulum (G. anisophyllon, G. anisophyllon subsp. bellatulum, G. pawlowskii) - E (EC), RRL (III)
G. carpaticum (G. polonicum) - E (EC), RRL (V)
G. x polonicum (G. abaujense subsp. polonicum) - E (EC), RRL (III)
G. suberectum - E (EC), RRL (V)
G. transcarpaticum - E (EC), RRL (IV)
Genista rupestris (G. alpicola, G. oligosperma, G. tinctoria subsp. hungarica, G. tinctoria subsp. oligosperma) - E (SEC), RRL (II)
Gentiana acaulis (G. excisa, G. kochiana, Ciminalis acaulis) - RRL (IV), RBU
G. laciniata - E (EC), RRL (IV), RBU
G. lutea - RRL (II), RBU
G. nivalis - RRL (II)
G. punctata - RRL (III), RBU
G. verna subsp. verna (G. arctica, Calathiana verna) - RRL (III), RBU
Gladiolus imbricatus (G. apterus) - RRL (IV)
G. palustris - RRL (I), RBU
Glyceria nemoralis - RRL (III)
Goodyera repens - RRL (III), RBU
Gymnadenia conopsea subsp. conopsea - RRL (V), RBU
Hammarbya paludosa (Malaxis paludosa) - RRL (II), RBU
Hedysarum hedysaroides subsp.hedysaroides (H. obscurum) - RRL (III), RBU
Helianthemum grandiflorum subsp. grandiflorum - RRL (IV)
H. nitidum (H. grandiflorum subsp. glabrum, H. nummularium subsp. glabrum) - RRL (II)
Helleborus purpurascens - RRL (V)
Heracleum carpaticum (H. sphondylium subsp. carpaticum) - E (SEC), RRL (III), ERL
H. palmatum (H. palmatum subsp. transsilvanivum, H. sphondylium subsp. transsilvanivum, H. transsilvanivum) - E (SEC), RRL (III)
Herminium monorchis - RRL (II), RBU
Hesperis candida (H. albiflora, H. matronalis subsp. candida, H. nivea) - E (PC), RRL (IV)
Hieracium atrellum (H. atratum) - E (PC), RRL (III)
H. caesiogenum - E (SEC), RRL (III)
H. kotschyanum - E (SEC), RRL (III)
H. krasanii - E (SEC), RRL (III)
H. lomnicense - E (SEC), RRL (III)
H. mukaczevense - E (EC), RRL (III)
H. rapunculoidiforme - E (EC), RRL (III)

H. x roxolanicum (H. guthnickianum, H. rehmannii) - E (EC), RRL (III)
H. wimmeri - E (PC), RRL (III)
Huperzia selago subsp. selago (Lycopodium selago) - RRL (IV), RBU
I. helenium - RRL (III)
I. graminea subsp. graminea - RRL (III)
I. pseudocyperus (I. graminea subsp. pseudocyperus) - RRL (II), RBU
I. sibirica - RRL (III)
Jovibarba preissiana (J. hirta, J. hirta subsp. glabrescens, Sempervivum hirtum, S. hirtum subsp. glabrescens, S. hirtum subsp. preissianum , S. preissianum, S. soboliferum subsp. glabrescens) - E (PC), RRL (III)
J. sobolifera (J. hirta subsp. borealis, S. soboliferum) - RRL (III)
Juncus bulbosus subsp. bulbosus (J. supinus) - RRL (III), RBU
J. triglumis - RRL (IV)
Juniperus sabina - RRL (II)
Knautia kitaibelii (K. kitaibelii subsp. alpigena, Scabiosa kitaibelii) - E (PC), RRL (III)
Larix x polonica (L. decidua subsp. polonica) - RRL (II), RBU
Leersia orysoides - RRL (IV)
Leontodon kulczynskii (L. repens) - E (SEC), RRL (IV)
L. pseudotaraxaci (L. montanus subsp. pseudotaraxaci, Scorzoneroides pseudotaraxaci) - E (PC), RRL (III)
Leontopodium alpinum - RRL (II), RBU
Leopoldia comosa (M. comosum) - RRL (IV)
Leucanthemum subalpinum raciborskii, L. vulgare subsp. subalpinum, Chrysanthemum montanum) - E (SEC), RRL (IV)
L. waldsteinii (L. rotundifolium, Ch. rotundifolium, Tanacetum waldsteinii) - E (PC), RRL (V)
L. vernum - RRL (V), RBU
Leucorchis albida (Pseudorchis albida) - RRL (IV), RBU
Lilium bulbiferum subsp. bulbiferum - RRL (II)
L. martagon subsp. martagon - RRL (IV), RBU
Linum extraaxillare (L. perenne subsp. extraaxillare) - RRL (III)
Liparis loeselii - RRL (II), RBU
Listera cordata - RRL (III), RBU
L. ovata - RRL (V), RBU
Lloydia serotina - RRL (III)
Loiseleuria procumbens - RRL (III)
Lonicera caerulea subsp. caerulea - RRL (I)
Lotus tenuis (L. tenuifolius) - RRL (III)
Lunaria rediviva - RRL (V), RBU
Lycopodiella inundata (Lycopodium inundatum, L. palustre) - RRL (II), RBU
Lycopodium annotinum (L. juniperifolium, Lepidotis annotine) - RRL (V), RBU
Malaxis monophyllos (Microstylis monophyllos) - RRL (IV), RBU
Matteuccia struthiopteris (Struthiopteris germanica, S. filicastrum) - RRL (IV)
Melampyrum saxosum - E (SEC), RRL (V)
Melica ciliata (M. nebrodensis, M. simulans) - RRL (III)
M. transsilvanica (M. ciliata subsp. transsilvanica) - RRL (IV)
Menyanthes trifoliata - RRL (IV)
Minuartia zarecznyi (Alsine zarecznyi) - E (PC), RRL (III)
Muscari botryoides subsp. transsilvanicum (M. transsilvanicum) - E (EC), RRL (II)

Myricaria germanica (Tamarix germanica) - RRL (III)
Narcissus poeticus subsp. angustifolius (N. angustifolius, N. radiiflorus) - RRL (IV), RBU
N. poeticus subsp. stellaris (N. stellaris, N. seriorflorens) - RRL (II)
Neottia nidus-avis - RRL (IV), RBU
Nepeta cataria - RRL (III)
Noccaea dacica (Thlaspi dacicum) - E (SEC), RRL (II)
Nuphar lutea - RRL (II)
Oberna carpatica (Silene carpatica) - E (PC), RRL (V)
Ophioglossum vulgatum - RRL (III)
Orchis coriophora - RRL (IV), RBU
O. laxiflora (O. ensifolius) - RRL (III), RBU
O. mascula subsp. mascula - RRL (V), RBU
O. mascula subsp. signifera (O. signifera, O. speciosa) - RRL (III), RBU
O. militaris - RRL (III), RBU
O. morio - RRL (V), RBU
O. pallens - RRL (II), RBU
O. palustris (O. elegans, O. laxiflora subsp. elegans, O. laxiflora subsp. palustris) - RRL (V), RBU
O. ustulata - RRL (IV), RBU
Oreochloa disticha (Poa disticha, Sesleria disticha) - RRL (II), RBU
Orlaya grandiflora - RRL (III)
Orobanche caryophyllacea (O. vulgaris) - RRL (IV)
O. reticulata (O. scabiosa) - RRL (IV)
Oxycoccus microcarpus (Vaccinium microcarpus) - RRL (II), RBU
Oxyria digyna - RRL (IV)
Oxytropis carpathica - E (PC), RRL (II), RBU
Padus avium subsp. petraea (Prunus padus, P. petraea) - RRL (III)
Pedicularis oederi - RRL (III), RBU
P. palustris subsp. palustris - RRL (III)
P. sylvatica subsp. sylvatica - RRL (III)
Phyllitis scolopendrium (Asplenium scolopendrium, Scolopendrium officinale) - RRL (IV)
Physalis alkekengi - RRL (III)
Phyteuma tetramerum (Ph. spicatum) - E (SEC), RRL (V)
Ph. vagneri - E (SEC), RRL (V)
Pinguicula alpina - RRL (III), RBU
Pinus cembra - RRL (II), RBU
P. sylvestris - RRL (II)
Plantago altissima - RRL (IV)
P. atrata subsp. carpathica (P. montana var. carpathica) - E (PC), RRL (III)
Platanthera bifolia subsp. laxiflora - RRL (V)
P. chlorantha - RRL (III), RBU
Poa deylii (P. granitica subsp. disparilis) - E (SEC), RRL (III), RBU
P. media (P. laxa, P. ursina) - RRL (II)
P. nemoralis subsp. carpatica (P. balfourii, P. carpatica) - E (PC), RRL (III)
P. remota - RRL (III)
Polygala amarella subsp. amarella (P. amara) - RRL (III)
P. subamara (P. amara subsp. brachyptera) - RRL (III)
Potamogeton alpinus - RRL (II)

Potentilla crantzii - RRL (II)
Primula elatior subsp. leucophylla (P. leucophylla) - E (EC), RRL(II)
P. farinosa subsp. farinosa - RRL (I), RBU
P. halleri subsp. platyphylla (P. longiflora) - RRL (III)
P. minima - RRL (III), RBU
P. poloninensis (P. elatior subsp. poloninensis) - E (SEC), RRL(IV)
Ptarmica lingulata (Achillea lingulata) - RRL (III), RBU
P. tenuifolia (A. oxyloba subsp. schurii, A. schurii) - E (SEC), RRL(III), RBU
P. vulgaris (A. ptarmica) - RRL (IV)
Pulmonaria filarszkyana - E (EC), RRL(V), ERL
Pulsatilla alba (P. scherfelii subsp. alba) - RRL (V), RBU
Pyrola carpatica - E (PC), RRL (III)
Ranunculus carpaticus (R. dentatus) - E (SEC), RRL (IV)
R. hornschuchii (R. oreophilus) - RRL (II)
R.malinovskii (R. kladnii) - E (EC), RRL (III), ERL
R. montanus (R. geraniifolius) - RRL (III)
R. thora (R.. tatrae) - RRL (IV), RBU
Rhamnus cathartica - RRL (II)
Rhizomatopteris montana (Cystopteris montana) - RRL (III)
Rhodiola rosea (Sedum rhodiola) - RRL (III), RBU
Rhododendron myrtifolium (R. kotschyi) - RRL (IV), RBU
Rhynchospora alba - RRL (II)
Rumex rugosus (R. carpaticus, Acetosa alpestris subsp. carpatica) - E (EC), RRL (V)
R. scutatus - RRL (III)
Salix alpina (S. jacquinii) - RRL (II)
S. herbacea - RRL (III), RBU
S. phylicifolia - RRL (IV)
S. retusa subsp retusa - RRL (III), RBU
S. retusa subsp. kitaibeliana (S. kitaibeliana) - E (PC), RRL (IV)
S. rosmarinifolia (S. repens subsp. rosmarinifolia) - RRL (IV)
Saussurea alpina subsp. alpina - RRL (III), RBU
S. porcii - E (EC), RRL (II), RBU, ERL
Saxifraga adscendens subsp. adscendens - RRL (IV)
S. aizoides - RRL (II), RBU
S. androsacea - RRL (III), RBU
S. bryoides - RRL (III)
S. oppositifolia subsp. oppositifolia - RRL (II), RBU
Scabiosa barbata (S. lucida subsp. barbata) - E (SEC), RRL (IV)
S.opaca (S. lucida) - E (EC), RRL (IV)
Scheuchzeria palustris - RRL (III), RBU
Schoenus ferrugineus - RRL (II), RBU
Scilla bifolia subsp. subtriphylla (S. kladnii, S. subtriphylla) - E (PC), RRL (V)
Scopolia carniolica - RRL (V), RBU
Scorzonera humilis - RRL (IV)
Securigera elegans (Coronilla elegans, C. latifolia) - RRL (III), RBU
S. alpestre - RRL (III)
S. annuum - RRL (III)
S. atratum - RRL (III)

S. hispanicum (S. glaucum) - RRL (II)
S. selaginoides (Lycopodium selaginoides) - RRL (II), RBU
Sempervivum montanum subsp. carpaticum - E (PC), RRL (II), RBU
Senecio carniolicus - RRL (IV)
S. carpathicus (S. abrotanifolius subsp. carpathicus) - E (PC), RRL (IV)
Sesleria heufleriana subsp. heufleriana - RRL (IV)
Sideritis comosa (S. montana subsp. comosa) - RRL (III)
Silene dubia (S. nutans subsp. dubia) - E (EC), RRL (IV), ERL
S. jundzillii - RRL (III)
Soldanella hungarica (S. Maramaroshsiensis, S. montana subsp. hungarica) - E (EC), RRL (IV)
Sparganium angustifolium (S. affine, S. natans) - RRL (II)
Staphylea pinnata - RRL (II), RBU
Swertia alpestris (S. perennis subsp. alpestris) - E (PC), RRL (III), RBU
S. perennis subsp. perennis - RRL (II), RBU
S. punctata - RRL (II)
Syringa josikaea - RRL (III), RBU
Taxus baccata - RRL (III), RBU
Thelypteris palustris (Th. thelypteroides subsp. glabra) - RRL (IV)
Thymus alpestris (Th. subalpestris) - E (EC), RRL (V)
Th. clandestinus (Th. enervius, Th. montanus) - E (EC), RRL (IV)
Th. pulcherrimus (Th. circumcinctus, Th. sudeticus) - E (PC), RRL (V)
Th. roegneri (Th. alternans) - E (EC), RRL (V)
Tozzia carpathica (T. alpina subsp. carpathica) - E (PC), RRL (IV)
Traunsteinera globosa (Orchis globosa) - RRL (V), RBU
Trifolium pratense subsp. frigidum (N. frigidum, T. pratense subsp. nivale) - RRL (III)
Trisetum alpestre - RRL (III)
T. ciliare (T. carpaticum, T. fuscum) - E (PC), RRL (IV)N. macrotrichum - E (EC), RRL (II)
Valeriana dioica - RRL (II)
V. simplicifolia (V. dioica subsp. simplicifolia) - RRL (V)
Verbascum densiflorum (V. thapsiforme) - RRL (III)
V. lanatum subsp. lanatum (V. alpinum) - RRL (III)
V. lanatum subsp. hinkei - RRL (III)
Veronica alpina subsp. pumila (V. alpina subsp. australis, V. pumila) - RRL (IV)
V. aphylla - RRL (IV)
V. baumgartenii - RRL (IV)
V. bellidioides subsp. bellidioides - RRL (I)
V. fruticans - RRL (III)
V. spicata (Pseudolysimachion spicatum) - RRL (III)
Viola. dacica - RRL (III)
V. declinata - E (SEC), RRL (IV)
V. saxatilis subsp. saxatilis - RRL (III)
V. uliginosa - RRL (III)
Vitis sylvestris (V. vinifera subsp. sylvestris) - RRL (II)
Woodsia alpina (W. ilvensis subsp. alpina) - RRL (I), RBU

Threatened plant communities of the area

Asplenietea trichomanis (Br.-Bl. in Meyer et Braun-Blanquet 1934) Oberd. 1977

Potentilletalia caulescentis Br.-Bl. in Braun-Blanquet et Jenny 1926
Cystopteridion (Nordhagen 1936) Richard 1972
Asplenio-Cystopteridetum fragilis Oberd. (1936) 1949
Saxifrago luteoviridis-Trisetetum alpestris (Pawł. et Wal. 1949) Malinovsky et al. 1991

Elyno-Seslerietea Br.-Bl. 1948
Seslerietalia caeruleae Br.-Bl. in Braun-Blanquet et Jenny 1926
Festuco saxatilis-Seslerion bielzii (Pawł. et Wal. 1949) Coldea 1984
Saxifrago-Festucetum versicoloris Wal. 1933
Thymo-Festucetum inarmatae Ishbirdin et al. 1991
Oxytropido-Elynetalia Oberd. 1957
Oxytropido-Elynion Br.-Bl. 1948
Dryas octopetala (community)

Thlaspietea rotundifolii Br.-Bl. 1948
Galio-Parietarietalia officinalis Boşcaiu et al. 1966
Stipion calamagrostis Jenny-Lips ex Braun-Blanquet, Roussine et Négre 1952
Rumicetum scutati Faber 1936
Rumici scutati-Rhodioletum rosei Malinovsky et al. 1991

Juncetea trifidi Hadaè in Klika et Hadač 1944
Caricetalia curvulae Br.-Bl. in Braun-Blanquet et Jenny 1926
Juncion trifidi Krajina 1933
Primulo-Caricetum curvulae (Br.-Bl. 1926) Oberd. 1959

Loiseleurio-Vaccinietea Eggler 1952
Rhododendro-Vaccinietalia Br.-Bl. in Braun-Blanquet et Jenny 1926
Rhododendro-Vaccinion J. Br.-Bl. ex G. and J. Braun-Blanquet 1931
Rhododendretum myrtifolii Puscaru et al. 1956
Cetrario-Loiseleurion Br.-Bl. et Sissing 1939
Loiseleurio-Cetrarietum Br.-Bl. et Sissing 1939
Cetrario-Vaccinietum Kricsfalusy et al. 1991
Juniperion nanae Br.-Bl. et al. 1939
Juniperetum nanae Br.-Bl. et Sissing 1939

Salicetea herbaceae Br.-Bl. 1949
Salicetalia herbaceae Br.-Bl. in Braun-Blanquet et Jenny 1926
Salicion herbaceae Br.-Bl. in Braun-Blanquet et Jenny 1926
Salicetum herbaceae Br.-Bl. 1931
Polytricho-Poetum deylii Malinovsky et al. 1991
Arabidetalia coeruleae Rübel 1933
Arabidion coeruleae Br.-Bl. 1926

Salicetum retuso-reticulatae Br.-Bl. 1926

Mulgedio-Aconitetea Hadaè in Klika et Hadaè 1944
Adenostyletalia Br.-Bl. 1930
Adenostylion Br.-Bl. 1926
Ranunculo platanifolii-Adenostyletum alliariae (Krajina 1933) Dubravcova in Mucina et Maglocky 1985
Pulmonario-Alnetum viridis Paw³. et Wal. 1949
Calamagrostietalia villosae Paw³. in Paw³owski, Soko³owski et Wallisch 1928
Calamagrostion villosae Paw³. in Paw³owski, Soko³owski et Wallisch 1928
Hyperico alpigeno-Calamagrostietum villosae Paw³. et Wal. 1949

Phragmito-Magnocaricetea Klika in Klika et Novák 1941
Magnocaricetalia Pignatti 1953
Magnocaricion elatae Koch 1926
Caricetum paniculatae Wangerin 1916
Caricion gracilis Neuhäusl 1959 em. Balátová-Tuláèková 1963
Narcisso-Caricetum vesicariae Kricsfalusy 1987

Montio-Cardaminetea Br.-Bl. et Tüxen 1943
Montio-Cardaminetalia Paw³. in Paw³owski, Soko³owski et Wallisch 1928
Cratoneurion commutati Koch 1928
Brachytecio rivularis-Cardaminetum opizii (Krajina 1933) Hadaè 1983
Doronico-Cratoneuretum commutati Paw³. et Wal. 1949
Saxifragetum stellaris Deyl 1940
Saxifrago-Chrysosplenietum Paw³. et Wal. 1949
Calthetum laetae Krajina 1933

Scheuchzerio-Caricetea fuscae Tüxen 1937
Caricetalia fuscae Koch 1926
Caricion fuscae Koch 1926 em. Klika 1934
Caricetum goodenowii J. Braun 1915
Caricion lasiocarpae Van den Berghen in Lebrun et al. 1949 em. Rybnièek in Rybnièek et al. 1984
Caricetum chordorrhizae Paul et Lutz 1941
Scheuchzerietalia palustris Nordhagen 1937
Rhynchosporion albae Koch 1926
Caricetum limosae Br.-Bl. 1921
Carex dacica (community)

Molinio-Arrhenatheretea Tüxen 1937
Arrhenatheretalia Tüxen 1931
Arrhenatherion Koch 1926
Narcisso-Arrhenatheretum elatioris Kricsfalusy 1987
Cynosurion Tüxen 1947
Centaurio-Narcissetum angustifolii Kricsfalusy 1987
Molinietalia Koch 1926
Alopecurion pratensis Passarge 1964

Sanguisorbo-Narcissetum angustifolii Kricsfalusy

Nardo-Callunetea Preising 1949
Nardetalia Oberd. ex Preising 1949
Nardion Br.-Bl. 1926
Narcisso-Nardetum strictae Kricsfalusy 1987
Soldanello-Nardetum Kricsfalusy et al. 1991

Festuco-Brometea Br.-Bl. et Tüxen ex Braun-Blanquet 1949
Festucetalia valesiacae Br.-Bl. et Tüxen ex Braun-Blanquet 1949
Seslerio-Festucion pallentis Klika 1931 corr. Zólyomi 1966
Thymo-Festucetum saxatilis (Paw³. et Wal. 1943) Kricsfalusy et al. 1991

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Data to the vegetation of mushrooms in the Upper-Tisa Region

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Introduction

All the rivers of the historical Maramuresh (the Maramuresh Basin and the surrounding mountain ring) belong to the water system of River Tisa. The ecological conditions of the area within Romanian territory, constituting 3,217 sq. km, allowed the formation of a rich vegetation of mushrooms.

In Maramuresh, gathering mushrooms is an ancient activity, and is still regularly (seasonally) done. It is also done in an organized form, regarding especially certain species of the genus *Boletus* (*B. aerus*, *B. edulis*, *B. aestivalis*). Furthermore, *Cantharellus cibarius* is also purchased at the collecting centres. The organized gathering of *Armillariella mellea* has been discontinued.

At the vegetable markets mushrooms other than the above-mentioned species are also sold (we enlist only the most common ones), such as: (*Russula virescens*, *R. vesca*, *R. integra*, *R. czanoxantha*, *Lactarius glaucescens*, *L. piperatus*, *L. volemus*, *Grifola umbellata*, *Macrolepiota procera*, *Laetiporus sulphureus*, *Agaricus sp*., *Ramaria sp*.) etc.

The scientific value of the mushroom vegetation in Maramuresh is strengthened by mushrooms that grow here but are declared to be rare or becoming rare nationwide or in Europe: *Caloscypha fulgens* (Pers.) Boud., *Spathularia clavata* (Schff.) Sacc., *Mitrula paludosa* (Fr.: Fr.), *Sarcodon laevigatum* (Swartz.) Quél., *Hydnellum suaveolens* (Scop.:Fr.) P.Karst., *Clavariadelphus pistillaris* Fr., *Hygrocybe calyptraeformis* (Berk. et Br.) Fayod., *Lyophyllum ovisporum* Reid., *Melanoleuca brevipes* (Bull.: Fr.) Pat., *Catathelasma imperiale* (Fr.) Sing., *Sarcomyxa serotina* (Schnader: Fr.) Karst., *Amanita caesarea* (Scop.: Fr.) Pers. ex Schw., *Macrolepiota subsquarrosa* (Lasq.) Bon., *Xerocomus parasiticus* (Bull.: Fr.) Quel.

Keywords: mushrooms, Upper Tisa Region, Romania

Material and methods

The mushroom vegetation is an enormous biological and economic treasure, whose survey and enlistment are important. In our study, according to gathering sites, we have groupped the mushrooms from the Maramureshian Tisa region into two charts: the first consists of the species gathered from areas close to River Tisa, whereas the second chart, as a supplement, provides a list of species from the regions of 3 left-side tributaries of River Tisa (species found in the latter sites but already enlisted in the first chart are not included in the second chart).

The literature provides only few data about the mushrooms of the Upper-Tisa Region. L. Hollós, in his works mentioned in the bibliography, gives an account of the following Gasteromycetes: *Itiphallus impudicus* (L.) Fisch., *Calvatia candida* (Rostk.) Hol., *Lycoperdon furfuraceum* Schaeff., *L. hiemale* (Bull. p.p.) emend Vitt.

From the Romanian territory of Maramuresh a total of 17 species (of that six subterranean: *Tuber aestivum* Vitt., *Choiromyces meandriformis* Vitt., *Picoa carthusiana* Tul., *Elaphomyces hirtus* Tul., *E. aesperulus* Vitt., *Hysterangium fragile* Hesse) were found. Of these we found 3 species.

I started gathering and dissecting mushrooms for the Maramureshian Muzeum in 1977; these species are the subject of the present study, while I used certain species from the study published about my collecting trip with mycologist K. László. Some species were re-examined (primarily the ones whose identification was difficult), or classified by Margit Babos, Kálmán László and Dénes Pázmány, based on the material and description sent to them. I hereby thank them for their help.

An account of the natural conditions influencing mushrooms

I. Along the Upper-Tisa

This region lies along the border of Romania and Ukraine, in the N-NW part of Romania, stretching 62 km long and 50-900 m wide between the villages Valea Viseului (at an altitude of 337 m) and Piatra (190 m). Administratively it belongs to 12 villages/towns in county Maramuresh.

Geomorphologically, data provided are from two regions: (a) the flood plain of River Tisa, where abandoned river-beds, ox-bow lakes, tributaries and levees disrupt the monotony of the relief, (b) terraces I-IV, with smaller or larger interruptions, which can be traced along River Tisa.

Their substratum is Pleistocene, Holocene shales, sands, deluvium and colluvial deposits. Their soil is usually acidic alluvial soil. In the flood plain it is rough gravelly and sandy alluvial soil, on elevated parts it is alluvial soils humified to various degrees, gley, pseudogley and marshy meadow soils. On the 'Livada' terrace region there is yellowish brown forest soil.

Its climate belongs to the Df. b. k. sub-province according to Köppen, which is characterized by a rainy, boreal climate, cold winters and cool summers - even in the hottest month temperatures are below 22°C. The average annual temperature calculated over many years is 8°C. The first day of the year with a temperature below zero is October 6 on average, the last one is April 28. The average annual precipitation is 948.6 mm.

As regards flora, plant communities in the flood plains along the Upper-Tisa are influenced by water; their stands are steadily covered by water many times a year (at spring thaw, at times of torrential rains and floods).

The strip along the banks are characterized by bushy willow groves consisting of various species of willow. High tree stands usually stretch only in a narrow strip. (At certain sections they have been thinned or cut down completely in recent years.) In the countryside of Teceu Mic, Remeți, Săpânța, Câmpulung pe Tisa, there are significant willow-poplar gallery forests left, in which the species *Populus nigra*, *Salix alba*, *S. purpurea*, *S. triandra* etc., as well as the tree species *Alnus glutinosa*, *Acer campestre*, *Prunus padus* and in the shrub stratum *Sambucus nigra*, *Crataegus monogyna*, *Cornus sanguinea*, *Frangula alnus*, *Euonymus europaeus* etc. grow. With *Humulus lupulus*, *Vitis vinifera*, *Echinocystis lobata*, and *Clematis vitalba* climbing on them they constitute an impenetrable thicket, and cast a heavy shadow. Areas of deforestation are covered densely with stands of *Polygonum cuspidatum* and *Helianthus tuberosus*.

Grasses are more common at the edges of gallery forests, and forest belts at higher altitudes on the terraces. They are hygrophilous, meso-hygrophilous and mesophytic mosaic plant communities of secondary meadows, hayfields and pastures. Their areas are increasingly taken up by field (root) and ruderal plants.

In the village of Săpânța on the second terrace of the River Tisa, at an altitude of 270 m at the so-called 'Livada', an original forest community survives on 11.6 ha. Its main stand consists of specimens of *Quercus robur* as old as 150 years (0.58 m diameter, height of 23 m) and trees from natural regeneration. Beside the oak forest, in the place of deforestation, the Sighet Forest Inspectorate ('Ocolul Silvic Sighet') created a park forest consisting of 39 planted species in 1965 (a dendrological reserve).

II The environment of the tributaries of River Tisa

Along the lower section of the River Iza, northern, northwestern and northeastern hill slopes of Dealul Solovan (270-616 m) facing the river belong here. Their substratum is sandstone, clayey shale. Their soil is yellowish brown and brown forest soil. Their forest communities are *Querco-petrea-Carpinetum betuli*, *Carpino-Fagetum silvaticae* and their grass communities are known from the literature as *Agrostio-Festucetum rubrae*, *Arrhenatheretumelatioris*.

The Cărbunăreşti Stream rises at the foot of the volcanic plateau, crosses the piedmonts and flows into River Tisa at the village of Teceu Mic. Its substratum is talus, sandstone, clayey shale and Quaternary gravelly sand. Its flora is oak *Quercus robur* forests at a few places, alder (*Alnus glutinosa*) forests along the stream, and oak forests mixed with beech forests at higher altitudes.

The catchment area of the Săpânța Stream is on the Ignis volcanic plateau (also called Platoul Oaş Maramureş) at an average altitude of 900 m. Its substratum consists of pyroxene-andesite originating from Quaternary volcanism, while at the foot of the plateau it consists of accumulations of talus, then Mesozoic and Quaternary deposits. Its soil types are acidic brown forest soils (podsolized, eubasic, argillaceous, alluvial) and sphagnous swamps. Its vegetation belongs to the Carpathian flora region, to the oak zone. Around 75% of the forest stand is beech, interspersed by spruce forests (17%), at its lower section there are hornbeam-oak forests, at the confluence willow forests and all along the riverbed alder forests are found. As a result of deforestation, groved pastures (500 ha), alpine pastures, moors and peat bogs have formed. Their plant communities are known from the literature as *Festucetum rubrae montanum*, *Molinietum coeruleae*, *Leersietum oryzoidis*, *Nardo-Juncetum*, *Junco-Molinetum*, *Nardo-Molinietum*. Because of intense grazing *Nardus stricta* is becoming more and more common. Peat bogs are rich in glacial relict species. The climate of the volcanic plateau is wet (annual average precipitation is 1200 mm) and the narrow valleys provide high humidity for the nearby forests.

The mushroom vegetation of the areas surveyed

l. Mushrooms of the Upper-Tisa Region

The mushroom vegetation of the Upper-Tisa Region is primarily determined by the climate, soil conditions, and plant communities, to which anthropogenic factors largely contribute.

The taxonomical classification of mushrooms gathered here are enlisted in Table 1, in which I provided the exact locality, data concerning the habitat, and the date of collection. For classification I used the taxonomy appearing in the Handbuch für Pilzfreunde, Jena, 1975 by Michel - Henning - Kreisel (page 189, vol. 6) as a basis. Within the system species appear in an alphabetical order. Most of the mushrooms enlisted have their documentary material, from a dissection following the Herpell method, at the Department of Natural History in the Maramureshului Muzeum (Table 1).

The mushrooms classified so far belong to 26 families. Families representing the highest number of species are Trichomataceae with 12, Russulaceae with 8, Boletaceae with 6 species (the sporophores of the latter appeared in the Livada oak forest and forest park), Coprinaceae with 7, Stophariacea with 5, Polyporaceae with 4 species, mainly appearing in the flood plains. Genera are generally characterized by a low number of species. Genera with the highest number of species are *Russula* with 5, *Pholiota* with 4, *Coprinus* with 4, and *Lyophyllum* with 3 species. These are not final data, for we have more collected material yet to be classified, and surveys in the field are not complete either. The material still unclassified is from the flood plains, and contain primarily small, nitrophilous, ephemeral species.

Regular work in the fields and continuous surveys are necessary.

From an alimentary physiological point of view, taxa found have so far been distributed numerically as follows: saprobionts are represented by the highest number (34) of species, 19 species live in a mycorrhizal connection, 9 parasite species were present, and there were 8 saproparasites. Out of the total number of species (70) 45 live on the ground (on humus, leaf-mould, twigs or in grass). A total of 31 mushrooms live on wood (live or dead). The mycorrhizal species are exclusively from the 'Livada' site.

The mushrooms enlisted are considered to be common species, with some exceptions such as *Pluteus variabicolor* Babos (det. Babos, M.). It was found in two consecutive years in ruderal soil with sawdust, but later, due to construction and soil moving, we did not found any more sporophores. Sporophores of *Lyophyluum ovisporum* Reid. have also disappeared after gardening activities. Sporophores of *Melanoleuca brevipes* (Bull.: Fr.) Pat. appeared in patches of various sizes at the city boundaries, on rubbish dumpsites with sawdust. People use it as food. In the 'Livada' forest park character species appeared in the *Pinus* plantation: under *Chroogomphus rutilus* we found the mycorrhizal mushroom *Suillus granulatus*, while under *Larix decidua Suillus elegans* was found.

2. Mushrooms of the environment of the tributaries

These are mostly large forests in which thick leaf-mould and pine-needles accumulated on the ground. The moss strata, the special microclimate of the forests and the humid air of the narrow valleys all permit the establishment of an abundant mushroom vegetation representing a wide variety of species and being capable of growing sporophores (Table 2.)

Our table includes 126 taxa from 36 families (122 species and 4 variants), of which one is a subterranean mushroom (*Elaphomyces granulatus* Fr., det. Pazmany, D.).

The surroundings of the Săpânța Stream is one of the most significant habitats of *Boletus spp*. in Maramuresh. At a single purchasing centre 1870 kg were purchased in 1998, which is only a tiny part of the mushrooms collected here (by organizations or holiday-makers). There are several collecting centres that purchase boletuses from this region.

Pastures are much poorer in species. Apart from the typical *Calvatia caellata* (Bull.) Morgan yielding a number of sporophores, and *Marasmius oreades* (Bull.: Fr.) Fr. appearing in the form of witch-circles, *Stropharia semiglobata* (Batsch.: Fr.) Qel., and *Panaeolus semiovata* (Sow.: Fr.) Nannf. have become numerous because of grazing.

In the followings we highlight some rare species: *Anthurus archeri* (Berk.) E. Fischer, the population of which is increasing, is reported only from here in Romania. There are 5 places known in Maramuresh, of which 4 are near River Tisa, with several sporophores. *Phaeolepiota aurea* (Matt.: Fr.) Mre. appeared in 2 habitats in this region (on the banks of the Săpânța Stream, among young spruce and common nettle (*Urtica dioica*) and on the banks of the Cărbunăreşti Stream, under hazel and common alder (*Alnus incana*). I found it in Maramuresh in two other localities: in Polonenca (the village of Bistra) at an altitude of 1200 m in a common nettle field, and on the flood plain of the Luhei Stream among *Alnus incana* and *Urtica dioica*. I found the following mushrooms in only one habitat in Maramuresh: *Omphalotus olearius* (DC.) Sing. on a rotten treetrunk, which most likely had been an apple tree, and *Tylopilus felleus* (Bull.: Fr.) P. Karst. at one of the oxbows of Săpânța Stream, in a spruce forest, which has been cut down since then, thus the survival of the species is uncertain.

Porphyrellus pseudoscaber (Secr.) Sing. is regarded rare even in the region of Maramuresh; from here one locality is known: Săpânța-Colibi, the edge of the forest. *Strobilomyces floccopus* (Vahl.: Fr.), was encountered in the valley of the Săpânța Stream, in an oak grove; it was spotted in two more localities in Maramuresh.

Summary

The study enlists the mushroom species collected in the drainage basin of River Tisa, 196 taxa altogether, in 2 tables. The first table contains 70 taxa found in the floodplain and on the terraces of River Tisa, while the second table contains 126 taxa from the surroundings of the lower section of River Iza, the region of the streams Săpânța and Cărbunăreşti, all of which are tributaries of River Tisa in Maramuresh. We have highlighted some economically important and some rare mushroom species. The environment of River Tisa is an area of significant mushroom vegetation The conservation of its natural-ecological endowments, in the present condition at least, is an important task, because these characteristics have combined effects that influence the mushroom vegetation together.

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Table 1.

	ASCOMYCETES
PEZIZALES	
Pezizaceae	
1.Peziza cerea Sow. Ex Merat.	S.M.,on sandy soil,11.07.1984. (det. K. László)
2.Peziza varia (Hedwig : Fr.) Boud.-	S.M.,on bare calcareous soil,garden,30.04.1982
Morchellaceae	
3.Morchella esculenta (L.) Pers.	S.M. on meadow of Tisa, open wood-edge,amongst grass,19.04.1991
Sarcoscyphaceae	
4.Sarcoscypha coccinea (Fr.) Lambotte	S.M. Câmpu Negru, schrubby place, on rotting twigs, 19.04.1991 Sap:Livada,on rotting twigs, 02.04.1990
	BASIDIOMYCETES
PORIALES	
Laetiporaceae	
5.Laetiporus sulphureus (L. : Fr.) Pilat	S.M meadow of Tisa,on Salix, 05.05.1981
Coriolaceae	
6.Trametes versicolor (L. : Fr..) Pilat	Teceu Mic,meadow of Tisa, in open wood, on stumps, 02.10.1984
7.Daedalea quercina (L. : Fr.) Pilat	Sap. Livada, on stumps of deciduous trees 12.10.1984
Ganodermataceae	
8.Ganoderma lucidum (Fr.) Karst.	Sap. Livada, on Quercus stumps,03.09.1979
Hymenochaetaceae	
9.Inonotus hispidus (Bull. : Fr.) Karst.	S.M. valley Iza on Tilia, 01.09.1985 S.M. valleyTisa, on Acer,01.09.1985
CANTHARELLALES	
Fistulinaceae	
10.Fistullina hepatica (Schff.) Fr.	Sap.Livada ,on stumps of Quercus,12.10.1984
POLYPORALES	
Polyporaceae	
11.Fomes fomentarius (L. : Fr.) Gill	Câmpulung pe Tisa, bank of Tisa,on stump Populus,28 07.1979
12.Pleurotus ostreatus (Jacq. : Fr.) Kummer	S.M. in garden on a Juglans regia, 22.12.1977
13.Polyporus arcularius (Batsch.) Fr.	Sarasău, on bank of Tisa,on rotting twngs on the soil 07.098.1993. Sap.Livada,on rotting twigs, 07.09.1993.
14.Polyporus squamosus (Huds.) Fr.	Sap. and Câmpulung pe Tisa,on Populus nigra and Juglans regia,on bank of Tisa, 28.07.1979.

Table 1. continue

Schizophyllaceae	
15.Schizophyllum commune Fr.	Sap.Livada,on rotting twigs or wody debris, 12.09.1990
AGARICALES	
Hygrophoraceae	
16.Camarophyllus pratensis (Pers. : Fr.) Kummer	Sarasău,in grassland,on bank of Tisa,15.11.1984.
	S.M. on meadow of Tisa in grassy lace,07.11.1984.
Tricholomataceae	
17.Armillariella mellea (Vahl. : Fr.) Karst.	Sap.on stumps ad truncum ,02.09.19882.
18.Collybia dryophila(Bull.: Fr.) Kummer	Sap.Livada, on the soil,07.09.1994
19. Flammulina velutipes (Cart. : Fr.) Sing.	S.M. in garden on a Juglans regia, 22a ,01.12.1978.
20.Lyophyllumdecastes (Fr.) Sing.	S.M.Cămara, garden, on the soil,07.11.1984
21.Lyophyllum fumosum (Pers. :Fr.) Kühn § Romagn.	Câmpulung pe Tisa on decaying sawdust,02.10.1984.
22.Lyophyllum ovisporum Reid.	S.M. Cămara on the soil, 07.11.1984,(det. K.László)
23.Marasmius oreades (Bull. : Fr.) Fr.	S.M. In grassy place poplar wood, 30.05.1985.
24.Marasmius rotula (Scop. : Fr.) Fr.	Câmpulung peTisa ,on stump of Populus, 02.10.1984
	Sap.Livada,on rotting twigs,07.09.1993.
25.Melanoleuca brevipes (Bull. : Fr.) Pat.	S.M. on decaying sawdust, 24.04.1983, (det. K. Laszló)
26.Mycena viscosa (Secr.) R.Mre.	S.M. ad truncum Salix, 26.08.1982.
27.Mycena galericulata (Scop.: Fr.) S. F.Gray.	Sap.Livada,on stumps,07.08.1990.
28.Oudemansiella longipes (Bull.) Moser	Sap. Livada,on the soil,sub Quercus, 07.09.1994.
Rhodophyllaceae	
29.Clitopillus prunulus (Scop.:Fr.) Kummer	Sap. Livada ,vood-edge,on the soil,07.09.1994.
Cortinariaceae	
30.Gymnopilus spectabilis (Fr.) Sing.	S.M.Grădina Morii,on the roots Quercus robur,26.08.1984.
Amanitaceae	
31.Amanita phalloides (Vaill .:Fr.) Secr.	Sap. Livada on the soil, 07.08.1990
32.Amanita vaginata (Bull.:Fr.) Quél.	Sap. Livada,on the soil ,20.06.1986,(det.K.László)
Pluteaceae	
33.Pluteus depauperatus Romagn.	S.M. Street Eminescu,on stump Aesculus ,26.10.1984 (det. K. László)
34. Pluteus variabilicolor Babos	S.M. on the sawdust soil,20.08.1980,(det.M.Babos)
35.Volvariella speciosa (Fr.) Sing.	Câmpulung pe Tisa,on disturbed soil on banc of Tisa,02.09.1982.
Lepiotaceae	
36.Lepiota acutesquamosa (Weinm.) Kummer	SA.M. on sandy soil,25.09.1977.
	Câmpulung pe Tisa, on sawdust,02.10.1984.
37.Lepiota cristata (A.§ S.: Fr.) Kummer	S.M. in park,on the soil,18.09.1981.
Agaricaceae	

Table 1. continue

38.Agaricus xanthoderma Genev. var. xanthoderma Genev	S.M. in garden on the soil,28.09.1978.
39.Macrolepiota procera (Scop .: Fr.)Sing.	Sap. Livada,on the soil 07.09.1994.
Strophariaceae	
40.Hypholoma fasciculare (Huds.:Fr.)Kummer	S.M.,in park Grădina Morii,20.08.1980.
41.Pholiota aurivella (Batsch.:Fr.)Kummer	S.M.on stumps,rotting twigs,(Salix sp.,Populus sp.,26.10.1984.
42.Pholiota destruens (Brond.) Quél.	S.M.in park Grădina Morii,on stump Populus nigra,26.10.1984.
43.Pholiota gummosa (Lasch) Sing.	S.M. sub Salix,on bare sandy soil,18.09.1981.
44.Pholiota squarrosa (Pers.:Fr.) Kummer	S.M. Cămara on truncum Populus canadiensis,11.07.1984.
Bolbitiaceae	
45.Agrocybe aegerita (Brig.) Sing.	S.M. sub Populus sp.30.05.1985.
46.Pholiotina arrhenii (Fr.) Sing.	S.M. on sandy soil, sub Populus sp,Salix sp,16.04.1981
Coprinaceae	
47.Coprinus atramentarius (Bull.:Fr.) Fr.	S.M.on the soil,06.06.1982.
	Câmpulung pe Tisa,02.10.1984.
	Teceu Mic,02.10.1984
48.Coprinus comatus (Müll.in Fl.Dan. :Fr.) S.F.Gray	Sap. On bare sandy soil,26.08.1982.
49.Coprinus disseminatus (Pers.:Fr.) S.F.Gray	Sap. Livada on truncum of deciduous trees,07.08.1990
50.Coprinus micaceus (Bull.:Fr.) Fr.	S.M. park Grădina Morii,on stumps,26.10.1984.
	Teceu Mic,on stumps,02.10.1984.
51.Psathyrella candolleana (Fr.)Mre	Teceu Mic on stump,02.10.1984.
52.Psathyrella velutina (Pers.:Fr.)Sing.	S.M. in cemetery,on the soil, 26.08.1982.
BOLETALES	
Gomphidiaceae	
53.Chroogomphus rutilus (Schff.:Fr.) O.K.Miller	Sap. Livada under Pinus,07.09.1994.
Boletaceae	
54.Leccinum quercinum (Pill.) Green et Watl.	Sap. Livada,under Quercus robur ,17.07.1994.
55. Leccinum carpini (Schulz.) Mos.	Sap. Livada,under Quercus robur and Corylus avellana,17.07.1994.
56.Suillus elegans (Schum.) Snell.	Sap. Livada under Larix decidua culto,07.09.1994.
57.Suillus granulatus (L.) Kuntze	Sap. Livada,under Pinus,07.09.1994.
58.Xerocomus rubellus (Krbch.) Quélet.	Sap. Livada, under Quercus robur, 07.09.1993
59.Xerocomus subtomentosus (L.) Quél.	Sap. Livada, on the soil,12.09.1990
RUSSULALES	
Russulaceae	
60.Lactarius azonites Bull. : Fr.	Sap. Livada,wood-edge, 12.10.1984
61.Lactarius glaucescens (Crossl.) Pearson sensu Nechof	Sap. Livada, oakwood, on the soil, 02.09.1985
62.Lactarius pyrogalus Bull. : Fr.	Sap. Livada, under Corylus avellana, 07.09.1994

Table 1. continue

63.Russula foetens Fr.	Sap. Livada, on the soil,20.06.1986
64.Russula nigricans Bull. : Fr.	Sap. Livada, woodland, 02.09.1985
65.Russula heterophylla (Fr.) Fr.	Sap. Livada, on the soil, 20.06.1986 86,(det.K.Laszló)
66.Russula lutea (Huds.: Fr.) S.F.Gray	Sap. Livada, Quercetum,28.08.1983.
67.Russula virescens	Sap. Livada,on the soil, Quercetum,17.07.1994.
NIDULARIALES	
Nidulariaceae	
68.Cyathus olla (Batsch.:Pers.)	S.M. in garden,20.08.1980.
LYCOPERDALES	
Lycoperdaceae	
69.Lycoperdon pyriforme Schaeff.ex Pers.	S.M. Câmpu Negru,on stumps,.01.10.1980.
70.Calvatia excipuliformis (Scop.ex Pers.) Perd.	Sap. Livada, in grassy place,17.07.1994.

Nr. Taxon	Valea Iza Dl.Solovan	V.Cărbu-nărești	V.Săpân-ța
1.Otidea onotica (Pers. Ex S.F.Gray.) Fuck.	x		
2.Aleuria aurantia (Fr.) Fuckel			x
3.Scutellinia scutellata L. ex St.Amans			x
4.Gyromitra esculenta (Pers.: Fr.)Fr.			x
5.Gyromitra infula (Schff.: Fr.) Quél.			x
6.Ptychoverpa bohemica (Krbch.) Boud	x		
7.Chlorosplenium aeruginascens (Nyl.) Karst.			x
8.Sclerotinia tuberosa (Hedw. : Fr.) Fuck.	x		
9.Elaphomyces granulatus Fr.			x
10.Xylosphaera hypoxylon (L.) Dum.			x
11.Xylosphaera polymorpha (Pers. ex Méret) Dum.			x
12.Merulius tremellosus Schrad.: Fr.			x
13.Sarcodon imbricatum L. Fr.			x
14.Thelephora palmata Scop. : Fr.			x
15.Thelephora palmata var. diffusa (Fr.)			x
16.Thelephora terrestris Fr.			x
17.Albatrellus cristatus (Pers. : Fr.) Kotl. et Pouz.			x
18.Grifolla umbellata (Pers. : Fr.) Pil.	x		
19.Fomes fomentarius (L.: Fr.) Fr.	x	x	x
20.Fomitopsis pinicola (Sow. : Fr.) Karst.			x
21.Ganoderma applanatum (Pers. ex S.F.Gray.) Pat.		x	x
22.Hymenochaete rubiginosa (Dicks.§ Fr.) Leveille	x		
23.Cantharellus cibarius Quél.	x		x
24.Cantharellus cinereus Fr.	x		
25.Craterellus cornucopioides (L. : Fr.) Pers.	x		
26.Hydnum repandum Schaeff.			x
27.Hydnum rufescens (Schff. ex Pers.) Fr.			x
28.Hericium cirrhatum (Fr.) Nikol			x
29.Hericium ramosum (Bull. ex Mér.) Le			x
30.Lentinellus cochleatus (Pers.:Fr.) Karst			x
31.Ramaria flava (Schff. : Fr.) Quél.			x
32.Panus rudis Fr.		x	
33.Piptoporus betulinus (Bull. : Fr.) Karst.			x
34.Pleurotus dryinus (Pers. : Fr.) Kummer			x
35.Polyporus anisoporus Det. et Mont.			x
36.Polyporus variius Pers. : Fr.			x
37.Hygrophorus obrussea (Fr.) Wűnche			x
38.Hygrocybe eburneus (Bull.: Fr.) Fr.			x
39.Hyghophorus olivaceoalbus (Fr. : Fr.) Fr.			x
40.Hygrophorus pustulatus (Pers. : Fr.) Fr.			x
41.Hygrophorus russula (Schff. : Fr.) Quél.	x		
42.Calocybe gambosa (Fr.) Donk.	x		
43.Cantharellula umbonata (Gmel. : Fr.) Sing.			x
44.Collybia acervata (Fr.) Karst.			x
45.Collybia butyracea (Bull. : Fr.) Quél.			x
46.Collybia butyracea var. asema Fr.			x
47.Collybia fusipes (Bull.: Fr.) Quél.			x
48.Collybia maculata (A.§ Fr.) Quél.			x
49.Collybia marasmoides (Britz.) Brsky § Stangl.		x	
50.Clitocybe odora (Bull. : Fr.) Kummer.			x
51.Clitocybe gibba (Pers. : Fr.) Kummer.			x
52.Laccaria laccata (Scop. : Fr.) Bk.§ Br.	x		
53.Lentinellus cochleatus (Pers. : Fr.) Karst.			x
54.Lepista gilva (Pers. : Fr.) Roze.			x

Nr. Taxon	Valea Iza Dl.Solovan	V.Cărbu-nărești	V.Săpân-ța
55.Lepista nebularis (Fr.) Harmaja	x		
56.Lepista nuda (Bull. : Fr.) Cke.	x		
57.Lepista sordida (Fr.)Sing.	x		
58.Lyophyllum fumosum (Pers.: Fr.)Kűhn.§ Romagn.			x
59.Marasmius alliaceus (Jacq. : Fr.) Fr.			x
60.Marasmius androsaceus (L. : Fr.) Fr.			x
61.Marasmius scorodonius (Fr.) Fr.			x
62.Mycena epipterygia (Scop. : Fr.) S.F.Gray.			x
63.Mycena inclinata (Fr.) Quél.			x
64.Mycena pura (Pers. : Fr.) Kummer.			x
65.Omhalina ericetorum (Pers. . Fr.) M.Lge.			x
66.Omphalina obscurata Reid.			x
67.Omphalotus olearius (DC.) Sing	x		
68.Oudemansiella mucida (Schrad. : Fr.) V.Hoehn.			x
69.Oudemansiella radicata (Relhan. : Fr.) Sing.		x	
70.Tricholoma imbricatum (Fr. : Fr.) Kummer			x
71.Tricholoma inodermeum (Fr.) Gill.			x
72.Tricholoma saponaceum (Fr.) Kummer.	x		
73.Tricholoma stans (Fr.) Sacc.			x
74.Tricholoma vaccinum (Pers. : Fr.) Kummer			x
75.Tricholomopsis rutilans (Schff. : Fr.) Sing.			x
76.Xeromphalina campanella (Batsch. : Fr.) R.Mre.			x
77.Rhodophyllus clypeatum (L. : Fr.) Kummer	x		
78.Rhodophyllus sinuatum (Bull. : Fr.) Kummer.	x		
79.Cortinarius venetus (Fr. : Fr.) Fr. var. montanus Mos.			x
79.Dermocybe cinnabarina (Fr.) Wünche.			x
80.Rozites caperata (Pers. : Fr.) Karst.			x
81.Amanita citrina (Schff.) S.F.Gray.	x		
82.Amanita gemmata (Fr.) Gill.			x
83.Amanita muscaria (L.:Fr.) Hooker.			x
84. Amanita regalis (Fr.)			x
85.Amanita rubescens (Prs. : Fr.) Gray5	x	x	x
86.Cystoderma fallax Smith § Sing.			x
87.Lepiota clypeolaria (Bull. : Fr.) Kumm.			x
88.Phaeolepiota aurea (Matt.: Fr.) Mre.	x		x
89.Agaricus esettei Bon.			x
90.Agaricus silvicola (Vitt.) Sac.			x
91.Hypholoma capnoides (Fr. : Fr.) Kummer.			x
92.Hypholoma sublateritium (Fr.) Quél.			x
93.Kuehneromyces mutabilis (Schff. : Fr.) Sing.§ Smith		x	x
94. Stropharia aeruginosa (Curt. : Fr.) Quél.			x
95.Stropharia semiglobata (Batsch. : Fr.) Quél.			x
96.Agrocybe praecox (Pers. : Fr.) Vay.	x	x	x
97.Panaeolus semiovata (Sow. Fr.) Lund.§ Nannf.			x
96.Omphalotus olearius (DC.) Sing.	x		
98.Paxillus atrotomentosus (Batsch.) Fr.			x
99.Gomphidius glutinosus (Schff.) Fr.			x
100.Boletus aestivalis Paulet : Fr.	x		x
101.Boletus edulis Bull. : Fr.			x
102.Boletus erythropus (Fr. : Fr.) Pers.			x
103.Boletus impolitus Fr.			x
104.Boletus pinicola Vitt.			x
105.Boletus regius Krbh.		x	

Nr. Taxon	Valea Iza Dl.Solovan	V.Cărbu-nărești	V.Săpân-ța
106.Suillus bovinus (L. : Fr.) O.Kuntze			x
107.Tylopilus felleus (Bull. : Fr.) P.Karst.			
108.Xerocomus badius (Fr.) Kühn. ex Gilb.			x
109.Xerocomus chrysenteron (Bull. ex St.Amans.) Quél.			x
110.Porphyrellus pseudoscaber (Secr.) Sng.			x
111.Strobilomyces floccopus (Vahl. : Fr.) Karst.			x
112.Lactarius mitissimus Fr.			x
113.Lactarius rufus (Scop.) Fr.			x
114.Lactarius serifluus DC. : Fr.		x	
115.Lactarius torminosus (Schff. : Fr.) S.F.Gray.	x		x
116.Lactarius volemus Fr.	x		
117.Russula adulterina Fr.			x
118.Russula atropurpurea Krbh.			x
119.Russula nauseosa (Pers. ex Schw.) Fr.			x
120.Russula ochroleuca (Pers.) Fr.			x
121.Crucibulum laeve (Bull. ex DC.) Kambly.			x
122.Cyathus striatus (huds. ex Pers.) Willdenov.			x
123.Lycoperdon perlatum Pers. ex Pers.			x
124.Calvatia utriformis (Bull. : Pers.) Jaap.	x		x
125.Anthurus archeri (Berk.) E.Fischer	x		x
126.Phallus impudicus L. ex Pers.			x

Water developments and their impact on runoff in the Upper Tisa catchment

Károly Konecsny

The 157 200 km^2 large catchment of the River Tisa[1] is situated in the eastern part of the Carpathian Basin, also known as the Central Danube Basin. The upper catchment down to the village Záhony is 32 782, that down to Tokaj 49 449 km^2 large.

The origin of the name Tisa is still unclear, some linguists trace it back to an Indo European root supposed to mean muddy, or silty. In Roman documents the river is mentioned under the names Parsiou, Pthirus, Tigas and Tisianus, while in the mediaeval Latin chronicles in the forms Tisia and Tysia.

Keywords: hydrology, Upper Tisa, Carpathian Basin

The Upper Tisa and her tributaries in the Ukraine

The headwaters of the Tisa are in the Maramuresh Alpine Mountains, the name Tisa is used downstream of the confluence of the Chorna Tisa and Bila Tisa. Of her 962 km total length, the mountain section is only 200 km long. From the confluence of the Chorna Tisa and the Bila Tisa down to the mouth of the Vişeu the average slope of the valley floor is very steep, 6.33 m/km, between the Vişeu and the Tereblja 2.28 m/km, flattening down to Tiszabecs to less than l m/km. Over the mountain section the valley is narrow, the river having carved her up to 50 m wide bed between steep banks. The normal depth is a few decimetres. Beyond her emergence into the plains at Hust the Tisa becomes a typically lowland river meandering in a spreading valley.

The Ukrainian part of the Tisa catchment (Zakarpatia) upper of Tokaj is drained by the right hand tributaries, the Chorna Tisa (564 km^2), the Bila Tisa (487 km^2) the Teresva (1224 km^2), the Tereblja (766 km^2), the Rika (1240 km^2) and the Borzhava (1418 km^2). The only major left hand tributary over the Zakarpatia section is the Bătar/Batár[2] Creek, the 54 km long valley of which crosses three countries: Her origin is in Romania in the Oaş Mountains, her longest section is in the Ukraine, she forms the boundary between the Ukraine and Hungary to discharge at Tiszabecs into the Tisa. Of her 396 km^2 large catchment only 10 km^2 are on Hungarian territory. The mean streamflow in the Tisa is 13.8 m^3/s, which corresponds to a unit runoff of 23.0 l/s km^2. The mean streamflow at Vilok is 210 m^3/s. The annual mean streamflow

[1] The Hungarian name of the river is Tisza.

[2] The first name of common streamflow is Romanian the second Hungarian

fluctuates between rather wide limits, the maximum (39.0 m^3/s in 1970) being three times as high as the lowest (12.6 m^3/s). The highest streamflow of 734 m^3/s was recorded on June 8, 1969, the lowest (1.14 m^3/s) on February 2, 1963. The ratio of the tow is thus 1:644. The highwaters show a rising trend (Figure 1.).

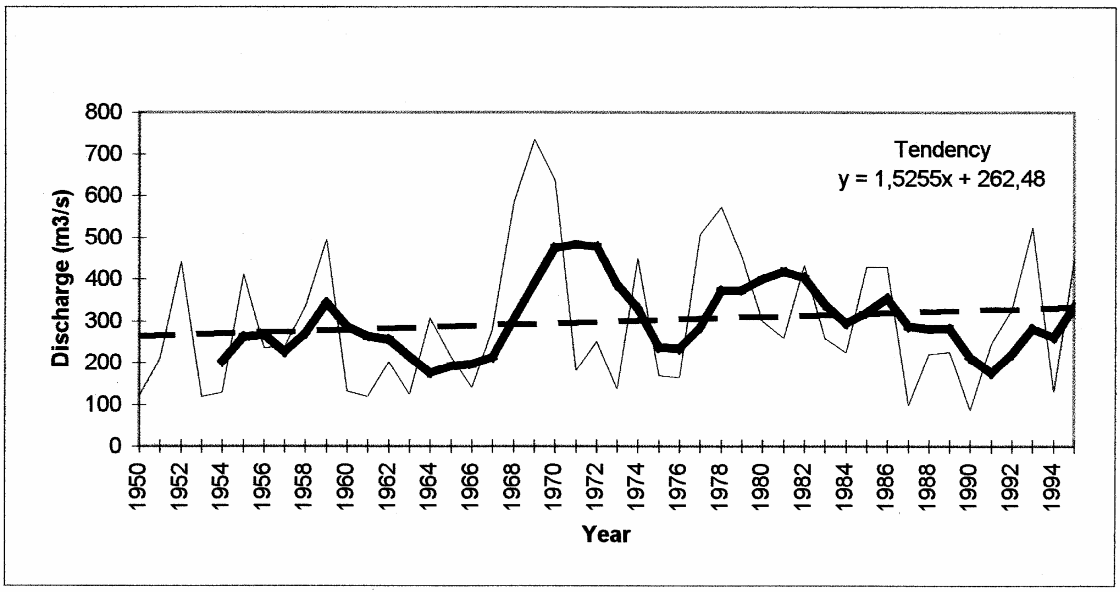

Figure 1. Annual peak streamflows (annual data, five year moving average, linear trend) past the Rahiv station on the Tisa (1950—1994)

Reservoirs

The theoretical water power potential in Zakarpatia is 10.2 thousand million kWh, of which a small part alone is developed. There are three water power stations, the largest of which is the 29.5 MW Olsoni hydropower station fed by the Tereblja and Rika rivers. The net storage volume is some 20 million m^3 only.

Flood defences

Embankments of some 230 km total length were built in the Ukraine along the Tisa and her major tributaries, further of some 220 km length along the minor streams The toal length of the bank linings amounts to some 40 km. The right hand embankments of the Tisa were strengthened over the section between Vinogradiv and Vilok bridge in recent years. The embankment section was designed to safely withstand the 1% flood. The Bătar/Batár Creek presents no flood hazard, but her highwaters back up the Tisa over several kilometres upper of the confluence. As a control measure a 9.6 km long embankment with 4.0 m crest width and 1.5 m safety freeboard was built between Tiszabecs and Magosliget in Hungary.

In the boundary zone high capacity runoff lift stations were built at the mouth of the Csaronda main canal discharging to the Latorica in the areas of Yavorovo and

Solovka and elsewhere with over 40 m^3/s aggregate capacity. These pumping stations are large enough to lift at times of high stages in the recipients the entire surface runoff from the Ukrainian part of the Bereg lowlands and some of it on the Hungarian part. The Kovács stream, the Szipa, the Mosztok and the Déda-Mitz principals convey the runoff towards Hungarian territory, while the Kaszony-Botrágy, the Barabás, the Szipa-Csaronda and the Egercse canals carry the runoff from Hungarian territory towards the Ukraine. The runoff conveyed in the Déda Mitz canal is lifted by means of a 2.2 m^3/s pumping station into a storage basin, whence it is released over a 1.0 m^3/s capacity sluice to the Hungarian side of the border.

The water arriving from Hungary in the Szipa-Csaronda principal is divided to the Csaronda-Tisa and the Csaronda-Latorica canals, which discharge into the Tisa and Latorica, respectively. The tailworks of the Csaronda-Tisa canal include a 37 m^3/s sluice and an 8.4 m^3/s lift station, wile that of the Csaronda-Latorica canal a 60 m^3/s sluice and a 15 m^3/s lift station. At times of coinciding flood waves on the Tisa and the Latorica and when the capacity of these two lift stations is inadequate to pump the collected surface runoff, the 6.2 m^3/s Solovka pumping station is also started. The New Batár canal and tailgate were built on the low land secton of the Bătar/Batár Creek in the Ukraine by which most of the water is conveyed to the Tisa over a shorter route. In the Hungarian catchment of Bătar/Batár Creek 616 hectares of farmland were provided with land drainage between 1985 and 1990, of which 143 ha have underdrains.

Groundwater

The groundwater supplies available for use amount to 7 m^3/s. The major aquifers in Zakarpatia are Pliocene Quaternary sediments. The sands and gravels in the thick Pliocene and Quaternary formation under the Chop-Mukacheva basin hold 90% of the groundwater supplies in the entire region. In the alluvial layers the groundwater table is situated at depths between 0.5 and 7 m below the terrain. The yield of the wells ranges from 6 to 20 l/s. The 15 m deep shaft wells of the Mukacheva water works yield 10-20 l/s at 2.5 m drawdown. The deep aquifers are developed by 150m deep wells, in the interior of the basin by means of 250 m deep wells. The well yields range from of few thousands to 8.5 l/s. The groundwater supplies in the Chop-Mukacheva basin have been estimated at 6.1 m^3/s. In the Tyachiv-Hust-Vinogradiv basins the groundwater supplies are substantially smaller.

In contrast to these, the adjacent mountain areas are relatively poor in groundwater. In the volcanic range running parallel to the Carpathian sandstone belt to the north of the Uzhgorod-Mukacheva line, the main aquifers are the recent volcanic rocks, the Pannonian and alluvial layers in the valleys being of inferior importance. The groundwater in these areas is abstracted from depths ranging from 5 to 300 m. The yields vary between 1 and 15 l/s and are thus of an order comparable to that of the natural springs.

In the largest communities Uzhgorod and Mukacheva 85 and 87 %, respectively, of the population are served with piped water. In the other towns the percentage is lower, whilst a few villages only have water works. In the aforementioned towns the water works draw on the phreatic aquifer. The per capita consumption is approximately 200 l/day. Hardly over one half of the urban population and 10% of the population in the major villages live in sewered areas.

The quality of surface waters is good over the upper sections, especially in terms of the oxygen parameters, but farther downstream recurring phenol and hydrocarbon discharges, high concentrations of suspended solids and total iron cause pollution concerns.

Water quality in the Upper Tisa is still good relative to that in the River Someş/Szamos and the River Crasna/Kraszna. This is in part attributable to the absence of major industrial centres in the catchment. The major sources of pollution in the Ukraine are the communal discharges at Rahiv, Tyachiv, Hust, Vinogradiv, Irshava and Beregove. In Romania the towns Sighetu Marmației, Borşa along the Vişeu, Vişeu de Sus and the non ferrous metal ore mines and dressing plants at Borşa are the potential sources of pollution. Although the volume of industrial production has declined generally in recent years, the number of pollution accidents has increased. The solution of the Stretter Phelps set of equations describing the oxygen balance in streams for the state corresponding to the critical streamflow of 80% duration in August has implied that the low in the oxygen curve occurs at approximately 40 km from the point of discharge to the Tisa River. As a consequence of the still considerable logging and timber industry considerable amounts of organic enter the streams and the sediment load has increased.

The Upper Tisa and her tributaries in Romania

In the north western part of Romania the tributaries of the Upper Tisa are the Vişeu, the Iza, the Săpânța, the River Someş/Szamos and the Crasna/Kraszna.

The Romanian section of the River Tisa

The Upper Tisa crosses the northern part of the Maramuresh Basin in E W direction, forming over 60 km length the boundary to the Ukraine between the mouth of the Vişeu and Teceu Mic. Between the Vallea Vişeului and Lunca the river flows in an 8 km long gorge. From the viewpoint of flood safety the section between Remeți below the mouth of the Teresva and Teceu Mic causes the greatest concern, where the river meanders, forming several densely overgrown abandoned beds. Some 270 hectares of the flood plain downstream of the Iza mouth are covered by a forest of phreatic trees.

Over the Romanian river section rock bank linings were built in 48 km length. The town of Sighetu Marmației is protected by a 4.6 km long flood embankment and also the water works drawing on bank filtered supplies are protected by a 1.4 km long ring dyke. Further flood defences are on the left hand bank at Bocicoiu Mare, Sarasău, Câmpulung la Tisa and Remeţi.

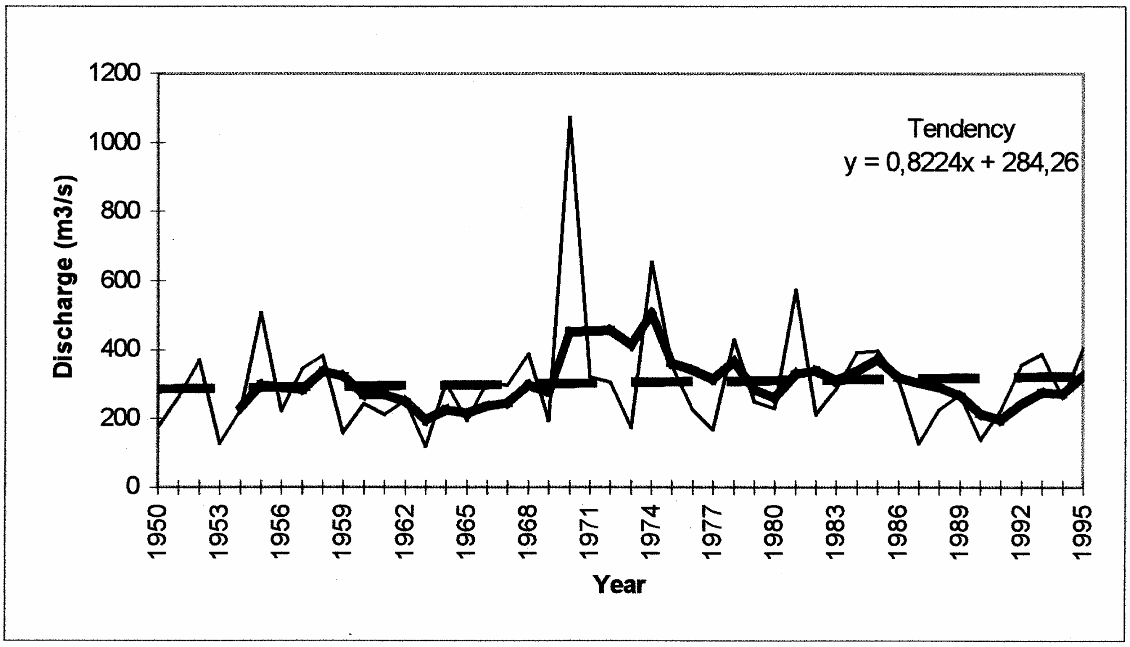

Figure 2. Annual peak streamflows (annual data, five year moving average, linear trend) past the Bistra station on the Vişeu (1950 1994)

The first and the largest tributary of the upper Tisa section in Romania is the Vişeu, the headwaters of which emerge from the Prislop saddle between the Rodna and Maramuresh Alpine mountains. The 80 km long river drains an 1580 km^2 large, asymmetrical catchment, the right hand feeders emerging from the Maramuresh Alpine Mountains, the Cisla, Vaser and Ruszkova/Ruscova, surpassing greatly in both catchment size and streamflow those entering from the left hand side (the Sebeş, or Repedea). The normal annual mean stremflow at Bistra is 32.0 m^3/s, the highest streamflow recorded during the May floods in 1970 was 1072 m^3/s (Figure 2.). The total length of the bank linings and flood embankments along the Vişeuis some 15 km, most of these protecting the communities Borşa , Vişeu de Sus, Leordina, Petrova and Bistra.

The second largest tributary, the Iza emerges from the Rodna Alpine Mountains and crosses the Maramuresh Basin in S N direction over 70 km length. The catchment drained is 1305 km^2 large. The normal annual mean flow past the Vadu Izei hydrographic station situated between the mouth to the Tisa and the entrance of the Mara stream is 15.9 m^3/s, while the 1% peak flood discharge is 780 m^3/s.

River training works and flood embankments were built of some 20 km total length in the Iza Valley: in the areas of Săliştea de Sus, Dragomireşti, Rozavlea, Bârsana and Sigethu Marmaţiei.

On the upper section of the Mara stream construction work is under way on the dam of the Runcu reservoir. The 90.5 m high dam will create a storage space of 28 million m^3. A tunnel drilled into the volcanic rock of the Gutâi mountain will transfer a flow of 1.5 m^3/s to the Strâmturi, or the Frizia reservoir on which the towns of Baia Mare and Sighetu Marmației, further the villages in the Mara Valley will rely for their water supply. The reservoir will serve also flood control purposes and after the completion of the two underground power stations Runcu and Frizia will generate 28 mW of power.

Săpânța Creek is the third left hand tributary of the Upper Tisa. At a length of 20 km she drains a 135 km^2 large catchment with a mean flow of 3.80 m^3/s. The valley of 15 m/km average slope is cut into andesite rock.

Water uses

Water to the towns Borşa, Vişeude Jos and Sighetu Marmației is supplied from groundwater resources, withdrawn from 9-12 m deep wells and springs at the rate of 0 363 m^3/s, of which 0.190 m^3/s are used for domestic purposes. The present demands are met, but assuming economic growth over a longer period this supply will prove inadequate. Water distribution networks have already being built in the villages Budeşti, Čalineşti, Ocna Şugatag, Dragomireşti, Săcel and Sâliştee de Sus, in other communities piped water projects are under construction or in the planning stage. However, in the majority of the communities water is still obtained from wells and springs.

Water quality is generally high along the headwater, mountain sections of the streams, deteriorating gradually to acceptable farther downstream. Zinc of natural origin in elevated concentration was observed on some stream sections.

The non ferrous metal ore mines at Baia Borşa, further the towns Borşa, Vişeude Sus and Sighetu Marmației are the major sources of pollution. The wastewater treatment plants at these communities were built with mechanical and biological stages of the necessary capacity, but the removal efficiency is poor and should be improved by more careful operation. The mine drainage waters from the non ferrous ore mines at Baia Borşa , situated in the catchment of the Cisla stream are discharged over three settling ponds without any further treatment to the recipient. The villages are unsewered and have no sewage treatment facilities.

The Tur/Túr catchment

The 1 261 km^2 large catchment is bounded on the northern side by Tisa catchment, on the souther side by the catchment of the River Someş/Szamos. Of the total catchment area the share of Romania is 944 km^2 (75%), that of Hungary 317 km^2 (25%).

Figure 3. The Tur/Túr catchment, flood embankments, reservoir, key gauges

The Tur/Túr emerges in the Gutâi Mountains at an elevation of 989 m. The tributaries along the upper section, the Valea Rea, Valea Albă, Lechincioara, and Târşolţ drain to the Oaş Basin (Figure 3.).

Downstream of Călineşti Oaş the river sope becomes flatter, the mountain character changing successively to that of a lowland stream. The left hand tributaries Talna and Racta, further the right hand tributary Turţ enter in the lowlands already.

The mountain parts of the catchment have relatively abundant precipitation and owing to the favourable runoff conditions the unit runoff is high, over 20 l/s km^2.

The flood and runoff control system in the Tur/Túr catchment consists of the following components:

- The flood embankments along the flood plains the section of the Tur/Túr between Călineşti Oaş and the national boundary, further the donwstream sections of the Turţ, the Talna Mare and the Egher creeks.
- The Călineşti Oaş reservoir, which serves also flood control purposes upper of the flood defences.
- The drainage canals built to remove the surface runoff from the areas behind the flood defences.
- The runoff lift stations.

Prompted by the losses caused by the floods in May, 1970 in the Romanian part of the Tur/Túr catchment, the Călineşti Oaş reservoir was built in 1972, which serves besides flood control, the purposes of fish farming and power generation. Following the first trial impoundment in June, 1974, the reservoir was commissioned definitely in 1979.

The creeks carrying abundant water drain a 375 km^2 large part of the catchment (30% of the total) to the reservoir. The 798 m long, 9.5 m high gravity dam was built of local rock Of the total 23.09 million m^3 reservoir space 20.34 million m^3 serve flood control purposes. At the normal retention level the surface area of the 4.7 km long and 1.2 km wide reservoir is 382 ha. Under emergency conditions the bottom outlet, the gates and the spillway weir are capable of releasing a discharge of 200 m^3/d. The two turbines installed in the powerhouse at the toe of the dam have a combined capacity of 1.4 mW at 13.8 m^3/s discharge.

The feasibility of diverting the Talna Creek into the Călineşti reservoir has been studied. This transfer scheme would expand the catchment above the reservoir to 599 km^2, or to 50% of the total area.

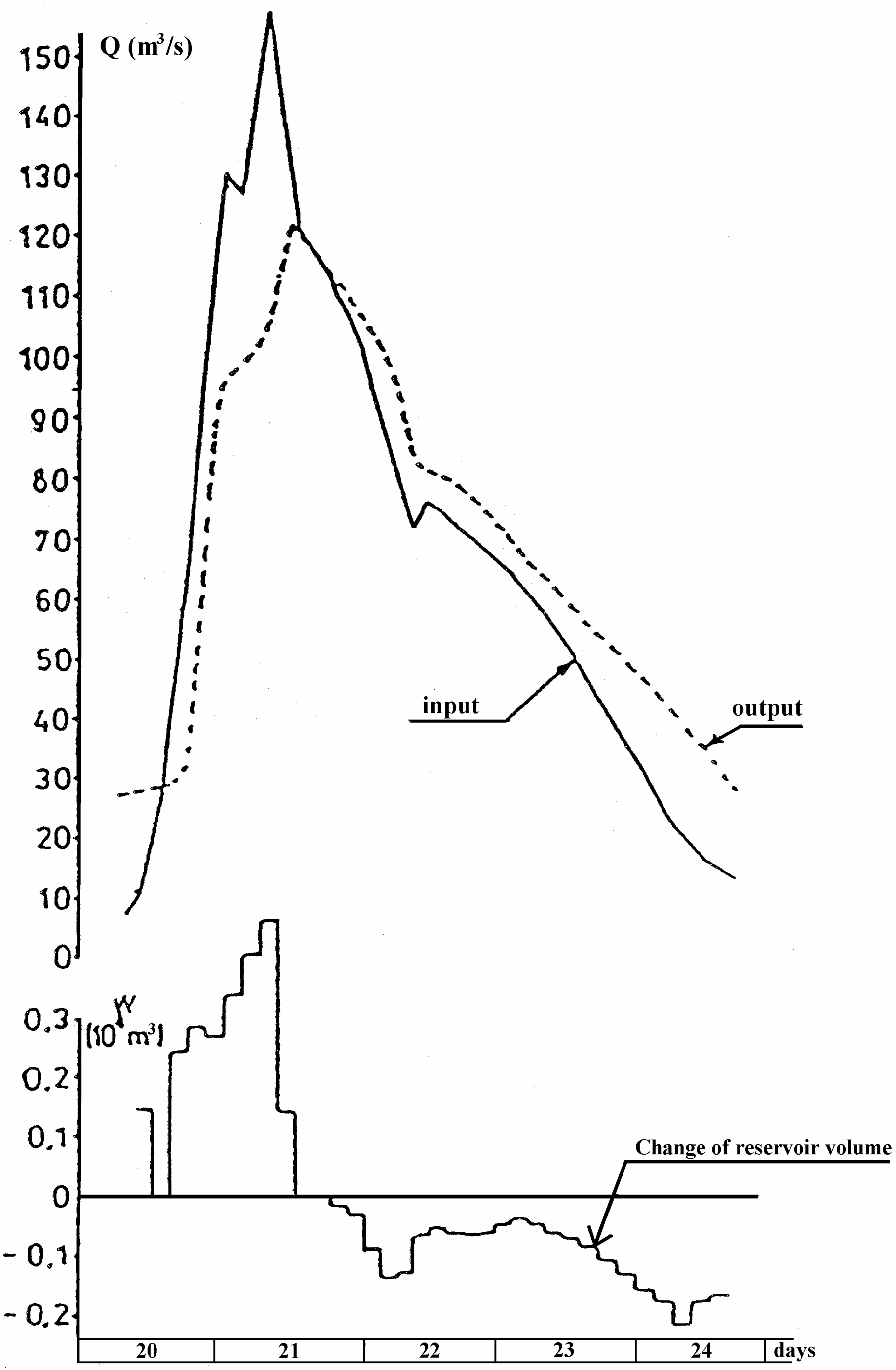

Figure 4. Attenuation of the 1993 December flood by the Călineşti Oaş reservoir on the Tur/Túr river

The impacts of the Călineşti Oaş reservoir on the monthly and annual flows

The annual mean flows past the Negreşti Oaş gauging station upper of the reservoir, that is uninfluenced by storage, during the 1979-1994 period were lower by approximately 9% than over the 12 years (1963-1978) before commissioning the reservoir, while the mean flows past the downstream gauging stations Turlung and Garbolc on the Tur/Túr river the mean flow has increased by 10 and 6%, respectively, under the equalising impact of the reservoir (Konecsny, Sorocovschi 1996).

The annual highest flows in the Tur/Túr will be seen from the records of the Negreşti Oaş gauging station to have diminished by 9% on the average, while the avereage decrease thereof was 67 and 74% on the Turulung and Garbolc stations, respectively. The reservoir has thus reduced significantly the flood peaks and consequently the flood hazard. The falling limb of the flood hydrographs has become at the same time longer than under natural conditions (Figure 4.).

On the Turulung and Garbolc gauges peak flows higher than 200 m^3/s were recorded in five years over the 16 year period (1963-1978) prior to commissioning the Călineşti Oaş reservoir, whereas between 1979 and 1994 such event has occurred on a single occasion only, in 1980 (Turulung 220 m^3/s, Garbolc 195 m^3/d).

The annual low and the lowest monthly mean flows were found to have diminished by 9 and 17%, respectively, on the Negreşti Oaş gauge upper of the reservoir in the second half of the dry period 1979 1994. In contrast thereto, the low water flows have increased by about 10% on the gauges Turulung and Garbolc downstream of the reservoir.

In addition to the beneficial impacts outlined in the foregoing (flood peak reduction, augmentation of low flows), the adverse impacts of abnormally high heavy metal pollution in the Tur/Túr could also be reduced, thanks to the diluting and flushing effect of the flows released from the Călineşti Oaş reservoir at times of low water.

Runoff lift stations with a total capacity of 28 m^3/s are situated along the river section downstream of Turulung on both banks. These are. Drăguşeni left hand bank, 17+328 km, 3.1 m^3/s, Micula left hand bank, 9+115 km, 5 0 m^3/s, Mesteacăn right hand bank, 5+200 km, 7.41 m^3/s, Porumbeşti right hand bank, 1+050 km, 2.40 m^3/s, Cer left hand bank m 0+760 km, 2.10 m^3/s, further on the Egher canal Bercu left hand bank, 8.06 m^3/s.

Water quality in the Tur/Túr was excellent a few years ago, the oxygen level was high, organic and total dissolved salt concentrations were low (70-334 mg/l). The high values were registered during the summer low flow periods.

In recent years sewage bacteria have been detected at growing frequency, turning water quality to acceptable in terms of the coliform counts. Organic pollution in the river has scattered widely and displayed a growing trend. The ammonium content tended to decrease gradually from spring to late summer, although considerable fluctuations were registered periodically. In some samples ammonium ion was present in concentrations surpassing the classification criteria of good water (Konecsny,A. 1995). High iron (1 mg/l) and manganese (0.4 mg/l) concentrations were registered. Elevated zinc concentration (0.61 mg/l) was registered first in 1985. This was considered sporadic, but further heavy metal data have prompted frequent sampling and analyses necessary. These have revealed that the presence of zinc and other heavy metals is caused by continuous discharges to the river network.

The very high zinc concentrations in the Tur/Túr were traced back to the Turț Creek. Owing to careless operation of the wastewater treatment plant of the non-ferrous metal ore mine along the creek, the effluent discharged represented a source of continuous heavy metal pollution. The peak concentrations of copper, lead, nickel and chromium remained below the limit set for excellent water quality, but the concentrations of cadmium, mercury and zinc have prompted a classification into the polluted and highly polluted categories. Sediment analyses have shown high accumulations of zinc in the deposits.

The groundwater aquifers are situated below the phreatic groundwater relatively close (2-3 m) to the surface, at depths of 15-80 m (Upper Pleistocene), 50 170 m (Lower Pleistocene) and 180 m (Upper Pannonian).

The Crasna/Kraszna catchment

Of the 3142 km^2 large catchment 2253 km^2 (72%) are in Romania, while 889 km^2 (28%) in Hungary. The Crasna/Kraszna emerges at El. 997 m below the Măgura Priei peak rising between the Meseş and Rez Mountains in the southern part of the Şimleu Silvaniei Basin.

Over her headwater reach she collects several minor streams, the more important ones of which, the Ponița valley, the Banului Creek, the Mărtăuța and the Şomoş Creek, drain the larger, left hand slopes. The mean unit runoff over this section is little above 6 l/s km^2. The river has carved her bed into sedimentary rocks with a wide loop around the crystalline shale block of the Măgura Şimelului (579 m). Notwithstanding the fact that this is the upper part of the catchment, the river slope is relatively flat at 10.2 m/km.

Down to Supuru de Jos the river meanders in the rolling Sălaj country between relatively recent Piemont type Pliocene Quaternary formations. Extending to the lowlands, the deep valleys provide ready drainage to the groundwater. The more important tributaries include the Zalău, the Corund, the Cerna and the Maria creeks, which drain the right hand catchment (Figure 5.).

Over the middle reach the river slope diminishes from 5.0 to 3.2 m/km down to the area of Moftinu Mare Ghilvaci. Upon her emergence into the lowlands, the river has deposited an alluvial fan which contributed to filling the Ecedea/Ecsed depression.

The eutrophic marsh known as the Ecedea/Ecsed Bog developed along the lower reaches of the Crasna/Kraszna during the last glaciation period. Before the reclamation drainage project, the Crasna/Kraszna has fed regularly the Ecsed/Ecedea Bog, while according to Benedek (1973) at times of major floods the inundation have extended between Acâş and Mihăieni as far as the Ier/Érmellék, which belongs to the catchment of the River Barcău/Berettyó. Depending on the alternation of wet and dry periods, the area of the marsh varied continuously. Reclamation, which involved the construction of drainage canals and embankments, has brought about profound changes in the original, natural stream network.

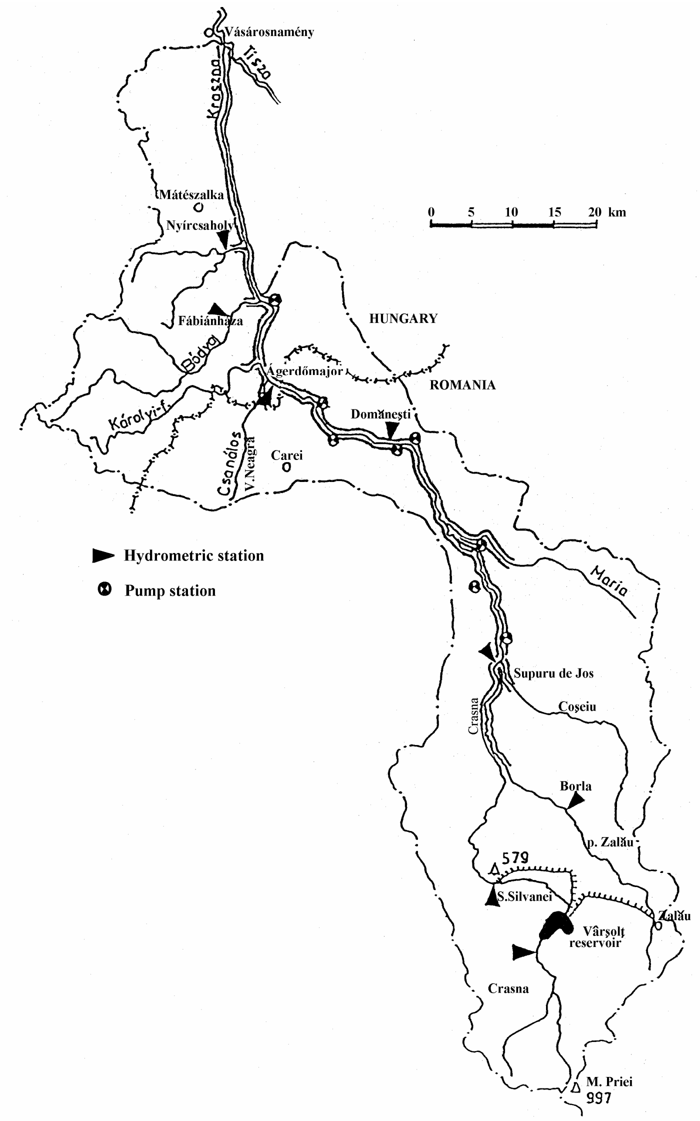

Figure 5. The Crasna/Kraszna catchment, flood embankments, reservoir, key gauges

Based on the designs of 1877, the bed of the Crasna/Kraszna was deepened, but the works providing the definite solution were started on the initiative of the ”Ecsed Marsh Reclamation and Szamos Left Hand Flood and Runoff Control Association” founded in 1894. The project was completed from 1895 to 1898. The 66 km long Crasna/Kraszna Canal (from the railway bridge at Moftinu Mic to Vásárosnamény) was excavated and flanked by flood embankments. The canal by passed the marsh and discharged directly to the Tisa instead of the River Someş/Szamos. An embankment was also built along the left hand bank of the River Someş/Szamos, the small streams draining the Făget and the Nirului/Nyírség sand hills were trained, interrupting this way water supply to the marsh. The next step consisted of the excavation of the Boghiş/Keleti, the Északi and the Central/Lápi drainage principals. As a result of these measures the 9200 ha large Romanian part of the marsh retreated and dried up within a relatively short period of time.

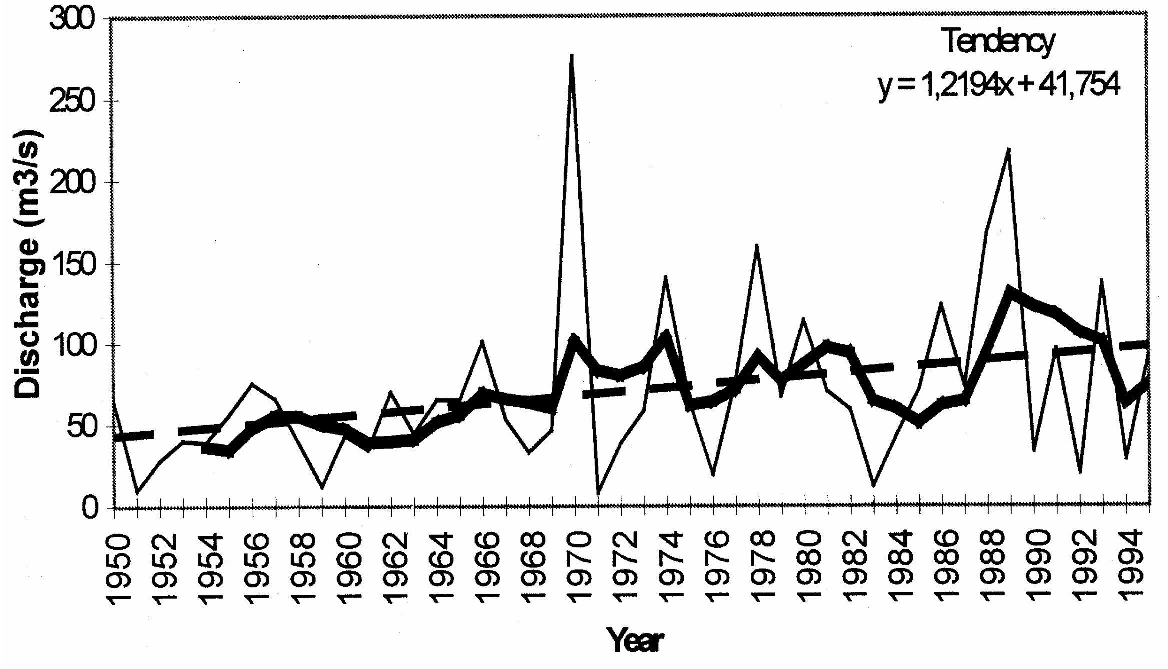

Figure 6. Annual peak stram flows (annual data, five year moving average, linear trend) past the Supuru de Jos station on the Crasna/Kraszna (1950-1994)

Flood embankments extend presently along both banks of the Romanian section of the Crasna/Kraszna from the mouth of the Zalău Creek to the national boundary and thence to the Tisa. On the tributaries embankments were built along short sections upper of their inflow to the recipient. The defences were strengthened in 1979-1985 to withstand floods of 2.5 10% probability. The embankments rise to 1.5-3.5 m above the terrain, the distance between the low water bankline and the embankments Arieş from 60 to 80 m. The mouth of the Maria Creek was relocated 3.5 m upper, increasing thus the size of the catchment pertaining to the Alsószopor hydrographic station.

On the 45 years long 1950-1994 record three periods can be distinguished. While there were no major floods from 1950 to 1964 and 1985 to 1994, major flood waves travelled down the river every second to fifth year between 1965 and 1984 (Figure 6.).

The aggregate capacity of the pumping stations built to lift surface runoff in the Crasna/Kraszna catchment is 72 m^3/s, of which that of the 14 stations on Romanian territory is 58.2 m^3/s. Three of these pumping stations (1.5 m^3/s) are upper of Supuru de Jos, seven (32.9 m^3/s) between Supuru de Jos and Domaneşti, while four (23.8 m^3/s) between Domaneşti and the national boundary. The largest pumping stations are those at Moftin (22.5 m^3/s) and Berveni (18.0 m^3/s) (Pandi 1992).

Although reclamation has eliminated open water surfaces, the groundwater table is still very close (0.5—1.0 m) to the surface locally.

Reservoirs

Following the large floods of the 70s, the 2160 m long and 14 m high earth dam was built between 1977 and 1979 at Vârşolţ, which created a 40.65 million m^3 storage space of 460 ha large water surface at normal retention level. The catchment area above the reservoir is 345 km^2 (11% of the total). Over one half (23.88 million m^3) of the reservoir space serves flood control purposes. The total capacity of the bottom outlet and the spillway weir is 263 m^3/s and thus considerably higher than the conveying capacity of the flood bed. The conservatively dimensioned storage space allows complete retention of 0.8% probability flood waves. Drinking water to the towns Zalău (0.5 m^3/s) and Şimleul Silvaniei (0.25 m^3/s) is supplied from this reservoir.

The Moftinu Mare emergency reservoir was built in 1980 on the right hand bank of the low land section of the Crasna/Kraszna. The reservoir is capable of retaining 6.8 million m^3 of flood flow (2.4 million in the first and 4.4 million in the second basin). The 274 ha large reservoir enclosed by a 3 m high embankment is 2.4 km long and 1.3 km wide. Water to the first basin can enter only at stages overtopping the 70 m long fixed weir, the maximum capacity of which is 115 m^3/s. After the flood the water is released through two 2.0 by 1.2 m vertical lift gates of 10 m^3/s combined capacity.

For the complete development of the flood control system two further emergency reservoirs are envisaged, one at the mouth of the Maria Creek to the recipient (catchment area: 240 km^2, or 11% of the total) and one at Răteşti (catchment area 117 km^2, or 8% of the total).

Water transfers

Part of the Crasna/Kraszna flood flow can be diverted at Acâş into the catchment of the Barcău/Berettyó, specifically into the valley of the Ier/Ér Creek, provided that the latter carries no flood at the same time. In the upper part of the catchment, on the other hand, a flow of some 0.2 m^3/s is transferred from theBarcău /Berettyó catchment to the Vârşolţ reservoir to augment the relatively low flow available in arid periods. The meet the considerable demand of the industries in the Zalău region water is also imported from the River Someş/Szamos through the diversion at Jibou (0.8 m^3/s).

Construction of the Vârşolţ reservoir and other water resources projects have opened the possibility of transferring some 1 m^3/s to the Crasna/Kraszna catchment from the neighbouring River Someş/Szamos and Berettyó/Barcău catchments. The return flow appears in the Crasna/Kraszna as domestic effluent at Şimleul Silvanei, which is supplied with piped water from the reservoir, and farther downstream in the tributary Zalău Creek to which industrial effluents from the River Someş/Szamos and domestic effluent from piped water supply obtained from the Vârşolţ reservoir are discharged.

The flows entering the reservoir can be estimated from the records of the Crasna/Kraszna gauging station, at the village Crasna, while the released volumes from those of the gauging station at Şimleu Silvanei and Supru de Jos situated downstream of the Zalău Creek, further on the Ágerdőmajor gauge. The streamflow record of the guaging station at the village Crasna on the Crasna/Kraszna river reflects the natural runoff influenced little by human activities, while the flow registered on all gauges downstream of the reservoir are modified ones. The record of the Domaneşti and Ágerdőmajor stations is influenced by the operation of the runoff lifting stations in the lowlands and the impoundment of the Moftinu Mare emergency reservoir at floods higher than the Alert Level I.

The impact of the Vârşolț reservoir on the monthly and annual flows

The annual mean flows before (1963—197) and after impoundment (1979—1994) were compared with the following conclusions:

- On the Crasna/Kraszna gauging station the flows during the first period were 8% higher than during the second, owing mainly to the sequence of 13 arid years after 1979.
- On the Şimleul Silvanei gauge impoundment has reduced the mean flow by 40%.
- On the stations downstream of the Zalău Creek (Supuru de Jos, Ágerdőmajor) the impact of impoundment was no more detectable.

The annual peak flows averaged over the 1979—1994 period

- have grown slightly on the Crasna/Kraszna gague upper of the Vârşolț reservoir,
- have dropped drastically, to 22.5% of the former (from 72.6 to 15.9 m^3/s) on the Şimleul Silvanei gauge, and
- have dropped moderately from 96.4 to 78.1 m^3/s (19%) on the Ágerdőmajor gauging station.

The impacts of the Vârşolț reservoir and the inter basin transfers are significant ones also in low water periods:

- The low flows past the Crasna/Kraszna gauge have increased slightly (10%).
- The low flows past the Şimleul Silvanei station have decreased following impoundment of the reservoir.
- The averages of the annual minima have doubled on the gauges Supuru de Jos (from 0.261 to 0.568 m^3/s) and Ágerdőmajor (from 0.366 to 0.771 m^3/s) (Figure 7.).

Sediment transport in the River Tur/Túr and Crasna/Kraszna rivers

From the data of the sediment observations in Romania it was noted that the rate of suspended sediment transport in the Crasna/Kraszna at the Domaneşti station (3.87 kg/s) was 2.5 times as high as that in the Tur/Túr at Turulung (1.45 kg/s), although the streamflows in the latter are appreciably higher.

A comparison of the records registered before and after the construction of reservoirs has lead to the unexpected result that rather than decreasing, the transport rate has increased upon impoundment by 57% on the Tur/Túr and 88% on the Crasna/Kraszna. The phenomenon is interesting enough to merit further study, but it

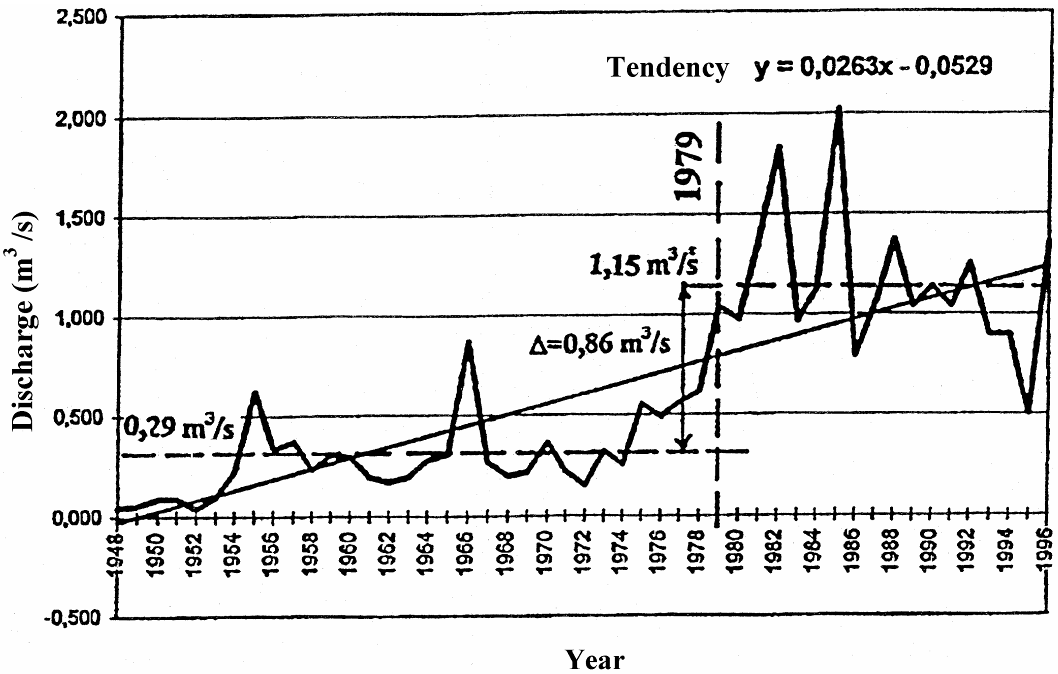

Figure 7. Increase of the annual minimum flows by the Vârşolţ/Varsolc reservoir after its commissioning in 1979, on the Ágerdõmajor gauge on the Crasna/Kraszna

appears obvious that the increase in the rate of suspended sediment transport is unlikely related directly with the commissioning of the reservoirs. In fact, the two reservoirs are on the upper reaches of the rivers, where owing to moderate erosion rates the sediment transport rates are relatively low. The distance between the reservoirs and the stations with sediment observation data is long and it is the middle reach of the rivers, where physico geographical conditions, precipitation, surface runoff and channel erosion, are conducive to sediment entertainment.

The Crasna/Kraszna is the stream with the poorest water quality in the region. In the boundary cross section the arriving flow is virtually sewage. The organic content is high, although the organic load in terms of the COD has diminished slightly relative to the level in the 80s. The high ammonia content is the result of the liquid manure discharges. Relative to the streamflow the ammonium ion flux is the heaviest. The TDS content is also high. The phosphate ion level originating from poorly treated effluents depends on the actual streamfow and is comparable in this respect to the other streams (phosphate removal being rare).

The DO content is consumed by the large amount of decaying organic, algal growth is triggered by the abundant nutrient supply and is the cause of secondary organic pollution. In this respect the worst (4.6 mg/l) month is May, when the water temperature starts rising and the decomposing activity of bacteria intensifies.

Prolonged oxygen deficient conditions in summer with DO levels as low as 0.9 3.0 mg/l are the result of high organic loads. Fibrous fungi (Sphaerotilus) appear in the water, while others are present in the form of fine floating flocs.

No higher animals can survive in the stream bed. The nitrogen and phosphorus content responsible primarily for eutrophication keeps growing and affect the aquatic ecosystem by extended exposure (Erdelics, Barta 1989).

The causes of poor water quality and organic silt deposits in the stream bed are the sources of pollution. like the poorly treated effluent discharges and the sugar refinery at Carei, and the untreated liquid manure from the Moftinu Mare pig farm.

Groundwater

The aquifers in the entire catchment yield generally little water. There are no more than six major water works drawing on groundwater, abstracting a total of 0.268 m^3/s, of which 0.226 m^3/s, pumped from depths between 50 and 400 m, are used for industrial and agricultural purposes in the lowlands around Carei.

The River Someş/Szamos catchment

The River Someş/Szamos catchment is shared by Romania and Hungary. The Romanian part of the is 15 217 km^2 large. The length of the river section in the catchment is 345 km. The two headwater branches, the Someşul Mare and the Someşul Mic join at Dej, downstream of which the river is called River Someş/Szamos.

The catchment enclosed by the 726 km long divide is drained by a dense stream network, which includes some major tributaries originating in areas of higher elevation and abundant precipitation, like the Someşul Mare, the Someşul Mic and the Lapuş.

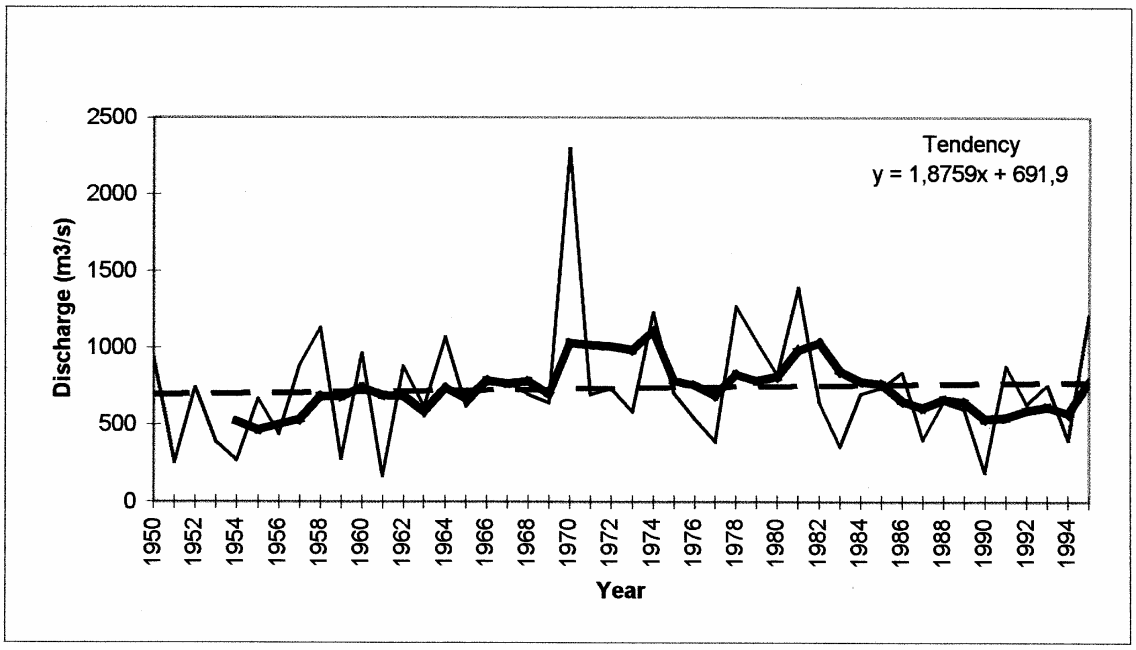

Figure 8. Annual peak streamflows (annual data, five year moving average, linear trend) past the Dej station on the River Someş/Szamos (1950 1994)

Climate and hydrology are influenced basically by the geographic location of the catchment, which is 170 km long at an average width of 90 km. The mean elevation is 536, the average slope 170 m/km, the density of the stream network is 0.59 km/km^2. The mean discharge of the River Someş/Szamos at Satu Mare is 120 m^3/s, which carries a suspended sediment load of 136 kg/s. The variations of the annual peak flows is illustrated in Figure 8.

Flood embankments were built generally along the river sections in the mountain and hilly parts to protect major communities and where the channel is not embedded deep enough in the valley floor. Continuous embankments run along the Someşul Mare between Năsăud and Dej, along the Someşul Mic between Gilău and Dej, further in the plains between Berindan and the national boundary.

Reservoirs

The Colibița reservoir was built from 1977 to 1995 on the upper reaches of the Bistrița, a tributary to the Someşul Mare, on the western slope of the Căliman Alpine Mountains. The 1.6 million m^3 of volcanic rock for the 92 m high, 252 m long valley dam were excavated in the vicinity. The upper slope was sealed with a special asphalt lining. The storage space created by the dam has a volume of 90 million m^3 at a water surface area of 300 ha. The flow of the Bistrița and that of five creeks diverted via tunnels are impounded. The maximum release rate of 741 m^3/s is composed of the 6 m diameter glory hole spillway (550 m^3/s), the bottom outlet (104 m^3/s and the power station (87 m^3/s). The 21 MW underground power station is connected over a 6.2 km long tunnel.

The Someşul Mic water power and water management system project was implemented between 1969 and 1988. The scheme includes 16 dams of different size and serves to provide flood control to the Gilău-Dej section of the Someşul Mic, to save thus the costs of embankments, to supply drinking water to communities and to create welfare, recreation opportunities.

The 102 m high, at the crest 410 m (at the base, owing to the steep valley slopes only 270 m) long Mărişel gravity dam ios lined on the upper slope with r.c. slabs of 0.35-0.94 m thickness and 34 100 m^2 total surface area. The Fântânele (Beliş) reservoir is 13.5 km long and 815 ha large at normal retention level. At the highest storage level the volume is 250 million m^3, of which 48 million m^3 serve flood control purposes, so that the net storage space is 200 million m^3 (Figure 9.).The reservoir is fed by the 6.81 m^3/s mean flow of the Someşul Cald, the creeks (4.09 m^3/s) diverted from the Someşul Rece catchment and the Iara (1.78 m^3/s), a tributary of the Arieş. These flows are diverted to the reservoir through tunnels os 21 km total length. Under emergency conditions a maximum flow of 700 m^3/s can be passed over the spillway (Pop 1997).

The Mărişel underground power station was excavated in very hard metamophic rock to accommodate three Francis turbine generating sets of 220 MW total capacity (73.5 MW each). The power flow of 60 m^3/s is conveyed in a 8,75 km long, 4.4 m dia. tunnel from the reservoir under a head of 470 m.

The 232 m long, 97 m high double curvature arch dam Tarnița was built 16 km farther downstream and commissioned in 1974. The powerhouse at the toe of the dam

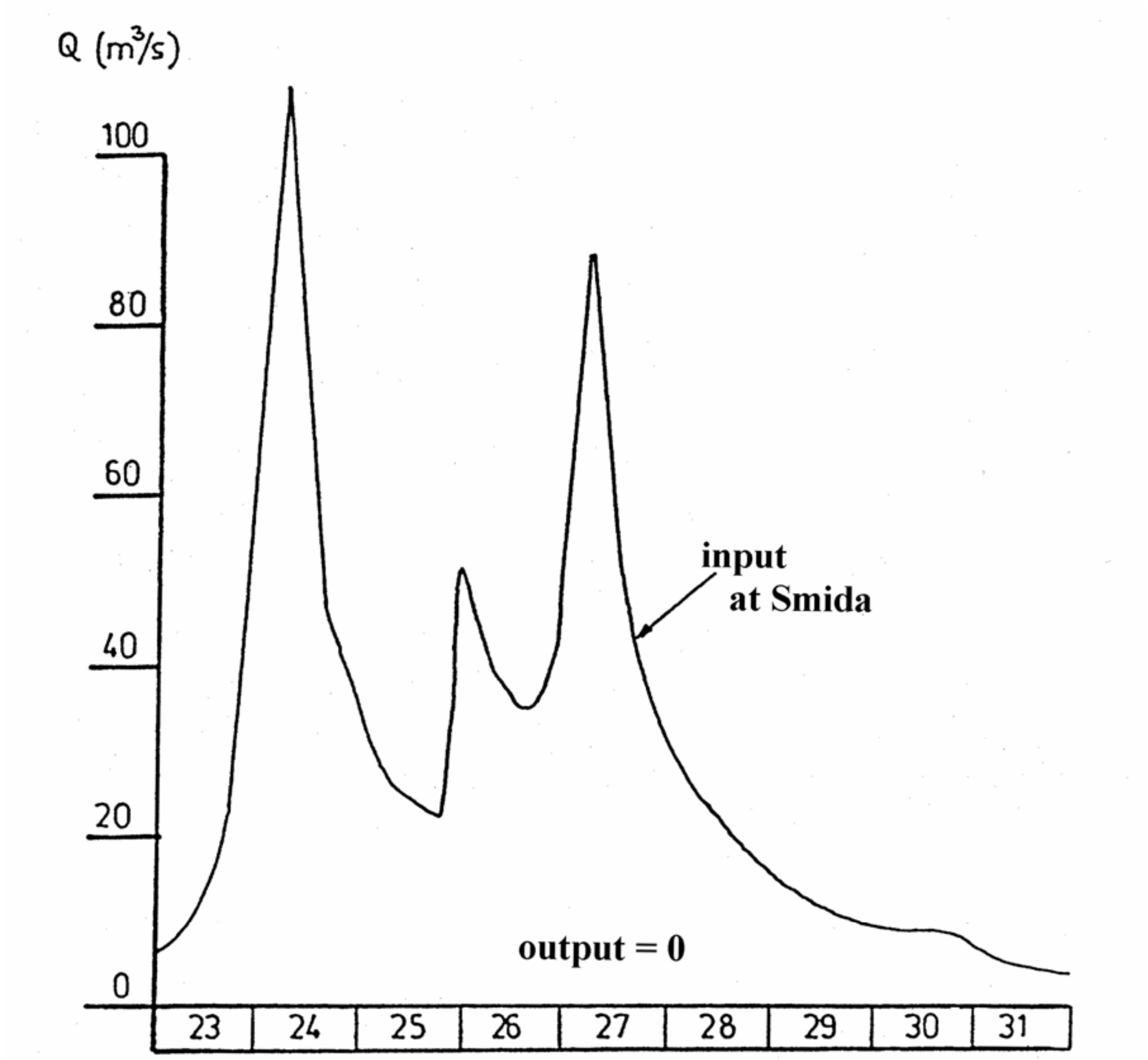

Figure 9. Retention of the 1995 December flood wave on the Someşul Cald in the Fântânele reservoir

accommodates two 22.5 MW turbines, the rated discharge of which is 70 m^3/s. The 15 m^3/s flow released to the Someşul Cald is compensated by the 0.8 m^3/s transferred from the Someşul Rece valley (Măguri Răcătău). The reservoir is 9 km long, has a greatest width of 0.8 km and a water surface area of 230 ha at normal retention level. The total storage space is 71 million m^3, of which 41 million m^3 are dead storage. Of the remaining 30 million m^3 net storage space 7 million serve flood control purposes.

The Someşul Cald reservoir was completed in 1983 with the main purpose of preventing the large volume of sediment transported by the Agârbiciu Creek from entering the Gilău reservoir (the source of water supply to the town Cluj). The 3.5 km long, 85 ha surface area reservoir created by the 130 m long, 33.5 m high concrete gravity dam is capable of impounding 10.8 million m^3 of water, which is used also for generating 12 MW of power by a Kaplan turbine.

The Gilău I dam was built between 1968 and 1971 on the Someşul Mic, downstream of the confluence of the Someşul Cald and the Someşul Rece. The 285 m long and 23 m high consists of a 117 m long r.c. secrtion, a 59 m long rockfill section and a 109 m long earth embankment of local materials. The 1.8 km long and 72 ha large water surface corresponds to a storage space of 4 million m^3. The design discharge of the three 6.3 MW turbines is 61 m^3/s. Drinking water to the towns Cluj, Gherla and Dej, further to a number of minor communities is supplied from the reservoir over an 80 km long pipeline.

The smaller Gilău II, Floreşti I, Floreşti II and Cluj I power stations were built downstream of the Gilău dam. The 7 km long power canal extending on the left hand side of the Someşul Mic between the Gilău I dam and the Floreşti II power station has a slope of 0.175% and is capable of conveying the 60 m^3/s discharge of the turbines in the Gilău power station for use at the Gilău II and Floreşti I power stations, each equipped with a vertical shaft 5.6 MW Kaplan and one horizontal shaft 0.65 MW EOS 1100 turbine.A weir with four movable gates was built in the bed of the Someşul Mic at the village Floreşti, which impounds the 2 km long, 31 ha large Floreşti reservoir of 1 million m^3 capacity. A flow of 25.8 m^3/s is released therefrom to drive the six 220 kW capacity EOS 1100 turbines in the Floreşti II power stations.

The last unit in the chain of of power developments is the 0.49 MW small hydro station Cluj I, where six turbines of the EOS 1100 type are mounted on a weir built formerly to divert a flow of 1 m^3/s for the Canalul Morii (millrace) crossing the centre of the town.

It should be noted that the Someşul Cald (the valley of which comprises the overwhelming part of the storage space and the power stations) contributes no more than 55.5% to the operation of the Someşul Mic hydropower scheme, 32.6% being contributed by the Someşul Rece and 11.9 by the Iara, a tributary of the Arieş river in the Maros/Mureş catchment. The chain of reservoirs built on the Someşul Cald is capable of retaining flood waves of virtually any size and to provide over year flow control.

On the small streams of the Câmpia Transilvanei region, especially in the Fizeş Valley there are a number of minor reservoirs used for fishing. The majority of these was created by Man. The number of ponds has diminished gradually since Meviaeval times. One century ago 150 of such ponds were mentioned in the documents, but presently no more than 13 are registered. Of these seven are on the Someşul Mic and the tributary Fizeş thereof, one on the Şieu (Săndulache 1970). These are as follows: Țaga Mare 3.9 million m3, 220 ha; Sântejude 0.94 m^3, 38 ha; Lake Ciucaş 1.88 million m^3, 26 ha; Lake Cătina 1.40 million m^3, 56 ha; Lakes Tău Popii I, II 0.75 million m^3, 26 ha; Lake Geaca 0.54 million m^3, 38 ha, Lake Țaga Mică 0.24 million m^3, 21 ha. Some distance away, in the valley of the Şieu (a tributary of the Someşul Mare) is Lake Brăteni 0.12 million m^3, 18 ha.

The Sălățig permanent fish pond and flood control reservoir was built between 1982 and 1984 on the Mineu Creek (a tributary of the Sălaj Creek, which, in turn, is a left hand tributary of the middle reach of the River Someş/Szamos). The 265 m long earth dam rises to a greatest height of 11.1 m and the upper face is lined with concrete slabs. The reservoir created is 2 km long, 0.1 km wide and 23 ha large at normal retention level, and is capable of holding up to 3.4 million m^3. The highest discharge which can be released simultaneously is 114 m^3/s.

The Strâmturi or Frizia dam and reservoir was built 10 km to the north of Baia Mare, in the catchment of the Lăpuş, on the Frizia Creek between the years 1960 and 1964. The catchment above the dam site is 130 km^2 large, to which 82 km^2 must be added from the catchment of the Runcu Creek, a tributary of the Mara (which belongs via the Iza to the Tisa stream network). The reservoir serves three purposes, viz., water supply to Baia Mare, power generation and the attenuation of flood waves. The dam proper is 150 m long, but on the right hand side the local rock is concrete lined over 48 m length, so that the dam is actually 198.4 m long. The greatest height is 51.5 m. At normal retention level the water surface is 3 km long, 0.5 km wide and 113 ha large. The total storage space is 17.53 million m^3, or which 0.93 million m^3 are used for flood control purposes. In emergency situations up to 300 m^3/s can be released. The rated discharge of the 4.2 MW Kaplan turbine is 14.5 m^3/s.

Immediately (300 m) downstream of the Strâmturi dam is the 14.5 m high, r.c. concrete lined Berdu gravity dam, the reservoir behind which has a maximum capacity of 133 000 m^3 (at normal retention level 120 000 m^3). Mountain water of high quality is supplied from the reservoir to Baia Mare town over a 5.6 km long pipeline.

The Someşul Mic hydropower scheme with its 340 million m^3 of reservoir capacity has the greatest impact on the river regime. The normal annual runoff is 407 million m^3 so that theoretically, 84% of the annual runoff could be stored in the reservoirs.

N°	Stream	Reservoir	Net volume. million m^3	Purpose
1	Crasna /Kraszna*	Vârşolţ/Varsolc	41	water supply, flood control
2	Crasna /Kraszna	Majtény/Moftin	7	flood control
3	Tur/Túr	Călineşti-Oaş/Kányaháza	23	flood control, hydropower
4	Someşul Cald /Meleg-Szamos	Beliş/Béles	250	hydropower, flood control
5	Someşul Cald /Meleg-Szamos	Tarniţa/Tarnica	78	hydropower, flood control
6	Someşul Mic /Kis-Szamos	Gilău/Gyalu	4	water supply, hydropower
7	Bistriţa/Beszterce	Colibiţa/Kolibica	78	water supply, flood control. hydropower
8	Firiza/Fernezely	Firiza/Fernezely	18	water supply
9	Talabor/Teresva	Olsoni/Olszoni	20	hydropower
Total			**519**	

* The first name is Romanian, and second Hungarian

Table 1. The main data of the major reservoirs

The reservoirs have changed considerable the flow regime of the Someşul Mic, in that the monthly mean flows during the late summer later winter low water period increased (4-82%), while the spring high flows decreased by 8 to 66%. The change in the ratio of the monthly highest and monthly lowest flows from 1:5 to 1:3 is considered significant.

River/gauging station	$Q_{max.}$ with storage	$Q_{max.}$ without storage	$H_{max.}$ with storage	$H_{max.}$ without storage	$\Delta_{max.}$
Tisza-Tiszabecs	1900	1910	484	484	0
Tisza-Vásárosnamény	2650	2910	858	885	27
Tisza-Záhony	2800	3060	658	688	30
Szamos-Csenger	1220	1300	629	659	30
Kraszna-Ágerdőmajor	46	174	499	620	121
Túr-Garbolc	114	182	465	510	45

Table 2. Greatest potential impact of storage abroad on the peak stages and flood discharges in Hungary (Illés, Konecsny 1996)

The normal annual mean flow in the Someşul Mic at Cluj was 14.7 m^3/s. After the hydropower scheme was commissioned, the streamflows actually observed were 10.6% lower than those estimated without the scheme. For this fact the following explanations are offered:

Up to 4 m^3/s are diverted from the Someşul Mic at Gilău;

The total water surface area of the reservoirs is 1160 ha at normal retention level, which contributed perceptibly to evaporation and infiltration;

At the Cluj station on the Someşul Mic the errors of streamflow measurement in the water transfer from the Arieş catchment and in the water uses are probably superimposed upon each other.

Three runoff lift stations on the downstream reach of the River Someş/Szamos, in the border zone have a total capacity of 19.7 m^3/s. These are at Mărtineşti righ hand bank, 18+215 km, 9.43 m^3/s, Satu Mare right hand bank, 6+641 km, 3.55 m^3/s and Dara right hand bank, 2+070 km, 6.70 m^3/s.

Water quality

The River Someş/Szamos is polluted with organic, the DO level fluctuates rather widely, the dissolved substances (virtually mineral salts), just as the ratio of sodium ion have increased steadily over the recent decades.

The transport of ammonium ion (the bulk originating from sewage) has also increased. The high concentration of dissolved salts originates from the geological and geographical conditions in the catchment.

The high concentrations of chloride and phosphate ion affect adversely water quality. The high phosphate ion concentration is the main cause of the undesirable prolification of floating algae in the water, especially during the summer low water period. Rising water temperatures tend to dissolve the plant nutrients accumulated in the bottom sediment leading to several million counts of diatomaceous algae per litre. Biological studies under the microscope have shown the diatomaceous algae

(Cyclotella, Tabelaria) to predominate and a variety of green alga species to be also present in considerable numbers. Decaying algae deplete the DO and lead to significant secondary organic loading in the water.

Pollution accidents occur frequently. The heavy pollutant load arriving in the River Someş/Szamos in August, 1990, has depleted drastically the DO level in the water and destroyed part of the aquatic ecosystem. The heating oil spill at Satu Mare in autumn, 1993, has necessitated cleanup action lasting 20 days on the Hungarian river section, during which over 20 tons of oil were recovered.

The sources of pollution are situated downstream of Cluj on the River Someş/Szamos river. The water is clean over the mountain reaches, the Gilău reservoir supplying domestic water to Cluj and several other minor towns. However, downstream thereof treated industrial wastewater and the effluents of the communal sewage treatment plant are discharged to the river.

Large amounts of organic substance enter the river with the effluent of the paper mill at Dej. The heavy metals detectable originate from the mining activities and non ferrous metal ore processing at Baia Mare and are transported to the River Someş/Szamos by the Săsar stream.

Seini is a town with a small population but the untreated communal sewage thereof represents a heavy load of organic and bacteria on the River Someş/Szamos .

Water quality in the River Someş/Szamos is further deteriorated by the industrial waste waters and poorly treated communal effluents, further by the runoff from the pig farm at Satu Mare.

The untreated sewage from the cattle farm at Dorolţ village is discharged via a canal to the River Someş/Szamos . The stock of the pig farm at Vetiş has diminished recently, but represents still a major source of pollution.

Gauging station	**Catchment area** F_1 **(km^2)**	**Drained to reservoirs** F_2 **(km^2)**	F_2/F_1**x 100 (%)**	**Normal annual runoff Vres mill.m^3/y**	**Net storage space Vres mill.m^3/y**	**S=ΣVres /Wx100 (%)**
Tisza-Tiszabecs	9707	438	4,5	6898	20	0,3
Tisza-Vásárosnamény	29057	2093	7,2	1124	482	4,3
Tisza Záhony	32782	3675	11,2	12600	553	4,4
Szamos-Csenger	15283	1280	8,3	4095	439	10,7
Kraszna-Ágerdőmajor	1974	1582	80,1	198	23	35,8
Túr Garbolc	944	375	39,7	313	71	7,3

Table 3. Main indices of runoff control on the Upper Tisa and her tributaries (Illés, Konecsny 1996)

Groundwaters

From the viewpoint of hydrogeology, the Intercarpathian Depresssion, that is the Transylvanian Depression, can be dividided into two areas. The active recharge areas in the foothills have a significant impact on all components of the water regime, whereas the groundwater supplies originate in the basin, which forms the central part of the depression (Ujvári, Makkfalvi 1994). Owing to the fact that the basin was filled by torrential streams, the aquifers at different depths are relatively small in area and highly stratified. This is the reason why deep aquifers yielding abundant water exist in the perimeter areas of the basin alone. The logs of several deep boreholes demonstrate that down to 2000-3000 m depths impervious, clay, pelitic sediments predominate. These are followed by the similarly impervious salt level of the Baden horizon, the base of which consists of Oligocene and Eocene Paleocene clays. The sediments in the Transylvanian Depression were therefore deposited in a marine environment which explains the high salts content (HCO_3, SO_4, Cl_2) of the deep groundwater. The salts were leached by freshwater from the top 10-30 m thick sediment layer only, the salt content of this groundwater ranging between 0.5 and 1.0 g/l on the average. On the other hand, the groundwaters in the mountain areas belong without exception to the $CaHCO_3$ and $MgHCO_3$ types, their level of mineralisation in the eruptive belts is extremely low, less than 50 mg/l. Owing to the scarce supplies of poor quality, hard water of high salts content, the Câmpia Transilvanei region is economically less developed, even in areas with favourable soil conditions.

Along the lower, plain part of the River Someş/Szamos, in the Pannonian Basin, four hydrogeological units are distinguished above the crystaline shale and Tertiary sediments:

- the Torton Sarmatian layers under major foothill areas,
- the deep Pliocene Pleistocene aquifers,
- the Pleistocene Holocene formations mainly in the foothill areas, and
- the Upper Pleistocene Holocene alluvial fans.

Thermal waters of 35- 88 °C temperature have been struck in several boreholes in the Pannonian and especially the Pontinian aquifers of 50-250 m total thickness at 500- 1000 m depth.

The groundwater supplies in the River Someş/Szamos catchment down to the Hungarian border amount to 31.2 m^3/s, of which some 3.77 m^3/s are abstracted by 36 major water works. The groundwater supplies in the approximately 1300 km^2 large alluvial fan of the River Someş/Szamos in the plains have been estimated at 3.70 m^3/s (Cineti 1985, 1990), of which some 1.9 m^3/s are abstracted by nine major units. The most important of these is the Mărtineşti water works which supplies drinking water to the town Satu Mare from 53 wells extending down to 120 m depth, at the rate of 1.16 m^3/s.

The Upper Tisa/Tisza and her tributaries in Hungary

The Tisa enters Hungarian territory at Tiszabecs and is called upper over the over 200 km long section down to Tokaj Rakamaz (Figure 10.). The fundamental aim of the channel training works on the Upper Tisa and her major tributaries was to provide flood control to the wide plains. The first attempts date back to the 16th 17th centuries, but the definite project initiated by Count István Széchenyi and designed by Pál Vásárhelyi was started in 1846 only, following the establishment of the Tisza Valley Association. Of the 63 cuts envisaged upper of Tokaj, 61 were completed (28 upper of Záhony) by 1875 already.

The training project launched in 1846 has changed the flow regime of the Tisa gradually, as reflected by the lower low water and rising high water stages. A new period in river life was introduced between 1872 and 1908, when the flow regime adjusted to the new situation controlled by the embankments and the cuts. The extremes were still less pronounced, owing to occasional embankment failures, which prevented the development of flood peaks (Vágás 1977). Downstream of Tiszabecs the widely meandering bed is accompanied by silting oxbow lakes.

The annual rainfalls over the Upper Tisa catchment vary over a very broad range (Figure 11.).

Over the Hungarian section of the Tisza and the Szamos the flood and low water levels differ by 10-12 m, while on the Kraszna and Túr by 6-7 m. The rivers originating abroad (Tisza, Szamos, Túr, Kraszna) carry an important runoff, which amounts to 1.7 km^3 per year. The runoff volume in Hungary is hardly 0.2 km^3.

N	Stream	Gauge	LLQ	LQ_{mean}	C_v	C_s	Probability %			
			m^3/s	m^3/s			80	90	95	99
1	Tisza	Tiszabecs	14,0	62,8	0,29	0,00	42,0	33,0	26,0	14,0
2	Tisza	Záhony	47,0	82,0	0,32	0,53	64,0	58,0	49,0	38,0
3	Szamos	Csenger	10,5	22,9	0,36	0,70	15,6	13,0	11,2	8,30
4	Túr	Garbolc	0,099	0,847	0,76	1,55	0,315	0,195	0,126	0,052
5	Kraszna	Ágerdőmajor	0,037	0,609	0,82	1,70	0,207	0,127	0,086	0,042
6	Bódvaj	Fábiánháza	0,000	0,032	1,06	2,00	0,006	0,002	0,000	0,000
7	III. sz.ff.	Kántorjánosi	0,000	0,018	1,02	1,90	0,004	0,001	0,000	0,000
8	IV. sz. ff.	Levelek	0,003	0,061	0,69	1,30	0,026	0,016	0,010	0,003
9	VII. sz. ff.	Nagykálló	0,000	0,048	0,90	1,20	0,011	0,001	0,000	0,000
10	Lónyay-főcs	Kótaj	0,090	0,873	0,63	0,10	0,300	0,120	0,080	0,020

Table 4. Annual low flows and their probability

The normal meanflow in the Tisa at Tiszabecs is 217 m^3/s, at Vásárosnamény 355 m^3/s, that in the Szamos at Csenger 129 m^3/s, in the Túr at Garbolc 9.83 m^3/s, in the Kraszna at Ágerdőmajor 5.52 m^3/s. The distribution of the flows over the year is highly uneven, in that the flood discharge in the Tisa may be up to 3000 4000 m^3/s, dwindling in the arid summer autumn season to 30 50 m^3/s, so that the difference may be wider than 100 fold (Figure 12.). On the Tisa three floods occur typically: in early spring, in early summer (the green flood) and in late autumn (Figure 13.).

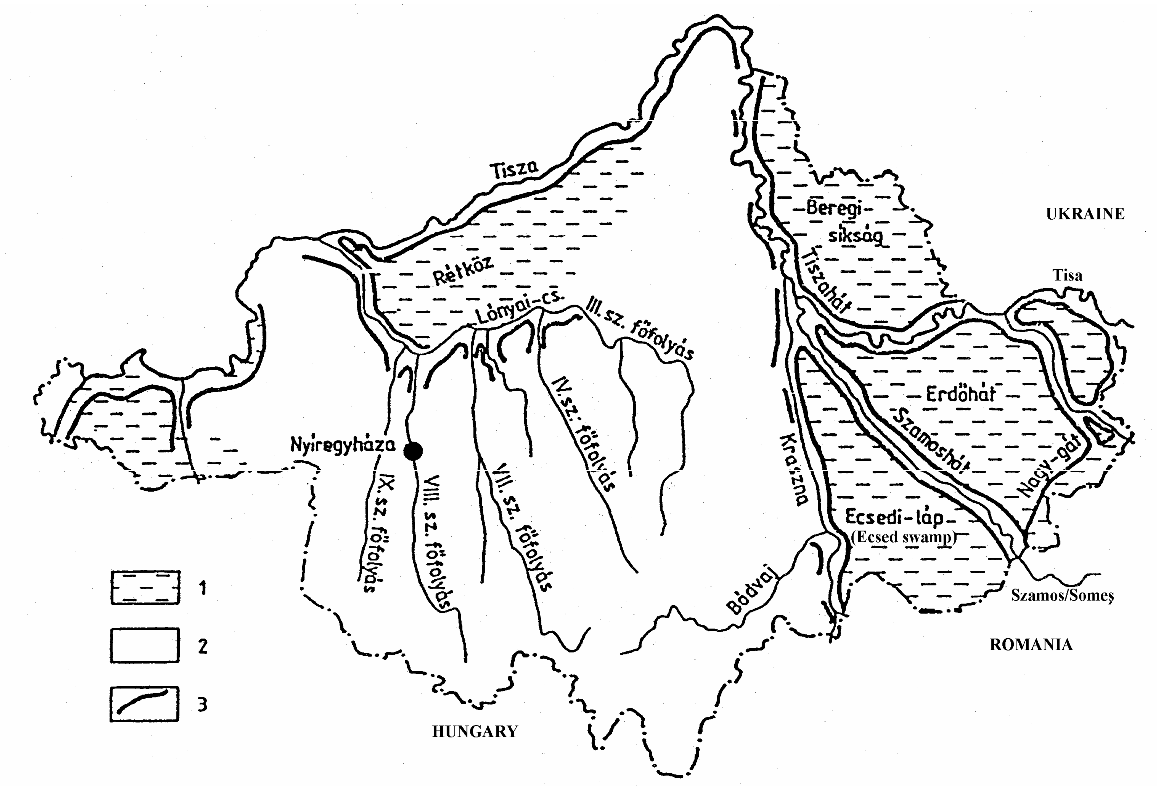

Figure 10. Reclaimed flood plains and major flood embankments in Szabolcs Szatmár Bereg County. 1 reclaimed flood plains, 2 terrain rising towards the flood plains with drainage canals, 3 flood embankments (Frisnyák 1993)

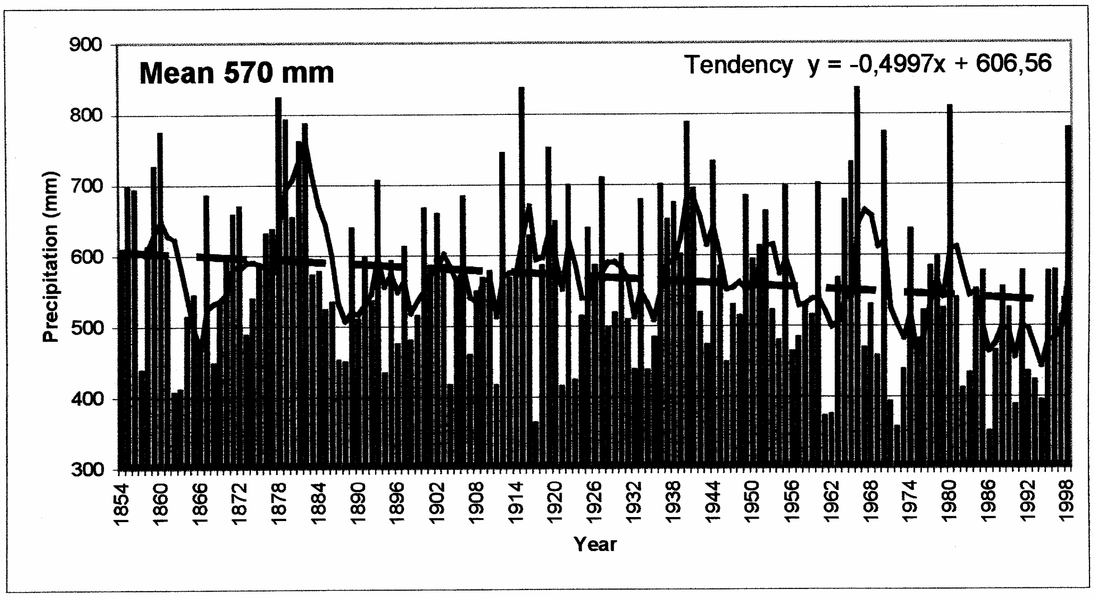

Figure 11. Annual rainfalls (mm) on the Nyíregyháza station (1950 1996)

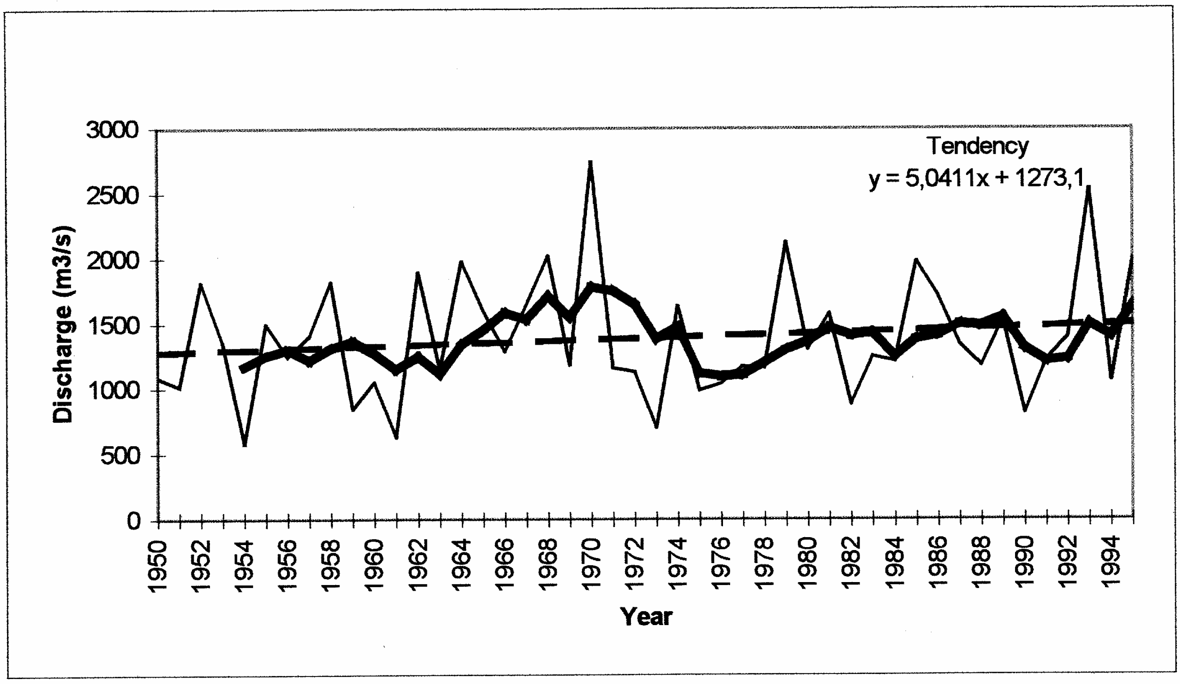

Figure 12. Annual peak streamflows (annual data, five year moving average, linear trend) past the Tivadar station on the Tisa (1950 1994)

The reservoirs built in the Nyírség Region and at Szabolcsveresmart in the 1960s and 1970s reduce the gap between the demand and supplies but slightly, the total storage capacity in the region being 37 million m^3 only.

Water quality over the Hungarian Tisa section

Under normal conditions the DO level is high along the entire river section, even the lowest levels observed at the stations meeting the criteria of good (Class II) quality. During algal blooms in the summer months the water may become over saturated with oxygen. The concentration of organic in terms of oxygen consumption increases slightly below the entrance of the tributaries, but does not surpass the limit value of the acceptable category at any of the stations. The peak oxygen consumption levels measured by the dichromate method which indicate a high organic load, Class IV V water quality coincide with the passage of flood waves.

The oxygen parameters show a slight improvement at the Záhony and Balsa stations.

The average and maximum concentrations of ammonium nitrogen are below the limit values of good water quality at all sampling stations. In terms of the average nitrite nitrogen parameters the water is of excellent quality and acceptable in terms of the peak values. Not even the highest nitrate nitrogen levels exceed the limit value of good water quality. The concentration of inorganic nitrogen is typically low in Tisa water. The levels of total nitrogen hardly surpass those of the inorganic nitrogen, implying that the amount of nitrogen present in organic forms is insignificant.

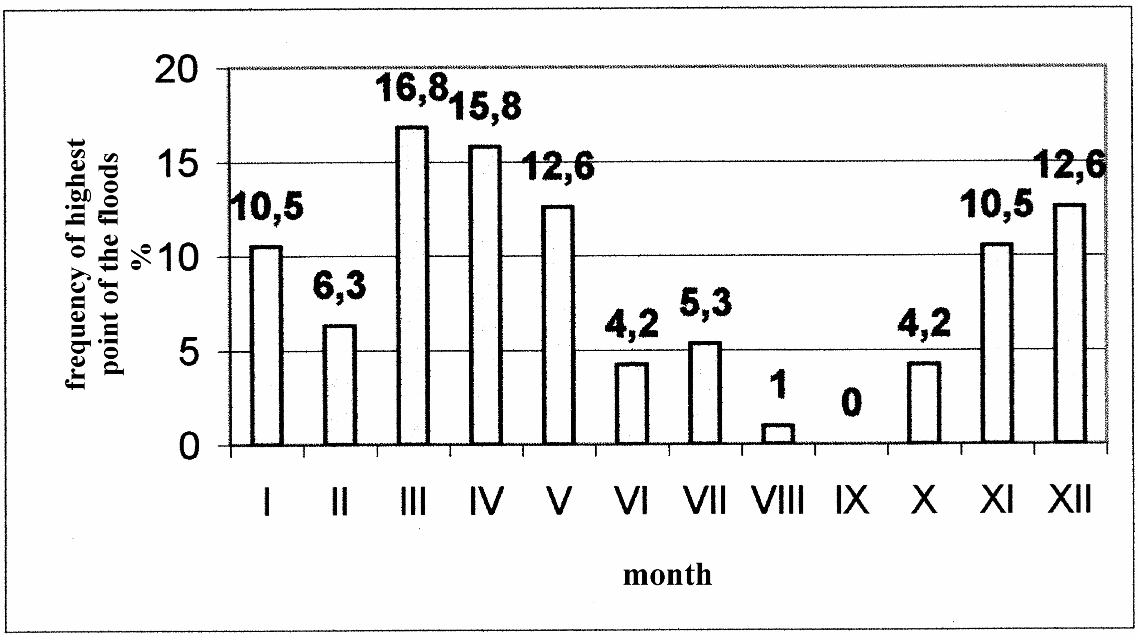

Figure 13. Frequency of high stages within the year (5)

In terms of the average orthophosphate content readily available to the plants, the water was of Class II quality, in terms of the peak levels of Class III quality at the border station, while of Class IV „highly polluted" at Balsa. The total P concentrations show and even poorer situation. Both the average and the peak levels increase with distance from the border station, the level at the border being acceptable, but „polluted" farther downstream.

Primary production depends basically on the amount of inorganic nitrogen and phosphorus form present and is described most simply in terms of the chlorophyll a levels. The average concentrations do not surpass the limit value of the acceptable quality class. The peak concentration is low at the border station, but increases more than seven fold below the tributaries, turning the water of Class IV „polluted" quality.

Bacterial pollution in the Tisa indicates very poor conditions. The coliform counts per millilitre are typically those of the polluted highly polluted quality classes. In terms of the average counts of faecal coli and streptococci the quality is acceptable. The peak values at the border station and below the tributaries indicate Class IV, polluted quality, while a slight improvement, lower counts were noted in the samples taken farther downstream.

The concentration of the various organic trace pollutants, such as phenoles, detergents, hydrocarbons is very low, close to the detection limit in Tisa water. In terms thereof the water is of excellent, Class I quality.

Of the inorganic trace pollutants, neither the average, nor the peak concentration of copper, arsenic, lead and chromium surpass the limit values of the quality classes I-II.

In most samples nickel was present in low concentrations, but the peak at the Tiszabecs station attained the limit of the acceptable category.

In terms of the peak zinc concentrations the water was classified „polluted” at the border station, but improved to „acceptable” farther downstream. In terms of aluminium the water was highly polluted, but the concentration diminished in the direction of flow and the quality improved to acceptable at Balsa. The concentration of heavy metals was found depend decisively on the quality of flow past the border station.

The peak pH levels indicated slightly alkaline water but remained below the limit of „good” water quality. Electric conductivity, as a measure of total dissolved substances, has met the criteria of excellent good water quality.

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Chemical water quality of the upper section of river Tisa (the Ukrainian and NE Hungarian part of the catchment area)

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Introduction

The first detailed international control of the water quality of River Tisa and its main tributaries took place in September 1992. A longitudinal sampling series was carried out along River Tisa in August 1995. The investigations included the river section extending from the source area of rivers Black and Bila Tisa to Tiszaszalka.

Keywords: water chemical analysis, Upper Tisa

Material and method

Water samples were collected from 11 cross sections of the river. River Tisa has two source tributaries. One of them is Chorna Tisa (main tributary, 2) and the other is Bila Tisa (1) which were the first and second sampling sites. These tributaries originate from the mountainous area of Ukraine. The first section of the river, even after the confluence of the tributaries, has a relatively great fall and high velocity. The third sampling point was at the village Rahiv (3), and the next at Delove (4). There were no sampling sites near the C-Romanian border line. The next point was before the mouth of River (5) and after the confluence of the two rivers (6). The next site was at Viskove (7), and the following was not far from Vinonogradiv (8), after River Rika, which is the largest tributary of River Tisa on its right hand side. The next point was at the Hungarian-Ukrainian border Vilok which place is an international monitoring station (9). The two last sampling sites were on the Hungarian part of the catchment area of River Tisa before (at Tivadar 10) and after River Szamos (at Tiszaszalka 11), which is the main tributary of the Upper Tisa in Hungary.

The total catchment area of River Tisa to the mouth of River Szamos is about 13.172 km^2.

The chemical parameters of the water and sediment samples of River Tisa were analysed in accordance with the specifications laid down in Hungarian Standards. Besides some general parameters (pH, conductivity, macroions etc.), the components of the oxygen and nutrient budget of the river were studied. Concentrations of inorganic micropollutants (metals) were measured by AAS.

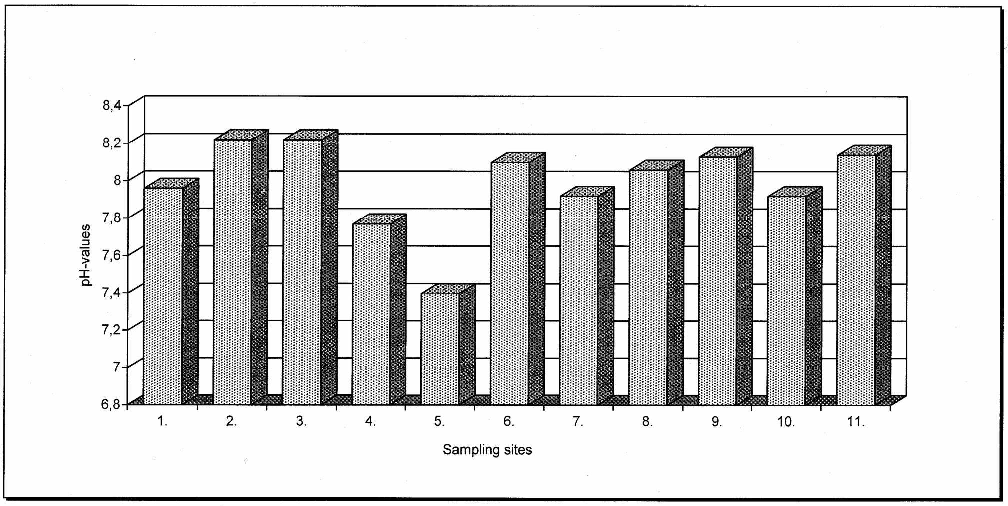

Figure 1. pH values in the upper section of River Tisa

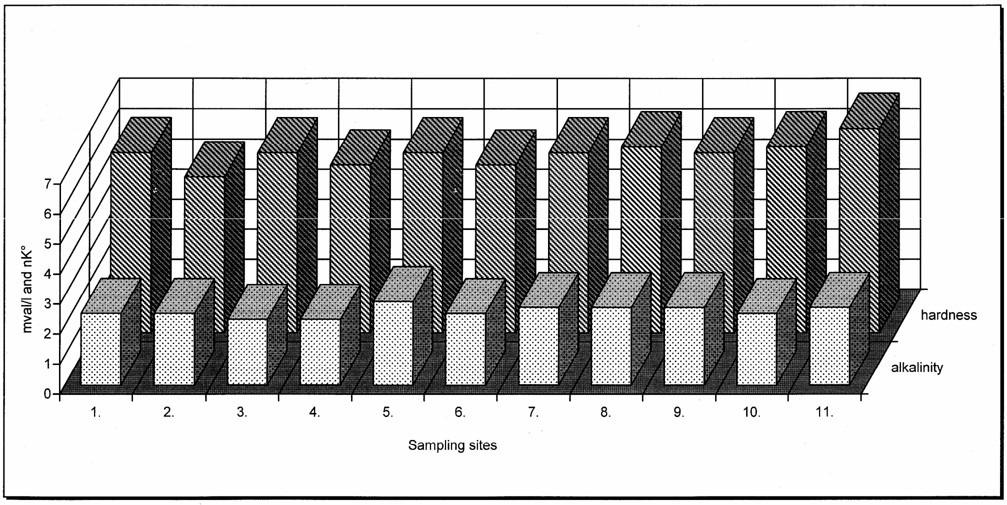

Figure 2. Alkalinity and total hardness in the upper section of River Tisa

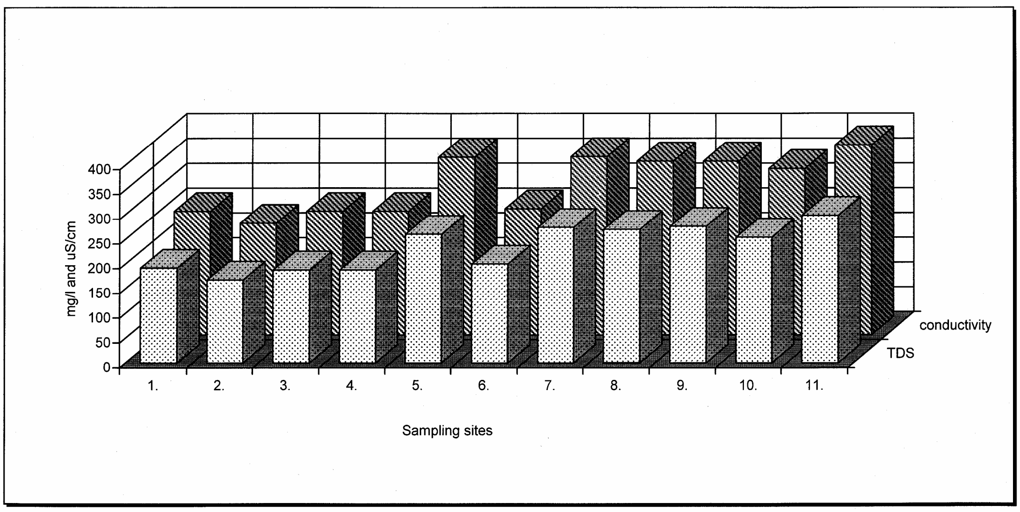

Figure 3. Conductivity and total dissolved solids in River Tisa

Results and evaluation

General features

Recorded pH values (Fig. 1) were found to change between 7,40-8,22, meaning that at some places the water was alkalic. It is supposed that the reason was intensive algal production. The lowest value was measured before the mouth of River Tereblia.

The alkalinity of the whole river was very moderate and low, and the total hardness (expressed in German centigrade) shown in Figure 2. was lowest in River Chorna Tisa, and highest after the mouth of River Szamos.

In Figure 3. values of conductivity and concentrations of total dissolved solids can be seen. Conductivity values varied between 226-383 μS/cm, the minimum was measured in River Chorna Tisa, and the maximum was due to the influence of the salt concentration of River Szamos. The values were relatively low in the water, and showed excellent water quality, according to Hungarian standards.

TDS concentrations were in a good relation with conductivity, because of the relatively low salt content of the water. Total concentration was the lowest in the first section of the river, and from sampling site 5 it slightly increased.

Only two main cations and anions were measured, thus the ion type of the water was not determined. Calcium and magnesium concentrations appear in Figure 4, while sulphate and chlorine concentrations are shown in Figure 5. Concerning cations, there were no significant differences between sampling points. Concentrations of calcium did not exceed 40 mg/l, and magnesium concentrations changed between 2,6 and 6,9 mg/l. The highest value was measured at Rahiv.

Concentrations of sulphate were almost equal along the entire section, but chlorine concentrations varied significantly (Fig. 5). Concentrations were relatively low at the first half of the river section (8-10 mg/l), but increased considerably from the mouth of River Vişeu: concentrations here were threefold or fourfold. At the next point concentrations decreased because of the dilution effect of River Tereblia, but below this point all the investigated sites had chlorine concentrations exceeding 30 mg/l.

Parameters of oxygen budget

Concentrations of dissolved oxygen were extremely high at every sampling site along the river. It seems that some sampling or methodological problem may have occurred. Formerly, dissolved oxygen content had never been found to be higher than 30 mg/l in River Tisa, not even in the case of great photosynthetic activity characterised by the abundance of planktonic algae.

COD values were measured by two types of oxidation compounds, such as chromate and permanganese. Concentrations of COD_{Mn} and COD_{Cr} (Figure 6) changed in the same tendency in the river. The highest values were measured in River Bila Tisa (11,5 mg/l and 30 mg/l respectively), and under the mouth of River Vişeu. The highest values reached the water quality class III. (fair) according to Hungarian standards.

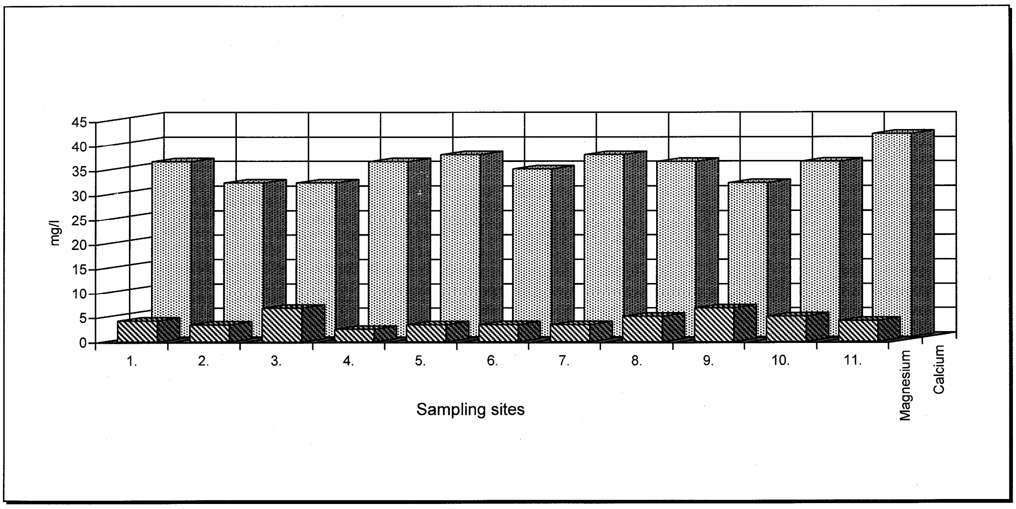

Figure 4. Calcium and magnesium concentrations in the upper section of River Tisa

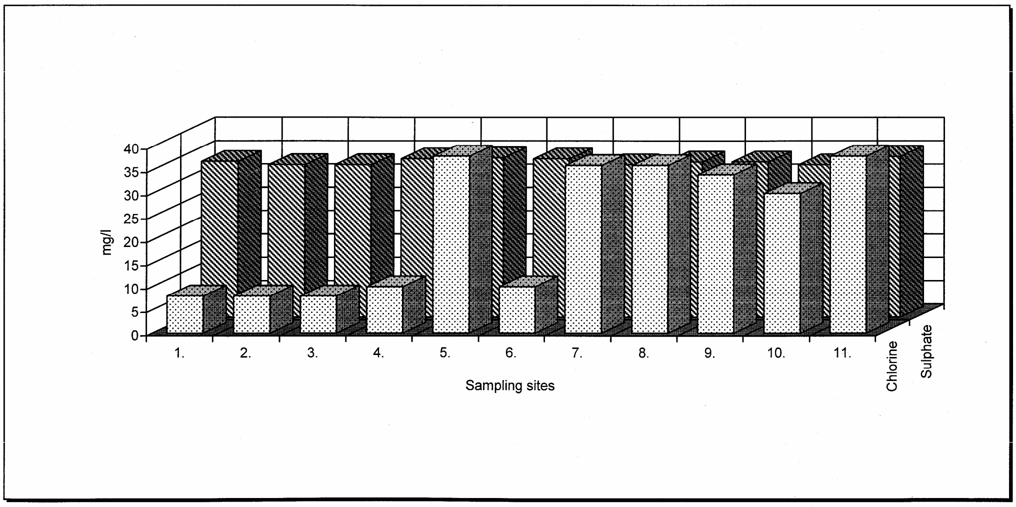

Figure 5. Sulphate and chlorine concentrations in River Tisa

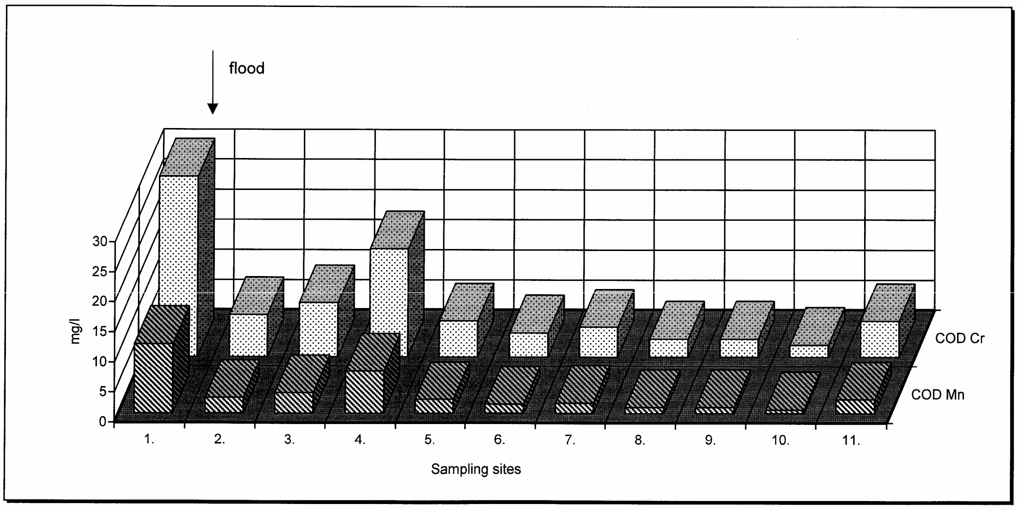

Figure 6. Chemical oxygen demand in River Tisa

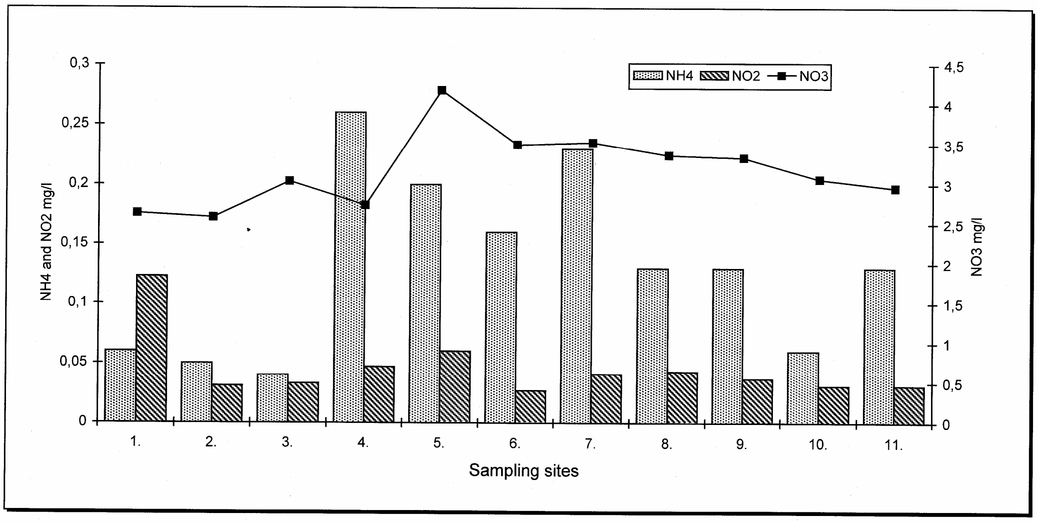

Figure 7. Concentrations of different nitrogen compounds in River Tisa

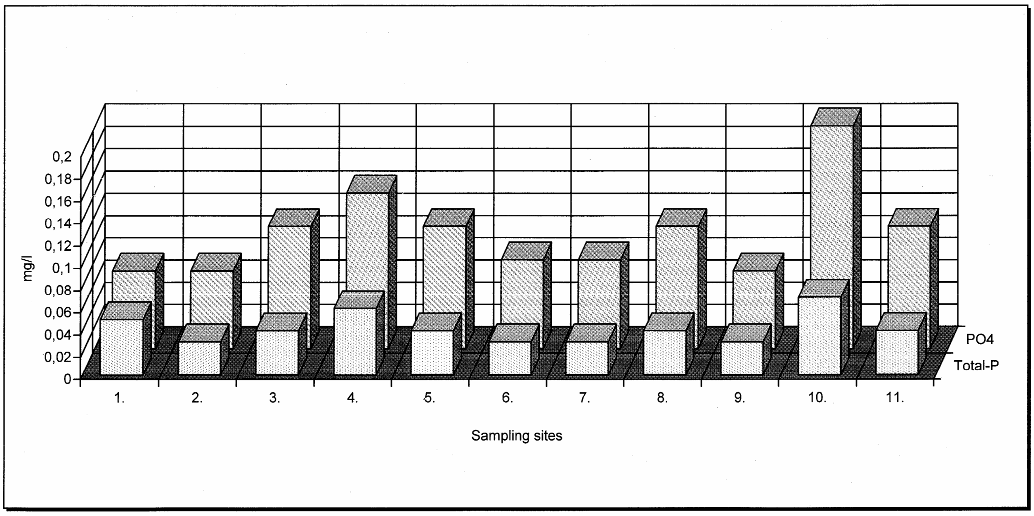

Figure 8. Concentrations of ortho-phosphate and total phosphorus in River Tisa

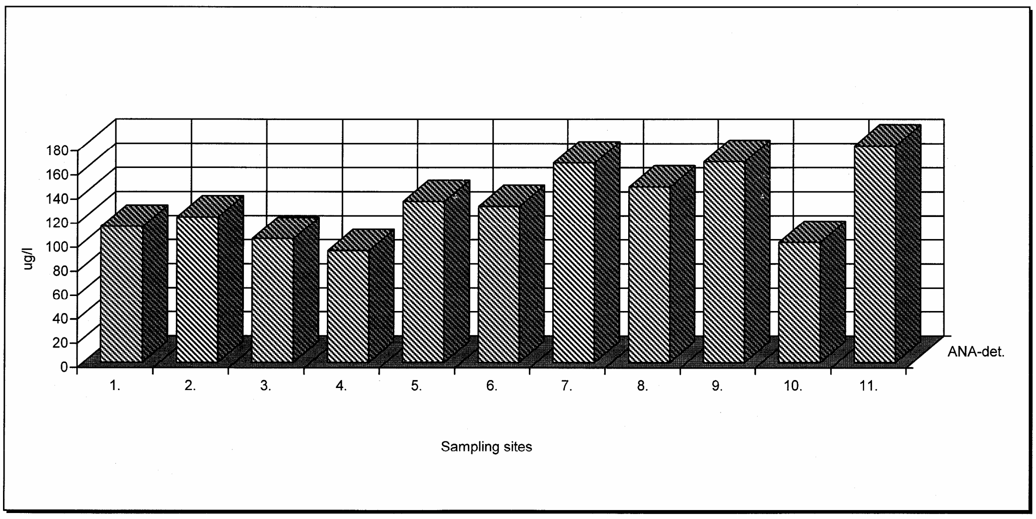

Figure 9. Concentrations of anionactive detergents in River Tisa

Parameters	unit	Number of sampling sites										
		1	2	3	4	5	6	7	8	9	10	11
pH	----	7,96	8,22	8,22	7,77	7,40	8,10	7,92	8,06	8,13	7,92	8,14
Conductivity	µS/cm	250	226	250	250	359	255	360	351	351	336	383
Total dissolved solids	mg/l	192	168	188	188	260	200	274	270	276	254	298
Alkalinity	mval/l	2,4	2,4	2,2	2,2	2,8	2,4	2,6	2,6	2,6	2,4	2,6
Total hardness	NK°	6,0	5,2	6,0	5,6	6,0	5,6	6,0	6,2	6,0	6,2	6,8
Calcium	mg/l	35,8	31,5	31,5	35,8	37,2	34,3	37,2	35,8	31,5	35,8	41,5
Magnesium	mg/l	4,3	3,5	6,9	2,6	3,5	3,5	3,5	5,2	6,9	5,2	4,3
Chlorine	mg/l	8,0	8,0	8,0	10,0	38,0	10,0	36,0	36,0	34,0	30,0	38,0
Sulphate	mg/l	33,4	32,7	32,7	34,0	34,2	34,0	32,7	33,3	33,3	32,7	34,5
Dissolved oxigen	mg/l	31,1	32,8	33,0	37,5	33,5	34,6	34,0	33,0	34,8	----	----
COD Mn	mg/l	11,5	2,6	3,4	7,0	2,3	1,5	1,7	1,0	1,0	0,6	2,3
COD Cr	mg/l	30,0	7,0	9,0	18,0	6,0	4,0	5,0	3,0	3,0	2,0	6,0
Ammonium	mg/l	0,06	0,05	0,04	0,26	0,20	0,16	0,23	0,13	0,13	0,06	0,13
Nitrite	mg/l	0,123	0,031	0,033	0,047	0,060	0,027	0,041	0,043	0,037	0,031	0,031
Nitrate	mg/l	2,64	2,59	3,04	2,74	4,18	3,50	3,53	3,37	3,34	3,07	2,96
Orto-phosphate	mg/l	0,07	0,07	0,11	0,14	0,11	0,08	0,08	0,11	0,07	0,20	0,11
Total phosphorus	mg/l	0,05	0,03	0,04	0,06	0,04	0,03	0,03	0,04	0,03	0,07	0,04
Total Fe	mg/l	0,61	0,65	0,61	0,54	1,00	0,92	0,67	0,60	0,54	0,54	0,86
Total Mn	mg/l	0,03	0,02	0,02	0,04	0,06	0,05	0,06	0,05	0,04	0,05	0,07
ANA-detergent	µg/l	113	121	103	93	134	130	166	146	167	100	180

Table 1.

The organic pollutant load at other river sections was low, and water quality was excellent, since COD concentrations did not exceed 5 and 12 mg/l.

Nutrients

Nutrients included different types of nitrogen and phosphorus compounds. Figre 7. shows the changes in the concentrations of inorganic nitrogen forms: ammonium, nitrite and nitrate. Ammonium concentrations were the lowest at the upper part of the Ukrainian section of the river, but all values were relatively low (0,06-0,26) and concentrations indicated excellent water quality.

Concentrations of nitrate were low, too. The highest concentration values were measured above the mouth of River Tereblia (4,18 mg/l), and generally at the middle section of the river in the Ukrainian areas, between Delove and Viskove.

Nitrite concentrations were the highest in the first half of the river section, with the maximum value being measured in the water of River Bila Tisa (0,123 mg/l). This concentration indicates polluted water (class IV.), based on Hungarian water quality standards. The results suggest that the major part of inorganic nitrogen compounds in River Tisa is nitrate.

Concentrations of ortho-phosphate and total phosphorus are shown in Figure 8. Each concentration fits for class I. water quality (excellent) according to Hungarian standards.

Organic micropollutants

Only anionactive detergent (ANA) concentrations were measured. The amount of this important pollutant did not change significantly. Values were between 93-180 µg/l (Figre 9). The maximal concentration was measured in River Tisa, under the mouth of River Szamos.

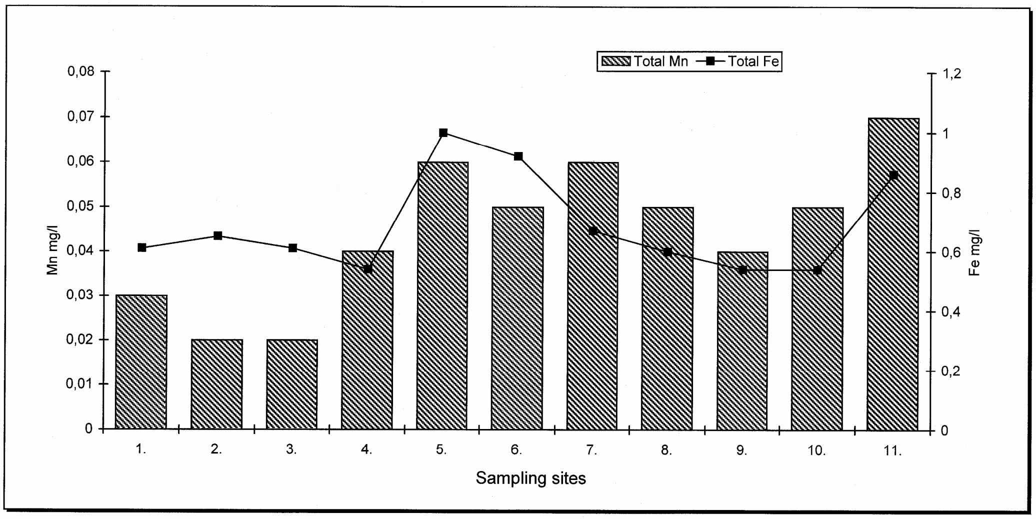

Figure 10. Iron and manganese concentrations in River Tisa

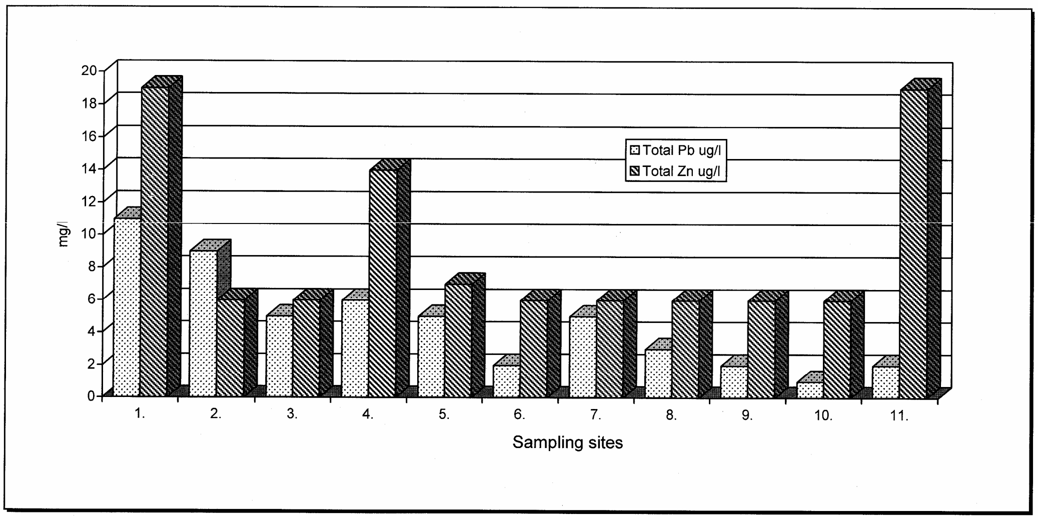

Figure 11. Concentrations of zinc and lead in River Tisa

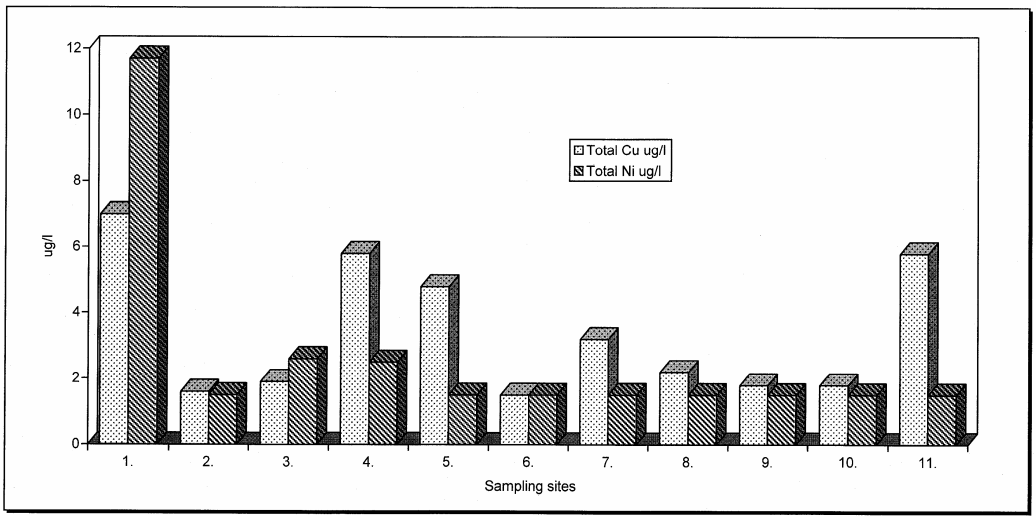

Figure 12. Concentrations of cuprum and nickel in River Tisa

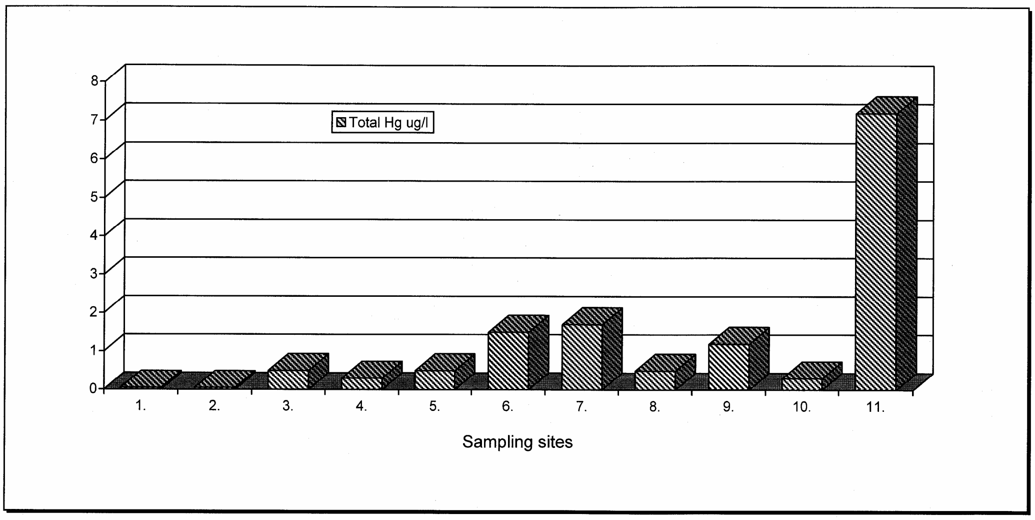

Figure 13. Concentrations of mercury in River Tisa

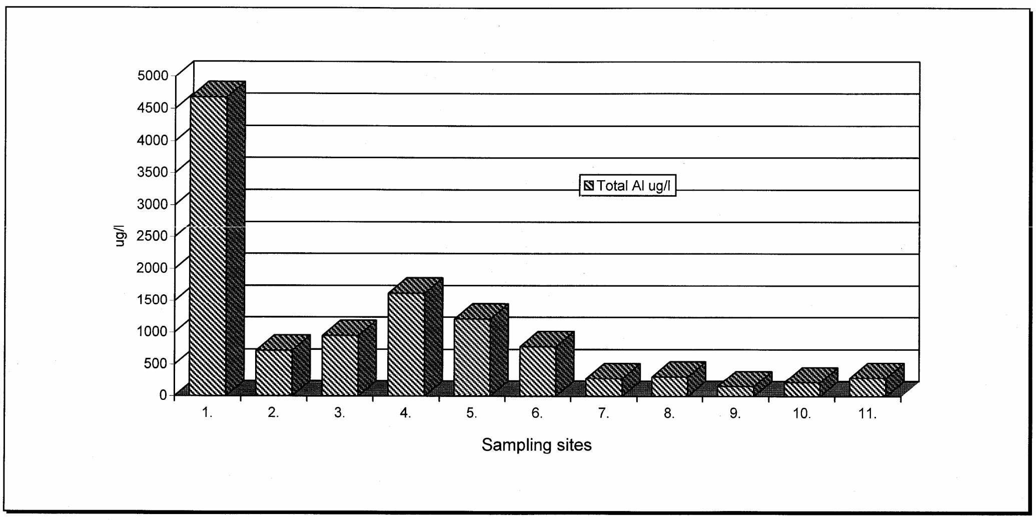

Figure 14. Concentrations of aluminium in River Tisa

All the concentrations were low, and water quality was excellent or good at every sampling point, in respect of ANA concentrations.

Metals

Due to the geological conditions of the catchment area the concentration of iron was relatively high in the water at every sampling site. The water is categorised as polluted according to Hungarian water quality classification. Concentrations were found to range between 0,54-1,00 mg/l (Figre 10.) The highest value occurred at the mouth of River Tereblia.

The concentration of total manganese was relatively low, the highest value was detected after the water of River Szamos admixed with River Tisza.

Parameters	unit \ site	1	2	3	4	5	6	7	8	9	10	11
Total Cu	µg/l	7,0	1,6	1,9	5,8	4,8	1,5	3,2	2,2	1,8	1,8	5,8
Total Cd	µg/l	0,3	<0,1	0,1	0,1	<0,1	0,1	<0,1	<0,1	<0,1	0,2	0,1
Total Ni	µg/l	11,7	<1,5	2,6	2,5	<1,5	<1,5	<1,5	<1,5	<1,5	<1,5	<1,5
Total Zn	µg/l	19	6	<6	14	7	<6	<6	<6	<6	<6	19
Total Cr	µg/l	<6,2	<6,2	<6,2	<6,2	<6,2	<6,2	<6,2	<6,2	<6,2	<6,2	<6,2
Total Pb	µg/l	11	9	5	6	5	2	5	3	2	<1	2
Total Al	µg/l	4680	720	950	1620	1210	780	280	310	157	220	290
Total Hg	µg/l	<0,05	<0,05	0,5	0,3	0,5	1,5	1,7	0,5	1,2	0,3	7,2
Total As	µg/l	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Table 2.

Besides aluminium and mercury, concentrations of all the measured essential and toxic inorganic micropollutants (metals) were low in the water of the upper section of River Tisa.

Concentrations of zinc and lead can be seen in Figure 11. Every single concentration value of the two metals indicated excellent water quality of the whole river section. In the case of zinc relatively high concentrations were measured in River Bila Tisa, and in sections influenced of the water quality of River Szamos, but this value (19 µg/l), too, fits for the standards of class I.

The concentration of nickel and cuprum (Figure 12) were the highest in River Bila Tisa, yet, water quality was excellent or good (classes I. and II.). Nickel concentrations were near the measurement limit value (<1,5 µg/l) at most of the sampling sites.

The maximum concentration of cadmium was measured in River Bila Tisa, nevertheless, water quality was excellent concerning cadmium in the whole section of River Tisa. At every sampling site, the concentration of arsenic indicated water quality class I. (excellent), ranging near the methodological limit value.

Mercury concentrations were quite variable. The highest value was caused by River Szamos. Its concentration measured after the mouth of River Szamos indicated heavily polluted water quality (7,2 µg/l). Relatively high concentration was measured at the middle section of the river too, after the confluence with River Tereblia (Figre 13).

Among metals, the concentration of aluminium was extremely high in the water of the two source tributaries of River Tisa. The maximum value in River Bila Tisa was over 4 mg/l (Fig. 14). Further on, concentrations decreased, but water quality remained polluted down to the mouth of River Tereblia. Concentrations significantly decreased in the lowest section.

In respect of heavy metals there is a great influence of River Szamos on River Tisa's water quality. The water of upper tributary (Bila Tisa) contains a relatively large amount of heavy metals, but the concentrations are not beyond the limits.

The results of sediment analyses indicated that the concentrations of different heavy metals in the riverbed were low. Only the concentration of zinc at some points was higher than the target value as shown in the following table. Aluminium concentrations were high along the entire river section, since pollution in sediment was the same as in the water body.

Table 3. Standards for bed sediment of running waters (Water Resources Research Centre)

Parameters	Target values	Acceptable
Cromium mg/kg dried matter.	100	120
Nickel mg/kg dried matter.	50	60
Cuprum mg/kg dried matter.	50	60
Zinc mg/kg dried matter.	50	60
Cadmium mg/kg dried matt.	1.0	1.5
Mercury mg/kg dried matter.	0.5	1.0
Lead mg/kg dried matter.	100	120

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Hygienic bacteriological valuation of the Upper Tisa Region

Judit Soós

Introduction

The load of organic and inorganic pollutants on waters increases year by year. The increase of the level of organic pollution is indicated by the worsening of hygienic bacteriological characteristics of rivers and lakes. Csépai (1995) reported on the same tendency in River Maros. The present paper analyses the pollution effect of River Szamos and presents the bacteriological characteristics of the Ukrainian upper section of River Tisa. These parameters are compared with the bacteriological values obtained for the North Hungarian section of the river.

Keywords: hygienic bacteriology, Upper Tisa

Material and Methods

We took samples at 9 sites on the Ukrainian section of the Upper Tisa between 16-18 August 1995. The samples were kept in cool and sterile glass vessels until the investigations commenced on 18 August 1995. Coliform and Faecal coliform bacteria were detected according to Hungarian Standards No. MSZ ISO 9308-2:1994. Numbers of Faecal streptococcus were determined according to Hungarian Standards No. MSZ 448/44:1990, and the total number of colonies was obtained according to Hungarian Standards No. MSZ ISO 622:1992.

Results and Evaluation

Nine water samples (numbered in accordance with the direction of flow) were taken in the Ukrainian catchment area of the Upper Tisa section, at the following locations:

Sampling sites: 1. Chorna Tisa, 2. Bila Tisa, 3. Tisa below Rachiv, 4. Tisa at Dilove, 5. Tisa above Tereblia, 6. Tereblia at confluence, 7. Tisa at Viskove, 8. Tisa at Vinogradiv, 9. Tisa at Vilok

The bacteriological measures of collected water samples appear in the following table:

	Chorna Tisa 1.	Bila Tisa 2.	Tisa below Rahiv 3.	Tisa at Dilove 4.	Tisa above Tereblia 5.	River Tereblia 6.	Tisa at Viskove 7.	Tisa at Vinogradiv 8.	Tisa at Vilok 9.
Coliform	II.	II.	II.	II.	II.	III.	IV.	III.	III.
F.coliform	II.	III.	III.	III.	III.	IV.	V.	IV.	III.
F.strepto-coccus	III.	III.	III.	III.	II.	II.	I.	I.	I.

Classification: I.- excellent, II- good, III.-moderately, IV.-polluted, V.-strongly polluted

Components	Dimension	Samples								
		1	2	3	4	5	6	7	8	9
Total colony 22 °C	1/ml	40000	14000	44000	160000	60000	48000	51600	13400	38000
Total colony 37 °C	1/ml	5520	2700	24200	81600	25600	22560	26800	7040	22400
Coliform	1/ml	1,7	2,4	6,2	8,1	7,2	28,0	<160	21,0	21,0
Faecal coliform	1/ml	0,8	1,9	5,2	6,4	4,7	22,0	160,0	11,0	2,0
F. streptococcus	1/ml	6,6	6,0	5,2	10,6	1,2	0,6	(*)	0	0,1

(*) - Sampling error !!

Table 1. Results of the bacteriological investigation of water samples

The total number of colonies were of the same order at each of the sampling sites. Values of Coliform bacteria numbers were between 1.7/ml - 8.1/ml at sampling points 1-5, which indicated water quality of class II. From sampling site 6, the number of Coliforms increased by one order, indicating organic contamination. Sampling site 7 did not fit in this tendency with its extreme Coliform value (160/ml), since the total number of colonies did not indicate such marked increase of organic contamination. Consequently, this value was considered a sampling error.

At sites 1-5 the number of Faecal coliforms varied between 0.8/ml and 6.4/ml, which indicated water quality of class III. Their numbers were higher at sampling sites 6-9, where the quality of water was of class IV.

Values of Faecal streptococcus numbers ranged between 0.1/ml and 10.6/ml. For the qualification of sampling sites see Table 1. Valuation proceeded as specified in Hungarian Standards No. MSZ 12749:1994.

Sampling sites	Time	Chloro-phyll-a ug/l	Total algal number ind/l	Total colony 37°C	Coliform ind/ml	F. coliform ind/ml	F. strepto-coccus ind/ml
Tisa at Tiszabecs	VI. 19. 8^{00}	2,96	433.700	15.000	33	5,6	0,2
Tisa at Tivadar	VI. 19. 23^{00}	2,96	440.000	13.100	49	7,9	0,2
Tisa at Jánd	VI. 20. 8^{00}	3,6	180.000	21.000	130	22	0
Tisa at Vásárosnamény (left)	VI. 20. 9^{00}	4,7	540.000	400.000	170	49	0,1
Tisa at Vásárosnamény (current)	VI. 20. 9^{00}	9,5	572.000	166.000	310	70	0,3
Tisa at Vásárosnamény (right)	VI. 20. 9^{00}	8,3	630.000	25.000	79	22	0,3
Tisa at Aranyosapáti	VI. 20. 13^{00}	15,7	3.286.000	27.300	220	46	0,6
Tisa above Záhony	VI. 21. 11^{00}	4,7	3.024.000	17.000	170	17,0	0,2
Tisa below Záhony	VI. 21. 11^{45}	14,2	2.448.000	15.000	130	11,0	0,4
Tisa above Tuzsér	VI. 21. 18^{00}	5,9	4.266.700	19.000	130	2,96	0,7
Tisa below Tuzsér	VI. 21. 18^{40}	13,0	4.400.000	20.000	140	2,96	0,8
Tisa at Dombrád	VI. 22. 9^{00}	11,8	3.377.800	6.000	170	12	0,2
Tisa Tiszatelek	VI. 22. 19^{00}	11,8	2.833.000	13.000	33	3,3	0,6
Tisa at Tiszabercel	VI. 23. 5^{00}	14,2	3.555.600	7.000	33	3,3	0,4
Tisa at Gávavencsellő above	VI. 23. 13^{00}	23,3	-	5.000	13	4,9	0,4
Tisa below Gávavencsellő (above Lónyai)	VI. 23. 13^{30}	30,8	7.428.600	9.000	17	7,0	0,4
Tisa at Balsa (left) (below Lónyai)	VI. 23. 15^{00}	19,0	7.600.000	4.000	7,8	3,3	0,1
Tisa Balsa (sodor) (beloweLónyai)	VI. 23. 15^{15}	33,2	5.466.000	9.500	13	4,9	0
Tisa at Balsa (right) (belowe Lónyai)	VI. 23. 15^{30}	23,7	5.314.300	7.000	7,8	3,4	0

Table 2. Results of the bacteriological study (19–23 June 1995)

Between 19-23 June 1995 a hygienic bacteriological survey focusing on the pollution effect of River Szamos was carried out by the Upper Tisa Environmental Agency, on the North Hungarian reach of River Tisa. For the results of the hygienic and biological analysis, see Figure 1. and Table 2.

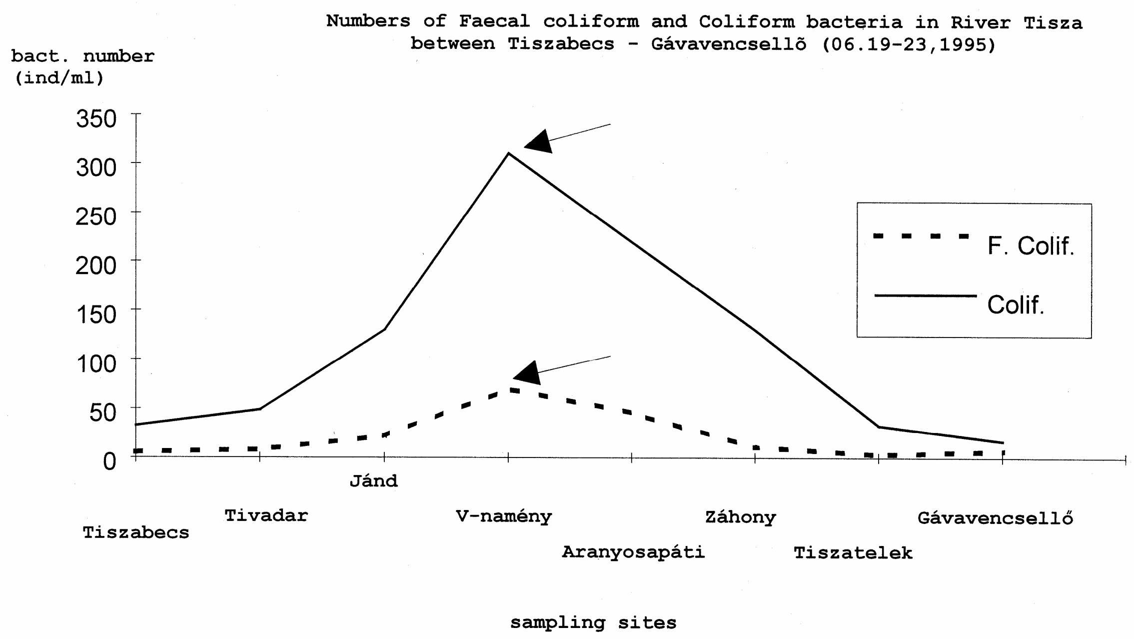

Figure 1.

The figure shows that pollution was limited between Tiszabecs and Vásárosnamény, as clearly reflected by bacteriological parameters. However, at Vásárosnamény (which is situated at the confluence of rivers Tisa and Szamos), the drastic contamination of River Tisa by the water of River Szamos is apparent. The high Coliform values (310/ml) were detected primarily in the main current of the river, while numbers near the right and left sides of the river were much lower. As a result of microbiological breakdown, Coliform numbers decreased moderately to 220/ml in the section extending to Aranyosapáti. Self-purification continued to Tuzsér, but slight contamination was detected again at Dombrád. Near Tiszatelek and Tuzsér self-purification reached its progressive stage resulting in the numbers of Coliforms dropping to 7.8/ml.

For being able to exactly determine the temporal and spatial processes of organic contamination in rivers Tisa and Szamos, it is necessary in the future to perform more frequent and more detailed hygienic bacteriological investigations of both rivers and their catchment area.

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Algological data on the upper reach of River Tisa[1]

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Introduction

The waters of the Eastern half of the Carpathian basin are collected and carried into the Danube by River Tisa. The catchment area of the river is about 150,000 sq.km and the river is approximately 1,000 km long. The upper reach of the river is 266 km long, measured from the sources (in Ukraine) to the confluence with River Szamos (one of its largest tributaries), in Hungary. The bottom of the Carpathian basin was formed by alluvial deposition created by the river. Deposits were discharged from the surrounding mountains into the Tertiary Pannonian Sea which had been filled by the beginning of the Pleistocene. River Tisa has an important role in the sedimental deposition of the Basin.

The highest section of the Upper Tisa is a typical mountainous region with stony bed, while the next section is in a hilly environment, with gravel bed. The dynamism of water discharge is considerable, thus there is a great difference in the ecological conditions between waves of flooding and low water outflow.

The river's suspended matter content is extremely high, especially at the time of the floods; therefore its popular name is 'Fair Tisa'.

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

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

The first reports on algae in the Ukrainian section of the Upper Tisa region were provided by Szabados, and the Hungarian section was observed by Uherkovich (1971). Hamar (in Ádámosi et al. 1977, Hamar 1991) studied the algological structure of the Hungarian reach.

Key words: phytoplankton, River Tisa

[1] FThe Hungarian name of the river is Tisza

Material and methods

Samples were taken at 11 sampling sites during a longitudinal sampling trip along the Upper Tisa in August 1996. Samples were fixed in Lugol's Iodine. Algae were counted under an inverted microscope. An Olympus type microscope was used in the identifications.

River Tisa has two source branches. One of them is Bila (White) Tisa (1) and the other is Chorna (Black) Tisa (2); there were the first and second sampling sites. These branches originate from the mountainous area of Ukraine. In the first section of the river, even below the confluence, the branches have relatively great dip and high speed. The third sampling site was at the village Rahiv (3), and the next at Delove (4). Here we nearly reach the mouth of River Vişeu, one of the main tributaries of River Tisa. There were no sampling sites near the Ukrainian and Romanian border line. The next site was before the mouth of River Teresva (5) and after the confluence of the two rivers (6). The following site was at Viskove (7), and the next was not far from Vinogradiv (8), after River Rika which is the largest tributary of River Tisa on the right. The next site was at the Ukrainian-Hungarian border at Vilok which is a regularly used international monitoring station (9). The two last sampling sites were on the Hungarian part of the catchment area of River Tisa before (at Tivadar 10) and after the mouth of River Szamos (at Tiszaszalka 11), which is the main tributary of the Upper Tisa in Hungary.

The total catchment area of River Tisa to the mouth of River Szamos is about 13.172 sq. km.

Results and discussion

Species composition

During this study 61 taxa of algae were found in the Upper Tisa:

Euglenophyta	5
Pyrrophyta	4
Chrysophyceae	2
Bacillariophyceae	25
Chlorophyta	25
Total	61

Euglenophyta

Algae belonging to this group are sporadic in the whole section, except for the section below the River Szamos junction (Sample No. 11) where species indicating polluted conditions appeared (Euglena viridis, Euglena proxima).

Pyrrophyta

Their occurence is sporadic in the Upper Tisa except for the section below the River Szamos junction where species (Chroomonas acuta, Cryptomonas curvata and C. obovata) indicated eutrophicated environment.

Chrysophyceae

They are rare all along this upper part.

Bacillariophyceae

The upper section of River Tisa is characterized by rheophylic elements which indicate a clear environment, although the number of species that generally occur in streams (like Achnanthes minutissima, Nitzschia fonticola, Ceratoneis arcus) is rather low. Some species indicating moderately polluted environments and eutrophic conditions appear right below the source (Nitzschia acicularis Nitzschia palea, Cyclotella meneghiniana, Navicula rhynchocephala). The precence of these taxa refer to moderately eutrophicated and polluted water conditions in the rheophilic environment.

The composition of diatoms in the last sample (No. 11.) indicated strongly eutrophicated and polluted water quality caused by River Szamos.

Chlorophyta

The occurrence of green algae is sporadic in the upper section of the river. Benthic elements (Spirogyra) occurred sometimes. Larger numbers of green algal taxa could be found only below the River Szamos junction. Most of them are cosmopolitan and occur in eutrophic waters.

Quantitative changes (Table 1.)

In the mountainous region of River Tisa small numbers of individuals were found and diatoms dominated. In the hilly part of the section the occurrence of other groups of planctonic algae indicated a moderately local contamination. As an effect of River Szamos, the last part of the upper section was eutrophic and pollution was indicated by a higher number of individuals (see sample 11. in Table 1.).

Ecological considerations

The composition of algal communities reflect both the hydrographical properties of the river and the effects of allochtonous factors like human activity. The mountainous-type headwater section is clear with local contamination. The adding up of contaminations caused a gradually increasing slight pollution along the Upper Tisa. Yet, the Upper Tisa is one of the clearest river sections in Europe, on the basis of this investigation and other information.

I would like to thank my colleague Keve T. Kiss, for his hints.

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Table 1.

Taxa, 1000 ind.\ dm^3 \ Sampling sites	1	2	3	4	5	6	7	8	9	10	11
Euglena limnophila Lemm.											120
E. proxima Dang.											60
E. viridis Ehrbg.								6			60
Euglena spp.											180
Trachelomonas hispida (Perty)Stein											6
T. volvocina Ehrbg.								6			
Euglenophyta								12			426
Chroomonas acuta Uterm.		6	12	12	18	48	18	66	84	30	600
Cryptomonas curvata Ehr. em. Pen.									6	6	
C. obovata Skuja											1200
Cryptomonas sp.						6		12	12	30	
Cryptophyceae		6	12	12	18	54	18	78	102	66	1800
Chrysococcus rufescens Klebs										12	
Mallomonas spp.					6	6					
Chrysophyceae					6	6				12	
Achnantes minutissima Kütz.		18	6	6	24		90	48	108	30	
Asterionella formosa Hassal											600
Hannaea arcus (Ehrbg.) Patrick		6								6	
Cyclotella meneghiniana Kütz.					36		6	78	42	60	9000
C. silesiaca Bleisch			6	6		6	6	6			
Cymatopleura solea (Breb.) W.Smith					6						
Diatoma vulgaris Bory	6	6	6						6		
D. vulgaris v. linearis Grun.		6	6	6							
Didymosphaeria geminata (Lyngb.) M.Schmidt	6		6	6							
Fragilaria crotonensis Kitton											200
F. ulna (Nitzsch.) Lange-Bert.	6				6				6		
F. ulna var. acus (Kütz.) Lange-Bert.									6		
Gomphonema augur Ehrbg.					6						
G. minutum Agh.	6										
G. olivaceum (Horn.) Bréb.		6							6		
G. truncatum Her.			6								
Navicula cari Her.			6								
N. cryptocephala Kütz.		6	12	12				6	6	6	60
N. rhynchocephala Kutz.				6				6		6	60
Navicula spp.		6		12		6	6	6	18		
Nitzschia acicularis (Kütz.) W.M.Smith		6	18	6	60	24	18	72	120	240	1200

Table 1. continued

Taxa, 1000 ind.\ dm^3 / Sampling sites	1	2	3	4	5	6	7	8	9	10	11
N. fonticola Grun. in Cleve et Möller	12	6	6	30	24			6	6	6	
N. palea (Kütz.) W. Smith				6	6			6	6	6	600
Nitzschia spp.	12	12	24	30	36		6	78	60	90	900
Surirella ovata Kütz.					6						
Bacillariophyceae	48	78	102	126	210	36	132	312	390	450	12620
Actinastrum hantzschii Lagerh.											60
Closterium acutum Bréb.						6					
Coelastrum sphaericum Ng.					6						600
Cosmarium botrytis Menegh.											
Crucigeniella apiculata (Lemm.) Kom.									6	6	300
Dictyosphaerium ehrenbergianum Ng.										6	1320
Didymocystis planctonica Kors.											6
Lagerheimia wratislaviensis Schroed.											60
M. contortum (Thur.) Kom. et Legn.											120
M. griffithii (Berk.) Kom. et Legn.							6	12	6		
Oocystis lacustris Chod.											60
Scenedesmus acuminatus (Lagh.) Chod.											420
S. brevispina (G.M.Smith)Chodat											60
S. ecornis (Ehrbg.) Chod.								12	12	6	600
S. longispina Chodat											360
S. ovalternus Chodat											120
S. protuberans Fritsch											120
S. quadricauda (Turp.) Bréb.sensu Chod.								12	12	6	600
S. quadricauda var. setosus (Kirch.) Hansg.											480
S. setigera (Schröd.) Lemm.											120
Spirogyra spp.						12	6				
Tetraedron caudatum (Chod.) Hansg.											60
T. minimum v.apiculato-scrobiculatum (Reinsch)Skuja								12	12	6	
T. glabrum (Roll.) Ahlstr. et Tiff.											60
T. heteracanthum (Nordst.) Chod.								6			
Chlorophyta					6	18	12	54	48	30	5526
Total algal number	48	84	114	138	240	114	162	456	540	558	20372

Free-living Ciliates of River Tisa and its tributaries

Andrey Kovalchuk

Introduction

The largest left-side tributaries of River Danube, being the largest ones anyway, are River Tisa (966 km) and River Prut (926 km). The former proceeds on the territory of Ukraine, Romania, Slovakia, Hungary and Serbia, while the latter in Ukraine, Moldova and Romania. Despite the great value of these water courses, literature devoted to the study of protozoans inhabiting them is poor. Some of these papers (Pujin, Stanojevic 1979; Josa 1981; Kovalchuk, Kovalchuk 1984) deal with the ciliates of River Tisa. Data on ciliates of River Prut have been published recently (Kovalchuk 1993). More comprehensive data on the species composition of free-living ciliates of occasional eco-groups (Kovalchuk 1997, 1997a) have not been published in any paper, instead they were presented at two international conferences held in 1997 in Transcarpathia.

Keywords: free-living ciliates, species, abundance, biomass, saprobity

Material and methods

Time and location of the examinations: The seasonal expeditions on River Tisa and basins in its region were undertaken in 1991-92. When allocating the basic sampling sites it was recognized that River Tisa flows alternately in Ukraine, Romania and Hungary, under the conditions of a mountainous terrain, on lowland and in hilly lands. Accordingly, three sampling sites in the lower, middle and upper reaches of the river were defined initially: above the village Vilok (area typical of the hilly land of Berehovo), between the towns Hust and Tiachiv (at the village Veliatin: area typical of that adjoining River Tisa lowland) and on River Stohovets' above the village Luhi in the Rahiv region (a typically mountainous area). Taking into consideration the fact that River Tisa is characterised by an extremely unstable hydrological regime, three complex study journeys were made to these sites: the first one was dated for a freshet, the second took place in a stabilisation period after high water, and the third in a period of low water level.

In addition to the 15 basic sites on River Tisa (in its reach in Ukraine's Transcarpathian area), samplings were carried out on all of the basic tributaries of River Tisa (excluding the rivers Uzh and Latoritsa that had been investigated earlier: Kovalchuk 1993), on the Tereble-Rikske reservoir, and on lake Sinevir (Figure 1.).

During the summer and autumn journeys the network of sites at which the sampling was done was extended. When analysing the results, the sites were grouped in conditional zones (see below).

Collecting method

The planktonic samples were taken in 70-100 mm capacities at depths of 10-15 cm. With respect to the small depths of the investigated basins, the vertical distribution of ciliates was not studied. Benthic samples were taken using a microbenthos sampler of the type MB - TE (Babko 1989) with a 3,2 cm2 area of encroachment or throat banks by an area up to 6 cm2. The samples of periphyton were derived from overgrown stones by washing off.

During the research a total of 143 samples were taken and processed, with the following distribution: 45 planktonic, 46 benthic and 52 periphytonic.

Further methods

Sample processing was carried out in accordance with the procedure published earlier (Kovalchuk 1990; 1990a, 1993).

The identification of ciliate species was carried out based on the taxonomic work of Kahl (1930-1935). In a number of cases complementary references were used. The taxonomical system of Corliss (1977), with an independent Colpodea class (Foissner 1985), was applied.

Saprobity was assessed with the help of ciliate bioindicators and was calculated using the method of Toderash (1980):

$$S = \frac{\sum N_i \times G_i \times \breve{S}_i}{\sum N_i \times G_i}$$

where N_i, G_i and $\breve{S}_i$, respectively, are the value describing the amount of specimens, an indicator value, and the mean index of saprobity of *i* species.

The essential source of information about saprobic valency and the indicator value of ciliates were works by Bick (1972), Moravceva (1977), Ausgewahlte Methoden... (1979) and Foissner (1988).

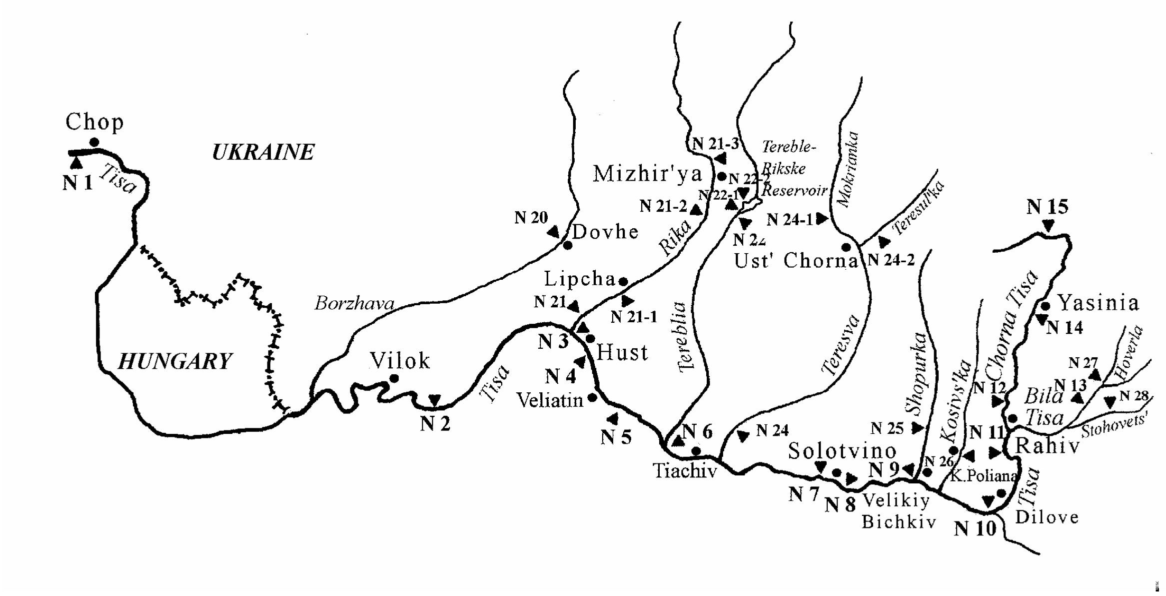

Figure1. The map of sampling sites in the Upper Tisa region in 1991-1992.

Results and Discussion

In the region of River Prut 111 species and varieties of ciliates had been revealed from the benthos, plankton and periphyton (Kovalchuk 1993). Considerably more species are now ascertained for basins and water courses of the region of River Tisa. A total of 254 species and varieties of ciliates were found with the following distribution: 113 species and varieties in the Kinetofragminophora class, 72 in the Oligohymenophora class, 63 in the Polyhymenophora class, and 6 Colpodea (Table 1.). As regards the taxonomic composition of ciliates in River Tisa, the richest was the benthos with 187 species, followed by periphyton with 138, and plankton with 85 species.

Formed cilioplankton was found to be practically absent from the water courses of the Prut and River Tisa. Euplanktonic species of ciliates occurred in the plankton only at the site at the town Chop.

The greatest diversity of ciliates was found in the summer (166 species), and in the autumn (164 species). One-hundred-and-six species occurred in the spring, while only 30 in the winter. Among different water courses it was River Uzh (115 species) that appeared to be the richest in the taxonomical structure of ciliates. Thirty-four species of ciliates were found in the high-mountainous lake Sinevir. The total number of ciliate species discovered in River Tisa was 255. This figure testifies that species structure was sufficiently revealed. In the well-investigated River Kura (Azerbaidjan) 45 species of ciliates were revealed (Aliev 1986), and 54 were found in River Biala Pshemsha (Poland) (Czapic 1982). However, the true species-richness of ciliates can be well over the revealed values in the investigated rivers. For example, in the

Hungarian area of River Tisa 80 species of ciliates (Josa 1981) were found, many of which are absent from our list.

Among sections of River Tisa and water courses of its region, the middle reaches of River Tisa appeared to be the richest where 122 species of ciliates were ascertained. Accordingly, in the upper and lower reaches of River Tisa (in Ukraine) 85 and 86 species were revealed, respectively.

Among the tributaries of River Tisa, River Rika is the most investigated. Thirty-nine species of ciliates were found here, 31 species were discovered in River Kosivs'ka, and 26 were found in River Teresva. In the rivers Mokrianka and Borzhava 23 and 24 species of ciliates, respectively, were ascertained.

Planktonic ciliates

The strong flow of the rivers has an effect on the development of planktonic ciliates. However, the availability of organic substances is also important. The abundance of ciliates in the plankton depends primarily on the level of organic pollution. It is distinctly observable at sites along a flow (Kovalchuk 1993). In the presence of large areas inhabited by humans such increase can be very sharp. Without them it is less appreciable.

On River Hoverla we investigated a «standard» ecosystem in a Carpathian reserve area characterised by the lack of human economic activity. At this site ciliates were completely absent from the plankton, which was probably caused by the high velocity of the flow. The adverse influence of fast flow on ciliates has been known for a long time (Chorik 1968). The negative effect of this factor especially applies to planktonic ciliates. For River Kuban' the velocity of which is 0.2-1.7 m/sec, Kornienko (1972) reported not more than 14 species of planktonic ciliates. In slow rivers the species-richness of this eco-group is much higher. For example, 29 species of ciliates with a biomass of 0.1-3.4 mg/l were found in the plankton of the quiet river Berezina (Belarus) (Rassashko, Markelova 1982). Values obtained by us at the majority of sites in the mountain rivers are remarkably above those reported in both of the above examples.

In spring, during the first trip, the mean abundance of planktonic ciliates naturally decreased towards the upper reaches. Abundance values there were by two orders less even during the second as well as the third (by two-three orders) sampling sessions (Table 2.). It is associated with the fact that ciliates are washed away from benthic depositions during high water.

The summer period was characterised by the maximal development of planktonic ciliates at the middle reaches of River Tisa (Table 3.), where the values of abundance approached those shown for the small rivers of the Dnieper, and biomass was also considerably more.

Water course	Abundance	Biomass	Destruction	Production
	thous. specim.	mg	cal/day	cal/day
PLANKTON per m^3				
Stohovets'	30 (0 - 142)	0.5(0- 2.3)	0.1(0 -0.9)	0.0(0 -0.5)
Tisa near Veliatin	858(14-4000)	44(0.3-305)	25(0.3-4.3)	8.2(0.2-41)
Tisa before Vilok	2263(0-10700)	16 (0 - 69)	18 (0 - 79)	8 (0- 27)
PERIPHYTON per m^2				
Stohovets'	500(200-5000)	6 (2- 20)	3 (1 -10)	2 (0.5- 6)
Tisa near Veliatin	9611(1200-34476)	61 (3- 202)	49 (3 -167)	30 (2-102)
Tisa before Vilok	7000(2000-12000)	38 (8- 69)	50 (10- 88)	30 (6- 54)
BENTHOS per m^2				
Stohovets'	1500(1000–800)	12 (10-23)	3 (1 - 6)	2 (0.5- 4)
Tisa near Veliatin	20200(5000-33500)	310(40-570)	240(35-450)	95 (21-243)
Tisa before Vilok	7368(68-13500)	85 (9 -100)	87 (2 -120)	25 (1 - 53)

Table 2. General characteristics of ciliates of the Upper Tisza region (April 1991).
Notes: Figures outside parentheses are geometric means, inside parentheses are minimum and maximum values.

In contrast with the middle reaches, the levels of the quantities of ciliates in the lower reaches did not vary sharply from spring to summer, with biomass remaining on a low level.

The sharp decrease of the quantitative parameters of planktonic ciliates was observed in the autumn (Table 4.). It appeared that the level of cilioplankton quantities was more in the winter (Table 5.), than in late autumn.

Benthic ciliates

In comparison with the significant oscillations of all parameters of planktonic ciliates, large density was characteristic for benthic ciliates (Table 2). The average abundance of bottom-dwelling ciliates at the investigated basins (including all) was 5.8 mln spec./m2, and biomass was 58.5 mg/m^2 (disregarding results from 1991). The variation of parameters from basin to basin was quite insignificant; even the remarkable diversity of biotopes which ranged from peat sludge to sand did not cause sharp differences in the quantities of these protozoans.

The average parameters for benthic ciliates of River Prut, obtained in 1987 by Kovalchuk (1993), are close to those for River Uzh in 1989, which accordance testifies the correctness of the indicated average parameters for this group obtained for the middle rivers and occasional satellite basins in June 1989. The 1987 data from River Uzh should not be taken into consideration, for these samples were taken at highly antropogenic sites (in places of sewage disposal). It also has resulted in very low mean abundance (about 60 mln spec./m^2) and biomass (0.8-0.9 g/m^2) parameters.

Water courses	Para-meter	Periphyton (on m^2)	Benthos (on m^2)	Plankton (on m^3)
Upper Tisa	N	6653(8.8±1.4)	-	2249(7.7±2.3)
	B	149.6(5.0±1.2)	-	51.9(4.0±1.6)
	R	137.2(4.9±1.2)	-	64.2(4.2±1.6)
	P	103.8(4.7±1.3)	-	39.4(3.7±1.6)
	n	3	-	2
Middle Tisa	N	5474(8.6±1.1)	5115(8.5±0.4)	12530(9.4±2.9)
	B	98.7(4.6±1.0)	80.0(4.4±0.9)	107.7(4.7±2.1)
	R	132.2(4.9±0.9)	106.9(4.7±0.7)	166.8(5.1±2.2)
	P	78.6(4.4±0.9)	64.0(4.2±0.7)	89.1(4.5±2.3)
	n	6	6	2
Lower Tisa	N	2815(7.9±0.5)	2843(8.0±0.3)	1414(7.3±3.4)
	B	56.3(4.1±0.5)	45.1(3.8±0.8)	19.1(3.0±3.5)
	R	82.5(4.4±0.3)	68.8(4.3±0.4)	37.4(3.4±3.5)
	P	46.9(3.9±0.2)	39.2(3.7±0.3)	24.4(3.2±3.4)
	n	3	3	2
Stohovets', Hoverla, Black Tisza	N	4192(8.3±0.4)	5554(8.6±0.1)	-
	B	38.0(3.7±0.2)	58.7(4.1±0.6)	-
	R	23.8(3.2±0.5)	50.0(3.9±0.5)	-
	P	13.3(2.7±0.3)	27.8(3.4±0.6)	-
	n	3	2	-
Mokrianka, Teresul'ka	N	10568(9.3±0.3)	-	-
	B	111.5(4.7±0.8)	-	-
	R	94.6(4.6±0.6)	-	-
	P	19.0(3.0±1.0)	-	-
	n	2	-	-
Teresva, Borzhava Rika, Kosivs'ka	N	28715(10.3±0.2)	54790(10.9±0.2)	-
	B	297.3(5.7±0.5)	1731.2(7.5±0.6)	-
	R	287.3(5.7±0.1)	1167.4(7.1±0.1)	-
	P	132.9(4.9±0.5)	707.4(6.6±0.1)	-
Sinevir	N	-	16787(9.7±0.1)	-
	B	-	668.8(6.5±0.3)	-
	R	-	352.0(5.9±0.1)	-
	P	-	201.0(5.3±0.2)	-
	n	-	2	-

Table 3. Average hydrobiological parameters describing communities of ciliates from various eco-groups of the River Tisa region in the summer season and the summer-autumn period (August - September) in 1991.

Notes: N - abundance (thousand specimens); B - biomass (mg); R and P: breakdown and production (cal/day).

Water courses	Para-meter	Periphyton (on m^2)	Benthos (on m^2)	Plankton (on m^3)
On all massif data	N	–	–	25(3.3±3.2)
	B	–	–	2.0(1.1±1.3)
	R	–	–	0.8(0.6±0.7)
	P	–	–	0.5(0.4±0.6)
	n	–	–	5
Upper Tisa	N	904(6.8±0.6)	520(6.3±0.2)	-
	B	5.4(1.9±0.3)	2.1(1.3±0.1)	-
	R	1.8(1.0±0.3)	0.9(0.6±0.1)	-
	P	1.1(0.8±0.2)	0.6(0.4±0.1)	-
	n	3	2	-
Middle Tisa	N	1853(7.5±1.2)	255(5.5±2.1)	-
	B	9.7(2.4±0.4)	6.7(2.0±1.5)	-
	R	4.0(1.6±0.6)	2.0(1.1±1.0)	-
	P	2.5(1.3±0.5)	1.4(0.9±0.9)	-
	n	5	4	-
Lower Tisa	N	2046(7.6±0.5)	-	-
	B	10.2(2.4±1.0)	-	-
	R	4.5(1.7±0.7)	-	-
	P	2.7(1.3±0.6)	-	-
	n	2	-	-
Shopurka, Rika, Teresva	N	340(5.8±2.4)	884(6.8±0.8)	-
	B	4.4(1.7±1.5)	4.3(1.7±0.4)	-
	R	1.9(1.1±1.0)	1.7(1.0±0.2)	-
	P	1.0(0.7±0.8)	0.7(0.6±0.5)	-
	n	3	3	-
Hoverla, Stohovets', Chorna Tisa	N	356(5.9±1.2)	-	-
	B	3.0(1.4±0.6)	-	-
	R	0.9(0.7±0.4)	-	-
	P	0.4(0.3±0.1)	-	-
	n	3	-	-

Table 4. Average hydrobiological parameters describing communities of ciliates from various ecogroups of River Tisa region in an autumn period (November) 1991. For abbreviations see Table 3.

The seasonal study of benthic ciliates was carried out in 1991. The distinct rise of the abundance and biomass of ciliates from the upper reaches to the middle section (Table 2.), and the subsequent decrease towards the lower reach (Table 3.) was observed.

Water courses	Parameter	Periphyton (on m^2)	Benthos (on m^2)	Plankton (on m^3)
On all massif data	N	2278(7.8±1.7)	5833	1750
	B	49.2(3.9±1.5)	310.7	52.2
	R	11.0(2.5±1.5)	42.5	9.0
	P	6.7(2.0±1.5)	19.4	4.1
	n	5	1	1

Table 5. Average hydrobiological parameters describing communities of ciliates from various ecogroups of River Tisa region in a winter period (Fabruary) 1991. For abbreviations see Table 3, n - sampling.

The repeated samplings executed in April before freshet, at the time of the freshet and after freshet allowed to ascertain the influence of a short-term high water on benthic ciliates.

At the same time, a lasting flood has a sharp negative effect on the ciliates of this eco-group. An example can be late autumn (November), when the average abundance of benthic ciliates of River Tisa and its tributaries was 200-900 th. sp./m^2, and the biomass was 2-7 mg/m2 (Table 4). This is essentially beneath the values both of the other seasons. Apparently, probably related to the stabilisation of the regime, the abundance of ciliates in the benthos was higher even in the winter (Table 5.).

It is essential to note that, although the seasonal abundance of benthic ciliates of River Tisa and its tributaries did not exceed $2\text{-}6\times10^6$ sp./m^2 as a mass average, extremely high values were observed in occasional watercourses. Accordingly, the mean summer abundance of bottom-dwelling ciliates for occasional tributaries of the middle reach was $50\text{-}60\times10^6$ sp./m^2, which completely corresponds to the data obtained for Uzh in 1987 (Table 3, Kovalchuk 1993).

Significant deviation (by 2-3 ranges) from the above-mentioned quantitative data of benthic ciliates were found in the mountain tributaries of River Danube (Kovalchuk 1993). The extremely unstable regime caused low values of ciliate abundance and biomass (Table 2). During the process of seasonal vegetation fluctuation in these rivers, a sharp summer decrease in the quantities of benthic ciliates was pointed out. Autumn parameters were found to be by 2 orders higher.

The functional activity of benthic ciliates at various reaches of the River Tisa region is determined by a complex of hydrophysical factors the cardinal ones of which are the velocity and the temperature of the flow. Fairly essential is the presence or absence of everyday sewage. By virtue of the above stated reasons, the maximal parameters of the transformation of organic substances (OS) by benthic ciliates are conventionally observed in the summer. On a site below Mizhir'ia the level of breakdown was 1265 cal/($m^2\times$day). Very high values 1076 cal/($m^2\times$day) were reported from the river Kosivs'ka inside the village Kosivs'ka Poliana. These confirm the high level of mineralisation of OS by ciliates at mountain anthropogenic areas.

The average coefficient of net production efficiency for the communities of benthic ciliates of the investigated rivers was about 0.35, based on which we can assume an insignificant predatory component (niliovorous).

Periphytic ciliates

Periphyton on stones is an important eco-group under the conditions of the upper reaches of River Tisa. As regards the quantities of ciliates, figures obtained for periphyton approximated the values for benthos. In particular, we note the spring and autumn increase of ciliate numbers in periphyton as well as in benthos, in transition from the upper to the middle reaches. Such difference between reaches was not observed in the summer (Tables. 2-5.).

In the process of the seasonal fluctuation of cilioperiphyton an autumn quantitative minimum is noted conventionally. The mean abundance parameters for the reaches of River Tisa varied between 1×106 – 9×106 sp./m^2, and biomass between 30 - 150 mg/m2. The biomass of cilioperiphyton of River Tisa, its value being more than in autumn (November), did not exceed 5-10 mg/m2, which fact refers to the fine size of ciliates in this period of the year.

The average value of cilioperiphyton quantities in the tributaries of River Tisa is dependent on their geographical altitude. For the tributaries of the upper sections in the Ukrainian reach (i.e. rivers Stohovets', Hoverla, Chorna Tisa) lower parameters of periphytonic ciliates were characteristic than those mentioned above for River Tisa. Much higher values of abundance and biomass were observed in the tributaries of the middle and lower reaches (i.e. rivers Teresva, Borzhava, Rika) which is possibly caused by the more favourable trophic conditions of these rivers. The importance of the influence of this factor on bottom-dwelling populations in small watercourses was emphasised by Baldock and Sleigh (1988). It is noted that the abundance of ciliates falls sharply only in case of the combined influence of catarobic water and high velocity of the flow.

Estimation of the degree of organic pollution on ciliates as bioindicators

Attempts to evaluate the degree of organic pollution on ciliate bioindicators has been formerly made by us on materials from 1987-1989 (Kovalchuk, 1993). The findings included indications of the gradual improvement of the saprobiological situation of River Uzh, the largest tributary of River Tisa, serving as the water supply of Uzhhgorod. The considerable amount of material on ciliates of River Tisa and it tributaries, which accumulated during a series of expeditions in 1991-1992, allowed the seasonal evaluation of the level of pollution on ciliate bioindicators. Recommendations to use such approach in various types of basins were also made. The influence of freshets on the saprobiological situation of the water was evaluated as well. Intense freshets were fairly frequent on the inspected rivers.

It is necessary to note that it is practically impossible to apply certain indices of saprobity for plankton. The reason is the negative influence of a fast flow on ciliates, due to which fact no formed cilioplankton were found at the majority of the sampling sites (except for site 1). The second reason for the low efficiency of water quality estimation from planktonic organisms was the insufficient number of indicator species. For example, neither of the three samples taken in the period of low water level at the site N 2 on 29 April 1991 yielded any ciliate bioindicators. A similar situation was observed on 25 April at site N 28 (River Stohovets'). As opposed to this, saprobiological estimation from benthic and periphytic organisms in the spring turned out to be impossible only in one instance, namely at site N 27.

In April, as a result of three journeys, data from sites N 2, N 5 and N 28 were obtained. As estimations specified, each sample appeared to indicate an alpha-mesosaprobic range of organic pollution (Table 6.). In the presence of parallel samples, indices obtained by estimating from cilioperiphyton were higher than those calculated from benthos. The period of freshet was characterised by fairly similar saprobity indices (Figure 2). The reason is the proportional increase of water volume and contaminants which, as experience has shown, are the most actively dumped in the rivers just in the period of freshets.

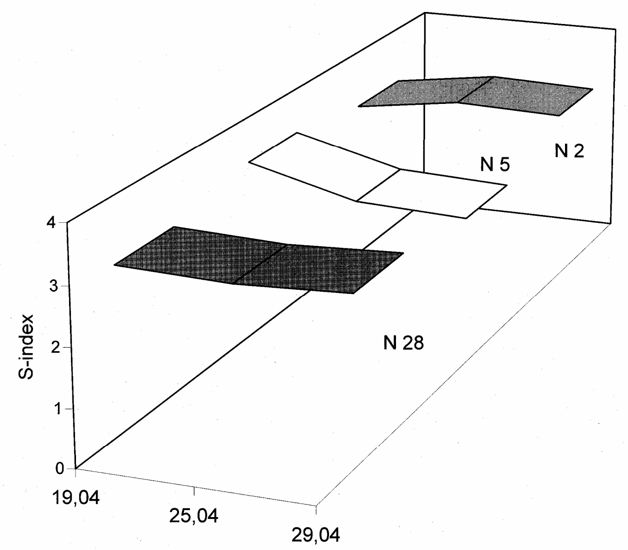

Figure2. Saprobiological indices of River Tisa in April 1991.

During an after-freshet period of stabilisation the decrease of the index from the upper course towards the lower was observed. It is natural if we consider the OS-attenuating effect of the still significant quantities of water.

During a period of low water level the indices of saprobity were characterised by a low alpha-mesosaprobic range on sites N 28 and N 5, and by an even lower alpha-mesosaprobic range at site N 2 (Table 6.). Consequently, in a lower flow of River Tisa the processes of the self-purification of water under normal conditions take place intensively enough. This allows the river to cope with pollution, despite the presence of large cities and other inhabited sites.

Site	Ecogroup	S-index	n	S-index	n	S-index	n
		19-20.04		25.04		29.04	
N 28	Plank.	3,00	1	—		3,48	1
	Benth.	—		—		2,94±0,11	2
	Peryph.	2,88±0,04	2	3,18±0,53	3	3,21	1
N 5	Plank.	2,51±0,31	3	3,10±0,42	2	3,00±0,00	2
	Benth.	2,81±0,08	3	—	3	—	
	Peryph.	—		2,69±0,14	3	3,21	1
N 2	Plank.	2,65±0,11	3	2,00	1	—	
	Benth.	2,90±0,98	3	2,52	1	2,43±0,61	2
	Peryph.	—		2,61±0,21	2	3,15	1

Table 6. Saprobiological characteristic of occasional sites on River Tisa in spring 1991

In the summer much attention was paid to the influence of inhabited areas on the saprobiological condition of River Tisa and its tributaries. At occasional points samples were taken repeatedly, which confirmed a disastrous state of the water ecosystem below large cities. The largest contaminator with ordinary sewage is the city Rahiv. Water quality, as suggested by ciliate bioindicators, was estimated here to be constantly upper alpha-mesosaprobic to polysaprobic (Table 7.). If we take into account the possibility of the breakdown of any of the sewage treatment systems, we can quite obviously predict the increase of saprobity indices in a cold season, as is observed in real life (Table 7.).

It is well known that the functional activity of hydrobionts falls with a decrease in temperature, which is reflected in their reduced ability to mineralise organic substances. Truly enough, when River Tisa is occasionally polluted on its reach above the cities, the effect is stronger in autumn than in summer.

Unexpectedly, there was an indication of pollution even in a state wildlife area, namely the high-mountainous lake Sinevir. While the main water body was oligotrophic and oligosaprobic, the beach showed mesosaprobic pollution. It is associated not only with the increase of poorly supervised tourism, but also with the activity of breeding domestic ducks by the local inspectors.

Site	Summer S-index				Early Autumn S-index				Late Autumn S-index				Winter	
	Pl.	Be.	Pe.	Ad.	Pl.	Be.	Pe.	Ad.	Pl.	Be.	Pe.	Ad.	S-in.	Ad.
N 1	2,84					3,09			2,80					
N 2	2,98		3,03				2,40				2,76			
N 2a											2,89	Upper to N2		
N 3			2,88							3,30				
N 4											2,37			
N 5	2,80		2,41	20.08				20.08	2,90		3,00		2,64	Pl.
		2,47	2,27	27.08				27.08					2,88	Pe.
													2,27	Pe. on Carex
N 6							2,87			2,94	3,11			
N 7		2,85	2,68								3,70			
N 8		3,00									2,75			
N 9		2,70												
N 10	2,80	2,60							3,00	4,00				
N 11	3,78		3,04	18.08				18.08					3,33	Pe.
	3,24			19.08				19.08			3,54		2,89	Be.
N 12			2,79								3,51		2,66	Pe.
N 14			2,79								2,51			
N 15		2,86								3,00	2,73			
Tributaries														
N 20							2.95							
N 21													3,40	Pe.
N 21-1							2,98				2,50			
N 21-2						2,92				3,07				
N 21-3							3,01				3,59			
N 22					2,95									
N 22–1					3,00									
N 22–2									2,80					
N 23						3,16	2,54							
N 23-1						3,04								
N 24							3,03			2,28				
N 24-1							2,66							
N 24-2							2,63							
N 25											2,80			
N 26	2,84													
N 27		2,50	2,82								2,84			
N 28							2,57	1.09			3,97			
							2,34	3.09						

Table 7. Saprobiological characteristic of occasional sites on River Tisa in the summer (19 Aug. - 30 Aug.), early autumn (1 Sept. -13 Sept.), late autumn (2 Nov. -14 Nov. 1991), and winter (14 Feb. - 15 Feb. 1992)
Notes: Pl. - plankton, Be. - benthos, Pe. - periphyton, Ad. - additional information, S-index - index of saprobity.

The classification of sampling sites on River Tisa and basins in its region, based on occasional structurally functional parameters of ciliate communities

The growing anthropogenic influence on basins and watercourses, and the need for eco-monitoring aquatic ecosystems call for fast methods of assessing their conditions. One stage of such assesment is their classification.

Can the quantitative and functional parameters characterising different groups of hydrobionts be criteria for such classification?

Using data from water courses and basins of the River Tisa region I lead the classification along 7 parameters: quantity of ciliate species, aggregate number, total breakdown of organic substances, ratios of algae-, bacterio- and ciliovores, saprobity on bioindicator ciliates. Evaluation was done by means of three types of cluster analysis: agglomerate-hierarchical, K-average and combined RQ-analysis. We received valid results for benthos and periphyton. The number of significant clusters for the spring and summer-autumn periods varied between 3 and 4.

N	Date, 1991	The name of the site (river zone)	Agglomerative - hierarchical	RQ	K-average	Mean
1.	18.08	Hoverla	1	1	1	1
2.	16.08	Tisa after Yasinia	1	1	1	1
3.	19.08	Tisa before Rahiv	1	1	1	1
4.	18.08	Tisa after Rahiv	3	3	3	3
5.	20.08	Tisa after Hust	1	1	1	1
6.	20.08	Tisa before Hust	2	2	2	2
7.	28.08	Tisa before Vilok	1	1	1	1
8.	27.08	Tisa before Hust	3	3	3	3
9.	29.08	Tisa after Solotvino	2	2	1	2
10.	1.09	Stohovets'	2	2	2	2
11.	5.09	Tisa before Vilok	2	2	2	2
12.	3.09	Stohovets'	2	2	2	2
13.	9.09	Tisa after Tiachiv	1	1	1	1
14.	9.09	Borzhava	3	3	3	3
15.	9.09	Rika near Lipcha	1	2	3	2
16.	10.09	Rika near Mizhir'ia	3	3	3	3
17.	13.09	Lake Sinevir	1	2	2	2
18.	13.09	Teresva	3	3	3	3
19.	12.09	Teresul'ka	2	2	1	2
20.	12.09	Mokrianka	2	2	1	2

Table 8. Results of cluster analysis of summer cilioperiphyton of sites on River Tisa and basins of its region, on seven variables

In practice, results of classification of ciliobenthos are not assessed together with hydrological conditions and the characters of the biotope. The occasional results of the classification of sampling sites are presented in Table 8. The results of clusterisation using various parameters of bioindication coincide with findings from the complex evaluation of water quality with the help of hydrochemical parameters (dissolved OS, heavy metals, biogenes, etc.). Polluted are River Rika in Mizhir'ia, River Tisa below Rahiv, River Teresva in the lower region and River Borzhava near the village Dovhe. River Hoverla and lake Sinevir (though not at all sites) are considered to be completely catarobic. Moderately polluted are River Stohovets', River Rika near the village Lipcha, River Tisa below the mouth of River Vişeu. The rest of the sampling sites with data from different periods appeared in neighbouring clusters. The same was observed when various procedures of cluster analysis were used.

Accordingly, the complex use of a number of parameters that characterise groups of ciliates appears a good perspective for the purposes of classifying aquatic objects based on their degree of influence on hydrobionts. Even the classification of basins using parameters of quantities and functional activity of ciliates is possible.

Summary

In the plankton, benthos and periphyton of the Upper Tisza region (in Ukraine) 85, 187 and 138 species of free-living ciliates, respectively, were found. The total amount of discovered species was 254. The distribution of ciliates in different seasons and biotopes, changes in their quantities, biomass, and their production characteristics are ascertained.

The saprobiological situation of ciliates as bioindicators was evaluated and it appeared to be extremely unfavourable: alfa-mesosaprobic and polysaprobic range of pollution were revealed. The worst water quality was observed below the city of Rahiv. The use of cluster analysis allowed the classification of sampling sites.

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N	Species	Pl	B	Pr	W	Sp	Su	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Class Kinetofragminophora																								
1	Acaryophrya mamillata Kahl	+					+	+	+															
2	Actinobolina vorax Wenrich		+				+																+	
3	Amphileptus pleurosigma (Stokes)		+				+																+	
4	Chaenea teres Duj.	+	+	+		+	+	+	+	+	+												+	
5	Chilodonella labiata Stokes		+								+											+		
6	C. uncinata Ehr.	+	+	+	+	+	+	+	+	+	+		+										+	
7	C. piscatoris Bloch.			+			+																+	
8	Chilodontopsis depressa Perty	+	+	+		+	+	+	+	+									+				+	
9	Chilophrya labiata Edm.		+																				+	
10	Coleps hirtus Nitzsch.	+	+	+		+	+	+	+				+		+								+	+
11	C. hirtus var. minor Kahl	+	+	+			+	+		+													+	+
12	C. elongatus Ehr.		+				+																	+
13	Dileptus bivacuolatus da Cunha	+	+			+			+	+														
14	D. margaritifer(Ehr.)Ding.	+	+	+	+	+	+	+		+	+												+	
15	D. monilatus Stokes		+	+		+	+	+		+	+												+	
16	D. mucronatus Pen.		+				+	+	+															
17	D. singularis Vux.		+					+				+												
18	D. gracilis Kahl			+				+			+													
19	Drepanomonas revoluta Pen.		+				+																+	
20	Enchelyodon nataliae Kovalch.		+				+																+	
21	Enchelys gasterosteus Kahl			+			+	+		+														
22	Enchelys sp.					+								+										
23	Gastronauta membranacea Buetschli		+			+		+		+						+		+						
24	Holophrya atra Svec.		+	+		+				+														
25	H. simplex Schew.			+			+	+			+													
26	H. oviformis Vux.		+				+																+	
27	Holophrya sp.		+					+					+											
28	Homalozoon vermiculare Stokes		+	+		+	+	+	+	+													+	
29	H. caudatum Kahl		+			+			+															
30	Lacrymaria filiformis Maskell		+	+			+	+	+											+			+	
31	L. olor O.F.M.		+	+		+	+	+		+	+												+	
32	L. olor var.pusilla Vux.		+	+		+	+	+	+		+												+	+
33	Lagynophrya ovalis v.Gelei	+		+			+	+	+	+	+									+				
34	L. mutans Kahl			+				+			+													
35	L. simplex Kahl	+					+	+		+														
36	Lagynophrya sp.			+		+					+													
37	Leptopharynx sphagnetorum (Lev.)		+	+		+	+			+				+									+	
38	Litonotus anguilla Kahl	+				+			+															
39	L. lamella (O.F.M.)		+	+			+	+	+												+		+	
40	L. l. var.armatum Vux.		+				+																+	
41	L. fusidens (Kahl)	+	+	+	+	+	+	+		+	+	+												
42	L. crystallinus Vux.			+			+	+		+														
43	L. cygnus O.F.M.		+			+			+															

Table 1. Species list and the distribution of free-living ciliates of River Tisa

	Species	Pl	B	Pr	W	Sp	Su	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
44	L. fasciola O.F.M.		+	+			+	+		+					+	+							+	
45	L. triqueter Pen.		+				+	+											+					
46	L. nanus Vux.	+	+			+	+		+														+	
47	L. uninucleatus Fois.		+	+		+	+	+		+	+									+				
48	Litonotus sp.	+	+	+		+		+		+	+	+	+	+		+	+	+		+				
49	L. sp.		+							+														
50	Longifragma obliqua Kahl	+					+	+	+															
51	Loxodes striatus Pen.		+				+	+					+										+	
52	Loxophyllum helus (Stokes)		+				+	+		+														
53	L. lionotiforme Vux.		+	+			+	+	+														+	
54	Mesodinium acarus Stein	+	+	+		+	+	+	+	+			+	+		+		+						+
55	Metacystis tesselata Kahl		+	+				+			+		+											
56	Monodinium balbianii Fab.-Dom.		+				+	+	+														+	
57	Nassula tumida Maskell			+			+	+		+	+									+				
58	N. rotunda Gelei			+			+	+		+														
59	Nassulopsis elegans (Ehr.)			+			+	+		+													+	
60	N. vorax (Stokes)	+	+	+			+	+		+	+												+	
61	Paraenchelis wenzeli Foiss.		+	+			+	+		+													+	
62	P. terricola Foiss.		+	+		+	+				+											+		
63	Paraurotricha discolor (Kahl)		+				+																+	
64	Penardiella crassa (?) Pen.		+					+											+					
65	Phascolodon vorticella Stein	+					+	+	+															
66	Phialina jankowskii Foiss.		+	+	+	+	+	+		+	+			+				+		+	+			
67	Ph. minima Kahl		+					+					+											
68	Ph. pupula O.F.M.		+			+	+	+	+						+								+	
69	Phialina sp.		+					+											+					
70	Phialina sp.1		+					+					+											
71	Pithothorax sp.		+				+												+					
72	Placus ovum Kahl		+	+		+		+		+	+													
73	Plagiocampa mutabilis Shew.		+	+		+	+	+	+	+	+								+				+	
74	P. metabolica Kahl		+				+																+	
75	P. nistroviensis Kahl		+	+		+	+	+		+			+	+					+				+	
76	P. rouxi Kahl	+	+	+		+	+	+	+	+	+	+	+		+				+			+	+	
77	P. longis Kahl		+	+			+																+	
78	P. sassykensis Kovalch.	+	+	+		+	+	+	+	+														
79	Plagiocampa sp.		+						+															
80	Prorodon ovum (Ehr.)		+				+																+	
81	Prorodon teres Ehr.		+				+	+	+		+												+	
82	Pseudochilodonopsis caudata(Perty)		+	+			+	+											+		+		+	+
83	P. algivora (Kahl)	+		+		+		+		+	+			+	+									
84	Pseudomicrothorax dubius (Maupas)		+				+																+	
85	Pseudoprorodon sp.		+					+					+										+	
86	Rhagadostoma completum Kahl		+			+	+	+	+										+				+	
87	Spathidioides sp.		+				+																+	
88	Spathidium brunneum Kahl		+			+				+														

Table 1. continue

	Species	Pl	B	Pr	W	Sp	Su	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
89	Sp. chlorelligerum Kahl		+					+	+															
90	Sp. latum Kahl		+	+			+	+		+														
91	Sp. spathula O.F.M.	+	+			+	+	+		+	+												+	
92	Sp. faurei Kahl		+				+																+	
93	Sp. peniculatum Kahl		+				+																+	
94	Sp. muscicola Kahl		+				+																+	
95	Spathidium sp.		+					+		+														
96	Spathidium sp.1			+				+			+													
97	Spathidioides sp.			+		+				+														
98	Supraspathidium multistriatum Foiss. et Didier		+				+																+	
99	Trachelius ovum Ehr.			+			+																+	
100	Supraspathidium sp.		+					+				+												
101	Trachelophyllum apiculatum Per.	+	+	+		+	+	+	+		+												+	
102	Tr. attenuatum Foiss.		+	+			+													+			+	
103	Trithigmostoma cucullus(O.F.M.)	+	+	+	+	+	+	+	+	+	+				+								+	+
104	T. hyalina Sramek-Husek			+				+		+														
105	T. steini (Blochman)		+	+		+	+	+		+	+							+	+			+		
106	Trochilia minuta (Roux)	+	+	+	+			+		+	+													
107	Trochilioides fimbriatus Foiss.			+				+							+									
108	Urotricha armata Kahl		+	+		+	+	+		+								+						
109	Ur. farcta Clap.-Lach.	+	+	+		+	+	+	+	+	+		+									+	+	+
110	Ur. furcata Clap.-Lach.	+	+	+		+	+	+	+	+	+													
111	Ur. ovata Kahl	+	+	+		+	+	+		+	+		+										+	
112	Ur. pelagica Kahl	+				+	+	+	+															+
113	Vasicola ovum Kahl		+			+	+	+	+	+									+		+		+	
Class Oligohymenophora																								
114	Astylozoon faurei Kahl			+			+	+		+														
115	Cinetochilum margaritaceum Perty	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	
116	Colpidium colpoda (Losana)			+				+								+								
117	C. kleini Foiss.			+				+							+									
118	Cohnilembus fusiformis Kahl	+	+	+	+	+	+	+	+	+	+				+		+		+			+		
119	Cohn. vexillarius Kahl		+				+																+	+
120	Cristigera setosa Kahl	+		+	+	+	+	+	+	+	+				+					+			+	
121	Cr. phoenix Pen.		+				+																+	
122	Ctedostema acanthocrypta Stokes		+	+			+	+	+	+	+		+	+	+			+						
123	Cyclidium bonnetti Groliere			+				+							+									
124	C. flagellatum Kahl		+					+					+										+	
125	C. glaucoma O.F.M.	+	+	+	+	+	+	+	+	+	+			+	+			+		+			+	+
126	C. g. var. elongatum Schew.	+	+	+		+	+	+	+	+	+					+	+	+	+				+	
127	C. g. var. minuta Vux.		+			+		+							+								+	
128	C. heptatrichum Schew.		+	+		+	+	+		+	+								+	+				
129	C. lanuginosum Pen.		+	+			+	+		+	+													
130	C. libellus Kahl		+	+			+	+		+	+													
131	C. oligotrichum Kahl	+	+	+		+		+		+	+											+		

Table 1. continue

	Species	Pl	B	Pr	W	Sp	Su	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
132	C. putrinum Vux.			+			+	+		+														
133	C. sapropellicum Vux.		+	+			+	+		+								+	+					
134	C. sphagnetorum Sramek-Husek		+					+					+											
135	C. singulare Kahl		+	+			+	+	+	+			+		+				+				+	+
136	C. versatile (?) Pen.		+			+				+													+	
137	C. simulans Kahl			+				+													+			
138	C. gracile Vux.		+			+																	+	
139	Cyclidium sp.	+	+	+	+	+	+	+	+	+	+	+			+	+	+	+	+	+		+	+	
140	Cyclidium sp.1		+	+		+		+	+	+	+				+									
141	Cyclidium (?) sp.	+	+	+		+		+	+	+	+	+		+	+									
142	Dexyostoma campyla (Jank.)		+	+	+	+	+	+	+	+	+													
143	Dexiotricha colpidiopsis (Kahl)		+				+																+	
144	Dexiotrichides centralis (Stokes)			+		+		+		+	+											+		
145	Disematostoma invallatum v.Gelei			+				+		+														
146	Epistylis plicatilis Ehr.	+		+			+	+		+	+													
147	E. rotans Svec	+		+		+			+	+														
148	Frontonia elliptica Beard.		+	+		+	+	+	+	+	+				+			+		+			+	
149	F. leucas Ehr.	+	+			+		+		+			+						+					
150	F. roquei Drag.	+	+	+		+	+	+	+	+	+			+				+					+	
151	F. depressa (?) Stokes	+					+		+															
152	F. sp.		+						+	+														
153	Frontoniella complanata Wetzel		+	+			+	+					+		+		+	+					+	
154	Glaucoma myriophylli Pen.		+				+																+	
155	Glaucoma sp.			+		+				+														
156	Monochilum elongatum Mermod.		+			+				+														
157	Ophryoglena flava Ehr.		+			+	+	+	+				+										+	
158	O. utriculariae Kahl			+				+		+					+									
159	Paramecium bursaria (Ehr.)		+	+	+		+	+			+				+			+					+	
160	P. caudatum Ehr.	+	+	+		+	+	+	+	+							+	+					+	
161	P. putrinum Cl.et L.	+	+			+	+		+														+	
162	P. calkinsi Woodruff		+	+	+					+	+													
163	Philasterides armata (Kahl)	+	+	+	+	+	+	+	+	+	+		+	+	+		+	+	+					
164	Platynematum sociale Penard		+	+		+	+	+	+						+								+	+
165	P. solivagum Kahl	+	+			+	+	+	+	+			+											
166	Pleuronema coronatum Kent	+	+	+		+	+	+	+	+	+		+	+	+	+		+					+	
167	P. crassum Duj.		+				+												+					
168	Pseudocochnilembus putrinus(Quen.)		+			+			+															
169	Stegochilum fusiforme Schew.		+	+			+	+		+	+									+			+	
170	Spirozona caudata Kahl	+	+			+	+	+	+	+	+								+			+	+	
171	Tetrahymena pyriformis (Ehr.)	+	+	+	+	+	+	+		+	+				+							+	+	
172	Turaniella vitrea Brodsky	+				+				+														
173	Urocentrum turbo O.F.M.	+	+	+			+	+		+													+	+
174	Uronema halophila (Kahl)	+	+	+		+	+	+	+	+	+	+	+	+	+		+		+				+	
175	Ur. marinum (Duj.)	+		+		+	+	+	+	+	+												+	
176	Ur. sp.			+				+			+													

Table 1. continue

	Species	Pl	B	Pr	W	Sp	Su	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
177	Urozona buetschli Schew.		+	+		+		+		+	+											+		
178	Vorticella campanula Ehr.	+	+	+	+	+	+	+	+	+	+		+	+			+	+						
179	V. gracilis Duj.	+		+		+		+		+		+		+										
180	V. microstoma Ehr.	+		+	+	+	+	+	+	+	+													
181	V. mutans (?)(O.F.M.)	+						+		+														
182	V. venusta Nenninger	+				+				+														
183	Vorticella sp.		+						+															
184	Vorticella sp.1			+				+								+		+						
185	Zoothamnium sp.	+						+	+															
Class Polyhymenophora																								
186	Aspidisca cicada (O.F.M.)	+	+	+	+	+	+	+	+	+	+	+	+		+		+	+				+	+	+
187	Asp. lynceus Ehr.	+	+	+	+	+	+	+	+	+	+			+		+		+		+				+
188	Asp. herbicola Kahl		+				+																+	
189	Balladyna fusiformis Kahl	+	+	+	+	+	+	+	+	+	+												+	
190	B. similis Kahl	+	+	+			+	+	+	+	+		+		+								+	
191	Blepharisma steini Kahl		+				+																+	
192	Brachonella campanula Kahl		+				+																+	
193	Caenomorpha medusula var. dentata Wetzel		+				+	+		+														
194	Climacostomum virens (Ehr.)	+	+				+																+	
195	Codonella cratera (Leidy)	+					+	+	+															
196	Condylostoma tardum Penard			+				+	+															
197	C. vorticella (Ehr.)	+	+	+			+																+	
198	Hypotrichidium tisiae (Gelei)	+				+				+														
199	Keronopsis spectabilis Kahl			+				+		+														
200	Metopus es (O.F.M.)		+	+		+	+	+											+				+	
201	M. es var. rectus Kahl		+				+												+				+	
202	M. hasei Sond.		+				+	+							+				+					
203	M. tortus Kahl		+				+																+	
204	M. pulcher Kahl		+				+																+	
205	M. setifer Kahl		+			+	+		+														+	
206	Mylestoma cf. sp.		+			+			+															
207	Onichodromopsis flexilis Stokes	+			+					+														
208	Opistotricha crassistilata Kahl	+		+		+	+	+	+		+													
209	O. similis Engelmann			+	+					+														
210	Oxytricha furcata Smith		+	+			+	+	+	+	+											+		
211	O. agilis (Engelmann)			+			+	+		+														
212	O. granulifera Foiss. et Adam		+	+	+		+	+	+	+	+			+		+	+				+			
213	O. minor Kahl		+				+																+	
214	O. ludibunda Stokes	+	+	+			+	+	+	+														
215	O. similis Engelmann		+				+																+	
216	O. saprobia Kahl		+				+																+	
217	Oxytricha sp.		+					+		+														
218	Paruroleptus caudatus Stokes	+	+	+		+	+	+	+	+	+				+				+					
219	P. musculus(O.F.M.)			+				+					+											

Table 1. continue

	Species	Pl	B	Pr	W	Sp	Su	A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
220	Paruroleptus sp.		+					+							+									
221	Paraurostyla weissei (Stein)		+	+		+		+			+											+	+	
222	Pelodinium reniforme Laut.		+				+	+					+		+				+				+	
223	Perisincirra gellerti Foiss.		+			+																+		
224	Saprodinium mimeticum (Penard)	+				+			+															
225	S. triangulum Kahl		+					+					+											
226	Spirostomum minus Roux		+				+	+					+										+	+
227	Spirostomum teres Cl. et L.	+	+				+	+							+								+	
228	Stentor coeruleus (Pallas)	+	+	+				+		+				+				+					+	
229	Str. velox F.-F.	+	+	+	+		+	+	+	+	+	+	+		+			+					+	
230	Str. pulex Galad.			+		+																+		
231	Str. lacustris Foiss.,Skog.et Pratt	+	+	+			+			+														+
232	Strombidinopsis gyrans Kent	+					+																	+
233	Strombidium mirabile Penard	+					+																	+
234	S. viride f. pelagica Kahl		+				+																+	
235	Strongylidium danubiensis Kovalch.		+				+																	+
236	Stylonychia pustulata Ehr.	+	+	+	+		+	+	+	+	+												+	
237	S. mytilus-lemnae complex	+	+	+		+	+	+		+				+	+								+	
238	S. fissiseta Cl. et L.		+		+						+													
239	Tachysoma pellionellum (O.F.M.)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+		+	+	
240	T. furcatum Kahl			+		+				+														
241	Tintinnidium fluviatile Stein	+					+																	+
242	Tintinnopsis cylindrata Kof.-Camp.	+	+				+																	+
243	Trichotaxis fossicola Kahl		+			+					+											+		
244	Uroleptus dispar Stokes			+				+			+													
245	Ur. piscis (O.F.M.)		+	+			+																+	+
246	Ur. violaceus (?) Stein		+				+																+	
247	Urosoma cienkowskii Kowalev.		+	+		+	+	+	+	+	+				+				+			+	+	
248	Urostyla grandis Ehr.	+	+	+	+		+			+	+												+	
	Class Colpodea																							
249	Bursaria truncatella O.F.M.		+				+																+	
250	Colpoda aspera Kahl			+				+			+													
251	Colpoda sp.			+		+					+													
252	Paracolpoda steini (Maupas)			+	+			+			+			+										
253	Platyophrya cf. sp.	+				+			+															
254	Semiplatyophrya sp.		+	+		+	+	+		+	+								+			+		

Table 1. continue

Notes: Pl - plankton, B - benthos, Pr - periphyton, W - winter, Sp - spring, Su - summer, A -autumn. 1, 2, 3 - lower, middle and upper reaches of River Tisa, respectively, 4 - Tereble-Rikske reservoir, 5 - lake Sinevir; Rivers: 6 - Borjava, 7 - Rika, 8 - Mokrianka, 9 - Teresulka, 10 - Teresva, 11 - Kosivska, 12 - Goverla, 13 - Shopurka, 14 - Stogovets, 15 - Uzh, 16 - Latoritsa.

Crustaceans (Ostracoda, Cladocera, Copepoda) from basins of the River Tisa region (Ukraine)

Natalia Kovalchuk

Introduction

The existence of aquatic populations of any region is determined by the amount and quality of water accessing the area.

The quality of water in the river is dependent on interactions between a number of processes either natural or caused by anthropogenic agents. The former conventionally refers to the eduction (the so-called 'self-purification' processes) of water. Numerous living organisms participate in these processes by withdrawing organic matter and accessible mineral substances from the water. On the other hand, more often, certain hydrobionts are associated with the pollution of water with extraneous products related to the various economic activities of humans. The more stable a community of aquatic dwellers is, the more successful they will be in withdrawing and transforming various extraneous admixtures present in the water. As a result, better water quality will be achieved.

The knowledge about the structure and the peculiarities of the functioning of the communities of aquatic organisms is a necessary condition for the effective control of water quality and for the due detection of unfavourable changes. Knowledge in this field serves as basis for developing practical measures of the improvement of water quality.

Under the mountainous conditions of the Carpathian territory of Ukraine, a relatively big river (i.e. River Tisa: a large tributary of River Danube) serves as the basic drain of the area. River Tisa is the major aqueous artery and the basic source of drinking water in Hungary.

In accordance with those mentioned above, we consider that finding out the species composition of communities inhabiting the basins of the River Tisa region is an important stage of the research analysing the formation of water quality.

Keywords: microzoobenthos, zooplankton, crustaceans.

Materials and Methods

The material for the research was mainly samples of microzoobenthos and also periphyton and zooplankton. We took samples from rivers, brooks, springs and basins with stagnant water, which were associated with River Tisa. Sampling was carried out over 7 years, mainly in the summer period. The procedure of processing the samples is given in previously published papers (N. Kovalchuk 1990, 1993, 1997).

Results and Discussion

Microscopic organisms and animals that are fine by size but are highly organised are poorly investigated in this area of the Tisa region, and represent special interest. In particular, the planktonic and benthic crustaceans of the groups Copepoda, Cladocera and Ostracoda are concerned. Unfortunately, there has been only one monograph (Polishchuk and Garasevich, 1986) recently that offers an up-to-date representation of the richness of living organisms, including crustaceans, inhabiting the diverse basins of the region of River Tisa in its Ukrainian reach. In the monograph «Hydroecology of the Ukrainian reaches of the Danube and allied basins» (1993) only the chapter by A. A. Kovalchuk «Protozoans and the microfauna» contains data on the region of River Tisa, while the rest of the materials appearing there are more general, dealing with the regions of the rivers Tisa and Prut, and also including zooplankton data.

As a result of of our studies we revealed 28 species and subspecies of crustaceans, namely: 3 species from the group Ostracoda, 3 from Cladocera, 7 from Copepoda Cyclopoida, and 14 from Copepoda Harpacticoida. Data from our research and the findings of other authors allow to ascertain that presently 87 species and subspecies of crustaceans of the distinguished groups (see Table) are known from the basins of the diverse Ukrainian reach of River Tisa. It is necessary to emphasiye that the group Ostracoda had not been studied specially in the region. The specific findings do not give definitive information about species richness. The species composition of Cladocera, Copepoda Cyclopoida, and Copepoda Calanoida in the examined mass is usual for planktonic communities.

Te suborder Harpacticoida is of special interest. Based on the results of research studies focusing on this group of crustaceans, some have been assumed to be species new for science or for the region. Only Harpacticoida have considerably high organization in the microscopic range. Due to this, as climatic conditions changed in the course a long historic period, it became possible for these species to occupy different ecotopes: to leave open water and inhabit interstitial waters or the phreatic waters of springs. In contrast with larger animal species demanding large ecotopes with stable conditions, it is obvious that Harpacticoida, with their greater quantities, have been able to remain in the state of high species richness, and are today live witnesses of bygone epochs. All these make the group extraordinarily interesting to the researchers of the evolution of the world's fauna, and especially to biogeographers. Harpacticoids are valuable subjects for the analysis of the ways in which faunistic complexes and natural systems of present time have formed. Their group is a major object of ecological researches both in the general theoretical sense or in the applied nature conservation approach.

Conclusions

The knowledge about crustaceans inhabiting the basins in the Ukrainian reaches of River Tisa is unsatisfactory. Certain groups of crustaceans such as Ostracoda or bottom-dwelling and vegetation-inhabiting Cladocera have not been investigated generally. Our results of the study of the group Harpacticoida testify that they may have a potentially high and yet undescribed species richness. This especially concerns interstitial crustaceans. It is necessary to note that adverse changes are taking place in mountainous ecosystems. They are caused by the active economic activity of humans (in particular, mostly by improper forestry), which, as regards its strength, is comparable with natural disasters. Under such conditions a number of aquatic dwellers that presently ensure us catarobic water, may disappear from the Earth's surface, even before being described by science.

Summary

Systematised data on the species composition and distribution of crustaceans in the microzoobenthos, zooplankton and periphyton of basins in the diverse Ukrainian region of River Tisa are presented. In the final table 87 species and subspecies of crustaceans, discovered by the author and other researchers, are included.

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N	Species	Sample *	Our findings							Another findings ***	
			R. Tisa	tributaries	** headwater regions						
					I	II	III	IV	V	A	B
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	OSTRACODA										
1	Candona stagnalis G.O.Sars	-								7	
2	C.neglecta G.O.Sars	-								7	
3	C.paralle G.W.Mul.	-								7	
4	Cyclocypris ovom (Jurine)	mb			Uzh			+			
		ppb .			Tereblia				+		
										7	
5	Cypria stygia (Jurine)									7	
6	Cypridopsis parva G.W.Mul.	mb							+		
7	C. vidua (O.F.Mul.)	-								7	
8	C. orientalis Bronst.	mb			Bila Tisa	+					
	CLADOCERA										
9	Acroperus harpae (Baird.)	-								7	
		zp									8
10	Alona quadrangularis (O.F.Mul.)	pph							+		
11	Alonella excisa (Fischer)	-								7	7
12	A. nana Baird	zp									6
13	A. rectangula Sars	-								7	7
14	Biapertura affinis (Leydig.)	-								7	7
15	Bosmina longirostris (O.F.Mul.)	-								7	7
		zp									6,8
16	B. 1 cornuta (Jurine)	-								7	
17	Camptocercus rectirostris Schoedler	-									7
18	C. lilljeborgi Schoedler	-									7
19	Ceriodaphnia pulchella Sars	-									7
20	C. reticulata (Jurine)	mb			Uzh			+			
		-									7

Table. Crustaceans (Ostracoda, Cladocera, Copepoda) of basins in the region of River Tisa (in Ukraine)

Notes. *: «-» not specified, «mb» - microzoobenthos, «zp» - zooplankton, «pph» - periphyton, «inst» -interstitial. **: «I» - region of tributary, «II» - small rivers, brooks, «III» - springs, «IV» - puddles and other temporary basins, «V» - lake Sinevir. ***: - «A» - mountain reaches of the Tisa region, «B» - foothill reaches of the Tisa region (figures 1-7 in the last two coloumns refer to the corresponding serial numbers of the literature list; 8 - G.V. Parchuk, personal communication).

1	2	3	4	5	6	7	8	9	10	11	12
21	Chydorus sphaericus (O.F. Mul.)	-								7	7
		zp								8	8
22	Daphnia cucullata Sars	zp								8	8
23	D. galeata Sars	zp									8
24	D. longispina O.F. Mul.	-								7	7
25	D. l.littoralis Sars	-								7	
26	D. magna Straus	-									7
27	D.pulex (De Geer)	-									7
		zp									8
28	D. p. obtusa Kuts	-								7	
29	Disparalona rostrata rostrata (Koch)	-								7	7
		mb							+		
30	Ilyocryptus sordidus (Lievin)	-								7	7
31	Leydigia leydigii (Schoedler)	-								7	
32	Macrothrix laticornis (Jurine)	-									7
33	Moina brachiata (Jurine)	-									7
34	M. micrura Hellich	-									7
		zp									6,8
35	M. rectirostris (Leydig)	-									7
36	Pleuroxus truncatus O.F. Mul.	-								7	7
37	Rhynchotalona rostrata (Koch)	zp									8
38	Scapholeberis mucronata (O.F. Mul.)	-									7
39	Sida clystallina (O.F. Mul.)	-								7	7
40	Tretocephala ambigua (Lill).)	-								7	
	COPEPODA Calanoida										
41	Acanthodiaptomus denticornis (Wierz.)-	-								7	
42	Eudiaptomus coeruleus (Fischer)	-								7	7
43	E. gracilis (Sars)	-								7	7
		zp									8
	COPEPODA Cyclopoida										
44	Acanthocyclops americanus (Marsh.)	-									7

Table continue

1	2	3	4	5	6	7	8	9	10	11	12
45	A. a. spinosa (Monchenko)	-									7
46	A. gigas (Claus)	-								7	
47	A. kieferi (Chappuis)	inst								5	
48	A. robustus (Fischer)	zp									8
49	A. vernalis vernalis (Fischer)	mb			Uzh			+			
		-									7
50	A. viridis (Jlirine)	-									7
51	Cyclops furcifer Claus	-									7
52	Ń. strenuus (Fischer)	-									7
		zp									8
53	C. vicinus Uljanin	-								7	7
		zp									8
54	Diacyclops bicuspidatus (Claus)	-								7	
55	D. bicnspidatus f. odessana (Schmank.)	zp		Chorna Tisa							
56	Eucyclops macruroides (Lillj.)	-								7	7
57	E. macrurus (Sars)	-								7	
58	E. serrulatus (Fisch.)	mb		Chorna Tisa							
		pph							+		
		-								7	7
		mb								4	
59	E. s. proximus Lillj.	-								7	7
60	Macrocyclops albidus (Jurine)	-								7	7
		zp									8
61	M. fuscus (Jurine)	pph							+		
62	Mesocyclops leuckarti (Claus)	-									7
63	Metacyclops gracilis (Lillj.)	zp								8	
64	P. fimbriatus fimbriatus (Fischer)	zp							+		
		-								7	7
		zp					+				
		zp	+								
		mb								4	
		zp									8
65	P. f. chiltoni (Thoms)	mb			Uzh	+					
		-									7
		mb								4	

Table continue

1	2	3	4	5	6	7	8	9	10	11	12
66	Paracyclops poppei (Rehb.)	zp		Teresva							
67	Themiocyclops oithonoides (Sars)	-									7
		zp									8
	COPEPODA Harpacticoida										
68	Arcticocamptus laccophilus (Kessler)	mb			Teresva		+				
69	Attheyella crassa (G.O.Sars)	mb	+								
		mb			Už	+	+				
		mb							+		
		mb		Rika							
		mb		Bilae Tisa		+					
		mb	+								
		-								7	
		mb								4	4
70	Att. wierzeiskyi (Mrazek)	mb			Uzh	+	+				
		mb								4	
		mb			Bila Tisa	+	+				
71	Bryocamptus minutus (Claus)	mb			Uzh		+				
72	B. pygmaeus (Sars)	-								7	7
73	B. spinulosus v. occidentalis Sterba	mb			Teresva		+				
		mb			Uzh	+	+				
		mb			Bila Tisa	+	+				
		mb								4	
74	B. tamogradskyi Borutzky	mb			Tereblia	+					
		mb			Uzh	+	+				
		mb			Bila Tisa	+					
75	B. typhlops (Mrazek)	mb			Uzh	+					
76	B. zschokkei caucasicus Borutzky	mb			Uzh		+				
		zp		Chorna Tisa							
		mb			Uzh	+.					
		mb			Bila Tisa	+	+				
77	Canthocamptus staphylinus (Jurine)	-									7
		zp								8	8
78	C. s. staphylinus (Jurine)	mb								4	
79	Echinocamptus hoferi (VanDouwe)	mb			Teresva	+					

Table continue

1	2	3	4	5	6	7	8	9	10	11	12
		mb			Bila Tisa	+	+				
		mb			Uzh	+	+				
80	Ech. luenensis (Schmeil)	mb			Uzh		+				
		mb								4	
81	Epactophanes richardi v. quadrispinosus (Richters)	mb			Bila e Tisa	+					
		mb								4	
82	Moraria pectinata Tbieband et Pelosse	mb			Tereblia	+					
		mb			Uzh	+					
		mb			Bila Tisa	+	+				
83	M. poppei poppei (Mrazek)	mb			Uzh		+				
84	M. subterranea (Carl)	mb			Bila Tisa	+					
85	Paracamptus schmeili (Mrazek)	mb								4	
86	Parastenocaris gorganensis N. et A. Kovalchuk	mb			Teresva		+				
87	Viguierella paludosa (Mrazek)	-									7

Table continue

Zooplankton investigations in the Upper Tisa Region

Katalin Zsuga

Introduction

A detailed examination of the upper course of River Tisa was conducted in August 1995. I performed the determination of the zooplankton from the biological examinations. I performed the detailed investigation of the groups of the Rotatoria, Cladocera and Copepoda from zooplankton elements.

Keywords: zooplankton, Upper Tisa

Material and methods

Time and location of the examination:

A zooplankton examination from the Upper-Tisa was performed between 6th - 20th August 1995. The samples were taken from the river section extending from the source of the rivers White- and Black Tisa to Szalka in 12 segments, and from 2 streams which flow into the Tisa.

Collecting method:

100 or 200 liters of water was filtered through a 45 µm mesh size plankton net made of silk bolting cloth. The filtrate was conserved on-site by using 40 % formaldehyde solution to achieve a final concentration of 4 %.

Processing method:

During the course of microscopic examinations I performed all quantiative and qualitative processing. I used an Ergaval microscope, and the quantitative samples were counted using a box sized 80 by 35 by 6 mm and a cubby-hole numbered with a graticule of 5 by 5 mm. For the preparation of the mastax of Rotatoria I used hypoklorid solution. Quantitative data were given in 100 i/liter unit of measure. For the taxonomic determination of the animals identification keys by Bancsi (1986, 1988), Boruckij (1992), Carlin (1943), Damian-Georgescu (1970, 1983), Dévai (1977), Donner (1965), Flössner (1972), Dussart (1967), Flössner (1972)Gulyás (1974), Kutikova (1970), Negrea (1983) were used.

Sampling sites were the followings:
1. Chorna Tisa: near source
2. Yasina
3. Bila Tisa: near source
4. Breboja
5. Roztoki
6. Tisa: Troznik (at the confluence of the Chorna and Bila Tisa)
7. near Rahiv
8. Dilove
9. above Tereblia Stream
10. Vinograd
11. Tivadar
12. Szalka
13. Teresva Stream: before mouth
14. Tereblia Stream: before mouth

Results

The upper stretch of River Tisa has high flow velocities, abundance is therefore low and the species composition of the zooplankton community is poor.

Analysis of the plankton samples revelead the occurence of altogether 149 Rotatoria, 1 Cladocera and 1 Copepoda taxa from the examined stretch.

Rotatoria fauna

The fewest species number characterized the Bila Tisa where only 2-3 species were found (Fig. 1.).

In the Chorna Tisa this value was a thought more than in Bila Tisa. In the period of examination the highest number of taxa were identified at Trosnik where the Chorna and Bila Tisa unite. The number of Rotatoria species at Rahiv and Szalka was high too. In the streams (Teresva and Tereblia) the number of taxa was also rather small.

Organisms characteristic of various kinds of biotops could be found among the species. As a consequence of low water level and high flow velocities, real plankton communities do not develop.

The number of euplanktonic species was small and organisms found reperesented only a small fraction of them. On the shingly, stony bottom only few benthic organisms live. At the highest proportion mostly psammon species were found.

Most of the Rotatoria species found were euryoc and cosmopolitan organisms, although some rare rotifers were also recorded (Cephalodella remanei, Cephalodella theodora, Lecane chankensis, Proales theodora, Proales theodora calcarata).

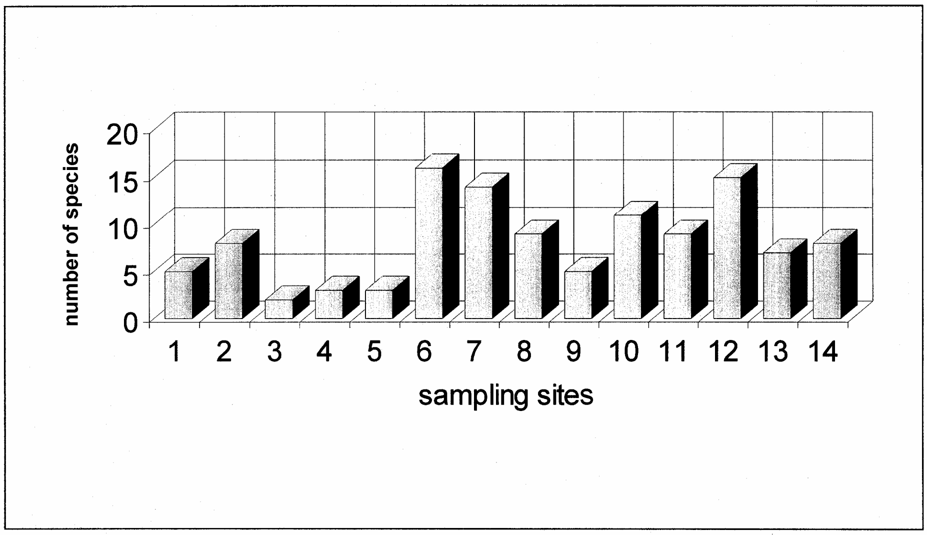

Fig. 1. Number of Rotatoria species

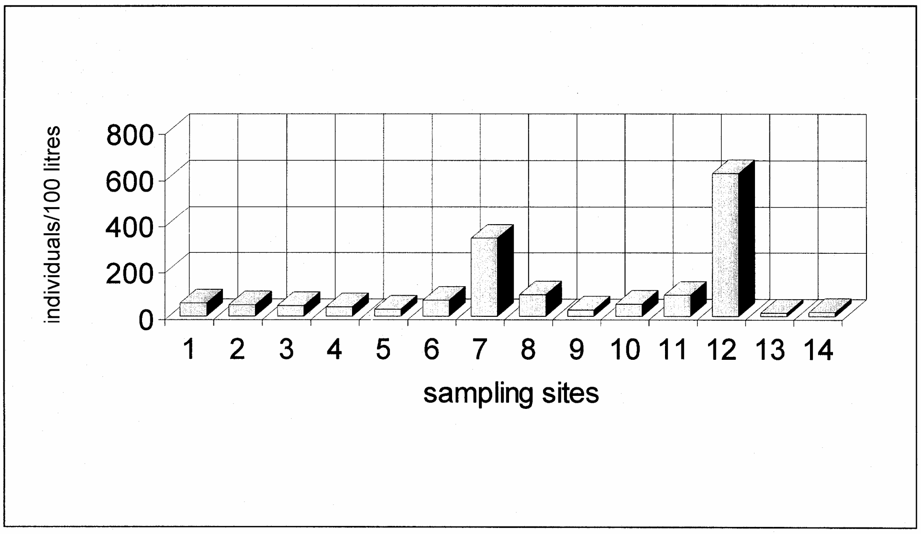

Fig. 2. Number of Rotatoria individuals per unit volume

Quantitative examinations showed that the hidrological properties resulted in low abundance values. A relatively high number of individuals per unit volume were found only at the Hungarian reach, at Szalka (Fig. 2.).

The composition and abundance of the zooplankton community at Szalka showed marked differences from other sampling sites. Here the character and structure of river bottom changed in comparison with the upper reach. Instead of shingly bottom, small, fine-grained sediment was found. The other reason for the discovered changes in the species community and abundance is River Szamos. This river brings high zooplankton biomass into River Tisa, and the water quality often becomes more unfavourable than in the upper reach.

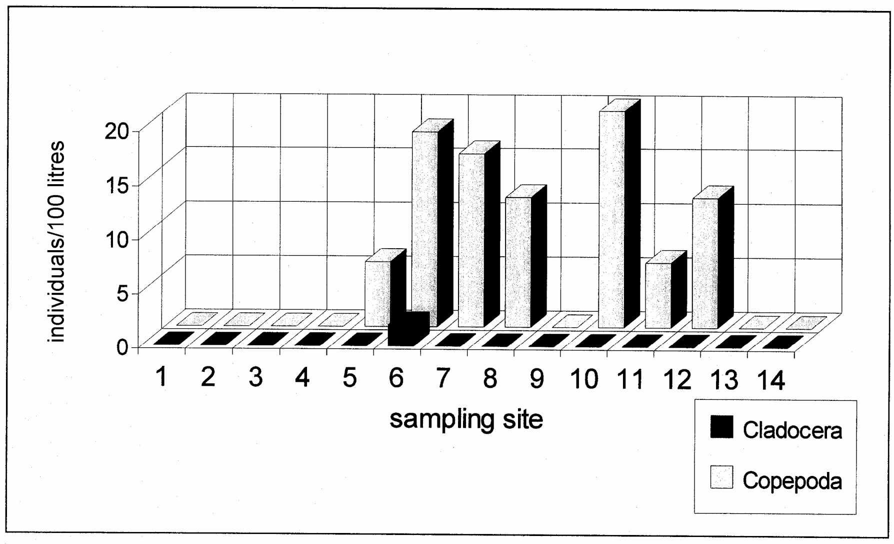

Fig. 3. Number of Crustacea individuals per unit volume

Crustacea fauna

The Crustacea fauna was extremely poor from the point of view of both abundance and species composition (Fig. 3.).

During the examined period altogether 1 Cladocera species was found. Bosmina longirostris is an euryoc, cosmopolitan organism.

The number of Copepoda was also very small. From adult organisms only one Bryocamptus species was found, otherwise nauplii and copepodit forms were characteristic in the samples.

Summary

Due to the hidrological properties in the upper Tisa Region (low water depth, high flow velocities, shingly, stony bottom) neither species composition nor abundance had high values.

During the investigation 149 Rotatoria, 1 Cladocera and 1 Copepoda taxa were recorded.

The species composition of the zooplankton community indicated good water quality at the upper stretch of River Tisa. At Szalka the zooplankton fauna showed marked diffrences from other samples, partly as a reason of the influence of River Szamos, partly due to changes of the hidrological characteristics of the river.

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TAXA	Sampling sites													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
ROTATORIA														
Brachionus angularis Gosse						2	8							
Brachionus calyciflorus calyc.Pallas		3										36		
Brach. quadridentatus brevispinus Ehr.												36		
Brach.quadr. cluniorbicularis Skorikov												204		
Brachionus quad. rhenanus Lauterborn												84		
Brachionus urceolaris O.F.Müller							16							
Brachionus sp.										2				
Cephalodella biungulata Wulfert				16		2				2				
Cephalodella catellina O.F. Müller												36		
Cephalodella crassipes Lord	4													
Cephalodella gibba Ehrb.						2	8	4						
Cephalodella forficula Ehrb.								4		4	6			
Cephalodella remanei Wisznievski								4						
Cephalodella sterea Gosse							8							
Cephalodella theodora Koch-Althaus	24	6			6		8		6				1,5	4
Cephalodella ventripes Dixon-Nuttal	4							4						
Cephalodella sp.		3					8				6			
Colurella adriatica Ehrb.						2		4				12	3	2
Colurella colurus Ehrb.		12											1,5	2
Colurella uncinata O. F. Müller		3									18			
Dicranophorus caudatus Ehrb.						2								
Dicranophorus uncinatus Milne						2	8	4		2	12			
Encentrum plicatum Eyfert											6			
Encentrum wisznievski Wulfert							8		3	2	6			
Epiphanes macrourus Barrois et Daday												6		
Euchlanis dilatata Ehrb.						4	8							
Filinia longiseta Ehrb.							32							
Keratella cochlearis Gosse						4								
Keratella cochlearis tecta Gosse						18		4		8	18	12		
Lecane bulla Gosse						4					12	84	1,5	2
Lecane chankensis Bogoslovsky							136		6					
Lecane closterocerca Schmarda	4			8	6							12		
Lecane hamata Stokes												12		

Table 1. Data on zooplankton taxa found at various sampling sites

TAXA	Sampling sites													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Lecane luna O.F. Müller												12		
Lecane ungulata Gosse							8							
Lepadella patella O.F. Müller			5			4		4		2			4,5	2
Mytilina crassipes Lucks							8							
Notholca squamula O.F. Müller		3												
Pleurotrocha petromyzon Ehrb.									3					
Polyarthra dolichoptera Idelson						6				2				2
Proales theodora Gosse										2			1,5	
Proales theodora calcarata Wulfert														2
Rotaria sp.	20	15	40	16	18	8	72	60	9	24		36	1,5	2
Synchaeta oblonga Ehrb.		3								2				
Testudinella patina Hermann												12		
Trichocerca brachyura Gosse						2								
Trichocerca insignis Herrick						2								
Trichocerca sp.						4					6			
Wolga spinifera Western												24		
Total Rotatoria	**56**	**48**	**45**	**40**	**30**	**68**	**336**	**92**	**27**	**52**	**90**	**618**	**15**	**18**
CLADOCERA														
Bosmina longirostris O.F. Müller						2								
Total Cladocera	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
COPEPODA														
Bryocamptus sp.					6		8				6			
nauplius						18	8	12		20		6		
copepodit												6		
Total Copepoda	**0**	**0**	**0**	**0**	**6**	**18**	**16**	**12**	**0**	**20**	**6**	**12**	**0**	**0**

Table 1. continue

The Oligochaete and the Chironomid fauna of the Upper Tisa Region and its tributaries

András Szító

Introduction

River Tisa and its tributaries serve as a possibility for organisms living in water to migrate as in a corridor. The drifting of different animals is well known, which is a passive way of travelling. Fishes often swim against the stream.

Scientific data showed that other animals, too, were able to migrate against water stream. Invertebrates, such the snail species of *Theodoxus fluviatilis* (Soós, 1965), a fresh water mussel (*Dreisena polimorpha*: Mollusca, Bivalvia) or a worm species (*Hypania invalida*: Annelida, Polychaeta) showed the praxis of this form of migration in recent years. *Hypania invalida* was first detected in 1969 near Szeged (Ferencz, 1969), and its specimens have become common in River Tisa near Tokaj by present time (Szító, 1996).

Different river sections serve as refuges for the species. Following an ecological injury, a species-poor river section will be recolonised by their active and passive migration.

There have been no literature sources about the oligochaete and chironomid fauna of the Upper Tisa Region (Pop, 1943, 1950; Albu, 1966), therefore our present data collection will the basis, showing the current situation.

The main goals were as follows: to make a data collection which shows the present situation of the species, identifies them, and presents the species-richness of different parts of the river system; to find the character species on different river courses, and to try to qualify the river profiles by indicating the presence or absence of indicator species in the river courses. This work is part of the data collection and evaluation analysing the state of ecological health in River Tisa and its tributaries, and serves as a standard for the assessment of ecological changes in the future (Szító, 1995).

Keywords: *Oligochaeta*, *Chironomidae*, Upper Tisa

Materials and Methods

Sediment samples were taken from the source area of the rivers Bila and Chorna Tisa, and from their mouth to the Hungarian reach down to Tiszaszalka in 17 cross sections (Figure 1.).

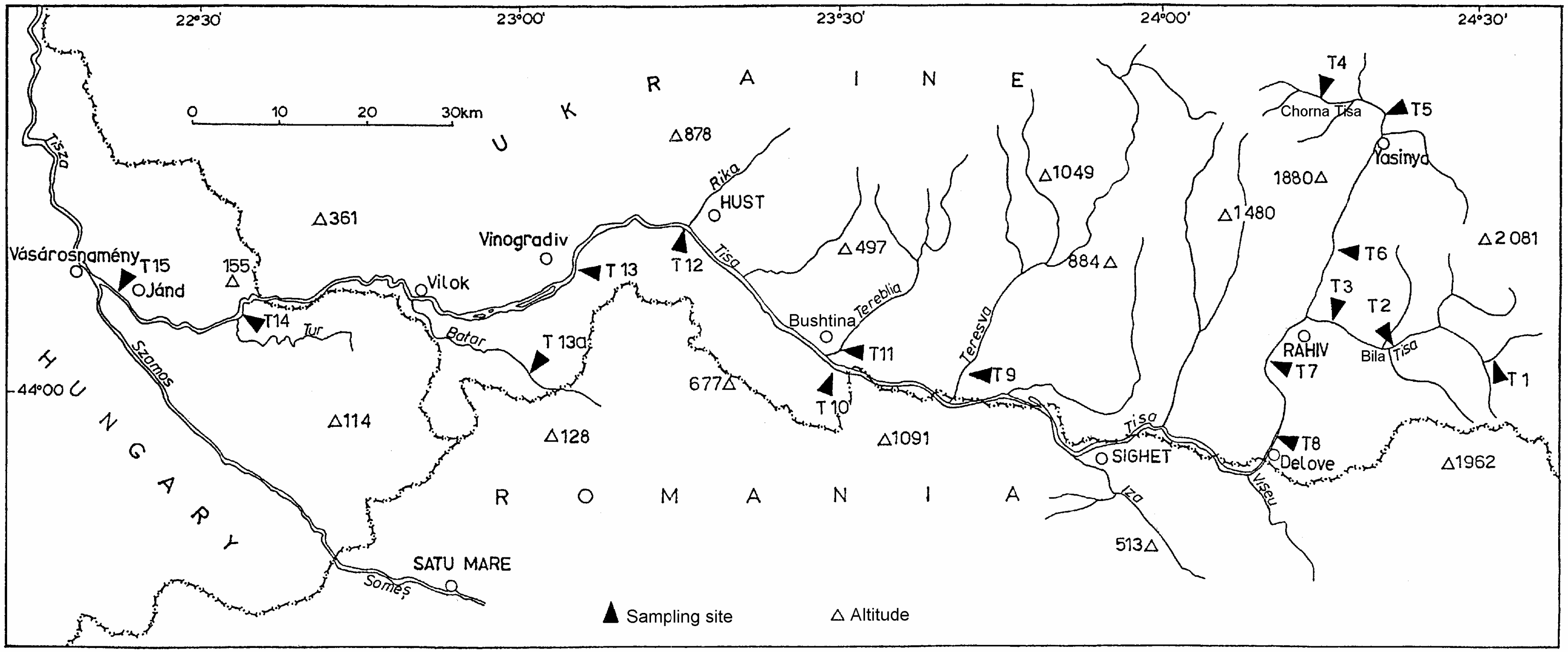

Figure 1. Sampling places

Sampling sites	Bila Tisa						Chorna Tisa						Tisa																									
	Head-waters	Breboya			junction		Head-waters		Control station		Yasinya		Rahiv		Dilove			Teresva		Tereblia		Bustina			Viskove		Hust		Vinogradiv			Trosnik			V. namény		Tisza-szalka	
Species: Oligochaetae	near the bank	near the bank	gravels	stagnant water	near the bank	biotecton	near the bank	biotecton	sandy sediment	biotecton	near the bank	biotecton	near the bank	biotecton	near the bank	stagnant water	filamentous algae	near the bank	biotecton	near the bank	biotecton	near the bank	sandy sediment	biotecton	near the bank	biotecton	near the bank	biotecton	near the bank	biotecton (slow current)	biotecton (rapid water)	near the bank	biotecton	Interst. water	near the bank	main current	near the bank	Frequency (%)
Aulodrilus limnobius																												67	37									5
Eiseniella tetraedra	100						100						33				100																					11
Limnodrilus hoffmeisteri															35													33	32			100					58	14
Limnodrilus udekemianus																																					8	3
Ophidonais serpentina																														100								3
Paranais litoralis																											25											3
Peloscolex ferox																										100												3
Potamothrix vejdovskyi																100																						3
Pristina longiseta														100																								3
Tubifex ignotus											63		33		13														32								17	14
Tubifex nevaensis											38		33		52												75										17	14
Total ind. (%)	100	0	0	0	0	0	100	0	0	0	100	0	100	100	100	100	100	0	0	0	0	0	0	0	0	100	100	100	100	100	0	100	0	0	0	0	100	
Chironomidae																																						
Ablabesmyia monilis														6																		4	38				63	11
Acricotopus lucens	25	25	33			11						50	15	19				13													4							24
Anatopynia plumipes																													16									3
Arctopelopia sp.																												40			7							5
Chironomus riparius																7							14		3	25			63					44				16
Chironomus thummi																																27						3
Cladotanytarsus mancus																															4		13					5
Cricotopus algarum													8	63				22			7			21				20			4		50					22
Cricotopus bicinctus														13																								3
Cryptochironomus defectus																						33															25	5
Cryptochironomus redekei																7																						3
Cryptotendipes anomalus																																8						3
Eukiefferiella bavarica																								50														3
Eukiefferiella longicalcar																				50																		3
Eukiefferiella quadridentata	25				25	43		100		67																		20			18							19
Harnischia albimanus					25																										4							5
Heleniella thienemanni						1																																3

Table 1. The percentage rate of oligochete and chironomid species in the source area and in the upper section of River Tisa

Sampling sites	Bila Tisa						Chorna Tisa						Tisa																									
	Head-waters	Breboya			Junction		Head-waters		Control station		Yaszinya		Rahiv		Dilove		Teresva			Tereblia		Bustina			Viskove		Hust		Vinogradiv			Trosnik			V. namény		Tisza-szalka	
Species: Chironomids	near the bank	near the bank	gravels	stagnant water	near the bank	biotecton	near the bank	biotecton	sandy sediment	biotecton	near the bank	biotecton	near the bank	biotecton	near the bank	stagnant water	filamentous algae	near the bank	biotecton	near the bank	biotecton	near the bank	sandy sediment	biotecton	near the bank	biotecton	near the bank	biotecton	near the bank	biotecton (slow current)	biotecton (rapid water)	near the bank	biotecton	Interst. water	near the bank	main current	near the bank	Frequency (%)
Krenopelopia binotata									10			8																			4							8
Macropelopia nebulosa									50						60	21					7																	11
Macropelopia notata											25																							11				5
Microcricotopus bicolor		50																																				3
Micropsectra praecox												8																										3
Microtendipes chloris												8				4																		11				8
Nanocladius bicolor						1	2																															5
Odontomesa fulva																									3													3
Orthocladius saxicola	38		33			29				33			4					13		50	7								2		29							27
Orthocladius thienemanni			33										4																									5
Paracladopelma camptolabis											25		4			4													2	10								14
Paralauterborniella nigrohalteralis																																8						3
Paratanytarsus lauterborni																					13					25		20										8
Pentapedilum sordens		25			25												100	7			47			29		50					11							22
Polypedilum convictum													4																									3
Polypedilum scalaenum		25											15			7						50	86		90				2			50		11				24
Procladius choreus																11													5					11				8
Prodiamesa olivacea	13				25				40		50		4		40	29																						19
Psectrocladius barbimanus												8																										3
Psectrocladius dilatatus						16												11													4						13	11
Psectrocladius psilopterus												8						2													7							8
Rheocricotopus effusus																					13																	3
Rheocricotopus gouini							98																															3
Smittia terrestris													8					2			7										4							11
Tanypus punctipennis													31			11						17			3				11	20		4						19
Tanytarsus curticornis																		20																11				5
Tanytarsus gregarius												8	4					2																				8
Tanytarsus lobatifrons																		9																				3
Thienemannimyia lentiginosa																														70	4							5
Total ind. (%)	100	100	100	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	0	100	100	100	100	100	100	100	0	100	100	100	100	100	100	100	0	0	100	
Species number	4	4	3		4	5	3	1	4	1	6	6	13	3	9	8	2	10	0	2	7	3	3	3	4	4	2	6	10	4	13	7	3	6			7	

Table 1. continue

Qualitative samples were taken from the surface of stone and gravel pieces by washing them off into a drifting net in each profile. Sampling sites were at various distances from the left and the right banks, and in the main current as well when it was possible.

Each sample was washed through a metal screen with a mesh pore size of 250 µm and was preserved in 3-4 % formol solution. The retained material was separated in the laboratorium into groups of oligochaetes, chironomids and 'other' using a Zeiss stereo microscope with 4 to 6 times magnification. The animals were preserved in 80 % ethylic alcohol.

For taxonomic identification the following works were used: Bíró, 1981; Brinkhurst and Jamieson, 1971; Cranston et al. 1983; Ferencz, 1979, Fittkau, 1962; Fittkau et al. 1983; Pinder et al. 1983; Pop, 1943, 1950.

Results

The qualitative rate of oligochaetes and chironomid species at different sampling places is presented in Table 1.

During the expedition, 11 species of oligochaetes and 46 species of chironomids were found in the examined river sections.

Species richness was low both in Bila and in Chorna Tisa. The very same oligochaete species, *Eiseniellla tetraedra* was the only one present in these rivers. The big boulders, the gravel and the rapid water current were inappropriate for other oligochaete species to live here.

Oligochaete specimens were often present in samples collected near the river bank. The number of the species changed between 0-3, with 4 species being the maximum (at only one sampling place: by Tiszaszalka). Some specimens of oligochaetes were found below the mouths of rivers Bila Tisa and Chorna Tisa. These species, except for *Limnodrilus hoffmeisteri*, were characteristic for clean streams (Table 1).

Only 11 chironomid species were found in Bila Tisa and 15 species were present in Chorna Tisa. The species richness changed between 3-5 in samples from Bila Tisa and between 1-6 in Chorna Tisa. The common species were as follows:

Specimens of *Prodiamesa olivacea* were found in the sediment only, while the rest of the listed species were present both in the sediment and in the biotecton (Table 1). Species found commonly in both rivers showed that the environment and the ecosystem were similar in the rivers Bila and Chorna Tisa. The presence of *Prodiamesa olivacea* indicated a low pollution level and clean water here.

13 chironomid species were found below the mouths of rivers Bila and Chorna Tisa. 10 species were present in the Teresva tributary. They were found in the biotecton only. No chironomid species were found in the sediment consisting of gravels. In the Tereblia estuary 8 chironomid species were determined from the sediment and 7 species from the biotecton.

The species richness of chironomids changed between 2-6 in the river section Bustina - Viskove - Hust, 10-13 species were present at Vinogradiv, and their number decreased to 3-7 species by Troznik (Table 1.).

32 % of the chironomid species were characteristic for living in the sediment. They were as follows: *Chironomus riparius, Chironomus thummi, Cladotanytarsus mancus, Cryptochironomus defectus, Cryptochironomus redekei, Harnischia albimanus, Krenopelopia binotata, Macropelopia sp.*, *Paracladopelma camptolabis, Paralauterborniella nigrohalteralis, Pentapedilum sordens, Procladius choreus, Tanypus punctipennis* and *Tanytarsus curticornis*.

The remainder 68 % of chironomid species were characteristic for the biotecton: algae growing on the surface of boulders and gravel served for them as food as well as a living environment.

Summary

A very important data collection was made during the international expedition, to cover up the oligochaete and chironomid fauna on the Upper Tisa Region and the tributaries of River Tisa. The information presented here serves as basic ecological information, because there had been no similar data and information from this area previously.

The river beds were covered by boulders and gravel, sediment was found only rarerly and it was not characteristic for this region. This was the reason why the macrozoobenthos was poor in species as well as in individuals. Its species- and specimen richness was bigger than those of the benthos.

Pollutants could not concentrate because of the lack of sediment, but these materials were transported downstream and were diluted. Anthropogenic pollution effects were not detected during the expedition, although the chironomid species *Prodiamesa olivacea* was not present in River Tisa below Delove. The absence of this species showed as an indicator that some kind of pollution effect may exist in this river region periodically.

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A study of aquatic molluscs in the Upper Tisa

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Introduction

In scientific literature we cannot find concrete reference to the distribution of molluscs in the Upper section of River Tisa. There are only general references to the fauna of molluscs in this area (Soós l943, Jadin 1952, Grossu 1962, 1986, 1987).

The fauna of aquatic molluscs has many species that can serve as indicators. By studying them we can assess the quality of waters and the degree of alteration caused by human interference.

Keywords: aquatic molluscs, Upper Tisa

Material and Methods

The research was done on the Upper Tisa from its two sources (rivers Bila Tisa and Chorna Tisa) in the territory of Carpathian Ukraine down to the confluence with River Szamos in Hungary (Figure l.). The research was carried out between 1-22 August 1995 within a single expedition.

Due to its tributaries, River Tisa is exposed to a series of influences. Therefore we also examined the molluscs in the rivers Teresva, Terebja and Batar.

The biological samples were collected at 16 testing sites.

Results and Discussion

The 16 testing sites and the occurrence of the 12 mollusc species are presented in Table 1.

The reduced diversity of the species populating this part of the river is obvious at first sight. The causes of this phenomenon are first of all the steep slopes of the riverbed. The high speed of the stream results in strong erosion. For the same reason large quantities of boulders are carried by the river. From the sources of the river down to site 13 (even down to the Hungarian border) the riverbed consists of large-sized boulders, which become more and more rounded going downstream.

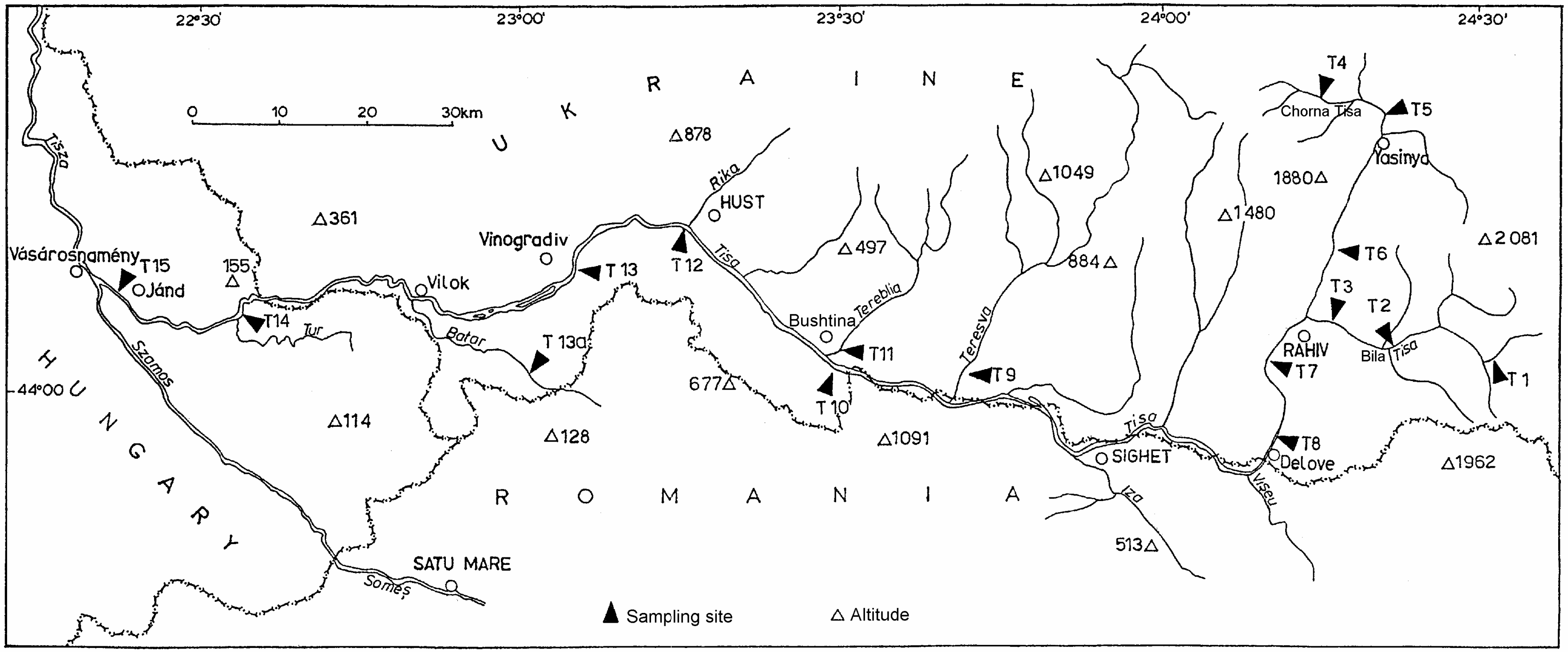

Figure 1. Sampling places

Species	Sites															
	1	2	3	4	5	6	7	8	9	10	11	12	13	13/a	14	15
Theodoxus fluviatilis L. 1758	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Lithoglyphus naticoides C.Pfeiff.1828	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+
Radix peregra (O.F.Müll. 1774)	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-
Radix auricularia (L. 1758)	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Stagnicola palustris (O.F.Müll.1774)	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Galba truncatula (O.F.Müll.1774)	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-
Ancylus fluviatilis O.F.Müll.1774	-	+	+	-	+	+	+	+	-	+	-	+	-	-	-	-
Unio crassus Phips. 1788	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+
Unio pictorum L. 1758	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+
Unio tumidus Phips. 1788	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Anodonta cygnaea L. 1758	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+
Pseudanodonta complanata Rossm.1835	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+

Table 1. Distribution of mollusc species along the Upper Tisa

The very high floods (when the variation of water level is 2-3 m) carry these boulders and deposit them over extensive areas, forming in the lower zone many islands and branches. Even *Ancylus fluviatilis*, an exclusively rheophilic species, has a low abundance (0,1-15 ind/m^2), since many individuals are destroyed by rolling pieces of rough sediment.

Most species of aquatic molluscs, especially bivalves, live in zones of slow flow, with sandy or muddy stable sediments. Thus, the bed of River Tisa does not provide favourable conditions for this fauna at sites 1-8, 10, 12 and 13, though water quality is good in this reach.

Conditions at sites 9 and 11 on the tributaries Terebia and Teresva are similar, but there are also habitats with stagnant water. The following species can be found in these habitats: *Radix peregra*, *R .auricularia, Stagnicola palustris* and *Galba truncatula.* The rich algal periphyton is favourable for the appearance of the above-mentioned species. We assume that this periphiton has developed as a result of eutrophication in these tributaries. Local inhabitants use large quantities of artificial fertilizers on the mountain pastures.

At station 14 on the Batar tributary we can find a fauna abounding in bivalves: *Anodonta cygnaea, Pseudanodonta complanata, Unio crassus* and *U. pictorum*. This tributary has slow flow and fine sediments. At the same place we could assess a 20% mortality of individuals, caused by the sewage of the neighbouring settlements.

At sites 14 and 15 the flow of the stream is slower, fine and stable sediments occupy a bigger surface, and the fauna is richer. We could find *Lithoglyphus naticoides* and *Unio crassus* at station 14 and *Theodoxus fluviatilis, Unio pictorum, U. tumidus, Anodonta cygnaea* and *Pseudanodonta complanata* at station 15.

Conclusions and Recommendations

1. There is only one species of Gastropoda (Ancylus fluviatilis) present in the mountain region of the Upper Tisa. Its occurrence here reflects the exceptional quality of the water.

2. The great amount of mineral nutrients in the tributaries Terebja and Teresva, and the presence of organic matter in the fine sediments of River Tisa downstream from Rahiv, are consequences of human interference.

3. The presence of Theodoxus fluviatilis in the Hungarian reach indicates good water quality.

4. The reduced relative diversity of the mollusc fauna does not have to be considered an alarm for this aquatic system. The Upper Tisa is a typical mountain river. At times of spring and autumn floods (3-4 m variation in water level) huge quantities of boulders are rolled.

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Some considerations about the rheophilic elements of the benthic fauna (ord. Ephemeroptera, Plecoptera and Trichoptera) of the Upper Tisa Region

Nicolae Găldean

Introduction

Many present-day rivers in the temperate zone flow directly within coarse-grained gravel masses that have been inherited from deglaciation out-wash and valley fill deposits (Gregory and Maizels, 1991). The Upper Tisa is one of such rivers. From the confluence of Bila Tisa with Chorna Tisa and up to the mouth of River Someş, River Tisa can be divided into two main sections:

a) the section from Rahiv to Troznik (in Ukrainian territory), characterised by stony bottom (with boulders, gravel, cobbles and pebbles).

b) the section from Jánd to Vásárosnamény, and a little further (in the Hungarian territory) characterised by sandy bottom (except for the left bank where there are some locations with stony substratum consisting of boulders).

Keywords: Ephemeroptera, Plecoptera and Trichoptera, Upper Tisa Region

Sampling sites

a) River Bila Tisa (#1, #3, #4, #8, #9)

#1 near Luhi village, 100 m from the confluence with Bila Rivulet. The substratum consists of boulders (in the central part of the stream) and gravel. The stony surfaces are covered with silt (very thin layer).

#3 5 km upstream from #1; many waterfalls, boulders with a thick layer of algae.

#4 downstream from the main sources, typical mountain stream.

#8 near Breboja village; boulders and cobbles on a sandy bed, covered with algae (bioderma).

#9 near Rostoki village, the same aspect like for #8; much waste (of domestic origin) in the water.

b) River Chorna Tisa (#5, #6, #7)

#5 2 km downstream from the main sources; boulders and cobbles.

#6 upstream from the reservation; cobbles and pebbles.

#7 near Svidovec village, cobbles and pebbles.

c) River Tisa (#10, #11, #12, #14, #16, #17, #18, #19, #20, #21, #22).

#10 near Rahiv; at the left bank, high velocity of the current; boulders, pebbles on a sandy bed; a thick layer of bioderma and silt on the stony surfaces.

#11 upstream from Dilove village; boulders, gravel, remarkable velocity of the current.

#12 near Bustina, upstream from the confluence with Tereblia; #12 A: boulders, high velocity of water current; #12 B: a slow-moving zone but also with boulders.

#14 downstream from Bustina, the same biotope like for #12.

#16 near Vinogradiv; a braided stream, pebbles, gravels, boulders near the right bank.

#17 near Hust, braided stream, a lot of gravel beaches, heterogenity of habitats (waterfalls, benthic zones, shoals, boulders with moss clumps).

#18 near Troznik (the last sampling point in Ukrainian territory), gravel and sand.

#19 near the Hungarian border where the river flows between narrow dykes; sand, coarse sand, muddy deposits at the right bank and boulders on the left one.

#10, #21, #22 near Tivadar, the same aspect.

d) The main tributaries (#2, #13, #15).

#2 Bila Rivulet, upstream from the confluence with Bila Tisa, boulders and pebbles.

#13 Tereblia near Bustina; gravel with Spyrogira, small waterfalls, pebbles.

#15 Teresva, 5 km upstream from the confluence with River Tisa; lentic zones with much algae on the gravel and small waterfalls with boulders.

In general, the conditions for the benthic fauna are very good:

- large stony surfaces accesible for larval populations
- an optimal velocity of the current, determined by the irregular bottom surface
- large amounts of bioderma representing the main food for many rheophilic species
- large fish populations controlling invertebrate populations.

We can assume that River Tisa has a relatively moderate load of suspended sediment. This situation determines, at least in the upper section of the river, the diversity of the benthic habitats. Despite such conditions, the considerable quantities of organic matter in the form of bioderma may be understood as a result of the dissolved organic matter and suspended particles containing nitrogen and phosphorus. Thus, the present conditions are favourable for the benthic fauna.

The natural geological conditions (coarse sedimentary particles such as boulders and gravel) are supplemented by the favourable quality of the water. The type of substratum, consisting of cobbles (boulders and gravel) and pebbles hold a wider range of taxa than silt or clay which, in turn, host more taxa than sand (Găldean,1994). Factors such as structural stability and complexity, available food resources and continuity over time are likely to be relevant in influencing the colonisation of these habitats by macro-invertebrates.

The main types of benthic associations identified in River Tisa

1. The moss clump association of stenotopic species (#4):
    Baetis gr. alpinus
    Rhithrogena hercynia
    Rhithrogena semicolorata
    Perla pallida
    Perlodes intricata
    Hydatophylax sp.
    Glossosomatidae
2. Stony surface with very “clean” bioderma (#3, #6):
    Baetis scambus
    Baetis lutheri
    Rhithrogena semicolorata
    Ecdyonurus submontanus
    Brachycentrus subnubilus
    Perla pallida
3. Gravel with moss clumps and a very fine layer of silt (#17):
    Epeorus sylvicola
    Rhithrogena semicolorata
    Ecdyonurus aurantiacus
    Centroptilum luteolum
    Heptagenia coerulans
    Caenis rivulorum
    Ephemerella ignita
    Hydropsyche sp.
4. “*Palingenia*” type (#19, #20, #21):
    Palingenia longicauda
    Centroptilum luteolum
    Caenis horaria
    Heptagenia flava
    Electrogena lateralis

From quantitative analyses it can be seen that at all of the sampling points it was ephemeropterans that showed the greatest numeric value in relation to the zoobenthos community.

Among the most abundant Ephemeroptera species in River Tisa are included *Oligoneuriella rhenana, Baetis scambus, Centroptilum luteolum, Ecdyonurus insignis, Heptagenia sulphurea, Choroterpes picteti, Ephemerella ignita, Caenis macrura, Caenis luctuosa*.

Ephemeropterans (see Table 1.) are very conservative in their choice of new biotopes; a wide range of species are of relic character and the relatively narrow ecological range of most species guarantees considerable sensitivity to changes in the quality of water.

Oligoneuriella rhenana is considered to be stenotopic and specialized, unable to tolerate changes in its biotope. Its presence in the sampling stations 10-20 (River Tisa) and also in rivers Chorna Tisa and Bila Tisa has great significance: the actual conditions of the biotope there are very good. On the other hand, the presence of *Ephemerella ignita* at the same sampling station demonstrates the tendency of the water to become more eutrophic. The proportion of *Ephemerella ignita* is about 20-30%.

The total proportion of resistant species (*Baetis vernus, Baetis rhodani and Ephemerella ignita*) does not exceed 10%.

The species of the genera *Heptagenia* and *Electrogena*, most of which require more oxygen, have a good representation in the sampling areas. The regular discharge of the affluents and, as a consequence, the regular flood of River Tisa (except for the spring period) provide an optimal oxygen level and control the decomposition processes. For mayfly larvae (especially for torrentile ones) the reduction of the speed of the stream and covering the bottom with mud are very dangeours phenomena. Under such conditions (which must be avoided for River Tisa), even the resistant species like Ephemerella ignita can be affected.

Vannote et al. (1980) developed the River Continuum Concept according to which, correspondingly to the particle size (mainly of organic matter), available light and water quality, different proportions of the functional groups are present. Besides, each species adapted to certain conditions is replaced by another one along the continuum. In the case of the Upper Tisa Region it is very interesting to observe a prior replacement within the family Baetidae (Ephemeroptera), and in the Trichoptera group. Namely, *Baetis alpinus* and *Baetis melanonyx* are replaced by *Baetis scambus*; species of the family Rhyacophylidae are replaced by species of the families Limnephilidae and Hydropsychidae (Trichoptera).

Baetis alpinus, *Baetis melanonyx* and *Baetis sinaicus* are the most rheophilic species within the genus *Baetis*. They are also the most stenoic of all baetids, but they display the reduced degree of specialization of the group. These species are very characteristic for stony substrata without moss or siltic deposits (#3).

Other *Baetis* species (i.e. *B. scambus, B. niger, B. vernus*) prefer silty sediments and they are characteristic for the surface of the moss (#10, 11).

All the species of the family Siphlonuridae are absent: they find no fine debris deposits which can accumulate on sandy bottoms (Găldean, 1994). This type of deposit is missing, too.

According to Janeva (1979), *Baetis scambus* is tipical for beta-mesosaprobic running waters. Its presence in River Tisa in many sampling areas prove the good quality of waters, normal for the altitude of 300-400 m. For *Centroptilum luteolum* I consider the situation to be the same.

Oligoneuriella rhenana and *Ephemerella ignita* have one generation annually. After oviposition in the autumn, eggs remain in diapause until spring next year or even during the summer. Older larvae develop very quickly during 2-3 mouths in the summer (Landa, 1968).

Taking into account the fact that Oligoneuriella rhenana and *Ephemerella ignita* are present from sampling point #7 to #19 (or even #20), and from #1 to #17 respectively, it is possible to conclude that they have the most adequate strategy for the conditions of the biotopes of River Tisa.

The high flood of the waters in the spring results in the strong transformation of the stony substratum (boulders, cobbles, gravel).

The Plecoptera group exhibits a special situation: only 3-4 species are present, which are more abundant on stony substrata and moss on the large stones. The preference of moss clumps in *Protonemura* and *Leuctra* larvae (bryorheal - Wulfhorst, 1994) is not only indicative of the oxygen content but also refers to the carrying capacity of this type of "substratum". Under the specific conditions of River Tisa, the organic load on moss clumps is moderate.

As a conclusion, I emphasize that there are two main types of trophic substratum for reophilic larvae of the groups Plecoptera, Ephemeroptera and Trichoptera:

a) stony bottom
b) moss clumps

Both of them have rich food sources (bacteria, algae, fine detritus, fine-particle organic matter) and seem to have been very stable up to now.

A real ecotonal zone (sensu Gopal, 1994) is missing: the deposit of branches and leaf which are important trophic and shelter substrata for amphipods (Gammaridae) are destroyed by the high flood of the waters in the springtime.

From the analysis of the rheophilic groups identified in the sampling areas (#1 - #21), the difficulty of an accurate biological division of the investigated zone of River Tisa is evident.

Nevertheless, the following important findings must be noted:

1. The remarkable percentage of Plecoptera in samples #10 (Rahiv) - #18 (Troznik).
2. The constant presence of *Oligoneuriella rhenana*.
3. The remarkable percentage (25%-42%) of Ecdyonurus species at sampling points #16, #17 and #18.
4. The dominance of *Centroptilum luteolum* (60% for sampling point #20) and *Heptagenia* species (over 85% for the stony substratum at sampling point #21).
5. The low numeric level of *Hydropsyche* populations.
6. The difference between the main tributaries Tereblia and Teresva: Tereblia seems to be a little eutrophic (*Hydropsyche* larvae represent 25% and *Caenis* larvae 22%), while Teresva is dominated by Protonemura (68%) and Oligoneuriella (17%).
7. The high level of the *Caenis* populations from Chorna Gora (#16) may be explained with local conditions: sites with reduced velocity of the current, and large pebble bars (it is a braided section). The layer of moss and detritus on the cobbles is thick but grazing invertebrates consume this trophic resource.

In my opinion, the Upper Tisa, as an ecosystem, has a high level of biodiversity but it is also characterised by a considerable uniformity of biotopes and benthic communities. This fact implies the vulnerability of the system in case the general conditions change. The lotic system of River Tisa is not "trained" to react to negative phenomena like pollution or the effects of hydrochemical improvements.

There are two main dependence categories for River Tisa:

a) the regular flow of the affluence
b) the survival of the natural dynamics of the alluvial sediments (i.e. boulders, gravel, cobbles, pebbles) and the absence of muddy and detritus deposits.

It can be asserted that River Tisa lies in a “wild” state determined by the absence of the negative anthropogenic influences. Nevertheless, it is necessary to re-emphasize its vulnerability.

Deforestation may become perhaps the most important cause of river degradation. The main consequence of deforestation is the siltation of river headwaters. Other effects can include reduction of precipitation, changes in flow regime and the undermining of river banks.

Some criteria considering River Tisa as a representative (maybe unique) wetland (from the faunistic point of view)

1. Comparing the benthic associations of River Tisa with other ones found in rivers belonging to the Tisa catchment area (which are very similar in riverbed morphology, hydrological conditions, trophic resources for the fauna), the faunistic richness of River Tisa is remarkable.
2. River Tisa represents the most important reserve of species in the entire catchment area. The studies having done on rivers Someş, Mureş, Iza, and Criş confirm this assessment.
3. The lotic ecosystem of River Tisa has a theoretical value as well: it represents a natural pattern of the ecological structure of a non-disturbed European river.

The braided sectors of the River Tisa (#12, #14 and especially #17) have the most remarkable biodiversity. Braided channels are marked by the succesive branchings and rejoinings of the flow around alluvial islets and shoals. The main channel is divided into several channels which meet and redivide (type described by Reineck and Singh, 1980). This fact creates a multitude of habitats characterised by different velocities of the current, differently grained deposits (coarse or fine) and varying quantities and qualities of bacterial and algal bioderma.

For Oligoneuriella rhenana populations, the most favourable habitats are cobble-sized gravel beds.

Pebbles are most favourable for species of the Baetidae family and for ones belonging to Ephemerellidae.

It is very important to preserve this type of sediment and to avoid the utilisation (exploitation) of gravel and pebbles for different purposes of building.

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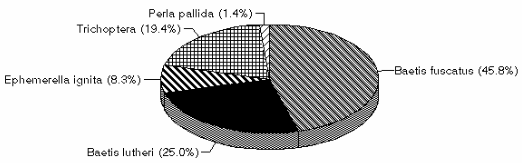
#1 BILA TISA



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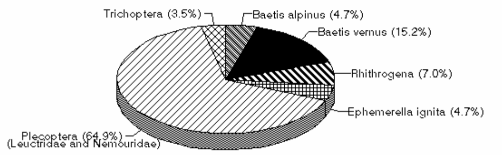

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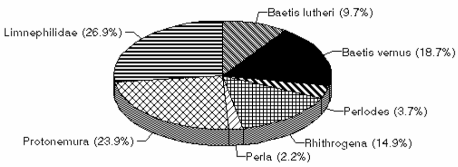

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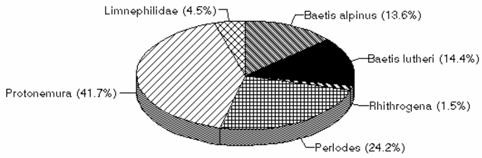

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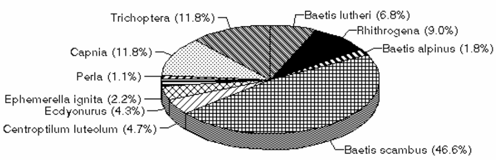

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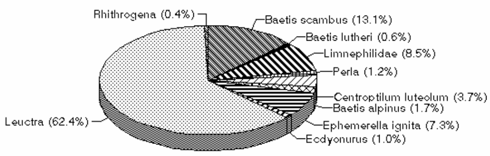

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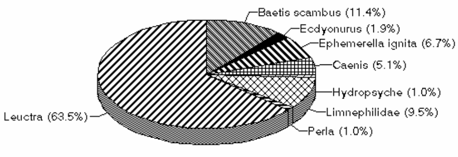

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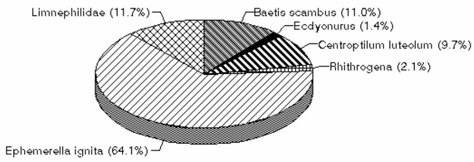

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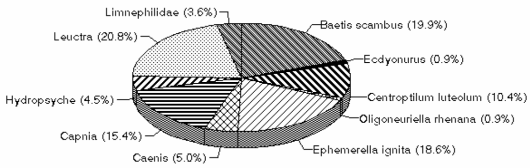
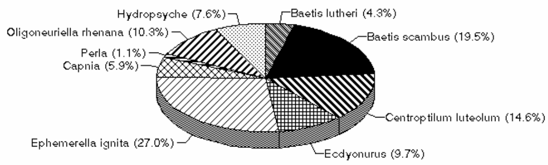


#10 TISA at RAHIV



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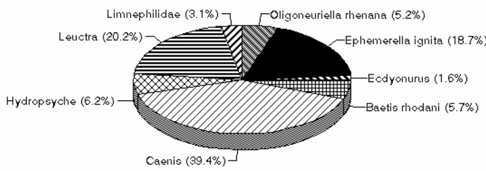

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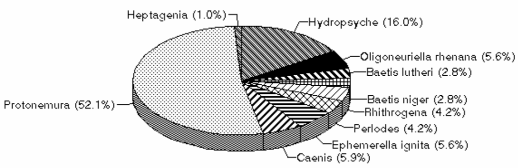
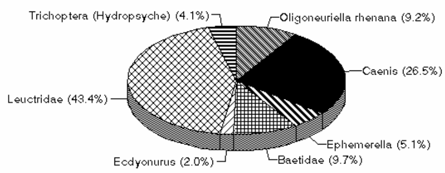


#12B TISA at BUSTINA



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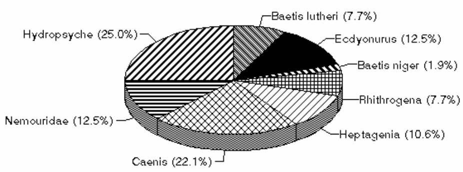

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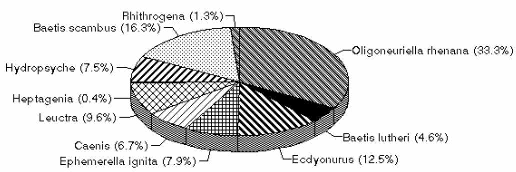

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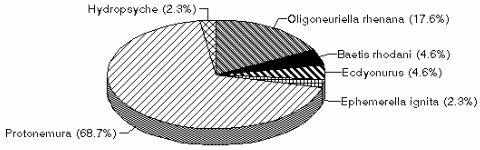
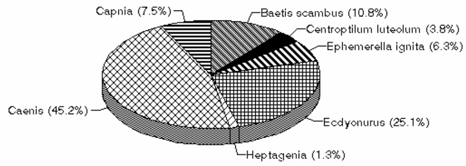


#16 TISA at CHORNA GORA



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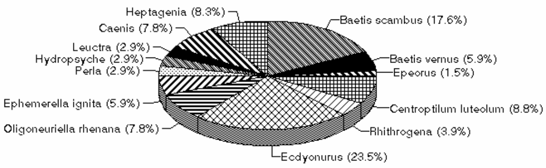

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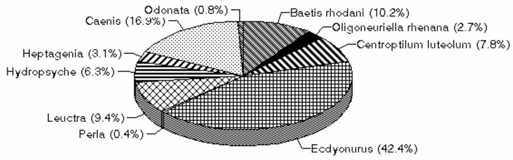

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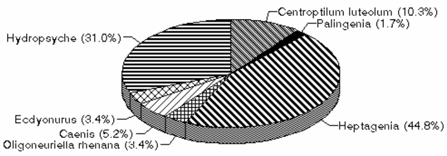

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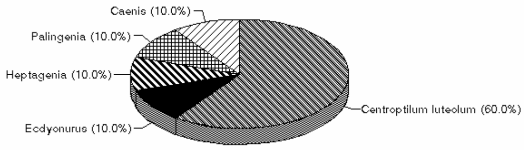

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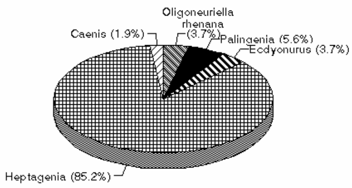

Table 1. Distribution of the mayflies along the Upper Tisa from headwaters to Tivadar village

SAMPLING POINTS EPHEMENOPTERA Fam. Baetidae	1	2	3	4	5	6	7	8	9	10	11	12a	12b	13	14	15	16	17	18	19	20	21	22
1.Baetis alpinus Pictet, 1843-45		x	x	x	x	x																	
2.Baetis melanonyx Pictet, 1843-45				x				x				x	x										
3.Baetis lutheri Müller-Liebemau, 1967	x		x	x	x	x						x	x	x	x								
4.Baetis sinaicus (Bogoescu, 1931)	x																						
5.Baetis rhodani Pictet, 1843-45									x		x						x		x		x		
6.Baetis gemellus Eaton, 1885																							
7.Baetis vernus Curtis, 1834		x	x															x					
8.Baetis fuscatus Linné, 1761	x			x	x					x					x					x			
9.Baetis scambus Eaton, 1870					x	x	x	x	x	x					x		x	x					
10.Baetis buceratus Eaton, 1870																			x				
11.Baetis tricolor Tshernova, 1928																						x	
12.Baetis niger Linné, 1761												x		x			x						
13.Baetis gracilis Bogoescu & Tabacaru, 1957												x											
14.Baetis muticus Linné, 1758																				x			
15.Centroptilum luteolum (Müller, 1776)					x	x	x	x	x						x		x	x	x	x	x		
16.Centroptilum pennulatum Eaton, 1870																	x						
17.Prolöeon bifidum (Bengtsson, 1912)																		x	x	x			
Fam. Oligoneuriidae																							
18.Oligoneuriella rhenana (Imhoff, 1852)						x			x	x	x	x	x	x	x	x	x	x	x	x			

Fam. Heptageniidae	1	2	3	4	5	6	7	8	9	10	11	12a	12b	13	14	15	16	17	18	19	20	21	22
19.Epeorus sylvicola (Pictet, 1865)																		x					
20.Rhithrogena hercynia Landa, 1969		x		x	x							x						x					
21.Rhithrogena loyolaea Navás, 1922		x	x																				
22.Rhithrogena semicolorata (Curtis, 1834)		x	x	x		x		x						x	x			x			x		
23.Ecdyonurus aurantiacus (Burmeister, 1839)															x			x	x			x	
24.Ecdyonurus austriacus Kimmins, 1958										x													
25.Ecdyonurus dispar (Curtis, 1834)					x					x					x		x			x			
26.Ecdyonurus insignis (Eaton, 1870)		x													x		x	x	x			x	
27.Ecdyonurus subalpinus Klapálek, 1907																		x					
28.Ecdyonurus submantanus Landa, 1969					x	x	x	x	x				x						x				
29.Ecdyonurus venosus (Fabricius, 1775)										x	x		x					x					
30.Electrogena lateralis (Curtis, 1834)																		x	x	x	x		
31.Heptagenia coerulans Rostock, 1877														x	x			x					
32.Heptagenia flava Rostok, 1877												x			x			x	x	x		x	
33.Heptagenia sulphurea (Müller, 1776)														x	x		x	x					x
Fam. Leptophlebiidae																							
34.Choroterpes picteti (Eaton, 1871)		x				x						x	x		x		x						
35.Leptophlebia marginata (Linné, 1767)																							
36.Paraleptophlebia submarginata (Stephens, 1835)					x																		
38.Habrophlebia fusca (Curtis, 1834)						x																	
37.Habroleptoides modesta (Hagen, 1864																							

Table 1. continue

Fam Potamanthidae	1	2	3	4	5	6	7	8	9	10	11	12a	12b	13	14	15	16	17	18	19	20	21	22
39. Potamanthus luteus (Linné, 1767)																			x				
Fam. Polymitarcidae																							
40. Ephoron virgo (Olivier, 1791)																				x			
Fam. Ephemeridae																							
41.Ephemera danica																			x			x	
Fam. Ephemerellidae																							
42. Ephemerella ignita (Poda, 1761)	x	x			x	x	x	x		x	x	x	x		x		x	x					
43. Ephemerella major (Klapálek, 1905)										x			x		x		x						
44. Ephemerella notata Eaton, 1887					x					x													
Fam. Caenidae																							
45. Caenis horaria (Linné, 1758)																		x	x			x	
46. Caenis luctuosa (Burmeister, 1839)									x	x	x	x			x		x		x	x	x		
47. Caenis macrura Stephens, 1835																							
48 Caenis rivulorum Eaton, 1884							x			x	x	x	x		x		x						
Fam. Palingeniidae													x	x				x	x				
49. Palingenia longicauda (Olivier, 1791)																				x	x	x	x

Table 1. continue

Caddisflies (Trichoptera) of the Hungarian section of River Tisa[1]

Sára Nógrádi & Ákos Uherkovich

Abstract

77 species occur along the river and its upper tributaries. Only 26 of them occur along the middle and lower sections of the river. The upper section and especially one of the tributaries (i.e. river Túr) had the most diverse caddisfly community. Both distribution data and the results of phenological examinations are presented. *Stactobiella risi* Felber lives only in the northeastern part of the Plain, in river Tisa and its water system.

Key words: caddisfly, Trichoptera, Hungary, River Tisa, phenology, communities, light trap

Introduction: a survey of earlier examinations

Our knowledge about the Hungarian Trichoptera fauna has developed considerably during the last two decades. We discovered the first Hungarian occurence of forty to fifty species at least, and studied many regions that had been totally unknown previously from the point of view of their caddisfly faunas. We already know well the caddisflies of the western and the southern parts of Hungary, and the Northern Mountains (mostly Bükk, Börzsöny and Mátra Mts. and Northern Borsod Karst). Several papers have been published about these regions. Many species were found in 100...200 sites in Hungary as we have presented (Nógrádi, Uherkovich 1995).

The caddisflies of the Great Hungarian Plain were known very poorly some years ago. The largest Hungarian collections had preserved hardly any material from this area, as it was published by Nógrádi (1989, 1995). Unquestionably, the fauna of the central part of the plain is not rich, but near the eastern and northeastern borders there are some microregions having more colourful vegetation and fauna. The middle-term examination (six years) along River Fekete-Körös yielded 57 species (Nógrádi, Uherkovich 1996), while 74 species were pointed out by our short but intensive study in Northeast Hungary, along River Tisa and its tributaries (Uherkovich, Nógrádi

[1] The Hungarian name of the river is Tisza

1998). Besides, Ujhelyi (1971) also mentioned some leptocerid caddisflies from the Tisa region.

Material and method

We collected 112 samples containing 1 to 32 species in 32 sites of the upper section of River Tisa and its tributaries, mostly river Túr, stream Batár and Gõgõ-Szenke, as it was published in our paper (Uherkovich, Nógrádi 1998). River Old Túr has a native bed and it has not been polluted yet until recent years. Close to the river a light trap functioned in 1994. During this time (from 11th June till 2nd November) the trap captured 15,914 adults of 66 species. Thus, this site proved to be one of the places with the most diverse caddisfly fauna in Hungary. Detailed results were published by us (above cited paper). Recently, about three years ago, a very heavy pollution arrived from the Romanian catchment area, but its influence on the caddisflies is still unknown.

We obtained and processed some samples originating from four sites from the middle and lower sections of the river too, and we also had some materials from further ones. Their detailed data were presented by Uherkovich and Nógrádi (1990).

The summary of the most important faunistical results is given in Table 1. In this table we do not present the results from River Körös; earlier they have been published in detail (Nógrádi, Uherkovich 1996).

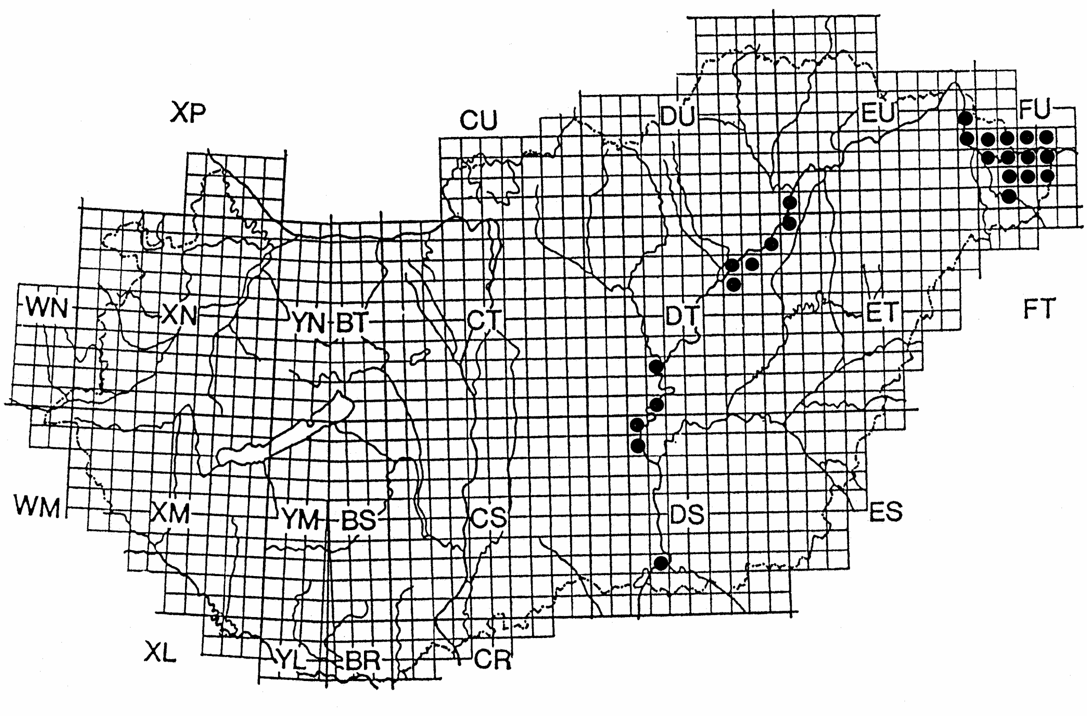

Figure 1. The collecting sites of caddisflies along River Tisa and tributaries of its upper Hungarian section, on the UTM map (10×10 km) of Hungary.

● = recent data; O = old data from literature.

Family/Species	Distribution 1	2	3
Glossosomatidae			
Agapetus laniger (Pictet, 1834)	●	●	.
Hydroptilidae			
Stactobiella risi (Felber, 1908)	●	●	.
Orthotrichia costalis (Curtis, 1834)	●	●	.
Orthotrichia tragetti Mosely, 1930	.	●	.
Oxyethira falcata Morton, 1893	.	●	.
Oxyethira flavicornis (Pictet, 1834)	.	●	.
Oxyethira tristella Klapálek, 1895	●	●	.
Hydroptila dampfi Ulmer, 1929	.	●	.
Hydroptila forcipata (Eaton, 1873)	●	●	.
Hydroptila lotensis Mosely, 1930	●	●	.
Hydroptila occulta (Eaton, 1873)	.	●	.
Hydroptila sparsa Curtis, 1834	.	●	.
Agraylea sexmaculata Curtis, 1834	.	●	●
Hydropsychidae			
Hydropsyche angustipennis Curtis, 1834	.	●	.
Hydropsyche bulbifera McLachlan, 1878	●	●	.
Hydropsyche bulgaromanorum Malicky, 1977	●	●	●
Hydropsyche contubernalis McLachlan, 1865	●	●	●
Hydropsyche modesta Navás, 1925	●	●	.
Hydropsyche ornatula McLachlan, 1878	●	●	.
Hydropsyche pellucidula (Curtis, 1834)	●	●	.
Cheumatopsyche lepida (Pictet, 1834)	●	.	.

Table 1. (A) Synopsis of the Trichoptera species occouring along the Hungarian section of River Tisa.

Glossary

Distribution areas: 1 = upper Tisa section, 2 = tributary of this section, 3 = middle and lower Tisa section;

Family/Species	Distribution 1	2	3
Polycentropodidae			
Neureclipsis bimaculata (Linnaeus, 1758)	●	●	●
Polycentropus irroratus Curtis, 1834	.	●	.
Holocentropus picicornis (Stephens, 1836)	●	●	.
Holocetropus stagnalis (Albarda, 1874)	.	.	●
Cyrnus crenaticornis (Kolenati, 1859)	●	●	●
Cyrnus trimaculatus (Curtis, 1834)	●	●	.
Psychomyidae			
Psychomyia pusilla (Fabricius, 1781)	●	●	.
Lype phaeopa (Stephens, 1836)	.	●	.
Ecnomidae			
Ecnomus tenellus (Rambur, 1842)	●	●	●
Phryganeidae			
Trichostegia minor (Curtis, 1834)	.	●	.
Agrypnia varia (Fabricius, 1793)	.	●	.
Phryganea bipunctata Retzius, 1783	.	●	●
Phryganea grandis Linnaeus, 1758	.	●	●
Brachycentridae			
Brachycentrus subnubilus Curtis, 1834	.	.	○
Limnephilidae			
Limnephilus affinis Curtis, 1834	●	●	●
Limnephilus auricula Curtis, 1834	●	●	○
Limnephilus binotatus Curtis, 1834	.	●	.
Limnephilus bipunctatus Curtis, 1834	●	●	○
Limnephilus decipiens (Kolenati, 1848)	.	●	●
Limnephilus flavicornis (Fabricius, 1787)	●	●	●
Limnephilus griseus (Linnaeus, 1758)	●	●	○
Limnephilus hirsutus (Pictet, 1834)	.	●	.
Limnephilus incisus Curtis, 1834	.	●	.
Limnephilus lunatus Curtis, 1834	●	●	.

Table 1. (B) Synopsis of the Trichoptera species occouring along the Hungarian section of River Tisa.

Glossary

Distribution areas: 1 = upper Tisa section, 2 = tributary of this section, 3 = middle and lower Tisa section;

Family/Species	Distribution 1	2	3
Limnephilus rhombicus Linnaeus, 1758	.	●	.
Limnephilus vittatus (Fabricius, 1798)	●	●	●
Grammotaulius nigropunctatus (Retzius, 1783)	●	●	●
Grammotaulius nitidus (Müller, 1764)	.	.	○
Glyphotaelius pellucidus (Retzius, 1783)	●	●	.
Anabolia furcata Brauer, 1857	.	●	.
Halesus tesselatus (Rambur, 1842)	.	●	.
Stenophylax meridiorientalis Malicky, 1980	.	●	.
Stenophylax permistus McLachlan, 1895	●	●	.
Micropterna testacea (Gmelin, 1798)	.	●	.
Goeridae			
Goera pilosa (Fabricius, 1775)	●	.	.
Leptoceridae			
Athripsodes albifrons (Linnaeus, 1758)	●	●	○
Athripsodes aterrimus (Stephens, 1836)	.	●	.
Athripsodes cinereus (Curtis, 1834)	●	●	.
Ceraclea alboguttata (Hagen, 1860)	●	●	.
Ceraclea annulicornis (Stephens, 1836)	●	.	.
Ceraclea aurea (Pictet, 1834)	●	●	.
Ceraclea dissimilis (Stephens, 1836)	●	●	.
Ceraclea fulva (Rambur, 1842)	.	●	.
Ceraclea riparia (Albarda, 1874)	●	●	.
Ceraclea senilis (Burmeister, 1839)	.	●	.
Mystacides azurea (Linnaeus, 1761)	.	●	.
Mystacides longicornis (Linnaeus, 1758)	●	●	●
Mystacides nigra (Linnaeus, 1758)	.	●	●
Triaenodes bicolor (Curtis, 1834)	●	●	.
Oecetis furva (Rambur, 1842)	●	●	●
Oecetis lacustris (Pictet, 1834)	.	●	●
Oecetis notata (Rambur, 1842)	●	●	.
Oecetis ochracea (Curtis, 1825)	●	●	●
Oecetis tripunctata (Fabricius, 1793)	●	●	.
Setodes punctatus (Fabricius, 1793)	●	●	.
Leptocerus tineiformis Curtis, 1834	●	●	●
77 species altogether	45	71	26

Table 1. (C) Synopsis of the Trichoptera species occouring along the Hungarian section of River Tisa.

Glossary

Distribution areas: 1 = upper Tisa section, 2 = tributary of this section, 3 = middle and lower Tisa section;

Discussion

1. Distribution of some species

Stactobiella risi was first reported along the upper Tisa section and tributaries (Nógrádi 1994). Its distribution nowadays spreads over only the Szatmár-Bereg Plain, although an old specimen had been found (though not published) from West Hungary (Figure 2b). It sometimes reaches high dominance in the trichopteran community of upper Tisa and can be frequent elsewhere in that region.

The first Hungarian *Oxyethira tristella* was also collected here (Nógrádi literature cited). It is pretty common place by place in the Szatmár-Bereg Plain. In the recent years it has already been found along the upper Danube region, in Szigetköz (unpublished data, Figure 2a).

Hydroptila dampfi was published first by Andrikovics and Ujhelyi (1983) in Lake Fertõ. Later we found this continental (East European) species in several sites in Hungary, both in the Great Hungarian Plain and in small stagnant waters of hilly regions (Figure 2f). Females were also recognized by Nógrádi (1986). Somewhere it is common, e. g. in lake Balaton and in some oxbow lakes of larger rivers.

Cheumatopsyche lepida belongs to the rare speices in Hungary. It occurs only in a few hilly regions and somewhere in the upper Hungarian section of larger rivers. It is most frequent in the upper Tisa region (Figure 2c), but we never collected it in high numbers.

Ceraclea aurea (Figure 2d) and *Oecetis tripunctata* (Figure 2e) also belong to the rare species currently. Both of them are members of communities of larger rivers. During the last years we collected them only along the upper section of River Tisa, and from many regions they have already completely disappeared by recent years. Ujhelyi (1971) presented some more localities.

Authentic *Phryganea bipunctata* adults had been known from the Great Hungarian Plain, from the Tisa region and from a few other sites (see Nógrádi 1989), later it was not caught for years. Recently it became a not very rare species of some water bodies of Szigetköz, and other collecting sites became known. Along River Túr a single adult was captured.

2. Phenology

The activity and phenology of European species are well known in general. The Hungarian (Central European) caddisflies have two main types in their phenology: with or without a summer diapause. *Limnephilus, Stenophylax, Microptera, Grammotaulius* and some phryganeid species have shorter or longer diapause as it is shown by our graphs (Figure 3.). At first sight it seems these species have two generations, for their periods of activity are in May-June and in October-November. The adults of most species have an unbroken - but sometimes varying - activity lasting 2–4 months. The duration of life of individuals usually does not reach a month, but hatching is permanent in the late spring, summer and early autumn months Figure 3-4.). The peak of activity in some of the species is in early summer (e.g. Ceraclea annulicornis), while we know some typically autumn caddisflies being on wing in September-November or only in October-November (e.g. *Anabolia furcata, Halesus tesselatus*).

During the last dry years some of limnephilids disappeared or became rarities. Most probably they could not survive the too long dry and hot periods. Thus, *Limnephilus sparsus, L. rhombicus, L. bipunctatus, L. hirsutus,* etc. became rarer and disappeared from some of the regions. The years 1997 and 1998 were rich in precipitation, without long dry periods, therefore we can hope these species will be able to spread their distribution area.

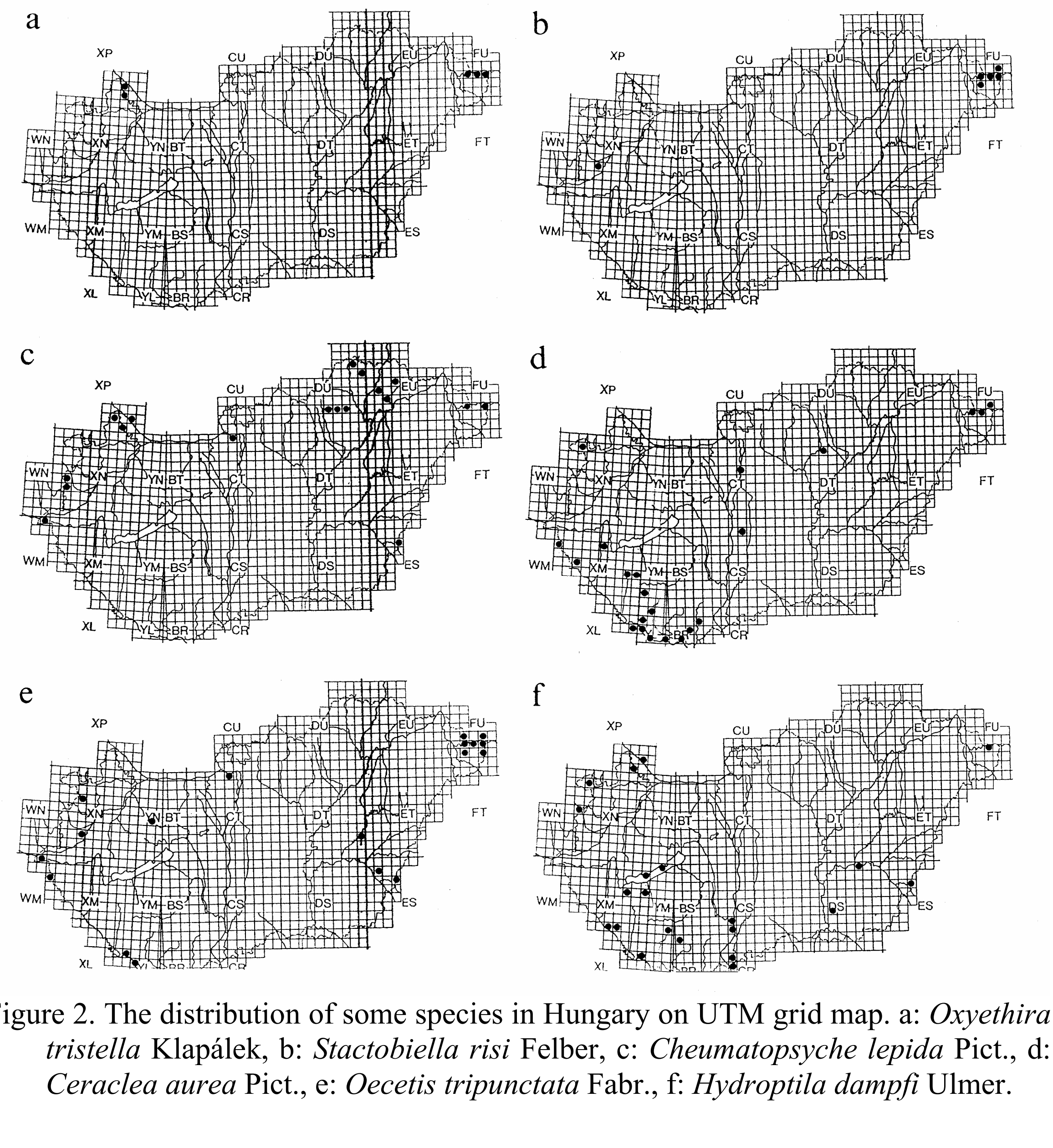

Figure 2. The distribution of some species in Hungary on UTM grid map. a: *Oxyethira tristella* Klapálek, b: *Stactobiella risi* Felber, c: *Cheumatopsyche lepida* Pict., d: *Ceraclea aurea* Pict., e: *Oecetis tripunctata* Fabr., f: *Hydroptila dampfi* Ulmer.

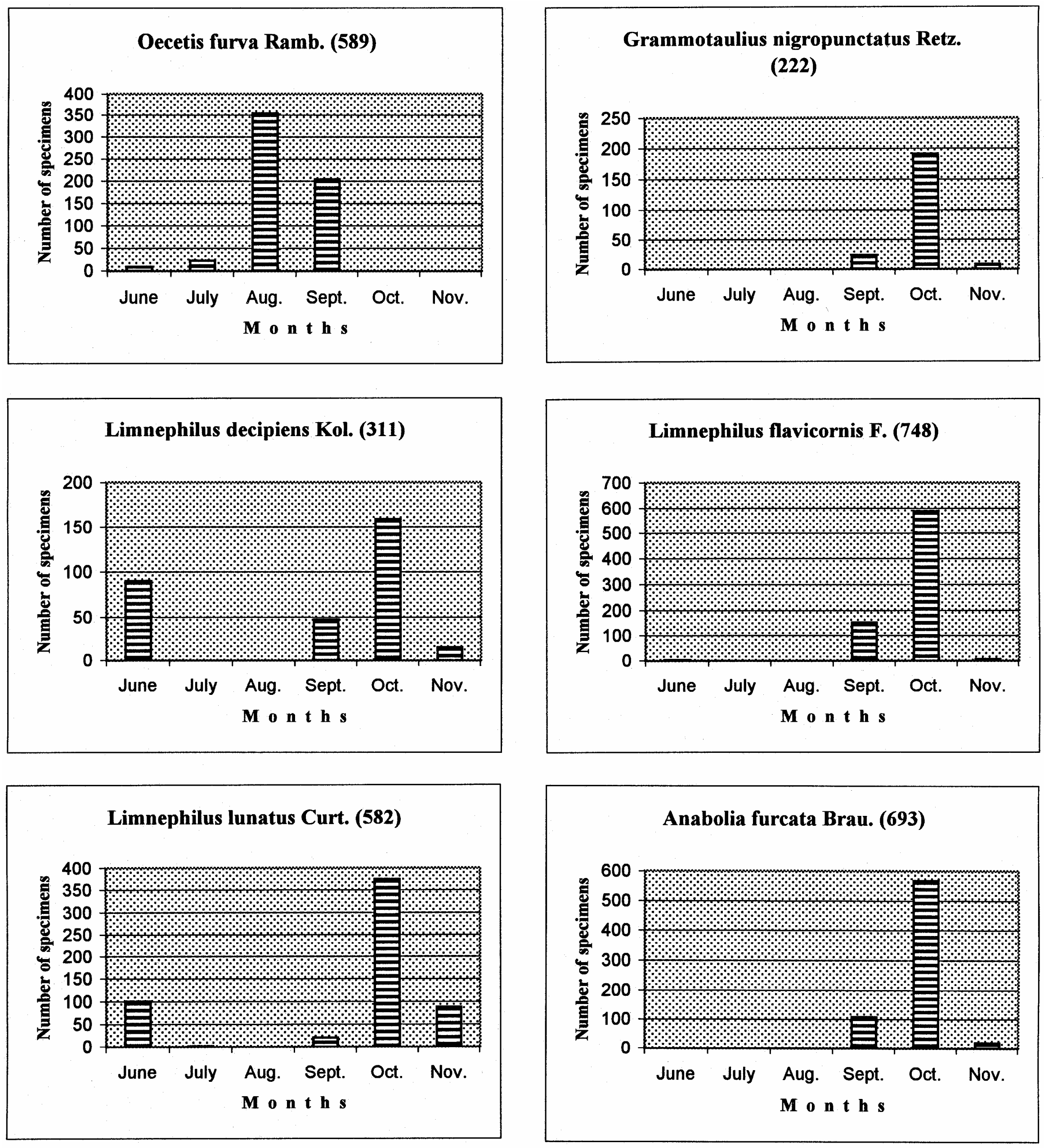

Figure 3. Activity graph of six caddisfly species in Túristvándi, 1994. The total number of specimens collected by the light trap is shown in brackets.

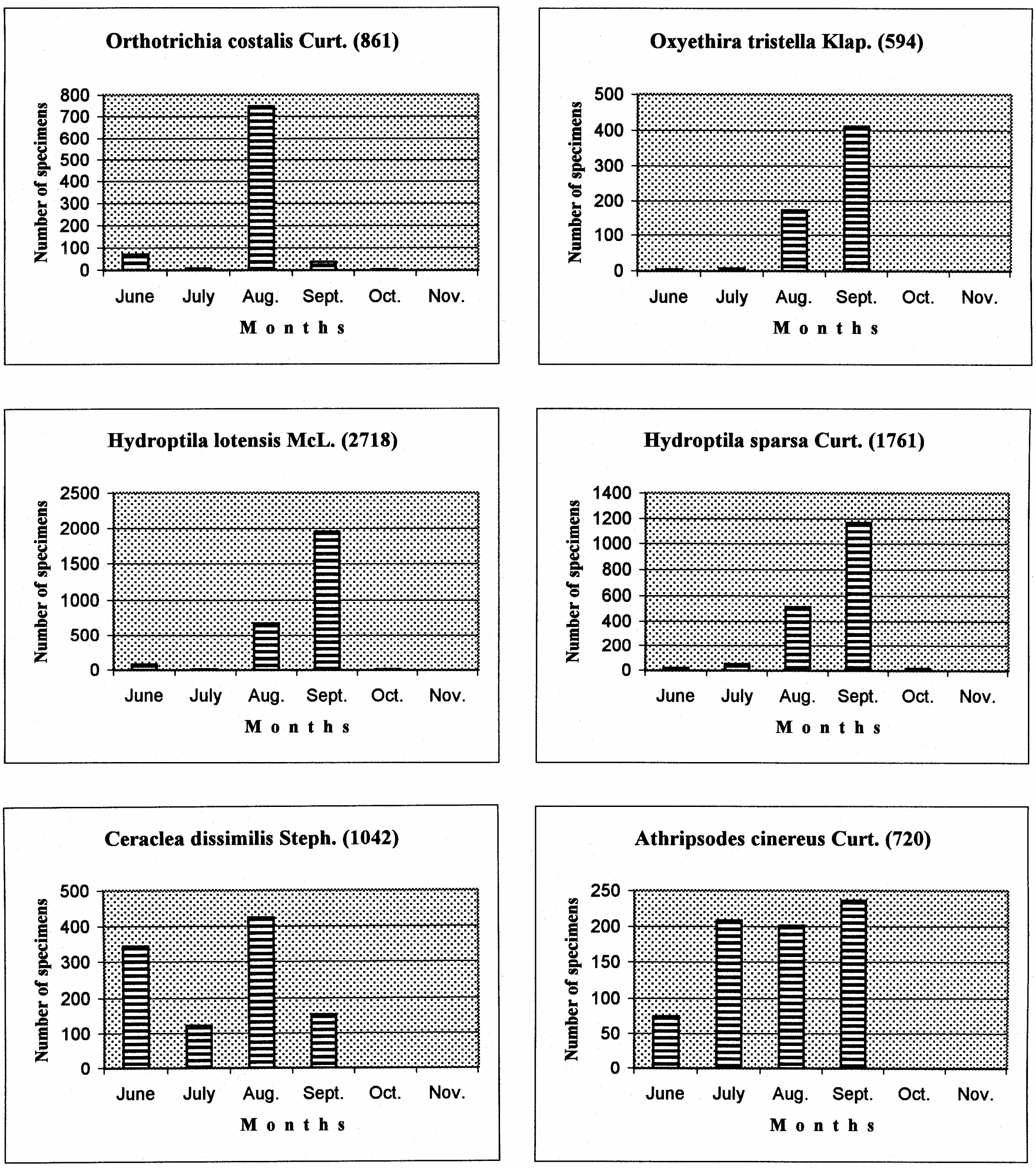

Figure 4. Activity graph of six caddisfly species in Túristvándi, 1994. The total number of specimens collected by the light trap is shown in brackets.

3. Transformation of Trichoptera communities

Trichoptera communities change both in time and from one region to the other. River Tisa has a relatively rich caddisfly community along its upper section, containing many species characteristic of only this region of larger rivers (see Uherkovich, Nógrádi 1997). The circumstances are more favourable for many species: higher velocity, soluted oxygen content, the material of the bed (gravel), and less pollution. After 30 km the bed material changes into sand and mud, and the velocity drops considerably. River Szamos brings heavily polluted water, therefore below its mouth the fauna of River Tisa is impoverished. Other studies (Botos et al. 1990) also show that the lowland sections of larger rivers have poor aquatic - e. g. caddisfly - communities.

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Fish fauna of the Upper Tisa

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Abstract

Between the headwaters of River Tisa in Ukraine and the city of Tokaj in Hungary[1], the reacher of which, including all backwaters, are named "Upper Tisa", 64 fish species are found. Although 10 species are adventives, their competition is not significant as regards the native fauna.

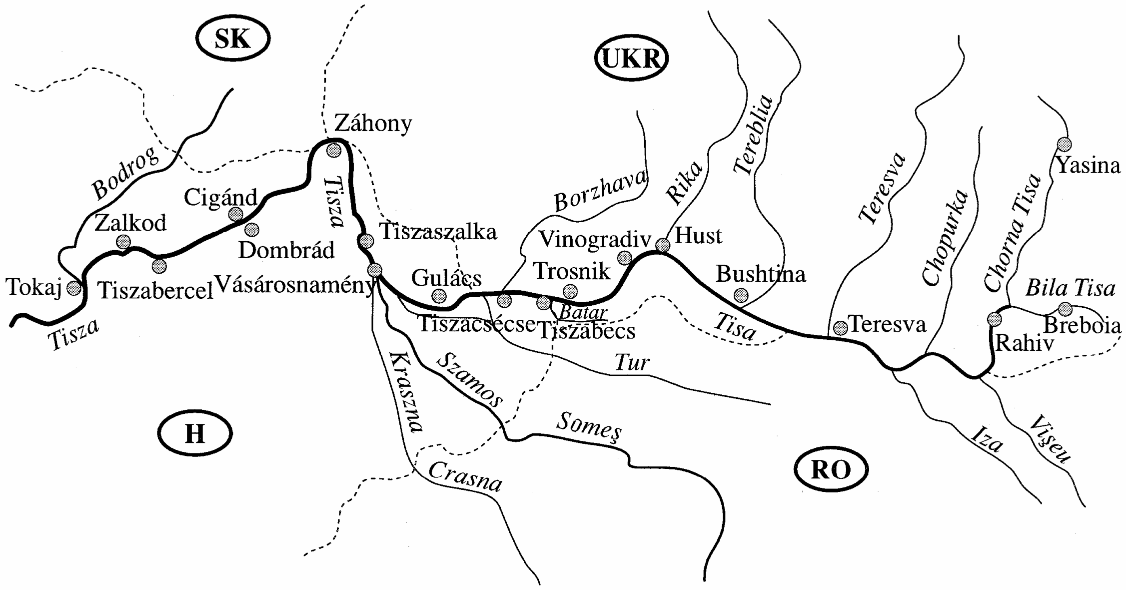
There are valuable characteristics of these reaches, which are related to well-defined ecological zonations, and there are four species endemic to the Danube Basin, one of which currently lives only in River Tisa catchment and River Timiş in nearby Romania. It is due to the relatively clean water and the variability of habitats that we find a diverse fish fauna. The Upper Tisa runs free of dams and other considerable human impacts, which contribute to the survival of the zonations and natural assets, which are now unique in Europe. The conservation of these natural assets is of common interest to four countries Ukraine, Romania, Slovakia and Hungary.
Keywords: River Tisa, fish fauna, ecological zonation, natural assets

Introduction

River Tisa is the main river of the Carpathian Basin. The studied reach of River Tisa is about 400 kilometres long, but in a hydrological sense only a section of 250 kilometres is considered an upper reach (see Map). There are many publications about its ichthyofauna, in spite of scarce scientific information about the upper section.

In the first important publication, Vutskits (1918), described 25 fish species based on earlier scientific findings (Jeitteles, Chyzer, Herman). His work identified 15 species in the river, 8 in the streams, 2 in the flood plain areas. Vladikov (1931) studied the fish fauna of the Upper Tisa Basin (Ukrainian Carpathians) and reported 49 native and one introduced species. Vásárhelyi (1960, 1961) noted some new data of River Tisa and its tributaries (Teresva, Tereblia).

[1] The Hungarian name of river is Tisza



In Movchan (l993) the number of fish species identified, including settled species from fisheries, is approximately 60 in the Upper Tisa Basin. Other data has been included by Györe, Sallai, Csikai (1995). With respect to these data, Harka (1997a) noted 51 species along the riverbed, and 5 species in the flood plain area. Bănărescu studied the fish fauna of the Upper Tisa and Teresva and Tereblia tributaries in August 1995. He made his collections from 3 sites of River Chorna Tisa, 4 sites of River Bila Tisa and 5 sites from the Ukrainen and 2 sites of the Hungarian reaches of River Tisa. The bulk of fish data has been collected by Harka, who first collected in 1984, and completed his study of the fish fauna between 1993 and 1994. He examined the Cigánd oxbow in 1985, the Tiszabercel oxbow in 1989, the Gulács oxbow in 1992, and the brook Batár in 1993. The fishing nets were suited to gather fish larger in size than 2-3 cm. He collected information from local sources as well.

Results

We verified the presence of 64 fish species along the Upper Tisa from the results of our expedition (see Table). We used the taxonomic work by Nelson (1984) as a basis.

Fam. Petromyzontidae

1. Carpatian Lamprey *Eudontomyzon danfordi* Regan, 1911

This species has been found in both the Chorna and Bila Tisa rivers, except at the source areas and in a short section below their confluence. Fishermen also found a parasitic specimen at Tiszabecs in Hungary in the 1980’s.

Fam. Acipenseridae

2. Ship *Acipenser nudiventris* Lovetzky, 1828

According to local sources, 2 species have been identified in the River Tisa, between Záhony and Tokaj (Hungary) as of 1986.

3. Sterlet *Acipenser ruthenus* (Linné, 1758)

This species is generally captured by fishing nets between Vásárosnamény and Tokaj and was found to occur near Tiszabecs as well in 1992 (Györe, Sallai, Csikai, 1995).

Fam. Anguillidae

4. Common Eel *Anguilla anguilla* (Linné, 1758)

This species is migratory, so it can be found everywhere in the Hungarian reaches of River Tisa. It is sometimes seen as far down the river as at Tiszabecs.

Fam. Cyprinidae

5. Roach *Rutilus rutilus* (Linné, 1758)

It has already appeared downstream from Bushtina. It is rare in the upper parts, and is abundant nearby Tokaj. We found the species in the lower reaches of the rivers Tersva and Tereblia, farther from the mouth of brook Batár and in each of the studied oxbows (Gulács, Cigánd, and Tiszabercel).

6. Danubian Roach *Rutilus pigus virgo* (Heckel, 1852)

Five specimens of this roach species could be collected between Tivadar and Lónya in 1994-95 (Györe, Sallai, Csikai, l995).

7. Grass Carp *Ctenopharyngodon idella* (Cuvier et Valenciennes, 1844)

Occasionally gathered by local fishermen in the riverbeds, but only in small quantities. It settles into the backwaters, mainly to forage amongst the hydrophytes. We collected this species from the Cigánd oxbow.

8. Rudd *Scardinius erythrophthalmus* (Linné, 1758)

We found large quantities of this species in the Gulács oxbow, the Cigánd oxbow and the Tiszabercel oxbow. It is not found in River Tisa.

9. Dace *Leuciscus leuciscus* (Linné, 1758)

The abundance of this species decreases drastically towards the middle and lower regions of the Danube Basin. Its being supplanted is observable in the waters of the Upper Tisa. We found only seven young specimens near the mouth of River Terebia, in the Ukrainian reaches. It is rare in the Hungarian reaches, though a few specimens have been found in the section between Tiszabecs to Tokaj.

10. Souffia Chub *Leuciscus souffia* Risso, 1826

This species deserves special interest, since the populations inhabiting the Upper Tisa and its tributaries are widely isolated and distant from those living in the other areas of the Danube basin (Germany to Croatia). L. souffia has been recorded in the Upper Tisa drainage area by Vladykov, who mentions its occurrence in River Tisa and five northern tributaries, among which Teresva and Tereblia. It has later also been found in the three southern tributaries of Tisa from Romania (Vişeu, Iza, Săpânța).

Only two specimens have been collected at Vinogradiv in 1995. It is abundantly found in River Iza at the present time, according to Zoltán Sallai (verbal comm.).

11. Chub *Leuciscus cephalus* (Linné, 1758)

It is abundantly found in River Tisa both in Ukraine and Hungary as well as in the rivers Teresva and Tereblia, and in the brook Batár.

12. Ide *Leuciscus idus* (Linné, 1758)

It does not occur in Ukrainian reaches. It can be found in small quantities in Hungarian stretch. Györe, Sallai, Csikai (1995) collected this species near Tiszabecs in the more fast-flowing reaches. It also inhabits the Cigánd oxbow.

13. Minnow *Phoxinus phoxinus* (Linné, 1758)

This species can be found downstream from Jasinia in River Chorna Tisa, downstream from Breboia in River Bila Tisa and from Rahiv to Bushtina in River Tisa.

14. Asp *Aspius aspius* (Linné, 1758)

It cannot be found in the Ukrainian reaches. We collected it throughout the Hungarian reaches from the Ukrainian border to Tokaj, as well as in the Cigánd oxbow and in the Tiszabercel oxbow.

15. Belica *Leucaspius delineatus* (Heckel, 1843)

We found the largest population in the Cigánd oxbow and the Tiszabercel oxbow, but we also collected specimens from the brook Batár. Györe, Sallai, Csikai (1995) found it below Tiszabecs in the more fast-flowing reaches.

16. Bleak *Alburnus alburnus* (Linné, 1758)

This is a species found very abundantly in River Tisa, except for the uppermost reaches. It is rarely found at Rahiv, but its population increases towards the lower reaches. This species is abundantly found in the lower reach of River Tereblia, in the brook Batár, and also in the three examined oxbows.

17. Rifle Minnow *Alburnoides bipunctatus* (Bloch, 1782)

This species is abundantly found in River Tisa from Rahiv to Tiszacsécse. Downstream from this section it is rarer. We did not find this species below Záhony. We collected it from the tributaries Teresva, Tereblia and brook Batár, too.

18. White Bream *Blicca bjoerkna* (Linné, 1758)

It always resides downstream from Tiszacsécse, but sometimes it can be found in Tiszabecs, too. It has a considerable population living in the Gulács and Tiszabercel oxbows.

19. Bream *Abramis brama* (Linné, 1758)

It can be found in the whole Hungarian reach, though it becomes abundant only near Tokaj. Considerable populations live in each of the examined oxbows.

20. Blue Bream *Abramis ballerus* (Linné, 1758)

It can be found in the whole Hungarian reach, but it is rare in the more fast-flowing parts. In spite of this, it was discovered in the rapid waters below Tiszabecs, too (Györe, Sallai, Csikai, 1995)

21. White-eyed Bream *Abramis sapa* (Pallas, 1811)

It can be found in the whole Hungarian reach. It is a rheophylic species and it was found to be the most abundant among the Abramis species in the Upper Tisa.

22. Vimba Bream *Vimba vimba* (Linné, 1758)

We observed this species downstream from Vinogradiv. This species is abundant in the upper reaches of River Tisa in Hungary, it is rare near Tokaj. We collected specimens from River Tereblia and brook Batár as well.

23. Knife *Pelecus cultratus* (Linné, 1758)

This species lives mainly in the lower and middle reaches of rivers. It is rare in waters of the Upper Tisa. In spite of this, it can sometimes be found in the Hungarian reaches.

24. Nose *Chondrostoma nasus* (Linné, 1758)

This species can be found downstream from Rahiv throughout River Tisa. It has been found in large quantities near the Ukrainian-Hungarian border, between Tiszabecs and Tiszacsécse particularly. This species is not rare in the lower reaches of the river.

25. Tench *Tinca tinca* (Linné, 1758)

This is a stagnophylic species, therefore it does not live in the river as it had been expected. We found the species living in the Gulács oxbow and the Tiszabercel oxbow.

26. Barbel *Barbus barbus* (Linné, 1758)

Only a few specimens were found downstream from Bushtina in the Ukrainian reaches. It can be found throughout the Hungarian reaches. This species is very abundant, especially between Tiszacsécse and Záhony.

27. Petényi's Barbel *Barbus peloponnesius petenyi* Heckel, 1847

This enduring population lives from Rahiv to Tiszacsécse, but the abundancy of specimens found is not as high as in the Romanian rivers. It was also found in the lower reaches of rivers Chorna Tisa and Bila Tisa.

28. Gudgeon *Gobio gobio* (Linné, 1758)

Small numbers of this species gather regularly in the riverbeds of River Tisa between Vinogradiv and Tiszaszalka. It is very rare downstream, but is not absent. We also collected this species in the Tereblia and Batár brooks.

29. White-finned Gudgeon *Gobio albipinnatus* Lukasch, 1933

It has its large number of specimens found everywhere from Vinogradiv to Tokaj and in the brook Batár as well, but it did not appear in rivers Teresva and Tereblia.

30. Long-whiskered Gudgeon *Gobio uranoscopus* (Agassiz, 1828)

Vladykov (1931) did not record this species in the Tisa, only from two tributaries: in River Shopurka (where we were not sampling) and in River Teresva. We did not find this species in River Teresva. We collected it only downstream from Trosnik in River Tisa, but it is most likely that this species can be found upriver, too. It lives only between Tiszabecs and Tiszacsécse in the Hungarian reaches, but it has a stabile population in this reach (Harka, 1996).

31. Pacific Gudgeon *Gobio kessleri* Dybowski, 1862

It can be found everywhere from Bushtina to Tokaj. This is the most abundant Gobio-species between Tiszabecs and Tiszaszalka, but it has became less abundant downstream from Záhony.

32. Stone Moroco *Pseudorasbora parva* (Schlegel, 1842)

We did not find this species in River Tisa, but we found it in a canal at Tiszabecs and in the Cigánd oxbow.

33. Bitterling *Rhodeus sericeus amarus* (Bloch, 1782)

This species can be found throughout the reaches, downstream from Trosnik in River Tisa, and in River Tereblia as well. It is abundant in the brook Batár and in oxbows (Gulács, Cigánd, Tiszebercel).

34. Crucian Carp *Carassius carassius* (Linné, 1758)

This species has become less abundant in the Middle-Danube Basin in the last two decades. Naturally it never has been abundant in the upper reach of the rivers. During the floods it was able to move into the riverbed from the backwaters. Vásárhelyi (1960) had described this species as a common fish in the Upper Tisa region, but we have not been able to detect it yet. According to local sources. this species has already gathered in the Tiszabercel oxbow as of 1989.

35. German Carp *Carassius auratus* (Linné, 1758)

This species can be found throughout the Hungarian reach of the river, and in all three examined oxbows as well. Its concurrence had an important role in the decrease of Crucian Carp.

36. Carp *Cyprinus carpio* Linné, 1758

This species can be found downstream from Tiszabecs in the Hungarian reach, although it is rare in the most rapidly flowing reaches. It inhabits the Gulács oxbow, the Cigánd oxbow and the Tiszabercel oxbow.

37. Silver Carp *Hypophthalmichthys molitrix* (Cuvier et Valenciennes, 1844)

This Far-Eastern species has become semi-acclimatizated to the river. For some years it has managed to reproduce in the Upper Tisa. Györe, Sallai, Csikai (1995) collected its young offspring downstream from Tiszabecs. It can be found throughout the Hungarian reaches and it turned up in the Gulács oxbow as well.

38. Spotted Silver Carp *Aristichthys nobilis* (Richardson, 1845)

It does not reproduce in the River Tisa and tributaries, but occasionally it finds its way into the natural flowing waters from the ponds. Fishermen sometimes catch it in the river downstream from Tiszabecs. This species also inhabits the Gulács oxbow.

Fam. Cobitidae

39. Stone Loach *Orthrias barbatulus* (Linné, 1758)

This species has been found in large quantities downstream from Jasinia in River Chorna Tisa, downstream from Breboia in River Bila Tisa, from Rahiv to Vinogradiv in River Tisa, and in River Teresva.

40. Weather-fish *Misgurnus fossilis* (Linné, 1758)

This stagnophylic species was not found in the riverbed (we were able to find it during the recent heavy flood), but we also collected it from the Gulács and the Cigánd oxbows.

41. Spined Loach *Cobitis taenia* Linné, 1758

This species cannot be found in Ukraine, but it is present in the Hungarian reaches. It is relatively rare at Tiszabecs but is more abundant towards Tokaj. It is abundant in the brook Batár and the Tiszabercel oxbow.

42. Balkan Loach *Sabanejewia aurata* (Filippi, 1865)

This species can be found downstream from Bushtina. Its population varies with time and space, but it lives in large quantities without any fluctuations in the Hungarian reaches.

Fam. Siluridae

43. Sheatfish *Silurus glanis* Linné, 1758

This species can be found throughout the Hungarian reaches and has economic importance. It is rare in the upper reaches but is more abundant in the lower reaches. It also inhabits the Tiszabercel oxbow.

Fam. Ictaluridae

44. Brown Bullhead *Ictalurus nebulosus pannonicus* (Harka et Pintér, 1990)

This European catfish subspecies can be distinguished from the American prototype by the smaller number of rays in the anal fins and by the roughness of the frontal surface of the spine (Harka and Pintér, 1990). It is rare in the Hungarian reaches. We did not find any specimens in the riverbed, but we found a large population in a developmental canal. This species appeared downstream in the riverbed (Györe, Sallai, Csikai, 1995). It has a considerable population in the oxbows examined.

45. Black Bullhead *Ictalurus melas* (Rafinesque, 1820)

This catfish species was introduced to Hungary from Italian rivers in 1980. Presently its population increases. It appears in Romania as well (Harka et al. 1988). We first noticed it in spring 1997 (Harka, 1997b) and already it was found in the upper reaches upstream from Tokaj in 1998.

Fam. Salmonidae

46. Grayling *Thymallus thymallus* (Linné, 1758)

We were able to collect this species only at Jasinia in River Chorna Tisa, but its presence has been established in River Tisa, as a specimen of this species has turned up near the border in Hungary (Györe, Sallai, Csikai, 1995).

47. Huchen *Hucho hucho* (Linné, 1758)

The occurrence of this species in the Upper Tisa was mentioned by Herman (1887), and then by Vásárhelyi (1960). It can also be found in the rivers Teresva and Tereblia (Vásárhelyi, 1961). According to our information, this fish can be found in the Ukrainian reach of River Tisa, but we were unable to find any specimens. More specimens were found in the upper reaches of Hungary over the last few years (Györe, Sallai, Csikai, 1995).

48. Brook Trout S*almo trutta m. fario* Linné, 1758

This species is abundant in the rivers Chorna Tisa and Bila Tisa and in a short section below their confluence. A few specimens were found in the Hungarian reaches, mainly in the upper area.

49. Rainbow Trout *Oncorhynchus mykiss* Walbaum, 1792

This salmon was introduced and propagated artificially and now the mountainous tributaries of the Upper Tisa is populated with their offspring. Fishermen have reported finding this species in their nets.

Fam. Umbridae

50. European Mud-minnow *Umbra krameri* Walbaum, 1792

As expected, this species was not found in the riverbed, but it is abundantly found in the common flood-areas and stagnant waters of River Tisa and River Bodrog. Hoitsy (1995) noticed it in large quantities in a 10-km section far upriver from Tokaj, at Zalkod.

Fam. Esocidae

51. Pike *Esox lucius* Linné, 1758

This species is rare in the most rapid waters, but it can be found throughout the Hungarian reaches and in the Batár brook as well. Particularly high numbers of this species live in the backwaters and the oxbow lakes (Gulács, Cigánd, Tiszabercel).

Fam. Gadidae

52. Burbot *Lota lota* (Linné, 1758)

It can be found throughout the Hungarian reaches. This species is relatively populous in the upper reaches though is rare downstream. It was not found in the brooks and oxbows.

Fam. Cottidae

53. Bullhead *Cottus gobio* Linné, 1758

This species can be found in the lower reach of rivers Chorna Tisa and Bila Tisa to their confluence, but it is missing from their upper reaches. It is abundant from the confluence of the two rivers down to Rahiv. This fish is rarer downstream but it is present at Bushtina. We also collected this species from River Teresva, 4 km above the mouth of the river.

54. Siberian Bullhead *Cottus poecilopus* Heckel, 1836

We collected this species from the source of the rivers Chorna Tisa and Bila Tisa to their confluence at Rahiv. This species is abundant in the upper reaches of these rivers (where it is the single member of the genus), though downstream it becomes increasingly rare, being replaced by *C. gobio*.

Fam. Centrarchidae

55. Common Sunfish *Lepomis gibbosus* (Linné, 1758)

We managed to collect this species only in the Hungarian reaches between Tivadar and Tokaj. We also found it in the Cigánd oxbow and the Tiszabercel oxbow.

Fam. Percidae

56. Perch *Perca fluviatilis* Linné, 1758

This species can be found everywhere downstream from Vinogradiv in River Tisa, where the water has high velocity. It was also found in the brook Batár and in all three examined oxbows.

57. Ruffe *Gymnocephalus cernuus* (Linné, 1758)

We collected this species in the brook Batár at Tiszaabecs and in the riverbed of the Tisa below Tiszacsécse. We also found it in the Cigánd and the Tiszabercel oxbows.

58. Balon's Ruffe *Gymnocephalus baloni* Holcik et Hensel, 1974

We found this ruffe species downstream from Tiszabecs. It is a rheophylic species, which is rare in the backwaters, therefore we could not find it in the oxbows.

59. Yellow Pope *Gymnocephalus schraetzer* (Linné, 1758)

This ruffe species was not found in the Ukrainian reaches, but it can be found in the Hungarian areas. Though it would not be considered rare between Tiszabecs and Tiszacsécse, larger numbers occurred farther downstream.

60. Pike-perch *Stizostedion lucioperca* (Linné, 1758)

This species can be found throughout the Hungarian reaches and it can be considered important for fishing. It is relatively rare between Tiszabecs and Tiszacsécse, while downstream it becomes more abundant. The floods of 1998 have created favourable conditions for its reproduction, therefore we were able to gather large quantities of its offspring.

61. Volga Pike-perch *Stizostedion volgense* (Gmelin, 1788)

This pike-perch species can be found only rarely downstream from Tiszabecs. We collected only a single specimen near Dombrád in 1998.

62. Zingel *Zingel zingel* (Linné, 1758)

This species can be found throughout the Hungarian reaches and it is relatively abundant between Tiszabecs and Záhony. It is rarer near the Tokaj region.

63. Streber *Zingel streber* (Siebold, 1863)

In the freshwaters of the Danube Basin the populations of this species have declined recently, but it can be found downstream from Bushtina in the Upper Tisa. It is abundantly found from Vinogradiv to Tiszaszalka, but it is rare (?) in the downstream reaches.

Fam. Eleotrididae

64. Amur Sleeper *Perccottus glehni* Dybowski, 1877

Russian aquarists have introduced this species from the Amur region into Europe. This fish was first released into ponds and lakes near Moscow in the 1950s and it has spread spontaneously into Central Europe. We found specimens of this species in the middle reaches of River Tisa, Hungary (Harka, 1998). We also found it near Tokaj in summer 1998. It lives primarily in the backwaters of the flood area, but it spreads aggressively in the rivers, too.

Discussion

The gradual transformation of the environmental elements has resulted in the formation of distinctive ecological zonations. The Trout zone, the Grayling zone, the Nose zone, the Barbel zone, the Bream zone and the Ruffe-Plaice zone follow each other respectively, downstream from the springs into the main rivers of Europe. Except for the Ruffe-Plaice zone, all of the others can be found in Upper Tisa.

1. *Trout zone:* River Chorna Tisa, River Bila Tisa and the short upper reach of River Tisa at Rahiv belong to this zone. The stony bed, rapid current (1,5-2 m/s), low water temperature (below 13°C) and high oxygen content (10-12 mg/dm^3) are unique to this zone. In addition to the eponym *Salmo trutta m. fario, also Eudontomyzon danfordi, Phoxinus phoxinus, Orthrias barbatulus, Cottus gobio* and *Cottus poecilopus* are abundant fish in this zone.

2. *Grayling zone:* This zone stretches from Rahiv to Hust along River Tisa. The bed is stony and pebbly, the velocity of the water is 1,1-1,5 m/s, water temperature stays below 16°C, and oxygen content is 9-10 mg/dm^3 in this zone. Its characteristic fish are the eponyms *Thymallus thymallus* (Which is rare here) moreover *Barbus peloponnesius petenyi* and *Leuciscus souffia agassizi.*

3. *Nose zone:* It has been formed only in rivers that exhibit a gradual transition between their mountain and lowland reaches. This zone is from Hust to Tiszacsécse in River Tisa. In this zone the bed is covered by small riverstone, the velocity of the current is 0,7-1,1 m/s, water temperature stays below 20°C even in the summer, oxygen content is 8-9 mg/dm^3. Its characteristic fishes are the eponym Chondrostoma nasus, which can be very abundant here. Other fish species include *Hucho hucho, Alburnoides bipunctatus* and *Gobio uranoscopus*.

4. *Barbel zone:* This zone extends from Tiszacsécse to Záhony. The bed is gravelly or coarse-grain sand, the velocity of the water is 0,5-0,7 m/s, water temperature does not rise above 20°C even during the summer, oxygen content is 7-8 mg/dm^3 in this zone. In addition to the eponym Barbus barbus, characteristic fish species are Acipenser ruthenus, Leuciscus leuciscus, Vimba vimba and Gobio kessleri.

5. There is no *Bream zone* that could be considered natural in the upper reaches of the river. This zone formed after the Tiszalök Dams were put into operation in 1954. The Barbel zone, which extended to Tokaj before the dam construction, has transformed into a Bream zone in the reaches under Záhony, as a consequence of the rising water. The bed is made up of fine-grain sediments, sand or mud. Water temperature can reach 23-25°C in the heat of the summer, velocity is below 0,5 m/s, oxygen content is only 5-6 mg/dm^3. In addition to the eponym Abramis brama, its characteristic fish are: *A. sapa, A. ballerus, Cyprinus carpio, Gobio albipinnatus, Silurus glanis, Stizostedion lucioperca*.

The regular sequence of zones edges have become confused in many European rivers due to the effect of dam construction, which were built in the upper reaches of the rivers. It is well known that in order to make the important waterways of large rivers (Danube, Maine, Rhine) more navigable in their upper areas, many river barrages were built so as to increase water depth. There is less information about the smaller rivers, but they do not seem to be in a better condition. More than twenty dams hinder the formation of the natural conditions along River Drava, which similar in size to River Tisa. The zonation of the Upper Tisa is a natural value, which has become unique in the European continent.

In addition to zonation, another significant aspect, which may be of even higher value is the completeness of natural fish fauna. Despite the introduction of other non-endemic species which now co-occur and compete with the native species, those species native to the area are able to maintain viable populations. The unpolluted water of the Upper Tisa and the unchanging hydrographic conditions have played a decisive role in the survival of these valuable species. In addition to trying to preserve the ecological conditions, we continue our efforts for the survival of this valuable fish fauna.

From 64 species which compose the fish fauna, 10 are adventives, while the other 54 native species comprise the real natural value of fish fauna and some of them deserve distinctive attention.

1. *Eudontomyzon danfordi.* This species occupies a limited area. It is an endemic species of the Carpathian Basin. It lives only in the upper reaches of the Tisa and Timiş catchment. It has received protection in Hungary, is registered in the Ukrainian Red Book, and considered a threatened species by European valuation (Lelek, 1987).

2. *Acipenser nudiventris.* Originally this species lived near the banks of the Black and Caspian Seas, and it swam upriver only to spawn in these rivers. The populations now liwing in the Danube Basin have changed their way of life and they live always in fresh water. It is rare and protected in Hungary and is a vulnerable-endangered species in Europe.

3. *Rutilus pigus virgo.* The prototype of this species, R. pigus pigus, is native to the waters of North-Italy. R. pigus virgo is an endemic sub-species of the Danube river-system. It is a rare and threatened species by European listing. It received protection in Slovenia previously. It is not protected in Hungary but its protection is expected.

4. *Leuciscus souffia agassizi.* The Upper Tisa population of this species which lives 6-700 km from its main distribution area has different characteristics brought about by its isolation. These tributary reaches signify the easternmost borders of the areal of L. souffia agassizi. This species is considered to be vulnerable-endangered in Europe and has been registered in the Ukrainian Red Book. Although only stray specimens could be found in Hungary, it has received Hungarian protection.

5. *Phoxinus phoxinus*. This species is a vulnerable species in Europe. This fish is sensitive to changes in its environmental conditions, therefore it has disappeared from many previously inhabited territories. For this reason it has received protection in Hungary.

6. *Leucaspius delineatus.* This species is a rare and vulnerable species in Europe. Because of its small size it does not have economic importance. However, increased pollution throughout its habitats threatens its existence. It has received protection in Hungary.

7. *Alburnoides bipunctatus.* This species is characteristic of the sub-mountainous and hilly reaches of rivers. It is a vulnerable-endangered species in Europe. It has received protection in Hungary. Established populations live in the Upper Tisa.

8. *Barbus barbus.* This cyprinid species, after which the Barbel zone is eponymously named, lives in the hilly and plain reaches where the river flows within its bed. It is a vulnerable species in Europe. This fish is sensitive to water quality

(pollution) and retires from reaches which are flooded as a result of dam operation. It is not rare in Hungary, but in Ukraine has been registered in the Red Book.

9. *Barbus peloponnesius petenyi.* The prototype of this species is native to southern Greece. The centre of the expanding distribution of this sub-species is the Danube Basin, and it also lives in the Upper Tisa river-system. It has an important natural value, and has received protection in Hungary. It is registered in the Hungarian Red Book.

10. *Gobio albipinnatus.* This species lives in Central- and Eastern-Europe, mostly in the catchment area of rivers running into the Black and Caspian Seas. It is rare in Europe, is protected in Hungary, and has recently become more plentiful in River Tisa.

11. *Gobio uranoscopus.* The centre of its relatively small area is the Danube Basin. The literature contains much useless and inaccurate data about its distribution. This species has been described as living in rivers in which it is most unlikely to survive. Probably these observations are records of the similar G. albipinnatus and G. kessleri. It is a rare and vulnerable species by European valuation. It is protected in Hungary.

12. *Gobio kessleri.* The centre of its distribution is the Danube Basin, therefore it has a great natural value here. It is recorded as a rare and vulnerable species in Europe and is protected in Hungary. It is relatively abundant in the Carpathian Basin including the Upper Tisa, because here the Barbel zone of rivers keep original characteristics.

13. *Orthrias barbatulus.* This species is a rare and threatened species of European listings, and is protected in Hungary. It is still abundant in the mountainous and hilly creeks, and its protection serves to keep the population viable.

14. *Misgurnus fossilis.* This species lives in marshy type habitats, but floods have served an important role in soreading and in maintaining its habitat. This species can be found across Europe, though it is a rare and vulnerable species. It is protected in Hungary.

15. *Cobitis taenia.* This species ranges widely and is less sensitive to environmental conditions. It is rare in Europe but abundant in the river-system of Tisa and within the Carpathian Basin. The protection of this species serves its preservation in Hungary.

16. *Sabanejewia aurata.* This is an Aralo-Pontho-Caspian species, which also is presently expanding into the Carpathian Basin. It is a rare and vulnerable species in Europe. It is relatively abundant in the upper section of River Tisa and is included in the list of protected species in Hungary.

17. *Thymallus thymallus.* This fish is characteristic of the Grayling zone. It is a vulnerable species in Europe, is protected in Hungary and is registered in the Ukrainian Red Book. Recently, it has only been observed in the upper section of River Tisa in Hungary.

18. *Hucho hucho.* It is an endemic species of the Danube river-system. It is an endangered species under European listing, strictly protected in Hungary and registered in the Ukrainian Red Book. Two habitats were known in Hungary, one of which was the reaches of River Danube in the Szigetköz, downstream from Bratislava. The Gabcikovo Dam has had considerable impact on the environmental conditions of

River Danube which is probaly why this species has now only a single stable habitat in the Upper Tisa.

19. *Salmo trutta m. fario.* This species is a vulnerable species in Europe and has been registered in the Ukrainian Red Book. Its ranging offspring which arrive from mountain rivers, can be found regularly in the Hungarian reaches of the Upper Tisa.

20. *Umbra krameri.* Originally, this species lives in the backwaters, canals and oxbows of the flood plains, appearing in the rivers during high floods only. It lives in very few suitable habitats outside the Danube Basin. It is a vulnerable-endangered species by European listing. It has received protection in Hungary and has also been registered into the Hungarian Red Book.

21. *Lota lota.* This species ranges widely but it has become increasingly rare in the Danube Basin. The species recommended in the Romanian Red List . It has mostly disappeared from streams and creeks by the present time, but is still not rare in the upper section of River Tisa.

22. *Cottus gobio.* This species ranges in Europe and it is listed as a vulnerable species. It has been given protection in Hungary, but it is abundant in the Ukrainian reach of the Upper Tisa. Sometimes the two Cottus species occur together in the same habitats in the rivers Chorna Tisa and Bila Tisa.

23. *Cottus poecilopus.* This species is a rare and vulnerable species by European listing. It does not have a permanent population in Hungary, even though occasional specimens found here are protected. Its stable populations can be found in the rivers Chorna Tisa and Bila Tisa, which have a great natural value.

24. *Gymnocephalus baloni.* This is a Pontho-Caspian species. Mostly it can be found in larger rivers. It is a vulnerable species in Europe and has received protection in Hungary.

25. *Gymnocephalus schraetzer.* This is an endemic species of the Danube Basin. It is a endangered species in Europe and has received protection in Hungary. It has a large and stable populations in River Tisa, which represent a considerable natural value.

26. *Zingel zingel.* This species is distributed within a small area the centre of which is the river-system of Danube. It is endangered under European listing, it has been registered in the Ukrainian Red Book and is protected in Hungary. Its natural habitat has become smaller and smaller within its area, because it is forced to withdraw from river reaches flooded as a result of damming. It is still relatively abundant in the Upper Tisa.

27. *Zingel streber.* The Danube Basin is the centre of its habitat, like for its relatives. It is a endangered species in Europe, has been registered in the Ukrainian Red Book and is protected in Hungary. This species is more sensitive to the damming of rivers, because it can breed only in the river reaches with moving water and its food organisms live in alluvial deposits rolled by rivers. The populations of this species represent a major natural value in the Upper Tisa region.

Among the listed fishes, 4 species or subspecies are endemic to the Danube Basin. Six species have a narrow range of distribution and find their centre of area here. Ten species have been registered in the Red Book of one or more counties, 23 species are protected in Hungary, and even more are rare and threatened species in

Europe. The unique natural values of the Upper Tisa region extend also to organisms other then fish. A high respect for these species is apparent throughout the region. The preservation and protection of this unique and complex value is of common interest to all four neighbour countries: Ukraine, Romania, Slovakia and Hungary.

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Table: Fishes of the Upper Tisa

		Ukraine						Hungary				
	Presence of the fish species	Chorna Tisa	Bila Tisa	Teresva	Tereblia	Tisa 1	Tisa 2	Batar Brook	Tisa 3	Tisa 4	Tisa 5	Backwaters
1	Eudontomyzon danfordi	+	+			+			(+)			
2	Acipenser nudiventris										(+)	
3	Acipenser ruthenus								+	+	+	
4	Anguilla anguilla									+	+	
5	Rutilus rutilus							+	+	+	+	+
6	Rutilus pigus virgo									+		
7	Ctenofharyngodon idella									+	+	+
8	Scardinius erythrophthalmus											+
9	Leuciscus leuciscus				+				+	+	+	
10	Leuciscus souffia agassizi						+					
11	Leuciscus cephalus			+	+	+	+	+	+	+	+	
12	Leuciscus idus								+	+	+	+
13	Phoxinus phoxinus	+	+	+	+	+						
14	Aspius aspius								+	+	+	+
15	Leucaspius delineatus							+	+			+
16	Alburnus alburnus			+	+		+	+	+	+	+	+
17	Alburnoides bipunctatus				+	+	+	+	+	+		
18	Blicca bjoerkna								+	+	+	+
19	Abramis brama								+	+	+	+
20	Abramis ballerus								+	+	+	
21	Abramis sapa								+	+	+	
22	Vimba vimba				+		+	+	+	+	+	
23	Pelecus cultratus								+	+	+	
24	Chondrostoma nasus					+	+		+	+	+	
25	Tinca tinca											+
26	Barbus barbus						+	+	+	+	+	
27	Barbus peloponnesius petenyi	+	+	+		+	+		+			
28	Gobio gobio				+		+	+	+	+	+	
29	Gobio albipinnatus						+	+	+	+	+	
30	Gobio uranoscopus						+		+			
31	Gobio kessleri					+	+		+	+	+	
32	Pseudorasbora parva											+

Tisa 1: Rahiv - Hust
Tisa 2: Hust - Tiszabecs
Tisa 3: Tiszabecs - Tiszacsécse
Tisa 4: Tiszacsécse - Záhony
Tisa 5: Záhony - Tokaj
+: presence, (+): rarity

Table continue

		Ukraine						Hungary				
	Presence of the fish species	Chorna Tisa	Bila Tisa	Teresva	Tereblia	Tisa 1	Tisa 2	Batar Brook	Tisa 3	Tisa 4	Tisa 5	Backwaters
33	Rhodeus sericeus amarus				+		+	+	+	+	+	+
34	Carassius carassius											+
35	Carassius auratus								+	+	+	+
36	Cyprinus carpio								+	+	+	+
37	Hypophthalmichthys molitrix								+	+	+	+
38	Aristichthys nobilis								+	+	+	+
39	Orthrias barbatulus	+	+	+		+						
40	Misgurnus fossilis											+
41	Cobitis taenia							+	+	+	+	+
42	Sabanejewia aurata					+			+	+	+	
43	Silurus glanis								+	+	+	+
44	Ictalurus nebulosus pannonicus								+	+	+	+
45	Ictalurus melas										+	
46	Thymallus thymallus	+							(+)			
47	Hucho hucho					+	+		+	+		
48	Salmo trutta m. fario	+	+			+			+	(+)		
49	Oncorhynchus mykiss								(+)	(+)		
50	Umbra krameri											+
51	Esox lucius							+	+	+	+	+
52	Lota lota								+	+	+	
53	Cottus gobio	+	+	+		+						
54	Cottus poecilopus	+	+			+						
55	Lepomis gibbosus								+	+	+	+
56	Perca fluviatilis						+	+	+	+	+	+
57	Gymnocephalus cernuus							+		+	+	+
58	Gymnocephalus baloni								+	+	+	
59	Gymnocephalus schraetzer								+	+	+	
60	Stizostedion lucioperca								+	+	+	+
61	Stizostedion volgense									+	+	+
62	Zingel zingel								+	+	+	
63	Zingel streber					+	+		+	+	+	
64	Perccottus glehni										+	

Tisa 1: Rahiv - Hust
Tisa 2: Hust - Tiszabecs
Tisa 3: Tiszabecs - Tiszacsécse
Tisa 4: Tiszacsécse - Záhony
Tisa 5: Záhony - Tokaj
+: presence, (+): rarity

Data to the fish fauna of River Tisa and its tributaries in Hungary and Romania

Károly Györe, Zoltán Sallai & Csaba Csikai

Abstract

The fish fauna of River Tisza/Tisa[1] and its tributaries was investigated between 1992 and 1996 in Hungary and in Romania. During the five years of investigation more than 40 thousand fish individuals were caught and identified. The fish individuals belonged to 59 different species. The fish were collected with an electric fishing gear from a boat, but in rivers Săpânța, Iza and Mara we waded into the river. Among the species with small distribution areas and important faunistic and conservational value the following ones were present: Eudontomyzon danfordi, Rutilus pigus virgo, Leuciscus souffia agassizi, Barbus pelopennesius petényi, Gobio uranoscopus, Gobio kessleri, Hucho hucho, Gymnocephalus schraetzer, Zingel zingel, Zingel streber, Cottus poecilopus.

Keywords: Fish fauna; River Tisa basin;

Introduction

The present fish fauna of natural water bodies is insufficiently known in several regions. The unsatisfactory level of faunistic and taxomomic investigations is obvious in the detection of the rare fish species. Some endemic fish species, the decrease of which started at the time of river regulations at the end of the last century, have disappeared completely by now.

Within the framework of a five-year project, River Tisa and its tributaries were investigated. The 59 different species found also sustain the fact that the protection of the upper reach of River Tisa and its tributaries is reasonable from a nature conservational point of view of. This species number is completed with other species on the lower reach.

During the investigation several rare and endemic fauna element were found, which will be described in the followings. Hucho hucho, being a very rare and strictly

[1] The Hungarian name of the river is Tisza

protected species in Hungary, was in the focus of our investigation. In Hungary its presence has been proved from the upper reach of River Tisza and the upper reach of River Danube. We wanted to find out about the size of he population of the endangered Hucho hucho outside the Hungarian border, and see which tributaries they use for spawning in the spawning period, which species they occur together with in the various habitats. To answer our questions we also investigated the Romanian reach of River Tisa.

Literature review

One of the earliest data on the fish fauna of River Tisa can be found in the description by Bél (1767), in which 6 species were mentioned. Later, 12 species were registered by name from the river by Reisinger (1830), and the presence of 16 further species can be assumed based on his descriptions. The first faunistical investigation is linked with the name of Heckel (1847), Heckel & Kner (1858). The presence of 10 species is mentioned in their work. Kriesch (1868) mentioned 26 species from River Tisa passing through the Hungarian fauna area of that time. 38 species were registered by Herman (1887) based on experiences of others. On the species list drawn up by Vutskits (1904) 39 species can be observed, and in his work in 1918 the presence of 40 species is mentioned. In his book Kolosváry (1928) described 36 species from the river. P. Szalai (1946) relied in his work on the catch of fishermen, and mentioned 18 species.

The presence of 56 species is mentioned in the work of Vásárhelyi (1960) dealing with River Tisa. In the illustrated fish identification book written by Vásárhelyi (1961), River Tisa is signed as the finding place of 45 different fish species. His species list is mostly similar to that of Kriesch (1868) and Herman (1887). Ferencz (1965) collected data from several points of the river. 28 species were found according to his investigations. The presence of 32 species in the river was proved by Harka (1972). Botta et al. (1984) made regular samplings on the natural waters of Hungary, and they described the presence of 18 fish species. Harka (1986b) registered 49 species in the publication dealing with the fishing-biology of the Kisköre-resevoir. The first recent data on Hucho hucho during the last decades were presented by Csikai & Végh (1991). Harka investigated the tributaries of River Tisa: in River Túr (1994) 38 species and in River Szamos (1995) 46 species were described. The presence of 45 species was detected by Györe et al. (1995) from the upper reach of River Tisa in Hungary. Harka (1997), when completing his findings with recent data of other researchers, described 56 species from River Tisa, in which pool data from the oxbow-lakes near the river were also included.

Materials and methods

In the Hungarian water-bodies we used an aggregate electric fishing gear for fishing, and in Romania we used a portable electric gear with little efficiency. Fish were put back to the water after identification. Species numbers were written down on the spot with the following method. Secies number below 10 individuals appeared as exact figures, below 100 individuals figures were rounded, and above 100 specimens numbers were estimated. On the Hungarian reach of the river samplings were made from boat, thus the data can not be connected to distinct sampling points; this is why only the reach where the sampling was carried out is mentioned. In cases when it was possible the finding places were narrowed down to administrative areas of the settlements.

The list of the fish species found follows the taxonomical order of Nelson (1984). The publication of data is done according to the formal requirements of faunistic data publication suggested by Dévai et al. (1987). After dates, numbers of individuals appear. The breaking up of the number of individuals inside the brackets in the case of Eudontomyzon danfordi means that one of the two caught fish was in larval stage while the other was fully developed (1+1). Pieces of data collected at the same place are separated with a semicolon.

Results

PETROMYZONTIDAE

1. Eudontomyzon danfordi Regan, 1911
Mara: 26.04.1996, 2 (1+1).

ACIPENSERIDAE

2. Acipenser ruthenus Linnaeus, 1758
Tisza (the mouth of River Túr): 03.07.1993, 1.

ANGUILLIDAE

3. Anguilla anguilla Linnaeus, 1758
Tisza (the mouth of River Túr): 03.07.1993, 1.

CYPRINIDAE

4. Rutilus rutilus Linnaeus, 1758

Little-Túr (Oxbow, Sonkád): 24.04.1993, 12. - Szamos (Vásárosnamény): 05.07.1994, 3. - Tisza (between Tiszabecs and Tiszacsécse): 28.04.1994, 3. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 1. - Tisza (between Tiszabecs and Tivadar): 23.10.1993, 1. - Tisza (between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 1. - Tisza (Tivadar): 15.07.1996, 3. - Tisza (between Tokaj and Tiszalök): 14.07.1993, 100. - Tisza (the mouth of River Túr): 03.07.1993, 2.

- Tisza (Vásárosnamény): 17.07.1996, 2; 20.06.1995, 2. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 05.07.1994, 2. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 25. - Tisza-Lake (Kisköre): 01.12.1994, 15. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 60. - Túr (Sonkád): 24.11.1993, 10.

5. Rutilus pigus virgo Heckel, 1852

Tisza (between Tiszabecs and Tiszacsécse): 15.09.1995, 2; 29.04.1996, 2. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 1. - Tisza (between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 3. - Tisza (Tivadar): 15.07.1996, 1. - Tisza (Vásárosnamény): 20.06.1995, 1. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 05.07.1994, 1. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 2.

6. Ctenopharyngodon idella Valenciennes, 1844

Little-Túr (Oxbow, Sonkád): 24.04.1993, 1; 15.09.1995, 1. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 1.

7. Scardinius erythrophthalmus Linnaeus, 1758

Little-Túr (Oxbow, Sonkád): 24.04.1993, 5. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 2. - Tisza-Lake (Kisköre): 01.12.1994, 2. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 1. - Túr (Sonkád): 24.11.1993, 40.

8. Leuciscus leuciscus Linnaeus, 1758

Tisza (between Tiszabecs and Tivadar): 11.05.1993 - Túr (between the Hungarian border and Sonkád): 16.03.1995, 1.

9. Leuciscus cephalus Linnaeus, 1758

Iza (Sighetu Marmației): 25.04.1996, 70. - Little-Túr (Oxbow, Sonkád): 24.04.1993, 1; 15.09.1995, 2. - Szamos (Vásárosnamény): 06.07.1993, 25; 21.06.1994, 50; 05.07.1994, 30. - Tisza (between Lónya and Tuzsér): 07.07.1994, 200. - Tisza (Lónya): 10.07.1993, 20; 11.07.1993, 50; 06.07.1994, 30. - Tisza (between Tiszabecs and the mouth of River Túr): 27.06.1994, 200; 16.06.1995, 80. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 200; 01.10.1993, 200; 21.10.1993, 150; 22.10.1993, 200; 15.03.1994, 50; 16.03.1994, 50; 17.03.1994, 10; 27.04.1994, 200; 28.04.1994, 150; 29.04.1994, 200; 25.06.1994, 150; 26.06.1994, 50; 15.03.1995, 120; 17.03.1995, 50; 23.04.1995, 120; 15.06.1995, 120; 14.09.1995, 120; 15.09.1995, 160; 16.09.1995, 120; 29.04.1996, 120. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 120. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 02.10.1993, 300; 11.05.1993; 23.10.1993, 200; 27.05.1994; 20.10.1994. - Tisza (Tiszabecs): 01.07.1993, 100. - Tisza (between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 500. - Tisza (Tivadar): 05.07.1993, 100; 14.07.1996, 30; 15.07.1996, 22. - Tisza (between Tokaj and Tiszalök): 14.07.1993, 5. - Tisza (between the mouth of River Túr and Tivadar): 01.07.1994, 30. - Tisza (the mouth of River Túr): 03.07.1993, 80; 30.06.1994, 2. - Tisza (Vásárosnamény): 20.06.1995, 50; 17.07.1996, 70. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 40; 05.07.1994,

600. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 12. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 120. - Túr (Sonkád): 24.11.1993, 20.

10. Leuciscus souffia agassizi Cuvier et Valenciennes, 1844
Iza (Sighetu Marmației): 25.04.1996, 50.

11. Leuciscus idus Linnaeus, 1758
Tisza (between Tiszabecs and Tiszacsécse): 25.06.1994, 1. - Tisza (Between Tokaj and Tiszalök): 14.07.1993, 10.

12. Phoxinus phoxinus Linnaeus, 1758
Mara: 26.04.1996, 6. - Săpânța: 27.04.1996, 3.

13. Aspius aspius Linnaeus, 1758
Szamos (Vásárosnamény): 05.07.1993, 1; 06.07.1993, 1; 21.06.1994, 15. - Tisza (between Lónya and Tuzsér): 07.07.1994, 1. - Tisza (Lónya): 06.07.1994, 1. - Tisza (between Tiszabecs and the mouth of River Túr): 27.06.1994, 3; 16.06.1995, 1. - Tisza (between Tiszabecs and Tiszacsécse): 21.10.1993, 2; 22.10.1993, 1; 16.03.1994, 3; 17.03.1994, 1; 27.04.1994, 10; 28.04.1994, 7; 29.04.1994, 4; 25.06.1994, 4; 23.04.1995, 9; 15.06.1995, 4; 14.09.1995, 6; 15.09.1995, 3; 16.09.1995, 3; 29.04.1996, 8. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 1. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993; 02.10.1993, 3; 23.10.1993, 1; 27.05.1994; 20.10.1994. - Tisza (Tivadar): 14.07.1996, 1. - Tisza (Vásárosnamény): 20.06.1995, 5. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 05.07.1994, 1. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 1.

14. Leucaspius delineatus Heckel, 1843
Tisza (between Tiszabecs and Tiszacsécse): 29.04.1996, 1. - Tisza (between Tiszabecs and Tivadar): 11.05.1993.

15. Alburnus alburnus Linnaeus, 1758
Little-Túr (Oxbow, Sonkád): 24.04.1993, 50. - Szamos (Vásárosnamény): 06.07.1993, 50; 21.06.1994, 600; 05.07.1994, 300. - Tisza (between Lónya and Tuzsér): 07.07.1994, 500. - Tisza (Lónya): 11.07.1993, 50. - Tisza (between Tiszabecs and the mouth of River Túr): 27.06.1994, 500; 16.06.1995, 2000. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 500; 01.10.1993, 500; 21.10.1993, 2000; 22.10.1993, 500; 15.03.1994, 5; 16.03.1994, 20; 17.03.1994, 5; 27.04.1994, 2000; 28.04.1994, 1200; 29.04.1994, 1000; 25.06.1994, 500; 26.06.1994, 300; 15.03.1995, 100; 17.03.1995, 50; 23.04.1995, 200; 15.06.1995, 2000; 14.09.1995, 1500; 15.09.1995, 1000; 16.09.1995, 800; 29.04.1996, 800. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 1500. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993; 02.10.1993, 600; 23.10.1993, 1000; 27.05.1994; 20.10.1994. - Tisza (Tiszabecs): 01.07.1993, 200. - Tisza (between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 400. - Tisza (Tivadar): 05.07.1993, 200; 14.07.1996, 300; 15.07.1996, 135. - Tisza (between Tokaj and Tiszalök): 14.07.1993, 20. - Tisza (between the mouth of River Túr and Tivadar): 01.07.1994, 500. - Tisza (the mouth of

River Túr): 03.07.1993, 100; 30.06.1994, 20. - Tisza (Vásárosnamény): 20.06.1995, 1000; 17.07.1996, 100. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 80; 05.07.1994, 1200. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 60. - Tisza-Lake (Kisköre): 01.12.1994, 50. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 80. - Túr (Sonkád): 24.11.1993, 3.

16. Alburnoides bipunctatus Bloch, 1782

Tisza (between Tiszabecs and the mouth of River Túr): 27.06.1994, 12; 16.06.1995, 10. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 200; 01.10.1993, 200; 21.10.1993, 100; 22.10.1993, 50; 23.11.1993, 40; 15.03.1994, 15; 16.03.1994, 20; 27.04.1994, 50; 28.04.1994, 80; 29.04.1994, 80; 26.06.1994, 15; 17.03.1995, 70; 23.04.1995, 6; 15.06.1995, 10; 14.09.1995, 300; 15.09.1995, 300; 16.09.1995, 200; 29.04.1996, 3. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 200. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993; 02.10.1993, 300; 23.10.1993, 3; 27.05.1994; 20.10.1994 - Tisza (between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 120. - Tisza (Tivadar): 05.07.1993, 2; 14.07.1996, 20; 15.07.1996, 10. - Tisza (between the mouth of River Túr and Tivadar): 01.07.1994, 15. - Tisza (the mouth of River Túr): 03.07.1993, 5. - Tisza (Vásárosnamény): 20.06.1995, 2. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 05.07.1994, 35.

17. Blicca bjoerkna Linnaeus, 1758

Little-Túr (Oxbow, Sonkád): 24.04.1993, 2. - Szamos (Vásárosnamény): 05.07.1993, 2; 06.07.1993, 1; 05.07.1994, 4. - Tisza (Lónya): 10.07.1993, 5; 11.07.1993, 10. - Tisza (between Tiszabecs and Tivadar): 11.05.1993; 02.10.1993, 1; 23.10.1993, 1; 27.05.1994 - Tisza (between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 1. - Tisza (Tivadar): 15.07.1996, 1. - Tisza (the mouth of River Túr): 30.06.1994, 1. - Tisza (Vásárosnamény): 20.06.1995, 1. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 5; 05.07.1994, 40. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 20. - Tisza-Lake (Kisköre): 01.12.1994, 1. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 3. - Túr (Sonkád): 24.11.1993, 1.

18. Abramis brama Linnaeus, 1758

Szamos (Vásárosnamény): 05.07.1994, 1. - Tisza (between Tiszabecs and Tiszacsécse): 15.03.1994, 10; 16.03.1994, 20; 17.03.1994, 4; 27.04.1994, 5; 28.04.1994, 3; 29.04.1994, 2; 23.04.1995, 7; 14.09.1995, 1; 29.04.1996, 3. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993; 23.10.1993, 1; 27.05.1994 - Tisza (Vásárosnamény): 17.07.1996, 1. - Tisza-Lake (Kisköre): 01.12.1994, 5. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 1. - Túr (Sonkád): 24.11.1993, 4.

19. Abramis ballerus Linnaeus, 1758

Tisza (between Tiszabecs and Tiszacsécse): 23.04.1995, 9.

20. Abramis sapa PALLAS, 1811

Szamos (Vásárosnamény): 05.07.1993, 5; 06.07.1993, 5; 05.07.1994, 3. - Tisza (Lónya): 10.07.1993, 5; 11.07.1993, 8. - Tisza (between Tiszabecs and the mouth of River Túr): 16.06.1995, 10. - Tisza (between Tiszabecs and Tiszacsécse): 27.04.1994, 1000; 28.04.1994, 600; 29.04.1994, 600; 25.06.1994, 1; 23.04.1995, 50; 15.06.1995, 80; 29.04.1996, 120. - Tisza (between Tiszabecs and Tivadar): 11.05.1993; 02.10.1993, 1; 27.05.1994 - Tisza (between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 20. - Tisza (Tivadar): 05.07.1993, 3; 15.07.1996, 15. - Tisza (the mouth of River Túr): 03.07.1993, 2. - Tisza (Vásárosnamény): 17.07.1996, 5. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 6; 05.07.1994, 100. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 1.

21.Vimba vimba Linnaeus, 1758

Tisza (between Tiszabecs and Tiszacsécse): 16.03.1994, 1; 14.09.1995, 1; 15.09.1995, 4; 16.09.1995, 1. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 1. - Tisza (between Tiszabecs and Tivadar): 27.05.1994.

22. Pelecus cultratus Linnaeus, 1758

Tisza (between Tiszabecs and Tiszacsécse): 28.04.1994, 1.

23. Chondrostoma nasus Linnaeus, 1758

Szamos (Vásárosnamény): 06.07.1993, 5; 21.06.1994, 30; 05.07.1994, 50. - Tisza (between Lónya and Tuzsér): 07.07.1994, 70. - Tisza (Lónya): 10.07.1993, 5; 11.07.1993, 15. - Tisza (between Tiszabecs and the mouth of River Túr): 27.06.1994, 150; 16.06.1995, 150. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 300; 01.10.1993, 150; 21.10.1993, 500; 22.10.1993, 300; 23.11.1993, 1. - 15.03.1994, 1000; 16.03.1994, 300; 17.03.1994, 50; 27.04.1994, 1000; 28.04.1994, 500; 29.04.1994, 500; 25.06.1994, 200; 26.06.1994, 70. - 15.03.1995, 150; 17.03.1995, 300; 23.04.1995, 90; 15.06.1995, 220; 14.09.1995, 500; 15.09.1995, 370; 16.09.1995, 350; 29.04.1996, 150. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 380. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993; 02.10.1993, 200; 23.10.1993, 250; 27.05.1994; 20.10.1994 - Tisza (Tiszabecs): 01.07.1993, 60. - Tisza (between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 50. - Tisza (Tivadar): 05.07.1993, 15; 14.07.1996, 3; 15.07.1996, 40. - Tisza (between the mouth of River Túr and Tivadar): 01.07.1994, 20. - Tisza (the mouth of River Túr): 03.07.1993, 15. - Tisza (Vásárosnamény): 20.06.1995, 30; 17.07.1996, 30. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 20; 05.07.1994, 400. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 3. - Túr (Sonkád): 24.11.1993, 1.

24. Tinca tinca Linnaeus, 1758

Little-Túr (Oxbow, Sonkád): 24.04.1993, 20.

25. Barbus barbus Linnaeus, 1758

Iza (Sighetu Marmaţiei): 25.04.1996, 15. - Szamos (Vásárosnamény): 06.07.1993, 15; 21.06.1994, 2; 05.07.1994, 25. - Tisza (between Lónya and Tuzsér): 07.07.1994, 15. - Tisza (Lónya): 11.07.1993, 25. - Tisza (between Tiszabecs and the mouth of River Túr): 27.06.1994, 30; 16.06.1995, 10. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 15; 01.10.1993, 15; 21.10.1993, 10; 22.10.1993, 10; 15.03.1994, 3; 17.03.1994, 2; 27.04.1994, 50; 28.04.1994, 50; 29.04.1994, 30; 25.06.1994, 20; 26.06.1994, 10; 15.03.1995, 4; 17.03.1995, 1; 15.06.1995, 10; 14.09.1995, 110; 15.09.1995, 160; 16.09.1995, 100; 29.04.1996, 2. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 20. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993; 02.10.1993, 10; 23.10.1993, 20; 27.05.1994; 20.10.1994 - Tisza (Tiszabecs): 01.07.1993, 13. - Tisza (between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 100. - Tisza (Tivadar): 05.07.1993, 15; 14.07.1996, 3; 15.07.1996, 5. - Tisza (between the mouth of River Túr and Tivadar): 01.07.1994, 1. - Tisza (the mouth of River Túr): 03.07.1993, 10. - Tisza (Vásárosnamény): 20.06.1995, 1; 17.07.1996, 2. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 30; 05.07.1994, 150.

26. Barbus peloponnesius petényi Heckel, 1847

Iza (Sighetu Marmației): 25.04.1996, 2. - Mara: 26.04.1996, 10. - Săpânța: 27.04.1996, 1. - Tisza (between Tiszabecs and the mouth of River Túr): 16.06.1995, 1. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 3; 01.10.1993, 1; 28.04.1994, 3; 29.04.1994, 2; 17.03.1995, 1; 23.04.1995, 1; 15.09.1995, 1; 16.09.1995, 1. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 2. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993 - 23.10.1993, 1; 27.05.1994; 20.10.1994 - Tisza (Tiszabecs): 01.07.1993, 2. - Tisza (Tivadar): 15.07.1996, 1.

27. Gobio gobio Linnaeus, 1758

Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 2. - Tisza (the mouth of River Túr): 03.07.1993, 5.

28. Gobio albipinnatus Lukasch, 1933

Szamos (Vásárosnamény): 06.07.1993, 1; 21.06.1994, 1. - Tisza (Lónya): 11.07.1993, 5. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 6; 01.10.1993, 2; 21.10.1993, 1; 22.10.1993, 6; 29.04.1994, 3; 15.03.1995, 2; 17.03.1995, 2; 14.09.1995, 3; 15.09.1995, 6; 16.09.1995, 1. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 3. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993; 02.10.1993, 1; 23.10.1993, 1; 27.05.1994; 20.10.1994 - Tisza (Tiszabecs): 01.07.1993, 3. - Tisza (between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 5. - Tisza (Tivadar): 05.07.1993, 3; 14.07.1996, 1; 15.07.1996, 2. - Tisza (the mouth of River Túr): 03.07.1993, 3.

29. Gobio uranoscopus Agassiz, 1828

Iza (Sighetu Marmației): 25.04.1996, 3.

30. Gobio kessleri Dybowski, 1862

Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 4; 27.04.1994, 1. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 3. - Tisza (between Tiszabecs and Tivadar): 20.10.1994 - Tisza (the mouth of River Túr): 03.07.1993, 1.

31. Pseudorasbora parva Schlegel, 1842

Tisza (Tivadar): 15.07.1996, 1. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 30.

32. Rhodeus sericeus amarus Bloch, 1782

Little-Túr (Oxbow, Sonkád): 24.04.1993, 4. - Szamos (Vásárosnamény): 06.07.1993, 3. - Tisza (between Lónya and Tuzsér): 07.07.1994, 3. - Tisza (Lónya): 06.07.1994, 1. - Tisza (between Tiszabecs and Tiszacsécse): 16.03.1994, 1. - 27.04.1994, 2. - 29.04.1994, 2. - 15.09.1995, 1. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 1. - Tisza (between Tiszabecs and Tivadar): 20.10.1994 - Tisza (Tivadar): 05.07.1993, 10. - Tisza (between Tokaj and Tiszalök): 14.07.1993, 10. - Tisza (the mouth of River Túr): 03.07.1993, 4. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 2. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 15. - Tisza-Lake (Kisköre): 01.12.1994, 1.

33. Carassius carassius Linnaeus, 1758

Little-Túr (Oxbow, Sonkád): 24.04.1993, 1; 15.09.1995, 2.

34. Carassius auratus Linnaeus, 1758

Little-Túr (Oxbow, Sonkád): 24.04.1993, 15. - Szamos (Vásárosnamény): 21.06.1994, 2. - Tisza (between Lónya and Tuzsér): 07.07.1994, 1. -Tisza (Lónya): 11.07.1993, 8. - Tisza (between Tiszabecs and Tiszacsécse): 27.04.1994, 1. - 28.04.1994, 3. - 29.04.1994, 1. - Tisza (the mouth of River Túr): 30.06.1994, 4. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 05.07.1994, 3. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 250. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 20. - Túr (Sonkád): 24.11.1993, 1.

35. Cyprinus carpio Linnaeus, 1758

C. carpio m. acuminatus

Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 05.07.1994, 3.

C. carpio m. hungaricus

Tisza (Tiszabecs): 01.07.1993, 1. - Tisza (between Tokaj and Tiszalök): 14.07.1993, 1. -

C. carpio m. nobilis

Little-Túr (Oxbow, Sonkád): 24.04.1993, 20; 15.09.1995, 10. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 40.

36. Hypophthalmichthys molitrix Valenciennes, 1844

Tisza (between Tiszabecs and Tiszacsécse): 15.03.1994, 1. - Tisza (between Tiszabecs and Tivadar): 23.10.1993, 1; 27.05.1994 - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 05.07.1994, 1. - Tisza-Lake (Kisköre): 01.12.1994, 5. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 1.

37. Aristichthys nobilis Richardson, 1836

Tisza (Tarpa): 07.07.1994, 1.

COBITIDAE

38. Barbatula barbatula Linnaeus, 1758

Iza (Sighetu Marmației): 25.04.1996, 5. - Mara: 26.04.1996, 25. - Săpânța: 27.04.1996, 15.

39. Misgurnus fossilis Linnaeus, 1758

Little-Túr (Oxbow, Sonkád): 15.09.1995, 1.

40. Cobitis taenia Linnaeus, 1758

Tisza (Tivadar): 05.07.1993, 1.

41. Sabanejewia aurata Filippi, 1865

Iza (Sighetu Marmației): 25.04.1996, 2. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 1. - Tisza (Tivadar): 14.07.1996, 1. - Tisza (Between Tokaj and Tiszalök): 14.07.1993, 1.

SILURIDAE

42. Silurus glanis Linnaeus, 1758

Szamos (Vásárosnamény): 05.07.1993, 30; 06.07.1993, 20; 21.06.1994, 20; 05.07.1994, 12. - Tisza (between Lónya and Tuzsér): 07.07.1994, 12. - Tisza (Lónya): 10.07.1993, 3; 11.07.1993, 3; 06.07.1994, 1. - Tisza (between Tiszabecs and the mouth of River Túr): 27.06.1994, 1; 16.06.1995, 1. - Tisza (between Tiszabecs and Tiszacsécse): 14.09.1995, 1; 15.09.1995, 3; 16.09.1995, 2. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 2. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993; 02.10.1993, 1. - Tisza (Tivadar): 15.07.1996, 2. - Tisza (the mouth of River Túr): 03.07.1993, 1. - Tisza (Vásárosnamény): 20.06.1995, 1; 17.07.1996, 20. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 2; 05.07.1994, 30.

ICTALURUDAE

43. Ictalurus nebulosus Lesueur, 1819

Tisza (the mouth of River Túr): 30.06.1994, 15.

THYMALLIDAE

44. Thymallus thymallus Linnaeus, 1758

Tisza (Tiszabecs): 16.03.1994, 1.

SALMONIDAE

45. Hucho hucho Linnaeus, 1758

Tisza (Milota): 15.03.1994, 1. - Tisza (between Tiszabecs and Tiszacsécse): 11.05.1993, 1; 27.04.1994, 1. - Tisza (Tiszabecs): 16.03.1994, 1; 23.04.1995, 1.

46. Salmo trutta m. fario Linnaeus, 1758

Iza (Sighetu Marmației): 25.04.1996, 7. - Săpânța: 27.04.1996, 12. - Tisza (between Tiszabecs and Tiszacsécse): 04.11.1992, 1.

ESOCIDAE

47. Esox lucius Linnaeus, 1758

Little-Túr (Oxbow, Sonkád): 24.04.1993, 10; 15.09.1995, 5. - Tisza (between Tiszabecs and Tiszacsécse): 01.10.1993, 1; 21.10.1993, 3; 22.10.1993, 1; 15.03.1994, 1; 27.04.1994, 1; 28.04.1994, 1; 25.06.1994, 1; 26.06.1994, 1; 14.09.1995, 1; 15.09.1995, 1; 29.04.1996, 1. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 5. - Tisza (between Tiszabecs and Tivadar): 02.10.1993, 2. - Tisza (between Tiszabecs and Tivadar): 11.05.1993; 23.10.1993, 2; 27.05.1994; 20.10.1994 - Tisza (between Tokaj and Tiszalök): 14.07.1993, 1. - Tisza (the mouth of River Túr): 03.07.1993, 3. - Tisza (Vásárosnamény): 20.06.1995, 1. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 3. - Tisza-Lake (Kisköre): 01.12.1994, 50. - Túr (between the Hungarian border and Sonkád): 16.03.1995, 25. - Túr (Sonkád): 24.11.1993, 30.

GADIDAE

48. Lota lota Linnaeus, 1758

Szamos (Vásárosnamény): 05.07.1993, 2; 06.07.1993, 3. - Tisza (Lónya): 10.07.1993, 1; 06.07.1994, 1. - Tisza (between Tiszabecs and the mouth of River Túr): 27.06.1994, 1. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 5; 01.10.1993, 3; 21.10.1993, 3; 22.10.1993, 1; 15.03.1994, 2; 16.03.1994, 1; 27.04.1994, 1; 25.06.1994, 4; 23.04.1995, 1; 15.06.1995, 1; 14.09.1995, 17; 15.09.1995, 14; 16.09.1995, 10. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 6. - Tisza (between Tiszabecs and Tivadar): 02.10.1993, 1; 04.11.1992; 11.05.1993; 27.05.1994 - Tisza (Tiszabecs): 01.07.1993, 4. - Tisza (between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 1. - Tisza (Tivadar): 05.07.1993, 8; 14.07.1996, 3; 15.07.1996, 5. - Tisza (the mouth of River Túr): 03.07.1993, 3. - Tisza (Vásárosnamény): 20.06.1995, 3; 17.07.1996, 20. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 1; 05.07.1994, 15.

CENTRARCHIDAE

49. Lepomis gibbosus Linnaeus, 1758

Tisza-Lake (Kisköre): 01.12.1994, 1.

PERCIDAE

50. Perca fluviatilis Linnaeus, 1758

Little-Túr (Oxbow, Sonkád): 24.04.1993, 8. - Szamos (Vásárosnamény): 06.07.1993, 3. - Tisza (Lónya): 10.07.1993, 5; 11.07.1993, 1. - Tisza (between Tiszabecs and the mouth of River Túr): 27.06.1994, 2. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 1; 01.10.1993, 1; 21.10.1993, 3; 22.10.1993, 2; 15.03.1994, 1; 16.03.1994, 1; 25.06.1994, 5;

26.06.1994, 3; 14.09.1995, 1; 15.09.1995, 3; 16.09.1995, 2. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 6. - Tisza (between Tiszabecs and Tivadar): 11.05.1993; 02.10.1993, 2; 27.05.1994; 20.10.1994 - Tisza (between Tokaj and Tiszalök): 14.07.1993, 3. - Tisza (the mouth of River Túr): 03.07.1993, 5. - Tisza (Vásárosnamény): 20.06.1995, 1; 17.07.1996, 2. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 3; 05.07.1994, 1. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 10. - Tisza-Lake (Kisköre): 01.12.1994, 1. - Túr (Sonkád): 24.11.1993, 1.

51. Gymnocephalus cernuus Linnaeus, 1758
Tisza (Tarpa): 07.07.1994, 1.

52. Gymnocephalus baloni Holeik & Hensel, 1974
Szamos (Vásárosnamény): 06.07.1993, 1. - Tisza (Lónya): 10.07.1993, 1; 11.07.1993, 1. - Tisza (between Tiszabecs and Tivadar): 11.05.1993 - Tisza (between Tokaj and Tiszalök): 14.07.1993, 2.

53. Gymnocephalus schraetzer Linnaeus, 1758
Szamos (Vásárosnamény): 06.07.1993, 1; 21.06.1994, 1. - Tisza (between Tiszabecs and the mouth of River Túr): 16.06.1995, 5. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 2; 01.10.1993, 1; 21.10.1993, 1; 22.10.1993, 1; 15.03.1994, 5; 16.03.1994, 1; 27.04.1994, 10; 28.04.1994, 3; 29.04.1994, 14; 15.03.1995, 1; 17.03.1995, 1; 23.04.1995, 7; 15.06.1995, 10; 14.09.1995, 2; 15.09.1995, 6; 16.09.1995, 3; 29.04.1996, 1. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 2. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993; 02.10.1993, 2; 23.10.1993, 1; 27.05.1994; 20.10.1994 - Tisza (Between Tivadar and Vásárosnamény-Gergelyiugornya): 03.07.1994, 4. - Tisza (Tivadar): 05.07.1993, 3. - Tisza (between the mouth of River Túr and Tivadar): 01.07.1994, 1. - Tisza (the mouth of River Túr): 03.07.1993, 1. - Tisza (Vásárosnamény): 20.06.1995, 10. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 05.07.1994, 4.

54. Stizostedion lucioperca Linnaeus, 1758
Szamos (Vásárosnamény): 06.07.1993, 1; 21.06.1994, 1; 05.07.1994, 1. - Tisza (between Lónya and Tuzsér): 07.07.1994, 1. - Tisza (Lónya): 10.07.1993, 1; 11.07.1993, 4. - Tisza (between Tiszabecs and the mouth of River Túr): 27.06.1994, 4. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 3; 01.10.1993, 1; 21.10.1993, 3; 22.10.1993, 3; 23.11.1993, 1; 15.03.1994, 1; 16.03.1994, 7; 17.03.1994, 1; 27.04.1994, 7; 28.04.1994, 8; 29.04.1994, 5; 25.06.1994, 3; 17.03.1995, 2; 23.04.1995, 3; 15.06.1995, 2; 14.09.1995, 1; 29.04.1996, 7; Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 1. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993; 23.10.1993, 2; 27.05.1994; 20.10.1994 - Tisza (Tiszabecs): 01.07.1993, 5. - Tisza (between Tivadar and Vásáros- namény-Gergelyiugornya): 03.07.1994, 2. - Tisza (Vásárosnamény): 20.06.1995, 1. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 1; 05.07.1994, 7. - Tisza-Gravel-pit pond (Milota): 15.09.1995, 60. - Tisza-Lake (Kisköre): 01.12.1994, 5.

55. Stizostedion volgensis Gmelin, 1788
Tisza-Lake (Kisköre): 01.12.1994, 1.

56. Zingel zingel Linnaeus, 1758

Szamos (Vásárosnamény): 06.07.1993, 1; 21.06.1994, 10; 05.07.1994, 1. - Tisza (between Lónya and Tuzsér): 07.07.1994, 1. - Tisza (Lónya): 10.07.1993, 1; 11.07.1993, 2. - Tisza (between Tiszabecs and the mouth of River Túr): 27.06.1994, 4; 16.06.1995, 8. - Tisza (between Tiszabecs and Tiszacsécse): 30.09.1993, 25; 01.10.1993, 15; 21.10.1993, 5; 22.10.1993, 4; 23.11.1993, 1; 15.03.1994, 7; 17.03.1994, 1; 27.04.1994, 15; 28.04.1994, 10; 29.04.1994, 7; 25.06.1994, 20; 26.06.1994, 6; 15.03.1995, 2; 23.04.1995, 4; 15.06.1995, 15; 14.09.1995, 17; 15.09.1995, 13; 16.09.1995, 12; 29.04.1996, 5. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 25. - Tisza (between Tiszabecs and Tivadar): 04.11.1992; 11.05.1993; 02.10.1993, 20; 23.10.1993, 15; 27.05.1994; 20.10.1994; Tisza (Tiszabecs): 01.07.1993, 7. - Tisza (between Tivadar and Vásárosnamény- Gergelyiugornya): 03.07.1994, 5. - Tisza (Tivadar): 05.07.1993, 2; 14.07.1996, 3; 15.07.1996, 10. - Tisza (Between Tokaj and Tiszalök): 14.07.1993, 1. - Tisza (between the mouth of River Túr and Tivadar): 01.07.1994, 1. - Tisza (the mouth of River Túr): 03.07.1993, 5. - Tisza (Vásárosnamény): 20.06.1995, 20; 17.07.1996, 1. - Tisza (between Vásárosnamény-Gergelyiugornya and Lónya): 09.07.1993, 1; 05.07.1994, 20.

57. Zingel streber Siebold, 1863

Tisza (between Tiszabecs and the mouth of River Túr): 16.06.1995, 1. - Tisza (between Tiszabecs and Tiszacsécse): 28.04.1994, 1; 25.06.1994, 1; 15.03.1995, 1; 17.03.1995, 1; 15.06.1995, 3; 14.09.1995, 3; 15.09.1995, 1; 16.09.1995, 2. - Tisza (between Tiszabecs and Tiszakóród): 18.10.1996, 1. - Tisza (between Tiszabecs and Tivadar): 11.05.1993; 27.05.1994; 20.10.1994 - Tisza (Tiszabecs): 01.07.1993, 1. - Tisza (between the mouth of River Túr and Tivadar): 01.07.1994, 1.

COTTIDAE

58. Cottus gobio Linnaeus, 1758
Mara: 26.04.1996, 10.

59. Cottus poecilopus Heckel, 1836
Mara: 26.04.1996, 1. - Săpânța: 27.04.1996, 10.

Conclusions

The most common species were Leuciscus cephalus, Alburnus alburnus and Chondrostoma nasus. The populations of some rare species are also stable: Alburnoides bipunctatus, Barbus peloponnesius petényi, Gymnocephalus schraetzer, Zingel zingel. However, the population of some species that are not protected, can be considered to be vulnerable: Rutilus pigus virgo, Carassius carassius, Gymnocephalus cernuus. The protection of our rare, endemic fauna element Rutilus pigus virgo would be reasonable. A few decades ago Carassius carassius was a common species in Hungarian water bodies, but during the last decade it became very rare. Wehave received information about its vulnerability and disappearance also from the bordering countries (conveyed by Bănărescu, P.).

Being a disappearing fauna element, its protection is also reasonable. Gymnocephalus cernuus has become the rarest Gymnocephalus species according to Hungarian experiences. We must pay attention to the changes of its population size. Mainly young individuals of the strictly protected Hucho hucho were found in Hungary. Five individuals were found during the samplings, and we suppose that it has a stable population beyond the Hungarian border, on the upper reach of the river. This is proved by the fact that the individuals were found mainly during floods. During late autumn they look for feeding places on the lower reach and this is why they arrive in Hungary. 21 of the 59 species caught are protected in Hungary. 15 of them were found in the river and its tributaries inside Hungary.

29 species are protected according to the Bern Convention. The upper reach of River Tisa and its tributaries provide feeding and spawning places for many fauna elements that are valuable from the point of view of nature conservation and the fish fauna. The protection of only the species themselves is not sufficient for the maintenance of the populations; what is reasonable is the protection of their habitats from water pollution.

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Biogeographical characterisation of Szatmár-Bereg plain based on the mollusc fauna

Tamás Deli & Pál Sümegi

Introduction

Connected to the biological inventory on the territory of the Hortobágy National Park Directorate in 1993 and 1994 we could investigate the land snail fauna in 20 of the Szatmár-Bereg Plain forests.

Besides the supply of data, we were looking for answers to some zoogeographical questions. From where and how can we trace the descent of snail fauna of the forests of Bereg Plain? Is the migration of the species still in process? What kind of connection is there between the faunas of the relatively close NE-Carpathians and the forests of the Bereg Plain.

Keywords: mollusc fauna, biogeography, Hungary

The inventory of the forests of the Szatmár-Bereg Plain

In the course of the field researches we collected soil samples for the malacological investigations according to the quadrat method (25x25x5 cm/quadrat). We usually took 10 samples in each forest. Besides the quadrat method we applied the bulk collection method.

We worked on 390 quadrats, from wich 3264 entities were examined. These entities belong to 43 species. 1000 entities are from the snail bulk collection method.

It is typical of the species-abundance of the Bereg Plain that 64% of the 74 species possibly found on the Great Plain can be traced here (Bába, 1983). The land-snail fauna of the plain is outstanding not only nationally but also on the Great Plain. Because of the relatively high percentage (11%) of the Carpathians species and the dominance of closed forest species the fauna of the plain hardly fits into the fauna of the dominant, forest-steppe vegetation of the Great Plain. It is reasoned by two facts, first the territory was covered with closed forests, second the origin of the Molluscs of the plain should be searched in the subcarpathian mountain ranges of the Easter-Carpathians.

The territory can be properly typized with a snail-community which consists of the following species: *Aegopinella minor, Cochlodina laminata, Clausilia pumila, Balea stabilis, Perforatella dibothrion, Perforatella vicina.* The coexistance of the first three and the last species on the Great Plain indicates that the region is touched by mountainous influences (eg. Bátorliget). The species which live only on one- or two spots are: *Discus perspectivus, Vitrea diaphana, Bielzia coerulans, Ruthenica filograna, Balea biplicata*. A similar place can be found along River Tisza, the Bagiszeg Forest. Its connection with the subcarpathion region is still ensured by Tisza. On the Szatmár Plain there is only one similar but poorer site, the Cserköz Forest near Magosliget. The undergrowth is rich in Carpathian *Crocus Heuffelianus* and the snail-community consisting of *Aegopinella minor, Cochlodina laminata, Clausilia pumila, Perforatella vicina* can be also found here. Since fauna of the similar kind cannot be seen anywhere else on the Szatmár Plain, we rank Cserköz Forest to the Bereg Plain from a zoogeographycal point of view.

The closeness of the Carpathians, the transportation-role of Tisza river, the relatively high vapour content and the cold mezoclimate determine the zoogeographical features of the plain (Bába, 1983).

Most of these forests are cut down and are replaced with pastures. Consequently the grassy biotops are secondary features of the plain. The spread of the snails in lack of rivers is very slow. Because of all these factors the land-snail fauna of these fields and pastures are very poor or in most of the cases "snail-free". The change is still in process and we can observe the sudden advance of termophilous and draught-resistante elements. A very good example of this advance is the appearance of the steppe "dweller" *Chondrula tridens* along the sides of the paved road leading through Lónyai-forest. A considerably greater expansion was achieved by the *Cepaea vindobonensis* partly along the pathes in the forests and partly in the bushes along the roads. The advance of this species started earlier and is still in process. This change -

Carychium minimum O. F. Müller, 1774	*Limax maximus* Linnaeus, 1758
Carychium tridentatum (Risso, 1826)	*Limax cinereoniger* Wolf, 1803
Succinea oblonga Draparnaud, 1801	*Lehmannia marginata* (O. F. Müller, 1774)
Succinea putris (Linnaeus, 1758)	*Bielzia coerulans* (M. Bielz, 1851)
Cochlicopa lubrica (O. F. Müller, 1774)	*Euconulus fulvus* (O. F. Müller, 1774)
Cochlicopa lubricella (Porro, 1838)	*Cochlodina laminata* (Montagu, 1803)
Columella edentula (Draparnaud, 1805)	*Ruthenica filograna* (Rossmässler, 1836)
Truncatellina cylindrica (Férrussac, 1807)	*Clausilia pumila* C. Pfeiffer, 1828
Vertigo angustior (Jeffreys, 1830)	*Laciniarai plicata* (Draparnaud, 1801)
Pupilla muscorum (Linnaeus, 1758)	*Balea biplicata* (Montagu, 1803)
Vallonia pulchella (O. F. Müller, 1774)	*Balea stabilis* (L. Pfeiffer, 1847)
Acanthinula aculeata (O. F. Müller, 1774)	*Bradybaena fruticum* (O. F. Müller, 1774)
Chondrula tridens (O. F. Müller, 1774)	*Perforatella bidentata* (Gmelin, 1788)
Punctum pygmaeum (Draparnaud, 1805)	*Perforatella dibothrion* (M. v. Kimakowicz, 1884)
Arion subfuscus (Draparnaud, 1805)	*Perforatella vicina* (Rossmässler, 1842)
Vitrina pellucida (O. F. Müller, 1774)	*Perforatella rubiginosa* (A. Schmidt, 1853)
Vitrea diaphana (Studer, 1820)	*Euomphalia strigella* (Draparnaud, 1801)
Vitrea crystallina (O. F. Müller, 1774)	*Chilostoma banaticum* (Rossmässler, 1838)
Vitrea contracta (Westerlund, 1871)	*Cepaea vindobonensis* (Férussac, 1821)
Aegopinella minor (Stabile, 1864)	*Helix pomatia* Linnaeus, 1758
Nesovitrea hammonis (Ström, 1765)	*Helix lutescens* Rossmässler, 1837
Zonitoides nitidus (O. F. Müller, 1774)	

Table 1. List of species collected by us on the Szatmár-Bereg Plain

in the lack of sufficient data about holocen fossil Molluscs - cannot be traced. The forests of the Tiszahát region represent the territory of great changes because of the antropogen-effects and the fact that the climate of the region becomes more and more arid. The forests of Szatmár died, so their undergrowth cannot be typized with the spring-time geophitons any more but with different grass species like *Alopecurus sp*. These events had a great effect on the land-snail fauna. The forest-species disappeared or the shells found reminded us to subfossil forms. While other species like *Pupilla muscorum, Vallonia pulchella* and *Truncatellina cylindrica* appeared.These species which are so typical of the areas, stand out from and do not fit into the species of a closed-forest on the Szatmár Plain. The Bereg Plain from this point of view is in a more favourable position, though changes can be also observed here and will strenghten. With the improvements of infrastructure probably irreversible changes will happen. With permanent monitoring we can easily follow these changes.

Carpathian effects on the fauna of the Bereg inselberg: Kaszony Hill

In the course of malakofaunistical examination of the Kaszony Hill we distinquished 7 typical biotops (in accordance with the things mentioned above). All of these forests are planted or naturally revived. We cannot find Molluscs on vineyards and on greens. In accordance with the biotopes we worked on 70 quadrats and determined 913 entities. Besides, 200 entities were collected with the bulk method. The list of species includes 23 taxons and hopefully it will be enriched with the number of the naked-snail species.

The examination proved that in comparison with the surrounding territories the land-snail fauna of the Kaszony Hill is very rich. The fauna of the Shoutheastern exposed bushes correspond to the snail communities of the zonal wooded-steppe vegetation of the Great Plain, with an element from the NE-n part of the Plain (*Helix lutescens*). The relationship can be traced between the enpoverished faunas of the southern hillsides and oak forest spreaded on the hill-country.

In the snail-faunas of the Eastern hill-sides in considerable proportion, we can find such fauna elements that recquire forest-environment. These are the Carpathian (*Balea stabilis, Perforatella vicina*), the middle-European species (*Vitrea diaphana,Vitrea contracta, Clausilia pumila, Balea biplicata*) and species that are wide-spread in mountain-ranges. This fauna combination is not typical of the Great Hungarian Plain. Even on the northern part of the Plain, which has great precipitation and mostly covered with forests, it can be considered irregular (esp. because of the presence of *Balea stabilis* and *Vitrea diaphana*). In our oppinion relationships can be traced between this fauna-combination and the one on the mountain-range of medium hight of the Carpathians. The land-snail fauna of the Kaszony Hill, although most of the species can be in the undisturbed forests of the surrounding plain-regions, still shows (in an ecological sense) features of an island fauna. It rises above its surrounding plain as an island in which faunas corresponding with 3 fauna-zones distinct from one another, have survived still in these days.

The recent microclimatic and malacological investigations (Sólymos, 1997, Sólymos-Nagy, 1997) suggest that the microclimate of the hill slopes has direct and indirect effects on molluscs. Direct effects are linked with the temperature and the relative humidity of the biotope. The interrelation between the air and the plants has an indirect effect: closed and transitional vegetation can keep an increase in humidity, which is favourable for molluscs. This interrelation is very important because plants as generative surface generate the microclimate and this microclimate provides many other living organisms, such as molluscs with proper conditions. It seems to us that some different microclimatic mosaics and lithobiomes (Huggett, 1995) developed on the slopes of Kaszony Hill, thus the different ecological habitat loving Mollusc species (e.g. open or shade loving communities) can live close to each other.

According to the qurtermalacological data (Sümegi-Szabó, 1992) similar mosaic-like habitat developed on these hill slopes during the Pleistocene when the "cold stage" taxa and "warm stage" taxa (Willis et al. 1995) could survive some different climatic changes in small approving environmental pockets (or *oasies*: Willis et al. 1998) therefore there were highly mixed communities in both flora and fauna. Thus these hillslopes were favourable places for temperate refugial populations, firstly Carpathian and Middle European forest elements.

Malakofaunistical evaluation of two floodplain forests

The *Chilostoma banaticum* species, according to our researches live on two floodplain regions of the Szatmár-Bereg Plain. It was first discovered by Bába (1969) in the Bagiszeg Forest belonging to a town of Vásárosnamény. Later it was also found in Szabó-füzes Forest near Tiszabecs (Fintha et al, 1993).

In the course of the biological inventory we collected samples from 8-8 quadrats, and a great amount of material was collected with the bulk method. On the two territories we found 26 species altogether which is more than 50% of the species found on the Szatmár-Bereg Plain. The common species almost without exception, are of SE-European, European and Carpathian expansion.

Most of the snails, living only near Bagiszeg, are species existing in European closed forests. All of the species living only in Tiszabecs are wide-spread holarctic and palearctic ones which favoure humid, watery biotops independetly from light intensity. The spectacular difference comes from the water-supply of the biotops. The odd thing is that we found twice as many entities in Bagiszeg as in Tiszabecs from the same amount of quadrats (8-8). This diversity cames from the great density of entities of the small-sized species, which is due to the luxuriant undergrouth and the thicker forest floor meaning a more favourable biotop for them.

According to our research besides *Chilostoma banaticum* as the dominant species - we can also find *Bradybaena fruticum, Helix pomatia, Cepaea vindobonensis* on the flood plain. In Bagiszeg *Perforatella bidentata, Perforatella vicina* enrich this community.

The nearest locality of the population of this species was found along River Tisza at the town Huszt (recently Ukraine).

On the basis of earlier assumptions the Bagiszeg substance was due to the result of a transport by River Szamos (Bába, 1969; Domokos, 1987). Their appearance on the banks of river Tisza and in Hungary near Tiszabecs questions this assumption. To sum it up, the population at Tiszabecs if not constantly but periodically, at the time of great floods is in connection with the population near Huszt. The population living in Bagiszeg forest probably has already detached from the mountain biotopes. The most evident explanation though is ecological, namely that the microclimate of the two examined territories are different.

	Bagiszeg Forest		**Tiszabecs Szabó-füzes**	
common species	**quadrat**	**sporadic**	**quadrat**	**sporadic**
Carychium minimum	200		4	
Succinea oblonga	1		1	
Succinea putris	1		1	
Cochlicopa lubrica	5		20	
Punctum pygmaeum	19		1	
Arion subfuscus	0	*	0	*
Zonitoides nitidus	1		5	
Limax maximus	0	*	0	*
Bradybaena fruticum	9		15	
Perforatella vicina	6		0	
Perforatella rubiginosa	2		6	
Chilostoma banaticum	5		8	
Cepaea vindobonensis	0	*	0	*
Helix pomatia	1		2	
Helix lutescens	0	*	0	*
only Bagiszeg				
Carychium tridentatum	30			
Vitrea crystallina	199			
Aegopinella minor	1			
Bielzia coerulans	0	*		
Cochlodina laminata	10			
Laciniaria plicata	1			
Perforatella bidentata	7			
only Tiszabecs				
Vitrea contracta			2	
Nesovitrea hammonis			6	
Euconulus fulvus			0	*
Euomphalia strigella			0	*
together	498			

Table 2. Valuation of the quadrats and sporadic data on two floodplain biotopes (Bagiszeg Forest, Szabó-füzes)

Summary

In the course of a 2 years long biological inventory carried out on the Szatmár-Bereg Plain, more than 4000 entities of land snails were identified and classified into 43 species. Consequently, we could enlarge our information about the range of land snail species with 218 data. On the basis of the outstanding 11% presence of Carphatian species within the 30% of Middle-European mountain elements found in the forests, we suggest that "*Praecarpathicum*", as a new distinctive zoogeographical unit should be introduced. This zoogeographical unit developed between the foothill of Carpathians and lowland region, around the Carpathian forested mountain region, which called *Carpathicum* (Soós, 1943). Some fragments of the Carpathicum can be found on the side of rivers which spring from Carpathian mountain. The hidrochor spreading Mollusc species can colonise in these closed forested fragments (*green corridor effect*: Deli et al. 1994). Probably, the Praecarpathicum is a biogeographical fluctuation zone of Carpathian and Central European shade-loving Molluscan elements where the forest habitat loving molluscs can spread in the favourable, warm and wet climatic cycles of Quaternary and they could survive in some small oasis-like spots, which were the rest of temperate forests (the *biogegoraphical islands of Carpathicum*), during the unfavourable, cold and dry climatic cycles.

The quartermalacological (Sümegi-Szabó, 1992) and recent malacological data suggest that some small diffusion forest spots developed in the Bereg Plain during the last glacial of Pleistocene. The shade-loving Mollusc elements (e.g. *Vestia turgida, Cochlodina laminata, Perforatella vicina*) could survive in these forest spots during the Weichselian glacial cold phases.Then these elements expanded from these small *oasis* spots (Willis et al 1998) at the transition of the lateglacial/postglacial time when an sharp and large increase developed in the temperature and humidity (Bennett et al. 1991, Kutzbach-Guetter, 1986, Willis et al. 1995).

Based on the radiocarbon-dated quartermalacological records (Sümegi-Hertelendi, 1998) the best place for refugial forest population could be found between the foothill and floodplain zone where higher temperature microclimate on the southern slope associated with more humid microenvironment. Similar situation developed in the region of Bereg Plain where a wet floodplain has surrounded some small volcanic hills (e.g. Tipet-hill at Barabás, Nagy-hill at Tarpa). Thus the effect of the slope morphology and base-rock: the altitudinal microclimatic gradients and mosaic microenvironments (lithobiomes) were favourable for developing of relict forest populations during the Pleistocene glacial times.

These results suggest that some important refugial spots of temperate trees with shade-loving mollusc species developed on the studied region. Although this forest refugial area was effectively an isolated community but importance of these refugial areas for both short-and long-term conservation of biodiversity cannot be overestimated (Willis, 1996). Thus present day diversity of the forest habitat loving fauna and flora on the Bereg Plain is probably related not only to its geographical situation (between the Carpathian mountains and the Great Hungarian Plain) and green corridor effects but also is refugial role.

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The third and most significant record of Chilostoma banaticum (Rossmässler, 1838) (= Helicigona banatica) in Hungary (Tiszabecs, floodplain of River Tisa)

Anikó Szabó & István Fintha

From 21st to 27th September 1992 we were busy surveying flora and fauna in the vicinity of Tiszabecs. One day Anikó Szabó found the species in the so-called Szabó-Willow-Grove in the floodplain (geographical coordinates: 48° 06’ 50" N, 22° 49’ 30" E). The observed great quantity of empty snail shells indicated a large population of the species. The population occupies a 100-200 m wide zone of the left-side bank of the river, starting at a 30-50 m distance from the riverbed. The habitat covers approximately 15 hectares. On the periphery of the biotope (on roughly 8-10 hectares) an average of 1-2 individuals were be found per square metre, and on a 5-6 hectare piece of the central area the mean number individuals was 2-25 (confirmed by data of joint census with Pál Sümegi, Kossuth Lajos University, Debrecen - Fintha - Sümegi et al. 1993).

According to our moderate counted-estimated data, *Helicigona banatica* (= *Chilostoma banatica*) can be found in a viable population of ten thousand or more individuals in the area.

The entire area of the floodplain is dominated by semi-cultivated character: there are planted walnut groves, wild-growing orchards (a mixture of plum-, apple-, walnut- and mulberry trees) in transition to softwood forests (Salicetum albae-fragilis), with the latter being present only in small fragments.

The vegetation patch inhabited by the highest density population of the snail is, curiously enough, a forest grove which either was planted in the middle of an ancient willow-poplar forest or had been a forest the management of which was discontinued. Presently it is mainly an Acacia grove (Robinietum) with some box-elder (*Acer negundo*). In its undergrowth elder-berry (*Sambucus nigra*), stinging nettle (*Urtica dioica*) and chickweed (*Stellaria media*) can be found sporadically.

Along its direct border a dense edge-vegetation preserves the microclimate of the habitat, which acts as a bottom of a glass bell, composed of a closed mass of Reynoutria japonica and false erdbirne (*Helianthus decapetalus*).

In the neighbouring vegetation we have found some individuals of the species, but none were found in the poplar plantation.

Other species of the snail fauna of the habitat in Tiszabecs (Fintha - Sümegi et al. 1993) are:

Carychium minimum (Müller, 1774)
Cochlicopa lubrica (Müller, 1774)
Vallonia pulchella (Müller, 1774)
Arion subfuscus (Draparnaud, 1805)
Zonitoides nitidus (Müller, 1774)
Bradibaena fruticum (Müller, 1774)
Euomphalia strigella (Draparnaud, 1801)
Cepaea vindobonensis (Férussac, 1821)
Helix pomatia Linnaeus, 1758
Helix lutescens Rossmässler, 1837

Chilostoma (=*Helicogonia*) *banaticum* (=*banatica*), a species of outstanding faunistical importance, is an endemism of the Carpathian Basin, being legally protected in Hungary. Its nature conservational value is 10.000 HUF. The habitat of this species should be designated as a protected area of national importance.

Reference

Fintha I.-Sümegi P.-Szilágyi G. (1993): A *Chilostoma banaticum* faj új élőhelye Magyarországon (A new biotope of Chilostoma banaticum in Hungary). - Malakológiai Tájékoztató, 12. pp. 29-33.

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Birds of the Ukrainian region of the Upper Tisa

Ludvik Potish

Introduction

During the past 7 years we examined the avifauna of River Tisa and some of its tributaries. The information collected makes it possible to look at the contemporary aviafauna of the River Tisa valley and some of the tributaries, and can help us obtain a current status of the ornithofauna of the basin. With the help of this publication we are trying to give the most complete annotated list of the ornithofauna of the investigated region.

Key words: birds, River Tisa region, Ukraine

Material and methods

We divided the Upper Tisa region into three parts.

Part 1 - includes two rivers which form River Tisa (rivers Chorna Tisa and Bila Tisa), and the section of River Tisa extending from Rachiv to Solotvino. At this section River Tisa is a typical mountain river and it flows between the ranges of Chornogora, Svidovec and Maramarosh.

Part 2 - includes the section of River Tisa extending from Solotvino to Korolevo. At this section the river runs through the Hust-Solotvin depression. The character of the river is mountainous but the river valley is much wider. Here there are many small arms which are isolated from the main river in the summer. Also, there are many small islands.

Part 3 - includes the section of River Tisa extending from Korolevo to Vilok. At this section the river runs in the Transcarpathian plain. The mountain ranges are far from the river, but the character of the river does not change. Large number of islands and arms form the typical landscape of River Tisa in the Transcarpathian plain.

In our work we used the point system of bird observation. In the summertime we floated on the river on catamarans to study the nesting waterfowl fauna. We used Stepanyan's classification during the systematic examination of the fixed birds. This classification is the one that is used by the majority of ornithologists in the former USSR. To avoid vast numbers and to simplify statements we used the definitions by Moshansky (1977).

Thus, based on staying vs. migrating we divided the birds into the following categories:

Vagrant: - species flying about, they can appear any time of the year;

Remigrant: - nesting species that, instead of flying across the area, come only to nest, and migrate away having finished nesting;

Hibernant: - winter species;

Transmigrant: - species that fly over, and definitely do not nest in the area;

Sedentary: - species that are always found in the area.

Results

On the whole we have focused our observations on bird species (see Table 1.) that characterize the avifauna of the River Tisa valley. We did not consider the complete list of Transcarpathian's ornithofauna but only those species which we have good knowledge about (Table 1.).

Strautman (1954) wrote that valleys are the main migratory routes during seasonal bird migration and notes that river valleys play an important role when birds need to cross mountain regions.

The valley of River Tisa is the largest migration flyway of the Rook (C. frugilegus) (Lugovoj, 1992). The Hust-Solotvin depression which we differentiated as Part 2, a is a place where Starlings regularly concentrate during the autumn migration. The valley of River Tisa has the most abundant and diverse avifaunava. Many of the birds species now exist only in this valley. Here we can see colonies of the Common Tern (Potish,1995), although back in the middle of the 20th century it was a nesting species in all Transcarpathian river valleys (Grabar , 1931). Two other tern species i.e. the Little Tern and the Black Tern nest in the valley of River Tisa.

We want to emphasize that the valley of River Tisa is under high anthropogenic pressure. Many of its elements have an impact on the near-water bird fauna. During 7 years of investigations we experienced a process of colonial nester Common Terns splitting into smaller groups. In 1991 this colony had 87 nests and was situated on a single island. Now they spread out on the whole Part 2 of River Tisa.

Because River Tisa is the biggest water area of the Carpathian region and an ecologically important area for many species of the ornithofauna during the nesting period and their seasonal migrations, we believe that it is necessary to include the River Tisa valley into the territories protected by the Ramsar Convention.

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Nr.	Species	Part 1	Part 2	Part 3	Status
1	*Gavia stellata*	+	+	+	*TRANS.,VAGANT*
2	*Podiceps ruficolis*		+	+	*REMIFRANT*
3	*P.nigricolis*		+	+	*REMIGRANT*
4	*P.auritus*			+	*REMIGRANT*
5	*P.grisseigena*			+	*REMIGRANT*
6	*P.cristatus*		+	+	*REMIGRANT*
7	*Phalacrocorax carbo*			+	*VAGANT*
8	*Botaurus stellaris*		+	+	*REMIGRANT*
9	*Ixobrychus minutus*		+	+	*REMIGRANT*
10	*Nycticorax nicticorax*			+	*rare REMIGRANT*
11	*Egretta alba*		+	+	*VAGANT*
12	*E.garzetta*		+	+	*VAGANT*
13	*Ardea cinerea*	+	+	+	*REMIGRANT*
14	*A.purpurea*	+	+	+	*VAGANT,rare REMIG.*
15	*Ciconia ciconia*	+	+	+	*REMIGRANT, TRANS.*
16	*C.nigra*	+	+	+	*REMIGRANT, TRANS.*
17	*Platalea leucorodia*			+	*VAGANT*
18	*Branta rufficolis*		+	+	*rare VAGANT*
19	*Anser anser*	+	+	+	*TRANSMIGRANT*
20	*A.fabalis*	+	+	+	*TRANSMIGRANT*
21	*A.albifrons*	+	+	+	*TRANSMIGRANT*
22	*A.erytropus*	+	+	+	*TRANSMIGRANT*
23	*Cygnus olor*	+	+	+	*rare TRANSMIGRANT*
24	*Anas platyrhynchos*	+	+	+	*REMIGRANT, HIBERNANT, TRANSMIGRANT*
25	*A.crecca*		+	+	*REMIGRANT, TRANSMIGRANT*
26	*A.strepera*			+	*rare REMIGRANT*
27	*A.penelope*		+	+	*TRANSMIGRANT*
28	*A.acuta*		+	+	*TRANSMIGRANT*
29	*A.querquedula*		+	+	*REMIGRANT, TRANSMIGRANT*
30	*A.clypeata*			+	*rare REMIGRANT, TRANSMIGRANT*
31	*Aythya ferina*		+	+	*rare REMIGRANT, TRANSMIGRABT*
32	*A.nyroca*			+	*rare TRANSMIGRANT*
33	*A.fuligula*		+	+	*rare REMIGRANT, TRANSMIGRANT*
34	*Bucephala clangula*		+	+	*TRANSMIGRANT*
35	*Mergus serrator*	+	+	+	*TRANSMIGRANT*
36	*M.merganser*	+	+	+	*TRANSMIGRANT*
37	*Pernis apivorus*	+	+		*REMIGRANT*
38	*Milvus migrans*		+	+	*REMIGRANT*
39	*Circus cyaneus*		+	+	*REMIGRANT, TRANSMIGRANT*
40	*C.pygargus*		+	+	*REMIGRANT, TRANSMIGRANT*
41	*Accipiter gentilis*	+	+	+	*SEDENTAR*
42	*A.nisus*	+	+	+	*SEDENTAR*
43	*Buteo lagopus*	+	+	+	*HIBERNANT*

Table1. Species composition and status of bird communities of the River Tisa

Nr.	**Species**	**Part 1**	**Part 2**	**Part 3**	**Status**
44	*B.Buteo*	+	+	+	*REMIGRANT*
45	*Aquila pomarina*	+	+	+	*REMIGRANT*
46	*A.chrysaetos*	+			*SEDENTAR*
47	*Falco peregrinus*		+	+	*REMIGRANT*
48	*F. subbuteo*		+	+	*REMIGRANT*
49	*F.vespertinus*		+	+	*REMIGRANT*
50	*F.tinunculus*	+	+	+	*REMIGRANT*
51	*Perdix perdix*		+	+	*SEDENTAR*
52	*Coturnix coturnix*		+	+	*REMIGRANT, TRANSMIGRANT*
53	*Phasianus colchicus*			+	*SEDENTAR*
54	*Grus grus*	+	+	+	*TRANSMIGRANT*
55	*Rallus aquaticus*		+	+	*REMIGRANT*
56	*Porzana porzana*		+	+	*REMIGRANT*
57	*P.parva*		+	+	*REMIGRANT*
58	*Crex crex*		+	+	*REMIGRANT*
59	*Gallinula chloropus*		+	+	*REMIGRANT*
60	*Fulica atra*	+	+	+	*REMIGRANT, rare TRANSMIGRANT*
61	*Charadrius dubius*		+	+	*REMIGRANT*
62	*Vanellus vanellus*	+	+	+	*TRANSMIGRANT, REMIGRANT*
63	*Tringa glareola*		+	+	*TRANSMIGRANT*
64	*T.nebularia*		+	+	*TRANSMIGRANT*
65	*T.totanus*		+	+	*TRANSMIGRANT*
66	*Actitis hypoleucos*	+	+	+	*REMIGRANT*
67	*Lymnocryptes minimus*		+	+	*TRANSMIGRANT*
68	*Gallinago gallinago*		+	+	*TRANSMIGRANT, REMIGRANT*
69	*Scolopax rusticola*	+	+	+	*REMIGRANT*
70	*Limosa limosa*		+	+	*TRANSMIGRANT*
71	*Larus ridibundus*	+	+	+	*TRANSMIGRANT, HIBERNANT*
72	*L.argentatus*		+	+	*VAGANT, HIBERNANT*
73	*L.canus*		+	+	*VAGANT, HIBERNANT*
74	*Chlidonias niger*		+	+	*REMIGRANT*
75	*Sterna hirundo*		+	+	*REMIGRANT*
76	*St.albifrons*			+	*REMIGRANT*
77	*Columba palumbus*	+	+		*REMIGRANT*
78	*C.oenas*	+	+		*REMIGRANT*
79	*C.livia*	+	+	+	*SEDENTAR*
80	*Streptopelia decaocto*		+	+	*SEDENTAR*
81	*Str.turtur*		+	+	*REMIGRANT*
82	*Cuculus canorus*	+	+	+	*REMIGRANT*
83	*Bubo bubo*	+		+	*SEDENTAR*
84	*Asio otus*	+	+	+	*SEDENTAR*
85	*A.flammeus*		+	+	*REMIGRANT*
86	*Athene noctua*	+	+	+	*SEDENTAR*
87	*Strix aluco*	+	+	+	*SEDENTAR*
88	*S.uralensis*	+	+	+	*SEDENTAR*
89	*Tyto alba*		+	+	*SEDENTAR*
90	*Apus apus*	+	+	+	*REMIGRANT*

Table 1. continue

Nr.	Species	Part 1	Part 2	Part 3	Status
91	*Alcedo atthis*	+	+	+	*REMIGRANT, rare HIBERNANT*
92	*Merops apiaster*			+	*REMIGRANT*
93	*Upupa epops*		+	+	*REMIGRANT*
94	*Jynx torquila*		+	+	*REMIGRANT*
95	*Picus viridis*	+	+	+	*SEDENTAR*
96	*P.canus*	+	+	+	*SEDENTAR*
97	*Dryocopus martius*	+	+		*SEDENTAR*
98	*Dendrocopos major*	+	+	+	*SEDENTAR*
99	*D.syriacus*		+	+	*SEDENTAR*
100	*D.minor*		+	+	*SEDENTAR*
101	*Riparia riparia*		+	+	*REMIGRANT*
102	*Hirundo rustica*	+	+	+	*REMIGRANT*
103	*Delichon urbica*	+	+	+	*REMIGRANT*
104	*Galerida cristata*		+	+	*REMIGRANT*
105	*Alauda arvensis*		+	+	*REMIGRANT*
106	*Eremophila alpestris*				*HIBERNANT*
107	*Motacilla flava*			+	*REMIGRANT*
108	*M.cinerea*	+			*REMIGRANT*
109	*M.alba*	+	+	+	*REMIGRANT*
110	*Lanius collurio*	+	+	+	*REMIGRANT*
111	*L.excubitor*		+	+	*REMIGRANT, rare HIBERNANT*
112	*Oriolus oriolus*		+	+	*REMIGRANT*
113	*Sturnus vulgaris*	+	+	+	*TRANSMIGRANT, REMIGRANT*
115	*Garrulus glandarius*	+	+	+	*SEDENTAR*
116	*Pica pica*	+	+	+	*SEDENTAR*
117	*Nucifraga caryocatactes*	+			*SEDENTAR*
118	*Corvus monedula*	+	+	+	*TRANSMIGRANT, SEDENTAR*
119	*C.frugilegus*		+	+	*TRANSMIGRANT, REMIGRANT*
120	*C.corone*	+	+	+	*SEDENTAR*
121	*C.corax*	+	+	+	*SEDENTAR*
122	*Bombicilla garrulus*		+	+	*HIBERNANT*
123	*Cinclus cinclus*	+	+		*REMIGRANT, rare HIBERNANT*
124	*Troglodites troglodites*	+	+	+	*REMIGRANT, HIBERNANT*
125	*Prunella modularis*	+	+	+	*REMIGRANT*
126	*Silvia atricapilla*	+	+	+	*REMIGRANT*
127	*S. borin*		+	+	*REMIGRANT*
128	*S.curruca*		+	+	*REMIGRANT*
129	*Phylloscopus collybita*	+	+	+	*REMIGRANT*
130	*Ph.trochilus*	+	+	+	*REMIGRANT*
131	*Regulus regulus*	+	+	+	*SEDENTAR*
132	*Ficedula hypoleuca*		+	+	*REMIGRANT*
133	*F.albicollis*		+	+	*REMIGRANT*
134	*Muscicapa srtiata*		+	+	*REMIGRANT*
135	*Saxicila torquata*		+	+	*REMIGRANT*
136	*Oenanthe oenanthe*			+	*REMIGRANT*

Table 1. continue

Nr.	Species	Part 1	Part 2	Part 3	Status
137	*Phoenicurus ochruros*	+	+	+	*REMIGRANT*
138	*Erithacus rubecula*	+	+	+	*REMIGRANT, rare HIBERNANT*
139	*Luscinia megarinchos*		+	+	*REMIGRANT*
140	*L.luscinia*		+	+	*REMIGRANT*
141	*Turdus pilaris*		+	+	*REMIGRANT, HIBERNAT*
142	*T.torquatus*	+			*REMIGRANT*
143	*T.merula*	+	+	+	*REMIGRANT, HIBERNANT*
144	*T.iliacus*		+	+	*REMIGRANT*
145	*T.philomelos*		+	+	*REMIGRANT*
146	*T.viscivorus*		+	+	*REMIGRANT*
147	*Aegithalos caudatus*	+	+	+	*SEDENTAR*
148	*Remiz pendulinus*			+	*REMIGRANT*
149	*Parus palustris*		+	+	*SEDENTAR*
150	*P.montanus*	+	+	+	*SEDENTAR*
151	*P.cristatus*	+			*SEDENTAR*
152	*P.ater*	+	+	+	*SEDENTAR*
153	*P.caeruleus*		+	+	*SEDENTAR*
154	*P.major*	+	+	+	*SEDENTAR*
155	*Sitta europea*	+	+	+	*SEDENTAR*
156	*Certhia familiaris*	+	+	+	*SEDENTAR*
157	*Passer domestica*	+	+	+	*SEDENTAR*
158	*P.montanus*	+	+	+	*SEDENTAR*
159	*Fringilla coelebs*	+	+	+	*REMIGRANT, rare HIBERNANT*
160	*F.montifringilla*	+	+	+	*HIBERNANT*
161	*Serinus serinus*	+	+	+	*SEDENTAR*
162	*Chloris chloris*		+	+	*SEDENTAR*
163	*Spinus spinus*	+	+	+	*SEDENTAR*
164	*Carduelis carduelis*	+	+	+	*SEDENTAR*
165	*Acanthis cannabina*		+	+	*SEDENTAR*
166	*Pyrrhula pyrhula*	+	+	+	*rare REMIGRANT, HIBERNANT*
167	*Coccothtaustes coccothraustes*		+	+	*SEDENTAR*
168	*Emberiza citrinella*	+	+	+	*SEDENTAR*

Table 1. continue

Vertebrates of the Subcarpathian section of the River Tisa flood area (Ukraine)

Gyula Krocskó

In fulfillment of the requirements set down by the Ramsar Convention, a study of vertebrates along the River Tisa basin in Subcarpathia was performed. The study addressed only amphibians, reptiles and mammals.

On the basis of our study we can summarize the results as follows:

Instead of suffering from human impact, vertebrates of the flood area are diverse and are in abundance.

The distribution of the species is as follows: amphibians, reptilians and mammals.

The abundance of species is characteristic of the river valley, and is in accordance with the heterogeneity of the environment.

The number of species varies along the river and the vertebrate fauna is the most abundant and diverse in the submontainous reaches.

Keywords: vertebrates, River Tisa, flood area

Results

Amphibians/*Amphibia*

Fire salamander *Salamandra salamandra* Laur. This species was found in the mountainous region (around 150-1500 m altitude, above Baltic sea level), near the stony and rocky environment of the riverside. Their activity begins at nightfall and in wet weather in daylight hours also. Their reproductive period lasts from April to November. They are viviparous animals. They are useful amphibians; a cutaneous gland excreta is a valuable material in pharmacology. Athough it was found to be a frequent species in the Transcarpathian region, it is registered as a threatened species in the Ukrainian Red Book.

Smooth newt *Triturus vulgaris* L. One of the most abundant amphibians in the River Tisa flood area. The species is frequent in regions 600-700 m above sea level. Different small lotic basins, brooks and other shallow riverine habitats where found as their environment. They activa at night and they are useful, insectivorous animals. The protection of this species is recommended.

Carpathian newt *Triturus montandoni Boulenger*. It is one of the characteristic species of the Transcarpathian region, generally found at 150-2000 m altitude above see level. It is encountered frequently in the its reproductive period in different wetland habitats of the flood area. It is a relatively small-sized species without a crest. The end of its tail is elongated. This useful species is registered in the Ukrainian Red Book.

Crested newt *Trirurus cristatus Laurenti*. This species is distinct from T. montandoni with its verrucosus skin surface. The species is found in areas situated at not higher than 250 m above see level. Its way of life is similar to that of T. vulgaris.

Alpine newt *Triturus alpestris Laurenti.* This rare species lives in areas of the flood area that are situated higher than 400 m above see level. Their way of life is similar to that of T. montandoni. It was found in shaded mountainous brooks, rivers, pools. Its distribution is sporadic, therefore its registration in the Ukrainian Red Book is recommended.

Fire-bellied toad *Bombina bombina L.* One of the smallest and rarest anurans of the flood area, found in small pools, backwaters and canals. It is distributed only in lands lower than 120 m altitude above see level. Like all amphibians they are insectivores, and have daylight activity. This useful species is recommended for protection.

Yellow-bellied toad *Bombina variegata L.* Its size is similar to B. bombina, but its abdomen is marked with yellow patches. It is a very abundant species, which was found in the backwaters and other small wetlands up to 1800 m altitude above sea level. Its biology is also similar to that of B. bombina. This very useful species is recommended for protection.

Common spadefoot toad *Pelobates fuscus Laurenti.* It is a middle-sized species, the internal part of its hind foot fingers is verrucosous. The product of its cutaneous gland smells slightly like garlic excreta. It was found only in the lower section of the Upper Tisa. It is a rare species and is recommended for protection.

Common toad *Bufo bufo L.* It is the greatest anuran species in Ukraine, of 83 mm length, weighing 150 gr. Females are generally larger then males. Their colour is greenish brown or dark grey. It is one of the common species of the flood area, distributed up to around 1300 m altitude above sea level. Their optimal habitats are wet oak forests and orchards, potato plantations. Its reproductive period is in March-April, when they breed in stagnant waters. They are usually insectivorous, but occasionally they can consume smaller mammals and birds. It is a very useful species that is recommended for protection.

Green toad *Bufo viridis Laurenti*. It is similar to B. bufo concerning its biology and distribution. It is a useful species recommended for protection.

Common tree frog *Hyla arborea L.* It is one of the small frog species found in Ukraine. It is different from the others bearing emerald-green colour and having suction pads on the tip of its fingers. It is a characteristic species of the lower part of Upper Tisa flood area. It lives mainly in forests and bushes, and in orchards and vineyards as well. They hunt for food in foliage and prefer leaf-beetles. They are active from March to November. It is a useful species which is recommended for protection.

Marsh frog *Rana ridibunda Pall.* It is one of the greatest frog species in Ukraine, similar to R. lessonae, but lacking isolated yellow marking on the hind feet. It is distributed only up to the submountainous region of the flood area, sometimes in abundance. It is usually insectivorous, but it consumes small fish occasionally. Its importance is questionable. In some places it is useful, in some other it is considered a pest. It is recommended for protection.

Pool frog *Rana lessonae Camerano.* Its body is smaller and slimmer then those of R. ridibunda, and its legs are shorter as well. It is one of the most abundant frog species of the flood area. It lives mainly in pools covered with floating vegetation and in other wetlands. It is insectivorous, 60% of its food is made up of species that are harmful for human activity. Its gastonomical importance could be important.

Common frog *Rana temporaria L.* It is a typical forest-dwelling species. Its back is from brownish to yellow-brownish. A deep brown streak can be seen extending from the eye to the hind leg, along its back. It was found in woody and bushy habitats of the flood area. During its reproductive period, they gather in brooks and pools. It is a useful species recommended for protection.

Moor frog *Rana arvalis Nilsson*. This species was found in similar habitats to that of the former species. Its numbers have drastically decreased in the past years and it is now registered in the Ukrainian Red Book.

Agile frog *Rana dalmatina Bonaparte.* It lives in the deciduous forests of the flood area. It has a characteristic leg that is longer than body length. It has been registered in the Ukrainian Red Book as a rare species.

Reptilians/*Reptilia*

Ten species were found in the flood area of the Upper Tisa.

European pond terrapin *Emys orbicularis L.* It is found in the lower part of the flood area. This rare species lives sporadically in stagnant waters, oxbow lakes, canals and marshes. Its food consists of varied insects, molluscs, amphibians, as well as fish and aquatic weeds. This species is of no economic importance, but is decreasing in abundance as a result of human activities. As a rare species, it has been registered in the Ukrainian Red Book.

Slow-worm *Anguis fragilis L*. It is a legless lizard. In contrast with snakes, its tail is blunt and it has moveable eyelids. Its body is reddish-brown, sometimes bronze or copper-coloured. All sections of the Upper Tisa flood plain can serve as its habitat. It is usually observable in the edges or clearings of forests with ferns and stones. It is insectivorous and is a useful species recommended for protection.

Green lizard *Lacerta viridis L*. It is one of the rarest species of the flood area. It is found only in Chorna Hora (conservation area) near Vinogradiv, and in the Hust and Berehovo districts. It is the largest lizard species of Transcarpathia, with a length of 127 mm, without tail. It was found mainly in bushy, rocky and stony habitats. A considerable part of its food is insects, but it consumes young mice occasionally. It is a protected species.

Sand lizard *Lacerta agilis L*. It is the most frequent lizard of the Upper Tisa flood area. Sexual dimorphism in colouration can be observed as well. This species was found mainly in bushy, rocky and stony habitats. It is insectivorous; there are lot of pests and insects in its diet. This useful species is recommended for protection.

Viviparous lizard *Lacerta vivipara Jacquin*. This species can be found in the mountainous reaches of the flood area, at altitudes of more than 650-700 m above see level. Generally it lives along brooks, in the edge of forests, in alpic areas and young forest clearings as well. It is a useful species which is recommended for protection.

Grass snake *Natrix natrix Laurenti*. It is one of the most frequent species of the flood plain. Its body length is more than 1 m (max. 1.4 m). It has characteristic yellow or orange markings on the head. The upper part of its body is from light grey to dark grey or olive, adapting to different environmental conditions. It was found mainly along the banks of rivers, brooks, small lakes, on dykes and in forestation clearings. Generally it feeds on amphibians and insects, and it consumes fishes as well.

Dice snake *Natrix tessellata Laurenti*. Its body lengths reaches 930 mm. The colour of its body varies from olive to black; the ventral side is orange with black markings. It is a common species of the River Tisa flood plain, occurring mainly in the lowland and submontainous regions where it is frequently found on the stony banks of streams. This species consumes fish and frogs. Its distribution is sporadic.

Aesculapian snake *Elaphe longissima Laurenti.* It is the largest grass snake of the River Tisa basin. Its body length can reach 2 m. Its ventral side is white or yellow. It is found in the submountainous sections, mainly in thin beech woods, shrubs, forest edges and stony places as well. Its diet consists of birds, mice, voles, and shrews. It is a useful species, but its populations have decreased in the last few years, and it is therefore recommended to be added to the Ukrainian Red Book.

Smooth snake *Coronella austriaca Laurenti*. It is a medium sized grass snake with brown, rust-brownish colours. They prefer deciduous, stony forests, shrubs and forest clearings. They feed on reptiles, mainly lizards, and snakes, too at times. Cannibalism is frequent in this species. It is a rare species noted in the Ukrainian Red Book.

Adder *Vipera berus L*. A triangle-shaped head is its primary characteristic. Its body is squat and the tail is short. Body colouration ranges from grey to rust-brown or black. The adder belongs to the mountain foest ecotype in the Upper Tisza area. In the highlands its primary habitats were forest clearings, shrubs, blueberry bushes. It feeds on smaller rodents and occasionally on lizards. Its bite is dangerous to humans.

Mammals/*Mammalia*
Insectivores/*Insectivora*

Hedgehog *Erinaceus europaeus «concolor» Martin*. This species is our largest insectivorous mammal. It is a common species of deciduous forests, shrubs, orchards and vineyards. This species is a 'visitor animal' in the flood area, therefore it is rare here. It feeds on all smaller animals: molluscs, insects and mammals, and fruits, mushrooms as well. It is a very useful species recommended for protection.

Mole *Talpa europaea L.* It is a typical insectivorous mammal which is frequent in the flood area. Its body formation is adapted for living underground. It lacks auricles, and its eyes are vestigial. The forelegs are used for digging. It usually feeds on insects, but it is generally viewed as unwanted in gardens and fields.

Pygmy shrew *Sorex minutus L*. It is one of the smallest mammals of this area. and it is quite rare here. It lives in meadows, and feeds on insects, snails and earthworms. It is a protected species.

Common shrew *Sorex araneus L*. It is our most frequent and prolific shrew species. It occurs in old forests where there are decaying woods and vegetation and an abundance of food sources. It is a nocturnal animal feeding on insects and snails. It is a useful animal which should be protected.

Alpine shrew *Sorex alpinus Schinz.* It is an inhabitant of mountainous and submontane regions of the flood area. Its biotope is pinewoods, and deciduous forests on occasion. Like other shrew species, it takes shelter in decayed trees, subshrubs and under dry leaves were it can usually be found. It is a useful species listed in the Ukrainian Red Book.

Water shrew *Neomys fodiens Schreb.* It is our largest shrew species. Its colour is deep brown-black on the dorsal side and dirty-white on the underparts. It is thought to settle down near water basins; it has been noted to be good swimmer. It feeds on insects, snails, earthworms and fishes sometimes. It is a nocturnal species but it appears at dayltime, too. It is a useful and protected species.

Miller's water shrew *Neomys anomalus Cabrera.* It is smaller than the water shrew but their markings are similar. The biology of this species is the same as that of the the previous one. It is found in smaller numbers and its distribution is not uniform. It is an infrequently seen shrew species. It has been registered in the Ukrainian Red Book.

White-toothedshrew *Crocidura leucodon Hermann.* It is a medium-sized shrew species. Its fur is brown on top and white underneath. These two colours separate quite distinctly. It is a ubiquitous inhabitant of the flood areas along River Tisa. It is also found in dry areas. It is found in gardens, meadows and buildings, too. Their reproduction does not got a fix time, and can take place any time between May and August. This shrew eats insects mainly. It is a useful mammal that must protected.

Lesser white-toothed shrew *Crocidura suaveolens Pallas.* It is like the previous species, but it is not as big. The stomach (abdomen) becomes white in winter. In contrast to the other shrews it prefers cultivated fields. Sometimes it withdraws to different buildings. The den is made from hay. They reproduce once a year. They feed on various isects. They are useful mammals which must be protected.

Bats/*Chiroptera*

There are many species of Chiroptera in the flood area of River Tisa. This region is primarily a hunting territory for such bats as Rinolophus hipposideros, Rinolophus ferrum-equinum, Myotis oxignatus, Myotis myotis, Myotis mystacinus, Plecotus autitus L., Plecotus austriacus Fischer, Nyctallus noctula Schreb., Pipistrellus pipistrellus Schreb., Pipistrellus nathusii, Eptesicus seritinus, Myotis daubentoni K?hl. These bats nest in hollow trees next to the flood plain.

Daubenton's bat *Myotis daubentoni Kühl*. It is a medium-sized bat with proportionate ears. Usually it lives alone or in small groups. In the daytime it finds shelter in hollows or in attics of houses. Its activity starts at nightfall. The hunting territories are near water. This bat frequently flies above the water surface. A part of the population migrates in winter, while others hibernate in warm hollows, caves or cavities of buildings. This species feeds on tiny insects. It is a very useful species which must be protected.

Common long-eared bat *Plecotus auritus L.* It is an average-sized bat with long ears (35-39 mm). It lives alone or in small groups. Its hiding places are hollows, wood-stocks, and attics of buildings, and larger underground cavities. This species stays in the same area for several years. It hibernates from the second half of November to the middle of March. It eats large quantities of insects and is therefore a very useful animal. This species is under protection.

Grey long-eared bat *Plecotus austriacus Fischer.* It is a bit larger than the common long-eared bat. This species is grey, the ears are bordered by a dark stripe, the first finger of the wing is short. Its way of life is the same as that of Plecotus autitus L. This species is under protection.

Noctule *Nyctallus noctula Schreb.* It is one of the largest bat species. Usually it lives in large groups. Its hiding places are hollows. It is seldom found in buildings in wintertime. It feeds on a variety of insects. It lives in colonies. It is a protected species.

Pipistrelle *Pipistrellus pipistrellus Schreb.* It is our smallest bat species. It lives in colonies, often sharing the same hiding place with noctules. This bat is a migratory species. It is a useful bat species requiring protection.

The remaining bat species in the area are also very useful small mammals which are registered in the Ukrainian Red Book. Because they are migratory species, we recommend their international protection.

Carnivores/*Carnivora*

Pine marten *Martes martes L.* It is a relatively small carnivore. This species lives in deciduous forests throughout the year. It makes a nest in tree hollows. Martens are active at nightfall and at night hours. They hunt on smaller mammals such as mice, shrews, dormice, and birds. They also eat forest fruits. Their fur is very valuable. Hunting on martens is limited.

Beech marten *Martes foina Erxleb.* It is like the previous species but is has a white patch extending from the neck onto the forelegs. There is no fur on its footpads. It lives in rocky and stony areas of the flood area along River Tisa, often in the neighbourhood of people. This species has been found to build its den in attics, crevices or slits and stone-stacks on buildings. Although it moves fast in the trees, it hunts on the ground and it feeds on various rodent species. Its fur is very valuable. Hunting of them is limited.

Polecat *Mustela putorius L.* Polecats are slimmer than martens. There is a black mask around the eyes and on the forehead. There is a white border on its ears. Its colouration along its side is dark-brown to black. Usually it lives near people in the flood area of River Tisa. It feeds mainly on fish and amphibians. It causes damage to poultry stocks. Its fur is of quite good quality, therefore polecats are hunted.

Mink *Mustela lutreola L.* Its size and body form is similar to those of the polecat. The fur of this species is usually of various shades of brown, but there are white spots on its lips. It lives next to water. It has webbed feet. It lives along fast-flowing creeks in the mountains. The main items of mink diet are fish, amphibians and small rodents, but when food is limited, it eats insects as well. It is an infrequently seen and protected mammal. It is registered in the Ukrainian Red Book.

Weasel *Mustela nivalis L.* This species is our smallest carnivorous mammal. Its fur is brown in summer except for the abdomen. In winter it is totally white. It has a thin and slim body. It exists in the plain and submountains in the flood area of River Tisa. It eats mice and voles. Sometimes it attacks young rabbits and pheasants as well. It is a useful small mammal which must be protected.

Stoat *Mustela erminea L.* It is a bit larger than the weasel. It is different from the weasel in its white-tipped tail which remains so both in summer and winter. It is a very cautious animal. This is a very infrequently found species in the flood area of River Tisa. It feeds on mice and voles. This species is one of the most useful animals, which is protected and has been registered in the Ukrainian Red Book.

Badger *Meles meles L.* The badger is a medium-sized mammal. Its fur is coarse and long. Black stripes run through its eyes to the ears on both sides of the white head. It has white tail and black legs. This species is not indigenous to the flood area of River Tisa. It builds its underground den with multiple entrances hidden in the stony and rocky mountains or alpine areas. It is a very tidy animal; it always cleans its den and leaves its waste in specific places. It eats insects, earthworms, molluscs, small rodents, birds and birds' eggs, seeds, forest fruits and mushrooms. Badgers are hunted for their skin and fat. Due to their small numbers is reasonable to register this species in the Ukrainian Red Book.

Otter *Lutra lutra L.* The otter is a medium-sized mammal. It can be found in smaller streams of the mountains or submountains. The body of the otter, which is long and flexible, is adapted to living in water. The head is flat and the ears are small. It has thick brown fur. It lives in or near water. The entrance of the den is found below the water surface, but the den itself is above the water. It usually feeds on fish but will eat frogs or small mammals, too. This rare mammal is registered in the Ukrainian Red Book.

Brown bear *Ursus arctos L.* This is the largest land mammal in the area. This non-indigenous creature lives only the high mountains in the flood area of River Tisa. Usually it spends the daytime hours in large hollows or caves. It is a night hunter. The bear hibernates during cold winters, but hibernation is interrupted when the weather becomes milder. Bears are omnivorous. They have not been hunted in the last decades which practice should be continued, as the number of bears is not more than just satisfactory.

Wolf *Canis lupus L.* It is the most well-known carnivore. Similarly to bears, wolves live in the high mountains in the flood area of River Tisa only as a transient animal. It is rarely found in submountanious areas. Its weight is around 70 kilograms. This species lives in packs. It is a brave predator. Wolves hunt on living prey ranging in size from mice to large ungulates. It is only seldom dangerous to humans, but it does much damage to game and livestock. Hunting is open all year.

Red fox *Vulpes vulpes L.* This species is quite widespread. It is a visitor animal to the flood area of River Tisa. It usually lives in the forest or in clearings. Although hunters eagerly persecute them, they have an imortance in the ecosystem. Hunting foxes is not limited, but it is worth hunting them in winter, when its fur coat is thickest.

Wild cat *Felis silvestris Schreb.* It is a relative of house cats but its body is more massive. Wild cats have a short, strong tail with dark rings. In the flood area of River Tisa it usually lives in mixed or deciduous forests of the mountains. It hunts at night. It feeds on small rodents but it catches small birds as well. The number of wild cats in the Carpathians is low, therefore it has been registered in the Ukrainian Red Book.

Lynx *Lynx lynx L.* It is the largest carnivore among the felids of the Carpathians. It is a visitor animal there. The lynx feeds on young roe deer or weakened red deer. Its fur is a very valuable hunting-trophy, but at present its hunting is prohibited. It has been registered in the Ukrainian Red Book as a rare carnivore.

Ungulates, Artiodactyles /*Ungulata, Artiodactyla*

Wild boar *Sus scrofa L.* The wild boar has a strong bristle coat. It has a typical long head. Fully grown males have well-developed strong fangs. The young are striped. Boars can be found everywhere in the flood area of River Tisa, but it is rare in the plains. They usually live in the forests, but occasionally they sally out to cornfields. The wild boar is most active at nightfall. It lives in groups except for older males that roam alone in the forests. The wild boar is a typical omnivorous mammal. Hunting on them is regulated. Its coat, flesh and fangs are valuable trophies.

Roe deer *Capreolus capreolus L.* The roe deer can be found everywhere in the flood area of River Tisa. It mostly lives in the forests, but a field population has developed in the recent years. It is the most frequent species among the

Artiodactyla. The roebuck sheds its antlers in autumn. The roe deer is a valuable game animal. It feeds on sap-rich vegetation of forests and meadows. Hunting on the roe deer is permitted but regulated. Its skin, flesh and antlers are valuable trophies. Roe deer meat is very delicious and its skin is used as souvenirs or rugs.

Red deer *Cervus elaphus L.* It is the biggest artiodactyle. Like the roe deer, it sheds its antlers in autumn. It is a forest animal but it regularly comes out to glades and clearings. The deer eats several times a day, mainly in the early morning, at twilight and at midnight. Its diet consists of grasses, leaves and young shoots. It lives in groups. Within the flood area of River Tisa it can be found only in the mountains or seldom in the submountains. Its skin, flesh and antlers are valuable trophies. Its hunting is regulated.

Lagomorphs/*Lagomorpha*

Hare *Lepus europaeus Pall.* It is different from the rodents in having a tiny incisor behind each of the two long incisors. It is fairly frequent in the flood area of River Tisa. It lives in open or semi-open areas, but it can be found in the forests as well. Its highly characteristic footprints talk about its presence in wintertime. It is a herbivorous animal which causes damage in young orchards, but is important as a game animal: it is hunted in large numbers each year for its flesh and sometimes for its fur.

Rodents/*Rodentia*

Red squirrel *Sciurus vulgaris L.* The red squirrel lives in trees. It is a forest animal tolerating the presence of humans, therefore it also lives in the small groves or parks of cities. Its long tail with thick hair helps the animal to balance while making a flying jump from tree branch to another. It is herbivorous, but its food varies throughout the year. It feeds on hazelnuts or other nuts and seeds in autumn, and on the seeds of the pinecone in the winter months. Red squirrels have interesting ways of storing their food. For example they pin out mushrooms on trees in order to dry them. They live in hollows or in small nests. They can be found in the mountains or submountais in the flood area of River Tisa. It is a valuable furry animal. Their hunting has been stopped.

European suslik *Citellus citellus L.* The souslik, as oppsed to the red squirrel, lives on the ground. It is found only in the plains in the flood area of River Tisa. The souslik prefers dry and warm places which are found amongst and within dykes, elevated fields next to agricultural areas that have not been ploughed recently. It usually lives in communities. Its main food supply is various seeds, but it feeds on the green parts of the local vegetation as well. The souslik hibernates during the wintertime. It is a rare species in the Carpathians; it can be found only sporadically. It has been registered in the Ukrainian Red Book.

Fat dormouse *Glis glis L.* It is a dormouse much like a small grey squirrel, though its ears do not end in brush-like tips. It is a very rare animal of deciduous forests of the submountains in the flood area of River Tisa. This dormouse species hides in hollows and nests during the day. Its activity begins at sunset. It eats the seeds of different trees. A typical behaviour of this species is that it rings tree branches. It hibernates during the winter.

Hazel dormouse *Muscardinus avellanarius L.* It is a tiny mammal. It is very rare in the flood area of River Tisa. It can be found in the submountains but it appears also in pinewoods. This species builds its nests among the small branches of lower trees or in the grass. It hibernates in wintertime. This dormouse species feeds on buds, seeds and and the bark of young sprigs. Though rarely, it eats insects as well. It needs to be protected as a biological species.

Common rat *Rattus norvegicus Berk.* Its distribution has developed alongside that of humans everywhere in the flood area of River Tisa. It lives in places that are inhabited by man. This rat species is fond of wet places; therefore in nature it is not rare next to the water. It lives in hierarchically organised colonies. It is an omnivorous rodent that can cause serious damage to goods in stores or warehouses. It is pathogenic by transmitting germs dangerous to humans, and must often be eradicated from populated areas.

House mouse *Mus musculus L.* It lives everywhere in the flood area of River Tisa where people live. It is a tiny rodent which, with human influence, has become omnivorous. It is very prolific. This mouse causes considerable damage to humans, similarly to most rats. It is a carrier of pathogens of different diseases and must often be exterminated from populated areas.

Harvest mouse *Micromys minutus Pall.* It is the smallest mouse species. It is infrequently found in the flood area of River Tisa. Usually it lives in bushy, wet areas or in cereal fields. This mouse builds its nest on long-stem grasses and sometimes on the ground. The nest is made of leaves and it is much like the nest of birds. The animal retires to the nest only at night. It also hides in straw-stacks or abandoned buildings. Because of its small population and tiny stature it does not cause large damages, so there is no need for controlling its numbers.

Striped field mouse *Apodemus agrarius Pall.* Its main characteristic is a black stripe that runs down in the length of the back from head to tail. It can be found in the plains or in the submountains. It is a common species, which is characteristicly found in fields. Some years it is very prolific under which circumstances it can cause considerable damage to the agriculture. Although it is herbivorous, it often eats insects as well.

Small-footed wood mouse *Apodemus microps Kratochvil.* It is a recently discovered species. It is typical of the plain territories of the flood area of River Tisa. This mouse species lives in the fields and pastures. It can also occur in wet places. Its lifestyle is like that of other mice species. It has a relatively small population and it may be concluded that it does not cause large damage to the agriculture.

Wood mouse *Apodemus sylvaticus L.* It can be found everywhere in the flood area of River Tisa. It is interesting that it can not be found deep inside forests. Its favourite living places are bushes and forest edges. A peculiar trait in this species is a long tail, and the unbroken transition from dorsal to ventral colour. Sometimes it has a light rust-coloured patch on its throat. Its population size depends on the quantity of beech nuts. Occasionally it can cause damage to the newly planted forests and nurseries. Its population should be monitored and controlled.

Yellow-necked wood mouse *Apodemus flavicollis Melchior.* It differs from the wood mouse by its the bigger size and more contrasting colours. The rust-coloured spot is always discernible. Its lifestyle is similar to that of the former species.

Hamster *Cricetus cricetus L.* It is a fairly large rodent. In the flood area of River Tisa it can be found in cultivated lands and gardens. This hamster species lives alone. Its burrows can be recognised from the small mounds of earth dumped near the entrances. It keeps large quantities of food in its underground burrow, particularly during the winter. It feeds on the seeds of cereals, on potato, carrot and fruits. It is a very aggressive animal causing great damage in the fields and gardens from time to time. Its presence is unpopular here.

Bank vole *Clethrionomys glareolus Schreb.* It is a relatively small rodent. It is different from the mice in that it has a relatively short tail measuring only half of its body length. It has smaller ears as well. The teeth of this vole species have no roots. It can be found in the mountains and submountains in the flood area of River Tisa. Its population size is dependendant on the quantity of the beech nuts. It is species harmful to human economy. Its population size must be kept within limits.

Muskrat *Ondathra zibethica L.* It is the largest of our rodents. It is an aquatic animal but it feeds on the mainland. It has thick fur and a vertically flattened tail. It lives in hollows or in small dens with the entrance under the waterline. The nest itself is higher than the water level. In the flood area of River Tisa it can be found in the plains or in the submountains. It is mainly herbivorous, but also feeds on molluscs, crustaceans or other invertebrates. Its fur is valuable but it is not allowed to be hunted at present.

Water vole *Arvicola terrestris L.* It has size of a rat. It builds its underground burrow in the banks of waters, close to the surface. Often it builds a rounded nest from dried grasses at ground level. The food supply of this vole species is found near its nest. It is a herbivorous animal. This species is very prolific in the flood area of River Tisa. It is a harmful rodent, and its population must be limited.

Little water vole *Arvicola sherman Shaw.* It can be found in the mountainous area of the flood area of River Tisa. Its lifestyle is like that of the previous species. In some years it can cause much damage, therefore its numbers must be controlled.

Field vole *Microtus agrestis L.* In the flood area of River Tisa it is typically found in the mountains. It lives on the banks of the creeks where there is lush vegetation. It is herbivorous and it feeds on the green parts of plants. In the winter it eats the bark of decidous trees. It is active in the daytime and at night as well. It does not cause considerable damage, but its proliferation is undesirable.

Common vole *Microtus arvalis Pall.* It is the most populous and frequently found rodent, living mainly in the plains and submountains of the flood area of River Tisa. It lives in open areas. It is most prolific in grazing grounds, in grain and trefoil fields. In some years it has explosive population growth and causes serious damage. Therefore it must be controlled in agricultural fields. Carnivores and raptors should be given prioroty in controlling their numbers.

Common pine vole *Pitymys subterraneus De Selys Longchamps.* It is a tiny rodent. In the flood area of River Tisa it lives in the mountains. Its living place is well recognisable from its beaten tracks on the ground. It is a herbivorous rodent which feeds on the green parts of plants. In some years its population increases detrimentally and it can cause great damage to grazing grounds.

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