BIODIVERSITY IN THE YUGOSLAV SECTOR OF THE DANUBE

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It is not too modest to say that the Yugoslav part of the Danube river region is one of the most important cradles of European civilisation. Many traces of ancient cultures were found along the banks of the Danube in Yugoslavia, witnessing a long continuity of inhabitancy of this area. The Lepenski Vir culture arose by the banks of the Danube in the Neolithic age, between 7000 and 6000 BC. The Starcevo culture - 6000-5000 BC - is the first Neolithic culture in this region. Remnants of one of the most vastly spread and most advanced Neolithic cultures in South-eastern Europe, the Vinca culture, which flourished between 4500 and 3500 BC, are also found in the Danube region.

The Roman Empire left behind a number of historical and cultural monuments in the Yugoslav part of the Danube river region. This is particularly interesting considering the fact that this was a high level priority area. The Danube Limes, being a fortified border, was a part of the Roman system created for the protection against barbarian intrusions. The Danube Limes are far more enduring compared to the Rhine Limes build by the Romans in Western Europe. It is thought that in 14-37 AD, the Emperor Tiberius initiated the construction of a strategically important road through the Djerdap gorge, continued by the Emperor Traianus in the period 101-106 AD. Traianus also built one of the first bridges across the Danube, as a part of this road. There are a number of centres of Serbian culture in this region, especially the monasteries in the Fruska Gora mountains, as well as forts and old mines.

Today the banks of the Danube host a large number of towns, with more than two million inhabitants. Two of these, Novi Sad and Belgrade, the capital of Serbia and Yugoslavia, are major urban and industrial centres. At present, perhaps more than ever before, human activities are jeopardising the biodiversity of both the riparian and terrestrial ecosystems along the Danube, extending from the plains of Vojvodina to the magnificent mountains of the Djerdap gorge.

Biodiversity in Yugoslavia

The central position of Yugoslavia - Serbia and Montenegro - in the Balkan Peninsula and its north/south extension, as well as its exposure to varying climatic influences, modified by complex mountain projections, and various petrographic and edaphic conditions, are the major abiotic factors contributing to the great biodiversity of its territory. However, to understand the great magnitude of the biodiversity of Yugoslavia, one must take into account the historical dimension of abiotic and biogenic changes the Balkan Peninsula went through from the Tertiary up to the present.

Almost all European biomes, in terms of representative ecosystems, occur in Yugoslavia: the steppe biome in the north of Vojvodina, i. e. the south-eastern Panonian Plain; the temperate deciduous forest biome in the greatest part of the lowlands and the central mountainous regions; and the mediterranean chaparral biome on the Montenegrin Adriatic coast. Due to the particular relief, there are two basic types of biomes in the mountains, that more or less correspond to the biomes of the northern regions of the Holarctic: the coniferous boreal forest biome (taiga) and the tundra biome in the highest mountains of Yugoslavia.1,2 Each biome is characterised by heterogeneous flora and fauna where, in addition to the widely distributed species, the regional, local and stenoendemics play a significant role. In addition to the climatic zonation of ecosystems, a great number of extrazonal, intrazonal and azonal ecosystems - such as wetlands, peat bogs, salt marshes, and sandy steppes which make the ecosystem and landscape mosaic increasingly various - occur in Yugoslavia.3

The territory of Yugoslavia was one of the most significant refugial regions of Europe during the Ice Age. Its geographical position, being a convergence point of the major routes of various florogenetic and faunogenetic impacts, resulted in the present heterogeneous flora and fauna composed of various geno-, migro- and geo-elements. Therefore, species of different origin and age colonise nowadays the same habitat, which is a rare pattern anywhere in Europe. Endemic species, particularly those of local and stenolocal distribution, as well as relicts/endemo-relicts greatly contribute to species diversity in Yugoslavia. A significant number of endemic species, notably those of local and stenoendemic distribution, fall into the category of globally or internationally significant species. In addition, this category also encompasses the species whose range extends to a major degree in Yugoslavia, as well as the species that are included in the Annexes to the Bonn, Bern and CITES Conventions. There are about 1,600 mentioned species of terrestrial and freshwater Yugoslav flora and fauna. These species significantly contribute to the total species diversity of particular groups, as well as to biodiversity as a whole.4

In 1995, the Faculty of Biology at the University of Belgrade published an inventory of the great biological diversity of Yugoslavia, in order to acknowl-edge its characteristics and significance, and set guidelines for its preservation. It was a first and most important step and now efforts should be made to doggedly pursue the goal of protecting the sustainable use of otherwise of global significance resources. In this respect, the help of the international community will be welcome, given that a considerable portion of this species diversity is not only an integral part of the living

world of Yugoslavia, but it is also of global significance.

The Danube in Yugoslavia

The total length of the Danube river is approximately 2,950 kilometres and its length in the territory of the Federal Republic of Yugoslavia, is 588 km, or approximately 20% of its total length. 134 km constitute the border with Croatia and 220 km the border with Romania. The average width of the Danube in Yugoslavia is 1 km, thus forming a total water surface of 52,000 ha. Nowadays, the flood area of the Danube is approximately 100,000 ha, while the accumulation lake of the hydroelectric power plant Djerdap I has a surface area of about 1,050 ha and that of Djerdap II about 800 ha. The Yugoslav section of the Danube mainly covers the region of the Mid and, partly, the Lower Danube, with a relatively low overall river slope value. The total slope of the river is 678 m (24cm/km) and the slope between the Hungarian and Yugoslav border is 7 m or 2,7 cm/km. From Mohac to Ram, near Veliko Gradiste, the average river slope value is 0,4%. Very illustrative data about the overall profile of the Danube river in Yugoslavia are the altitude values of some spots situated near the river: Bezdan 80.61 m; Apatin 78.81 m; Novi Sad 75.00 m; Belgrade 73.00 m; the mouth of the Nera river 69.50 m; Djerdap I - 48.00 m; the mouth of the Timok river 35.00 m.
The maximum depth of the Danube in Yugoslavia is 90 m; before the construction of the Djerdap dam, it was 82 m. Not taking into account the Djerdap accumulation lake, the maximum depth of the river in Yugoslavia is 27 metres near the town of Dalj, after the bridge in Bogojevo. The minimum depth, measured between the 1968th and 1969th kilometre near Futog, is 3.5 m with a water level of 400 cm.5 The average input flow rate of the Danube in Yugoslavia is 2,413 m3/s, while the output flow rate, thanks to the water input of the Drava, Tisa, Sava and Velika Morava rivers is approximately 5.840m3/s. The specific draining coefficients significantly differ in the individual river basins of the rivers joining the Danube in Yugoslavia and in the immediate neighbourhood of its banks. The average draining coefficient in the Danube river basin in Yugoslavia approximately equals 38%. The hydrographic net of the Danube river basin is rather well-developed, averaging about 460m/km2.6
Regarding the hydrological characteristics of the Danube in Yugoslavia, and from an aspect of these studies, it was concluded that the alluvial layers surrounding the depression regions of the Danube and its tributaries contain a significant amount of underground waters. More than one hundred years ago, most drastic changes took place in the habitats around the Danube. Floods were frequent and long lasting, and occurred mainly in Vojvodina. The flood zone occupied between 660,000 and 1,500,000 ha. A number of marshes, lakes and swamps remained after the flooding of the Danube and its tributaries, particularly in the regions of Banat, Baranja and central part of Backa.
First moves towards the regulation of the Danube were undertaken under the Austro-Hungarian Monarchy, in 1793, by digging large channels: the Veliki Backi Channel, the Mali Channel, the old Begej Channel, the Brzava Channel, and the Vrsac Channel. However, the largest and most important project of was the Danube-Tisa-Danube hydrosystem, also known as the "bloodstream of the Vojvodina plain," realised in the period 1947-1977. The main channel is 248 km long, but the whole system encompasses 700 km of secondary channels and approximately 10,000 km of accessory channels. One of the results of the construction of this channel is that the flood zone was reduced by about 1,200,000 ha. The main reasons for the construction of this hydrosystem include: the improvement of the region; the improvement of the water supply to the public and to industry; the collection of waste waters; the development of fisheries; the improvement of the living conditions of the people in the region; and the improvement of the quality of arable areas.7
However, the whole venture was not really an improvement in itself, because most of the predetermined demands expected from the system were not fulfilled. The enlargement of crop production and number of harvests was not recorded because it was not possible to overcome the drought problems - more than 50 in last 100 years - with only 41,000 ha, out of 500,000 ha, being regularly watered. The cannel system was not used for boat traffic, although the route is 200 km shorter compared to the Danube river route. The water supply was not improved because the channel system had become a collecting system for waste waters from the region. It is thought that more than 30 million m3 of waste waters are dumped into the channel system.8
Important hydrological works on the Danube were undertaken during the construction of the hydroelectric power plant Djerdap I (1969-1972). One of the illustrative consequences of these activities was the change that occurred in the Pancevacki Rit Swamp, where the channel network was enlarged from 155 km to 1,200 km. Simultaneously, a new food industrial complex, the PKB Corporation, one of the largest in the Balkans, was founded in the same region, occupying around 42,000 ha. This complex emits poorly recycled or crude waste waters directly into the swamp, usually due to non-functioning collectors, and, thus, pollutes the ecosystem to the level of extinction of most living organisms.
In 1937, S. Stankovic contributed to the research of the Danube flood zones in Yugoslavia and recorded their importance to the overall diversity of the river and surrounding areas.9 The flood zones of the Danube are variable and dynamic; in the spring, floods reach their maximum, covering vast areas with moving water comprised of all local water ponds without distinct borders between them, but during the drought period when the Danube withdraws, the unique freshwater sea splits apart into numerous separate shallow ponds filled with still water. The total water surface decreases rapidly in that period, leaving dry ground behind. It is obvious that the ecological conditions are very susceptible to various seasonal changes in the flood zones, making the habitats of different organisms very variable, which results in high spatial and temporal diversity. Romanian and Yugoslav hydrobiologists and ecologists9 pointed out that flood zone width and duration of flooding are crucial and prerequisite factors for the recruitment of fish populations. Today, half a century after the construction of the Djerdap dams, the flood zone is very restricted and the self-purification of the river shows remarkable insufficiency, while productivity of river organisms has increased more than ten times. That is the reason why one of the main characteristics of the biodiversity of those ecosystems is a constant change in their composition - quality - and abundance - quantity - because any change over time forms optimal living conditions for different organisms with different life strategies and ecological niches.

In 1856, according to the Paris Convention, the Danube was recognised as one of the most important international rivers. Research on the Yugoslav part of the Danube, from the very beginning, was completely integrated and co-ordinated with other sub-Danubian countries. It is important to mention that, in 1934, in the course of a unique biological and ichthyological study, an International Commission for Hydrobiological Research of the Danube (IAD), was formed, during the VIIth International Limnological Congress held in Belgrade. Recently, a research project

supported by the European Union and realised in Yugoslavia, was "Studies on the pollution status of the Danube river basin: measures of protection and rational exploitation of water resources." This project was carried out from July, 1985 to July, 1989. The results of this research became the foundation for the study The Danube in Yugoslavia: contamination, protection and exploitation by Jankovic and Jovicic, in 1994.10

Ecosystem diversity of the Danube region

On the banks of the Danube and in the river's flood zone two biomes are present: the broad-leaved deciduous forest biome and the pontic-caspian steppe or meadow-steppe biome. These biomes are represented by various ecosystems:

Forest ecosystems

- alluvial and long time flood forests of willows, white and black poplars and narrow-leafed ash
- galleric and short-time flood forests of pedunculate oak and hornbeam
- relict polydominant forest in the Djerdap gorge, represented by numerous and rare forest communities composed of ancient dendroflora - Celto-Juglandetum, Fago-Colurnetum mixtum, Querco-Colurnetum
- durmast oak and hornbeam forests at the slopes of Fruska Gora mountain - Querco-Carpinetum, Festuco-Quercetum petraeae
- mesophilous beech forest at the foothills of Fruska Gora mountain and the surroundings of Negotin - the strict natural reserve of Bukovo

Steppe and meadow-steppe ecosystems

- woodland-steppe sub-zones in the Pannonian plain, distributed on sandy plateaus along the Danube: slopes of Fruska Gora mountain, Srem loess plateau, sandy regions in the lower Yugoslav part of the Danube basin
- meadow-steppes on plateaus recently represented by the pastures
- sub-Danubian sand steppes. Azonal marsh, swamp and still-water ecosystems are frequently distributed and mosaicaly overlap with forests, comprising the characteristic landscape composition of wetlands along the Danube river banks and flood zones. Intrazonal ecosystems of salt marshes and salt steppes, or pastures having a scattered distribution in the Backa region, enrich the ecosystem mosaic of the sub-Danubian landscape.

Azonal biomes of marshes and swamps

- still-water ecosystems in the river flood zones covered by submersed and floating vegetation communities
- water fringe ecosystems composed of reed, reed-mace and club-rush communities
- wet and periodically flood sedge meadows
- intrazonal ecosystems of saline habitats
- brackish marshes
- salt steppes and pastures

According to the EU-CORINE habitat codes of 1991, the following natural habitats are present along the Danube basin:

- salt steppes and grasslands, salt pastures and salt meadows
- river sand beaches and river islets and banks, pebble river islets and banks, and mud river banks
- standing fresh waters, permanent watered marshes and ponds, periodically watered marshes and ponds, former river branches and natural channels
- standing brackish water, periodically watered ponds of haline habitats
- running water, sandy, pebble and muddy river-bottom
- dry grasslands and steppes at plateaus and at the foots of low mountains
- humid grasslands and tall herb communities
- mesophile grasslands
- broad-leaved deciduous forests
- alluvial and very wet forests and brush
- inland sand-dunes and sandy vegetation

Danube protected areas in Yugoslavia

Concerning the high level of both species and ecosystem diversity, Yugoslav experts, the Ministry for the Environment of the Republic of Serbia and the Institute for the Protection of Nature of Serbia defined a number of protected area management categories (IUCN, 1994). A protected area is defined in the New Guidelines for Protected Area Management Categories as: "An area of land and/or sea/water especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means." The protected areas in the Danube river region in Yugoslavia fall under the following categories:

National parks

- The Fruska Gora National Park, classified under IUCN category V, with a total surface area of 25,000 ha. This national park includes strict nature reserves/wilderness areas that the IUCN has characterised as protected areas managed mainly for science or wilderness protection: Zmajevac, 5.00 ha; and Papratski Do, 62.68 ha.
- The Djerdap National Park, classified under IUCN category IV, with a total surface area of 63,500 ha. This national park includes the following nature reserves: Bojana, 19.96 ha; Bosman-Sokolac, 296.05 ha; Ciganski potok, 55.16 ha; Coka Njalta with Posac, 618.48 ha; Boljetinska river Canyon-Greben, 114.01 ha; Lepenski Vir, 98.70 ha; Strbacko Korito, 1,047.93 ha; Somrda, 21.62 ha; and the Golubacki Grad fortress 10.72 ha.

Nature reserves and managed resource protected areas

- The Koviljsko-Petrovaradinski rit swamp/wetlands is classified under IUCN category IV and has a total surface area of 4,840.00 ha.
- The Gornje Podunavlje region/wetlands near Sombor and Apatin is classi-fied under IUCN category IV and has a total surface area of 9,996.00 ha.
- The Deliblatska pescara sand pit is a managed resource protected area, which according to the IUCN is a protected area managed mainly for the sustainable use of natural ecosystems. It is classified under IUCN category V and has a total surface area of 29,352.00 ha.

Nature parks and natural monuments

- the Mirkovic bara swamp, near Apatin, with a surface area of 15.26 ha
- Mackov prud, near Novi Sad, with a surface area of 3,78 ha
- the white-tailed eagle and black stork habitats, near Sombor, with a total surface area of 10,000.00 ha
- Omoljicka ada, near Pancevo with a surface area of 6.46 ha
- Kalandos II, Karapandza, Kozuh, Kozara, Siga, Sumaguc, and Sumaguc-Siga-Kalandos, near Sombor, with a total surface area of 118.69 ha
- 19 natural monuments in the Yugoslav part of the sub-Danubian region

Species diversity of the Danube

The high level of species diversity of water organisms is the reason for presenting only the general characteristics of the diversity of some groups: bacteria, phytoplankton, zooplankton, fauna of the river bottom (Oligochaeta), molluscan fauna and ichthyofauna.

Microbiological analyses of the Danube river water show that four physiological groups of bacteria can be recognised: ammonifiers, proteolites, phosphofiers and phosphomobilizers.11 Ammonifiers represent a dominant microbial group, not surprising concerning the fact that these bacteria are included in the starting phases of the mineralisation of organic biodegradable compounds. The presence of proteolytic bacteria is significant at most of the river profiles. Phosphofiers, although commonly present, were not abundant. The presence and activity of phosphomobilisers are practically negligible.11 The results of qualitative and quantitative microbiological analyses of the Danube bottom sediments show a richer bacterial flora of the sediments compared to the river water, but the diversity of the sediments' bacterial flora was rather poor.11 According to recent microbiological research, the Danube shows a significant recipient capacity, enabling the ecosystem to undermine the influence of the emitted pollutants with preserved selfpurification capacity.11

Algological investigations of phytoplankton show a heterogeneous diversity of these groups. Approximately 300 algal species were recorded by a recent study12,13 of the Danube river. Approximately 1,400 algal species were recorded in the freshwater ecosystems of Yugoslavia. The majority of the species belongs to one of the following groups: unicellular algae; Bacillariophyta, Chlorophyta, Euglenophyta, Cryptophyta, Cyanophyta and multicellular algae; Charophyta. The group of Bacillariophyta is dominant in the spring (42%), while Chlorophyta are dominant in the autumn (32%).12

On the basis of many studies of zooplankton in the Yugoslav part of the Danube river, it was possible to conclude that this part of the Danube exhibits a heterogeneous zooplankton composition.14,15,16,17 On the basis of a one year study, Pujin et al.14 list 16 species of Protozoa, 32 species of Rotatoria, 10 species of Cladocera, 6 species of Copepoda and 2 other zooplankton representatives. Kalafatic15 describes 50 species of Testacea found in the Yugoslav part of the Danube; the total number of species of these organisms for Yugoslavia is 236. Two local endemic species, Colaropyxida stankovicii and Protocucurbitella danubialis, were recorded for the first time. These are species of international importance, both found in Djerdap. The largest group of zooplankton organisms is Rotatoria, with 218 species. 3 species were recorded for the first time and 35 were new additions to the Danube river fauna. Also, 3 species are internationally important: Lecane apatinensis, Lepadella mica and Testudinella pannonica. The total number of Rotatoria species in Yugoslavia is 327.16 All these facts clearly show the high importance of the Danube river and its flood zones, as one of the biodiversity centres in Yugoslavia.

The Cladocera are represented by 91 species in the Yugoslav fauna and 26 species are present in the Yugoslav part of the Danube river; 3 of them, Camptocercus fennicus, C. uncinatus, and Simocephalus congener, are of international importance.17 The Copepoda are represented by 72 species in the Yugoslav fauna and 19 species are present in the Yugoslav part of the Danube river. Cladocera and Copepoda diversity is endangered by the pollution of the Danube, but particularly by the commercial development of areas with swamps, marshes and other small water ponds.

Several groups of bottom-dwelling fauna were recorded in the Yugoslav part of the Danube during a one-year study: Turbellaria, Nematoda, Oligochaeta, Gammaridae, Chironomidae, Gastropoda and Lamellibranchia, with Oligochaeta being the most numerous with 24 species.18,19 The total number of Oligochaeta species in Yugoslavia is 77. In the course of a recent study of the molluscan fauna of the Yugoslav part of the

Danube20 22 species were recorded: 17 species of Gastropoda and 5 species of Lamellibranchia.

The Danube/Black Sea system constitutes one of the five characteristic regions for Yugoslav ichthyofauna. The Danube/Black Sea system harbours 110 species of freshwater fishes, including 1 species with 6 subspecies and 12 species with 2 subspecies, totalling 127 species/subspecies recorded for the territory of Yugoslavia.21 In addition, the Yugoslav ichthyofauna also includes 5 species of Cyclostomata.21

In the Danube river basin, 79 species of freshwater fishes are recorded, in-cluding Salmo trutta, Gobio kessleri and Sabanejewia aurata with 2 subspecies, totalling 82 species/subspecies, or 64.56% of the total Yugoslav ichthyofauna. In the same basin 3 species of Cyclostomata are recorded, or 60% of the Yugoslav Cyclostomata fauna. Moreover, the Yugoslav part of the Danube river is char-acterised by the seasonal presence of 5 species of Acipenseriade: beluga, Huso huso; Russian sturgeon, Acipenser güldenstädti; stellate sturgeon, A. stellaris; ship sturgeon, A. nudiventris; and sterlet, A. ruthenus. It is also characterised by two species of Clupeidae - Black Sea herring, Alosa pontica and Danube herring, A. caspia nordmanni - that migrate from the Black sea to the Danube for spawning. Unfortunately, the construction of the Djerdap hydroelectric power plants cut off their migratory route up to 17.8 km upstream from the Yugoslav-Romanian border, near the Djerdap II power plant. 8 species of freshwater fishes are found in the Danube river system in Yugoslavia: Acipenser nudiventris, A. sturio, Cobitis elongata, Gobio kessleri banaticus, Zinggel streber streber, Z. zingel, Huso huso, and Umbra krameri. There is also 1 species, Endontomyzon danfordi, of Cyclostomata. All species are of international importance.21,22

Species diversity in terrestrial ecosystems of the Danube region

The Balkan peninsula harbours one of the richest amphibian and reptilian biodiversities in Europe, with a total of 95 species; 66 in the Pyrrenean peninsula and 74 in Apennine peninsula. 70 species are recorded for Yugoslavia and 22-32 species for the Yugoslav sub-Danubian region.23 These groups, particularly the amphibians, are endangered by human activities: water pollution, separating the mainstream of the river from the marshy bank areas, commercial development, etc. Some representatives of this fauna are of international importance and all the species listed are Panonian endemites: Rana arvalis wolterstorffi (Amphibia); Ablepharus kitaibelii fitzingeri, Vipera (ursinii) rakosiensis (Reptilia).23

Yugoslavia is a territory with a high level of bird biodiversity, with 382 regularly, irregularly and potentially present species, and 260 nesting species, compared to the Balkan peninsula with 300, and Italy with 256 species.24 The southern part of Serbia is richer in bird species in comparison with the plains of sub-Danubian and Carpathian Serbia. In Vojvodina, there are 188 bird species, and 131 waterfowl species. In Carpathian Serbia, there are 177 bird species and 143 waterfowl species. The Obedska Bara swamp, in the close vicinity of the Danube and approximately 60 km from the river Sava's mouth to the Danube, is one of the most important centres of bird diversity, with approximately 200 species. Twenty localities in Yugoslavia are defined as internationally important protection areas with high bird diversity. Eight of these are either a part of or very near to the Danube: the upper and lower sub-Danubian regions, Fruska Gora mountain, Stari Begej or the Carska Bara complex, the Koviljski rit swamp, the Deliblatska pescara sand pit, and the Obedska Bara swamp.24

There is a total of 140 mammalian species in Europe and 96 species have been recorded in Yugoslavia. The Serbian fauna constitutes 98% of the whole mammalian fauna of Yugoslavia. 69 species are recorded in Vojvodina and 82 in Serbia, excluding the Kosovo region. 38+22 species are common for both regions. Carpathian Serbia harbours 47 mammal species, southern Banat 45, and the Srem and Backa regions 43 species. The northern Banat region has 31 species.25 Several mammalian species of the sub-Danubian region are of interna-tional importance and are included in The Red List: Canis lupus, Sicista subtilis, Nannospalax leucodon, Pitymys subterraneus. It is essential to intensify taxo-nomic research on the genus Mus for further species validity analyses, and implement plans for their protection. Important taxonomic research is carried out on the deer Cervus elaphus and the chamois Rupicapra rupicapra, in Baranja, in the Deltblatska pescara sand pit and in the Djerdap region, to determine their subspecies status, since subspecies are the focus of regional protection plans.25

Regarding insects, this paper will only focus on three species found in the Yugoslav part of the Danube river region. Zeuneriana amplipennis - a katydid species - is endemic to northern Serbia, and has been recorded within the narrow zone of mesophyllic and hygrophyllic communities surrounding the Yugoslav part of the Danube and Sava rivers. It is highly unusual that this species has never been recorded outside this region of Yugoslavia, although the appropriate habitats are relatively widespread. Simulium columbaszense - the Golubac fly - is found in the Djerdap region and is of veterinary significance, being an insect that attacks cattle, sometimes with a fatal outcome. Apis mellifera carnica (A. m. panonica) - the Banat yellow honey bee - was the object of a Yugoslav-USA co-operative research project on the "Possibilities of breeding of honey bees for re-sistance to Varroa jacobsoni," that started in 1984. The main aim of the project was to study the Yugoslav bees' resistance to mites. The bees were brought to the United States in July of 1989. This was the first time that the US Department of Agriculture Research Service had ever released an insect as breeding stock. The bees from Yugoslavia were twice as resistant to varroa mites as domestic US bees. The Yugoslav bees were also highly resistant to tracheal mites, so any kind of chemical control for these pests would not have been necessary. The initial material for this project consisted of two queens from Veliko Gradiste and three queens from Zrenjanin, being the surviving specimens from apiaries that suffered heavy losses caused by Varroa jacobsoni in previous years.26,27

Conclusion

The great number of habitats and corresponding ecosystems give the Yugoslav part of the Danube river basin extremely high values of biodiversity. Unfortunately, large areas covered with natural ecosystems have been destroyed or transformed into agricultural and urban landscapes. However, some regions where natural ecosystems still occur nowadays represent protected areas of National parks and natural reserves. These areas are the last remnants of former virgin forests and wetlands. Protected forests and wetlands at the river banks and inside of narrow flood zones have a very important role for river ecosystem stability and productivity. Nowadays, anthropogenic factors result in the unification of living conditions in the Danube river and the surrounding areas, and in addition to the pollution process, represent a force that endangers biodiversity of both the river and surrounding terrestrial ecosystems.

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