

# The Nature Protection Aspects of the Gabčíkovo–Nagymaros Project

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## I. Natural values affected by the construction of the Gabčíkovo-Nagymaros Project

It is a well-known fact that the natural values of a given landscape are not restricted to the living components alone, but include inanimate formations of nature. In this study we shall examine the flora and fauna of the area affected by the diversion of the Danube, and discuss their conservation value.

The affected area may be divided into three major sections: the Szigetköz, the Danube valley (from the Szigetköz downstream to the Danube Bend) and the Danube Bend (including the northern part of Szentendre Island). The botanical assessment of these three sections was based on a uniformly distributed sampling, the zoological on less evenly distributed collecting efforts. While the flora and fauna of the Szigetköz is fairly well-known, the fauna of the Danube valley is practically unexplored, as is the zoological assessment of the Danube Bend, since it started only a year ago in 1992. We would like to emphasise though, that except for the Szigetköz, research is not exclusively focused on the dam's effect on the flora and fauna, but it is aimed to clearly show their present state.

The detailed environmental impact assessment of the flora and fauna of the Szigetköz is of paramount importance, since this region was most highly affected by the human activity arising from the bilateral treaty between Hungary and Czechoslovakia, and by continued Slovak works after the termination of the treaty by Hungary.

### *I. 1. General characterization of the flora and fauna of the Szigetköz (its state prior the diversion)*

The Szigetköz is a unique section of the Danube valley, since a braided branch-system on a similar alluvial cone neither exists upstream nor downstream. In a relatively small area, this branch-system accommodates a wide range and an amazing diversity of habitats. Considering the size of Szigetköz, the flora and the fauna are remarkably rich.

The greatest value of the Szigetköz is the landscape itself, which was created by the Danube, with the unique geomorphological and hydrological formations and the natural values, both botanical and zoological. Because of extensive river regulations and the agricultural use of all available land, the area covered by riparian woodlands elsewhere in Europe is continuously and drastically decreasing, with alterations to their natural state and biological degradation. In contrast, significant stands of soft and hard wood riparian forest remain intact in the Szigetköz. Therefore, these riparian forests, and nearby bordering areas with their fauna, are natural values of European significance.

Owing to its special geological, geomorphological, climate and water-regime features, the Szigetköz has unique fauna. The waters arriving from the Alps constantly carry plant seeds and other reproductive components, which occasionally get stuck in the slow side branches, and when other ecological circumstances are favourable (for example cool, moist temperatures) may eventually settle in the Szigetköz. The near-natural, lowland-type forest stands owe their uniqueness to the dealpine and montane beech forest elements (for example the following species: *Selaginella helvetica*, *Achillea ptarmica*, *Lilium bulbiferum*, *Gentianella ciliata*, *G. austriaca*, *Carex alba*, *Parnassia palustris*). Although a majority of these plant associations are not rare, the species composition is peculiar. For example the diversity of orchid species is remarkable (23 species). In the maintenance of botanical diversity, the immigration of species and the repeated inundation are essential. Both of these were previously ensured by vast flow of the Danube into the side branch-system during the floods.

As a consequence of the decreased flow of the Danube, the Szigetköz has received significantly less water, resulting in a drastic decrease in the size of the wetland habitat (moors, fenwoods, marshes). Therefore, the remaining patches of these habitats with their exceptionally rich biota should be strictly protected. At higher elevations, in certain localities, the original steppe vegetation is still prevailing.

These conclusions hold true for the fauna, too. As a general rule the fauna of the great Central-European river basins are very similar, regardless to their exact geographical location. However, the fauna of the Szigetköz is unique from that of any other river basin because of its special geographical situation. Since the fauna of the Szigetköz is enriched with particular species assemblages, its species composition is unequalled (for example East-Alpean, Atlantic, lower-montane, and steppe species – beetles: *Leptura maculicornis*, *Acanthocinus aedilis*, *A. griseus*; lepidopterans: *Aricia artaxerxes*, *Scopula umbelaria*, *Acasis viretata*, *Perizoma sagittata*; fishes: *Cottus gobio* *Hucho hucho*; mammals: *Microtus oeconomus*).

Thus, not only the highly valuable rare species, but also the species combination and composition of the Szigetköz are unique.

The high species diversity of fauna is indicated by the fact, that 30-50% of the species of the Hungarian fauna may be found in the Szigetköz, and in the case of some taxa an even higher proportion may be established, of course, the numbers refer to the animal groups studied. These species were recorded on the 9000 hectares of the Nature Reserve. The high number of species may be explained by the presence of a large quantity of mosaic-like patches of habitat over a relatively small area. In these patches, many of the main habitat types may be found: submontane river, connected and isolated side branches, canals, moorlands, marshes, hard and soft wood riparian forests, *Convallario-Quercetum*, *Salicetum triandrae-purpureae* associations, relict *Carpino-Quercetum* associations, fens and remnant patches of forested steppe vegetation.

According to our present knowledge 57 protected and 56 Hungarian Red Data Book plant species have been ascertained in the Szigetköz. From among the animal species specifically examined by us 314 species are protected while 66 are included in the Hungarian Red Data Book. Of the animal species 159 (Appendix II) and 113 (Appendix III) are found in the Bern Convention. Furthermore, the Convention on the Conservation of Migratory Species of Wild Animals lists 2 species in Appendix I and 100 species in Appendix II. In the IUCN Red List of Threatened Animals (1994) 17 species are mentioned.

## 1. 2. The flora and plant associations

**The vascular plants.** According to botanical surveys undertaken over the last three years, the number of plant species between the Moson-Danube and the Öreg-Danube is 917. Considering the relatively small area and the high percentage of land cultivated or otherwise affected by forest management, this number is quite high, since it comprises some 42 % of the total Hungarian flora. During botanical surveys a number of species were not found and considered to have disappeared during the past decades, e.g. *Selaginella helvetica*, *Daphne cneorum*, *Carlina acaulis*, *Centaurea arenaria*, *Salvia aethiopsis*. Vascular plants are either somewhat rare or not always present in the flora; in other cases, their exact place of occurrence cannot be defined.

**The plant associations.** Approximately 25 % of the 26 000 hectares of the Szigetköz is covered by near natural or semicultivated associations, such as forests, poplar and willow stands, aquatic plant associations, marshes, pastures. Although poplar and willow stands are originally cultivated plantations, they are nevertheless regarded as near natural associations because they accommodate floodplain and montane elements.

According to recent botanical assessments several floodplain associations live in the Szigetköz in a natural or near-natural state. 67 associations have already been found in this area, and the number is expected to rise. From the point of view of nature protection, 17% of these associations are highly valuable, including relicts (2 associations) and those demanding protection (10 associations); 46% are valuable, including near-natural (25 associations) and pioneer (6 associations). 9% of these associations are disturbance tolerant and 6 are categorised as less degraded; however, 27% are highly disturbed weed association, with degradation of 18, which is the direct outcome of intense agricultural disturbance.

### *Vascular (flowering) plant species and plant associations of the water bodies and aquatic habitats of the Danube*

**The flora.** The vascular flora of aquatic and marshland habitats is rich. Except for some rarities, all characteristic species of floodplains are present in the Szigetköz area. Characteristic aquatic and protected species:

*Elodea canadensis*, *Groenlandia densa* (Upper-Szigetköz), *Callitriche cophocarpa*, *Ceratophyllum demersum*, *Hippuris vulgaris*, *Hottonia palustris* (Lower-Szigetköz), *Hydrocharis morsus-ranae*, *Lemna minor*, *Myriophyllum spicatum*, *M. verticillatum*, *Najas minor* (Middle- and Lower-Szigetköz), *Nuphar luteum*, *Nymphaea alba*, *Nymphoides peltata*, *Pedicularis palustris* (Middle- and Lower-Szigetköz), *Polygonum amphibium* (Lower-Szigetköz), *Potamogeton acutifolius*, *P. compressus* (Atlantic species, that occur only in the Szigetköz in Hungary), *P. crispus*, *P. gramineus* (Lower-Szigetköz), *P. lucens*, *P. natans* (Upper-Szigetköz), *P. nodosus* (Upper-Szigetköz), *P. panormitanus* (Lower-Szigetköz), *P. pectinatus*, *P. perfoliatus*, *P. trichoides* (Lower-Szigetköz), *Ranunculus baudotii* (Lower-Szigetköz), *R. circinnatus* (Upper-Szigetköz), *R. fluitans* (in Hungary appears only in the Upper-Szigetköz), *R. petiveri*, *R. radians* (Middle-Szigetköz), *R. rionii* (Lower-Szigetköz), *R. trichophyllus*, *Salvinia natans*, *Stratiotes aloides*, *Utricularia australis* (Lower-Szigetköz), *U. minor* (Upper-Szigetköz), *U. vulgaris* (Middle-Szigetköz), *Vallisneria spiralis* (Upper-Szigetköz). Further marshland vegetation elements and protected species: *Epipactis palustris*, *Iris pseudacorus*, *Dactylorhiza incarnata*.

**The plant associations.** Widespread aquatic and marshland associations, which are classified as relicts or deserving protection:

*Lemno-Spirodeletum*, *Salvinio-Spirodeletum*, *Lemno-Utricularietum*, *Hydrochari-Stratiotetum* (Upper-Szigetköz), *Batrachietum fluitantis* (which is only found in the Upper-Szigetköz), *Hottonietum palustris* (Lower-Szigetköz), *Elodeetum canadensis*, *Myriophyllo-Potamogetonetum*, *Potamogetono perfoliati-Batrachietum circinnati* (Upper-Szigetköz), *Potamogetonetum lucentis*, *P. natantis*, *Nymphaetum albo-luteae*, *Nymphoidetum peltatae*, *Scirpo-Phragmitetum austro-orientale*, *Sparganietum erecti*, *Glycerietum maximae*, *Rorippo-Oenanthetum*, *Sparganio-Glycerietum fluitantis*, *Caricetum elatae*, *Carici-Menyanthetum*, *Carici-Typhoidetum*, *Caricetum acutiformis-ripariae*, *Caricetum vulpinae*, *Eleochari-Caricetum bohemicae* (pioneer associations), *Calamagrosti-Salicetum cinereae*, *Dryopteridi-Alnetum* (willow relicts and alder marsh vegetation).

### *Vascular plant species and plant associations of the Szigetköz floodplain*

**The flora:** Seriously endangered or strictly protected species: *Ophrys apifera*, *O. insectifera* (these two are rare in both Hungary and the Upper-Szigetköz);

Protected species include all of the further 21 species of the Orchidaceae family: *Anacamptis pyramidalis*, *Cephalanthera damasonium*, *C. longifolia*, *C. rubra*, *Epipactis atrorubens*, *E. helleborine*, *E. microphylla*, *E. palustris*, *Orchis coriophora*, *O. laxiflora* subsp. *palustris*, *O. militaris*, *O. morio*, *O. purpurea*, *O. ustulata*, *Dactylorhiza incarnata*, *D. maculata*, *Neottia nidus-avis*, *Gymnadenia conopsea*, *Listera ovata*, *Platanthera bifolia*;

Other protected species, including some montane elements: *Ophioglossum vulgatum*, *Dryopteris carthusiana*, *D. dilatata*, *Thelypteris palustris*, *Adonis vernalis*, *Anemone sylvestris*, *Clematis integrifolia*, *Parnassia palustris*, *Astragalus exscapus*, *Lathyrus pannonicus*, *Dictamnus albus*, *Vitis sylvestris*, *Gentiana cruciata*, *G. pneumonanthe*, *Gentianella ciliata*, *G. austriaca*, *Aster amellus*, *Inula oculus-christi*, *Jurinea mollis*, *Pyrola rotundifolia*, *Dianthus superbus*, *Primula elatior*, *Hemerocallis lilio-asphodelus*, *Lilium bulbiferum* (this species occurs in the Szigetköz plain only at low elevations, where its richest population in Hungary may be found), *Scilla vindobonensis*, *Leucojum aestivum*, *Iris pseudacorus*, *I. pumila*, *I. sibirica*, *I. spuria*, *Eriophorum angustifolium*, *E. latifolium*, *Stipa borysthena*, *S. pennata*;

The *Fagetalia* species are also characteristic of the Szigetköz area: *Euphorbia amygdaloides*, *Majanthemum bifolium*, *Carex pilosa*, *C. alba*, *Galium odoratum*, *Viola sylvatica*, *Allium ursinum*, *Arum orientale*, and a montane element: *Pyrola rotundifolia*;

In the marshland meadows, important species include: *Sanguisorba officinalis*, *Sesleria uliginosa* (rare species), with the following representative endemics: *Molinia hungarica*, *M. arundinacea*, *Allium angulosum*. In the meadows and hayfield rare species include: *Achillea ptarmica*, *Gallium boreale*. In the fall *Colchicum autumnale* occurs in masses. Steppe elements include: *Anemone sylvestris*, *Festuca rupicola*, *Peucedanum alsaticum*, *Tunica saxifraga*.

The above-listed species show the diversity of the rich floodplain flora and indicate the importance of the primary and original state of the Szigetköz.

**The plant associations.** There are near natural associations of forests (near the villages of Feketeerdő, Halászi, Dunakiliti, Rajka and Hédervár), and *Molinietalia*, *Molinion* and *Arrhenatheretium* communities are found in the Upper- and Middle-Szigetköz. The near-natural or relict associations requiring protection include:

*Salicetum triandrae-purpureae*, *Salicetum albae-fragilis*, *Fraxino pannonicae-Ulmetum* (in several stands, for example at Dunasziget, with the co-dominant species *Alnus incana*), *Quercu robori-Carpinetum* (its only stand in the Szigetköz is found near Halászi in the Derék forest, the species composition of this beautiful relict forest has not changed since 1930, and similar forests are only found in Hungary on the Great Hungarian Plain), *Festuco-Quercetum roboris* (at Püski, with fragments also present in the Kímle forest), *Deschampsietum caespitosae croato-pannonicum*, *Alopecuretum pratensis*, *Agrostetum albae*, *Cirsio cani-Festucetum pratensis*, *Agrostio-Typhoidetum*, *Trisetetum flavescens*, *Carici flavae-Eriophoretum*, *Succiso-Molinietum* (Lower-Szigetköz), *Arrhenatheretum elatioris* et subass. *festucetosum rubrae*, *Brometum tectorum*, *Astragalo-Festucetum rupicola*, *Potentillo-Festucetum pseudovinae*.

The relicts of alder and willow swamps (and the associations of alder and willow), which deserve protection, are of great importance because they are the last remnants of the original marshland. The *Phragmitetum* and *Glycerietum moxinae* associations cover the largest area. There are smaller fragments of *Nymphoidetum*, *Hottonietum*, and fragments of *Caricetum elotae* and *Seslerietum uliginosae*. Relict and protected species also occur in these associations. The high number of natural associations is a characteristic of the Szigetköz, and this mosaicity is a crucial element of the landscape. Other important elements include willow stands, *Fraxino-pannonicae-Ulmetum* riparian forests, and *Potame-tea*-, *Phragmitetea*-, *Molinio-Juncetea* communities. It is worth mentioning that only occurrence of *Ranunculaetum fluitans* association is in the Szigetköz. The preservation of these remnant patches is essential for the conservation of the region's original biota because these patches could serve as the starting point for reconstructing the original state of the Szigetköz. The plant associations of the meadows and pastures fortunately indicate lower level of disturbance. Several hundred years of agricultural use undoubtedly facilitated the invasion of weed associations.

### I. 3. The fauna of the Szigetköz

The description of the Szigetköz fauna is more difficult than that of the flora, because animals are not as constant and clearly distinguishable, as plant associations and vegetation types. While a botanical data record (the occurrence of a certain species) shows that any given species (or individual plant) is a member of a specific association (belt, zone), a zoological reference only shows that at given animal was spotted at a particular place, and may or may not be a member of that community. Furthermore, there is not characteristic group of animals in the Szigetköz, in contrast to the vascular (flowering) plants that characterise the plant community. Therefore, the fauna of the Szigetköz is described here according to large taxonomical units.

#### Mollusca (*Molluscs*)

116 Mollusca species were collected from 74 localities (this constitutes 48% of all Hungarian Mollusca fauna). On the basis of detailed studies, we concluded that the number

of species is very high and that the Szigetköz is of paramount importance in the preservation of Mollusca species. Several species occurred only a limited array localities. The patchiness of the Szigetköz might explain this phenomenon, and these patches are important reservoirs in some cases. The occurrence of an additional 13 species is possible and these may be introduced or rheophilous species. Specimens of *Paladilhia oshanove* were not found in the upper reaches of the Danube, although intensive research was carried out in Germany and Austria. This ground-dwelling snail has gills and lives in the ground water of the alluvial fan. It is probably an endemic species of the Szigetköz. As the *Paladilhia* species are real stygobiont organisms, they may live in holes with moving. The other molluscs are grouped according to their habitats.

Rheophilous species live in fast-flowing waterbodies, with strong current:

Gastropoda: *Theodoxus (Theodoxus) transversalis*, *Theodoxus (Theodoxus) danubialis*, *Viviparus (Viviparus) acerosus*, *Potamopyrgus jenkinsi*, *Lithoglyphus naticoides*, *Fagotia (Microcolpia) acicularis*, *Fagotia (Fagotia) esperi*, *Ancylus fluviatilis*; Bivalvia: *Unio pictorum*, *Unio crassus*, *Anodonta (Anodonta) cygnea*, *Pseudanodonta complanata*, *Dreissena polymorpha*, *Sphaerium (Sphaeriastrum) rivicola*, *Pisidium amnicum*, *Pisidium henslowanum*, *Pisidium supinum*.

Species in slowly-flowing waterbodies, including those living in canals, ponds, dead branches:

Gastropoda: *Viviparus (Viviparus) contectus*, *Valvata (Valvata) cristata*, *Valvata (Cincinna) piscinalis*, *Valvata (Cincinna) pulchella*, *Bithynia (Bythinia) tentaculata*, *Bithynia (Bythinia) leachi*, *Acroloxus lacustris*, *Lymnaea (Lymnaea) stagnalis*, *Lymnaea (Galba) truncatula*, *Lymnaea (Radix) auricularia*, *Lymnaea (Radix) peregra*, *Physa fontinalis*, *Physella (Constatella) acuta*, *Planorbis corneus*, *Planorbis planorbis*, *Planorbis carinatus*, *Anisus vortex*, *Anisus vorticulus*, *Bathyomphalus contortus*, *Gyraulus (Gyraulus) albus*, *Gyraulus (Torquis) laevis*, *Gyraulus (Lamorbis) riparius*, *Gyraulus (Armiger) crista*, *Hippeutis complanatus*; Bivalvia: *Sphaerium (Sphaerium) corneum*, *Sphaerium (Musculium) lacustre*, *Pisidium milium*, *Pisidium nitidum*, *Pisidium obtusale*, *Pisidium subtruncatum*.

Species capable of living in marshes and water accumulating in pits:

Gastropoda: *Lymnaea (Stagnicola) palustris*, *Aplexa hypnorum*, *Anisus spirorbis*, *Segmentina nitida* and Bivalvia: *Pisidium casertanum*, *Pisidium personatum*.

Gastropoda species characteristic of *Carex* vegetation and wet meadows:

*Carychium minimum*, *Cochlicopa nitens*, *Vertigo (Vertilla) angustior*, *Vallonia (Vallonia) enniensis*, *Succinea (Succinella) oblonga*, *Oxyloma elegans*, *Nesovitrea hammonis*, *Deroceras (Deroceras) laeve*, *Perforatella rubiginosa*.

Snails characteristic of moist meadows and shaded places: *Cochlicopa lubrica*, *Vertigo (Vertigo) pygmaea*, *Pupilla (Pupilla) muscorum*.

Species occurring in dry grasslands or along roads: *Cochlicopa lubricella*, *Truncatellina cylindrica*, *Granaria frumentum*, *Vallonia (Vallonia) pulchella*, *Helicella (Helicella) obvia*, *Helicopsis (Helicopsis) striata*, *Monacha (Monacha) cartusiana*, *Cepaea vindobonensis*.

Snail species characteristic of marshlands, riparian forest:

*Carychium tridentatum*, *Vertigo (Vertigo) antivertigo*, *Vertigo (Vertigo) moulinsiana*, *Succinea*

(*Succinea*) *putris*, *Macrogastra* (*Macrogastra*) *ventricosa*, *Arion* (*Mesarion*) *subfuscus*, *Semilimax semilimax*, *Zonitoides* (*Zonitoides*) *nitidus*, *Vitrea* (*Crystallus*) *crystallina*, *Aegopinella nitens*, *Euconulus* (*Euconulus*) *fulvus*, *Trichia* (*Trichia*) *striolata*, *Trichia* (*Trichia*) *hispida*, *Helicigona* (*Arianta*) *arbustorum*, *Cepaea hortensis*.

Snails living in moist forests: *Columella edentula*, *Acanthinula aculeata*, *Clausilia* (*Clausilia*) *pumila*, *Balea* (*Alinda*) *biplicata*, *Punctum* (*Punctum*) *pygmaeum*, *Discus* (*Discus*) *rotundatus*, *Discus* (*Discus*) *perspectivus*, *Bradybaena* (*Bradybaena*) *fruticum*, *Perforatella* (*Monachoides*) *umbrosa*, *Trichia* (*Trichia*) *unidentata*.

Snails living in dry deciduous forests: *Vallonia* (*Vallonia*) *costata*, *Chondrula* (*Chondrula*) *tridens*, *Cochlodina* (*Cochlodina*) *laminata*, *Vitrina* (*Vitrina*) *pellucida*, *Aegopinella minor*, *Limax* (*Limax*) *cinereoniger*, *Perforatella* (*Monachoides*) *incarnata*, *Euomphalia* (*Euomphalia*) *strigella*, *Helix* (*Helix*) *pomatia*.

Snails characteristic of the human environment, or living in cultivated lands: *Cecilioides* (*Cecilioides*) *acicula*, *Arion* (*Arion*) *lusitanicus*, *Oxychilus* (*Oxychilus*) *draparnaudi*, *Tandonia budapestensis*, *Limax* (*Limax*) *maximus*, *Deroceras* (*Agriolimax*) *reticulatum*, *Eobania vermiculata*.

### Crustacea (*Microcrustaceans*)

Hungary has a total of 150 crustacean species (90 Cladocera, 60 Copepoda), 96 of which are present in the Szigetköz (64 Cladocera, 32 Copepoda), thus the Szigetköz is extremely rich in species, for several reasons. First of all, the fact that the Danube meets a plain creates a high diversity of aquatic habitats. The fauna of the main branch, side branches, dead arms, canals and stagnant water bodies is further affected by the dynamics of the water regime and by flooding. This pattern is demonstrated by material collected from the side branch-system at Ásványráró in 1991. Desiccating shallow water bodies are characterised by *Daphnia magna* and *Moina brachiata*. Samples collected near lake Öntési contain these species, as well as Chydoridae species, which are usually present in the vegetation of the littoral zone. *Daphnia cucullata*, which is widespread in larger stagnant water bodies, was also found in these samples. *Eurytemora velox* was also found, the first record of this species in Hungary. In 1992 the latter species was the most widespread crustacean in the Szigetköz, and it has colonised several water-types.

We can conclude that the Szigetköz is a very species-rich in Crustaceans.

### Odonata (*Dragonflies*)

Forty-five species of Odonata were found in the Szigetköz (adults of 42 and larvae of 32 species were collected). This is more than the half of the Hungarian Odonata fauna. The high species diversity is partly maintained by the slow flowing of the Danube in the Szigetköz, which transports and accumulates sediment, as well as the well-developed side branch-system. The larvae of dragonflies breath dissolved oxygen from the water, and water quality is therefore an important factor for their survival. There are three areas in the Szigetköz that are of paramount importance for maintaining Odonata: the Moson-Danube, Gazfűi Holt-Danube (Sérfenyősziget-Cikolasziget) and the Nováki-csatorna (Halászi, Püski).

The Moson-Danube is a meandering Danube branch, which preserved its original state

fairly well. Because of its different size of sediment, several habitat types have developed. These habitats, as well as the bog patches occurring in the riparian forest offer excellent conditions for the Odonata. Species living here include: *Stylurus flaviceps* (protected by the Bern Convention), *Aeshna cyanea* and *Sympetrum danae*.

The Gazfűi Holt-Danube and the Nováki-csatorna branching from it, are the only localities where *Epitheca bimaculata* may be found in the Little Hungarian Plain. The population of *Aeshna grandis* is remarkably strong here.

The Nováki-csatorna is the richest in Odonata species of the Szigetköz water bodies – 23 species were found. The most valuable species include *Somatochlora flavomaculata*, *Aeshna grandis* and *Anax parthenope*.

### Heteroptera (*Aquatic and semiaquatic bugs*)

Data on 27 species were obtained. Although Heteroptera species were absent in fast flowing river sections and lakes formed in gravel excavations, aquatic Heteroptera are rich in other localities. Interestingly, semiaquatic species are not as diverse.

Species characteristic of waterbodies partly covered by vegetation were dominant in the samples. The wide range of water and habitat types in the Szigetköz accommodate diverse species of aquatic and surface-dwelling heteropterans, comparable to that of Lake Balaton. The populations are limited by natural changes of the water-regime. Four species (*Hydrometra gracilentum*, *Micronecta griseola*, *Hesperocorixa sahlbergi* and *Sigara fossarum*) are interesting from faunistical point of view, and the latter species was recorded in Hungary for the first time.

### Neuropteroidea (*'Net-winged'*)

42 species of Neuroptera, one third of all Hungarian Neuroptera, were collected at 35 localities in the Szigetköz. In addition to the characteristic species of lower montane areas, several westernly and north-westernly distributed European species were found in the Szigetköz. *Coniopteryx aspoECKi* and three other Neuroptera species developing in the water along the banks of Moson-Danube (*Sialis morio*, *S. nigripes* and *Sisyra terminalis*) are of high natural values.

The Házi forest is the most natural stand of the hard wood riparian forests covering the higher elevations of the floodplain. The natural state of this forest is indicated by the fact that 7 of the 10 characteristic Neuropterans were recorded here. Four neuropteroid species living in the forest deserve protection, including *Nineta carinthiaca*.

### Coleoptera (*Beetles*)

Based on our knowledge of the Coleoptera of the Carpathian Basin, the estimated number of the beetles of the Szigetköz is 2000. One third of these has already been recorded. We have provided below a list of 44 species characteristic of the areas deserving protection. The species may be grouped as:

- protected species;
- endangered species, which should be protected;

- rare, faunistically important species (characteristic for Hungarian habitats); and
- extremely rare species in Hungary (recorded only in the Szigetköz), the survival of their populations is uncertain.

#### List of species

- Calosoma auropunctatum* (Herbst, 1784) – protected, endangered species.
- Calosoma reticulatum* (Fabricius, 1787) – protected species, also listed in the Red Data Book.
- Carabus coriaceus coriaceus* Linnaeus, 1758 – protected species.
- Carabus hungaricus hungaricus* Fabricius, 1792 – protected species, highly endangered.
- Carabus germarii exasperatus* Duftschmid, 1812 – protected species.
- Carabus granulatus granulatus* Linnaeus, 1758 – protected species.
- Carabus cancellatus cancellatus* Illiger, 1798 – protected species.
- Carabus ulrichii ulrichii* Germar, 1824 – protected species.
- Carabus scheidleri baderlei* Mandl, 1965 – endangered subspecies, its protection is recommended; in Hungary it is found only in the Szigetköz.
- Cychrus caraboides* (Linnaeus, 1758) – protected species.
- Nebria livida* (Linnaeus, 1758) – rare montane species, in Hungary it occurs only along the Danube and Rába rivers; its protection is recommended.
- Trechus obtusus* Erichson, 1837 – rare species, occurring sporadically in the western part of Hungary.
- Bembidion fasciolatum* (Duftschmid, 1812) – rare montane species, in Hungary it occurs only in the Szigetköz and along the Rába river.
- Bembidion modestum* (Fabricius, 1801) – sporadically occurring montane species.
- Perileptus areolatus* (Creutzer, 1799) – rare, endangered species, occurring along good water quality rivers and clear lakes, and dwelling on soaked gravel surrounding fresh lakes.
- Abax parallelepipedus* (Piller et Mitterpacher, 1783) – characteristic, abundant montane species, occurring only in the Szigetköz on plain localities of low elevation.
- Rantus consputus* (Sturm, 1834) – a characteristic species of rivers of continental steppe or forest habitats.
- Gaurodytes subtilis* (Erichson, 1837) – characteristic species of cooler, moist, montane habitats.
- Hydroporus rufifrons* (Duftschmid, 1805) – in Hungary it occurs only in the Szigetköz.
- Gyrinus minutus* (Fabricius, 1798) – one of the three known Hungarian localities of this species is in the Szigetköz.
- Orectochilus villosus* (O. F. Müller, 1776) – living in fast-flowing cool, clear waterbodies, in larger streams and rivers.
- Bledius pallipes* (Gravenhorst, 1802) – there are only two known localities of this species in Hungary, one of them is situated in the Szigetköz.
- Dicerca alni* (Fischer, 1823) – its occurrence is sporadic in Hungary.
- Lucanus cervus cervus* (Linnaeus, 1758) – protected species.
- Dorcus parallelipipedus* (Linnaeus, 1758) – protected species.
- Odonteus armiger* (Scopoli, 1772) – a widespread but rare species in the forested areas of Hungary; its protection is recommended.
- Potosia aeruginosa* (Drury, 1770) – protected species.
- Osmoderma eremita* (Scopoli, 1763) – protected species, highly endangered; throughout Europe it occurs sporadically only in old willow stands along rivers.
- Megopis scabricornis* (Scopoli, 1763) – protected species.

*Rhamnusium bicolor* (Schrank, 1781) – protected and endangered species.

*Lamia textor* (Linnaeus, 1758) – endangered but not yet protected species; its protection is recommended.

*Obrium brunneum* (Fabricius, 1792), *Leptura maculicornis* (De Geer, 1775), *Leptura rubra* (Linnaeus, 1758), *Leptura sanguinolenta* (Linnaeus, 1761), *Monochamus galloprovincialis pistor* (Germar, 1818), *Acanthocinus aedilis* (Linnaeus, 1758), *Acanthocinus griseus* (Fabricius, 1792) – are characteristic species of montane deciduous and pine forests; in the Szigetköz they live in the *Pinus silvestris* plantations.

*Obrium bicolor* Kraatz, 1862 – reaching the north-western border of its area in Hungary, it is abundant in the hard wood riparian forests of the Szigetköz.

*Nathrius brevipennis* (Mulsant, 1839) – occurs sporadically in Hungary.

*Aromia moschata* (Linnaeus, 1758) – characteristic of willow stands; deserves protection.

*Calamobius filum* (Rossi, 1790) – protected species.

*Timarcha tenebricosa moravica* Bechyně, 1949 – occurs sporadically on the plains, foothills and lower montane areas.

*Sermylassa halensis* (Linnaeus, 1758) – occurs in a limited number of localities in Hungary.

### Trichoptera (Caddis-flies)

64 species have been confirmed. Considering the plain character of the Szigetköz, this is a very high number. For example, on the Great Hungarian Plain, only 92 species have been recorded. The 64 species comprise some 30% of Hungarian Trichoptera (of a total of 202).

The following species are of great faunistic importance:

*Ceraclea nigronervosa* – a new species of the Hungarian fauna, it was recorded for the first time in 1992 in the Szigetköz; *Rhyacophila dorsalis*; *Agapetus laniger*; *Oxyethira flavicornis*; *Hydroptila forcipata*; *Polycentropus irroratus*; *Cyrnus trimaculatus*; *Lype phaeopa*; *Brachycentrus subnubilus* – the populations of these species were established only in the Szigetköz; *Limnephilus elegans* – rare throughout the whole of Europe, and its occurrence in the Szigetköz is important both from faunistic and ecological points of view; *Halesus radiatus*; *Lepidostoma hirtum*; *Athripsodes albifrons*.

The high species diversity of Trichoptera in the Szigetköz is maintained by the relatively clear water of the Danube and its side branch-system, as well as the current conditions, chemical characteristics and quality of the sediment.

### Lepidoptera (Butterflies and Moths)

1124 species of Lepidoptera were identified (663 macrolepidoptera and 461 microlepidoptera). On the basis of the available knowledge, the expected number of species is probably around 1300, which is 30% of Hungarian Lepidoptera.

The distribution of species within the main taxonomical units of lepidopterans, especially the ratio of species richness of Noctuidae and Geometridae, is similar to that of the lower montane forests. Namely, there is no significant difference from the ratio found in the whole Hungarian fauna (5:3).

Although the Lepidoptera of the Szigetköz is similar to the fauna of other Central-

European river basins, the relatively higher diversity and greater number of species are directly influenced by the presence of scattered patches of *Alnus* stands, (which otherwise are typical of Atlantic, or lower montane areas), as well as by the mosaicity and humidity of habitats.

The Lepidoptera species composition of riparian forests in Central and South-west Europe are not exclusively determined by their exact geographical location, and are generally fairly poor in species. The difference in species assemblages is not predominantly affected by the diversity of tree canopy layer, but by the richness of the herb layer. Intense forest management or flooding can almost completely destroy the herb layer and hence facilitate the invasion of certain weed species (*Impatiens*, *Solidago* spp.), which eventually become dominant in the affected associations. This process leads to a decrease in diversity, as the invading weed associations are usually uniform.

Although these tendencies generally hold true in the Szigetköz, the area is nevertheless unique because of certain characteristic features: its sub-Atlantic climate, and the effects of the nearby Alps. Several Lepidoptera species that live here are usually absent from or rare in other riparian forests. These faunal elements are characteristic species of closed montane mixed forest stands, Atlantic plain or lower-montane alder associations, or fens and moist stream basins. In the Szigetköz they may be found in the remnant forests of higher elevation, or in the small uncultivated forest mosaics of the floodplain. Consequently, their populations are often fragmented and isolated.

The dry, sandy patches of grasslands covering the higher localities of the Szigetköz are important landscape elements, since they conserve several characteristic species of the steppe forest vegetation, although these patches are becoming increasingly disturbed.

### Oribatida (*Oribatid mites*)

176 species of Oribatids were collected in the Szigetköz, which is an exceptionally high number compared to other nature reserves and national parks of Hungary. For example, 109 species of Oribatids have been found in the Hortobágy National Park, 195 in the Kiskunság National Park, 103 in the Barcs Nature Reserve and 164 in the Bátorliget Nature Reserves.

The composition of Oribatids can be characterised by chorological categorisation and ecological grouping. The size of these groups is also important.

#### 1. Wide-spread species (48 %):

cosmopolitan	(10 species)
holarctic	(40 species)
palaearctic	(34 species)
for a total of	84 species (48%)

#### 2. Species groups with smaller areas:

European	(24 species)
Central-European	(18 species)
North-West-European	(6 species)
South-western Central European	(24 species)
Mediterranean	(12 species) and
Hungarian endemic	(5 species)

#### 3. Unidentifiable species:

total of	3
	92 species (52%)

According to previous surveys, wide-spread Oribatid species are dominant elsewhere in Hungary, even at such particular places as the Bátorliget Nature Reserves (60–40%). In contrast, high numbers of Atlantic, Atlanto-Mediterranean, and even boreo-alpine faunal elements were found in the Szigetköz.

*Highly valuable faunal elements of the Szigetköz:* We have listed below the most important species of the area (occurring exclusively in the Szigetköz, demanding strict protection, or indicating the uniqueness and sensitivity of the area).

- Brachychthonius bimaculatus* Willmann, 1936
- Brachychthonius impressus* Moritz, 1976
- Brachychochthonius hungaricus* (Balogh, 1943)
- Brachychochthonius suecicus* (Forsslund, 1947)
- Neobrachychthonius magnus* Moritz, 1976
- Synchthonius elegans* Forsslund, 1956
- Atropacarus* sp. n. new species
- Steganacarus brevipilus* (Berlese, 1923)
- Mesoplophora pulchra* Sellnick, 1928
- Ctenobelba pectinigera* (Berlese, 1908)
- Dorycranosus* sp. n.? (probably a new species)
- Furcoribula furcillata* (Nordenskiöld, 1901)
- Machuella* cf. *ventrisetosa* Hammer, 1966
- Medioppia hygrophila* Mahunka, 1987
- Multioppia glabra* (Mihelcic, 1955)
- Oxyoppioides decipiens* (Paoli, 1908)
- Autogneta longilamellata* (Michael, 1885)
- Conchogneta dalecarlica* (Forsslund, 1947)
- Hydrozetes parisiensis* Grandjean, 1948
- Suctobelbella carcharodon* (Moritz, 1966)
- Suctobelbella messneri* Moritz, 1971
- Suctobelbella palustris* (Forsslund, 1953)
- Oribatula pannonica* Willmann, 1949
- Zetomimus furcatus* (Pearce & Wharburton, 1906)
- Punctoribates hexagonus* Berlese, 1908
- Eupelops curtipilus* Berlese (1916)

One of the most important results of our research is that some special Oribatids (*Suctobelbella messneri*, *S. carcharodon*), living in the floodplain or the moss layer covering fallen or rotten stumps or under their bark, can tolerate the repeating water cover. From the samples collected in localities (Kisbodak, Dunasziget) new species of the Hungarian fauna, or extremely rare species were collected. These habitats are undoubtedly of great importance in maintaining the Oribatid diversity of the Szigetköz. It is highly probable that these species will be the first to disappear from the floodplain in the course of the desiccation process.

From a soil-zoological point of view, one of the most interesting and valuable areas of the Szigetköz, indeed of all Hungarian habitats is the Derék Forest. The Central-European forest fauna here enriched with Atlanto-Mediterranean and boreo-alpine species. The highest species diversity of Oribatids in Hungary has been recorded here, in a relatively small area.

### Pisces (Fishes)

Since a separate detailed study of the fish fauna and their natural value has been prepared, we will not discuss this topic here.

### Amphibia (Amphibians)

Eleven species of amphibians were recorded in the Szigetköz (*Triturus vulgaris*, *Triturus cristatus*, *Bombina bombina*, *Pelobates fuscus*, *Bufo bufo*, *Bufo viridis*, *Hyla arborea*, *Rana arvalis wolterstorffi*, *Rana lessonae*, *Rana ridibunda*, *Rana esculenta*).

The amphibians occurring in the Szigetköz can be divided into two major groups. The first group consists of species living permanently in the water, while the members of the second require water only temporarily. The amphibian populations of the floodplain are directly controlled through their reproductive biology by the quantity and temporal distribution of water. The repeated lack of high or medium water levels in spring will severely endanger Amphibia populations in the long term. Present hybridization conditions and changes in water regime facilitate the spread of *Rana esculenta*. Similarly, the size of *Rana lessonae* habitats will obviously shrink.

### Aves (Birds)

206 species of birds were recorded in the Szigetköz, that is 57% of the Hungarian ornithofauna. 166 species are protected, of which 134 nest here. The high number of species is maintained by the mosaicity and habitat diversity of the Szigetköz, while the density of the species is increased by the dense shrub layer and the edge effect.

The species-composition of the Szigetköz is similar to that of lower montane forests, but with a higher density (150-200%). The presence and co-occurrence of diverse habitat types allow the breeding of several strictly protected species (*Ciconia ciconia*, *Haliaeetus albicilla*).

Montane faunal influence is indicated by nesting of *Parus montanus*. The strong breeding populations of *Prunella modularis* and *Hyppolais icterina* are also worth mentioning. With regard to species richness and diversity, the Szigetköz is the most valuable floodplain in Hungary.

This area is of vital importance as an overwintering ground for wildfowl. In fact this area is one of the largest overwintering areas in Europe. Some 10-14 thousand individuals of various duck species have overwintered here in previous years. Maximum numbers were recorded in January. The main channel and the side branches provide feeding sites of different qualities and flow speeds. High number of the strictly protected white-tailed eagle (*Haliaeetus albicilla*) winters here regularly. Either because of their exceptionally high abundance (e.g. mallards *Anas platyrhynchos*) or because of their international conservation value as a threatened species, the following bird species should be mentioned (the estimated number of overwintering individuals is shown in parentheses):

Mallard – <i>Anas platyrhynchos</i> :	(6000-7000)
Goldeneye – <i>Bucephala clangula</i> :	(ca. 3000)
Pochard – <i>Aythya ferina</i> :	(ca. 1000)
Tufted Duck – <i>Aythya fuligula</i> :	(500-1000)
Goosander – <i>Mergus merganser</i> :	(200-250)
Smew – <i>Mergus albellus</i> :	(ca. 400)
White-tailed Eagle – <i>Haliaeetus albicilla</i> :	(ca. 15)
Kingfisher – <i>Alcedo atthis</i> :	(500-1000)

The inclusion of the Szigetköz into the Ramsar Convention, as an important overwintering area for aquatic birds, is in progress. Similarly, the acceptance of this area into the IBA (Important Bird Areas) Project is on its way. Owing to the drop in water level, the food supply of waterfowl will probably decrease, and wintering grounds will shrink or might even disappear. This rich variety of wintering bird fauna is seriously threatened.

### **Mammalia (Mammals)**

The ice-age relict *Microtus oeconomus* is a very valuable species. It is found in almost every larger reed bed of the Szigetköz, and at certain places it is a dominant species. As the areas outside the dykes dry up, this species will probably disappear entirely. From among the known mammals 16 species are protected and endangered.

## **II. The effects of Version C on the biota of the Szigetköz**

The effects of the diversion of the Danube can be demonstrated by discussing the already detectable (1.), and the predictable long-term (2.) effects and damages.

### **II. 1. Damages already detectable**

The immediate impact affected mainly the aquatic organisms, in some cases being disasterously. It is also clear that the effect on the terrestrial fauna will be perceptible during the next vegetation period, since most of the invertebrates were already preparing for the wintering, and their activity was lower at the time of the diversion (October).

### **II. 2. Predictable long-term effects: damages and changes**

The natural values of the Szigetköz are maintained by the Danube river. As a consequence of the geographical and climatic characteristics of the Szigetköz it is the westernmost fragment of the zonal forest-steppe vegetation in the Carpathian Basin. If water supplementation will not be carried out, the following changes in the fauna are likely to occur.

As a consequence of the diversion, the Upper- and Lower-Szigetköz will change in character. The boundary between the two areas will probably run at around the Bagomér side branch-system, where there are already signs of impounding.

In the Upper-Szigetköz the radical change of the water discharge will transform plant associations, and it will seriously affect the fauna. If the surface- and ground-water level are stabilized at the present level, the most valuable and characteristic botanical and zoological feature of the Szigetköz will be lost: that is, the mosaicism of the landscape, and the presence of high diversity and wide range of habitats in a relatively small area.

The diversity of aquatic habitats in the floodplain, and outside the dykes will either vanish, or shrink to a critical point. Therefore, the aquatic flora and fauna and several affected terrestrial organisms may become extinct or emigrate to other locations. The size of the populations will considerably decrease. In the long-term biological diversity will decrease, although species diversity might even increase initially. We list some examples hereunder.

During the summer of 1993 rapid weed invasion with high productivity occurred in the desiccated side branch-system. Great quantities and high species diversities of weed associations were recorded. The following species were found:

*Chenopodium rubrum*, *Polygonum mite*, *Artemisia annua*, *Sonchus asper*, *Plantago lanceolata*, *Urtica dioica*, *Rorippa sylvestris*, *R. islandica*, *R. amphibia*, *Chenopodium striatum*, *Aster tradescenti*, *Bidens tripartitus*, *Gnaphalium uliginosum*, *Polygonum persicaria*, *Lythrum salicaria*, *Potentilla supina*, *Polygonum lapathifolium*, *Juncus bufonius*, *Rumex conglomeratus*, *R. sanguineus*, *Matricaria inodora*, *Bromus tectorum*, *Senecio vulgaris*, *Solidago gigantea*.

After two or three similar years the original aquatic, marshland and fen vegetation will be severely damaged. The floodplain forests cannot even endure that long and will probably be destroyed more quickly.

The desiccated gravel beds and shore lines of the Öreg-Danube have become xerotherm habitats (like a desert), where great numbers of xerophilous beetle species have recently been found (*Amara fulva*, *Amara similata*, *Anthicus schmidtii*, *Colotes hampei*, *Coccinella undecimpunctata*), for the first time in the shore habitats of the Szigetköz.

In the stagnant waterbodies of the side branches zooplankton stocks of a very high density emerged (for example in the Sziget-Danube 6073-28368 individuals pro 20 litres). This amount of rotatorians and planktonic crustaceans is usually found in polytrophic waterbodies.

The flora and fauna preserving capacity of terrestrial mosaic patches is strongly correlated with their size and shape. As a consequence of the decrease in the ground water level and its stabilization at a significantly lower level, these mosaics will be lost or will struggle on even smaller areas, under significantly worse conditions, especially on the floodplain and localities near the Öreg-Danube. The development of hard-wood riparian forests should take place. The possibilities of ground water uptake will be both spatially and temporarily the determining factors in the development of the new biota. In this respect localities close together may vary widely.

Outside the dikes the spread and dominance of zonal forest steppe vegetation is expected. Their species composition will be greatly affected by the spreading capacity of the species living in the small fragments of present steppe patches. Perhaps the only localities where quick changes will not take place are the alluvial forests standing along the Moson-Danube. Ecologically planned water-regime regulation of the Moson-Danube and the canals outside the dikes might slow down the desiccation process.

The expected degradation will first destroy the herb species – the most valuable botanical elements are within this group! Moreover, the species richness of phytophagous fauna is basically determined by the heterogeneity of the herb layer.

The mesophilization triggered off by desiccation will facilitate the spread of ubiquitous species, at the expense of stenoecious species. This process will probably initially increase the number of species, but the duration of the increase cannot be predicted. Thereafter a sharp decline in diversity will occur, as a consequence of the disappearance of the biota of the wet habitats.

The effects on the biota of the Lower-Szigetköz cannot be easily assessed. It is very probable that the value – at least the nature protection value – of this area will be more

respected. This section will be less desiccated, and, therefore, the expected changes, will be less pronounced or not take place at all. The Bagomér branch-system deserves special attention, since these branches still carry water. There is not any information on the hydraulic and hydrological processes going on in these waterbodies, but we suspect that several parameters have changed since the diversion of the Danube. There is no chance that this branch system will substitute for the damaged or vanished branch systems of the Upper-Szigetköz.

In the Szigetköz an enhancement of the multidirectional migration process is expected. It is impossible to predict on the basis of our biological knowledge, which species groups will be able to establish their populations under the conditions to come.

### III. Conditions of conservation and rehabilitation of the existing habitats

Under present circumstances or even with a minor water supplementation system the characteristic habitat mosaicity, sustaining the diversity and natural values of the Szigetköz, cannot be preserved. Under the conditions prior to the diversion nature protection and landscape reconstruction-rehabilitation were mainly aimed at enlarging the area of mosaic-like patches, and at creating larger zonal habitats.

Our advice concerning the rehabilitation and preservation of habitats is immediate and straight forward: the recreation of the ecological factors sustaining the original natural environment. These factors were controlled originally by the Danube itself. Therefore, the highest possible volume should be fed – without storing in the reservoir – into the Öreg-Danube. But this issue is not really a biological one, but a political and technical problem.

It is, nevertheless, possible to attempt to preserve some aquatic habitats. The price of this effort would be exceptionally high. Since the basic ecological rules predict the opposite we must bear in mind that in a considerably changed environment the long-term preservation of the biological values of these isolated small areas is almost hopeless.

### IV. The flora and fauna of the middle section of the planned river barrage system (from Győr to the Danube Bend)

The particular part of the barrage system that would have fundamentally affected the ecological conditions of this river section was not constructed. Considering aspects the nature protection this river section contains the least natural values, and most of the few found here are located not directly along the shoreline of the river. The research carried out in this area is far from complete, limited to small areas and few taxa. Since 1987, botanical monitoring has only been carried out at two localities (Tát – *Molinietalia* community, Almásneszmély – riparian forest) within this river section.

## V. Natural values of the Danube Bend

The landscape could itself be the target of nature protection, and valuable landscapes should be considered in their entirety when making conservation efforts. The beautiful Danube Bend is an exceptionally valuable region in both the geomorphological and aesthetic sense. A geological process lasting several millions of years was needed for the Danube to cut through the volcanic hills to form a deep and picturesque gorge. The outcome of this long and natural process is one of the most beautiful landscapes of Europe. Recent years of human interference have caused the most drastic landscape damage here, in the construction of the turbine pit for the planned power point at Nagymaros.

The World Conservation Strategy defines wetland and aquatic habitats and temperate deciduous forests as ecosystems demanding the strictest protection. The latter ecosystems are found today in the Pannonian and Kamchatkan biogeographical region. The Pannonian region is part of Hungary and of former Yugoslavia. The protection of aquatic habitats and wetlands – in Hungary several small regions belong to these categories – is of paramount importance in Europe.

It is impossible to predict the indirect effects of the filling up of the planned reservoir at Nagymaros on biota not directly located on the shoreline. Nevertheless we are certain that such an interference in a river valley bordered with steep mountain sides will considerably affect the micro- and meso-climate and, hence, damage the vulnerable and sensitive members of the biota, especially those suffering from the effects of previous anthropogenic environmental damages. The most vulnerable vegetation components are the *Quercetum-petraeae cerris* associations located on the slopes facing the Danube; *Chrysanthemo (corymbosi)-Luzulo-Quercetum* communities of the steep localities; and the *Corno-Quercetum poetosum pannonicae* and *Ceraso (mahaleb)-Quercetum pubescentis* plant associations. The *Festucion rupicola* vegetation of the south part of the Börzsöny mountains might also be endangered as might be the small, though valuable species composition of the fragments of loess steppe vegetation.

The original plant associations along the rivers in the Danube and Ipoly basin – ie. natural soft and hard wood riparian forests – were already severely damaged by the regulation of the Ipoly river, and the advanced work on the barrage system at Nagymaros. Only the willow and poplar associations survived. The remnant patches of alluvial hard wood riparian forest (oak, - ash- and elm trees) are still thriving on the small islands, peninsulas, and protected sections of the shore, but even these stands would be directly endangered by the damming below or above the barrage. Among the relatively more abundant wet habitats, soft wood riparian forests (poplar and willow), *Salicetum triandrae-purpureae*, *Molinietalia*, *Arrhenatheretalia*, and *Nanocyperion* associations would be endangered and perhaps destroyed.

The long-term effects endanger the *Agropyro-Kochietum* and grass associations on the high banks of the Danube between Vác and Göd, and the *Molinion* communities at Göd and Sződliget. Moreover the fate of extremely valuable grass (*Festucion vaginatae*) associations, which are essentially similar to those found in the Great Hungarian Plain, the sand-covered patches and sand dunes near the shore of the Szentendre Island is uncertain. The future of the specific habitats located north of the planned dam is also doubtful. At present this area is characterised by a high degree of mosaicity, wetland associations (*Phalaroidetum*, *Agrosteum albae*, *Magnocaricion*, *Phragmitetum*, in the dead arms

*Hydrocharition*, *Salicetum albae-fragilis*, *Salicetum cinereae*, *Carici elongatae-Alnetum*, *Nymphaetum albo-luteae*) and dry habitat patches (*Festucion vaginatae*) that may be present near each other. This shore line zonation is determined by the ground water table, and the planned reservoir will change the prevailing ground water conditions. The *Fraxino pannonicae-Alnetum* and *Carici elongatae-Alnetum* habitat patches along the Ipoly river, which are located farther away from the Nagymaros work site are of outstanding value and demand strict protection. As a consequence of the last regulation of the Ipoly river, these habitats were severely damaged and are presently in a critical state. Any further disturbance might entirely wipe out the biota of these wetlands.

It is very likely that the micro- and meso-climatic changes arising from the planned construction of the Nagymaros reservoir will transform these plant associations, and consequently affect the fauna living here. Before these slow-acting changes, the direct impact of the construction and the damming will heavily damage the biota. The fauna of the wet habitats (marshlands, fens, shoreline) are especially endangered by direct effects, while the animal communities of the dry-warm sand, loess-wall, and slope-steppe localities will be mainly affected by indirect effects. Consequently the future of the irreplaceable fauna elements of this region is doubtful. We must draw the attention to the fact that the populations of protected (or strictly protected) animals inhabiting the area – some of which are included in the Hungarian Red Data Book – were already severely affected by the construction of the round-dam at Nagymaros, because their habitats disappeared, or were constantly disturbed by human beings. The habitat of the biggest aquatic mammal living in Hungary, the otter (*Lutra lutra*), was almost completely destroyed around Nagymaros. Some others migrated upstream into the Ipoly river and might still be found in the mountains, but the former population focus was clearly located on the Danube.

With regard to birds, the aquatic birds and waders should be mentioned, of which most rest on the Danube during migration, or overwinter there. Both near the waterbodies and some distance away several bird species build nest: Mallard (*Anas platyrhynchos*), Little Grebe (*Tachybaptus ruficollis*) and Moorhen (*Gallinula chloropus*). The endangered and rare Black Stork (*Ciconia nigra*) nests in the riparian forests of the floodplain. The Little Ringed Plover (*Charadrius dubius*) nests along the Danube. During migration, many birds rest or find shelter here during the winter, including the Great White Egret (*Casmerodius albus*), the Spoonbill (*Platalea leucorodia*), eleven species of ducks, the Lesser White-fronted Goose (*Anser erythropus*), the White-fronted Goose (*Anser albifrons*), the Red-throated Diver (*Gavia stellata*) and the Black-throated Diver (*Gavia arctica*). The larger water surface created by the damming will enhance the virtual spread of the aquatic fauna (the spread of the non-sensitive aquatic species such as swans (*Cygnus* spp.) might be expected), but the valuable sensitive species may disappear because they require not only a substantial food supply, but a peaceful habitat. The construction of the river barrage and the power station – and the concomitant disturbance – would probably scare away the following species of winter guests: Merlin (*Falco columbarius*), Peregrine (*Falco peregrinus*), Spotted eagle (*Aquila clanga*), White-tailed Eagle (*Haliaeetus albicilla*) and Osprey (*Pandion haliaetus*), as well as several strictly protected species that nest on the steep cliffs facing the Danube: Raven (*Corvus corax*) and Saker (*Falco cherrug*), since these species are extremely sensitive to disturbance. The construction of the reservoir would surely cause their disappearance.

## VI. Literature

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