ANNALI DI BOTANICA
Ann. Bot. (Roma), 2011, 1: 1–8

CHANGES IN THE ACTIVE FLOODPLAIN VEGETATION OF THE SZIGETKÖZ

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(RECEIVED 15 OCTOBER 2010; ACCEPTED 17 NOVEMBER 2010)

ABSTRACT - The Szigetköz is situated in the northwest part of Hungary. In the late 19th century, a flood protection dam was built, which divided the original floodplain into an active part and an inundation-free part. In 1992, most of the water in the main Danube channel was diverted into a canal built to supply the hydroelectric power plant at Bős. This large-scale modification led to – among other things – the decline of surface water level in the active floodplain as well as the drop of groundwater depth beyond the dikes. The region's wetland vegetation was characteristically rich in species due to a favorable water supply and the wealth of propagules (seeds, fruits, shoots with live buds) dispersed over the area by recurring floods. The area supports only few rare species. Instead, its real value lies in the vast richness of species compositions: montane and lowland species often grow side by side. The degree of naturalness varies greatly for the different parts of the Szigetköz ranging from intensively managed arable fields under constant human influence to pristine wilderness proposed to be placed under strict legal protection. Plantations of hybrid poplar also cover extensive areas. The most severe water level decline took place on the active floodplain at the section of the Great Danube channel right upstream of the canal supplying the hydroelectric power plant. Even beyond the flood protection dams there are scattered patches of considerable botanical value, despite most of the land there being under cultivation. These precious habitat islands are dispersed across the area, and their water supply is largely ensured already or can be easily remedied due to their proximity to canals or former river channels. Terrestrial plants have very quickly established in the dried-up riverbed of the Old Danube channel. In the first years, the exposed gravel substrate abounded in usual riparian plant species otherwise common on bars. On the new shoreline, a 30 m wide belt of white willow (*Salix alba*) has developed. Above this, a zone of water-demanding tall forb community has established which tolerates temporary inundation. Further away up to the original shoreline, a strip of vegetation composed of box elder (*Acer negundo*) has appeared. Unlike the white willow belt, this zone developed slowly. At first, knee-high box elder saplings vegetated in the dry grassland, but once their roots has reached permanently wet soil layers, their growth has greatly accelerated. In the former riverbed, the mass appearance of invasive plants (*Acer negundo*, *Ailanthus altissima*, *Solidago gigantea*, *Aster lanceolatus*, *Fallopia* x *bohemica*) raises serious concerns for nature protection.

KEY WORDS: SZIGETKÖZ, FLOODPLAIN, VEGETATION, DAM

INTRODUCTION

On 25th October in 1992 a high proportion of the water of the Danube was diverted into a 42 km long artificial canal between Dunacsúny and Szap. As a result, the amount of water in the main riverbed decreased by 80-90% and water level dropped by 3 m. Some river branches have dried out completely. All these resulted in a general decrease in ground water level in the Szigetköz, though the degree depended on location and on actual amount of water in the Danube. The least change took place along the Mosoni-Danube, where water level is artificially stabilized. When high water levels

occur, ground water table level on the lowermost floodplains along the Old-Danube is 4 meter lower than before diversion. In addition to the decrease of available soil moisture content, long-term effects of diversion include scarcity or even lack of regular flooding of the lower floodplains.
The aim of our study was to record changes in the vegetation in response to this large-scale habitat alteration.

STUDY AREA: PRE-DIVERSION STATE

The Szigetköz is located in Northwest Hungary, in the interfluve of the Danube and Mosoni Danube rivers (between the coordinates 48.019309/17.205161 and 47.739682/17.765667). Its length is about 50 kilometers, maximum width is 7 km. The width of the inundation area is much smaller, only at larger tributaries exceeding 3 km (Fig. 1). The regularization of riverways in the 19th century caused marked alterations in the environment. At the end of the century, with few exceptions, forests beyond the dams were felled and replaced by arable land, hay meadows and pastures. The phytocoenological survey of forest communities started in the late 1920s and yielded detailed descriptions of willow woods, oak hardwood gallery forests, relict oak-hornbeam woods and swamp alder woods (Zólyomi, 1937). In that report, the forest stands studied were considered as remnants of former extensive natural woodlands. In the 1920s the proportion of forests to fields was 60 to 40, including hybrid poplar plantations which accounted for 12.5% of forest area. In the 1980s data show that this ratio was 20 to 80, thus agricultural land far exceeded forests already. Furthermore, within forests the share of hybrid poplar plantations reached 81% by that time, while seminatural forests covered 19% only.

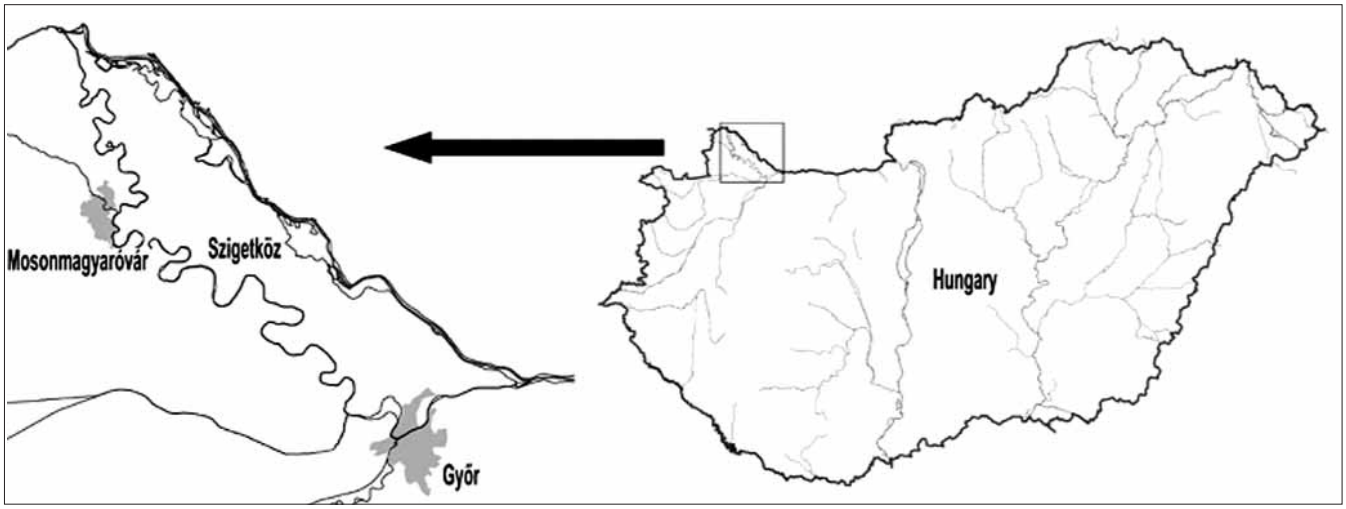

Fig. 1. The location of the Szigetköz in Hungary.

The character of wetland vegetation in the Szigetköz has been formed by a favorable water supply and the wealth of propagules (seeds, fruits and viable shoots) dispersed over the area by recurring floods maintaining high species richness in plant communities. Relatively few species rare to Hungary grow here. Instead, the real value of the vegetation lies in the richness of species compositions: montane and lowland species often grow next to each other. During riverway regularizations most winding tributaries were cut through, thus associated wetland habitats and their biota have greatly diminished. Prior to river diversion, 1013 vascular plant species were known to occur in the Szigetköz. This is regarded as of great natural value as it comprises 46% of the total vascular flora of Hungary. Among these, 118 species indicate natural conditions, many of them being protected or endangered. The most important of these are as follows: Adder's tongue (*Ophioglossum vulgatum*), marsh fern (*Thelypteris palustris*), spinulose woodfern (*Dryopteris carthusiana*), broad buckler fern (*Dryopteris dilatata*), marsh helleborine (*Epipactis palustris*), early marsh orchid (*Dactylorhiza incarnata*), small-leaved helleborine (*Epipactis microphylla*), fire lily (*Lilium bulbiferum*), bee orchid (*Ophrys apifera*), fly orchid (*Ophrys insectifera*), common spotted orchid (*Dactylorhiza fuchsii*), dark purple helleborine (*Epipactis atropurpurea*), feather grass (*Stipa pennata*), snowdrop anemone (*Anemone sylvestris*), moschatel (*Adoxa moschatellina*), blackcurrant (*Ribes nigrum*), water violet (*Hottonia palustris*), alpine rockcress (*Arabis alpina*), large bittercress (*Cardamine amara*), true oxlip (*Primula elatior*) and white sedge (*Carex alba*). The

swiss spikemoss (*Selaginella helvetica*) lives along the Dráva river and occasionally turns up in the upper reaches of the Danube as well.

On the Danube floodplain in the Szigetköz, water was one of the main landscape-forming factors by playing a key role in building and maintaining a highly diverse terrain. As the landscape changed, the vegetation slowly followed it. This was a secondary successional process for which the main source of species was natural plant communities in the neighborhood. In addition, waters running down from the Alps continuously carried plant propagules, most of which stopped, established and certain species even successfully colonized the slow water tributaries of the Szigetköz. In effect, the richness of these beechwood or alpine floristic elements in the otherwise lowland-type forests is what makes surviving natural or seminatural forests in the Szigetköz really unique.

In natural communities close to the riverbed, recurring floods not only provide favorable water supply, but also enrich the soil with external nutrients, and these all might explain the relative constancy amidst permanent change of the biota in gallery forests despite a characteristically high disturbance frequency. Inundations lasting for several weeks prevent intolerant terrestrial species establishing on the floodplain. This is why gallery forests are relatively species poor, but also this is behind their characteristic species composition.

Besides the high species richness, the number of phytocoenoses is also considerable in the Szigetköz (Simon et al., 1980; Kevey & Alexay, 1992; Kevey 1993; Simon et al., 1993; Kevey & Alexay, 1996a; 1996b; Kevey, 1996; Kevey, 1998; Simon, 1998; Kevey 1999). On the varied terrain, a high number of woody communities with diverse water requirements has developed. These are continental riverine willow scrub *(Rumici crispi-Salicetum purpureae, Polygono hydropiperi-Salicetum triandrae*), black poplar gallery forest (*Carduo crispi-Populetum nigrae*), continental willow gallery forest (*Leucojo aestivi-Salicetum albae*), white poplar gallery forest (*Senecioni sarracenici-Populetum albae*), alder wood *(Angelico sylvestri-Alnetum, Paridi quadrifoliae-Alnetum*), willow scrub (*Berulo erecti-Salicetum cinereae*), willow and alder swamp (*Calamagrostio-Salicetum cinereae, Thelypteridi-Alnetum*), summer-dry willow swamp *(Molinio-Salicetum cinereae*), mixed oak-elm-ash gallery forest (*Pimpinello majoris-Ulmetum*), oak-hornbeam wood (*Majanthemo-Carpinetum*) and closed and open dry oak woods (*Piptathero virescentis-Quercetum roboris, Peucedano alsatico-Quercetum roboris*). Grassland communities probably reach similarly high diversity, although no detailed study has addressed these yet. For different parts of the Szigetköz, the state of naturalness varies greatly ranging from completely anthropogenic agricultural fields to natural plant communities worth of special protection (Simon et al., 1993).

POST-DIVERSION STATE

A special local condition may greatly modify the course of terrestrial vegetation succession in the Szigetköz. Beneath the soil of various thickness a gravel deposit of weak capillary rise is situated. A thick soil layer reaches the groundwater, thus wetting of topsoil can be continuous from below through capillary rise. The roots of certain species may also reach down to the water table, hence their favorable water supply is provided. As groundwater depth declines, water stored deep becomes less available for plants. Even in such case, if the soil remains in contact with groundwater, capillary rise can still supply sufficient water for plants. The situation becomes critical when the level of groundwater descends into the gravel deposit and contact with the soil is lost. In such cases the vegetation becomes rain-fed exclusively and this leads to the gradual disappearance of water-demanding species with recurring dry periods. This process is apparent in the main Danube riverbed where water level has declined, during the years since river diversion soil has accumulated over the gravel deposit, and terrestrial vegetation developed via spontaneous succession (Gergely et al., 2001). In years with close-to-average precipitation, herbaceous plants cover the surfaces situated 2-3 m above the current shoreline. However, in dry years (like in 2003) herbaceous cover completely desiccates by midsummer leaving deep-rooted woody plants the only green component in that zone.

Though the succession process itself is inherently slow, the complete disappearance of a plant species from a given habitat can be very lengthy as well. This is explained by the long persistence of perennial plants. Individuals and their clones can survive for decades, though no longer able to reproduce. Many riparian, marsh or swamp dwelling species store nutrient reserves in considerable amount in their underground storage organs. By relying on such reserves, these plants can get through unfavorable years when less assimilates are produced than consumed by the plant.

The Hungarian part of the reservoir planned at the joint Slovak-Hungarian border has not been completed as the Hungarian government halted construction of the reservoir at Dunakiliti in 1989. As a result, a new surface appeared on an area of about 11.5 square km, which was originally meant as a water reservoir and about three quarters of it was a soilless gravel deposit. River water could not reach this place even during floods, only groundwater may occasionally attain the surface from the gravel deposit in deeper places. The western part of the intended reservoir preserves remnants of original gallery forests and semiarid grasslands as well as ponds and oxbow lakes. From nearby sand grasslands wind has spread a thin layer of sand to the gravel deposit. This opened way to vegetation succession. Among native woody species, the white and purple willows (*Salix alba,*

S. purpurea), and the black and grey poplars (*Populus nigra, P. canescens*) dominate. These are accompanied by exotic trees like hybrid poplar (*Populus x euramericana*), black locust (*Robinia pseudo-acacia*), tree of haven (*Ailanthus altissima*), boxelder (*Acer negundo*) and green ash (*Fraxinus pennsylvanica*) in greater amount.

In the dry grassland, ground orchids under nature protection have spontaneously established. The species white helleborine (*Cephalanthera damasonium*), burnt orchid (*Orchis ustulata*), military orchid (*Orchis militaris*) and green-winged orchid (*Orchis morio*) appeared in low abundance.

Water level decline in the Danube and associated drop in groundwater depth caused changes primarily in the tributaries, and in the gallery forests and meadows on the floodplain. According to the survey by Kevey (1999), the white willow thickets covering gravel deposits along the Great Danube channel have dried up by now. Their regeneration is unlikely in the absence of new gravel deposition. Nevertheless, blackcurrant (*Ribes nigrum*), a protected species from this community, has successfully established in the dried-up riverbed of the Great Danube. Before river diversion, a small population of alpine rockcress (*Arabis alpina*) lived in the environs of Lipót. By now its habitat is covered by an impervious stand of nettle and the rockcress has not been encountered for years. Large bittercress (*Cardamine amara*) associated with almond willow thickets has probably experienced a similar fate as it disappeared from all its localities by the second year after the Danube diversion.

Invasive plants occupy large areas on floodplains. Abundant species are panicled aster (*Aster lanceolatus*), Himalayan balsam (*Impatiens glandulifera*), small balsam (*Impatiens parviflora*) and giant goldenrod (*Solidago gigantea*). Invasive trees include boxelder (*Acer negundo*) and tree of heaven (*Ailanthus altissima*). Hardwood plantations were established on areas which became drier subsequent the Danube diversion. Among the species used for this purpose, Russian silverberry (*Elaeagnus angustifolia*) poses a potential risk as soon as it reaches reproductive age. Its fleshy fruits are consumed by birds, hard seeds are broadly dispersed and thus the species can easily become a noxious invasive element in wet, unmanaged habitats.

The various forest communities in the Szigetköz have been impacted differently by the diversion of Danube (Kevey, 2002; 2004a; 2004b; 2004c). The strongest effects were exerted on forests on the low floodplain. Although the bottom dike increases water level in the tributaries, a sharp drop in the gradient in the depth of groundwater appears towards the main Danube riverbed. This led to an almost complete decline of forests close to the river. The main shortcoming of the current water recharge system is that it is unable to simulate floods. In the absence of inundations the vegetation undergoes marked changes and loses its special character. The migration route for mountain floristic elements from the Alps to the Szigetköz has also been disrupted.

The magnitude of changes in the vegetation is proportional to the extent of changes in habitat water regime since river diversion. On the exposed shoreline of the main channel and on point bars the succession of terrestrial vegetation has progressed to an advanced phase. On the new shoreline a strip of willow thicket has grown up (Gergely et al., 2001), and tall forb communities containing invasive species in considerable amount has also spread over large areas. The dynamics of succession can be greatly influenced by the influx and germination of wind or water dispersed propagules (Leyer & Pross, 2009; Merritt et al., 2010).

The continental purple willow scrub *(Rumici crispi-Salicetum purpureae)* was the plant community most susceptible to the Danube's diversion. Since this vegetation grows largely along the main Danube, all of its stands have desiccated in the Upper Szigetköz and their original undergrowth has degraded beyond recognition. Gravel deposition has practically ceased since the diversion as the main Danube leaves behind floating sediments (i.e. fine sand and mud) only on its bars. Accordingly, there is no opportunity for the establishment of new purple willow scrub stands even on a lower floodplain terrain. By today, the only gravel deposition occurs downstream of the power canal inlet. However, such gravel bars appear at few localities only, like the southeast corner of the Madarász Island at Ásványráró, the Kolera Island at Vének, and in the neighborhood of Varasd. Among protected species of the purple willow scrub, the distribution of blackcurrant (*Ribes nigrum*) spreads from Rajka to Ásványráró. Its original habitats have dried up everywhere, so a gradual decline of all stands is expected, although new occurrences of the species have been observed in abandoned riverbeds taken over by terrestrial vegetation. As for non-protected rare species, wood stitchwort (*Stellaria nemorum*) was known from a single purple willow scrub stand at Doborgazsziget, but after the diversion of the Danube this plant has not been recorded any more.

Almond willow thickets (*Polygono hydropiperi-Salicetum triandrae*) have been damaged less. This is because these thickets continuously regenerate from the time when the river has been diverted not only in side branches, but along the Old Danube as well due to a substantial mud deposition. Even so, large bittercress (*Cardamine amara*) – a rare species of this community with the Szigetköz as the only occurrence in the Eupannonicum floristic district of Hungary – disappeared from all of its localities by the second year after the Danube's diversion.

Black poplar gallery forests (*Carduo crispi-Populetum nigrae*) in inundation areas have mostly dried up and became weedy in the Upper Szigetköz. Their persistence is doubtful

due to the lack of recurring floods. White willow scrubs (*Leucojo aestivi-Salicetum albae*) have been seriously damaged. Repeated inundations are inevitable for this vegetation, thus after the diversion of the Danube numerous individuals of white and crack willows withered, fell, and the picturesque undergrowth composed of marsh plants completely transformed and turned weedy. The invasive panicled aster (*Aster lanceolatus*), Himalayan balsam (*Impatiens glandulifera*) and giant goldenrod (*Solidago gigantea*) became abundant. By contrast, marsh plants like the protected summer snowflake (*Leucojum aestivum*) and fen ragwort (*Senecio paludosus*) diminished considerably. Each population of large bittercress (*Cardamine amara*) has disappeared, although the Szigetköz supported the only native occurrences of the species in the Hungarian Plain. White poplar gallery forests (*Senecioni sarracenici-Populetum albae*) occupying higher terrain in inundation areas have been less seriously impacted thanks to the beneficial effects of water recharge on habitat water regime as well as to the moderate water demand of this forest relative to other wetland woody communities. Due to changed competitive hierarchies, certain rare species like rough horstail (*Equisetum hiemale*), ragwort (*Senecio sarracenicus*) and dame's rocket (*Hesperis matronalis*) have been excluded from their former habitats. In the vicinity of flood protection dams purple moorgrass meadows (*Succiso-Molinietum*) often form mosaics with summer dry willow swamps (*Molinio-Salicetum cinereae*).

OTHER IMPACTS

In addition to the diversion of the Danube, other impacts of national or European scale also reached the Szigetköz in the late 20th century. The political transition in Hungary and the opportunity to join the European Union initiated economic processes that influenced the vegetation indirectly, mostly through substantial changes in land use. Changes in land ownership have especially marked effects. Forests and grasslands became private properties, and for certain pieces of land ownership remained uncertain for a long time. During our field surveys in the Szigetköz we often encountered occasional logging or the removal of the shrub layer in forests. Substantial increase in fuel prices led to illegal felling of complete forest stands. More or less simultaneously, a series of unfavorable changes in the Hungarian agriculture resulted in a marked decline of livestock and thus the need for forage. Throughout the country, pastures and hay meadows were abandoned, and the species composition of these unmanaged grasslands changed to a great extent. In numerous places the original grassland has been replaced by patches of tall forb communities, scrubs or groves including the following species: boxelder (*Acer negundo*), common ash (*Fraxinus excelsior),* green ash (*Fraxinus pennsylvanica*), European bird cherry (*Padus avium*), blackthorn (*Prunus spinosa*), wild pear (*Pyrus pyraster*), buckthorn (*Rhamnus catharticus*) and black locust (*Robinia pseudo-acacia*).

Global Climate models (IPCC 1996) forecast 0.5 ºC increase in annual mean temperature for the northern hemisphere in the next 20-30 years. As a result, annual mean temperature is expected to rise by 0.8-1.0 ºC, yearly precipitation to decline by 25-55 mm, and sunshine to increase by 250 hours per year in our region. Model calculations suggest that under such circumstances the mean number of dry months per year will increase from the current 1.4 to 2.2. According to the VAHAVA program – an interdisciplinary survey on potential impacts of climate change in Hungary – wetlands along the Danube will be greatly damaged by diminishing floods and declining groundwater depth, both anticipated to occur with climate change. Natural adaptation of the biota to altered environmental conditions on climate change is hampered by small population sizes in fragmented habitats for many species. Under such circumstances the extinction of species with limited dispersal capacity is highly probable.

DISCUSSION

Changes in the environmental status and in the land use

The greatest problem in the Szigetköz today is a marked decline in the amount of water available for plants in areas affected by the diversion of Danube. It should be noted, however, that the drop in groundwater level is not the only reason, as aerial drought in the last 10-15 years has also contributed to the water shortage. Yet, the impacts of groundwater drop were critical in certain parts of the Szigetköz as deficiency in precipitation can elicit much profound, often irreversible changes if it occurs in concert with the decline of water reserves deep in the soil, particularly for plant species or vegetation of inherently high water requirements and intolerant of drought. Another, long-term influence on the species composition is that the Danube does not transport and distribute plant propagules (seeds, spores or viable shoots) to the inundation area any more, thus montane species – the most susceptible elements in this lowland environment – will gradually disappear. With this change the flora of the Szigetköz will lose its very character as its specialty is that mountain and lowland species live side by side.

Along river branches and canals where water level is artificially stabilized, plant species with a need for fluctuating water level are expected to disappear in the long run. The impoverishment of spatial heterogeneity and species diversity generally takes a long time, usually decades. Until now, mostly long-term observations from North America have

documented the precise nature of successional changes in the environs of artificial canals or rivers with regulated water level (Rood & Heinze-Milne, 1989; Rood et al., 1995; Ligon et al., 1995; Barnes, 1997; Millman, 1997; Nemecek, 1997; Nilsson et al., 1997; Williams, 1997).

In the Szigetköz, areas beyond flood protection dikes are covered by arable land mostly, while in the inundation area forests and meadows thrive. Native forests in the inundation area appear on small islands mostly. On lower terrain, wetlands preserve patches of the original reed, marsh or tall sedge vegetation. Since these latter communities are influenced by land use changes less than forests, their response to modifications in water regime is much faster than that of forests. For these communities – assuming natural processes only – the time scale of transition from one community type to the other can be centuries, but even in managed forests it may take decades while foresters adjust the cultivated tree species to the altered environment. This is why forest types in the inundation area still correspond to the pre-diversion state even 15 years after river diversion.

Nevertheless, it should be noted here that if a certain species is not encountered at a former locality for years, it does not necessarily mean that the plant has gone extinct from there. The only thing what the absence certainly indicates is that the study method used have not detected the occurrence. A number of plant species is known not to bring shoots each year. It also happens that individuals of a species are not adequately developed for identification even to the genus level. Small population size and short plant stature may easily lead to the failure of detecting a species even in the most careful field survey. According to expert opinion, at least ten – others say twenty – years have to be elapsed without observing a single individual of a species for qualifying the species as extinct from the given locality with confidence. In fact, for unquestionable extinction the habitat itself should undergo profound changes and in the new state it would not support the species' environmental needs any more. To declare a plant species extinct from Hungary, the requirement is a minimum of fifty years in a row without detecting it.

The various management regimes applied (cutting, grazing or reforestation) may also considerably influence the course and pace of vegetation succession. As cutting is no longer practiced on meadows, spontaneous forest regeneration commences in relatively dry and nutrient poor habitats, while in wet and nutrient rich biotopes weedy tall forb associations grow up or forests of pioneer character develop (as it occurs in the Szigetköz). With appropriately planned reforestation the regeneration of seminatural gallery forests can be greatly accelerated. Without such intervention, the outcomes of spontaneous forest regrowth are uncertain at least. The most frequent experience is that during spontaneous secondary succession alien invasive species reach dominance easily and the new forest abounds in weeds and lacks any particular character.

The naturalness of the forests in the Szigetköz

The ecologically desired target state for the Danube reaches in the Szigetköz is a spatial complex of species-rich habitats devoid of invasive organisms. Propagules from surviving seminatural biotopes – as refugia – and from external sources arriving through water transport would be sufficient to supply native species specific to the Szigetköz for the regeneration of seminatural vegetation on degraded land. Currently, the dispersal of propagules by water is very limited, that will probably further reduce the share of montane species in the flora in addition to the effect of general drying of the environment.

In a country-scale comparison of willow-poplar (i.e. softwood) gallery forests with mixed oak-elm-ash (i.e. hardwood) gallery forests the state of naturalness is quite the same for the two, yet in certain criteria substantial differences appear. The proportion of alien species is higher in the softwood than in the hardwood gallery forest (considering forests of native trees only), and this holds for the canopy, shrub and herbaceous layers, and for the recruitment separately as well. Altogether, due to such compositional differences the degree of naturalness is lower for the softwood gallery forests. This is because softwood gallery forests rich in soil nutrients and receiving floods frequently provide better habitat for nutrient demanding invasive species adapted to recurrent disturbances than do hardwood gallery forests remaining humid throughout most part of the growing season. The spread of invasive alien species is currently the most serious threat to softwood gallery forests throughout the country. Nonetheless, the abundance of old trees and the amount of dead wood (particularly large-sized dead wood of high biological importance) are very high in softwood gallery forests, that greatly improves the value of naturalness for these forests. This is compatible with the fast growth and short lifetime of the canopy forming tree species, and with disturbances caused by recurring floods. Additionally, softwood gallery forests are often prime nesting sites for large-bodied birds. The difference in the degree of naturalness of the species composition between these two forest communities is relatively smaller in the Szigetköz than elsewhere in the country, because softwood gallery forests contain less alien species here than in other regions.

When softwood gallery forests in the Szigetköz are compared with those elsewhere in the country the overall degree of naturalness does not differ considerably. However, if component criteria or indicator values are contrasted separately between softwood gallery forests and other forest types in the country, it turns out that forests in the Szigetköz do not posses lower naturalness in any aspect, but even a higher one according to certain criteria. While structural

characteristics are alike for individual canopy layers, the naturalness of species composition for almost each layer is higher in the Szigetköz than elsewhere, and this is due to the lower proportion of alien species (particularly in the shrub layer and in the recruitment), the higher share of natural accompanying species, and the lower preponderance of disturbance tolerant species. Given that the spread of alien species in softwood gallery forests is a key problem for nature conservation, forests in the Szigetköz possess nationwide significance and particularly high natural value. In our comparison, mixed oak-elm-ash gallery forests composed of native canopy forming trees in the Szigetköz were not different in any of the studied variables from other forests elsewhere in Hungary. When within a certain potential vegetation category forests composed of native or alien canopy forming trees were contrasted, the forests of native trees possessed higher naturalness in almost every respect than the forests of alien trees. This is an intuitive result, thus attention should be paid to those variables which were not different between forests of native and alien trees. It is of no surprise that the spatial structure of the shrub layer and the naturalness of big game impact are identical in the two forests. However, it has dire consequences for nature conservation that the degree of naturalness and the proportion of aliens (20-25%) for the recruitment are just the same for native and alien forests. These suggest that in the canopy of forest communities dominated by natural tree species today, the share of alien plants (boxelder, common hackberry) will increase in the future. This will lead to the degradation of natural forests if current trends sustain. In the comparison of native and alien tree dominated forests we received similar results irrespective whether samples were from the Szigetköz or from elsewhere in Hungary.

REFERENCES

Barnes W.J., 1997. Vegetation dynamics on the floodplain of the lower Chippewa River in Wisconsin. Journal of the Torrey Botanical Society 124, 189-197.

Gergely A., Hahn I., Mészáros-Draskovits R., Simon T., Szabó M. and Barabás S., 2001. Vegetation succession in a newly exposed Danube Riverbed. Applied Vegetation Science 4, 35-40.

Kevey B., 1993. A Szigetköz ligeterdeinek összehasonlító-cönológiai vizsgálata. Kandidátusi értekezés tézisei. [Comparative phytocoenological study of forest associations in the Szigetköz. C.Sc. Thesis] Pécs.

Kevey B., 1998. A Szigetköz erdeinek szukcessziós viszonyai. [Successional relationships of forests in the Szigetköz.] Kitaibelia 3, 47.

Kevey B., 1999. A szigetköz erdei I. Ligeterdők. [Forest communities of the Szigetköz I. Gallery forests.] Moson Megyei Műhely 2/1, 59-82.

Kevey B., 2002. A Duna szlovákiai elterelésének hatása a Felső-Szigetköz tölgy-kőris-szil ligeteire (Pimpinello majoris-Ulmetum Kevey in Borhidi – Kevey 1996). [Impacts of the diversion of the Danube at the Slovakian side on oak-ash-elm gallery forests (Pimpinello majoris-Ulmetum Kevey in Borhidi – Kevey 1996) in the Upper Szigetköz.] Kanitzia 9, 22.

Kevey B., 2004a. A Duna szlovákiai elterelésének hatása az Alsó-Szigetköz csigolya bokorfüzeseire (Rumici crispi-Salicetum purpureae Kevey in Borhidi – Kevey 1996). [Impacts of the diversion of the Danube at the Slovakian side on purple willow scrubs (Rumici crispi-Salicetum purpureae Kevey in Borhidi – Kevey 1996) in the Lower Szigetköz.] Bot. Közlem. 90, 1–18.

Kevey B., 2004b. A Duna szlovákiai elterelésének hatása a Felső-Szigetköz fehér fűzligeteire (Leucojo aestivi-Salicetum albae Kevey in Borhidi – Kevey 1996). [Impacts of the diversion of the Danube at the Slovakian side on white willow gallery forests (Leucojo aestivi-Salicetum albae Kevey in Borhidi – Kevey 1996) in the Upper Szigetköz.] Kitaibelia 9 (1), 173–186.

Kevey B., 2004c. A Duna szlovákiai elterelésének hatása a Felső-Szigetköz fehér nyárligeteire (Senecioni sarracenici-Populetum albae Kevey in Borhidi – Kevey 1996). [Impacts of the diversion of the Danube at the Slovakian side on white poplar gallery forests (Senecioni sarracenici-Populetum albae Kevey in Borhidi – Kevey 1996) in the Upper Szigetköz.] Kanitzia 12, 177–195.

Kevey B., & Alexay Z., 1996a. A Szigetköz tőzegpáfrányos-égerlápjai (Thelypteridi-Alnetum). [Marsh fern alder swamp woods (Thelypteridi-Alnetum) in the Szigetköz.] Széchenyi István Főiskola, Győr. Tudományos Közlemények 7, 1-24.

Kevey B., & Alexay Z., 1996b. A Szigetköz mocsári sásos-égerlápjai (Carici acutiformis-Alnetum). [Lesser pond sedge alder swamp woods (Carici acutiformis-Alnetum) in the Szigetköz.] Természetvéd. Közlem. 3-4, 81-96.

Kevey B., & Alexay Z., 1992. Adatok a Szigetköz flórájához. [New records for the flora of Szigetköz.] Acta Óvariensis 34, 29-37.

Leyer I., & Pross S., 2009. Do seed and germination traits determine plant distribution patterns in riparian landscapes? Basic and Applied Ecology 10, 113–121.

Ligon F.K., Dietrich W.E., Trush W.J., 1995. Downstream ecological effects of dams. BioScience 45, 183-192.

Merritt, D. M., Nilsson C., Jansson R. 2010. Consequences of propagule dispersal and river fragmentation for riparian plant community diversity and turnover. Ecological Monographs 80, 609–626.

Milliman J.D., 1997. Blessed dams or damned dams? Nature 386, 325.

Nemecek S., 1997. Frankly, my dear, I don't want a dam. How dams affect biodiversity. Scientific American 277, 20.

Nilsson C., Jansson R., Zinko U., 1997. Long-term responses of river-margin vegetation to water-level regulation. Science 276, 798-800.

Rood S.B., & Heinze-Milne S., 1989. Abrupt downstream forest decline following river damming in southern Alberta. Canadian Journal of Botany 67, 1744-1749.

Rood S.B., Mahoney J.M., Reid D.E., 1995. Instream flows and the decline of riparian cottonwoods along the St. Mary River, Alberta. Canadian Journal of Botany 73, 1250-1260.

Simon T., 1988. A hazai edényes flóra természetvédelmi-érték besorolása. [Nature conservation ranks of the Hungarian vascular flora.] Abstracta Botanica 12, 1-23.

Simon T., Szabó M., Draskovits R., Hahn I., Gergely A., 1993. Ecological and phytosociological changes in the willow woods of Szigetköz, NW Hungary, in the past 60 years. Abstracta Botanica. 17(1-2), 179-186.

Simon T., Horánszky A., Kovács-Láng E., 1980. Potentielle Vegetationskarte der Donau-Strecke Zwischen Rajka und Nagymaros. Acta Bot. Acad. Sci. Hung. 26, 191-200.

Williams N., 1997. Dams drain the life out of riverbanks. Science 276, 683.

Zólyomi B., 1937. A Szigetköz növénytani kutatásának eredményei. [Results of botanical research in the Szigetköz.] Bot. Közlem. 34, 169-192.