

DANUBE FLOODPLAIN FORESTS

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The Danube floodplain forests represent, within the framework of Slovakia and also within the framework of Central Europe, a scarce complex, which is remarkable for several reasons. They are a significant landscape/ecological element, forming the entire character of the landscape, even if the Danube floodplain forests currently cover only a fraction of their original range. At present, the highest extent of floodplain forests is in the area of direct inundation/inter-dike space. Protected anti-flood dikes, built from surface loam, have soil mechanical qualities that enable the relatively rapid infiltration of floodwaters. Therefore the existence of floodplain forests behind dike spaces is not an exception and they are also found in habitats, where gravel benches rise up to the soil surface and create forest soil unsuitable for agricultural activity.

However, it is necessary to stress, that in the Danube floodplain it is not possible to determine the original tree composition of the floodplain forest, because, even before the construction of the Gabčíkovo-Nagymaros dam, the main tree species, mainly in transitional and soft floodplain forests, were replaced by the introduction of cultivated poplars. This fact also influenced other changes, such as the deepening of the Danube river by gravel excavations in the 1960s and, practically, the disappearing of elm after the graphiosis calamity.

Commercial forms of poplar were planted in the surroundings of the Danube river at the end of the last century. These plantations were connected with the building of anti-flood dikes and later, mainly after 1918, stands of newly-cultivated Euro-American poplars, began to be established on a larger scale. These poplars were cultivated to a great extent mainly in the beginning of the 1960s. Contemporary Danube floodplain forests, including the arm system between Dobrohoš and Szap, are prevailingly - about 80 % - created from artificially cultivated poplars with a prevalence of I-214 clones and Robusta.

Regarding the above-mentioned fact, emphasis will be given to the evaluation of the ecological significance of the Danube floodplain forests, narrowly connected with their vulnerability to selected stress factors, as important qualities of the Danube floodplain landscape.

Ecological significance and vulnerability

Ecological significance is, according to Hrnčiarová et al., aimed at the quality of the landscape, and focuses on the determination of the scale for the preservation of positive ecological processes and functions of the landscape. As ecologically positive landscape elements are considered the ones which create favourable assumptions for the functioning of positive processes in the ecosystem and for the preservation and maintenance of favourable conditions for the regeneration and the renovation of the landscape gene pool, natural resources, ecological stability and biodiversity. Ecological significance is evaluated according to the degree of fulfilling the ecological and selected benefit function of the landscape. According to Jurko², territories with the highest ecological significance are indicated by increased gene pool, health, aesthetic, landscape and other environmental and socio-economic functions.

Table 1. Ecological significance and vulnerability of Danube floodplain forests

Forest types	Ecological significance	Vulnerability by stress factors				
		A	B	C	D	E
Soft floodplain forests	high	1	1	1	1	1
Transitional floodplain forests	high to moderate	1	2	2	1-2	1
Hard floodplain forests	high to moderate	1	2	2-3	1-2	1
Corneal-oak forests	high	1	1	3	1	1
Cultivated poplar monocultures	moderate to low	2-3	2	2	2-3	3
Other deciduous monocultures	low	3	3	2-3	3	3

Stress Factors: (A) artificial change of vegetation, (B) mechanical destruction of soil surface, (C) changes of groundwater level, (D) chemical pollution of the environment, (E) excessive biomass sampling.

Vulnerability: (1) Critical - outside interference means permanent change of vegetation type (forest), replacement is impossible, or serious and long-dated destruction at which regeneration is very hard and can last more than 10 years. (2) Moderate - high degree of destruction, replacement or regeneration is long-dated and difficult, and the original state is not entirely restored. (3) Low - not very serious destruction, changes are temporary, regeneration is possible by natural or artificial support and it lasts less than 5 years.

An important element for the determination of ecological significance is the vulnerability of forest vegetation. To evaluate vegetation according to its vulnerability by outside factors is extraordinarily difficult, because vegetation units are complex and also stress factors act in a complex manner^{2,3,4}. Outside negative factors are not as stressful as destructive ones, if the vegetation structure is not entirely changed and it can return by its own auto-mechanisms to its original state. On the other hand destructive factors destroy vegetation. Similarly, in the face of negative interferences of permanent character, which essentially change the present habitat conditions, forest vegetation is not able to return to its original state. It disappears or it is replaced by other types, which are gradually adapted to the new conditions.

Degree of vulnerability, or supposed possible replacement of vegetation, depends not only on the type and intensity of the negative impact, but also on the various circumstances which can essentially influence such consequences. Vulnerability of floodplain forests has been evaluated according to Roberts's definition, which indicates vulnerability/sensibility as "a relative scale of vegetation type ability to resist some pressures and changes without reducing its quality" (Table 1)⁵.

Evaluation of the Danube floodplain forests

According to frequency of floods and groundwater level, several kinds of forests occur along the Danube river^{6,7}:

- soft floodplain forests - willow-poplar forests - with frequent periodical floods, groundwater level in average 1-2 m under surface
- transitional floodplain forests - elm-ash forests with poplar or oak - on places less frequently, but regularly flooded, with groundwater level under 1 m
- hardwood floodplain forests - elm-ash with hornbeam and elm forests - on places not reached by periodical floods, with groundwater level out of the reach of the root systems of the main tree species
- Corneal-oak forests in small areas, characteristic by a specific tree composition, a rich shrub layer and forest-steppe vegetation types

Up to the end of the 1950s there occurred also some secondary forest types: cultivated poplar monocultures, mainly I-214 clones and Robusta - planted almost in all the habitats of the natural floodplain forests, but mostly in soft and transitional areas; other deciduous monocultures - plantations of *Junglans regia*, rarely *Junglans nigra*, stands of *Ailanthus altissima*, all scattered mainly beside the inundation area.

The ecological significance of all the above-mentioned forest types, in connection with their vulnerability to selected stress factors, is shown in Table 1. Based on their ecological significance and vulnerability, Danube forest ecosystems fall under three categories.

The first category - ecologically very significant forests - is made up of willow-poplar soft floodplain forests, original Corneal-oak forests and forest steppe with some rare and threatened plant species. Regarding its high degree of significance, this forest category is also highly vulnerable/sensitive to selected stress factors, of which, for soft floodplain forests, the most important one is the decrease of groundwater level. Corneal-oak forests are not vulnerable to changes in groundwater level, because they lie very deeply. Lack of water determines an occurrence of rare xerophytic and sub-xerophytic vegetation.

The second category - ecologically significant forests - is created by transitional and hardwood floodplain forests, which are also moderately sensitive to selected stress factors, including the decrease of groundwater level, but highly sensitive to any artificial changes.

The third category - ecologically less significant forests - comprises monocultures of all types, also with less vulnerability. In spite of that, poplar monocultures cover at present almost 80% of the inundation area and their ecological significance is evidently less than that of the original floodplain forests, even though their commercial function in forest management is not negligible. Also, their vulnerability is lower and mainly depends on activities of forest management.

In conclusion, Danube floodplain forests have a high ecological significance and they are also relatively highly vulnerable to outside stress factors. These communities have gone through many changes during the last hundred years and it is still an assumption that they will also be preserved for future generations, through human intervention and a sensible approach to floodplain ecosystem management.

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