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*FLORA ȘI FAUNA
REZERVATIEI NATURALE
„RÂUL TUR”*

*THE FLORA AND FAUNA OF
THE TUR RIVER NATURAL
RESERVE*

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VEGETATION OF THE RIVER TUR PROTECTED AREA – PRESENTATION, NATURALNESS AND THREATENING FACTORS

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Summary. The paper presents the results of the surveying of the vegetation in the River Tur Protected Area. We aimed to explore all the vegetation types, to assess the naturalness and conservation values of the habitats. We also paid attention to identify those factors that are threatening the integrity of the plant communities. The identified 34 vegetation communities form a colorful mosaic, the spatial heterogeneity being the essential characteristics of the area. Since the water supply is the major influencing factor, a wide vegetation spectrum had formed along the soil humidity gradient: from floating or rooted waterweed associations, through marshes and meadows, to shrubs and woods. The most threatening factors that affect the natural vegetation are the hydrological alterations, the spread of some invasive species and the human activities that are continuously changing the landscape: intensive agriculture, grazing the livestock and mowing. Although the repeated man-made disturbances have altered the majority of the plant communities, several known factors suggest the potential recovery of them through appropriate management or natural regeneration.

Rezumat. Vegetația Ariei Protejate Râul Tur – descriere, naturalitatea vegetației și factorii de amenințare. Articolul de față prezintă rezultatele studiului vegetației din Aria Protejată Râul Tur, efectuată pe perioada verii în anii 2005 și 2006. Pe lângă identificarea habitatelor caracteristice și comunităților de plante prezente, scopul studiului a fost aprecierea gradului de naturalitate și a potențialului în conservarea speciilor, în cazul fiecărui tip de habitat. De asemenea, am încercat să identificăm factorii care au periclitat sau ar putea amenința în viitor integritatea comunităților vegetale. Am identificat 34 de comunități vegetale, care formează un mozaic diversificat, eterogenitatea spațială fiind proprietatea esențială a ariei. Deoarece nivelul apei este cel mai important factor care influențează vegetația în acest teritoriu, principalele habitate sunt strâns legate de gradientul de umiditate: găsim aici comunități natante și submerse, rogozișuri și pajiști umede, vegetație arbustivă și păduri. Următorii factori reprezintă amenințări majore: alterarea regimului hidrologic, răspândirea unor specii invazive precum și activitatea antropică care modifică peisajul prin utilizarea extensivă a comunităților vegetale (practici intensive în agricultură, pășunat, cosit). Deși intervenția umană a tulburat în repetate rânduri majoritatea comunităților vegetale, refacerea lor este încă posibilă cu ajutorul gestionării atente care ar favoriza procesele de regenerare naturală.

Introduction

The Tur River Protected Area is situated on the lower part of the river, between Călinești-Oaș and the border with Hungary, covering 6215 hectares. According to the

first military map (18th century), the area was mainly covered by various types of riparian woodland. Due to the water management work, since the second half of 19th century, the primary vegetation has been altered totally. Today, the dominant vegetation types are humid and semi-humid meadows or pastures and sedge communities. During our survey, 34 vegetation communities and 418 vascular plant species were identified.

Materials and methods

A field data sheet was completed on each homogenous vegetation patch. Association type, dominant, characteristic and rare species were noted on the data sheet; the naturalness, land use practice and invasion degree of alien species was also identified by means of 0-5 degree scales for each category. Exhaustive list of species (412 species of vascular plants belonging to 81 families) was compiled for the area and floristic value estimated based on the presence of protected species according to IUCN Red List, Bern Convention and Habitats Directive. Phytosociological and habitat type identification was made according to Doniță et al. (2005), Borhidi (2003) and Fekete et al. (1997). For each habitat type diagnostic species and associations belonging were identified. The vegetation map has been prepared on the basis of land use map edited in 2004.

Presentation of vegetation types

The vegetation of the mapped area can be classified into five major groups of habitats, according to soil humidity gradient.

I. Euhydrophyte habitats

1. Free-floating surface communities with *Lemna* and *Salvinia* (*Lemno-Spirodeletum* W. Koch 1954).

Common in the fringe zone of most of vegetated backwaters and channels in the study area, this vegetation type is dominated by duckweed species (*Lemna minor*, *Lemna trisulca* and *Lemna gibba*), with less *Salvinia natans* and *Spirodella polyrrhiza*. It often occurs together, in the same habitat type, with a monodominant community, *Ceratophylletum demersii* Hild 1956.

2. Rooted submerged and floating vegetation with *Nymphaea alba*, *Trapa natans*, *Nuphar luteum* and *Potamogeton natans* (*Myriophyllo verticillati-Nupharetum luteae* W. Koch 1926 and *Trapaetum natantis* V. Kárpáti 1963).

This habitat type occurs on the surface of deeper backwaters and fishponds. It requires a lower level of disturbance than the previous communities, never occurs in newly grubbed channels. The *Myriophyllo verticillati-Nupharetum luteae* community is

widespread in the backwaters near Porumbesti forest, the so-called "Patkólapos" area and in some of the old channels around the Adrian forest. The second community, *Trapaetum natantis* V. Kárpáti 1963 was found in only one fishpond, near Adrian forest. The dominant species *Trapa natans* is declared as vulnerable species on IUCN plant red-list.

3. The highest conservation value in the group of free-floating, submerged and rooting waterbed vegetation have the *Stratiotetum aloidis* Nowinski 1930 and *Hottonietum palustris* R.Tx 1937 communities, both rare in the surveyed area. The single water-soldier raft stand is closely twitted with the former habitat-group, having the same ecological demands (deep eu- or mesotrophyc standing water).

Two of the many occasionally drying, shallow channels are covered by water violet community (*Hottonietum palustris* R.Tx 1937), an association demanding oligo- or dystrophyc water and mostly undisturbed water regime. Since they are surrounded by overgrazed pastures, the water violet community is one of the most threatened associations of the area.

II. Marshes and water-fringe vegetation

The forthcoming vegetation group is widespread on the surveyed area, occurring at the shore of channels, fishponds, backwaters and even along the riverbed in less disturbed sections with slower water flow. Due to differences in their water level preference, these communities form a characteristic water-gradient spatial distribution pattern on the undisturbed sites.

1. The deepest water level favors formation of mostly monodominant communities of reed and reedmace beds (*Scirpo-Phragmitetum* W Koch 1926 and *Typhaetum latifoliae* Ct. Long. 1973).

In spite of their relative poverty in species (frequently met accompanying species are *Iris pseudacorus*, *Cahystegia sepium*, *Butomus umbellatus*, *Glyceria maxima*) they have a major role in conserving wetland habitats, forming a sieve between land and water. Reed communities are colonizing with success the abandoned fishponds with 0.2-3m deep water, process which should be favored by further management activity, with keeping the constant water level on such stands.

2. Some of the reed beds, especially those with still, shallow water stands in Adrian forest's area, are followed by monodominant common clubrush beds (*Schoenoplectetum lacustris* Chouard 1924, or *Scirpetum lacustris*), forming the outer belt of *Phragmites* communities. They do not tolerate drying periods, therefore they could be an important water-supply indicators in the mentioned area.

3. The almost permanently wet floodplain stands are occupied by the more widespread communities of large sedge beds (*Caricetum ripariae* Knapp et Stoffer 1962), forming large continuous belts on the bank or patchy mosaic stands in deeper bank

pits. On backwaters and channels they appear on the landward side of reed banks. The dominant species is *Carex riparia*, but *Carex acuta*, *C. acutiformis* and *C. vesicaria* are often co-dominant, particularly on large, continuous stands. They often form species rich complex stands with grey willow (*Salix cinerea*) groves and edge belts adjacent to the remnants of riverside ash-alder and oak-hornbeam forests.

III. Riverine woodlands and lowland oak-hornbeam forest

This group of riparian habitats represents the dominant potential vegetation on the surveyed area, nowadays withdrawn to few vegetation patches, linear formations and forest plots mostly under forest management.

1. The shrubby willow formations (*Salicetum triandrae* Malcuit 1929) dominated by *Salix triandra* with *S. fragilis* and *S. purpurea* occupies the river bank as more-or-less continuous 3-10 m wide band. It is almost absent from the riverside villages area and recently arranged banks. Strait string-like stands are scanty in characteristic species and often invaded by alien species. Stands with high level of naturalness were found on the three-border area and between Turulung Vii and Gerta villages (on both sides of the river). Here the willow shrubs have a rich herb layer with marsh, sedge-bed and wet meadow species (ex: *Alisma plantago-aquatica*, *Butomus umbellatus*, *Eleocharis ovata*, *Eleocharis palustris*, *Carex acuta*, *C. ovalis*, *C. otrubae*, *Alopecurus pratensis* etc.), including the rare *Carex disticha* sedge. On 15-20 m distance from the river-flow are already present the species of willow galleries and gallery forests in the shrub layer (*Salix cinerea*, *Salix caprea*, *Populus nigra*, *Ulmus laevis*, *Acer campestre*, *Acer tataricum*), marking a possible succession way towards those vegetation types.

2. Mature stands of above-mentioned willow galleries (*Salicetum albae-fragilis* Issler 1926 em. Soó 1957) are almost missing from the studied area. One single mature reminiscent patch was found nearby the Adrian forest, but well regenerating young stands (with 15-20 year old, low and shrubby canopy layer) were surveyed on some sites (the three-border zone, abandoned fishpond near the railway line, etc.). At present stage a mixture of *Salix* and *Populus* species (mainly *S. alba*, *S. fragilis* and *P. nigra* and *P. alba*) form the low canopy layer, but the future shrub layer is also sketched by the presence of species like *Frangula alnus*, *Cornus sanguinea*, *Viburnum opulus*. Since they are regenerating on former pastures and abandoned meadows, the herb layer is not representative one yet; it frames a mixture between sedge-meadow species and disturbance-tolerating species.

3. On the first belt of floodplain, in abandoned digs as well as near old channels, a discrete patches of dense, shrubby vegetation, the *Rubus caesii-Salicetum cinereae* Rațiu et Gergely 1979 association can be detached, often with *Prunus spinosa* dominated fringe belt. This grey willow dominated, species-poor vegetation type is frequently invaded by alien species (*Amorpha fruticosa*, *Echinocystis lobata*) and usually has a scanty herb-

layer. Probably this type is going to become a constituent part of willow galleries in a later succession stage.

4. Another remnants of the potential floodplain vegetation in the area are the riparian mixed forests (*Fraxino-Ulmetum* Sanda et Popescu 1999), represented by two stands: a narrow band in Turulung Vii forest and the northeastern part of Adrian forest. Their range was diminished probably due to the long-term drainage and forest management. The canopy layer is shaped by relatively old but coeval *Quercus robur*, *Ulmus laevis* and *Fraxinus excelsior* trees, rarely appears hornbeam and linden, the shrubby layer is represented only in the fringe zone of the stands (*Corylus avellana*, *Ligustrum vulgare*); the herb layer is dominated by *Aegopodium podagraria* and other nemoral species. The abundance of oak, elm and ash seedling in the glades and forested backwaters still denotes a good regeneration potential of this vegetation type in spite of the past drainage.

5. A rare vegetation type of the marshy floodplain area is the alder swamp woods with *Iris pseudacorus* (*Carici acutiformi-Alnetum* (Dostal 1933) Soó) in Porumbesti forest. The stand is well conserved, with characteristic salient roots of the alder trees, marshy patches dominated by sedge species, *Iris* and other swampy species in the herb layer, and drier zones dominated by *Rubus* and nemoral species.

6. The lowland oak-hornbeam forest (*Quercu robori-Carpinetum* Soó et Pócs 1957 em. Soó 1980) constitutes the zonal vegetation in the surveyed area. The majority of forested plots belong to this group; they all are under forest management, which traces some characteristic changes in their composition, particularly concerning the canopy layer. On richer stands oak and hornbeam are the major components, with *Acer campestre*, *Fraxinus excelsior*, *Populus tremula* in the low canopy. In intensely managed plots the hornbeam and the low canopy layer fails, the same as the scrub layer. The estival herb layer is rich (*Crocus heufflerianus*, *Anemone nemorosa*, *Ficaria verna*, etc); usually the layer is formed by mezohigrophilous forest species.

7. The subcontinental peri-pannonic scrub vegetation (*Pruno spinosae-Crataegetum* Soó (1927) 1931) also belongs by it's origin to the group of riverine forests, but its development is not strictly dependet of the humidity gradient. The scrubs mainly occur on abandoned pastures, on the riverbank or behind the dike. In the first case, they occupy degraded *Lolium*-dominated pastures; here, near the blackthorn and hawthorn species, the dense (70-90%) schrub canopy has large number of riverine wood scrubs and young trees (*Viburnum opulus*, *Populus nigra*, *P.alba*, *Salix cinerea*, *Cornus sanguinea*, etc.), but invasive species too (*Amorpha fruticosa*, *Robinia pseudoacacia*, *Echinocystis lobata*, etc.). With proper management activity these stands can turn into willow galleries or mixed forests by succession. In other stands the scrubs invaded abandoned fen-meadows or even dryer pastures.

IV. Meadows and pastures

Meadows and pastures are the most extended vegetation type of the area. They occupy large plots on the riverbank and outside the dikes as well. All subtypes derive from the rich fen-meadows through drainage and overgrazing, having a large set of common species.

The rich fen meadows form three associations on the area, in accordance to the flood length in the spring and soil humidity: *Carici vulpinae-Alopecuretum pratensis* (Máthé et Kovács 1967) Soó 1971 corr. Borhidi 1996, *Agrostio stoloniferae-Deschampsietum caespitosae* Ujvarosi 1947 and *Agrostideto-Festucetum pratensis* Soó 1949. The structure of the first two associations is determined by the sedge species (*Carex vulpina*, *C. acuta* etc.) and *Deschampsia caespitosa*, to which higrophilous and mesophilous species associate. They occupy a few plots on the river-bank and are used as pastures. The third association is more widespread, almost all the hay meadows of the area belong to this type. Their two-layered structures is determined by tall grasses (*Alopecurus pratensis*, *Festuca pratense*, *Poa pratense*, *Phleum pratense*, in a lesser extent *Deschampsia caespitosa*) and small grasses with mesophilous dicotyledons (*Agrostis stolonifera*, *Ranunculus acris*, *Trifolium repens* etc.). The richest hay-meadows between Gerța and Călinești contain a large set of species, including *Serratula tinctoria*, *Sanguisorba officinalis*, *Orchis laxiflora*. They are mowed twice in midsummer and usually a second time in autumn, which conserves their species-richness. The 3-5 year old, partially abandoned meadows around the Porumbesti forest and Turulung Vii surroundings are invaded by scrub species. In case of pasture practices, or combination of mowing and grazing, the stand became dominated by *Agrostis stolonifera* and gradually loses its two-layer structure and most of the characteristic fen meadow species disappear. In these areas, the shallow drainage channels and little wet depressions are vegetated by *Juncetum effusi* Soó (1931) 1949. As a next step, the disturbance tolerant species are increasing, and the perennial ryegrass will co-dominate (*Lolio-Alopecuretum pratensis* Bodrogközy 1962). The continuously drained pastures, with no flood-cover in spring are covered by *Anthoxantho-Agrostetum capillare* Silinger 1933.

The driest plots, far from the riverbed, are covered by steppe grassland (*Achilleo-Festucetum pseudovinae* Soó 1947).

V. Sites with major human impact

Agricultural sites and recently abandoned agricultural fields

Small-sized family owned farms and specialized monoculture production, largely dominated by corn and cereals, can be found in the territory of the River Tur Protected Area. From conservation point of view, it is highly appreciated that more and more sites are abandoned from agricultural cultivation. Ruderal species are dominant in early succession stages of the old-fields (*Convolvulo-Agropyretum repentis* Felföldy 1943). *Agropyron repens* is the primal colonizing grass species, with weedy herbs such as *Erigeron canadensis*, *Artemisia annua*, *Daucus carota* and *Ambrosia*

artemisifolia. In the course of time the early successional species are replaced by the characteristics species of the meadows, like *Agrostis stolonifera* or *Festuca pseudovina*, depending on abiotic characteristics and usage. The development of these sites must be monitored and managed, if it is necessary, for proper recovery of the natural stands.

Industrial ruderal sites, roads, buildings, water jumps with characterless vegetation

Weed vegetation characterizes the depot at Porumbesti, the railway station, and the road, the dirt roads and railway verges. These anthropic communities can be hardly classified, being very varied. Both sides of the dikes are characterized by the *Lolietum perennis* Gams 1927 community, with *Polygonum aviculare*, *Lolium perenne*, *Sclerobloa dura*, *Plantago major* among others. The environmental conditions of these habitats and their role as corridors promote the dispersion of exotic species, thus makes the survival of the native flora even more difficult (Jantunen et al. 2006).

Spatial heterogeneity, naturalness and regeneration potentials

The landscape of the River Tur's riparian zone is composed of a matrix of vegetation patches developed in function of the availability of the required abiotic sources. Water supply and the small scale topography of the ground are the two main factors responsible for the patchy nature of the vegetation. Non-contiguous willow shrubs, patches of mesotrophic meadows, beds of large sedges form a colorful vegetation mosaic, as a common feature of this territory.

Spatial heterogeneity is even more emphasized, but with negative effect, by the disturbing forces of. In order to distinguish the various degrees of alteration, we used the 'naturalness' of the vegetation patches as a measure of its conservation value. We considered naturalness as an interaction between species richness, occurrence of threatened species, structural complexity and successional stage of a certain habitat. Considering all these components, remnant natural patches with high conservation values are very few in the studied territory. All these alteration are caused by the repeated man-made disturbances.

Nevertheless, the fact that the territory was declared protected area might mean an important step for the recovery of the damaged habitats. Some sites could, through appropriate management or natural change, eventually develop a significant nature conservation value, even if it is difficult to be predictive about trends in composition and structure of the stands. The spatial heterogeneity must be appreciated and sustained, because it provides a greater variety of microhabitats, a greater range of microclimates, which could be related to the higher species richness and structural diversity (Begon et al. 2006).

There are some important factors that allow us to be optimistic with regard to the rehabilitation of the damaged sites along the River Tur by means of proper control. **First**, the remnant patches with high conservation values could serve as sources for

species that had not tolerated human disturbances. These kind of valuable patches are the well conserved alder swamp woods at Porumbești, the backwaters of the river near Turulunk Vii village and at the “Patkólapos”. A truly precious and divers territory is the Adrian forest: mature stands of willow galleries and patches of riparian mixed forest with oaks, elms and ashes can be found there; a colorful mosaic with *Salix cinerea* shrubs and beds of large sedges and reed; backwaters and fishponds with rare communities such as the *Trapaetum natantis* V. Kárpáti 1963, and species rich mesotrophic meadows. **Second**, riparian plant communities are known to be among the species rich and very productive communities under temperate climates (Nilsson et al. 2000); the regeneration cycle is very fast, because nutrient and water uptake of the plant species is assured all along the year. **Third**, hydrological disturbances tend to increase spatial heterogeneity by allowing pioneer patches to coexist closely with mature ones (Planty-Tabacchi et al. 2001). Thus, it facilitates potential transfers of individuals between patches of distinct stages or sequences.

The protection of the remnant patches with high conservation value and regeneration of the disturbed habitats is feasible only by ceasing the exaggerated human interventions.

Threatening factors of the riparian plant communities along the River Tur

1. Hydrological alterations

Natural riparian ecosystems include a variety of community types, offer habitats for many species, function as filters between land and water, and serve as pathways for dispersing and migrating organisms (Naiman and Décamps 1997). These areas are particularly sensitive to variation in the hydrological cycle and serve as good indicators of the environmental changes (Nilsson and Berggren 2000).

The River Tur is constrained by a dam at Calinesti-Oas, and a dike system all along the both side of the river for flood protection. Since this storage reservoir is in the headwater region of the river, the dam affects riparian communities downstream by altering flow regimes. This usually means changes to flood frequency, seasonal timing and duration (Brinson 1990), which have marked impacts on patterns of vegetation structure and production in the whole part of the protected area. These kind of hydrological alterations, the cut off meanders and several drainage ditches placed in the area cause a long-lasting desiccation of the territory. Due to these changes the dominant plant communities show degradation, an impoverishment in species and might also lead to invasion of exotic species, as follows.

The riverside willow shrub is very sensitive to the duration of the floods; it needs five to seven months inundation a year (Fekete et al. 1997). As the community gets less water continuously for several years, the regeneration of this vegetation type slows down and it becomes more susceptible to the colonization of weeds or invasive species. In case of lowland mesotrophic meadow and beds of large sedges, which have to be wet throughout most part of the growing season the sensitive species disappear from the site, just a few, stress-tolerant or ruderal species form the community. The

appearance of the Calystegion elements and invasive species also suggest this kind of degradation of these habitat types (Fekete et al. 1997). Likewise, for all components of the vegetation, differences in the frequency of flooding have major influence on variation in species composition and also on primary production.

Thus maintaining and increasing the conservation values of wetlands within these riparian plant communities will require a focus on the reinstallation of more natural flow regimes. Decisions regarding flow management need to be based on the best possible knowledge of the ecological responses to altered flows.

2. Invasion of exotic species

Biological invasions are one of the most severe threats to biological diversity and are studied worldwide with increasing intensity. Invasive plants have been shown to alter habitats and ecosystem processes, and to cause significant environmental damages (Manchester & Bullock 2000). When non-indigenous species invade new territories, they can replace native plant species, threaten endangered or rare species and cause local extinctions (Kolar & Lodge 2001). The response to the introduction and spread of non-native species must urgently become an important part of local nature conservation policies.

In case of riparian ecosystems this should be even better emphasized, because riparian zones are more vulnerable to invasions than other ecosystems. This fact is related to landscape structure of the riparian zone: linear corridors facilitate the spreading of organisms (Planty-Tabacchi et al. 2001). Hydrological disturbances (floods) are also likely to increase the invasibility of the riparian corridors by creating bare ground areas, places for primary colonization of the invasive species. Flood events have the connecting power to access “the external species” to riparian habitats, thus facilitating new colonization (Pysek & Prach 1993).

Although there are no severe invasion events in the riparian zone of the River Tur, several factors suggest a possible aggravation of the situation in the future:

1. the already presence of some harmful invasive species with self-sustaining population
2. the degraded, disturbed vegetation as a result of the hydrological alterations mentioned above, the exaggerated grazing and trampling activities of domestic livestock
3. the proximity of human settlement and the presence of human action, which often is the most important vector of the invasive species
4. the road and railway verges serve as dispersal corridors for invasive species and also disturb the integrity of the riparian habitats

The most menacing invasive plant species is the false indigo, *Amorpha fruticosa* L. This species is a hygrophilous shrub, frequent in human-disturbed environments. If the soil moisture is suitable, it enters quickly the new habitat, forming a close and

exclusive covering (Mihály & Botta-Dukát 2004). In the riparian zone of the River Tur, *Amorpha fruticosa* can be found along the drainage ditches, indicating the places of human activities, but their spread is more threatening in the willow shrub communities, where, probably thanks to the high competitive ability of the species, it replaces the native willow species.

The Jerusalem artichoke, *Helianthus tuberosus* L. and the hybrid knotweed *Reynoutria x bohemica* Chrtek & Chrtková three-border zone, abandoned fishpond near the railway line, etc. are perennial clonal herbs, introduced into Europe primarily as garden ornamentals. They are vigorously growing plants forming vast stands and producing a large amount of biomass (Mihály & Botta-Dukát 2004). The *H. tuberosus* can be found just in few places in the studied territory, but there the species already form monodominant stands. The *Reynoutria x bohemica* occurs near settlements, forming wide patches. It does not occur in (semi)natural habitats yet. These species are very invasives and considered to be transformers, i.e. invasive species that change the character and conditions of ecosystems. Because of incredibly extensive root system and sprouting ability, landscape level control must be thought of within the context of a program. Although there are potentially successful mechanical or manual control options for small patches, landscape level projects and large sites will almost certainly require integrating herbicide use into a control strategy, and successful eradication is likely to take more than one year.

The annual ragweed, *Ambrosia artemisiifolia* L. is one of the most known invasive species, because it is a significant human health hazard, as the pollen contains highly potent allergens that can aggravate asthma and cause respiratory allergies such as hay fever (Dahl et al. 1999). The ragweed in our studied area rapidly colonizes cultivated fields, wasteland and disturbed soil, mainly due to the large seed production. It indicates the recent disturbance of a habitat, thus in the River Tur Protected Area can be controlled by diminishing the human interventions. An important part of the management of annual ragweed should be to raise awareness of the impact of annual ragweed on human health and as an agricultural pest, so that the public are willing to help prevent its spread.

The wild cucumber *Echinocystis lobata* (MICHX.) TORR. & A. GRAY is a monoecious annual of North American origin (Silvertown 1985). It occurs in riparian habitats of the River Tur climbing just up to 10 m into the canopy of trees and shrubs. There are very little information about this species, and few available management techniques. Because it is annual, it may be effectively suppressed by the systematic mechanical removal before flowering.

The small balsam, *Impatiens parviflora* can only be found on the verges of the railway crossing the River Tur at Porumbestii. This annual species is assumed to be successful invader in some central European moist forests. The species' roots do not penetrate deeply into the soil, thus avoiding root competition with indigenous trees and herbaceous plants (Heger & Trepl 2003). In this way the *I. parviflora* can be the only spreading alien species in the invasion-resistant central European oak-hornbeam

forests. The managers of the protected area must assure that this invasive species will not enter the near forests.

3. Human activity

Human settlement has always been focused on rivers, and human activity is often a major determinant of riparian structure and function (Dynesius & Nilsson 1994). Human activities that are continuously changing the territory (agriculture, improving or correcting the net of ditches etc.) negatively affect the protected area. The grazing and trampling activities of domestic livestock have had a particularly pervasive influence on riparian habitats (Trimble & Mendel 1995). The mowing for hay-making could be the only activity with beneficial result, promoting species diversity and richness for meadows and preventing the development towards woodland.

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