ASSESSMENT OF ECOSYSTEM SERVICES TROUGH HABITAT DIVERSITY WITHIN A PERI-URBAN RIVER AREA - BEGA RIVER IN THE EASTERN PART OF TIMIȘOARA

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Abstract. *Over the past centuries, wet areas have faced major threats and surface reductions due to urbanization, pollution and hydrotechnical arrangements. Concrete dams took the place of riparian forests and marshes especially in the urban, peri-urban and even rural areas as a flood control method. Even though in the past two or more decades in the Western part of the E.U. and U.S.A. the general trend was to restore riverbeds from concrete to their natural state, in Romania the trend has followed the opposite direction with repercussions on biodiversity, water quality and difficult invasive species control. In the summer of 2021 we have botanically surveyed the Bega river in the eastern part of Timișoara in order to investigate the benefits that this naturalized state brings to the city and European biodiversity conservation efforts. Our survey led to the identification of key species for conservation and favorable habitat conservation status, resulted from habitat mapping of the area. We identified seven main habitat types: 92A0, 3150 (Natura2000); G5.1, X25 (EUNIS) and R5307, R5309, R5310 (Romanian system). Our study aims to bring attention to such sites and their importance as biodiversity holders in urban landscapes and as ecosystem service provides and to further reconsideration of the methods used in their future development.*

Key words: *biodiversity, habitat, Natura 2000, EUNIS, ecosystem services, peri-urban river area, Bega, Behela*

INTRODUCTION

The term "habitat" is polysemantic, used in many fields (ecology, biogeography, nature conservation, architecture, geography, anthropology, etc.). In the most general way, habitat means a place/living space, where an individual lives (by extension, a species), a community of organisms, sometimes including human communities. In the latter case, the term "oikumen" is more appropriate for the environment inhabited directly by humans and significantly modified by them: urban and rural settlements, farms, transport routes, industrial platforms, etc. When we refer to species other than *Homo sapiens sapiens*, the habitat means "monotope", i.e. the habitat of a population, identifiable and delimitable, or the habitat of a species, when it is defined by general abiotic and biotic attributes and should not be confused with "areal" of a species, a term with a clear biogeographical connotation. This meaning is one of the two under which the term habitat is included in the well-known Habitats Directive (Council Directive 92/43 / EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora) as defined in Art. 1 (f) as the habitat of a species. The other meaning in the Directive is that of habitats of more or less homogeneous communities, which are characterized by abiotic attributes and especially by combinations of characteristic species. The Directive, on the basis of which the Natura2000 network was set up in the European Union, defines habitat types of community importance.

In addition to Natura2000 habitats, there are other habitat classification systems, of which, at EU level, the most important is EUNIS (European Nature Information System), a more comprehensive system as it includes non-conservation habitats, urban habitats, etc.

It should be mentioned that during the pre-accession of Romania to the EU, a national habitat classification system was developed (DONIȚĂ *et al*., 2005, 2006). There are correspondences between Natura2000 habitat types (set out in the Directive and described in Natura2000 habitat interpretation manuals), EUNIS types and national typology (DONIȚĂ *et al*., 2005, 2006), but not always (habitats without correspondent in another system, Natura2000 habitat with several corresponding national habitats types, etc.).

Inventory, mapping and establishing the conservation status of habitats are preliminary actions to make management decisions in areas such as nature conservation, land management and planning.

Through this study, we made an inventory of the main types of habitats in the major riverbed of Bega between the Water Plant and the upstream portion of it up to about 800 m from the bridge in Ghiroda. The aim of the study is to make a picture of plant diversity and habitats, assess their condition in terms of types of anthropogenic impacts and ecosystem services, and formulate management recommendations that can be integrated into development plans so that the imperatives of urban development, should not lead to drastic erosion of biodiversity.

Brief history of botanical research

The first scientific work exclusively on the flora of Timișoara and its surroundings is that of Lajos (Ludovic) TŐKÉS (1905), who publishes an *enumeratio* comprising 743 taxa, the vast majority of which are cormophyte species, including species described by the great botanist Vincze von BORBÁS, author, also of *Temesmegye vegetációja* (1884); In fact, in the preamble to the volume of the *Natural History Notes* in which he publishes his research, Tőkés thanks Vincze BORBÁS for his kindness in revising the text before publication. In this paper, there are mentioned species near Bega, from Ghiroda (Gir.), Moșnița (Mosn.), two localities close to the area approached by our study, such as[1]: *Marsilia quadrifolia* L. („Négylevelü mételyfü. Méh. álló tócsákban, Mosn. és Gir. mocsarakban."); *Equisetum arvense* L. („Mosn. és Gir., freidorfi út mellett, a Bega árterületein m indenütt vizenyős helyeken."); *Typha latifolia* L. ("Mosn., Gir. és .Méh. mocsaraiban, az orsovai és aradi vasútárkok."); *Sparganium erectum* L. („A Bega parti kiöntéses területeken s az összes mocsarakban, sáncokban."); *Potamogeton gramineus* L. („Csak a Gir. mocsarakban („holt Bega")."); *Triglochin palustre* L. („Mosn. és Gir. vadászterületek egyes zsombékos szigetein."); *Alisma Plantago* L. („Mosn., Gir., Méh. és a összes vasúttöltések árkaiban, a sáncokban s a Bega indkét parti töltése mentén fekvő mocsarakban."); *Alopecurus pratensis* L. („A Mosn. és Gir. nedves réteken s mindenütt a kaszálókon."); *Agrostis stolonifera* L. („Mosn. és Gir. réteken."); *Carex vulpina* L. („Mosn. és Gir. mocsarak."); *Carex stricta* Good. („Sáncok, Mosn. és Gir. mocsarak."); *Scirpus maritimus* L. („Mosn., Gir. és a gyárvárosi Bega mindkét partján.")

In 1916, ZSÀK Zoltán published a *Contribution to the knowledge of the vascular flora in the Timișoara area*, in which appear species in our area of interest: *Scirpus silvaticus* („Giroda, Bega ártere"); *Carex vulpina* („Temesvár, a Bega mentén."); *Carex hirta* („Kissé nedves kaszálón Temesváron; Szabadfalu : legelőn; Giroda: Bega ártere"); *Juncus articulatus* („Giroda: Bega ártere."), *Juncus effusus* („Giroda: Bega ártere."); *Allium Scorodoprasum* (Giroda: Begatöltés.); *Scutellaria hastifolia* ("Temesvár, szántóföldi fasorban; Giroda, Bega ártere."); *Veronica Beccabunga*, („Giroda, mocsaras réten."); *Valérianella rimosa* Bast. (*V. Auricula, V. dentata*) („Kaszálókon Temesvár és Szabadfalu mellett; Giroda, Begatöltés.").

[1] here and below, the names of the species are given according to the sources (the current valid names are not given, in the case of synonyms)

The flora of Bistra Forest, located about 2.5 km NE of the study area, is the subject of a botanical research (LENGYEL, 1915) whose results can serve as a general indicator of the flora and vegetation of wetlands around Timisoara; thus, the woody vegetation of the wetlands in the Bistra Forest is composed of *Salix cinerea*, *Salix triandra*, *Alnus rotundifolius* (*A. glutinosa*) and *Viburnum opulus*, while the herbaceous one consists of *Alisma plantago* (*A. plantago-aquatica*), *Sagittaria sagittifolia*, *Equisetum palustre*, *Glyceria aquatica*, *Phragmites communis* (not much), *Schoenoplectus lacustris*, *Rorippa palustris* și *R. amphibia*, *Bidens tripartita*, *Lycopus europaeus*, *Caltha cornuta* (*C. palustris*), *Epilobium* (without specifying the species), *Polygonum amphibium*, *P. hydropiper*, *Stachys palustris*, *Galium palustre*, *Cirsium palustre*, *Oenanthe aquatica*, *Senecio paludosus*, *Lythrum salicaria*, *L. virgatum*, *Juncus effusus*, *Carex elata*, *C. gracilis*, *C. vulpina*, *C. acutiformis*, *C. riparia*, *C. hirta*, *Butomus* (*umbellatus*), *Iris pseudacorus*, *Ranunculus sceleratus*, *Myosotis palustris*, *Sium latifolium*, *Sium erectum* (*Berula erecta*), *Rumex conglomeratus*. In the forest ponds, LENGYEL (1915) finds *Castalia alba* (*Nymphaea* alba), *Nuphar luteum*, *Ranunculus aquatilis*, *Hydrocharis morsus-ranae*, *Lemna minor*, *L. trisulca.*

BORZA (1941) mentions hydrophilic, hygrophilous, ruderal species from the Bega meadow: *Sagittaria sagittifolia*, *Butomus umbellatus*, *Glyceria fluitans*, *Glyceria maxima* ("Fluvio Bega prope opp. Timișoara."), *Althaea officinalis* („Locis uliginosis penes fl. Bega, sollo argilloso."), *Conium maculatum* („Timișoara, loco ruderali ad fl. Bega. Solo argillaceo."), *Scutellaria galericulata* („In Phragmiteto penes fl. Bega.").

BUIA (1942) reports on: *Salvinia natans* ("la Ghiroda, pe canalul Bega..." - at Ghiroda, on the Bega canal), *Bromus japonicus* („Timișoara, pe marginea canalului Bega." – Timisoara, on the banks of the Bega canal), *Salix triandra* („Timișoara, pe marginile canalului Bega" - Timisoara, on the banks of the Bega canal), *Chenopodium strictum* („Timișoara, pe marginea canalului Bega" - Timisoara, on the banks of the Bega canal).

An exhaustive list of species identified in the Timișoara region (by which the author understands the urban area and the neighboring area within a radius of 4-6 km) is published by BUJOREAN (1942); in this list we find species with general location indications (e.g. "Everywhere on the roadside"), but also species found in or near our study area:

- *Salvinia natans* („Pe Bega mai sus de plaja comunală și-n alte bălți liniștite și scutite." - *On Bega above the communal beach and in other quiet and sheltered ponds*;
- *Equisetum arvense* f. *agreste* („Pe malul Begei deasupra plajei comunale, în asociația de *Agropyron repens*" - On the banks of the Bega above the communal beach, in the association of *Agropyron repens*);
- *Potamogeton nodosus* („Pe Bega, la plaja comunală ..." - On Bega, at the communal beach...);
- *Potamogeton acutifolius* („În Bega, mai sus de plajă..." - In Bega, above the beach ...);
- *Leersia oryzoides* („Pretutindeni, în marginea asociației de *Phragmites communis*." - Everywhere, on the edge of the association of *Phragmites communis*);
- *Poa palustris* var. *glabra* („În pârloagă umedă pe malul Begei aproape de plajă" - In a humid fallow, on the banks of the Bega, near the beach);
- *Salix triandra* var. *discolor* f. *semperflorens* („Pe malul Begei mai sus de plaja comunală" - On the bank of the Beg, above the communal beach);
- *Salix viminalis* var. *splendens* („Pe Bega lângă plaja comunală" - On Bega, near the communal beach)
- *Epilobium hirsutum* var. *villosum* („În fânaț umed (șumuz) la „Bugeac" aproape de plajă" - In the wet meadow (șumuz) at "Bugeac", near the beach)
- *Myosotis scorpioides* ssp. *palustris* var. *strigulosa* f. *laxiflora* („în asociație de

Glyceria maxima pe Bega" - in *Glyceria maxima* association, on Bega)

- *Stachys paluster* var. *vulgaris* f. *petiolatus* („Pe marginea asociației de *Phragmites c.* la plajă" - At the edge of the association of *Phragmites c.* At the beach);
- *Mentha aquatica* ssp. riparia („Pe marginea trestișului (*Phragm. c.*) la plajă" - at the edge of the reedbed (*Phragm. c*.), at the beach);
- *Xanthium italicum* („În loc viran lângă plajă ș.a." - In barrens, near the beach, etc.);
- *Cirsium arvense* var. *vestitum* („În loc umed la umbră, la plajă pe malul Begei" - In a humid place in the shade, on the beach on the banks of the Bega).

Brief references to the flora and vegetation of wetlands in Timișoara and its surroundings are included in a *Geobotanical Guide for the Banat* (POPESCU & SAMOILĂ, 1962):

"The aquatic and swampy vegetation is also quite rich. We mention the associations of *Wolffia arrhiza, Salvinia natans, Leersia oryzoides, Scirpus tabernaemontani, S. silvaticum, Phragmites communis, Glyceri aquatica,* etc. In swamp associations it still grows: *Iris pseudacorus, Lemna trisulca, Carex nutans, Typha latifolia, Glyceria fluitans, Carex vulpina, Roripa amphibia, Phalaris arundinacea, Oenanthe aquatica, Mentha aquatica, Heleocharis palustris, Bolboschoenus maritimus* etc.

The associations of *Agrostis stolonifera, Juncus effusus, Poa trivialis, Alopecurus prtensis, Poa pratensis*, etc. are widespread in the meadow and in the low places."

In his doctoral dissertation, GRIGORE (1971) mentions, with chorological indications likely to refer to our study area: *Equisetum pratense,Equisetum palustre, Populus alba, Populus tremula, Populus nigra Bilderykia (Fagopyrum) dumetorum, Callitriche polymorpha, Caltha palustris, Nymphoides peltate, Vallisneria spiralis, Potamogeton fluitans, Potamogeton natans, Potamogeton gramineus, Zannichellia palustris, Scirpus sylvaticus, Acorus calamus, Carex brizoides, Lathyrus latifolius, Myriophyllum verticillatum, Myriophyllum spicatum*.

Among the species reported by GRIGORE (1971) someone may also find:

- *Angelica sylvestris* ("*Locuri umbrite în lungul pârâului Behela. Tmș.*" - *Shaded places along the Behela creek. Timișoara*), common species in hilly and mountainous areas;
- *Lindernia pyxidaria* All., syn. *Lindernia procumbens* (Krock.) Philcox., species listed in Annex IV to the Habitats Directive, an annex containing animal and plant species of Community importance, in need of strict protection.
- *Elatine triandra,* species from the red list of vascular plants in Romania (DIHORU & NEGREAN, 2009), where it appears with the status of critically endangered species. GRIGORE (1971) reports it in the mudslides, ponds, ditches, in Ghiroda and Timișoara, sporadic; also from Ghiroda, this author also points to the congeneric *Elatine alsinastrum*, present sporadically.

To these, GRIGORE (1971) adds reports of plant associations, of which: *Ceraotphyllo-Hydrocharitetum* I. Pop 1962 (at Ghiroda), *Potamogetono-Ceratophylletum* I. Pop 1962 ("în preajma […] canalului Bega, la Timișoara…" - near […] the Bega canal, in Timișoara), *Myriophyllo-Potamogetonetum* Soó 1934 (at Ghiroda), *Glycerietum maximae* (Now. 1930) Hueck 1931 ("în lungul cursurilor de ape (la Timișoara, Ghiroda) și în canale" - along flowing waters (in Timișoara, Ghiroda) and in canals), *Caricetum acutiformis-ripariae* Soó 1937 ("în locuri depresionare, băltite, în lunca Timișului și a canalului Bega, […] la Ghiroda, Timișoara" - in depressed, muddy places, in the Timiș low-meadow and the Bega canal, […] at Ghiroda, Timișoara).

FAUR & COSTE (1998) undertakes research on the cormoflora in the area of the *Timisoara Fisheries Company* (later *Pescotim*, on the right bank of the Bega, in the immediate vicinity of the studied area, whose basins are currently dry) and identifies 41 species, mostly aquatic and hygrophilous, among which is *Marsilea quadrifolia*, a species in Annex II of the

Habitats Directive, comprising animal and plant species whose conservation requires the designation of special areas of conservation.

Within the BIOTOWNS project (2011[2]) a study was carried out to evaluate the flora in the urban area of Timișoara, a study that also included the banks of the Behela and the part of the Bega canal in the studied area, of which we find mentioned in the floristic survey on: *Anchusa officinalis*, *Aristolochia clematitis*, *Avena fatua*, *Calamagrostis arundinacea*, *Carex hirta* (all on Cometa Street, on the banks of Behela), *Calystegia sepium*, *Conium maculatum*, *Epilobium hirsutum*, *Equisetum arvense*, *Galium mollugo*, *Mentha aquatica*, *Phragmites australis*, *Symphytum officinale*, *Typha latifolia*, *Typha angustifolia* (on the banks of Bega and Behela), *Ceratophyllum demersum*, *Lemna minor*, *Lemna trisulca*, *Salvinia natans* (in Bega and Behela), *Eupatorium cannabinum*, *Pastinaca sylvestris* (on the banks of Behela) and others.

MATERIAL AND METHODS

The study area includes the course of Bega and its major riverbed upstream of the Water Plant, on a length of about 3.5 km, and the the terminal part of the course of the Behela brook which flows into the Bega (Fig. 1). The surface of the area thus delimited is 34.45 ha.

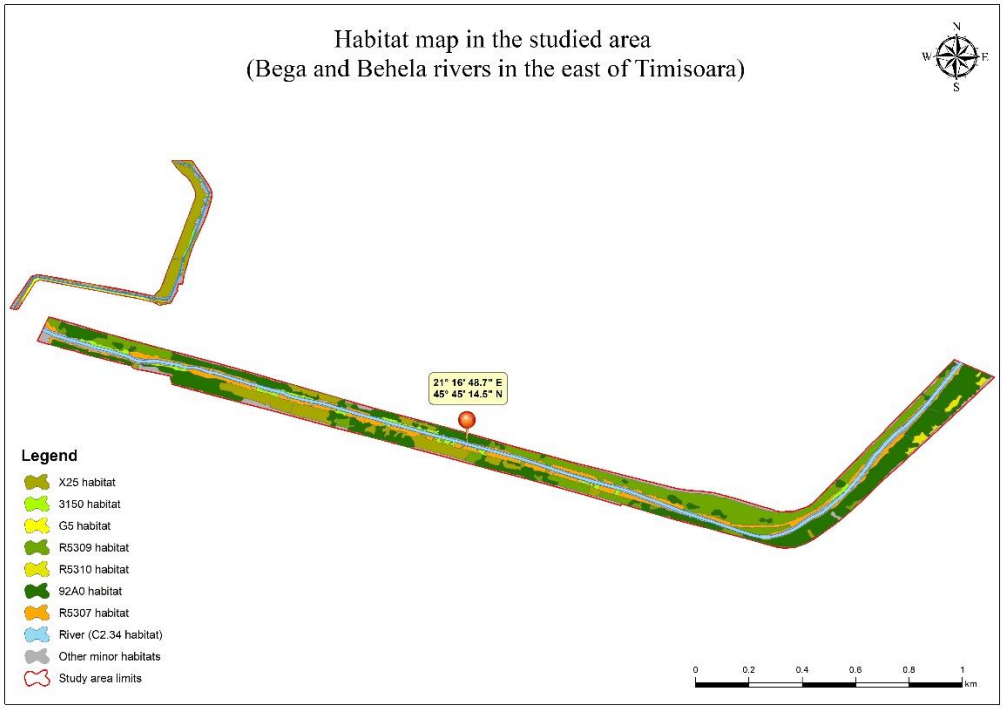

Fig. 1. Location, delimitation of the study area and identified habitats (map made by Laurențiu ARTUGYAN).

Prior to the survey, bibliographic investigations were carried out in the botanical literature, retaining those sources that expressly mention plant species and observations on the vegetation in Bega, the urban area and the low-meadow, and Ghiroda.

The field stage of the study consisted of field trips between May and September 2021,

[2] *Flora Municipiului Timișoara - Studiul de evaluare a biotopurilor urbane din municipiul Timișoara*, at URL: https://www.biotowns.ro/index.php?meniuId=13&viewCat=36&lg=ro

both on Bega's and Behela's left and right banks, as well as on a water trip, with kayaks, the latter for observing aquatic vegetation. The identified cormophyte species were noted and the coordinates of the points and lines considered significant (populations' locations and phytocenosis / habitat's boundaries) were recorded. In cases where it was not possible to identify the species on the spot, samples were taken, photographs were taken and an identification was made in the laboratory phase; thus, we used the dichotomous keys from SÂRBU *et al*. (2013).

Observations were also made on the current negative impacts (pressures), mainly of an anthropogenic nature. The codes for impacts are those from the Natura 2000 system presented in Annex no. 1 to the *Guide for the elaboration of the management plans of the protected natural areas* (Order of the Minister of Environment no. 304/2018). The magnitudes of these pressures are estimated on a relative scale: low, medium and high.

In the interpretation of habitats, the current theoretical tools were used:

- for the habitats in Romania: DONIȚĂ *et al*. (2005, 2006);
- for Natura2000 habitats: EUR28 manual (2013) and GAFTA & MOUNTFORD (2008);
- for EUNIS habitats: classification tree presented at https://eunis.eea.europa.eu/habitats-code-browser.jsp.

Aerial images (made with a drone) and satellite images available in GoogleEarth were used to delimit the patches. Auxiliary, the main Romanian (COLDEA *et al*., 1997, 2015) and European (MUCINA *et al*., 2016) phytosociological sources were also used.

Very small areas (patches usually less than 400 m^2) with vegetation corresponding to other types of habitats, often heavily anthropized, have been included together in the category of other minor habitats.

The typology of ecosystem services considered is CICES v.5.1 (Common International Classification of Ecosystem Services (CICES) for Integrated Environmental and Economic Accounting[3]). The inventory of ecosystem services was done by corroborating information from the field and from various scientific publications. The measure of the importance of an ecosystem service is rendered on an arbitrary three-step scale: "+" - service of reduced importance; "++" - service of medium importance; "+++" - important ecosystem service. The assessment is made for all habitats in the study area taken together (Annex 1).

RESULTS AND DISCUSSION

Following the interpretation of the fieldwork data, we identified areas with plant communities and plant species that fall into types R5307, R5309, R5310 (from the national habitat classification system), 3150 and 92A0 (habitats of Community importance - Natura2000 habitats) and habitats C2.34, G5 and X25 (EUNIS habitat). We did not include the small areas in other communities (e.g. those dominated by rushes - *Typha ssp*.), nor the ruderal vegetation, the segetal vegetation in the gardens in the area, nor the cultivated plants (ornamentals, vegetables, medicines, etc.) in these gardens, nor the vegetation on the slopes and the ridge of the dam.

Habitat R5307 - Dacian-Danubian communities with *Glyceria maxima* and *Schoenoplectus lacustris*

Cenoses built by *Glyceria maxima* are widespread in all wetlands in Romania, at the edge of puddles and smoothly flowing waters, generally mesotrophic and eutrophic, with slightly fluctuating water levels during the year (COLDEA *et al*., 1997). In the studied area, such

[3] https://cices.eu/resources/

phytocenoses occupy discontinuous bands from the banks of Bega, in which the dominant and characteristic species (*Glyceria maxima*) is clearly dominant, being accompanied by: *Alisma plantago-aquatica, Butomus umbellatus, Carex acutiformis, C. riparia, C. vulpina, Equisetum palustre, Eupatorium cannabinum, Galium palustre, Glyceria plicata, Hydrocharis morsus-ranae, Iris pseudacorus, Leersia oryzoides, Lycopus europaeus, Lysimachia numularia, L. vulgaris, Lythrum salicaria, Mentha aquatica, Myosotis palustris, Phalaris arundinacea, Phragmites australis, Poa trivialis, Polygonum amphibium, Ranunculus repens, Rumex hydrolapathum, Sagittaria sagitifolia, Scirpus sylvaticus, Sparganium erectum, Stachys palustris, Symphytum officinalis, Typha latifolia, T. angustifolia, , Veronica anaglis-aquatica.*

In the meshes left by *Glyceria maxima*, in the very weak parts of the water, there are clusters of *Salvinia natans, Lemna minor, Spirodela polyrhiza*. At the water's edge, hydrophilic species such as *Valisneria spiralis* and *Najas marina* are found. Other species appear in this vegetal association, many common with those found in the neighboring reeds or sedges; in some places, this habitat is adjacent to habitat 91A0 (willow and poplar gallery forests).

From a phytosociological point of view, this type of phytocenosis is included in the association *Glycerietum maximae* Hueck 1931, *Phragmition* Koch 1926, the alliance *Phragmitetalia* Koch, the order 1926, *Phragmitetea* Tx class. and Prsg. 1942 (COLDEA *et al*. 1997).

In the European vegetation classification system (MUCINA *et al*., 2016), phytocenoses with *Glyceria maxima* are included in the alliance *Phragmition communis* Koch 1926, order *Phragmitetalia* Koch 1926, class *Phragmito-Magnocaricetea* Klika in Klika et Novák 1941, in the category of *Vegetation of freshwater springs, shorelines and swamps*. DONIȚĂ *et al*. (2005) considers habitat type R5307 - Dacian-Danubian communities with *Glyceria maxima* and *Schoenoplectus lacustris* corresponding to the association *Glycerietum maximae* Hueck.

The negative impacts found are: F2.03.02 – pole fishing (Low); G01.01 – nautical sports (Low); H05.01 – garbage and solid waste (Low); I01 – invasive non-native species (*Elodea canadensis*) (Low).

Glyceria maxima is a perennial plant with a strong ability to propagate by tillering and emitting rhizomes. In the case of shallow watercourses and canals, the proliferation of this species may slow down the flow of water. In the case of phytocenoses of this kind in the studied area, their extension in the minor riverbed is limited by the great depth of the water. If for birds they are not an important nesting place, they are instead an important place for spawning by fish. From an ecological point of view, dredging and bank clean-up work to eliminate this species is not recommended; at the limit, in case of clogging of the banks, works can be carried out, but in small portions and staggered over several years.

Habitat R5309 - Danubian communities with *Phragmites communis* and *Schoenoplectus lacustris*

The reeds (*Phragmites australis*) occupy large areas, especially on the right bank of the Bega, in the major riverbed, on flat ground. On the left bank, we also find patches of reeds, but interrupted by lots used as gardens or as recreational places from which the reeds were removed and replaced with grass or various trees. In other cases, the reeds form an intermediate cenosis between *Glycerietum maximae* and habitat 91A0 patches, which also expresses the progressive direction of vegetation evolution (floating vegetation → phytocenoses of *Glyceria maxima* → phytocenoses of *Phragmites australis* → groups of shrub willows and poplars).

Such cenoses are known for their lush appearance, but also for their floristic poverty. The reed achieves the highest coverage, being accompanied, in the study area, by: *Althaea officinalis, Bidens tripartita, Butomus umbellatus, Calystegia sepium, Carex riparia, C,*

vulpina, C. hirta, Cirsium vulgare, Epilobium hirsutum, Eupatorium cannabinum, Gratiola officinalis, Glyceria maxima, Iris pseudacorus, Juncus effusus, Lycopus europaeus, Lysimachia vulgaris, Lythrum salicaria, Mentha aquatica, M. longifolia, Myosotis palustris, Poa palustris, Phalaris arundinacea, Salix capraea, S. alba, Schoenoplectus lacustris, Solanum dulcamara, Stachys palustris, Symphytum officinale, Teucrium scordium, Typha latifolia, Urtica dioica. In the drier micro-habitats there are grasses of low-meadow and mesophilic meadows (in contact with the acclivity of the dam): *Arrhenatherum elatius, Festuca arundinacea, F. gigantea, Dactylis glomerata, Poa pratensis* etc. Also at the contact limit with the dam slope we found various ruderals (*Cirsium vulgare, Conium maculatum, Onopordon achantium* etc.).

From a phytosociological point of view, the reed-built phytocenoses are framed by COLDEA et al. (1997) to the association *Scirpo-Phragmitetum* W. Koch 1926, in the same cenotaxonomic scheme as the association *Glycerietum maximae* Hueck 1931. According to MUCINA *et al*. (2016), reeds are also part of the alliance *Phragmition communis* Koch 1926. Reedbeds can persist for hundreds of years without major environmental changes; In most hydroseries, they make the transition to mesophilic communities, meadows or lowland forests.

From a conservative point of view, *Scirpo-Phragmitetum* cenoses are not of great conservative importance by themselves. In fact, in the Romanian habitat classification system (DONIȚĂ *et al*., 2005, 2006) they are of moderate conservative importance and are assigned to the type R5309. Things are completely different if we consider the whole ecosystem. Thus, reeds are an essential habitat for feeding, sheltering, nesting in the case of many species in the fauna of river lowland meadows and the banks of lakes and swamps. The dense vegetation of the reeds houses species of *Coleoptera* (*Carabidae*, *Chrysomelidae*, *Staphylinidae*, etc.), *Diptera* (*Cecidomyiidae*, *Muscidae*, *Syrphidae*, etc.), *Hemiptera* (*Aphididae*, *Cicadellidae*, etc.), *Hymenoptera*, *Lepidoptera*, *Odonata*, etc. (PACKER *et al*., 2017). In the reedbeds nest bird species such as *Botaurus stellaris* (L.), *Circus aeruginosus* (L.), *Panurus biarmicus* (L.), and in large areas of reedbeds, various species of geese and wild ducks. In the predominantly agricultural landscapes of the plains, the reedbed is often a refuge for wild boar, deer and other mamal species.

The anthropogenic pressures found and their magnitudes are as follows: A04.02.05 – non intensive mixed animal (Low); D01.01 – paths, tracks, cycling tracks (Low); E01.03 – dispersed habitation (Low-Medium); F02.03.02 – pole fishing (Low); H05.01 – garbage and solid waste (Low); I01 – invasive non-native species (Low).

In no case is it recommended to burn reeds in any season, a traditional method from the past in which reeds were used as construction material (roofs, fences, etc.). In order to be able to fulfill their ecological role, it is recommended that the reeds be kept in areas as large as possible and as little disturbed as possible by anthropogenic interference. We do not consider that in the studied area there is a danger that the reed will behave as invasive and occupy areas occupied by other phytocenoses. Possible water drainage could reduce the surface of the reedbed. Tourist / visitor access is only recommended on a few marked trails.

Habitat 5310 – Dacian-Danubian with *Carex elata, C. rostrata, C. riparia* and *C. acutiformis*

The habitat includes phytocenoses built by large sedge species (over 1 m) in biotopes with permanent or temporary humidity, on the banks of ponds and rivers, in meadows. DONIȚĂ *et al*. (2005) present as corresponding associations: *Caricetum elatae* Koch 1926, *Caricetum rostratae* Rübel 1912, *Caricetum acutiformis* Eggler 1933, *Caricetum ripariae* Knapp et Stoffer 1962, plant associations without a correspondent in the Natura 2000 habitat system in Romania (GAFTA & MOUNTFORD, 2008). DONIȚĂ *et al*. (2005) give the Palearctic Habitats

type (DEVILLERS, 2010) 53,151 *Reed Sweetgrass* corresponding to R5309 type, but in the Palearctic typology, at 53,151 it is specified "*Communities of eutrophic Palaearctic waters dominated by [Glyceria maxima], rather low, usually constituting strips in or along ditches or small streams, often in grasslands, requiring fairly constant inundation by eutrophic water and with a fairly rich associated flora*." Instead, the type 53,212 is called *Banat sedge beds*, with the associated syntax *Caricetum bueckii* and the explanation: „[*Carex buekii] formations of mesotrophic sandy or clayey soils in Franconia, eastern Bavaria, Saxony, northern Italy, eastern central Europe, eastern Europe and western Asia"*. On the same level of the Palearctic system (53,212) there are also *Lesser pond sedge beds* – „[*Caricion acutae*]: [Caricetum acutiformis], [*Leucojo-Caricetum*] [p.], [*Caricetum ripario-acutiformis*] [p.]", and at 53,215, *Tufted sedge tussocks* - [*Caricetum elatae*]. In the Hungarian Natura2000 Habitat Interpretation Manual[4], the type B5 - *Nem zsombékoló magassásrétek* (*Non-tussock tall-sedge beds*), which includes, among others, cenoses of *Caricetum acutiformis* Eggler 1933, *Caricetum buekii* Kopecký et Hejný 1964, *Galio palustris-Caricetum ripariae* Bal.-Tul. *et al*. 1993, is also given without a Natura 2000 correspondent type.

In the EUNIS system, a distinction is made between the sedges built by *Carex acutiformis* (D5.2122 - *Lesser pond sedge beds*[5]) and those dominated by *Carex riparia* (D5.213 - *Greater pond sedge beds*[6]), the first more tolerant to aridity.

We therefore find some difficulties in interpreting this habitat, which is why we chose to present it according to the Romanian classification system as R5310.

The vegetation of tall sedges is usually found interspersed in the bottom of reeds or in wet meadows or in areas with heavy soils, but with significant rainfall in the spring. In the study area, the sedges are indeed in contact with the reeds (R5309) or insular inside it, presenting, in addition to the dominants of the genus *Carex (C. acutiformis, C. gracilis, C. riparia*), other species as: *Agrostis stolonifera, Bidens tripartita, Butomus umbellatus, Calystegia sepium, Carex vulpina, Cirsium arvense, Eleocharis palustris, Equisetum palustre, Festuca pratensis, Galium aparine, G. palustre, Gratiola officinalis, Iris pseudacorus, Juncus effusus, Lycopus europaeus, Lysimachia numularia, L. vulgaris, Lythrum salicaria, Mentha aquatica, Phalaris arundinacea, Phragmites australis, Ranunculus repens, Rubus caesius, Schoenoplectus lacustris, Solanum dulcamara, Salix cinerea, Stachys palustris, Symphytum officinalis*, *Typha latifolia, Urtica dioica* etc.

The cumulative surface of the sedge patches is about 0.34 ha.

The anthropogenic impacts on this habitat are neither numerous nor significant. Thus, similar to the cases of other habitats, we inventoried the following pressures: D01.01 – paths, tracks, cycling tracks (Low); - H05.01 – garbage and solid waste (Low); - I01 – invasive non-native species (Low).

This type of phytocenosis is important for fixing the banks and reducing their erosion, contributes to improving water quality and is a source of food and habitat for a multitude of animal species, especially invertebrates. The birds find here a place to feed and nest. In the case of water-high sedges, they are a source of invertebrate food that is a trophic source for fish. The ecosystem services provided by these ecosystems are therefore diverse.

From the point of view of management in the landscape of a river meadow, it is recommended that these cenoses be preserved and not intervened as much as possible. Due to

4 www.novenyzetiterkep.hu%2Fsites%2Fnovenyzetiterkep.hu%2Ffiles%2FANER%2520012%2520B5.pdf&usg=AOvVaw3FgOqbgsCmCeIF-9MkXCDM

5 https://eunis.eea.europa.eu/habitats/5132

6 https://eunis.eea.europa.eu/habitats/5139

litter and biomass on abundant stands, fires should be avoided during periods of vegetation rest.

Habitat 3150 - Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*

Habitat comprising cenoses of aquatic plants floating and fixed to the substrate, in stagnant or smoothly flowing waters with a high content of bases, with a pH usually having values above 7 (GAFTA & MOUNTFORD, 2008). Its characteristic species belong to alliances *Hydrocharition* (*Lemna spp*., *Spirodela spp*., *Wolffia spp., Hydrocharis morsus-ranae*, *Stratiotes aloides*, *Utricularia australis, U. vulgaris*, *Aldrovanda vesiculosa*, pteridophytes (*Azolla*), *Hepaticae* (*Riccia spp., Ricciocarpus spp*.)) and *Magnopotamion* (*Potamogeton lucens, P. perfoliatus*).

The alliance *Hydrocharition* "groups submerged or emerged aquatic cenoses, less floating than duckweed cenoses" (COLDEA *et al*., 1997, p. 44), while in the alliance *Magnopotamion* (syn. *Potamogetonion pectinati* in COLDEA *et al*., 1997, synonim for *Potamogetonion* in MUCINA *et al*., 2016) groups associations of rooted and floating macrophytes in the fresh waters of low altitudes in Europe. If we take into account the communities built by *Lemna ssp., Wolfia ssp., Spirodela ssp*., presented as characteristic species for habitat 3150, as well as the corresponding associations for this habitat presented in the *Habitat Interpretation Manual* (GAFTA & MOUNTFORD, 2008), it appears that the habitat name is narrow because it also includes associations from *Lemnetea minoris*, ordo *Lemnetalia minoris* with its three alliances (*Lemnion minoris, Utricularion vulgaris* and *Stration*), according to MUCINA's *et al*. (2016) classification.

In the case of floating cenoses, but also those composed mostly of aquatic macrophytes, the distribution pattern can be very variable, from one year to another, so these cenoses (and implicitly the habitat) are considered "fleeting". The strict phytosociological approach, beyond some practical difficulties, also depends on the size of the sample areas considered, the mapping rules applied to land habitats, more stable, can not be applied here. For example, inhabited islands / meshes if they are less than 400 m^2 in size, are considered to be merged in the background habitat, while in the case of a patches dominated by duckweeds, with an area of 1.5 m^2 in a cluster of floating fern (*Salvinia natans*) , some phytosociologists may choose to consider two different plant associations. For these reasons, we have chosen to include in the habitat 3150 those areas dominated by species characteristic of the habitat and characteristic of the corresponding plant associations. Thus, in this habitat we identified: *Butomus umbellatus, Ceratophyllum submersum, Lemna gibba, L. minor, L. trisulca, Glyceria maxima, Hydrocharis morsus-ranae, Myosotis scorpioides, Myriophyllum verticillatum, Najas marina, Polygonum amphibium, Potamogeton natans, P. crispus, Phragmites communis, Rumex hydrolapathum, Sagittaria sagittifolia, Schoenoplectus lacustris, Sparganium erectum, Spirodela poyrhiza, Trapa natans, Typha angustifolia, T. latifolia, Valisneria spiralis, Wolfia arhiza* etc. *Marsilea quadrifolia* also appears in the synthetic tables of the corresponding associations, a species of conservative importance that we did not find, just as we did not identify another characteristic species of aquatic moss (*Ricciocarpus natans*) harvested from Bega by BUJOREANU & BĂNĂRESCU in 1942. (ȘTEFĂNUȚ, 2008).

The habitat is widespread in the waters of Behela and Bega, where it most often borders the habitat R5307 (Dacian-Danubian communities with *Glyceria maxima* and *Schoenoplectus lacustris*).

In the absence of *Marsilea quadrifolia*, the conservation value of the habitat itself is moderate, but the role of these communities in the economy of the rheophilic ecosystem is important, with many species that make up the pleuston, invertebrate species and fish finding here their species habitat (in the sense of habitat of the species).

The main pressures identified are: A08 – fertilisation (on land in the immediate vicinity of the canal) (Low? - difficult to quantify); F02.03.02 – pole fishing (Low); G01.01.01 and G01.01.01 – motorized nautical sports, and respectively non-motorized nautical sports (Low-Medium); I01 – invasive non-native species (Low).

Large water fluctuations, especially floods, can profoundly affect floating plant communities as well as heavy navigation. Fishermen often "clean" the fishing grounds of such plants, as we have seen in the field. The actions of dredging and correcting the banks, especially in the case of running water, can lead to the disappearance of the habitat for several years. Community members, inhabitants of surroundings, should be aware that the appearance of "stagnant water" covered with duckweeds and floating ferns is far from a bad thing for the aquatic ecosystem, *a contrario*.

Note: the unoccupied surface of the water with visible vegetation was classified in type EUNIS C2.34 - *Eutrophic vegetation of slow-flowing rivers*, but it also presents some species of type C2.33 - *Mesotrophic vegetation of slow-flowing rivers*.

Habitat 92A0 - *Salix alba* and *Populus alba* galleries

Lowland forests are widespread along the rivers on the hilly ares and in the plains of Europe. They are a continuation from the mountain the riparian woody vegetation of priority type 91E0 * - *Alluvial forests with Alnus glutinosa and Fraxinus excelsior*. According to the Interpretation Manual of Natura2000 habitats in Romania (GAFTA & MOUNTFORD, 2008), and in the Romanian habitat classification system (DONIȚĂ *et al.*, 2005), the species characteristic of habitat 92A0 are:

- in the layer of trees and shrubs – *Salix alba, Populus alba, Fraxinus pallisae, F. angustifolia, Quercus robur, Quercus pedunculiflora, Cornus sanguinea, Crataegus monogyna, Rosa canina, Evonymus europaeus, Sambucus nigra, Prunus spinosa, Amorpha fruticosa, Clematis vitalba, Humulus lupulus.*

- in the herbaceous layer: *Rubus caesius, Calystegia sepium, Cicuta virosa, Althaea officinalis, Galium aparine, Lycopus europaeus, Lysimachia nummularia, L. vulgaris, Physalis alkekengi, Ranunculus repens, Scutellaria galericulata, Solanum dulcamara*.

Almost all of these species were identified in the study area, with the exception of *Amorpha fruticosa* (a formidable invasive species), *Cicuta virosa*, *Fraxinus pallisae, Quercus pedunculiflora* and *Scutellaria galericulata*.

In addition to these characteristic species, we also came across: *Aegopodium podagraria, Acer negundo, Agrostis stolonifera, Alnus glutinosa, Angelica sylvestris, Arctium lappa, Bidens tripartita, Brachypodium sylvaticum, Calystegia sepium, Carex hirta, Cornus sanguinea, Dactylis polygama, Echinochloa crus-galli, Equisetum arvense, Erigeron annuus, E. canadensis, Eupatorium cannabinum, Falopia dumetorum, Galium palustre, Glechoma hederacea, Geum urbanum, Humulus lupulus, Iris pseudacrous, Juglans regia, Ligustrum vulgare, Morus alba, Myosotis scorpioides, Populus nigra, Robinia pseudoacacia, Salix triandra, Silene alba, S. baccifera, Solanum dulcamara, Symphytum officinale, Ranunculus repens, Rubus caesius, Rumex obtusifolius, Sonchus oleraceus, Urtica dioica, Verbena officinalis, Vicia cracca, Vitis sylvestris agg.*

Habitat 92A0 is a correspondent of the association *Salici-Populetum* Meijer-Drees 1936 (GAFTA & MOUNTFORD, 2008), while COLDEA *et al*. (2015) classify such phytocenoses under the association *Salicetum albae* Issler 1926 (syn. *Salicetum albae* R. Tx. 1931), included in *Salicion albae* Soó 1951, respectively *Salicetalia purpureae* Moor 1958, in the class *Salicetea purpureae* Moor 1958. This classification scheme is also used by MUCINA *et al.* (2016) which include the class *Salicetea purpureae* in category H - *Forests and alluvial bushes*,

in the largest category of azonal vegetation in Europe.

The conservative importance of these willow and poplar galleries lies in providing habitat for many species of wildlife. For many bird species, the trees in this habitat are the only nesting places in many plain landscapes. Numerous invertebrate species also have here their habitat.

The negative impacts found in the studied area are: B07 – Forestry activities - felling and extraction of trees (Low); D01.01 – paths, tracks, cycling tracks (Medium); E01.03 – dispersed habitation (Low); F02.03.02 – pole fishing (Low); H05.01 – garbage and solid waste (S); I01 – invasive non-native species – (Low-Medium). The habitat is very vulnerable to invasion by non-native wood species: *Acer negundo, Amorpha fruticosa, Ailanthus glandulosus, Fraxinus pensylvanica*, American-European poplar hybrids, etc.

Note: the line of trees along the Behela was included in the type G5 - *Lines of trees, small anthropogenic woodlands, recently felled woodland, early-stage woodland and coppice.*

Habitat X25 - Domestic gardens of villages and urban peripheries

The habitat is characterized as follows: domestic gardens, usually small, less than 0.5 ha, often cultivated with mixtures of species, interspersed with paths and small buildings, close to human habitats, agricultural land, natural or semi-natural habitats[7].

In this habitat we have included gardens (mainly vegetables with fruit trees, orchards, etc.) cultivated or currently abandoned and plots of land fenced or not, for recreational purposes, some sown with lawn mixtures, planted with some ornamental species, some with constructions, temporary in the vast majority of cases. Communities of numerous segetal and ruderal species assert themselves on the abandoned surfaces. The total cumulated surface of the habitat in the studied area is about 4.57 ha.

This habitat, being a largely anthropogenic one, cannot be evaluated in terms of the anthropogenic pressures suffered, but can be considered as a generator of pressures. The use of land in the major riverbed for agriculture raises ecological issues, some of which are regulated by law, but cultivation practices are unlikely to be entirely in accordance with the law. Thus, the use of fertilizers, regardless of type (natural or synthetic) has the potential for eutrophication (the area is classified as sensitive to nitrate pollution); the use of plant protection products can impact wildlife (e.g. birds that can eat dead insects as a result of applying insecticide treatments). The presence of groups of people at leisure has an disturbing effect on some species (e.g. birds). The gardens stretched between the dam and the waterfront (sometimes up to 2-3 m from the shore) are a factor in the fragmentation of the habitat of some non-flying insect species.

Regarding the management of this habitat, which offers cultural services (leisure), it is difficult to formulate a recommendation that reconciles the needs of the local community with nature conservation. However, solutions can be identified, such as raising awareness among garden users towards organic micro-agriculture, regulating leisure activities so that they are allowed only during certain periods (ensuring silence for birds), regulating the construction regime in dam-waterfront area, signing agreements with landowners/users, stipulating actions related to good practices, etc.

CONCLUSIONS

Most of the cormophyte species mentioned in the botanical literature were found in the studied area.

We did not identify large populations of invasive species. In the area we found:

[7] https://eunis.eea.europa.eu/habitats/2488

Ambrosia artemisiifolia, Acer negundo, Conyza canadensis, Elodea canadensis, Erigeron annuus, Fraxinus penssylvanica, Helianthus tuberosus, Pathenocissus inserta, Phytolacca americana, P. decandra, Robinia pseudoacacia, Xanthium orientale ssp. *italicum.*

The share of habitat areas occupied in the study area is as follows: habitat 3150 – 2,83 %; habitat 92A0 – 32,65 %; habitat 5307 – 10,87 %; habitat 5309 – 18,71 %; habitat 5310 – 0,99 %; habitat X25 – 13,28 %; habitat G5 – 0,83 %; habitat C2.34 – 6,76 %; other minor habitats – 12,98 %.

The study area is home to a high specific diversity, close to the diversity of similar cenoses presented in phytosociological publications, although under various anthropogenic pressures and offering a wide spectrum of ecosystem services (especially support, regulation and cultural services, Annex 1) which are good to keep account in landscaping projects. Examining the references and historical maps of the area[8] allows even its designation as a protected area of local interest.

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BIBLIOGRAPHY

BORZA, A., 1941 – Schedae ad "Floram Romaniae Exiccatam*"*. A Museo Botanico Universitatis Clusiensis (in Timișoara) editam, Centuriae XXII-XXIII, Buletinul Grădinii Botanice și al Muzeului Botanic dela Universitatea din Cluj la Timișoara, vol. XXI, No. 3-4, pp. 81-130.

BUIA, A., 1942 – Notițe preliminare pentru flora regiunii Timișoara, Buletinul Grădinii Botanice și al Muzeului Botanic dela Universitatea din Cluj la Timișoara, vol. XXII, pp. 57-62.

BUJOREAN, G., 1942 – Contribuție la flora Timișoarei, Buletinul Grădinii Botanice și al Muzeului Botanic dela Universitatea din Cluj la Timișoara, vol. XXII, pp. 77-96.

COLDEA, G. (éd.), INDREICA, A., OPREA, A., 2015 – Les associations végétales de Roumanie. Tome 3 – Les associations forestières et arbustives, Presa Universitară Clujeană & Accent, Cluj Napoca.

COLDEA, G. (éd.), SANDA, V., POPESCU, A., ȘTEFAN, N., 1997 – Les associations végétales de Roumanie. Tome 1 – Les associations herbacées naturelles, Presses Universitaires de Cluj, Cluj Napoca.

DEVILLERS P., DEVILLERS-TERSCHUREN J., VAN DER LINDEN C., 2001 - PHYSIS Palaearctic Habitat Classification. Updated to 10 December 2001. Institut Royal des Sciences Naturelles, Bruxelles. Compléments à la table : SPN-MNHN / INPN, février 2010.

DIHORU, G., NEGREAN, G., 2009 – Cartea roșie a plantelor vasculare din România, Ed. Academiei Române, București.

DONIȚĂ, N., PAUCĂ-COMĂNESCU, M., POPESCU, A., MIHĂILESCU, S., BIRIȘ, I.-A., 2005 - Habitatele din România, Ed. Tehnică Silvică, Bucureşti.

DONIȚĂ, N., POPESCU, A., PAUCĂ-COMĂNESCU, M., MIHĂILESCU, S., BIRIȘ, I.-A., 2006 - Habitatele din România. Modificări conform amendamentelor propuse de România și Bulgaria la Directiva Habitate (92/43/EEC), Ed. Tehnică Silvică, Bucureşti.

GAFTA, D., MOUNTFORD, O. (coord.), 2008 - Manual de interpretare a habitatelor Natura 2000 din România, Ed. Risoprint, Cluj-Napoca,

FAUR, F.M., COSTE, I. (coord.), 1998 – Flora și vegetația din întreprinderea piscicolă Timișoara, Lucrare de diplomă, Universitatea de Științe Agricole și Medicină Veterinară a Banatului Timișoara, Facultatea de Agricultură, specializarea Biologie-Științe agricole, 48 p.

GRIGORE, S. 1971 – Flora și vegetația din interfluviul Timiș-Bega, Teză de doctorat, Institutul Agronomic Ion Ionescu de la Brad, Facultatea de Agronomie, Iași.

LENGYEL, G., 2015 - A vadászerdei m. kir. külső erdészeti kísérleti állomáshoz tartozó Vadászerdő,

[8] https://adt.arcanum.com/ro/, https://maps.arcanum.com/en/

Bisztra és Hidasliget erdőrészek növényzete, Erdészeti Kísérletek, XVII, pp. 175-233.

MUCINA, L., BÜLTMANN, H., DIERSSEN, K., THEURILLAT, J.-P., RAUS, T., ČARNI, A., ŠUMBEROVÁ, K., WILLNER, W., DENGLER, J., GAVILÁN GARCÍA, R., CHYTRÝ, M., HÁJEK, M., DI PIETRO, R., IAKUSHENKO, D., PALLAS, J., DANIËLS, F.J.A., BERGMEIER, E., SANTOS GUERRA, A., ERMAKOV, N., VALACHOVIČ, M., SCHAMINÉE, J.H.J., LYSENKO, T., DIDUKH, Y.P., PIGNATTI, S., RODWELL, J. S., CAPELO, J., WEBER, H. E., SOLOMESHCH, A., DIMOPOULOS, P., AGUIAR, C., HENNEKENS, S. M., TICHÝ, L., 2016 - Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. Applied Vegetation Science. Wiley, vol. 19, supp.1, pp. 3-264.

PACKER, J.G., MEYERSON, L.A., SKÁLOVÁ, H., PYŠEK, P., KUEFFER, C., 2017 - Biological Flora of the British Isles: Phragmites australis, Journal of Ecology, 105, pp. 1123–1162. doi: 10.1111/1365-2745.12797

POPESCU, P.C., SAMOILĂ, Z.A., 1962 – Ghid geobotanic pentru Banat, Elaborat cu prilejul excursiei celei de a IV-a Consfătuiri de geobotanică, organizată de Secția de Botanică a Societății de Științe Naturale și Geografie din R.P.R., în Banat, între 21-31 iulie 1962, București, p. 65.

SÂRBU, I., ȘTEFAN, N., OPREA, A., 2013 – Plante vasculare din România. Determinator ilustrat de teren, Ed. Victor B. Victor, București.

ȘTEFĂNUȚ, S., 2008 – The hornwort and livewort atlas of Romania, Ars Docendi - Universitatea din București, București, p. 261.

TŐKÉS, L., 1905, Enumeratio plantarum vascularium ad Temesvár (Hungária,comit. Temes) sponte crescentium et frequentius cultarum, Természettudományi Füzetek, A Délmagyarországi Természettudományi Társulat Kolonel. XXIX. Évfolyam, 2. Füzet, pp. 7-49.

ZSÀK, Z., 1916 - Adatok Temesvár környéke edényes növényzetének ismeretéhez, Magyar Botanikai Lapok, XV, No. 1/5, pp. 66-75

ANNEX 1

Assessment of ecosystem services (according to CICES v. 5.1. typology) in the study area.

Ecosystem services class	Ecosystem services code	Quantitative importance
Cultivated terrestrial plants (including fungi, algae) grown for nutritional purposes	1.1.1.1	+
Fibres and other materials from wild plants for direct use or processing (excluding genetic materials)	1.1.5.2	+
Wild animals (terrestrial and aquatic) used for nutritional purposes	1.1.6.1	+
Surface water for drinking	4.2.1.1	+++
Surface water used as a material (non-drinking purposes)	4.2.1.2	++
Freshwater surface water used as an energy source	4.2.1.3	+++
Ground water (and subsurface) used as a material (non-drinking purposes)	4.2.2.2	+
Bio-remediation by micro-organisms, algae, plants, and animals	2.1.1.1	+++
Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals	2.1.1.2	+++
Smell reduction	2.1.2.1	++
Noise attenuation	2.1.2.2	++
Visual screening	2.1.2.3	++
Control of erosion rates	2.2.1.1	+++
Buffering and attenuation of mass movement	2.2.1.2	+
Hydrological cycle and water flow regulation (Including flood control, and coastal protection)	2.2.1.3	++
Wind protection	2.2.1.4	+
Fire protection	2.2.1.5	+
Pollination (or 'gamete' dispersal in a marine context)	2.2.2.1	+++
Seed dispersal	2.2.2.2	+++
Maintaining nursery populations and habitats (Including gene pool protection)	2.2.2.3	+++
Pest control (including invasive species)	2.2.3.1	+
Disease control	2.2.3.2	+
Weathering processes and their effect on soil quality	2.2.4.1	+
Decomposition and fixing processes and their effect on soil quality	2.2.4.2	++
Regulation of the chemical condition of freshwaters by living processes	2.2.5.1	+++
Regulation of chemical composition of atmosphere and oceans	2.2.6.1	+++
Regulation of temperature and humidity, including ventilation and transpiration	2.2.6.2	+++
Characteristics of living systems that that enable activities promoting health, recuperation or enjoyment through active or immersive interactions	3.1.1.1	+++
Characteristics of living systems that enable activities promoting health, recuperation or enjoyment through passive or observational interactions	3.1.1.2	+++

Ecosystem services class	Ecosystem services code	Quantitative importance
Characteristics of living systems that enable scientific investigation or the creation of traditional ecological knowledge	3.1.2.1	++
Characteristics of living systems that enable education and training	3.1.2.2	+++
Characteristics of living systems that are resonant in terms of culture or heritage	3.1.2.3	++
Characteristics of living systems that enable aesthetic experiences	3.1.2.4	++
Elements of living systems that have symbolic meaning	3.2.1.1	++
Elements of living systems used for entertainment or representation	3.2.1.3	++
Characteristics or features of living systems that have an existence value	3.2.2.1	+
Characteristics or features of living systems that have an option or bequest value	3.2.2.2	+
Dilution by freshwater and marine ecosystems	5.1.1.1	+
Mediation by other chemical or physical means (e.g. via Filtration, sequestration, storage or accumulation)	5.1.1.3	+
Natural, abiotic characteristics of nature that enable active or passive physical and experiential interactions	6.1.1.1	++