

OVERVIEW OF THE FLORA AND VEGETATION OF THE HUNGARIAN BODROGKÖZ

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Tuba, Z. (1995): Overview of the flora and vegetation of the Hungarian Bodrogeköz. - Tiscia 29, 11-17.

Abstract. This paper presents an overview of the flora and vegetation of Bodrogeköz, Hungary. A brief introduction to the physical geography of the region is followed by a floristic account, a brief summary of the bryophyte flora and a list of protected, rare and/or endangered vascular species of the region. Of the flowering plants the mountain woodland herbaceous species, which very rarely occur in the Hungarian Plain, are of special interest. The list of protected or locally important plants contains species which are not under protection in Hungary, but are enlisted in the Red Data Book of the International Union for Conservation of Nature (IUCN). The abundant occurrence of *Trapa natans*, *Salvia natans*, *Marsilea quadrifolia* and *Stratiotes aloides* makes Bodrogeköz a conservation area of international importance. The flora listing is followed by the description of the associations with an emphasis on the woodland formations.

Key words: *Samicum*, flora, bryophytes, vascular plants, protected plants, plant communities, woodland formations.

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Introduction

This paper is an overview of the flora and vegetation of the Bodrogeköz, Hungary. There is a dearth of vegetation data from the Bodrogeköz. Those published are either restricted to two localities, Bodrogekzug (at Tokaj) and Long-erdő, or are of short notes (Chyzer, 1905; Margittai, 1927; Kiss, 1939; Simon, 1950; Dévai, 1971, 1972-73, 1975; Fintha, 1994).

The history of botanical research in the Bodrogeköz will be dealt with in a separate paper because of the outstanding botanical interest of the Long-erdő and because the Bodrogeköz area as a whole has never been dealt with on its own merit. Three of the botanists, Antal Egey, who first reported the existence of the Long-erdő; Hargitai (1938), who first described the plant communities of the Long-erdő; and Bodrogeközy (1962, 1990), who reported the non-wooded vegetation formations in the Bodrogekzug, need mentioning here.

The description of the physical geography of the area is followed by a floristic account. First, a brief summary of the bryophyte flora is presented then rare or endangered species or species of outstanding

botanical interest are discussed. This is followed by the description of plant communities of which the woodland formations are discussed in detail. Except for the Long-erdő the woodland formations of the region were exclusively investigated by the author of the present paper. Observations of the importance for conservation are also presented. Separate papers will discuss the vegetation of the Bodrogeköz in detail.

The geomorphology, climate, soils and hydrography of the Bodrogeköz

The area called Bodrogeköz (Fig. 1) is the alluvial plain of the rivers Bodrog and Tisza (Borsy, 1969). The plain is covered by Holocene alluvial sand, silt, and clay. The areas near to the banks of the river are mostly sandy as opposed to the central areas which are on deposits of finer particle size with Pleistocene sand islands at Tiszakarád, Cigánd, Révleányvár and Zemplénagárd.

The climate is moderately warm and dry with cold winters (Péczely, 1969). Summers are warm with cooler temperatures in the north-east. Average mean monthly temperature in July is 19.5 (W) - 21

(NE) °C, and -3.5 °C in January. Winter is cold, the number of winter days is high (35-40). Snow lies for 29-35 days. The growing season starts in late spring. Predominant wind direction is northeast to southwest. Total annual precipitation is 550-600 mm with June as the wettest month (65-75 mm) and January as the driest one (18-35 mm). The second peak in precipitation in the autumn is negligible. In early spring, the Bodrogeköz is one of the driest areas in Hungary. Average annual water deficit is 75-100 mm.

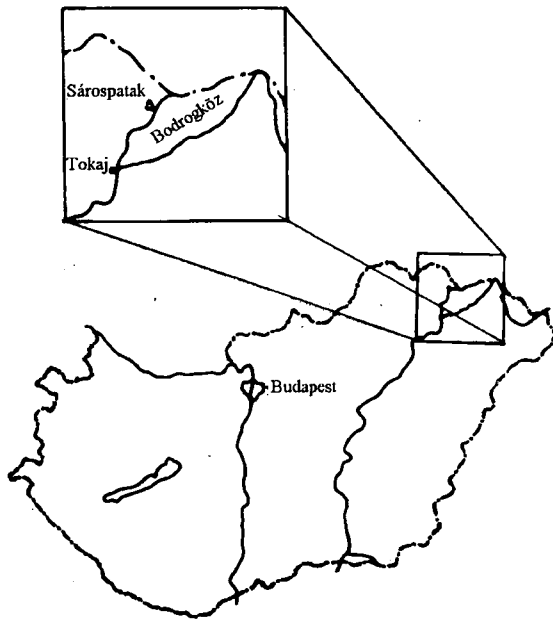


Fig. 1. Situation of the Hungarian Bodrogeköz.

The young soils of the alluvial plain are low in humus content and contain no calcium carbonate (acidic) (Stefanovits, 1969). Their physical structure, both macro and micro, and their water conductivity are poor. The soil profiles have iron pans with mobile iron salts. The pH in surface samples is 6.0-6.5; in the subsurface it is about 7.0. The subsoil is often gley, clay and below 1 m depth calcium carbonate may precipitate (Stefanovits, 1969). The central low lying depression of the Bodrogeköz has no direct connection with the bordering rivers and differs considerably from the areas affected by regular flooding by the rivers Tisza and Bodrog. Backwaters of the two rivers are characteristic of the area. The water table is 3 m on average which may drop to 6 m on the alluvial plain. Areas such as Cigánd and Ricse are affected by partial waterlogging causing high salinity of calcium

hydrogen carbonate and sodium hydrogen carbonate type.

The flora of the Bodrogeköz

The plant geographical classification places the Bodrogeköz in the Samicum (North Hungarian Plain) of the Pannonicum (Simon, 1969). The flora is predominantly of European species (Simon, 1969).

Cryptogamic species

No data other than that on the mosses has been collected so far.

Liverworts and mosses

The bryophyte flora of the Bodrogeköz has been enumerated by Tuba and Kis (1995) and Kis and Tuba (1995) following the very limited data (restricted altogether to three species) by Boros (1968). Kis and Tuba (1996) listed more than 60 species of which eleven had rarely been reported from the Great Plain:

- Brachythecium glareosum* (Spruce) B.S.G.
- Brachythecium mildeanum* (Schimp.) Schimp.
- Bryum caespiticium* Hedw.
- Campylium polygamum* (B.S.G.) C. Jens.
- Dicranum scoparium* Hedw.
- Homalia trichomanoides* (Hedw.) B.S.G.
- Metzgeria furcata* (L.) Dum. var. *ulvula* Nees
- Orthodicranum montanum* (Hedw.) Loeske
- Pterygynandrum filiforme* (Timm.) Hedw.
- Riccia huebeneriana* Lindenb.
- Riccia rhenana* Lorbeer in. K. Müll.

Nomenclature follows Orbán (1991).

Vascular plants

A list of protected (Csapody, 1982), rare or plant geographically interesting species is given below. Other species of interest are woodland forbs which occur there; they will be listed together with the woodland communities. Species which require protection for their local or nation-wide status are being studied and a report on them will be published later.

- Achillea ochroleuca* (*Kitaibeliana* Soó) Ehrl.
- Acorus calamus* L.
- Agrimonia odorata* (Gouan) Mill.
- Alchemilla vulgaris* L.
- Anacharis canadensis* (Rich.) Planchon
- Aster amellus* L.
- Chrysanthemum serotinum* L. *
- Cicuta virosa* L.

Epipactis helleborine (L.) Cr.
Fritillaria meleagris L. (observed in 1977) * *
Gentiana pneumonanthe L. *
Iris sibirica L. *
Marsilea quadrifolia L. *
Nymphoides peltata Ktze. *
Pulsatilla hungarica Soó (observed in 1968)
Silaum silaus (L.) Schinz et Thell.
Sparganium emersum Rehman
Thalictrum flavum L.
Veronica longifolia L.
Wolffia arrhiza L.

where * - potentially endangered; ** - endangered (Németh, 1990). Nomenclature follows Soó (1973).

The waterweeds such as *Trapa natans*, *Salvinia natans*, *Marsilea quadrifolia*, *Stratiotes aloides* deserve highlighting because although not protected these species are listed in Red Data Book of the International Union for Conservation of Nature (IUCN) (see Németh, 1990). This and their abundance in the Bodrogeköz makes them of outstanding conservation value internationally. Their protection can only be ensured by designating their habitat a nature reserve which will also serve to protect the wildlife of the area.

Wetland areas feature prominently in international conservation projects such as for example the Wetland Conservation Program (e.g. Maltby et al., 1992). The Bodrogeköz area should receive much greater attention from local, national and international conservation authorities to recognize its importance for world heritage.

Plant communities

The broad scale of hydrological variation over the area has resulted in a variety of communities.

Aquatic communities

These occur abundantly in the backwaters of the Bodrog (natural and man-made) and in lakes (e.g. Kis-Nádas tó, Nagy-Nádas tó, Kapitány-tó, ó-Bodrog, Füzesér, Törökér, etc.).

Floating aquatic communities

Lemno-Utricularietum

This is the most common aquatic community in the Bodrogeköz. All three Hungarian *Lemna* spp. are represented in places sometimes with abundant *Utricularia vulgaris* growth.

Salvinio-Spirodeletum

This community is characterized by the abundant presence of *Salvinia natans* with *Spirodela*

polyrrhiza in some places.

Marsilea quadrifolia occurs in several places in the Bodrogeköz as part of the rooting aquatic communities.

Hydrochari-Stratiotetum

Both *Hydrocharis morsus-ranae* and *Stratiotes aloides* are abundant in the Bodrogeköz.

Wolffio-Lemnetum

Local and in some places in the southern Bodrogeköz (Bodrogzug) increasing (spreading from the Tiszadob region).

Large pondweed communities

Myriophyllo-Potametum (submerged pondweed community)

with *potametosum natantis*;

potametosum crispi;

polygonetosum amphibii;

potametosum lucentis sub-associations.

Very characteristic of the area is the sub-association dominated by *Potamogeton lucens*. This species only occurs in and along the river Tisza and its community is called *Potametum lucentis* Bodrogeközy 1962 (Hueck 1931).

Nymphaeetum albo-luteae (rooting floating pondweeds)

In the backwaters of the river Bodrog this community often occurs without *Nuphar lutea*. *Hippuris vulgaris* is also present at several localities.

Nymphoidetum peltatae

Rare, mostly with *Trapa natans* forming a transition to the *Trapetum natantis* community.

Trapetum natantis

A very characteristic community which can be a kilometer in extent.

The account of *Magnocaricion* and *Agrostion albae* (tall *Carex* and wet meadow) communities follows to Bodrogeközy (1962, 1990) with additional data from my personal observations.

Reedbeds (*Phragmition*)

Sparganio-Sagittarietum, and

Scirpo-Phragmitetum.

Several sub-associations of the two communities occur in shallow water in lakes and backwaters. Frequent facies are *typhosum latifoliae* et *angustifoliae* and *sparganiosum*. It is noteworthy that the northern Eurasian *Cicuta virosa* also occurs in places.

Rorippo-Oenanthemum aquaticae

Glycerietum maximae

Pure stands of the above are rare.

Sparganio-Glycerietum fluitantis

The *glycerietosum fluitantis* and *agrostetosum stoloniferae* sub-associations of the above community occur in several places.

Small sedge communities (Nanocyperion)

Eleocharito acicularis-Schoenoplectetum supini

This community is most abundant on muddy stretches of river banks, backwaters and waterlogged areas.

Tall sedge communities (Magnocaricion)

These occur in the lake shore zone on the shore edge of reedbeds, or in some cases directly succeed the submerged aquatic zone.

Caricetum gracilis

Three sub-associations of this community occur: *caricetosum vulpinae* with several fen species; *bolboschoenetosum maritimae*; and *caricetosum vesicariae*, a typical tall sedge formation of the Bodrogeköz. This latter forms a transition to the *Caricetum acutiformis-ripariae* community.

Caricetum acutiformis-ripariae

Occurs abundantly in the Bodrogeköz.

Caricetum elatae

This community is nationally rare and occurs in the northern parts of the Bodrogeköz.

Caricetum inflato-vesicariae

A remnant of the old fen sedge vegetation.

Wet meadow communities (Agrostion albae)

Alopecuretum pratensis

The *agrostetosum albae* and *normale* sub-associations (facies *potentillosum reptantis*; *ranunculosum reptantis*; *trifoliosum reptantis*; and *poetosum reptantis*) grow over large open areas.

Lolio-Alopecuretum

Lolio-Potentilletum

These communities occur on pastures affected by seasonal flooding.

Salicetum cinereae fragments occur frequently as remnants of the earlier fen vegetation.

Weed communities

They are rich and varied. Several communities described at more southerly localities along the banks and seasonally flooded plains of the river Tisza (Timár, 1950) are present in the Bodrogeköz. There are some communities of interesting species composition which occur mainly along the river Bodrog. Recently, the abundant spread of *Asclepias syriaca*, *Ambrosia elatior*, and *Echinochloa crus-galli* has been noted.

River bank willow carr (Salicetum triandrae)

These occur on or near to river banks. Their canopy height is about 1-4 m; canopy dominants are *Salix triandra*, *S. viminalis*, and *S. alba*. Characteristic climbers are *Calystegia sepium* and *Echinocystis lobata*. The herb layer is mostly of *Rubus caesius*, *Phragmites communis*, *Lycopus europaeus* and *Rorippa austriaca*. *Solidago gigantea* is more frequent by the river Bodrog than along the Tisza. In places, a transitional form into the open willow-poplar gallery forest is apparent.

Willow-poplar gallery forest (Salicetum albae-fragilis)

The species composition of the above forest type in the Bodrogeköz is that of the *Salicetum albae-fragilis tibiscense* regional variant of the *Salicetum albae-fragilis hungaricum* Soó association. This is the most common community in the Bodrogeköz. It is usually found within a band 10-100 m wide flanking the river banks. The most extensive stands are at the confluence of the Bodrog and Tisza, and along the two rivers.

The soil is mostly compacted silt, or muddy sand which becomes periodically flooded. The average canopy cover is 50-75% which may reach 80-85% in older stands. Average tree height is 12-15 m. The shrub layer is about 1-5 m in height and its cover may vary between 2-30%. Natural regeneration of the trees is negligible. The ground cover is dense (80-100%) with an average height of 20-80 cm.

In some localities *Populus nigra* dominates the canopy (*P. nigra* consociation) with *Lycopus exaltatus* as the differential species. *Vitis riparia* is always present in great abundance while there is no *Glycyrrhiza echinata*. *Oenanthe banatica* and *Cornus sanguinea* are also absent in this community sometimes. This latter is in contrast with the open willow-poplar gallery forests in Szatmár-Bereg. The following facies occur: *Rubus caesius* (most frequent); *Echinocystis lobata*; *Lysimachia nummularia*; and *L. vulgaris*. This community usually forms an open canopy with thin

undergrowth, which is unfavourable for vegetation succession.

The percentage distribution of the flora elements is: Eurasian 62.4%; European and adventive 9.4% each; and continental 6.2%. The hemicryptophyte life form is the most frequent followed by the phanerophyte.

Ash-elm forests (Fraxino pannonicae-Ulmetum)

Ash-elm forests occur on higher ground in the Bodrogeköz. The average canopy cover is 70-80% or more. The dominant species in the canopy are *Quercus robur*, and to a lesser extent *Ulmus laevis* and *Populus nigra*. Trees in the upper canopy are 10-15 m high; the lower canopy is formed by *Ulmus* and *Quercus*. In the north-eastern parts of the Bodrogeköz *Fraxinus angustifolia* ssp. *pannonica* is frequent also. The shrub layer sometimes also consists of a taller and a lower layer with *Quercus robur*, *Crataegus oxycantha*, *Ulmus laevis*, *Cornus sanguinea*, *Euonymus europaeus*, *Corylus avellana*, *Ligustrum vulgare*; at the edges of the woodlands *Prunus spinosa* and *Rosa canina* as the most frequent species. The average cover of the shrub layer is 20% and its height is 1-5 m. At the edges, the climber *Vitis riparia* is characteristic.

The 20-40 cm tall herb layer covers about 30% of the forest floor with large patches completely devoid of ground cover. Characteristic facies are: *Rubus caesius* and *Convallaria majalis* with the former prevailing in most stands indicating wet soil conditions.

The ash-elm forests of the Ricsé region are of outstanding importance. They have two sub-associations: *circaeetosum* and *asperuletosum*. The facies in the wet *circaeetosum* sub-association are: *Circaea lutetiana*, *Stachys silvatica*, and *Cephalaria pilosa*; in the mesic *asperuletosum*: *Asperula odorata*, *Aegopodium podagraria*, and *Viola mirabilis*. Where the stands are more open *Brachypodium silvaticum* occurs in great abundance (*Brachypodium silvaticum* facies; *brachypodietosum* sub-association). The *Urtica dioica* facies is of secondary origin. Although *Cornus sanguinea* occurs persistently it does not form a sub-association in the Bodrogeköz, nor in the Northern Great Plain (Simon, 1957). In northern north-eastern regions *Fraxinus angustifolia* ssp. *pannonica* forms a consociation where it dominates the canopy.

The percentage distribution of the flora elements is: Eurasian 34%; European 21%; sub-Mediterranean (Euro-Mediterranean) 12%; and cosmopolitan and adventive 2%. The most common life forms are phanerophyte and hemicryptophyte.

The area these communities cover today is only a fraction of that in earlier days which is evident from the examination of historic maps (Kiséry, 1935; Hanusz, 1980). The cause of the reduction of the oak forests was mainly felling. More recently the oak gallery forests have been replaced by subsidized hybrid poplar plantations and some of the native willow-poplar forests were clear-felled. For the existing oak forests the rise in the water table following construction of the dams on the Tisza are causing noticeable changes in the species composition of the ground flora. The ground flora is generally impoverished and species characteristic in the willow-poplar forests and in the tall sedge communities are appearing apparent in older oak stands (*Lysimachia vulgaris*, *Lycopus europaeus*, *Scutellaria galericulata*, *Carex riparia*, *C. gracilis*, *Euphorbia palustris*). These changes certainly differ between topographies of stands; it is for example more noticeable in low lying oak woods at Bodrogekertesztúr than in the stands on higher ground at Bodrogolaszi. The effects are more pronounced in the spring when spring geophytes are becoming rare or absent even from the oak woods. Altogether the changes in the hydroecology of the area are causing a shift in species composition and species with higher tolerance to high water table are replacing the original oak gallery forest species. Such is the case for the lily of valley (*Convallaria majalis*), for example, which is giving way to *Rubus* and in places to *Carex* spp.; *Cornus sanguinea* is also being unfavourably affected.

The non-forested areas in the periodically inundated areas of the river valleys were covered by pastures and wet meadows about twenty years ago; today tall sedge communities grow there. The *Convallaria*-type oak forests, though classified together with the ash-elm forest, have a special character and they are similar to the oak forests at Sajólád (Ujvárosi, 1941) and Tiszadob (personal observation). This type therefore should receive special attention. It is suggested that these forests should be left unmanaged and bands of a mix of native species should be planted around them as buffer areas. Also, the native willow-poplar stands should be left to nature to work its succession there.

Noteworthy species in the oak forests are: *Epipactis helleborine* and in clearings *Gentiana pneumonanthe* in great numbers. In the open forest edges *Chrysanthemum leucanthemum* grows. This species also occurs at the edges of willow-poplar forests.

Hornbeam-oak mixed woodlands (Quercus petraeae-Carpinetum)

Their best example in the Bodrogek is the Long-erdő near to the confluence of the river Ronyva and the Bodrog (Hargitai, 1938). In other locations in the north and north-east (Ricse, Révleányvár) there are some remnant small stands which are however rather degraded.

The original area of the Long-erdő was much bigger than that at present day which cover the area between Vajdáciska and Végardó at Sárospatak (Kiséry, 1935; Hanusz, 1980). This forest is outstandingly unique in its species composition. The forest which lies at 90-95 m a.s.l. has a large number of hornbeam and also some beech trees. They probably represent a periglacial beech forest relict which could survive in the relatively cool climate there. The forest is a mosaic of few hornbeam-beech (at Nagykökényes erdő), some hornbeam-oak, and numerous and larger oak (*Quercus robur*) patches.

The ground flora is similar to the sub-montane hornbeam-oak forests with a number of montane species such as *Carex pilosa*, *Majanthemum bifolium*, *Circaea lutetiana*, *Galeopsis speciosa*, *Aegopodium podagraria*, *Heracleum sphondylium*, *Asperula odorata*, *Dentaria bulbifera*, *Ranunculus cassubicus*, *Sanicula europea*, *Euphorbia amygdaloides*, and *Campanula trachelium*. Some of these species also occur in the ash-elm forests in the north-east Bodrogek. The forest at Long-erdő gives way to alder and willow at lower elevation and the above species disappear there. Recently some of the forests were clear-felled!

Alder fens

They are relatively few in the Bodrogek. In the north east (Zemplénagárd), the *Carex acutiformis-C. riparia* type occurs. Another type is the mesophile alder fen with a ground flora largely similar to that in the ash-elm forests. Some stands have been dying recently.

Oak woodlands

A number of transitional types of the dry to wet oak woods on sand occur, mostly in small and degraded overgrazed groves.

Robinia plantations

Their types range from the dry to the wet and occur all over the area.

Sandy meadow grasslands

This vegetation type occurs on sand hills, non-cultivated sand patches (e.g. Budahomok, Dámoc). The stands are mostly degraded and of secondary

origin. *Festuca vaginata*, the dominant species of the characteristic *Festuco-Corynephorum* on acid sand, only survives in few locations (Simon, 1969). Some characteristic species of these stands are: *Pulsatilla hungarica*, *Helichrysum arenarium*, *Achillea ochroleuca*, *Chondrilla juncea*, *Gypsophila paniculata*, *Sedum sexangulare*, the moss *Tortula ruralis*, and the lichens *Cladonia convoluta* and *C. magyarica*.

Acknowledgement

This work was funded in 1980-84 by the Tisza Research Committee (Szeged) and by the Hungarian Scientific Research Foundation (OTKA 5337, Ecology Dept. of József Attila University, Szeged, Hungary). I am very grateful to Dr. Gy. Bodrogek for his encouragement and advice. I wish to thank Professors Gábor Fekete and Michael F. C. Proctor for their useful comments on the manuscript.

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