


Vegetation of the Biosphere Reserve "Danube Delta"

with Transboundary Vegetation Map

<p>Ministry of Waters and Environment Protection</p>  <p>Danube Delta Biosphere Reserve Authority</p>	<p>National Academy of Sciences of Ukraine</p>  <p>The Ukrainian Danube Delta Biosphere Reserve</p>
 <p>Danube Delta National Institute</p>	 <p>M.G. Kholodny Institute of Botany</p>



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Preface

This report is the result of a cooperation between Romanian, Ukrainian and Dutch scientists, with a big interest in the ecology of temperate wetlands. In 1998, the project team was formed between the Danube Delta National Institute in Tulcea, the Ukrainian Danube Delta Biosphere Reserve Authority in Vylkove, the M.G. Kholodny Institute of Botany in Kyiv and the Dutch Institute for Water Management and Waste Water Treatment/RIZA in Lelystad.

In June 1998, an agreement was made by the Romanian, Ukrainian and Dutch partners to produce a transboundary vegetation map of the Danube Delta Biosphere Reserve together. This map should contain also aspects of geomorphology and water quality. The project team worked together in the period from June 1998 until December 2002 with a pauze in 2000 en 2001.

For the Romanian Danube Delta Biosphere Reserve a vegetation map with report (in English) was produced already in 1994. In the Ukrainian part of the Danube Delta also lots of vegetation surveys were already carried out. Within the cooperation the Romanian counterparts have integrated the Ukrainian part into the GIS-system.

In April 1999 the draft of the legend of the map was completed. In summer 1999 a field trip was carried out to check the gathered information and to make sure that the same vegetation associations are belonging to the same legend unit. In 2000 the decision was made to postpone the production of the map and the report to 2002 due to financial shortages.

The transboundary project team



Now, at the end of 2002 we present the printed map with report for the Biosphere Reserve "Danube Delta". We hope that this first transboundary

product will contribute to further co-operation at least between the two neighbouring countries although the last political changes of Romania being an EU candidate state and Ukraine is not.

The report with map outlines once more the natural values of the Danube Delta and can help for instance scientists and decision makers in questions on monitoring and finding the right sites/areas for carrying out restoration measures.

1 Introduction

Since 1991 the Romanian Danube Delta (Figure 1.1) and the adjacent shallow part of the Black Sea have the status of Biosphere Reserve (total surface area inclusive water is 580,000 hectare). The Biosphere Reserve is administrated by the Danube Delta Biosphere Reserve Authority, which belongs to the Ministry of Waters and Environment Protection. In the Danube Delta, research is mainly carried out by the Danube Delta National Institute (DDNI), an autonomous organisation belonging to the

Figure 1.1
Danube Delta: topographical names and positions of cross sections presented in the figures 5.1 to 5.6



same Ministry. The Danube Delta Institute is the Romanian counterpart in this cooperation.

In Ukraine, the protection of the Danube Delta wetlands was started in 1976 by the establishment of the Chornomorski (Black Sea) Nature Reserve. In 1981, the Nature Reserve "Dunaiski Plavni" with a surface of 14,851 hectares was established. In 1998 a next step was made for the extension of the Ukrainian Danube Delta Biosphere Reserve. The reserve until today comprises 46,402 hectares (inclusive water of the Black Sea). The administrative organisation in charge of this Biosphere Reserve is the Ukrainian Danube Delta Biosphere, belonging to the National Academy of Sciences of Ukraine.

The Dutch Institute for Inland Water Management and Waste Water Treatment (RIZA) is a specialised institute of freshwaters belonging to the Directorate General of the Ministry of Water Management, Transport and Public Works. The Rhine Delta and its related wetlands are RIZA's main working areas. RIZA has the responsibility to protect people in the area from flooding and to take care of the water quantity and quality. RIZA is the Dutch counterpart in this cooperation of the transboundary vegetation map.

2 Abstract

The natural marsh vegetation and aquatic vegetations are the most widespread ones in the Danube Delta. The vegetation cover of these vegetations is 398,676 ha, of which 362,965 ha in the Romanian part and 35,711 ha in the Ukrainian part on the printed map.

The vegetation units were mapped at various scales (see chapter 4) and are combined on to a map at approx. 1:140,000 scale. These vegetation units (inclusive water areas cover about 544,491 hectares, of which 500,670 ha in the Romanian Danube Delta and 43,821 hectares in the Ukrainian Danube Delta.

The work was carried out in the framework of the scientific cooperation between the Romanian Danube Delta National Institute, the Ukrainian Danube Delta Biosphere Reserve Authority and the Dutch Directorate General for Public Works and Water Management. The aim of this product was to update the vegetation map printed in 1994 and to extend the map to the whole territory of the Biosphere Reserve "Danube Delta".

The vegetation map of the Danube Delta Biosphere Reserve is a combination of the Danube Delta vegetation map printed in 1994 (Hanganu *et al.*, 1994), the vegetation map of the Somova-Parches and Chituc area (Hanganu *et al.*, 1996) and the vegetation map of the Ukrainian territory of the Danube Delta (Dubyna, 1984; Dubyna & Zhmud, 1999). Some legend units (fish ponds, agricultural land, forest) of the vegetation map from 1994 which were treated as large polygons are now given in detail. The classification of the lakes based on trophic state was an important issue. For the classification remote sensing and field data (water depth, transparency, color, suspended solids, chlorophyll concentration, water-plant density and depth of occurrence) have been used.

Floating aquatic vegetation of White Water- lily (*Nymphaea alba*) and Yellow Floating Heart (*Nymphoides peltata*).



All legend units have been integrated into one legend (see chapter 8) of the Transboundary Vegetation Map. The integration has been made after a field visit in which the Romanian and Ukrainian specialists made sure that the same vegetation associations are covering the same legend units (Menke, 1999).

The objectives of the map production can be described as following:

- 1) ecological purposes (as distribution of plant communities and habitat differentiation e.g. for water birds),
- 2) economical purposes (as reed productivity, forest assessment and grassland assessment),
- 3) socio-economic purpose to create an example for a good cooperation work between the neighbour states of Ukraine and Romania.

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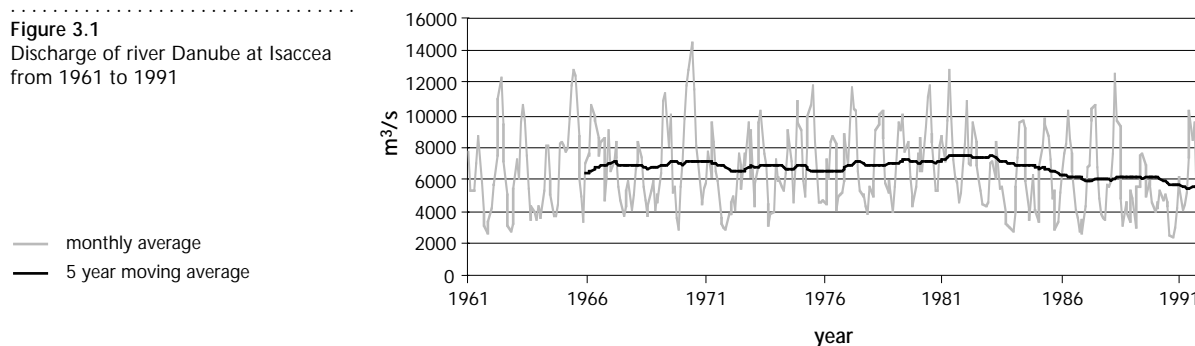
3 Geographical Framework

3.1 Facts and numbers

The Danube Delta is located in the eastern part of Europe and shared by two countries: Romania and Ukraine. The Danube, the second largest river in Europe, builds its delta at the first bifurcation of the river nearby the town of Izmail, where the river divides into two branches. 10 km downstream, east of Tulcea, the southern branch splits into the Sulina and Sf. Gheorghe branches, while the northernmost branch is named Chilia.

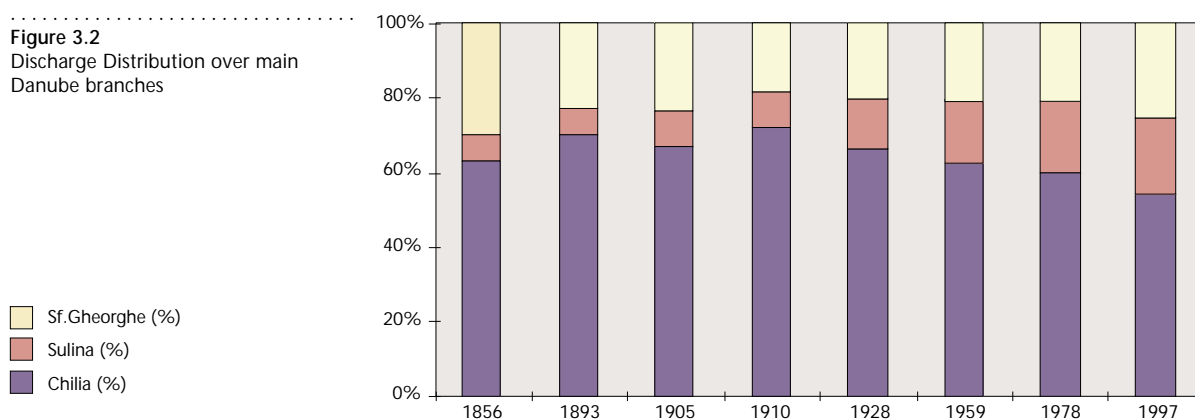
The total area of the Biosphere Reserve "Danube Delta" is about 5800 km² in Romania and more than 46 km² in Ukraine. In the Romanian part, this includes also the upstream Danube floodplain of Tulcea-Isaccea and the Razim-Sinoe lagoon complex. Not included in the vegetation map are the marine waters up to the 20 metres isobaths in the Black Sea.

Figure 3.1
Discharge of river Danube at Isaccea from 1961 to 1991



The river Danube has quite a regular discharge pattern. An example of the discharge at the city of Isaccea is shown in figure 3.1 in which the 5-year moving average shows little variation. The highest discharges occur in spring, the lowest in autumn. The discharge distribution of the three Danube branches changed during the last 150 years (see figure 3.2). Up to 1910 the Chilia branch was getting more water instead of the Sf. Gheorghe branch. Due to canalisation works in the Sulina and the

Figure 3.2
Discharge Distribution over main Danube branches



Sf. Gheorghe branches, the discharges in these branches increased on the cost of the Chilia branch (Oosterberg *et al.*, 2000).

The annual sediment transport has been changed significantly during the last 80 years. In the period from 1981-1990, the average annual suspended sediment discharge was 29,2 million tons (table 3.1).

Table 3.1
Amount of alluvia carried by the Danube at the Delta entrance (Bondar, 1970)

Period	Average Annual suspended sediment discharge	Impact
1921-1960	67,5 million tons/year	Iron Gates dam was built
1971-1980	41,3 million tons/year	
1981-1990	29,2 million tons/year	

The height (surface level) of the Delta nearby Izmail is 3.7 m above sea level and at the mouth of the Sulina Branch it is only 0.5 m. Reed beds occupy about 87% of the area of the delta, with depths reaching 1-2 metres and rarely 3-4 m (Samoilov, 1952). During the spring and summer floods the level of the water exceeds the height of the banks by 1.5 m at the Izmail branching point and by 0.3 m at the seaside. Before the ending many lakes located to the north of the Chilia Branch and to the south of the Sf. Gheorghe Branch would connect during the flooding time with the Danube, so the total flooded area would exceed 4,500 km². Such an area would accumulate about 7 billion m³ of water (Petrescu, 1963). Sediments are deposited along the banks of the main river channels, while inside the islands in the delta suspended material quickly sinks to the bottom because of the lower velocities, so the water becomes almost transparent. In such a way the spring floods sustain the alluvial process, which annually raises the land by 2-3 cm (Banu & Rudescu, 1965). But due to the epirogenetic fluctuations with a general sinking of 2-3 cm in the region (Bertman, 1964; - Banu & Buzeteanu, 1966), the delta seemed to have found an equilibrium.

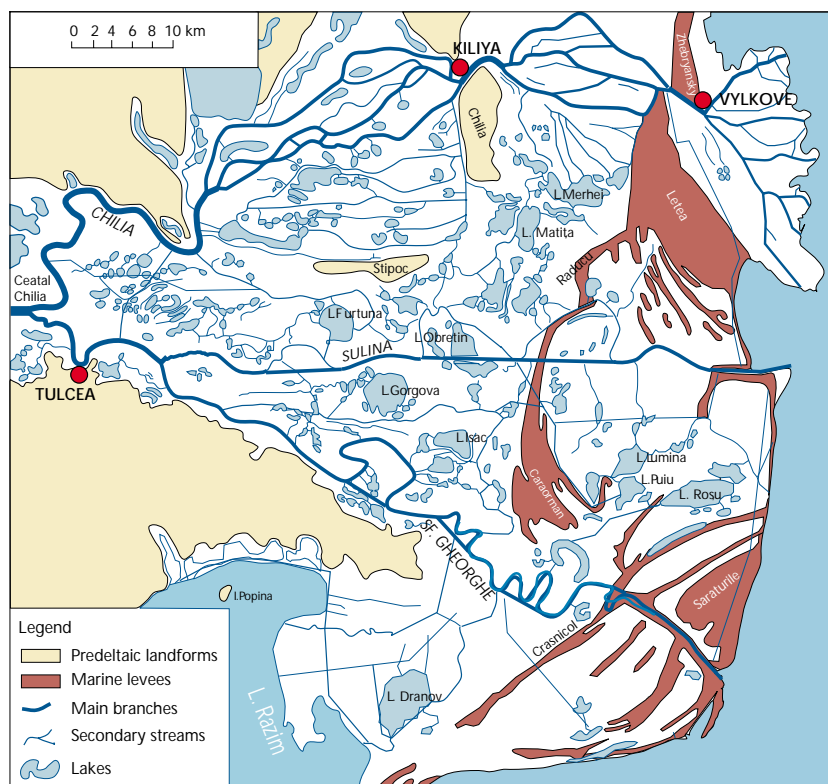
3.2 Main parts and features

Generally, the Danube Delta can be subdivided into two parts: the ancient river part and the fluvio-marine one of recent origin (Figure 3.3, see also the small Geomorphological Map on the printed Transboundary Vegetation Map, annex 1). A strip of coastal ridges built up of marine sand and shells marks the boundary between them.

These are the ridges Zhebryansky, Letea, Caraorman, Sărăturile, Crasnicol and Dranov. The coastal ridge on the seaside follows the eastern, outer edge of islands. In the north, the Chilia Branch has cut its way in between the Zhebrianske and Letea ridges and is building up a secondary delta in the sea.

The delta of the Chilia Branch located downstream from Vylkove is the youngest part of the enormous Danube Delta and the newest natural mainland in Europe. It is about 300 years old, while the age of the coastal strip is much less, not more than 150 years. Certain islands and spits have appeared just recently. The formation of the delta is continuing, however nowadays at a slower pace due to discharge changes as mentioned earlier in this chapter.

Figure 3.3
Morphohydrographic features of the
Danube Delta



3.3 Climate

The climate in the Lower Danube area is continental- temperate, with a short and mild winter, and an enduring and hot summer (Rudesçu *et.al.*, 1965). It is influenced by the circulation of atmospheric masses that appear in distance from one another places - the Atlantic Ocean, the Mediterranean Sea, and Eurasian continent (Diaconu & Iacov, 1963; Petrescu, 1963). According to climatic conditions, the area can be characterised as a hot southern agro-climatic region, where the annual sum of average day temperatures above 10° Celsius. Winters are relatively warm.

The average temperature of January fluctuates between -9 and +5° Celsius, and in June between 22,3-23,0° Celsius (Bilyk, 1977; Gastescu, 1996). The first autumn frosts appear in between the 15th and 30th of October, and the last ones in spring - 10th and 15th of April. Average day temperatures above 10° Celsius appear in spring in between the 12th and 16th of April, and disappear in autumn within the 22nd and 25th of October. The total number of such days is about 170 up to 200 (Shvebs, 1979).

Fresh water in the Danube Delta may be frozen partly in winter. Complete ice cover for long periods, however, is rare. In extreme winter times, the lowest temperatures of about -25 to -27° Celsius were recorded.

The total precipitation consists of 350-400 mm/year, the evaporation being at that 800-1000 mm/year. Such large evaporation should lead to the raising of the ground water, saturated by chlorides and sulphates, and, consequently, to salinisation especially of the humid soils. Salinisation, due to the severe precipitation deficit, however, is observed not everywhere, only in places heavily impacted by man. Salinisation is naturally avoided

by the strong flushing ability of the Danube during the spring, and occasionally, autumn flooding.

The level of water in the Danube and adjacent water bodies depends on seasonal phenomena, primarily the flooding which occurs in March-April. In the coastal area piling up of water due to strong winds plays a significant role.

3.4 Soils

The soils in the Danube Delta are described for the Romanian part by I. Munteanu, 1996. In the Ukrainian part the soils are described by A.I. Nabokikh, 1914.

Histosols, Gley soils, Limnosols, Psammosols & Sands and Alluvial soils are the most common ones. Smaller areas are covered by Solonchaks, Kastonozem and Anthrosols. Soils in combination with vegetation are shown in more detail in the cross sections of chapter 5.

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4 Methodology

4.1 Introduction

Different sources as satellite images, aerial photographs and field checks have been used to derive to the Transboundary Vegetation Map of the Biosphere Reserve "Danube Delta" (Annex 1). Of course, it would have not been possible to cover such a large wetland area without using Remote sensing techniques.

Nomenclature for most plant species follows the Flora Europaea. Nomenclature for vegetation communities and higher syntaxes is based on Oberdorfer (1983) and Doina *et al.* (1993). Nomenclature for soil types follows FAO/UNESCO (1989).

4.2 Vegetation survey and mapping for the Romanian territory

Due to the immense surface to be surveyed (circa 340,000 hectares plus tens of thousands of ha water surfaces), it was clear from the beginning that remote sensing must be used.

The production of the first printed vegetation map was based on aerial photo interpretation, satellite images and verification through field checks (Hanganu *et al.*, 1994).

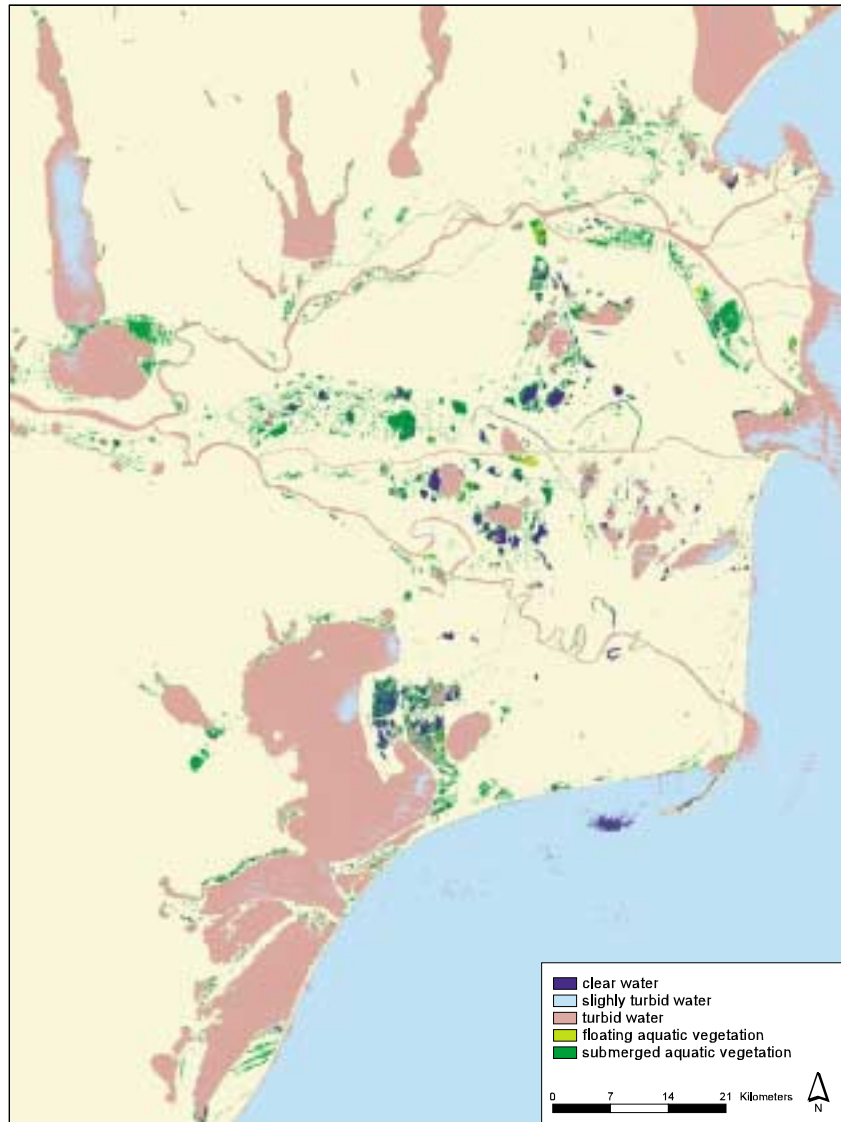
During the field visits, vegetation data were gathered in relevés. The data concerned the floristic composition and the vegetation structure, applying Braun-Blanquet estimates.

The vegetation in the field is often a fine-grained mosaic of very different classification units, that cannot be distinguished on a map at 1:150,000 scale. The legend of the vegetation map (Annex 1) therefore distinguishes specific mosaics of classification units, rather than pure ones.

Most of the photointerpretation was carried out at a scale 1:22,000 up to 1:25,000. Some legend units (fish farms, agriculture land, forest) from 1994 vegetation map treated as large polygons were detailed by the use of photo interpretation of recent (1995, 1996) Landsat TM satellite images. The image of Landsat TM, 6-7-1996, is used as the *information background* for the enclosed Transboundary Vegetation Map.

In the new printed map, special attention is paid to the differences in aquatic vegetation. Using remote sensing data (Landsat TM, 6-7-1996), a supervised classification was made of lake types in the Danube delta by Den Hollander, 1998 and Oosterberg, *et al.* 2000. Land areas were masked using the infrared band, and visual corrections were made a posteriori to account for floating vegetation patches. Eight categories were distinguished based on differences within a number of spectral bands: clear water, less clear water, low suspended matter, medium suspended matter, high suspended matter, algae, floating macrophytes, and submerged macrophytes. In order to reduce the legend units of the map that eight categories were grouped to four: floating aquatic vegetation, submerged aquatic vegetation, sparse macrophytes (clear water) and turbid without macrophytes (silt or algal bloom). A supervised classification is shown in figure 4.1.

Figure 4.1
Supervised classification of waters in
the Danube Delta



The categories were validated using monthly monitoring data from April–November 1996, consisting of hydro-chemical measurements (water transparency, depth, nitrogen, phosphorus, suspended solids, and chlorophyll-a), as well as a qualitative record of the vegetation in the summer of 1996.

A set of vegetation relevés collected in a large number of water bodies between 1993 and 1998 was used to produce a vegetation classification. The data set included lakes, channels and restored (inundated) polders. Abundance of species within each relevé was estimated using a 7-point scale (corresponding with the Braun-Blanquet scale).

The polygons that resulted from the image-interpretation mostly appeared to be small geomorphological units with characteristic vegetation mosaics, often rather homogeneous in vegetation structure. The polygons are usually rather homogeneous in soil type, too. The legend therefore is essentially a combination of (1) vegetation structure, determined by dominant plant species, and (2) soil conditions.

4.3 Vegetation survey and mapping for the Ukrainian territory

Before the cooperation of the transboundary project team has started, the vegetation map of the "Dunaiskie Plavni" Reserve area was made up by D. Dubyna in 1984.

The map was produced based on the visual estimation during the route survey of contours by the parallel movements. The route density was different depending on the vegetation character, and in particular, on the vegetation mosaic. For the mosaic communities, the distance between the routes was 200 m and for other communities it was 1 km.

Fortunately, the production of the vegetation map is based on photo interpretation. The photo interpretation was preceded by the numerous buzzings by the helicopters KA-26 and MI-2 over the mapped territory. The vegetation was mapped at 1:25,000 scale. The photo interpretation was verified through field checks, as well as under laboratory conditions. There was also the schematic vegetation map of the Ukrainian part of the Chilia (Kiliya) Delta of the Danube Delta produced using the method of the key sample plots.

The map produced is floristic by its nature and contains some additional criteria, which reflect specific features of the vegetation of the mapped territory. It differs from other maps by its dynamism and mosaic character. The lowest vegetation units, associations, were distinguished based on the floristic concept taking into account the duration of the flooding period, peculiarities of relief, level of salinisation, eutrophication, and water exchange. Considering that the role of the above factors is manifested in the vegetation of various types in different ways, not all the factors are reflected on the map for all units. The variations of communities degraded as a result of the excessive pasture are given separately. Due to the vegetation mosaic formed under the influence of high dynamism of different environmental factors, authors failed to avoid the isolation of the complex units, which combine different types of vegetation.

The map put forward was produced based on the peculiar features of vegetation with consideration for the habitat conditions, which correspond to the requirements of the modern tendency in the world map history. The indications of life forms were used by the authors when distinguishing combinations at the highest level: seashore dune vegetation, halophilous and semi-halophilous vegetation, psammophilous vegetation, meadow, marsh, forest, and aquatic vegetations. The relief, and ecological conditions, first of all, determine peculiarities of the vegetation of different types in the Danube Delta. For example, shrub and forest vegetations are associated with the seashore and riverside ridges, and run as narrow strips. The main principles of their integration, as well as of the subsequent subdivisions of the legend, include commonness of the vital forms, and ecological proximity of the elements of the same topo-ecological row in describing communities, which occupy only 10% of the area. Generalization of communities was carried out on the principle of going from the lowest rank to the highest one. Ecological conditions of the shrubby and forest vegetations are more diverse than those of the aquatic and marsh vegetations, and are, as a rule, more differentiated. The role of species as edificatory is more pronounced. In this connection, a well-defined group of species mentioned in the legend develops (see annex 2).

The aquatic and marsh vegetations are characterised by the development under constant ecological conditions with a constant water layer. In this connection, the role of edificatory species (with the exception of some species) is less pronounced. Because of this, the group of accompanying

species is fewer in number. Their species composition is conditioned by the ecological peculiarities of ecotopes. The meadow vegetation is mosaic and rather differentiated. The role of species-dominants as edificators is distinct. The halophilous vegetation is represented by communities, which are sporadic in the floristic and cenotic aspects. Their species diversity is scanty. The role of dominant species as edificators is slightly pronounced.

4.4 The making of the Transboundary Map

The Transboundary Vegetation Map is both ecological and floristic by its nature. At the same time, life forms, similarity of ecological conditions, peculiarities of the vegetation formation (diversity, complexity, microzonality) are accounted for in it. Thus, it reflects spatial and temporal peculiarities of the vegetation of the Danube Delta.

The finalisation of the Transboundary Map has been made after lots of discussions. The biggest problems that showed up have been the different scales of the vegetation surveys. Aggregation of polygons seem to be loss of information but finally, it is necessary in order to produce a readable map.

The idea was that there should be really an equilibrated map but that seemed to be not completely possible. A clear difference between the Romanian and the Ukrainian part is still visible while looking on to the printed map. This is mainly due to the comparatively smaller size of polygons in the Ukrainian part.

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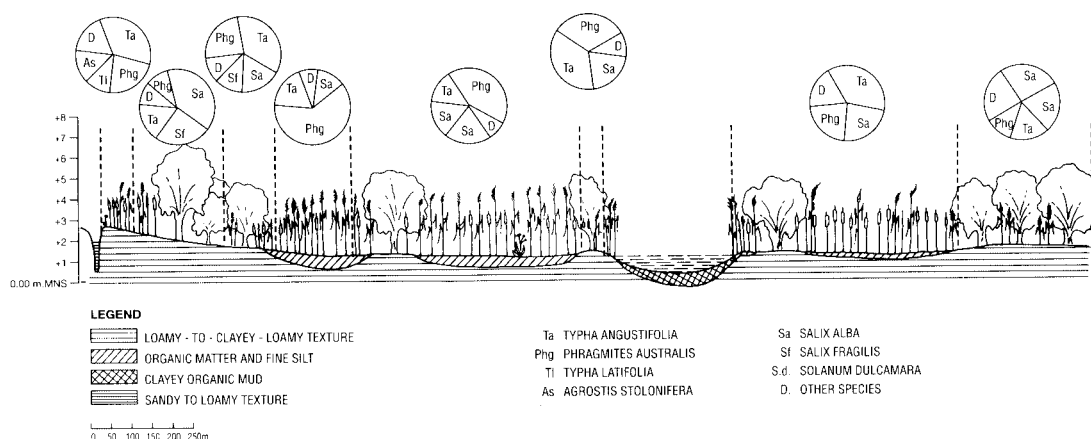
5 Zones of the Danube Delta

Within the Danube Delta, according to its genesis, three major different zones are distinguished. These are the fluvial zone, the transitional zone and the marine zone which have been described by I. Munteanu, 1989 & 1996; Hanganu *et al.*, 1994. Each zone has specific soils, hydrological regimes and vegetation patterns. A general description of these zones is given by cross sections. The main zones can be also identified by looking onto the geomorphological map of the Danube Delta which can be found as a small map on the printed map (annex 1).

5.1 The fluvial zone

The fluvial zone is geomorphologically a river floodplain in the process of being filled up by river sediments. Peat formation is limited to the most isolated parts of the backswamps. A soil-vegetation profile through the fluvial part of the Delta is given in figure 5.1.

Figure 5.1
Cross section in the fluvial zone of the Danube Delta; see figure 1.1 for position of cross section



The Danube branches in the fluvial part of the Delta are accompanied by river levees. The levees separate the summer bed of the river branches from the back swamps behind. During the flooding period (normally from mid-April to mid-June), the vegetation traps the suspended sediments. The greatest amount of sediment, including the coarsest material (fine sand), is trapped very close to the river, that means on the levees. White Willow forest with Ashes and white Poplars is the natural vegetation of the levees.

The tops of the levees are covered by forest or by pasture; both growing on well drained Calcaric Fluvisols. With decreasing elevation this vegetation is replaced by floodplain forest or pasture on Gleyi-Calcaric Fluvisols. In lower parts of the back swamps Reedmace - and Reed marshes grow

on periodically emerged/inundated alluvial Gleysoils. Natural White Willow forests also occur on the edges of silted lakes, in mosaics with Reedmace and Reed marsh.

The river levee vegetation is influenced by human exploitation on many places. Small gardens with corn (Maize) and vegetables are widespread. In areas with wood extraction and cattle grazing, the forest is replaced by pasture. In some places with less intensive land use, this results in pasture with isolated willow trees. In places where only grazing occurs, the tree layer may remain intact, but grassy vegetations replace the marsh-undergrowth.

Water entering the back swamps through marsh vegetation is relatively clear. In that case, the high organic productivity by the marshes in the back swamps, the low sediment input and the long lasting inundation together create the peat layers of histic alluvial Gleysoils. Reed on this soil is very tall (4 - 6m), but almost everywhere mixed with or dominated by Reedmace *Typha angustifolia*. Lakes in the fluvial part of the Delta are small and shallow (0,5 - 0,6 m depth in the dry season). Lake bottoms with mineral sediments emerge almost each summer at the edges of the lakes. Mudflat pioneers that complete their life cycle before the winter starts rapidly colonize these edges.

The natural flooding system has been influenced by man-made channels. The Mila 35 channel, for example, crosses the levee. It causes a strong discharge of sediment-loaded water directly into the back swamps. This results in an increased silting up, during which peat layers are buried under fresh clay sediments and the lakes are filled up extra rapidly. The vegetation reacts to this increased silting-up with an increased dominance by Reedmace over Reed and with an expansion of White Willow forest.

5.1.1 Stentsivsko-Zhebryansky flat (Ukraine)

This riverine flat area is the floodplain, which is left of the Primary Chilia Delta. Big parts of the former floodplain have been totally endiked and have been converted into fish ponds, rice paddles, and other kinds of farm land. The Stentsivsko-Zhebryansky flat has kept its wetland character but its hydrology is completely regulated.

Due to the enbankment and the controlled hydrological regime, the vegetation in this part is not diverse. More than 1/3 of the area is covered in general by the Scirpeto-Phragmitetum complexes. Their main areas occur in the central part of flats. Significant areas are represented by communities of aquatic vegetation with edificators characterised by their wide ecological amplitude - *Ceratophyllum demersum*, *C. plathyacanthum*, *Zannichellia palustris*, *Potamogeton pectinatus*, as well as represented by the riverside aquatic communities - Phragmitetum communis in the complex with Typhetum angustifoliae and fragments of Sparganietum erecti and Scirpetum lacustris. The flat marsh communities, which are nearest to the riverbed of the Danube, occupy insignificant areas. They consist of Scirpeto-Phragmitetum plant communities in the complex with Caricetum gracilis. The plant communities concerned are associated with the eastern part of flats, which was not subjected to the influence of flooding and is widely diverse in floristic composition (including representatives of the boreal flora - *Equisetum palustre*, *Poa palustris*, *Stachys palustris*, *Scutellaria galericulata*, *Ranunculus lingua*, *Orchis palustris*, *Epipactis*

palustris, *Calamagrostis neglectum*). Aquatic plant communities consisting of *Spirodela polyrhiza*, *Lemna minor*, *Salvinia natans*, *Hydrocharis morsus-ranae* followed by *Stratiotes aloides*, *Utricularia vulgaris*, *U. minor*, rarely of *U. intermedia*, and more rarely of *Potamogeton lucens*, *P. perfoliatus*, *Myriophyllum spicatum* and very rarely of *Nymphaea alba* occupy insignificant areas.

Salinised and saline soil plant communities consisting of *Limonium danubiale*, *L. meyeri*, *L. caspium* and other are characteristic of the near-dam sections; they are severely transformed.

Plant communities of the meadow vegetation consist of edificators characterised by wide ecological amplitude typical for the salinised meadows (*Agrostis stolonifera*, *Aeluropus littoralis*, *Puccinellia gigantea*, *Tripolium vulgare*). They are transformed as well as the above communities.

5.1.2 Yermakiv Island (Ukraine) and Babina/Cernovca (Romania)

Vegetation of the Yermakiv Island - river island - develops under conditions of regulated flooding regime and excessive pasture load, in particular, in its northern part. Scirpeto-Phragmitetum marsh communities accompanied by *Caricetum acutiformis*, which occupy sections with the prevailing prolonged flooding period. Scirpeto-Phragmitetum plant communities accompanied by *Bolboschoenetum maritimi* growing in the sections with the less prolonged flooding period compared to above sections occupy significant areas. The peripheral parts are represented by communities of hygrophytes with dominance of *Glyceria maxima*, *Butomus umbellatus*, *Schoenoplectus lacustris*, *Alisma plantago-aquatica*, *Agrostis stolonifera*, *Ranunculus (Batrachium) aquatilis*. In the shallow waters, plant communities with dominance of *Salvinia natans*, *Spirodela polyrhiza*, *Lemna minor*, *L. trisulca*, as well as of *Aldrovanda vesiculosa* (a relict species listed in the Red Data Book of Ukraine, see chapter 10) occupy significant areas. Sometimes *Azolla caroliniana* and *A. filiculoides* intensively develop there.

The marsh meadow plant communities occupy more elevated territories and are represented by the communities with *Caricetum gracilis* accompanied by *Caricetum acutiformis*, fragments of *Calamagrostidetum epigeios* and *Phalaroidetum arundinaceae* (lowered sections) and by the mixed thickets consisting of *Galega officinalis*, *Trifolium fragiferum*, *Arctium lappa*, *Lycopus europaeus*, *Althaea officinalis*, *Equisetum ramosissima*. Plant communities with dominance of *Calamagrostidetum epigeios* accompanied by *Agrostio giganteae* - *Festucetum pratensis* complex and fragments of *Caricetum gracilis*, as well as by the mixed thickets with dominance of *Galega officinalis*, *Trifolium fragiferum*, *Xanthium albinum*, *Althaea officinalis*, *Arctium lappa*, *Carduus acanthoides*, *Matricaria perforata*, occupy lesser areas compared to the above sections.

The near-dam and hilly sections are occupied by the communities consisting of *Hordeum murinum*, *Polygonum aviculare* s.l., *Lepidium draba*, *Arctium lappa*, *Artemisia vulgaris*, *Potentilla argentea*, *Xanthium spinosum*, *Onopordum acanthium* and other species. In those plant communities, a quarantine weed *Solanum cornutum* is widespread.

Riverside sections adjacent to rivers are occupied by the communities of floodplain-forest vegetation (*Salicetum albae* accompanied by the *Salicetum triandrae* and *Amorpha fruticosa* community and fragments of *Phalaroidetum arundinaceae*). Marsh-meadow communities grow in swampy areas.

.....
Transition zone of grassland between
the Letea forests and Popina area with
halophilous vegetation

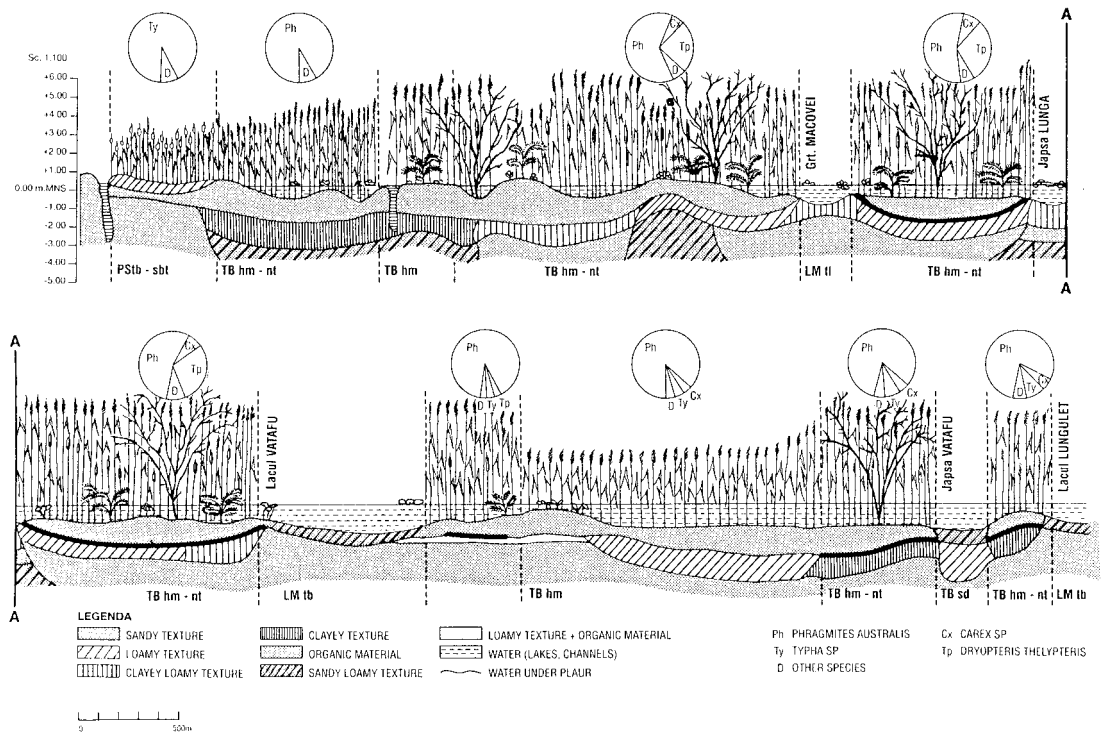


The river islands of Babina and Cernovca of the Romanian territory are part of a ecological restoration programme. On the vegetation map clear differences in the river islands compared to Yermakiv island can be seen. Babina is again under influence of the river Danube due to four openings in the dikes which were made in 1994. The vegetation patterns have changed as can be seen by comparison with the island Cernovca. The island Cernovca was also part of a restoration programme. The works, two openings in the dikes were carried out in 1996. The vegetation has been changed already compared to the published map. A regular flooding has solved the problem of salinised soils in this area. After (re-)connecting the area to the natural flood pulse of the river Danube, the vegetation succession has started with *Sparganium neglectum*, *Scirpus lacustris* and *Typha angustifolia* on intermediate elevated areas and *Phragmites australis* in deeper water. Lakes themselves were getting colonised by *Typha angustifolia*, *Nuphar luteum*, *Nymphaea alba* or *candida* but after 3-4 years of natural flooding regime *Phragmites australis* has become dominant. At present (2002), only low depressions have still open water with aquatic vegetation. The more elevated areas are covered by salinised grassland. The restoration of the river islands seemed to be very succesful. The river islands recoverd quite fast their ecological functions as a habitat for plants, birds and animals, habitat for spawning grounds for fish. The fast recovery of the islands is possibly due to being a part of the dynamic Danube river and that the islands were embanked not so long ago, in 1985 and 1987.

5.2 The transitional zone

Depressionary areas both in fluvial and marine part of the Delta are characterised by extensive Reed beds on thick (1-3m or more) peat deposits, and by the presence of large and 1-3m deep lakes. In a geomorphological sense it is composed of several former lagoons in the final stage of being filled up with peat. The lakes are the last remnants of the lagoon. Sedimentation of river sediments is much more limited than in the fluvial zone. This difference is due to the smaller amplitude of floods, so much closer to the Black Sea. River sediments are deposited only on narrow levees along the river branches and in the beds along the shores of large creeks.

Figure 5.2
 Cross section in the transitional zone of
 the Danube Delta.; see figure 1.1 for
 position of cross section



The cross section (figure 5.2) illustrates the correlation of vegetation units with soils in the transitional /depressionary zone of the Delta.

During the process of filling up, large parts of the lagoons were covered with a special type of Reed peat. In its initial stage this Reed peat is not connected to the mineral lagoon bottom or to the lake bottom. It is then a floating layer, consisting of a network of viable rhizomes (fibric peat) with a thickness of 0,8 - 1,3m, often with many patches of water in it. The local name for this peat marsh is "plaur" (Romania) and "plavy, splavy-ny" (Ukraine). The layer grows thicker gradually. Sooner or later it establishes contact with the mineral bottom. This happens first only during low water levels, later almost permanently. In that final stage the layer with viable rhizomes is situated on old and more mineralised peat (hemic or sapric peat).

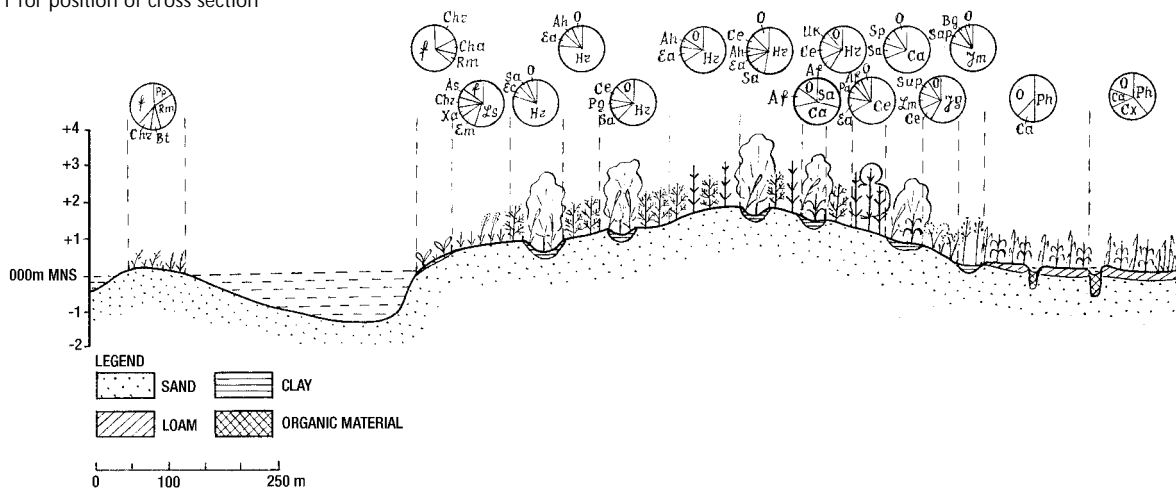
Reed marshes can occur upon isolated plaur islands in lakes, or upon mosaics of plaur with patches of water, or upon continuous plaur. The last (on plaur that can be fixed on the mineral subsoil or can be floating) represent a final stage of the filling up process of lagoons and lakes. Many Reed marshes are invaded by *Salix cinerea* bushes. Sometimes, pieces of floating plaur at the edge of the lakes are broken free and moved by the wind or water currents as small floating islands, after which they can stick to the bottom at shallow places.

The boundary between the fluvial and marine zones of the Delta is marked on two places by large ancient beach barrier complexes. These (the Letea and Caraorman complexes) are discussed in paragraph 5.3.2.

5.3 The marine zone

The marine zone of the Delta is characterised geomorphologically by the presence of parallel sandy beach barriers with shallow depressions in between. Most beach barriers are narrow and low: several tens to a few hundreds of meters wide, and lying 1,0 - 1,5m above sea level. The depressions between them are relatively wide: many hundreds to several thousands of meters. Three complexes occur in which the barriers are wider and the depressions narrower: the Sărăturile complex, the Caraorman complex, the Letea complex and the Zhebryansky ridges. The island Sachalin, at the present seashore, is the most recently formed beach barrier in the Romanian territory. When proceeding land inward from Sachalin, one finds barriers and depressions of increasing age. The distribution of soils and vegetations is strongly related to the geomorphologic structures and to their age. In the fast growing Chilia Delta we find the so-called "new land", sand bars that are developing from a northern to the southern direction. These sand bars will form later on the new beach when the area between the secondary delta and these new land has been silted up. A cross section of this area is shown in figure 5.3.

Figure 5.3
Cross section in the marine zone of the fast-growing Kiliya Delta; see figure 1.1 for position of cross section



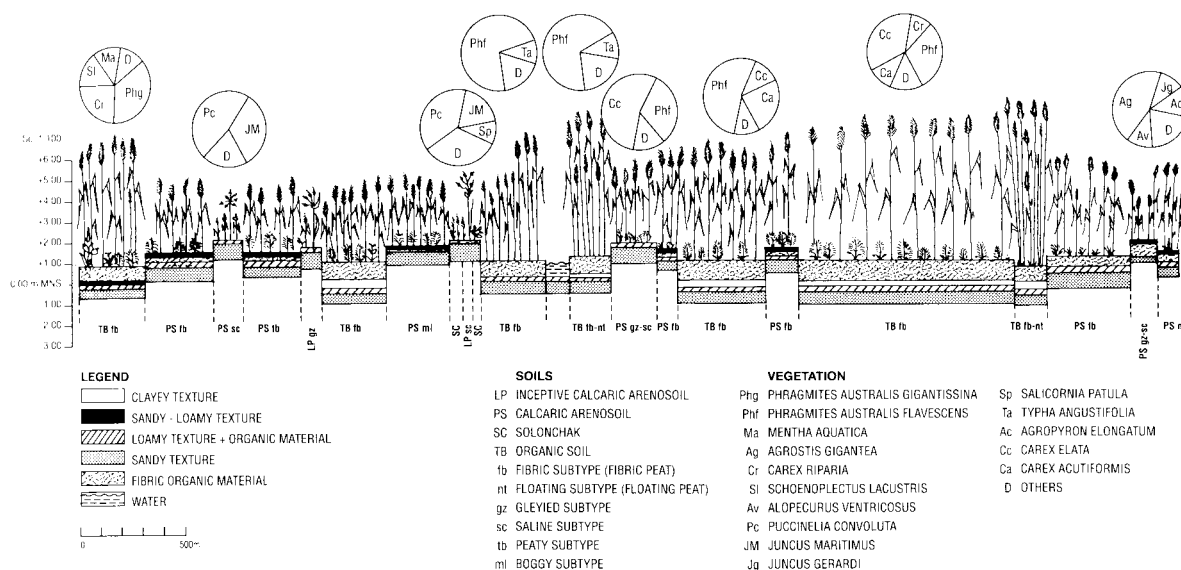
5.3.1 Isolated low and narrow beach barriers: south-west of Sf.Gheorghe (Romania)

Geomorphologically, this area consists of narrow beach barriers with very wide depressions in between. A soil-vegetation profile on this zone is given in figure 5.4.

The crests of major beach barriers as Buhaz, Palade and Crasnicol are 1-1,5m elevated above sea level. They are out of the reach of flooding. Locally they even are too high to be influenced by the saline groundwater. There shifting sands exist, and pasture with *Cynodon dactylon*, *Apera spica-venti ssp. maritima*, *Bromus squarrosus* and *Holoschoenus vulgaris*. The beach barrier soils at intermediate elevation are moderately salinised. The vegetation on these saline Calcaric Arenosols consists of a moderately salt tolerant pasture with *Puccinellia convoluta*, *P. distans*, *Apera spica-*

Figure 5.4

Cross section in the marine zone of the Romanian Danube Delta, see figure 1.1 for position of cross section



venti ssp. maritima and *Agrostis gigantea ssp. pontica*. Below this *Puccinellia convoluta* zone, the increasing influence of flooding with fresh water (up to 3 months per year) diminishes the salinisation. *Agrostis gigantea ssp. pontica*, *Juncus gerardi* and Reed are characteristic for this dynamic habitat, with alternating fresh water flooding and moderate salinisation. The next lower zone, flooded for 3-6 months per year, is covered by Sedge marshes, with Reedmace and some Reed. The depressions themselves, with a flooding period more than 6 months per year, are covered by Reed marshes with some Sedges, growing on peat soils. Some of the younger depressions are still in the process of being filled up with Reed peat. Small lakes occur in their center. Those lakes are the last remnants of the lagoonal water. Reed dominates on the plaur around these small lakes.

Strong salinisation (with *Salicornia patula*, *Suaeda prostrata* a.o.) is rare in this area. It only occurs in the few isolated depressions within beach barriers that are not flooded by fresh water.

The Sf.Gheorghe Danube branch cuts its way to the sea through this beach barrier landscape. It's river levees are low and narrow, and vegetated by a mosaic of *Alnus*- or *Alnus-Fraxinus* forest with humid pasture. Interesting gradients occur in the contact between the river levees and the beach barriers. In such special positions the lower flooded part of the beach barrier is vegetated by a narrow strip of *Alnus* forest instead of Sedge marsh. This forest surrounds an open salinised pasture with *Agrostis gigantea ssp. pontica*. The salinised pasture grows upon the central part of the beach barrier, slightly more elevated and less flooded.

This kind of complex is present in the Grindul Sărăturile, north of the villa-ge Sf.Gheorghe. The beach barrier sand contains many shell fragments in this area. Grindul Sărăturile differs geomorphologically from the previously described complex. The main difference is the closer succession of the beach barriers. The depressions between the barriers are far narrower.

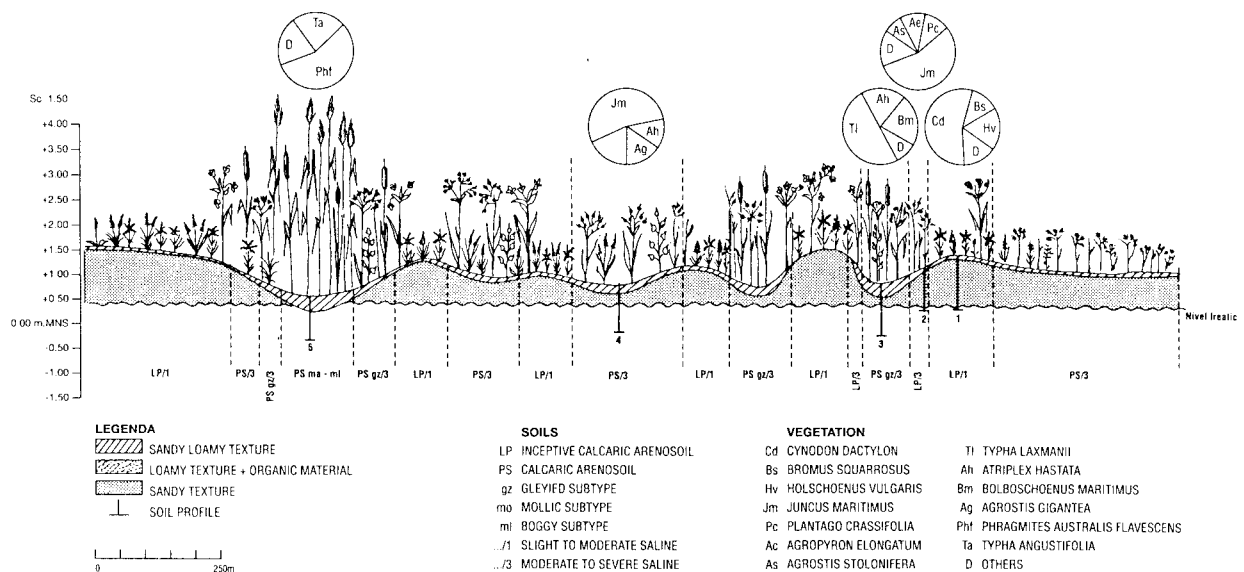
This makes flooding by fresh river water less intensive than in the previously described complex. Many depressions are more or less isolated from fresh water supply, and therefore more salinised.

The soils on beach barriers over 1,2m high have little or no contact with the saline groundwater. They have very dry conditions. They are covered by a pasture with *Cynodon dactylon*, *Apera spica-venti ssp. maritima*, *Bromus squarrosus* and *Holoschoenus vulgaris*. The active beach barrier along the sea has a different vegetation. This is dominated by sea shore ruderals like *Petasites spurius*, *Eryngium maritimum* and others; and exceptionally by sea shore bushes with *Hippophae rhamnoides*, *Elaeagnus angustifolia* and *Tamarix ramosissima*.

From the tops of the beach barriers to the depressions, two different types of gradients are obvious.

Gradients of the first type, of an increasing salinisation, are to be found in depressions without connection to the river. The lower a place, the closer it is to the saline groundwater and the stronger it is salinised. Flooded places here, are flooded by saline ground water. The intermediate zone of this gradient has a salinised Calcaric Arenosol. It is characterised by immense *Juncus* fields (*Juncus littoralis* and *J. maritimus*). The depressions themselves have a heavily salinised Solonchak soil and an open, salt tolerant vegetation with *Salicornia patula*, *Suaeda prostrata* and *Aeluropus littoralis*.

Figure 5.5
Cross section in Grindul Sărăturile: see figure 1.1 for position of cross section



Gradients of the second type are associated to flooding by fresh river water. The intermediately elevated zone is dominated by saline ground water, but the lowest zones are dominated by fresh river water (see figure 5.5). Fertile and productive *Elytrigia* grassland (*E. elongata*, *E. intermedia*) occurs at intermediate elevations. It is related to the *Elytrigia repens* river levee grasslands in the fluvial part of the Delta (see figure 5.1.), possibly by the comparable nutrient supply by the flooding river water and by the comparably good drainage. The depressions with little flooding have a

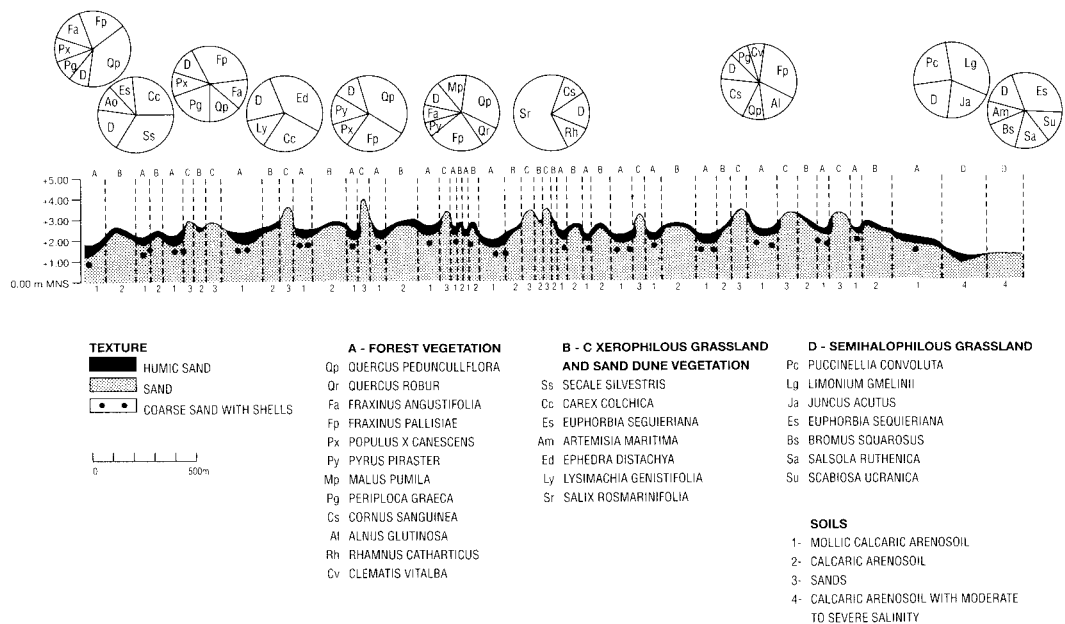
marsh vegetation of brackish conditions with *Typha laxmanii* with a longer flooding period (6-8 months per year) are covered by Reed marsh with Sedges, or, if very close to the river, by Reed marsh.

5.3.2 Beach barriers and dunes: Letea and Caraorman (Romania)

Two relatively high beach barrier complexes are situated on the boundary between the fluvial and transitional parts of the Delta. They are named after the main villages upon them: Letea and Caraorman.

Geomorphologically they consist of parallel old beach barriers separated by narrow depressions, comparable to Grindul Sărăturiile. At Letea and Caraorman, however, the initial beach barrier relief has partly been reshaped by the wind to a dune landscape. The dunes reach a maximum elevation of 11m above sea level. The ground water quality in the Letea and Caraorman complexes causes a second difference with Grindul Sărăturiile. Many depressions in the Letea and Caraorman complexes are fed by fresh ground water, even without being flooded by river water. This is a great contrast with the predominance of saline ground water in Grindul Sărăturiile. It creates relatively rare habitats with humid, nutrient-poor and non-saline sandy soils. One source of fresh ground water is a horizontal ground water flow from east to west. The driving power of this flow is the difference in water levels in the eastern (up-stream) and western (down-stream) water systems bordering the complexes. Ground water flows easily in large quantities through the highly permeable subsoil, facilitated among others by layers with high contents of shell fragments. Another fresh water source is the rainfall surplus in the elevated dunes. Figure 5.6 shows a cross section in the Letea complex.

Figure 5.6
Cross section in Letea complex; see figure 1.1 for position of cross section



The dunes are covered with open steppe vegetation with *Carex colchica*, *Ephedra distachya*, *Secale silvestre*, *Elymus giganteus* and *Festuca beckeri*.

Young depressions with fresh ground water may contain a low *Salix rosmarinifolia* shrub. Normally, however, the depressions with fresh ground water are forested by *Quercus pedunculiflora* and *Fraxinus pallisiae*. *Quercus robur* and *Fraxinus angustifolia* are locally mixed into these forests as rare individuals. The ground water in the depressions may rise to several decimetres above surface in flooding periods, and sink to 1,2-1,4 m below surface in the dry season.

.....
Letea dunes with *Quercus robur*/
pedunculiflorae and high areas with a
sparse vegetation cover and shifting
sands



Both Letea and Caraorman complexes include less elevated areas on their edges with saline ground water close to the soil surface. This is reflected by the presence of salt tolerant vegetation with *Puccinellia convoluta*, *Limonium gmelinii*, *Juncus maritimus* and *Aeluropus littoralis*. These vegetations grow in mosaics with less salt tolerant pasture and with bushes of *Tamarix ramosissima*, *Elaeagnus angustifolia* and *Hippophae rhamnoides*.

Further to the margin of the complexes, flooding becomes increasingly important. This is reflected by a gradual change from salt tolerant vegetations to brackish pasture with *Althaea officinalis*, and further to Reedmace marsh, which finally is replaced by Reed marsh with Sedges on peat soils.

5.3.3 Chilia (Kiliya) Delta of the Danube Delta (Ukraine)

An aerial view of the Delta vegetation represents boundless expanses consisting of communities with dominance of *Phragmites australis*, *Carex elata*, *C. acutiformis*, *Typha angustifolia*. Spots composed of *Salix cinerea* occur among them. Along the rivers, areas consisting of *Salix alba*, *S. triandra*, *S. fragilis*, *Populus deltoides* and *P. nigra* run in the form of strips (from 50 to 200 (500) m long). In the seaside zone, dense brakes composed of *Hippophae rhamnoides*, *Amorpha fruticosa*, *Tamarix ramosissima* occur. In the waterbodies, communities of aquatic vegetation consisting of *Trapa natans*, *Nymphaea alba*, *Nymphoides peltata*, *Stratiotes aloides*, *Salvinia natans* and other species occur as separate spots. Along the numerous river branches, areas occupied by *Phragmites australis*, *Typha angustifolia*, *Sparganium erectum* and other species run as narrow strips.

Each part of the Delta is characterised by its peculiar features. In particular, the northern part is characterised by prevailing salinised marsh, salinised meadow, and aquatic plant communities with a wide ecological amplitude. The southern part is characterised by prevailing marsh, forest, shrub, and aquatic plant communities. Main plant communities of psammophilous and halophilous vegetation are grouped in the eastern part; the forest and bush vegetations (occurring along rivers), grass, and marsh vegetations (occurring on islands) are grouped in the western part. Besides, territorial peculiarities in the distribution of several plant communities are characteristic of the Delta. In particular, on the seaside hills from North toward South the area occupied by communities with dominance of *Hippophae rhamnoides*, *Elaeagnus angustifolia*, *Tamarix ramosissima* is expanded up to Kubansky Island, and, beginning with the southern part of this island, the area concerned is narrowed.

The areas of saline soils and salinised meadows decrease in the southern direction. Areas covered by forests and shrub communities, in particular, those consisting of *Salix alba*, decrease eastward, and in partly northward. In the northern part of the Delta, communities of *Phragmites australis* accompanied by *Calamagrostis epigeios* prevail; in the central part, *Phragmites australis* accompanied by *Carex acutiformis* and *C. elata* is predominant; in the southern part - *Ph. australis*, *C. acutiformis* and *C. pseudocyperus* prevail. Aquatic vegetation is predominant in the eastern part of the Delta. In the northern area, communities consisting of *Ceratophyllum demersum*, *Najas marina*, *Myriophyllum spicatum*, *Potamogeton pectinatus*, *Zostera marina*, *Z. noltei* occur. In the central part, communities with *Trapa natans*, *Nymphaea alba*, *Nuphar lutea*, *Nymphoides peltata* are predominant. In the southern part communities with *Sparganium erectum*, *Nymphaea alba*, *Trapa natans* are widespread.

.....
Organic materials accumulate on fluvio-marine sands along the mouth of the Chilia (Kiliya) branch



Some islands of the delta are distinguished by specific distribution of the vegetation. Its character is determined by the age of islands, by peculiarities of their relief, as well as by their position in the delta, in particular, their remoteness from the sea.

5.3.4 Seaside part of Zhebryansky ridge (Ukraine)

Vegetation of the ridge is distinguished by originality related to the peculiarities of its geological complexes and by its location in the zone of the direct influence of the Black Sea. The largest areas of arenaceous and halophilous vegetation are grouped in the region. Marsh vegetation occupies large territories. Its development occurs under the influence of the Black Sea. A decrease of salinisation due to the influence of the Danube branches is observed there.

Vegetation is deeply transformed. The main anthropogenic factors include overgrowth of areas by forest plantations, sand extraction, cattle grazing, and recreation. The southern part of the ridge borders upon the town of Vylkove, its northern part is adjacent to Prymorske village, its eastern part borders upon Stentsivsko-Zhebryansky floodplain, where the water level is artificially kept high.

The littoral and floodplain zones of the Zhebryansky seaside ridge are distinguished by peculiarities of plant communities differing from the vegetation of the Chilia Delta of the Danube Mouth as a whole. They are characterised by the large proportion of the arena florocenotic complexes. On the narrow strip of the seaside hill, communities of the riverside sands with dominance of *Leymus arenarius*, *Euphorbia seguierana*, *Secale sylvestre*, *Artemisia scoparia*, *A. tschernieviana*, *Polygonum novoascanicum*, *Tragopogon borysthenticum*, *Asperula setulosa* and other species occur. Plant communities consisting of the seaside mainly neoendemic species with dominance of *Melilotus arenarius*, *Asperula setulosa*, *A. graveolens*, *Arenaria zozii*, *Cerastium sivashicum*, *Corispermum ucrainicum*, *Polypogon monspeliensis*, *Chondrilla juncea*, *Apera maritima*, *Centaurea odessana*, *C. orientalis*, *Syrenia cana* and other species are also widely distributed there.

Formation of the plant communities of the floodplain part of the Zhebryansky seaside ridge occurred under the influence of the branches of the northern direction and alluvial sea activity followed by the stabilization processes of the floodplain geological complex development (Samoilov, 1952). They are distinguished by prevailing *Phragmitetum communis*, *Typho angustifoliae* - *Phragmitetum australis*, *Caricetum acutiformis* communities accompanied by the large number of rare for the region species *Hottonia palustris*, *Naumburgia thyrsiflora*, *Pedicularis palustris*, *Glyceria fluitans*, *Cardamine pratensis*, *Nasturtium officinale*, *Valeriana officinalis*, *Salix caprea*, *S. cinerea*, *Cicuta virosa*, *Calamagrostis neglecta* and others, as well as by a set of surviving representatives, whose ancestors were widely distributed in the shallow zones and in the swamped sections of the Tethys (former paleo-ocean), concerning *Cladium mariscus*, *Cyperus difformis*, *Torulinium ferax*, *Mentha pulegium* and others. In the meadow marsh sections, representatives of orchids occur; these species (*Epipactis palustris*, *E. heleborine*, *E. atrorubens*, *Orchis palustris*) are listed in the Red Data Book of Ukraine.

Aquatic vegetation consisting of the species characterised by wide ecologic amplitudes plays a pronounced role in the functioning of the flat ecosystems.

5.3.5 Zhebryansky ridge - part attached to the mainland (Ukraine)

On the background of the flats, the ridge is clearly defined in the relief. It presents thick alluvial sandy deposits accompanied with a layer of sandy loam. Relief is severely differentiated into the hills extended up to hundreds meters in the form of wooded ridges and has depressions between the wooded ridges interspersed with the flat sections of transitional character.

The main part of the Zhebryansky ridge is covered with the artificial afforestation consisting of *Pinus pallasiana*, whereas the lowered part and spits are covered with the meadow, saline soil, and marsh vegetations.

The variability in the relief features and wide diversity of the ecological factors are responsible for the essential variety of the vegetation as a result of which it is mosaic in character and is distinguished by significant dynamism.

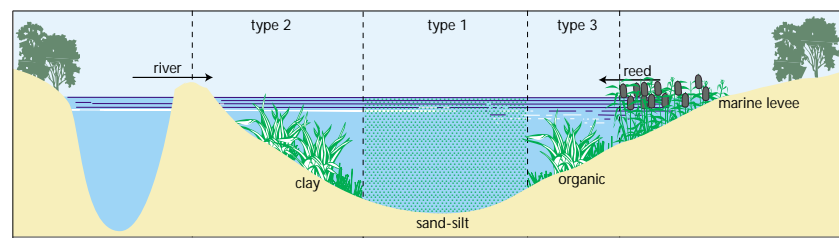
Pine forests of the Crimean pine are young, their crowns are not dense and only sometimes exceed indicator 0.6-0.7; the trees are 3-8 m high, and 6-16 cm in diameter, productivity is not high. Apart from the pine plantations on the ridge and, particularly, in its western part, insignificant areas occupied by *Populus canescens*, *P. tremula*, *P. alba*, *Fraxinus excelsior* occur. Plantations of the shrub vegetation consisting mainly of *Elaeagnus angustifolia*, *Amorpha fruticosa* also do not occupy significant areas. They are represented in different sections of the ridge. In places, the cultures of *Hippophae rhamnoides* occur. They cover circa 20 ha. The liana *Periploca graeca* was registered. The herbaceous layer is characterised by the presence of endemic psammophilous species (*Onosma borysthena*, *Centaurea borysthena*, *Asperula setulosa*, *Centaurea odessana*).

The plant community *Pinus pallasiana* - *Calamagrostis epigeios* is the most common in terms of the occupied area. It forms in the flat somewhat elevated sections under conditions of moderate humidity of the ridge. It is connected with complexes formed under both drier and more humid conditions, as well as with anthropogenic successions with different level of distinction through the numerous vegetation boundaries (called ecotones). This complex is widely distributed over all the territory of the ridge, however, to the large extent, occur in its western part. Subassociations, with herbaceous subdominants *Euphorbia seguierana*, *Cynodon dactylon*, *Carex colchica*, *Molinia euxina*, *Elytrigia repens* are incorporated into this complex.

5.4 Lakes within the Danube Delta

An important part in the different zones of the Danube Delta are the more than 300 lakes. The lake types have been distinguished for the Romanian

Figure 5.7
Schematic cross section of lakes in the Danube Delta



part by Oosterberg *et al.*, 2000. A schematic cross section is shown in figure 5.7. The lakes can be divided into three main types (zones), see table 5.1.

Table 5.1

Different types of lakes in the Danube Delta

Type 1	Characteristic for the marine parts in the lagoon; depth of 2 à 4 metres; large surface (>200 ha); sand-silt substrate; intermediate inflow of river water; turbid; high abundance of cyanobacteria and cladocera; low abundance of aquatic vegetation; fish community is eurytopic and limnophilic
Type 2	Characteristic for the fluvial part with high river water input (close to main branches); intermediate in size and water depth (e.g. lakes Furtuna and Baclanest); strong seasonal dynamics in water level; clear water; abundant aquatic vegetation (<i>Potamogeton trichoides</i>); abundant filamentous algae; fish community is eurytopic
Type 3	Characteristic for shallower parts with a longer distance to the main river branches; verlandungs area with strong reed colonization and peat accumulation; relatively small and shallow lakes; clear water; abundant aquatic vegetation (<i>Nitellopsis obtusa</i>); abundant "black fish" community

Lake in the Kiliya Delta with sedges, reed and Salix bushes



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6 Vegetation classification

6.1 Introduction

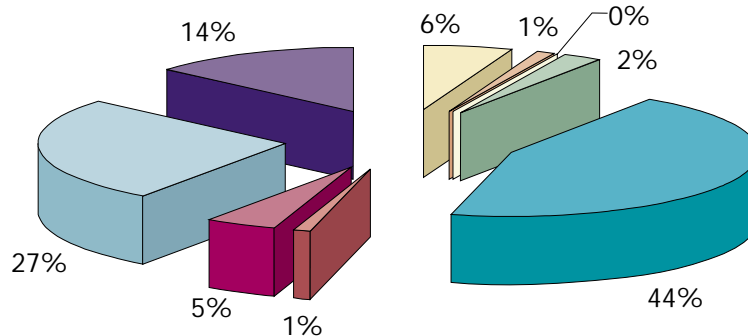
The flora of the Danube Delta contains ca. 1400 species of vascular plants. Studies on the species level by various authors have been summarized by Dihoru & Negreanu (1976). 157 plant communities have been described in the Danube Delta (Popescu *et al.*, 1997).

Our classification (Hanganu *et al.*, 1994 & Dubyna *et al.*, 1984) is adjusted to the objectives of the study. Vegetation structure is our first key in defining and distinguishing classification units. The vegetation structure determines the habitat for the fauna. The vegetation structure is strongly correlated with vegetation management and exploitation. Moreover, the vegetation structure is a robust and simple feature, easily verifiable and it requires no sophisticated concepts or complex data processing. And finally, in the field it is the vegetation structure that catches the eye.

Floristic composition is our second key in defining and distinguishing classification units. Independently from vegetation structure, floristic composition reflects in a more detailed way the hydrological conditions and soil conditions. And apart from that, the importance of vegetation for botanical biodiversity is based upon the floristic composition, too: upon the presence of rare or endangered species.

Figure 6.1
Vegetation units in the Biosphere Reserve "Danube Delta"

- beach/sea dune vegetation
- psammo. steppe
- desert-steppe
- levee grassland
- marshy vegetation
- forest dunes
- forest floodlands
- aquatic vegetation
- miscellaneous



The units of vegetation classification are presented in the following paragraphs. We will usually refer to plant species but also to plant communities and/or associations. An overview about the percentages per main vegetation unit is shown in figure 6.1.

From the European map of the potential vegetation units in the Danube Delta (Doina *et al.*, 1992) the following units are present:

Table 6.1
General vegetation units in the
Danube Delta

code	description
U 22	South European forest of willows and poplar
P4	North pontic dune vegetation
P7b	Pontic halophilous vegetation
P10	Continental halophilous vegetation
L12a	Danubian deltaic psammophilous steppe vegetation
M4	Steppe vegetation with <i>Stipa ucrainica</i>
M15	Pontic dry steppe vegetation (with <i>Agropyron pectiniforme</i>)
R1	Marshes with reed and sedges

6.2 Sea shore vegetations

Littoral vegetations of shifting sand are presented in annex 3, legend unit 2, ranging from slightly humid to extremely dry conditions. In this sequence they are dominated by *Crambe maritima*, *Argusia sibirica*, *Petasites spurius*, *Eryngium maritimum*, and *Elymus giganteus*. They are open vegetations with a low cover. These vegetations grow in moderately saline habitats.

By nature, such habitats are present in the youngest dunes and the youngest beach barrier along the Black Sea. By human influence, the same vegetations may be found further inland, upon dikes and any other recent accumulations of marine sand.

Often, these littoral vegetations are associated with bushes (*Hippophae rhamnoides* and *Elaeagnus angustifolia*).

A special vegetation cover can be found on the new sandbars in the Ukrainian part of the Danube Delta. Here, the pioneer seashore vegetation is mainly dominated by *Polygonum patulum*, *Rumex maritimus*, *Bidens tripartita*, *Echinochloa crus-galii*, *Chenopodium ambrosioides*, *Ch. rubrum*, *Ch. album*, *Artemisia annua*, *Suaeda prostrata*, *Xanthium rupicola* and etc. (see annex 2, legend unit 1).

Nova Zemlya - view from the new
marine sandbars to the South (Sulina)



6.3 Salt tolerant vegetations

Salt tolerant vegetations, halophilous vegetations, cover important surfaces on the complexes of old beach barriers and old dunes (Sărăturile, Caraorman, Letea and Zhebryansky ridges). There they occur on the lower, humid, sandy parts (salinised Calcaric Arenosols and marine Solonchaks). The salt tolerant vegetations reflect very strongly the degree of soil salinisation. At the highest salinities only bare soil is present. The first vegetation to be found at decreasing salinity is an open vegetation of annual herbs (*Salicornia patula*, *Suaeda maritima* var. *maritima*). In the annex 3, relevés of the legend units 6, 7 and 8 can be found.

Open vegetations with *Limonium gmelinii* are present at less extreme salinity in dry habitats. Dense vegetations of tough Rushes dominate at less extreme salinity in more humid habitats.

At lower salinity several types of semihalophilous grassland are found. The more salinised habitats are dominated by *Puccinellia distans* on clay soils and by *P. convoluta* with *Limonium gmelinii* on sandy soils. *Apera spicaventi* ssp. *maritima* and *Chrysopogon gryllus* are dominant in transitional habitats to dry shifting sands, and *Agrostis gigantea* ssp. *pontica* dominates in transitional habitats to flooded marsh.

6.4 Grassland of sandy steppe

The topsoil in the higher dune complexes has no connection with freatic ground water. As the sandy material has almost no water storage capacity, the summer conditions in these soils are very dry. Therefore, soil development is very slow, and many areas with shifting sand occur. Where vegetation is present, it consists mainly of an open herbaceous grassland. It's species composition resembles that of sandy steppes, with *Festuca beckeri*, *Carex colchica*, *Ephedra distachya*, *Secale silvestre*, and *Elymus giganteus*. Salt tolerant species are almost absent, only *Plantago maritima* and *P. indica* are recognised. In the annex 3, the relevés of the legend units 12, 13, and 14 are described.

In the Letea and Caraorman complexes, the steppe-like dunes occur in a mosaic with fresh water depressions. There the steppe grassland is mixed with an Oak-Ash forest (*Quercus pedunculiflora*, *Fraxinus pallisiae*) or with Reed, Reedmace and Sedge marsh (*Phragmites australis*, *Typha angustifolia*, *Carex elata*).

6.5 River levee grassland

River levee grassland is characterised by a mesophilous species composition and is flooded periodically. Subtypes can be defined due to the dominating species ranging from well drained to wet conditions. In that order they are dominated by *Agrostis stolonifera*, *Elytrigia repens*, *Phalaris arundinacea*, *Glyceria maxima* and *Galega officinalis*, respectively.

Some salinisation occurs in these grasslands. This is reflected by the presence of salt tolerant species as *Agrostis gigantea* ssp. *pontica*, *Aster tripolium* ssp. *pannonicus*, *Althaea officinalis*, *Trifolium fragiferum* and *Atriplex hastata*. They occur especially in the well-drained grasslands of Crisan and Grindul Ivancea.

In the fluvial part of the delta, river levee grassland often is bordered by or mixed with White Willow forest (*Salix alba*, *S. fragilis*) or Poplar forest (*Populus alba*, *P. canescens*).

In the downstream river levees, moderate to strong salinisation may occur. Grassland in such habitats is characterised by species like *Puccinellia convoluta* and *Aster tripolium ssp. pannonicus*. The highest parts with a sandy soil have a mesoxerophilous river levee grassland that is dominated by species like *Chrysopogon gryllus* and *Apera spica-venti ssp. maritima*. Most of the salt tolerant species are found in the more humid *Cynodon dactylon/Puccinellia convoluta* pasture.

6.6 Marsh vegetations

Reed is by far the dominant species in the Danube Delta. Reed marshes cover more than 220,000 ha. The main plant community is represented by Scirpo-Phragmitetum W.Koch 26 em. Soo 47. It can be found on hydromorphous and organic soils with neutral pH and low to moderate salinisation. The dominant species is *Phragmites australis* usually accompanied with many hydrophilous species as *Typha angustifolia*, *Schoenoplectus lacustris*, *Sparganium sp.* *Thelypteris palustris*. Different communities can be divided.

- **Phragmitetum communis** is an association found on gleyic or peat gleyic soils, temporary or quasipermanent flooded, with neutral pH.
- **Scirpo-Phragmitetum**, under this name the great majority of the reed types and subtypes in the Danube Delta is known, on hydromorphous and organic soils with neutral pH and low to moderate salinisation. Due to the variation of the main ecological factors there are important changes in the floristic structure and composition, changes that in connection with the biometrical parameters specificity of the reed populations determined the individualisation of many subassociations:
 - **Scirpo-Phragmitetum phragmitetosum** is a subassociation found on gleyic soils, psammosoils and organic soils.
 - **Scirpo-Phragmitetum solanetosum dulcamarae** is a border phytocoenosis, frequently found in the Danube Delta along the border of channels, on mineral and organic soils with a neutral pH and with low salinisation.
- **Bolboschoeno-Phragmitetum**, is a subassociation that settle as a variable width band around the typical association to the exterior edge. Being on the edge of these temporary flooded marshes, on gleyic soils and moderate-strong salinised psammosoils, with a low alkaline pH, it is noticed a raise of the halophyle species. For this subassociation we proposed the differential species *Eleocharis palustris*, *Carex distans* and *Rorippa austriaca*, mezohygrophyllous species. Confronted by the typically association there are noticed some changes in the structure of the phytocoenosis which belong to this subassociation, by decreasing the covering percentage accomplished by *Phragmites australis* and *Bolboschoenus maritimus* and increase considerably the percentage of *Eleocharis palustris* both as covering and as biomass quantity.

- **Astero tripolii-Phragmitetum**, is found on maritime banks, low temporarily flooded with salinisation psammosoils and alkaline reaction. The reed is not very high (0,90-1,65m) and has a diameter of 0,2-0,9 cm. The ratio of the reed from the total quantity of biomass is of 50-75%, but on the whole the phytocoenosis realise a reduced quantity of biomass by comparison with other types and subtypes of reed plots. A co-dominant species with maximum constancy but with a relatively low abundance-dominance index, is the species *Aster tripolium*, a halophytic specie which indicates floristic composition totally different confronted by the reed plots described until now.

The *Phragmites australis* is known to be a highly polymorphic species. Since large variation in morphological characters is largely present within single clones, which are partially attributed to environmental differences. Hanganu *et al.* (1994) distinguished two categories 'Giant reed' and 'Fine reed'.

.....
 Typical zonation of floating aquatic and marsh vegetation (fine and tall reed, Salix trees) in the Danube Delta lakes



Tall Reed vegetation

In areas with maximal Danube water circulation and maximal siltation, tall Reed is mixed with *Typha angustifolia* and *Schoenoplectus lacustris* (Ghiol Pojarnic). In areas with a strong but not so extreme river water influence, very vital tall Reed grows in dense and species-poor vegetations (Lacul Rosca). In peat areas, tall Reed vegetations are limited to habitats with fresh river water, and are often codominated by Sedge species (Sf. Gheorghe branch).

In peat areas typical tall Reed grows in narrow strips along streams and channels. Tall Reed in peat areas is also present in larger patches where the peat layer is thin and probably not connected to the mineral subsoil. Here the vegetation is a mosaic of tall Reed and very small ponds. The vegetation is in contact with river water circulating under the floating peat. This tall Reed vegetation is characterised by the presence of *Salix cinerea* bushes (Lacul Erenciuc). The patches of water may be partly covered with the fern *Thelypteris palustris* (Sf. Gheorghe branch) and with floating/submerse aquatic vegetations.

In the tall Reed marsh vegetations no salt tolerant species can be found.

Fine Reed vegetation

Monodominant fine Reed vegetations occur in peat areas with almost constant shallow inundation, without substantial supply of fresh river water. The constant inundation is reflected by the presence of the floating Duckweeds *Lemna minor* and *Salvinia natans* (e.g. Litcov channel, Lacul cu Lebede).

The typical fine Reed vegetations, however, are mixed with the sedges *Carex elata* and often *C. acutiformis* and *C. riparia* (Caraorman channel). Reedmaces *Typha angustifolia* and *T. latifolia* can be present, too (Sulina channel). The typical fine Reed vegetations occur in areas where the (ground)water level drops deeper (up to 0,4m) below soil surface. On large areas, *Salix cinerea* bushes grow in the fine Reed vegetations.

When the peat soils of fine Reed vegetations undergo increased mineralisation, the result is an increased release of nutrients. Such circumstances are caused usually by Reed harvest at unsuitable places or unsuitable times of the year. The increased mineralisation, caused by the dying-off of damaged Reed rhizomes, is reflected in the vegetation by an increase of ruderal tall forbs like *Eupatorium cannabinum*, *Lythrum salicaria*, *Urtica dioica* and *Epilobium parviflorum* (Buhaz channel). Increased drainage due to reclamation works may cause a comparable effect.

Salinisation plays in these fine Reed levees no significant role for the species composition. In the Romanian part just one species (*Samolus valerandi*) is associated with slightly saline conditions.

Sedge marshes (mixed Carex species)

The Sedge marshes occupy in the marine part of the Delta the transition from marsh to terrestrial grassland. In the lower parts of this transition with codominant fine Reed and many helophytic marsh species are present (*Alisma plantago-aquatica*, *Sparganium erectum*, *Typha angustifolia* and *Sium erectum*). At higher elevated areas, (ground)water tables are below the soil surface during a long time of the year. Fine Reed is only marginally present. The Sedges dominate. They are accompanied by some grasses and by herbs from humid conditions (*Calystegia sepium*, *Stachys palustris*, *Symphytum officinale*). Helophytic marsh species are practically absent.

Being more elevated than the Reed marshes, the Sedge marshes in general are more susceptible to salinisation. Species associated with saline conditions within the sedge marshes are: *Samolus valerandi*, *Althaea officinalis*, *Agrostis gigantea ssp. pontica*, *Atriplex hastata* and *Trifolium fragiferum*.

Reedmace marshes

The main Reedmace species in the Danube Delta is the Lesser Reedmace *Typha angustifolia*. The relevee of Typhetum angustifoliae can be found in annex 3, legend unit 19.

Reedmace is an important species in the fluvial part of the Delta. Its dominance in this region is strongly correlated with siltation. In years or places with strong siltation, Reedmace replaces Reed. Reed will resume dominance over Reedmace after a few years with moderate siltation.

Monodominant Reedmace stands are rare (Tataru channel and eastern part of the Stentsovsko-Zebryansky Plavni).

In all other than siltation habitats, Reed will replace Reedmace, wherever the two species enter into competition. Monodominant Reedmace vegeta-

tions that do exist, grow a.o. along the fringes of beach barriers that are heavily grazed by cattle. There the Reed has been removed from the mixed vegetation by grazing cattle in summer.

On other places Reedmace grows usually together with dominant or codominant Reed (Roşu-Caraorman channel) or with Sedges (Grindul Palade). A specific habitat for Reedmace is along the shores of the larger lakes, where it grows together with *Schoenoplectus lacustris*. This vegetation is the edge of the marsh vegetation (Caraorman complex). Here, too, grazing may be the decisive factor that favours Reedmace over Reed. Grazing in this habitat, however, is not due to cattle but to waterfowl: mainly Greylag Geese *Anser anser*.

Salinisation is practically absent in the Reedmace vegetations, just two salt tolerant species *Trifolium fragiferum* and *Bolboschoenus maritimus* are recognised.

6.7 Dune forest

A very interesting landscape of the delta is represented by the dune forests (annex 3, legend unit 33) in the Letea and Caraorman dune complexes.

The habitat conditions in the forests on these dune complexes are very diverse. They range from White Willow river levee forest to forest of salinised conditions and inland forest (*Fraxinus pallisiae*, *Malus dasyphylla* and *M. sylvestris*, *Pyrus pyraster* and *Quercus pedunculiflora*).

.....
Climbing plant of the Quercus forests
is *Periploca graeca*



Among the Oaks *Quercus pedunculiflora* is the only species of quantitative importance. *Quercus robur*, however, is present, too - but only very sparsely and often accompanied by *Fraxinus angustifolia*. Their presence illustrates the affinity of the habitat with central European hardwood forest floodplains. Locally, in isolated peaty depressions with more permanent inundation, *Alnus glutinosa* forest occurs. Inundation, drainage conditions and (ground-)water quality differ at a very small scale, due to the strong relief. This makes the classification of the dune forests rather complex. Homogeneous areas are hard to find.

So it is difficult to make releves in the tree layer that are representative for one homogeneous habitat. This heterogeneity is illustrated by looking through the relevee of annex 3, legend unit 33.

At the part of Zhebryanky ridge – attached to the main land, the dunes of the Ukrainian part, planted pine forests can be found. It is mainly *Pinus pallasiana* (see also chapter 5.3.5).

6.8 Floodplain forest

One table in annex 3 presents the releves in river levee forest (*Salicetum albo-fragilis*). White Willow forest is dominated by *Salix alba* and *S. fragilis* in the tree layer, with *Amorpha fruticosa* along the fringes. White Willow forest is very common on river levees and on fluvial sand banks in the river in the fluvial part of the Delta. The distribution of Willows and Poplars is related to the flooding regime. While White Willows survive flooding periods up to 6 months, *Populus alba* and hybrid poplars (in planted forest) are limited to habitats with maximally 3 months of flooding.

In the marine and transitional parts of the Delta, White Willow forest is associated with fresh river water, like tall Reed is in the marsh vegetations. The White Willow forest, however, grows in better drained habitats than tall Reed, and never on peat soils. Comparing the species in White Willow forest with those in tall Reed areas, we see that many species from wet conditions are absent in the White Willow forest (*Oenanthe aquatica*, *Berula erecta*, *Thelypteris palustris*, *Iris pseudacorus*, *Sium latifolium*).

.....
Natural floodplain forest at Lake Lung



White Willow forest often grows in mosaics with river levee pasture, or - if grazed by cattle only extensively - it has an undergrowth with many grasses (e.g. *Agrostis stolonifera*).

On river levees in the marine part of the Delta, where the Sf.Gheorghe Danube branch cuts through extensive peat landscapes, Alder trees *Alnus glutinosa* mix into the White Willows on the narrow clayey river levees. Often they grow together with Ashes *Fraxinus angustifolia* and *F. pallisiae*. In such case, the Ashes grow in the most elevated part of the levee, accompanied by bushes *Viburnum opulus*. The liana *Periploca graeca* occurs in river levee forests exclusively when *Alnus glutinosa* is present. Very locally, *Alnus glutinosa* is dominant in the tree layer. Conspicuous, here, is the presence of *Leucojum vernum*. This species is characteristic for forests in the transitional zones between river levee clay and peat deposits.

Alnus or *Alnus*-*Fraxinus* forest sometimes grows in mosaics with humid river levee pasture (*Galega officinalis* type). Exceptional gradients occur where (near Sf.Gheorghe) *Alnus*-*Fraxinus* forest grows in a mosaic with moderately saline pasture (*Agrostis gigantea* ssp. *pontica* type).

Alnus glutinosa is an Atlantic/Central European species. The Danube Delta is situated at the continental margin of its climatically determined area of distribution. *Alnus glutinosa* prefers base-poor fresh water habitats with mollic or histic sandy soils, and constant high water tables. Mollic/histic sandy soils with high water tables are present in the Danube Delta. Due to the precipitation deficit in the continental climate, however, those habitats are in the Danube Delta normally too salinised to be suitable for *Alnus glutinosa*. This is reflected in the isolated character and small size of the *Alnus glutinosa* stands in the Danube Delta, and in the apparent poor vitality of the *Alnus glutinosa* trees in stands like at lake Erenciuc. Nevertheless this position at the margin of the area of distribution makes the *Alnus glutinosa* stands of the Danube Delta geobotanically important sites.

6.9 Floodplain Bushes

Two associations are presented from levees in bush vegetations. The halophilous character of these bushes is reflected by the species composition in the annex 3, legend units 38 and 39.

Tamarix ramosissima is a salt tolerant bush. This is reflected by the presence of the very salt tolerant herbs *Salicornia patula*, *Spergularia media* and the moderately salt tolerant species *Aster tripolium* ssp. *pannonicus* and *Petasites spurius* in *Tamarix*-bushes. *Tamarix* bushes are widely spread on salinised river levees. On less saline and more sandy soils grow *Hippophae rhamnoides* bushes. They mix often with coastal dune vegetations, as is reflected by the presence of *Petasites spurius* in the levee.

Elaeagnus angustifolia has been introduced to the Danube Delta by man in plantations. However, it found in the Delta good conditions for natural reproduction, forming mixed bushes with *Hippophae* and sometimes with *Tamarix*.

A completely different habitat has been invaded by the bush *Amorpha fruticosa*, another introduced bush species. This North-American species

spreads along the fringes of the river levee forest with *Salix alba* and *S. Fragilis* (sharing *Galega officinalis* as a common species), and also mixes into *Salix cinerea* bushes in peat areas. The very species-poor levee in *Amorpha* bushes contains no salt tolerant species.

6.10 Aquatic vegetations

The aquatic plant communities of the Danube Delta have been described in the literature (Godeanu 1976; Popescu & Sanda 1976). The following description refers to the work of these authors. Recently, research is carried out on aquatic vegetation in the Romanian Danube Delta to reveal the trophic gradients in floodplain lakes (Oosterberg *et al.*, 2002). The legend units of 41 to 44 are referring to aquatic vegetations, examples of 6 associations of the levee 41 can be found in the annex 3.

Aquatic vegetations in the larger lakes consist of the submerse creeping *Charion fragilis* on the lake bottom, the relatively robust submerse Magnopotamion and Ceratophylletum demersi vegetations, and the equally robust floating Water Lily vegetations belonging to the Nymphaeion suballiance. Usually, when not too much exposed to waves, these lakes are bordered by marsh vegetations of *Typha angustifolia* and/or *Schoenoplectus lacustris*. Lake shores with an exposition to strong waves will develop vegetations with Reed and tall forbs (*Bidens sp.*, *Epilobium hirsutum*).

In smaller and more sheltered water bodies occur the less robust floating/submerse vegetations Nymphoidetum peltatae, Trapaetum natantis, Potametum natantis. In streams these are joined by the submerse Myriophyllo-Potametum association.

In the smallest and most sheltered waters the fragile floating/submerse vegetations Stratiotetum aloidis, Hydrocharetum morsus-ranae, Lemno-Salvinetum natantis, Myriophylletum spicati and Lemno-Utricularietum can be found.

Several lake categories were distinguished from the satellite image. Lakes were either dominated by one type, or by only a few, for instance when there was a channel inflow into the lake. In several (larger) lakes, a gradient between clear and turbid water was visible. Most of the lakes were of the clear water/vegetation type (in particular the smaller ones). The larger lakes (>1 km cross-section) were generally turbid, due to high concentrations of suspended matter.

The vegetation classification produced a number of types of aquatic vegetation. The greatest variation in the vegetation was found in small lakes (<10 ha). Ceratophyllum demersum-vegetation and Nymphaea/Nuphar vegetation showed little or no dependence on lake size, soil type, or water quality, while vegetation types of charophytes (e.g. *Nitellopsis obtusa*, *Potamogeton lucens* and *Myriophyllum spp.*) characterised the clear lakes with a dense cover of vegetation.

The lakes in the Danube Delta can be characterised by their rich aquatic vegetation. The richest vegetation, including dominance by charophytes, are found in isolated lakes. The large lakes in the Gorgova-Uzlina, Roşu-Puiu, and Merhei complexes, however, typically represented turbid lakes with a sparse submersed vegetation.

Eutrophic water from the river enters the lake particularly during high dis-

charges (usually in April-May). Depending on the local situation, the inflow may largely be water filtered during its path through extensive reed-beds, or from channel connections to the main branches of the delta. In the latter case, the inflowing water carries a high load of suspended solids, causing gradients from turbid to more clear water within a lake.

Vegetation distribution within a lake reflects the gradients of depth and transparency of the water (Spence, 1982). Probably, the presence of a dense vegetation structure enhances the latter gradient. There is a strong seasonal variation in water quality of the lakes, depending on the flood stage of the river Danube, together with the hydrological state of the lakes. Throughflow lakes are continuously flushed by water from the river, whereas isolated lakes only receive water during periods of rising water levels. Consequently, in many lakes seasonality of the vegetation was observed.

From the data it is concluded that (a) lake size, (b) connectivity, (c) morphometry, and (d) sediment determine vegetation density and composition of the lakes in the Danube Delta.

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7 Vegetation Map Legend

The legend of the vegetation map has no direct connection with the vegetation classification as described in the previous chapter. At approx. 1:140,000 scale most polygons upon the map consist of a mosaic of different units of vegetation classification. The units of legend, too, represent specific kinds of vegetation mosaics. Such a mosaics unit of legend is composed of several units of classification; their identification and proportion are summarised in the matrix tables in annex 2 and 3.

The legend of the map is composed of 43 vegetation units and 3 topographical units of agricultural polders, fish ponds and urban area, see table 7.1. The total mapped area (with exclusion of the waters of the Black Sea) is 544,491 ha. The surface of the individual legend units varies strongly. The smallest vegetation unit occupies 11 ha (natural flood bushes) in the Ukrainian territory. The largest vegetation unit occupies 37,270 ha of Reed vegetation (*Phragmites australis*) on compact plaur.

The complete data of the polygons size of the Transboundary Vegetation Map can be found in the annex 2.

Table 7.1
Surface areas of the vegetation legend units in the Danube Delta

Main unit	sub-unit	Romania (surface in ha)	Ukraine (surface in ha)	no.	
North Pontic vegetation of Beach/sea dune vegetation	Seashore pioneer vegetation (new sandbars)	0	282	1	
	Seashore vegetation	1122	149	2	
	Coastal high dune (2-3 m) vegetation	1407	35	3	
	Coastal intermediate dune (1-2 m) vegetation	7749	209	4	
	Coastal low dune (0.5-1.0 m) vegetation	1702	30	5	
	Vegetation in depressions between dunes strongly salinised	3454	214	6	
	Vegetation in depressions between dunes medium salinised	3526	78	7	
	Vegetation in depressions between dunes slightly salinised	5351	30	8	
	Vegetation on flat/riverine deposits strongly salinised	1324	117	9	
	Vegetation on flat/riverine deposits medium salinised	2760	396	10	
	Vegetation on flat/riverine deposits slightly salinised	0	194	11	
	Psammophilous steppe vegetation of danubian-deltaic type	Inland high dune vegetation	3954	0	12
		Inland medium dune vegetation	913	0	13
		Inland low dune vegetation	729	0	14

Table 7.1
Surface areas of the vegetation
legend units in the Danube Delta

Main unit	sub-unit	Romania (surface in ha)	Ukraine (surface in ha)	no.
Desert- steppe vegetation of Danube-delta type	Dry steppe vegetation on loess and rocks	64	0	15
River levee grassland	Grassland on lower levee	0	1361	16
	Grassland on medium high levee	1493	363	17
	Grassland on high river levee	7530	962	18
Marshy vegetation (South-European delta type)	Pure reedmace vegetation on mineral soils	1403	584	19
	Mixed reedmace vegetation on mineral soils	5095	824	20
	Mixed reedmace vegetation on organic soils	6063	0	21
	Mixed sedges vegetation on mineral soils	13528	1994	22
	Mixed sedges vegetation on organic soils	132	0	23
	Pure reed vegetation on mineral soils	29417	300	24
	Mixed reed vegetation on mineral soils	31786	5253	25
	Mixed reed vegetation and bushes/trees on mineral soils	2200	8150	26
	Mixed reed vegetation and bushes on organic soils	3359	5258	27
	Reed vegetation on salinised soils	23417	4806	28
	Reed vegetation on compact plaur	37270	0	29
	Reed vegetation and trees on compact plaur	11830	0	30
	Reed vegetation on open plaur	27573	0	31
	Reed vegetation and trees on open plaur	6552	0	32
	Forest/bush vege- tation of dunes	Natural dune forest	2744	0
Planted dune forest		1600	812	34
Forest/bush vege- tation of floodlands	Natural floodplain forest	11588	1107	35
	Natural floodplain forest with <i>Alnus glutinosa</i>	423	0	36
	Planted floodplain forest	9686	38	37
	Natural floodplain bushes	394	11	38
	Natural floodplain bushes with dense <i>Tamarix ramosissima</i> (sandy soils/ gley soils)	101	77	39
	Planted floodplain bushes	0	601	40

Table 7.1
Surface areas of the vegetation
legend units in the Danube Delta

Main unit	sub-unit	Romania (surface in ha)	Ukraine (surface in ha)	no.
Aquatic vegetation	floating aquatic vegetation	3853	4082	41
	submerged aquatic vegetation	23210	2425	42
	sparse macrophytes (clear water)	187	1957	43
	turbid without macrophytes (silt or algal bloom)	136088	77	44
Agricultural polder		45542	364	45
Fish ponds		13105	0	46
Village/Urban Area		9445	681	47

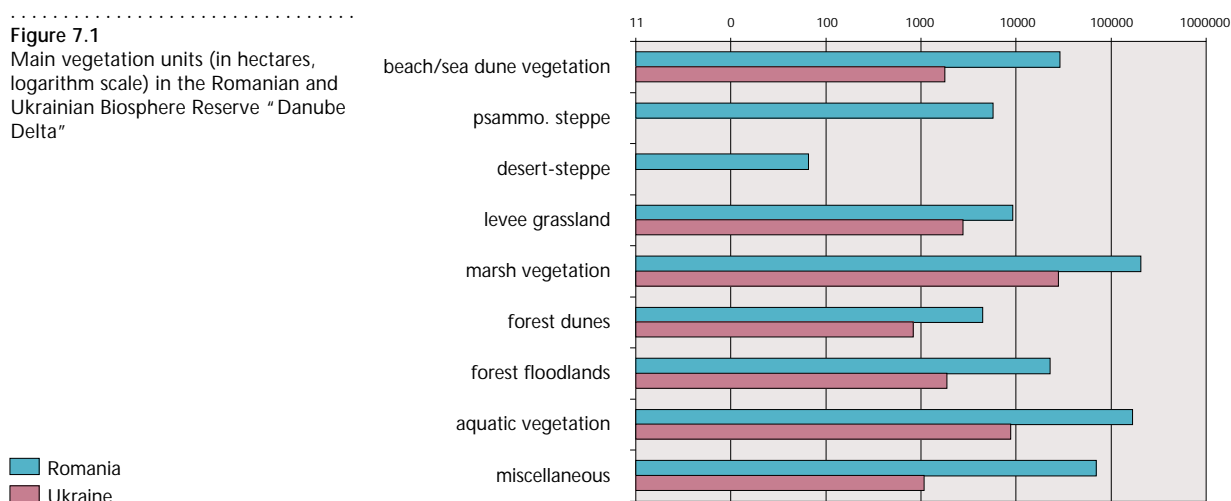
As could be derived from the map, there are certain legend units missing in the Romanian or in the Ukrainian territory.

Missing units in the Romanian territory are the legend units 1, 11, 16 and 40.

The first three mentioned units are typical for the new delta which is developing the Ukrainian Delta, that means that those vegetation associations have occurred in the Romanian part in former times but they are now transferred into other units, e.g. seashore pioneer vegetation is now seashore vegetation. The legend unit Natural floodplain bushes appears only in the Ukrainian Danube Delta, there are no bushes planted in the Romanian part.

Missing legend units in the Ukrainian territory are the units 12, 13, 14, 15, 21, 23, 29, 30, 31, 32, 33, 36, and 46. Of course, this is due to the evolution of the delta, as concerning the dune vegetation and the existence of Popina Island in Lake Razim, which is a remnant of the old tableland. In the main units of marsh vegetations, those associations referring to organic soils and/of to compact soils are missing in the Ukrainian part. Figure 7.1 gives an overview about the surface areas covered by main vegetation units in the Danube Delta.

Figure 7.1
Main vegetation units (in hectares,
logarithm scale) in the Romanian and
Ukrainian Biosphere Reserve "Danube
Delta"



8 Plant resources

Vegetation is a primary bioenergetic link in ecosystems of the delta, from which all further ways of migration of organic substance originate. Annually, the Danube Delta produces about 5 million tons of phytomass (air-dry weight), that is about 30% of primary production of all large rivers of the Northern Black Sea Region (Dubyna & Shelyag-Sosonko, 1989) and 0,15% of deltas all over the world (Leith, Wittaker, 1975). Forming of the primary production of the delta is mostly provided by mire vegetation, synthesized about 65-70% of its general quantity. The rest part of vegetation is aquatic and air-aquatic (10-15%), meadow (7%), wood-shrub (5%), saline and psammophyte (3%) vegetation.

The plant resources of the delta are of extreme ecological, social and economical importance in the region with limited, extraordinary transformed and exhausted natural resources. Besides of resource and utilitarian they are of much importance for environmental conservation, and also for use as a selected material. The last is caused by presence of large intraspecific diversity bound up with functioning of biotopes under conditions changed by many environmental factors. The deltas of the rivers of the Northern Black Sea Region are historically the refuges for many plant species of the northern regions of the continent survived here the troubles of the ice age. At the present period and later on these species area adapted to new environmental conditions, which is reflected in the intraspecific peculiarities at all levels of organization including molecular one. The last is not yet fully studied.

Concerning the plant resources, the fodder, technical, medicinal, decorative, food, poisonous, phytomeliorative and economic ones are of high interest. The group of food plants (in broad sense) is the largest. It is 34,0% of all flora of the Biosphere Reserve, meaning about 1460 vascular plants according to Romanian and Ukrainian data. In this group the honey-bearing and pollen-bearing plants prevail more than half of food plants. Among them the most areas are occupied by *Lycopus europaeus*, *Tripolium vulgare*, species of genera Limonium and Mentha, Epilobium, Melilotus and Stachys. There are many species, which are used as vegetable and salad (32,3%), especially *Apium graveolens* and *Portulaca oleraceae*. Species as substitutes of tea (15,9%), coffee (16,8%), mustard (10,1%) have much specific weight in the analysed group. *Rubus caesius*, for instance, is interesting as a substitute of tea (leaves, flowers and fruits are used). In Ukrainian part of the delta the primary production is 25-30 tons (Lebeda, Dubyna, Zhmud, 1999). Among these plants it ought to mark *Trapa natans*, which fruits are widely used in food.

At present in the area of the Kiliya branch of the Danube, the excessive extension of species leads to worse environmental conditions in these and adjacent ecotops. So, the partial and regulated withdrawing of *Trapa natans* fruits for economic purposes is becoming a problem for nature (Zhmud, 1996).

The representatives of family Fabaceae (Leguminosae) and Poaceae (Gramineae) are distinguished by fodder value.

Another large group are the medicinal plants, 28,4% of all reserve's flora. More than half of these species are used in people's medicine, one third - in officinal medicine and one fourth - in homeopathy. 3,2% of species are used for animal's treatment. Important resource species used in officinal medicine are the following: *Achillea setacea*, *Althaea officinalis*, *Amorpha fruticosa*, *Arctium lappa*, *Artemisia absinthium*, *A. vulgaris*, *Bidens tripartita*, *Capsella bursa-pastoris*, *Chelidonium majus*, *Cichorium inthybus*, *Equisetum arvense*, *Gratiola officinalis*, *Helichrysum arenarium*, *Hippophae rhamnoides*, *Humulus lupulus*, *Melilotus albus*, *M. officinalis*, *Plantago major*, *Polygonum aviculare*, *Populus nigra*, *Rumex confertus*, *Tanacetum vulgare*, *Taraxacum officinale*, *Tussilago farfara*, *Urtica dioica* and others. Among the medicinal plants, of a significant interest is *Hippophae rhamnoides*, which plantations are the natural in the delta. Only in the Ukrainian part of the Biosphere Reserve the general area of *Hippophae rhamnoides* is about 200 ha. Annually they produced more than 200 tons of fruits. Commercial provisions are 10% of the total.

16,5% of the reserve flora belongs to the group of technical plants. Reed harvesting is a traditional activity in the Danube Delta. Straw of *Phragmites australis* is used for thatching and building, and also as forage for cattle. The Reed exploitation increased during the last decennia, only in the Ukrainian delta over 350,000 sheaves of *Phragmites australis* were stored up. A tendency is observed to increase the *Phragmites australis* stores due to a worldwide rise of its demand. In Romania, reed is still harvested for thatching but the best quality reed is gotten outside of the Reed polders. The Reed is also used for the cellulose production in Braila. Until 1964 the annual Reed harvest was increasing up to 226,000 tons. But because of the heavy machinery destroying the Reed rhizomes, the amount of the harvest has decreased significantly. For the industrial harvest of high-quality Reed, it is necessary to have monodominant Reed marshes with one-year-old Reed shoots. In order to achieve this the reed has to be burned in winter before the growing season. But to restore the Reed dominance in areas, which have been invaded by other species, it takes about 3-4 years. Harvesting the whole surface every year is therefore not possible. Other species of this group are used incomparably less though their technical value is high. More than half total species number are appertaining

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Floating (*Trapa natans*) and diverse submerged vegetations in the Danube Delta lakes



to dyes species, 20,1% - tannic (*Rumex hydrolapatum*, species of genus Limonium, *Salix alba*, *S. cinerea*, *S. triandra* present resource interest), the rest are volatile oil-bearing and oil-yielding species (genera *Mentha*, *Artemisia*), spinning, cellulose-paper species, rubber-bearing plants and others.

The group of decorative plants, i.e. 22,4% of total flora's number, is quite numerous. It includes beautiful-flowered species (*Nymphaea alba*, *Nuphar lutea*, *Nymphoides peltata*, *Leucojum aestivum*, *Dactylorhiza majalis*, *Orchis palustris*, *Epipactis palustris*, *E. helleborine*, species of genus *Centaurea* and many others), and foliate-decorative species (*Trapa natans*, *Hydrocharis morsus-ranae*, *Stratiotes aloides*, species of genera *Sagittaria*, *Carex*, *Cyperus*, *Scirpus* etc.).

8,2% belong to the poisonous plant species. More than half of them (54,6%) are toxic for man and warm-blooded animals. Examples are *Anthriscus caucalis*, *Aristolochia clematitis*, *Caltha palustris*, *Cannabis ruderalis*, *Chelidonium majus*, *Cicuta virosa*, *Conium maculatum*, *Consolida regalis*, *Datura stramonium*, *Galega officinalis*, *Hyoscyamus niger*, *Oenanthe aquatica*, *Ranunculus acris*, *R. sceleratus*, *Sium latifolium*, *Solanum dulcamara* and *Vincetoxicum hirundinaria*.

A special group represent the phytomeliorative species, which can cover a lot of functions together with other plant species, e.g. anti-erosion, protection, accumulation, regulation, and water-clearing. Phytomeliorative species of common action are *Acer campestre*, *Alnus glutinosa*, *Quercus pedunculiflora*, *Fraxinus pallisiae*, *Amorpha fruticosa*, *Hippophae rhamnoides*, *Elaeagnus angustifolia*, *Populus alba*, *Salix cinerea*, *S. fragilis*, *S. purpurea*, *S. rosmarinifolia*, *S. triandra*, etc. More than 10% of total species number present water-clearing ones (*Agrostis gigantea*, *Elodea canadensis*, *Iris pseudacorus*, *Lemna minor*, *Phragmites australis*, species of genera *Potamogeton*, *Glyceria*, *Scirpus*, *Carex*, *Typha* and others). Species accumulating radionuclides are: *Aeluropus littoralis*, *Elodea canadensis*, *Hydrocharis morsus-ranae*, *Lemna minor*, *Lemna trisulca*, *Phragmites australis*, species of genus *Potamogeton*, *Stratiotes aloides*. Plants which accumulate rare metals are: *Lemna minor*, *Lolium multiflorum*, *Molinia caerulea*, *Phragmites australis*, species of genera *Potamogeton* and *Ruppia*.

For selection works the fodder species are much more important. The most prospective are the following species of genera: *Festuca* - *F. pratensis*, *F. arundinaceae*, *Medicago* - *M. kotovii*, *M. tenderiense*, *Trifolium* - *T. dubium*, *T. hybridum*, *T. pratense*, *T. diffusum*, *Vicia* - *V. angustifolia*, *V. picta*, *V. vilosa*, *Lathyrus* - *L. palustris*, *L. pratensis*.

The environmental, social, economical and scientific importance of plant resources in the Biosphere Reserve requires urgent conservation measures and sustainable use. The increase of anthropogenous impacts should be dealt with in such a dynamic ecosystem as the Danube Delta.

Rejuvenation will go on but we must be aware to keep the natural values and biodiversity.

The plant resources are regulated naturally by the hydrological regime and the alluvia carried by the Danube River and the Black Sea. The productivity and ratio of areas with different vegetation types depend on this natural power.

Contamination of water, a decrease of water flow and extraction activi-

ties, have led to a strong eutrophication, swamping of parts of reservoirs and their littoral territories, and an increased salinisation in certain areas. Non-regulated grazing, hydro-meliorative works, uncontrolled recreational use and other factors negatively influence biosphere ecosystems. This is accompanied by not only reducing of primary productivity but leads to destruction of soil cover and transformation of plant communities into low productive ones.

As a consequence - only sustainable use of plant resources should be allowed in the Biosphere Reserve "Danube Delta" .

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9 Red List species of vascular plants

The Danube Delta's universal value was acknowledged by including it in the Biosphere's international net of reservations (August 1990), as a part of the "Man and Biosphere" program (MAB) initiated by UNESCO in 1970. Danube's Delta Biosphere reservation was acknowledged in September 1990, as International importance wet zone, especially for water birds habitat - Ramsar Convention (8-th place for its surface among other 600 similar areas). Reservation's value as a universal natural patrimony was acknowledged by including it in the List of Natural Cultural Worldwide Patrimony, in December 1990. It involves the territories of the Biosphere Reserve "Danube Delta" in Romania (area is 580,000 ha) and Danube Biosphere Reserve in Ukraine (area is 46,403 ha).

Its establishment is a political effort to unificate two states on protection and conservation of an unique ecosystem and the biodiversity in the Danube Delta and to promote non-exhausted and sustainable use in this region. The support of nature conservation organizations played a very important role.

To establish and develop the Biosphere Reserve, scientific cooperations are important in order to provide an optimal functioning of the Danube Delta ecosystems. Among the paramount tasks, a phytosociological assessment of species and population state of the biosphere reserve has been implemented on unified principles and approaches. The assessment resulted in the "Red List", which is a basic tool to conserve species and communities.

Establishment of the first "Red List of the Biosphere Reserve Danube Delta" was important to have effective international cooperation in the field of conservation species, coenotic abundances and diversity of plants within an unique phytogeographical region of Europe. The Red List was prepared on the base of published lists of rare, endangered and other threatened categories for species of vascular plants in the Romanian and Ukrainian parts of delta. These lists were composed by detailed observations/surveys of the mentioned areas by Romanian botanists (Ciocârlan, 1994; Ciocârlan *et al.*, 2000) and Ukrainian botanists (Dubyna, 1990; Dubyna, 1999; Mosyakin, 1999). Basic criteria for categories of species and population conservation have been developed by the Standing Commission of endangered plant and animal species of the World Conservation Union (IUCN) by Walter *et al.*, 1997. The Romanian and Ukrainian botanists have made supplements and proposed more accurate definitions.

The Red List consists of 518 vascular plant species that is 35,5% of all flora of the Biosphere Reserve "Danube Delta" (Annex 4). The complete list of vascular plant flora of the Biosphere Reserve "Danube Delta" comprises 1460 species (Ciocârlan *et al.*, 2000; Dubyna, 1999).

The plant species cover a broad environmental range from semi-desert (tableland) to waterrich areas. In the delta area a lot of species are in danger because of the ongoing impact of man. Over the last four to five decades, the deterioration in habitats and loss in species was caused by (Baboianu and Goriup, 1995):

- construction of dams upstream subtly altering the flooding regime;
- creation of agricultural polders and fish ponds (reducing the natural area by more than 20%);

- increased eutrophication resulting in loss of aquatic vegetation plus change in fish communities;
- extension and excavation of channels for navigation leading to a poorer water quality within the delta.

In the delta, boreal species of wide environmental range have found favourable conditions, continuous areals belong to the forest and forest-steppe zones. The zones mainly occur along the Danube branches and they are rare and endangered. Also in the delta area their habitats are sharply reduced because of worsening of environmental conditions. Most of those species refer to the Red List (*Carex dioica*, *C. acuta*, *C. rostrata*, *Padus avium*, *Caltha palustris*, *Utricularia minor*, *Thelypteris palustris*, *Viola palustris*, *Salix cinerea*, *Glyceria fluitans* and others).

In the Red List, almost all of species of Azovo-Black Sea, Black Sea and Caspian Sea endemic psammophyte floristic complex are listed. All of them are rare and endangered in the region due to melioration works (*Agrostis maeotica*, *Alyssum borzaeanum*, *A. savranicum*, *A. tortuosum*, *Arenaria rigida*, *A. zozii*, *Astragalus levinae*, *Asperula setulosa*, *Astragalus borysthenicus*, *Centaurea odessana*, *C. pontica* etc.). Their largest habitats are conserved only in the areas of the Danube, Dnieper and above-sea spits of the Black and Azov Seas.

Most of ancient Mediterranean species of flora connected ecogenetically with the Tethys littorals are enrolled in the Red List. In the region and in the area of the delta they are rare and endangered (*Typha minima*, *Zannichellia pedunculata*, *Cladium mariscus*, *Frankenia pulverulenta*, *Lythrum melanospermum*, *L. thymifolia*, *Sagittaria trifolia* etc.).

The Red List contains a significant quantity of the Central and the West-European species, which are rare and endangered in the southern regions of Europe, e.g. *Carex elata*, *Urtica kijoviensis*, *Euphorbia lucida*, *Potamogeton acutifolius* etc. A group of plurizonal species is also represented sufficiently. They are rare and endangered man made changes of ecotopes, as *Marsilea quadrifolia*, *Ruppia maritima*, *Limnosella aquatica*, *Lemna gibba*, *Wolffia arrhiza*, *Aldrovanda vesiculosa* etc.

Most part of the remaining species on the Red List are vulnerable because of the difficulty to keep the environmental conditions intact.

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Annex 1

Printed Transboundary Vegetation
Map of the Biosphere Reserve
"Danube Delta"

The map is added to the report - Vegetation of the Biosphere Reserve
"Danube Delta" - in the fold of the back cover page.

Annex 2

Table with surface area of the different legend units of Transboundary Vegetation Map of the Biosphere Reserve "Danube Delta"

The surface areas per legend unit are derived from the ARCVIEW-files. The amount of hectares is given for the total area and for Romania and Ukraine apart.

Main unit	sub-unit	association	Total surface area (in ha)	Romania (surface in ha)	Ukraine (surface in ha)	no.
North Pontic vegetation of Beach/sea dune vegetation	Seashore pioneer vegetation (new sandbars)	<i>Polygonum patulum</i> , <i>Rumex maritimus</i> , <i>Bidens tripartita</i> , <i>Echinochloa crus-galii</i> , <i>Chenopodium ambrosioides</i> , <i>Ch. rubrum</i> , <i>Ch. album</i> , <i>Artemisia annua</i> , <i>Suaeda prostrata</i> , <i>Xanthium rupicola</i> , etc.	282	0	282	1
	Seashore vegetation	<i>Crambetum maritimae</i> , <i>Elymetum gigantei</i> , <i>Cakiletum friscum</i> , <i>Tournefortietum sibiricae</i> , <i>Salsoletum sodae</i>	1270	1122	149	2
	Coastal high dune (2-3 m) vegetation	<i>Ephedro - Caricetum colchicae</i> , <i>Poo bulbosae - Caricetum colchicae</i> , <i>Secalo sylvestre - Alyssetum borzeanii</i> , <i>Scabioso ucrainicae - Caricetum ligericae</i> , <i>Hippophaë - Salicetum elaeagni</i> , <i>Centaureo odessanae - Festucetum beckeri</i>	1441	1407	35	3
	Coastal intermediate dune (1-2 m) vegetation	<i>Artemisietum arenariae</i> , <i>Hippophaë - Salicetum elaeagni</i> , <i>Secaletum sylvestre</i>	7959	7749	209	4
	Coastal low dune (0.5-1.0 m) vegetation	<i>Puccinellietum limosae</i> , <i>Aeluropetum littoralis</i> , <i>Cynodontetum dactyloni</i> , <i>Agrostetum ponticae</i>	1732	1702	30	5
	Vegetation in depressions between dunes strongly salinised	<i>Salicornietum prostratae</i> , <i>Suaedetum maritimae</i> , <i>Bassietum hirsutae</i> , <i>Suaedo maritimae - Salicornietum prostratae</i>	3668	3454	214	6
	Vegetation in depressions between dunes medium salinised	<i>Juncetum maritimi</i> , <i>Juncetum acuti</i> , <i>Juncetum maritimi - Caricetum extensae</i> , <i>Tamarix ramosissima</i> , on ridges: <i>Aperetum maritimae</i>	3603	3526	78	7
	Vegetation in depressions between dunes slightly salinised	<i>Bolboschoenetum maritimi</i> , <i>Tripolio vulgare - Bolboschoenetum maritimae</i> , <i>Agrosti - Caricetum distantis</i>	5381	5351	30	8
	Vegetation on flat/riverine deposits strongly salinised	<i>Secaletum sylvestre</i> , <i>Ephedro - Caricetum colchicae</i>	1441	1324	117	9
	Vegetation on flat/riverine deposits medium salinised	<i>Scabioso ucrainicae - Caricetum ligericae</i> , <i>Festucetum beckeri - Centaureum odessanae</i> , <i>Quercetum roboris-pedunculiflorae</i> , <i>Fraxinetum pallisae</i>	3156	2760	396	10
	Vegetation on flat/riverine deposits slightly salinised	<i>Cynodonetum dactyloni</i> , <i>Aperetum maritimae</i>	194	0	194	11
Psammophilous steppe vegetation of danubian-deltaic type	Inland high dune vegetation	<i>Secaletum sylvestre</i> , <i>Ephedro - Caricetum colchicae</i>	3954	3954	0	12
	Inland medium dune vegetation	<i>Scabioso ucrainicae - Caricetum ligericae</i> , <i>Festucetum beckeri - Centaureum odessanae</i> , <i>Quercetum roboris-pedunculiflorae</i> , <i>Fraxinetum pallisae</i>	913	913	0	13
	Inland low dune vegetation	<i>Cynodonetum dactyloni</i> , <i>Aperetum maritimae</i> , <i>Dauco (guttati) - Chrysopogonetum grylli</i>	729	729	0	14
Desert- steppe vegetation of Danube-delta type	Dry steppe vegetation on loess and rocks	<i>Agropyretum pectiniforme</i> , <i>Agropyro - Thymetum zygoidi</i>	64	64	0	15
River levee grassland	Grassland on lower levee	<i>Rorippo amphibiae - Oenanthetum aquatica</i> , <i>Bolboschoenetum maritimi</i> , <i>Caricetum gracilis</i>	1361	0	1361	16
	Grassland on medium high levee	<i>Festucetum regeliana</i> , <i>Agropyretum elongatae</i> , <i>Agrostetum ponticae</i>	1856	1493	363	17
	Grassland on high river levee	<i>Cynodonteum dactyloni</i> , <i>Cynodonto - Plantagnetum coronopi</i> , <i>Bassietum sedoidis</i> , <i>Hordetum murini</i> , <i>Elytrigetum repentis</i>	8492	7530	962	18

Marshy vegetation (South - European delta type)	Pure reedmace vegetation on mineral soils	Typhetum angustifoliae	1987	1403	584	19
	Mixed reedmace vegetation on mineral soils	Typhetum angustifoliae, Scirpo-Phragmitetum, Salicetum albao-fragilis	5919	5095	824	20
	Mixed reedmace vegetation on organic soils	Typhetum angustifoliae, Scirpo-Phragmitetum, Caricetum acutiformis	6063	6063	0	21
	Mixed sedges vegetation on mineral soils	Caricetum elatae, Scirpo-Phragmitetum, Typhetum angustifoliae	15522	13528	1994	22
	Mixed sedges vegetation on organic soils	Caricetum acutiformis, Thelypterido-Phragmitetum, Salicetum cinereae	132	132	0	23
	Pure reed vegetation on mineral soils	Phragmitetum communis	29717	29417	300	24
	Mixed reed vegetation on mineral soils	Phragmitetum communis, Typhetum angustifoliae, Caricetum acutiformis-ripariae	37039	31786	5253	25
	Mixed reed vegetation and bushes/trees on mineral soils	Phragmitetum communis, Salicetum albo-fragilis, Thelypterido-Phragmitetum,	10350	2200	8150	26
	Mixed reed vegetation and bushes on organic soils	Scirpo-Phragmitetum, Phragmitetum communis, Typhetum angustifoliae, Caricetum acutiformis-ripariae, Salicetum cinereae	8617	3359	5258	27
	Reed vegetation on salinised soils	Astero-tripolii-Phragmitetum	28223	23417	4806	28
	Reed vegetation on compact plaur	Thelypterido-Phragmitetum	37270	37270	0	29
	Reed vegetation and trees on compact plaur	Thelypterido-Phragmitetum, Salicetum cinereae, Salicetum albao-fragilis	11830	11830	0	30
	Reed vegetation on open plaur	Thelypterido-Phragmitetum-Salvinietosum	27573	27573	0	31
	Reed vegetation and trees on open plaur	Thelypterido-Phragmitetum-Salvinietosum, Salicetum cinereae	6552	6552	0	32
Forest/bush vegetation of dunes	Natural dune forest	Quercetum roboris-pedunculiflorae, Fraxinetum pallisae,	2744	2744	0	33
	Planted dune forest	Saliceto-Populetum, Pinus pallisiana	2412	1600	812	34
Forest/bush vegetation of floodlands	Natural floodplain forest	Salicetum albo-fragilis, Saliceto-Populetum, Fraxinus sp., Salicetum cinereae	12695	11588	1107	35
	Natural floodplain forest with Alnus glutinosa	Salicetum albo-fragilis, Saliceto-Populetum, Fraxinus sp., Salicetum cinereae, Alnion glutinosae	423	423	0	36
	Planted floodplain forest	Populus X; Salix sp. Fraxinus sp.	9724	9686	38	37
	Natural floodplain bushes	Hippophaë -Salicetum elaeagni, Tamaricetum ramosissimi	405	394	11	38
	Natural floodplain bushes with dense Tamarix ramosissima (sandy soils/ gley soils)	Tamaricetum ramosissimi	178	101	77	39
	Planted floodplain bushes	Tamarix ramosissima, Elaeagnus angustifolia, Salix acutifolia	601	0	601	40
Aquatic vegetation	floating aquatic vegetation	Nymphaetum albo-luteae, Trapo-Nymphoidetum peltatae, Nymphaetum albae, Trapetum natantis, Lemno-Azolletum caroliniana, Salvinio-Hydrocharetum	7936	3853	4082	41
	submerged aquatic vegetation	Myriophylletum spicati, Potametum pectinati, P. perfoliati, Najadetum maritimae, Zannichellietum pedunculata and others	25635	23210	2425	42
	sparse macrophytes (clear water)	Potamogeton pectinatus, P. perfoliatus, P. trichoides, Myriophyllum spicatum, Najas marina, Elodea nutali,	2145	188	1957	43
	turbid without macrophytes (silt or algal bloom)	Cladophora, Spirogyra, Nostoc, Hydrodyction and other species of this genera	136165	136088	77	44
Agricultural polder			45906	45542	364	45
Fish ponds			13105	13105	0	46
Village/Urban Area			10126	9445	681	47

Annex 3

Vegetation Association Tables – relevés
for the Transboundary Vegetation Map
of the Biosphere Reserve “Danube
Delta” (legend unit in grey blok);
explanation of values for % coverage:

5 = 75 - 100%
4 = 50 - 75%
3 = 25 - 50%
2 = 10 - 25%
1 = 5 - 10%
+ = < 5%

2

Cls. *Cakiletea maritimae* Tx.et Prsg.1950

Ord. *Cakiletalia matitimae* Tx.apud Oberd. 1949

All. *Cakilion maritimae* Morariu 1957

Ass. *Crambetum maritimae* (I.Șerb.1965) Popescu *et al.* 1980

Relevee no.	1	2	3	4	5
Cover %	60	55	65	50	65
Surface of relevee (m ²)	10	25	6	25	20
<i>D.s. of the ass. Crambetum maritimae</i>					
<i>Cakile maritima</i>	3	3	3	2	3
<i>D.s. of the Cakilion maritimae</i>					
<i>Crambe maritima</i>	+	-	1	+	-
<i>Argusia sibirica</i>	1	1	+	-	1
<i>Polygonum maritimum</i>	+	+	-	+	-
<i>D.s. of the Cakiletalia matitimae</i>					
<i>Atriplex hastata</i>	+	-	+	1	+
<i>Salsola ruthenica</i>	-	+	-	+	-
<i>Glaucium flavum</i>	-	-	+	+	-
<i>D.s. of the Cakiletea maritimae</i>					
<i>Centaurea arenaria</i>	-	+	-	-	+
<i>Secale sylvestre</i>	+	+	1	1	+
<i>Medicago falcata</i> var. <i>filiformis</i>	-	-	-	1	+
<i>Other species</i>					
<i>Leymus sabulosus</i>	-	+	-	+	+
<i>Euphorbia seguieriana</i>	+	-	-	+	-
<i>Xanthium strumarium</i>	-	-	-	+	-
<i>Eryngium maritimum</i>	-	-	-	+	-
<i>Agropyron junceum</i>	-	-	+	-	1

Ass. *Elymetum gigantei* Morariu 1957

Relevee no.	1	2	3	4	5
Cover %	60	60	40	50	50
Surface of relevee (m ²)	25	25	25	25	25
<i>D.s. of the ass. Elymetum gigantei</i>					
<i>Leymus sabulosus</i>	4	4	2	3	4
<i>Leymus arenarius</i>	1		+		
<i>D.s. of the Ammophiletea</i>					
<i>Eryngium maritimum</i>	+	+	+	+	+
<i>D.s. of the Festucetea vaginatae</i>					
<i>Artemisia arenaria</i>	3		1	2	1
<i>Linaria genistifolia</i>					+
<i>D.s. of the Cakiletea maritimae</i>					
<i>Cakile euxina</i>	+				
<i>D.s. of the Crithmo-Staticetea</i>					
<i>Lactuca tatarica</i>	+				
<i>D.s. of the Agropyretea repentis</i>					
<i>Calamagrostis epigeios</i>	1			1	
<i>D.s. of the Artemisietea vulgaris</i>					
<i>Melilotus albus</i>				2	
<i>Other species</i>					
<i>Picris rigida</i>	+	+	+		
<i>Gypsophila perfoliata</i>	1				+
<i>Linum austriacum</i>		+			+
<i>Cynanchum acutum</i>					+
<i>Anchusa leptophylla</i>					4
<i>Syrenia cana</i>		3			
<i>Medicago kotovii</i>		+			
<i>Centaurea odessana</i>			1		

Cls. Festucetea vaginatae Soo 1968
 Ord. Festucetalia vaginatae Soo 1957
 All. Scabiosion argenteae (Boşcaiu 1975)Popescu, Sanda 1987
Ass. Secali sylvestri – Alyssoidetum borzaeani (Borza 1931 n.n.) Morariu 1959

3

Relevee no.	1	2	3	4	5
Cover %	80	75	85	80	75
Surface of relevee (m ²)	50	50	25	50	100
<i>D.s. of the ass. Secali sylvestri – Alyssoidetum borzaeani</i>					
Secale sylvestre	3	2	2	1	2
Alyssum borzaeanum	2	2	3	4	3
<i>D.s. of the Scabiosion argenteae</i>					
Scabiosa argentea	+	+	+	-	+
Carex colchica	1	1	+	+	+
Medicago falcata var. filiformis	+	-	-	+	-
Silene thymifolia	+	-	+	-	+
Ephedra distachya	+	1	-	-	+
<i>D.s. of the Festucetalia vaginatae</i>					
Artemisia arenaria	+	+	-	-	1
Inula salicina	+	-	-	+	-
Holoschoenus vulgaris	-	+	1	-	-
Astragalus varius	-	+	-	+	-
Astragalus virgatus	-	-	+	+	+
Euphorbia seguieriana	-	1	+	+	+
<i>D.s. of the Festucetea vaginatae</i>					
Echinops ruthenicus	+	-	-	+	-
Gypsophila paniculata	-	+	-	-	-
Helychrysum arenarium	-	-	-	+	-
Cynanchum acutum	-	-	-	+	+
Syrenia cana	-	-	-	+	-
<i>Other species</i>					
Plantago argentea	+	+	-	+	-
Atriplex hastata	+	-	+	-	-
Chondrilla juncea	-	+	-	+	-
Trifolium arvense	-	-	+	-	+
Erysimum diffusum	-	-	+	-	-
Filago arvensis	-	-	-	+	-

Cls. Ammophiletea Br. -Bl. et R.Tx. 1943
 Ord. Elymetalia gigantei Vicherek 1971
 All. Elymion gigantei Morariu 1957 em Gehu, Roman et Boulett 1992
Ass. Artemisietum arenariae Popescu et Sanda 1975

4

Relevee no.	1	2	3	4	5
Cover %	50	70	60	50	60
Surface of relevee (m ²)	25	25	25	25	25
<i>D.s. of the ass. Artemisietum arenariae</i>					
Artemisia arenaria	4	4	4	4	4
<i>D.s. of the Ammophiletea</i>					
Leymus sabulosus	+	2	1		1
Eryngium maritimum	+	+	+		+
<i>D.s. of the Festucetea vaginatae</i>					
Secale sylvestre	+	+	+	+	+
Carex colchica	+	+	+	+	+
<i>D.s. of the Festuco-Puccinellietea</i>					
Salsola soda		+	1	3	
<i>D.s. of the Cakiletea maritima</i>					
Cakile euxina				1	
<i>D.s. of the Crithmo-Staticetea</i>					
Lactuca tatarica				1	
<i>Other species</i>					
Centaurea odessana	+	+	+		
Picris rigida	+		+		
Leymus arenarius	+	+			
Medicago kotovii	+				+
Amorpha fruticosa		+			
Petasites spurius		+			
Rosa schmalgauseniana				+	
Syrenia cana					1
Tragopogon borysthenicus		+			

Ass. *Secaletum silvestre* Popescu et Sanda 1973

Relevee no.	1	2	3	4	5
Cover %	60	50	40	40	30
Surface of relevee (m ²)	25	25	25	25	25
<i>D.s. of the ass. Secaletum silvestre</i>					
<i>Secale sylvestre</i>	4	3	2	1	+
<i>D.s. of the Festucetea vaginatae</i>					
<i>Euphorbia sequierana</i>	3	+	1	2	1
<i>Carex colchica</i>	+	1	+	+	+
<i>Kochia laniflora</i>	+	+	+	+	+
<i>Linaria genistifolia</i>	+				+
<i>Gypsophila paniculata</i>			1		
<i>D.s. of the Ammophiletea</i>					
<i>Leymus sabulosus</i>		2			1
<i>D.s. of the Agropyretea repentis</i>					
<i>Bromus squarrosus</i>	1	+	2	2	2
<i>Calamagrostis epigeios</i>			1	1	
<i>D.s. of the Molinio-Arrhenatheretea</i>					
<i>Alopecurus pratensis</i>		+			
<i>Poa pratensis</i>				+	
<i>D.s. of the Asteretea tripolium</i>					
<i>Juncus gerardii</i>				+	
<i>D.s. of the Crithmo-Staticetea</i>					
<i>Lactuca tatarica</i>		+			
<i>D.s. of the Festuco-Brometea</i>					
<i>Plantago salsa</i>				1	
<i>D.s. of the Artemisietea vulgaris</i>					
<i>Lappula squarrosa</i>		+			
<i>D.s. of the Chenopodietea</i>					
<i>Hordeum murinum</i>		+			
<i>D.s. of the Galio-Urticetea</i>					
<i>Calystegia sepium</i>		1			
<i>D.s. of the Secalietea</i>					
<i>Thlaspi arvense</i>		1			
<i>Apera spica-venti</i>				1	
<i>Other species</i>					
<i>Medicago kotovii</i>	+	1		+	+
<i>Gypsophila perfoliata</i>	1	2	+	1	
<i>Cynodon dactylon</i>		1		1	1
<i>Scirpoides holoschoenus</i>	1		5	1	
<i>Verbascum banaticum</i>			+	+	+
<i>Artemisia austriaca</i>				2	2
<i>Linum austriacum</i>		1	1		
<i>Melilotus albus</i>	+				
<i>Anisantha tectorum</i>		+			
<i>Alyssum desertorum</i>					+
<i>Achillea micrantha</i>		2			
<i>Plantago scabra</i>	2				
<i>Onosma borysthenica</i>			+		
<i>Tribulus terrestris</i>	+				
<i>Centaurea odessana</i>			+		
<i>Picris rigida</i>			1		
<i>Chondrilla graminea</i>					2
<i>Apium graveolens</i>		+			
<i>Eragrostis pilosa</i>		1			
<i>Bromus japonicus</i>				1	
<i>Lithospermum officinale</i>			+		
<i>Camelina rumelica</i>			1		
<i>Teucrium scordium</i>			1		
<i>Vincetoxicum hirundinaria</i>			+		
<i>Inula salicina</i>			1		
<i>Syrenia cana</i>	+				

Cls. Puccinellio-Salicornietea Țopa 1939
 Ord. Puccinellietalia Soo 1947 em. Vicherek 1973
 All. Puccinellion limosae Soo 1933
Ass. Puccinellietum limosae (Rapaics et Soo 1937)

5	Relevee no.	1	2	3	4	5
	Cover %	75	85	80	85	80
	Surface of relevee (m ²)	50	75	50	100	100
	<i>D.s. of the ass. Puccinellietum limosae</i>					
	<i>Puccinellia limosa</i>	4	3	5	4	3
	<i>D.s. of the Puccinellion limosae</i>					
	<i>Aeluropus littoralis</i>	+	-	+	1	1
	<i>Obione pedunculata</i>	+	+	+	-	-
	<i>Artemisia santonicum</i>	+	1	-	+	+
	<i>Agrostis gigantea ssp. pontica</i>	+	1	+	-	1
	<i>Limonium bellidifolium</i>	+	-	+	1	-
	<i>D.s. of the Puccinellietalia</i>					
	<i>Lotus tenuis</i>	+	1	-	+	+
	<i>Aster tripolium</i>	+	-	-	+	1
	<i>Bassia hirsuta</i>	-	+	-	-	-
	<i>Chenopodium glaucum</i>	+	-	+	-	-
	<i>Atriplex hastata</i>	-	+	+	+	-
	<i>Lepidium ruderae</i>	-	+	-	-	+
	<i>D.s. of the Puccinellio-Salicornietea</i>					
	<i>Limonium gmelini</i>	+	+	-	-	+
	<i>Matricaria chamomilla</i>	-	+	-	+	1
	<i>Podospermum canum</i>	+	-	+	+	+
	<i>Taraxacum bessarabicum</i>	-	-	+	+	-
	<i>Puccinellia intermedia</i>	-	1	+	-	1
	<i>Plantago maritima</i>	-	-	-	+	-
	<i>Other species</i>					
	<i>Potentilla supina</i>	+	-	-	-	+
	<i>Agrostis stolonifera</i>	-	+	-	-	+
	<i>Lolium perenne</i>	-	-	+	-	+

Cls. Puccinellio-Salicornietea Țopa 1939
 Ord. Salicornietalia Br.-Bl.(1929)1933
 All. Salicornion prostratae Sanda, Popescu 1999
Ass. Salicornietum prostratae Soo(1947)1964
 (Syn. Salicornietum europaeae Soo 1927)

6	Relevee no.	1	2	3	4	5
	Cover %	65	60	50	70	65
	Surface of relevee (m ²)	25	20	40	25	30
	<i>D.s. of the ass. Salicornietum prostratae</i>					
	<i>Salicornia prostrata</i>	3	3	3	3	2
	<i>D.s. of the Salicornion prostratae</i>					
	<i>Suaeda maritima</i>	+	1	+	1	1
	<i>Salsola soda</i>	+	-	-	+	+
	<i>D.s. of the Salicornietalia</i>					
	<i>Aster tripolium</i>	1	+	-	1	+
	<i>Chenopodium glaucum</i>	+	-	-	-	+
	<i>D.s. of the Puccinellio-Salicornietea</i>					
	<i>Puccinellia limosa</i>	1	1	+	+	+
	<i>Aeluropus littoralis</i>	-	+	-	+	+
	<i>Obione verrucifera</i>	+	+	1	-	+
	<i>Hordeum hystrix</i>	-	+	+	-	-
	<i>Lotus tenuis</i>	-	+	-	-	+
	<i>Parapholis incurva</i>	-	-	1	-	-
	<i>Podospermum canum</i>	-	+	+	-	-
	<i>Limonium gmelini</i>	+	-	-	+	-
	<i>Atriplex litoralis</i>	-	-	-	+	+
	<i>Spergularia maritima</i>	+	-	-	-	+
	<i>Puccinellia distans</i>	-	+	+	-	-
	<i>Atriplex hastata</i>	-	-	+	-	+
	<i>Juncus gerardi</i>	-	-	-	-	+
	<i>Other species</i>					
	<i>Cynodon dactylon</i>	+	-	-	-	+
	<i>Bolboschoenus maritimus</i>	-	+	-	+	-
	<i>Trifolium fragiferum</i>	-	-	-	-	+

Cls. Juncetea maritimi Br./Bl.1931
 Ord. Juncetalia maritimi Br./Bl. 1931
 All. Juncion maritimi Br./Bl.1931
Ass. Juncetum maritimi (Rübel 1939)Pign. 1953

7

Relevee no.	1	2	3	4	5
Cover %	70	80	75	70	65
Surface of relevee (m ²)	25	50	50	50	40
<i>D.s. of the ass. Juncetum maritimi</i>					
Juncus maritimus	3	4	4	4	3
Agropyron elongatum	1	+	+	-	2
<i>D.s. of the Juncion maritimi</i>					
Artemisia maritima	+	1	1	-	+
Plantago maritima	+	-	-	-	-
Plantago cornuti	-	-	-	+	-
Aster tripolium ssp. pannonicus	1	1	+	+	+
Samolus valerandi	+	-	-	+	+
<i>D.s. of the Juncetalia maritimi</i>					
Lotus tenuis	-	+	+	-	+
Juncus gerardi	-	1	+	+	-
Taraxacum bessarabicum	-	-	+	-	+
<i>D.s. of the Juncetea maritimi</i>					
Carex extensa	+	-	1	-	-
Juncus littoralis	1	-	-	+	-
Schoenus nigricans	-	+	-	-	-
Centaurium pulchellum	+	+	-	-	+
<i>Other species</i>					
Festuca arundinacea	1	-	+	-	-
Cynanchum acutum	+	-	+	+	-
Bromus tectorum	-	+	-	-	-
Carex distans	+	-	-	+	-
Spergularia media	-	-	+	-	-
Suaeda maritima	-	-	+	-	-
Limonium gmelini	-	+	-	-	-
Plantago coronopus	-	-	-	-	+

Cls. Phragmitetea australis Tx. et Prsg.1942
 Ord. Phragmitetalia Koch 1926
 All. Cirsio brachycephali-Bolboschoenion maritimi (Passarge 1978)Mucina 1993
Ass. Tripolio vulgare-Bolboschoenetum maritimi Shelyag-Sosonco et V.Sl. 1987
 (syn. Bolboschoenetum maritimi Egglar 1933, *Astero tripolii-Phragmitetum humilis* Krisch(1972)1974, sau *Astero tripolii-Phragmitetum Ștefan et al.* 1995).

8

Relevee no.	1	2	3	4	5	6	7	8
Cover %	85	80	95	90	90	95	85	90
Surface of relevee (m ²)	50	100	75	100	100	50	100	50
<i>D.s. of the ass. Tripolio vulgare-Bolboschoenetum maritimi</i>								
Bolboschoenus maritimus	3	3	4	3	2	2	1	1
Aster tripolium	2	2	1	+	1	1	+	+
Phragmites australis var.humilis	+	1	1	2	3	3	3	2
<i>D.s. of the Cirsio brachycephali-Bolboschoenion maritimi</i>								
Juncus gerardi	1	+	+	+	+	+	+	+
Schoenoplectus tabernaemontani	+	+	+	-	-	-	-	+
Crypsis aculeata	-	+	-	-	-	-	-	+
<i>D.s. of the Phragmitetalia</i>								
Lycopus europaeus	+	-	+	+	+	-	-	+
Eleocharis palustris	1	+	-	+	+	+	1	1
Ranunculus lingua	-	-	-	+	-	+	+	-
Glyceria maxima	-	-	+	-	+	-	+	+
Mentha aquatica	-	-	+	-	-	+	-	-
Alisma plantago-aquatica	-	-	-	+	+	-	-	-
Berula erecta	-	-	-	+	-	-	+	-
Iris pseudacorus	-	-	-	+	-	-	-	-
Veronica anagallis- aquatica	-	-	+	-	+	+	-	-
<i>D.s. of the Phragmiti-Magnocaricetea</i>								
Typha angustifolia	+	-	-	-	+	1	+	-
Schoenoplectus lacustris	-	-	+	+	+	+	+	-
Galium palustre	-	+	-	-	+	+	+	-

Stachys palustris	+	-	-	+	+	+	-	+
Carex elata	+	+	-	-	-	-	-	+
Carex riparia	-	-	+	-	-	1	+	-
Carex acutiformis	-	-	-	+	1	1	+	-
Oenanthe aquatica	-	-	-	+	-	+	-	-
Lythrum salicaria	+	-	-	+	+	+	+	-
Lycopus exaltatus	-	-	+	-	-	-	-	+
Rumex hydrolapathum	-	-	-	-	+	-	-	-
Sium latifolium	-	-	-	-	+	-	+	-
Butomus umbellatus	-	-	-	-	-	+	-	-
Veronica beccabunga	+	-	+	+	-	-	-	-
Symphytum officinale	-	-	-	+	-	+	+	-
Myosotis scorpioides	-	+	+	-	+	+	-	-
Epilobium parviflorum	-	-	-	-	+	-	-	-
<i>D.s. of the Puccinellio-Salicornietea</i>								
Puccinellia limosa	+	1	+	-	+	1	-	+
Spergularia marina	+	-	+	-	-	-	-	+
Artemisia santonicum	-	-	-	-	-	-	-	+
Cyperus pannonicus	-	+	-	-	+	-	-	+
Suaeda maritima	+	-	-	-	+	+	-	-
Salicornia prostrata	+	+	-	-	-	+	-	+
Odontites rubra	-	-	+	-	-	+	-	-
Mentha pulegium	-	+	-	+	-	+	+	+
Atriplex hastata	-	-	-	+	+	-	-	+
Lythrum virgatum	+	-	+	+	-	-	+	-
Samolus valerandi	-	+	+	-	-	+	-	-
<i>Other species</i>								
Rorippa austriaca	-	1	+	-	+	-	+	1
Bidens tripartita	-	-	-	+	-	+	-	-
Althaea officinalis	-	-	-	-	+	-	-	-
Ranunculus sceleratus	-	+	-	-	-	+	-	-
Plantago major	-	-	+	-	+	+	-	+
Carex distans	1	+	+	-	-	-	-	+
Lysimachia vulgaris	-	-	+	-	+	+	+	1
Trifolium fragiferum	+	1	+	-	-	-	+	1
Agrostis stolonifera	1	+	+	1	+	-	1	1
Trifolium repens	-	-	-	+	+	-	1	-
Elytrigia repens	+	-	+	-	-	+	1	1
Rumex crispus	+	+	-	-	+	-	-	-

Cls. Festucetea vaginatae Soo 1968

Ord. Festucetalia vaginatae Soo 1957

All. Festucion vaginatae Soo 1929

Ass. Ephedro-Caricetum colchicae (Prodan 1939 n.n.) Morariu 1959

12

Relevee no.	1	2	3	4	5
Cover %	70	75	85	75	85
Surface of relevee (m ²)	25	40	25	50	40
<i>D.s. of the ass. Ephedro-Caricetum colchicae</i>					
Ephedra distachya	2	1	2	3	3
Carex colchica	3	3	3	1	2
<i>D.s. of the Festucion vaginatae</i>					
Secale sylvestre	+	1	1	+	1
Bromus tectorum	+	-	1	1	+
Kochia laniflora	+	-	-	+	+
Plantago arenaria	-	+	+	+	-
<i>D.s. of the Festucetalia vaginatae</i>					
Centaurea arenaria	+	-	+	-	-
Polygonum arenarium	+	-	-	+	-
Euphorbia seguieriana	+	1	-	+	+
Viola kitaibeliana	-	+	-	+	-
<i>D.s. of the Festucetea vaginatae</i>					
Anchusa ochroleuca	+	+	-	-	+
Echinops ruthenicus	+	-	-	+	+
Holoschoenus vulgaris	-	+	+	-	+
Achillea ochroleuca	-	-	+	-	-
Astragalus varius	-	-	+	+	-
Gypsophila paniculata	-	+	-	-	+
Inula salicina	-	-	+	+	-
Koeleria glauca	-	-	-	+	-

Linum hirsutum	-	-	-	-	+
Syrenia cana	-	-	-	-	+
<i>Other species</i>					
Alyssum borzaeanum	+	1	-	+	-
Cynanchum acutum	+	-	-	+	-
Scabiosa argentea	+	-	-	+	+
Medicago falcata var. filiformis	-	+	-	1	+
Centaurea diffusa	-	-	-	+	-
Anchusa procera	-	-	-	+	+
Sisymbrium orientale	-	-	-	-	+

Cls. Festuco-Brometea Br.-Bl. et Tx ex Klika et Hadac 1944

Ord. Festucetalia valesiaca Br.-Bl. et R. Tx. ex Br.-Bl. 1949

All. Festucion valesiaca Klika 1931 (syn. Festucion rupicolaee Soo 1964)

Ass. **Daucu guttati-Chrysopogonetum grylli** (Popescu et Sanda 1978)

14

Relevee no.	1	2	3	4	5
Cover %	90	90	80	85	75
Surface of relevee (m ²)	100	50	50	65	100
<i>D.s. of the ass. Daucu guttati-Chrysopogonetum grylli</i>					
Chrysopogon gryllus	4	5	4	3	4
Daucus guttatus ssp. zahariadi	+	+	+	1	+
<i>D.s. of the Festucion valesiaca</i>					
Festuca valesiaca	1	+	+	1	+
Thymus pannonicus	-	-	+	1	+
Linum austriacum	+	-	+	+	-
Verbascum phoeniceum	-	+	+	+	-
<i>D.s. of the Festucetalia valesiaca</i>					
Achillea setacea	+	+	-	+	-
Melica ciliata	+	-	-	-	-
Silene borysthena	+	-	-	+	-
Teucrium chamaedrys	-	+	-	+	+
Veronica spicata	-	-	+	-	-
Cruciata pedemontana	-	-	-	+	-
<i>D.s. of the Festuco-Brometea</i>					
Cynodon dactylon	+	+	1	2	+
Euphorbia seguieriana	+	-	-	+	1
Bromus hordeaceus	+	-	-	+	-
Bromus squarrosus	-	+	+	+	+
Arabis hirsuta	-	-	-	+	-
Crepis foetida ssp. rhoeadifolia	+	+	-	-	+
Arenaria serpyllifolia	-	+	-	+	-
Medicago falcata	+	+	-	+	+
Medicago minima	-	-	+	+	-
Plantago lanceolata	+	+	-	+	+
Achillea pannonica	-	+	-	-	-
Ononis spinosa	-	-	-	+	-
Asperula humifusa	-	-	-	+	-
Trifolium arvense	-	-	-	-	+
<i>D.s. of the Festucetea vaginatae</i>					
Asperula setulosa	+	-	+	-	-
Syrenia montana	-	-	-	+	-
Apera spica-venti ssp. maritima	+	+	+	+	-
<i>D.s. of the Chenopodietea</i>					
Hordeum murinum	+	+	-	+	+
Descurainia sophia	+	-	+	+	+
Carduus thoermeri	-	+	-	-	-
Sisymbrium loeselii	-	+	+	+	-
Lepidium ruderae	-	-	-	+	+
<i>Other species</i>					
Milium vernale	-	-	+	-	-
Convolvulus lineatus	-	-	-	+	-
Carex distans	+	-	+	+	-
Agrostis stolonifera	+	+	+	-	-
Scorzonera parviflora	+	+	+	+	-
Erodium cicutarium	+	-	-	+	+

Cls. Festuco-Brometea Br.-Bl. et Tx ex Klika et Hadac 1944
 Ord. Festucetalia valesiacae Br.-Bl. et R. Tx. ex Br.-Bl. 1949
 All. Festucion valesiacae Klika 1931 (syn. Festucion rupicolae Soo 1964)
Ass. Cynodonti-Poetum angustifoliae Rapaics ex Soo 1957
 (syn. Cynodontetum dactyloni Rapaics 1927)

18

Relevee no.	1	2	3	4	5
Cover %	85	95	90	80	85
Surface of relevee (m ²)	100	100	65	100	50
<i>D.s. of the ass. Cynodonti-Poetum angustifoliae</i>					
Cynodon dactylon	4	5	4	3	3
Poa angustifolia	+	+	1	1	2
<i>D.s. of the Festucion valesiacae</i>					
Festuca valesiaca	1	+	+	1	+
Botriochloa ischaemum	+	-	-	+	+
Thymus pannonicus	+	-	+	+	-
Xeranthemum annuum	-	+	+	-	-
Medicago minima	-	-	+	-	-
<i>D.s. of the Festucetalia valesiacae</i>					
Teucrium chamaedrys	+	-	+	+	+
Silene otites	+	-	-	+	-
Achillea setacea	+	+	+	-	+
Campanula sibirica	+	-	-	+	-
Astragalus onobrychis	-	-	+	-	+
Centaurea micranthos	-	+	+	+	+
Centaurea rhenana	-	-	-	-	+
<i>D.s. of the Festuco-Brometea</i>					
Koeleria gracilis	+	-	-	+	-
Medicago falcata	+	+	-	+	-
Asperula cynanchica	+	+	+	-	-
Potentilla recta	+	-	-	-	-
Arabis hirsuta	-	+	-	-	-
Euphorbia cyparissias	-	+	1	+	-
Plantago lanceolata	-	+	+	+	+
Euphorbia seguieriana	-	-	+	+	-
Asperula humifusa	-	-	+	1	-
Arenaria serpyllifolia	-	-	+	-	+
Crepis foetida ssp. rhoeadifolia	-	-	-	+	-
Bromus hordeaceus	-	-	-	+	-
Bromus squarrosus	-	-	-	-	+
<i>D.s. of the Chenopodietea</i>					
Plantago major	+	+	+	-	+
Polygonum aviculare	+	-	+	1	+
Cirsium arvense	+	-	+	+	-
Rumex crispus	-	+	-	+	-
Hordeum murinum	-	-	+	-	+
Elytrigia repens	-	-	+	+	1
Cardaria draba	-	-	-	+	-
Marrubium vulgare	-	-	-	-	+
Verbena officinalis	-	-	-	-	+

Cls. Phragmitetea Tx. et Prsg. 1942
 Ord. Phragmitetalia W. Koch 1926 em. Pign. 1953
 All. Phragmition W. Koch 1926
Ass. Typhetum angustifoliae (al. 1922) Pign. 1943

19

Relevee no.	1	2	3	4	5
Cover %	95	100	85	95	95
Surface of relevee (m ²)	50	25	100	50	65
<i>D.s. of the ass. Typhetum angustifoliae</i>					
Typha angustifolia	4	5	4	4	4
<i>D.s. of the Phragmition</i>					
Glyceria maxima	+	+	1	+	+
Phragmites australis	1	+	+	1	+
Schoenoplectus lacustris	+	-	+	+	-
Butomus umbellatus	-	+	-	+	-
Sium latifolium	-	-	+	-	+
Ranunculus lingua	-	-	-	+	-
Rumex hydrolapathum	-	-	-	+	-
Alisma plantago-aquatica	-	+	+	+	+
Sium latifolium	-	-	-	+	-

Oenanthe aquatica	-	-	-	-	+
<i>D.s. of the Phragmitetalia</i>					
Eleocharis palustris	+	-	-	+	+
Mentha aquatica	+	+	+	-	-
Lycopus europaeus	+	-	-	+	-
Iris pseudacorus	+	+	-	-	+
Veronica anagallis-aquatica	-	-	*	-	-
<i>D.s. of the Phragmitetea</i>					
Carex acutiformis	+	-	-	1	1
Carex riparia	+				
Carex vulpina	-	-	+	-	+
Typha latifolia	-	+	-	-	+
Carex pseudocyperus	-	-	-	+	-
Myosotis scorpioides	+	-	+	+	-
Veronica beccabunga	-	-	+	+	-
Berula erecta	+	-	-	-	-
Galium palustre	-	+	+	-	+
Lythrum salicaria	-	-	+	-	+
Stachys palustris	-	-	+	+	+
Lysimachia vulgaris	-	-	+	-	+
Other species					
Bidens tripartita	+	-	+	+	1
Polygonum lapathifolium	+	+	-	+	+
Eupatorium cannabinum	-	+	-	+	1
Ranunculus repens	-	-	+	+	-
Mentha longifolia	-	-	-	+	-
Agrostis stolonifera	-	-	-	+	+

Cls. Phragmitetea Tx.et Prsg.1942

Ord.Phragmitetalia W.Koch 1926 em.Pign.1953

All. Phragmition W.Koch 1926

Ass. Scirpo-Phragmitetum W.Koch 1926

20

Relevee no.	1	2	3	4	5
Cover %	75	90	85	95	90
Surface of relevee (m ²)	100	100	100	100	100
<i>D.s. of the ass. Scirpo-Phragmitetum</i>					
Phragmites australis	3	4	4	5	5
Schoenoplectus lacustris	1	+	1	+	-
<i>D.s. of the Phragmition</i>					
Oenanthe aquatica	+	+	-	+	-
Sium latifolium	+	-	-	+	-
Typha angustifolia	1	+	+	1	+
Ranunculus lingua	-	-	+	-	+
Scutellaria galericulata	-	-	-	+	-
<i>D.s. of the Phragmitetalia</i>					
Sium latifolium	+	-	+	+	-
Butomus umbellatus	+	-	-	-	+
Alisma plantago-aquatica	+	+	-	+	-
Glyceria maxima	+	1	+	+	-
Lycopus europaeus	+	-	-	+	+
Iris pseudacorus	-	-	+	-	+
Mentha aquatica	-	-	+	+	+
<i>D.s. of the Phragmitetea</i>					
Galium palustre	+	-	+	+	-
Stachys palustris	+	+	-	-	+
Carex acutiformis	+	1	+	+	+
Carex riparia	+	-	-	+	1
Carex elata	1	-	+	-	-
Lythrum salicaria	-	+	+	+	-
Myosotis scorpioides	-	+	-	+	-
Symphytum officinale	-	-	+	-	+
Veronica beccabunga	-	-	-	+	-
Rorippa amphibia	-	-	-	+	+
Cicuta virosa	-	-	-	-	+
Veronica anagallis-aquatica	-	-	-	-	+
<i>D.s. of the Puccinellio-Salicornietea</i>					
Aster tripolium	+	-	-	-	-
Juncus gerardi	+	-	+	-	-
Atriplex hastata	1	+	+	-	-
Suaeda maritima	+	-	-	-	-
Lythrum virgatum	+	-	-	+	-

Samolus valerandi	+	-	-	-	-
Mentha pulegium	+	-	+	-	-
Other species					
Eupatorium cannabinum	1	-	-	+	+
Polygonum lapathifolium	-	+	+	-	+
Urtica dioica	-	+	-	+	+
Epilobium hirsutum	-	-	+	-	+
Calystegia sepium	-	-	+	-	-
Bidens tripartita	-	-	-	+	+
Agrostis stolonifera	-	-	-	+	+
Ranunculus repens	-	-	-	-	+

Cls.Salicetea purpureae Moor 1958

Ord. Salicetalia auritae Doing 1962

All. Salicion cinereae Th. Muller et Gors ex Passarge 1961

Ass. Salicetum cinereae Zolyomi 1931

27

Relevee no.	1	2	3	4	5
Cover %	100	100	100	100	100
Surface of relevee (m ²)	250	250	250	250	250
D.s. of the Salicion cinereae					
Salix cinerea (D.s. of the ass.)	3	2	4	4	3
Salix pentandra		1			
D.s. of the Salicion albae					
Salix alba	+	+			
D.s. of the Salicetea purpureae					
Amorpha fruticosa	1	1			+
D.s. of the Phragmiti-Magnocaricetea					
Stachys palustris	+	1	+	+	+
Sium latifolium	+	+	+	+	+
Phragmites australis	3	2	1	1	3
Lycopus europaeus		1	+	+	+
Phalaroides arundinaceae	+	1	2	2	
Galium palustre		1	+	+	+
Iris pseudacorus	+	1			+
Typha angustifolia		+			+
D.s. of the Galio-Urticetea					
Calystegia sepium	2	2	+	+	
Galega officinalis		1			
D.s. of the Chenopodietea					
Sonchus palustre	2	+		+	+
D.s. of the Alnetea glutinosae					
Carex acutiformis	+	2	+	+	+
Myosoton aquaticum	1	1			
D.s. of the Bidentetea tripartiti					
Bidens tripartita		+			
Other species					
Symphytum officinale	+	2	+	+	+
Lythrum salicaria		1	+	+	1
Lysimachia vulgaris		1	+	+	+
Ranunculus polyanthemos		1			
Leucanthemella serotina		1			
Equisetum palustre		1			
Euphorbia palustris		1			

Cls.Querco-Fagetea Br.-Bl. et Vlieger in Vlieger 1937 em.Borhidi 1996

Ord. Fagetalia sylvaticae Pawl. 1928

All. Alno-Ulmion Oberd,1953

Ass.Quercetum robori-pedunculiflorae Simon 1960

33

Relevee no.	1	2	3	4	5
Tree cover %	75	70	70	80	85
Herbaceous cover %	30	40	35	25	20
Surface of relevee (m ²)	400	400	400	400	400
D.s. of the ass.					
Quercetum robori-pedunculiflorae					
Quercus robur	2	2	3	1	1
Quercus pedunculiflora	3	2	2	3	2
Vitis sylvestris	+	-	-	+	-
Periploca graeca	+	+	+	-	+

<i>D.s. of the Alno-Ulmion</i>					
<i>Alnus glutinosa</i>	+	-	+	-	-
<i>Ulmus laevis</i>	-	-	+	+	-
<i>Fraxinus pallisae</i>	1	2	+	2	3
<i>Fraxinus angustifolia</i>	+	-	+	1	1
<i>Viburnum opulus</i>	-	-	+	-	+
<i>Equisetum sylvaticum</i>	+	-	+	+	-
<i>Stellaria nemorum</i>	1	+	1	+	+
<i>Geranium phaeum</i>	+	-	-	+	+
<i>Carex remota</i>	-	-	+	+	-
<i>Carex brizoides</i>	-	-	-	+	-
<i>Aegopodium podagraria</i>	-	-	-	+	+
<i>Circaea lutetiana</i>	-	-	-	-	+
<i>D.s. of the Fagetalia sylvaticae</i>					
<i>Allium ursinum</i>	+	-	+	+	-
<i>Carex sylvatica</i>	1	+	-	-	-
<i>Cardamine bulbifera</i>	+	1	1	-	+
<i>Eupurbia amygdaloides</i>	+	-	+	-	-
<i>Mycelis muralis</i>	-	+	+	-	+
<i>Salvia glutinosa</i>	-	+	-	+	+
<i>Stachys sylvatica</i>	-	1	1	-	+
<i>Mercurialis perennis</i>	1	-	+	-	-
<i>Asarum europaeum</i>	+	-	+	-	-
<i>Sanicula europaea</i>	-	+	+	-	+
<i>D.s. of the Quercu-Fagetea</i>					
<i>Acer campestre</i>	+	-	-	-	-
<i>Pyrus pyraster</i>	-	-	+	-	+
<i>Clematis vitalba</i>	+	+	+	-	+
<i>Corylus avellana</i>	+	-	-	+	+
<i>Euonymus europaea</i>	-	-	+	-	+
<i>Euonymus verrucosa</i>	-	-	+	-	-
<i>Ligustrum vulgare</i>	-	+	+	-	-
<i>Crataegus monogyna</i>	+	-	+	-	-
<i>Hedera helix</i>	+	+	+	+	+
<i>Epipactis helleborine</i>	-	+	-	-	-
<i>Galium odoratum</i>	-	+	+	-	-
<i>Brachypodium sylvaticum</i>	1	1	+	-	+
<i>Geum urbanum</i>	+	+	-	+	+
<i>Polygonatum multiflorum</i>	-	1	-	+	-
<i>Polygonatum odoratum</i>	-	-	+	-	.*
<i>Lathyrus vernus</i>	-	+	+	-	+
<i>Glechoma hirsuta</i>	+	1	2	+	+
<i>Viola odorata</i>	-	+	+	-	-
<i>Platanthera bifolia</i>	-	-	+	-	+
<i>D.s. of the Phragmitetea</i>					
<i>Carex acutiformis</i>	-	+	-	1	2
<i>Thelypteris palustris</i>	-	+	-	1	1
<i>Carex vulpina</i>	-	-	+	+	+
<i>Iris pseudacorus</i>	-	+	+	+	1
<i>Lycopus europaeus</i>	-	-	-	+	+
<i>Stachys palustris</i>	-	+	-	+	+
<i>Galium palustre</i>	-	+	+	+	+
<i>Symphytum officinale</i>	-	-	-	+	-
<i>Other species</i>					
<i>Populus alba</i>	-	-	+	-	-
<i>Eupatorium cannabinum</i>	+	+	-	+	+
<i>Lysimachia nummularia</i>	-	+	+	+	+
<i>Urtica dioica</i>	+	-	+	-	+
<i>Equisetum telmateia</i>	-	-	+	-	+
<i>Cirsium arvense</i>	-	+	+	-	-
<i>Erigeron acris</i>	-	-	+	-	-
<i>Senecio vernalis</i>	-	-	+	-	-

Cls. Salicetea purpureae Moor 1958
 Ord. Salicetalia purpureae Moor 1958
 All. Salicion albae (Soo (1930) 1940) Muller et Gors 1958
 Ass. Salicetum albo-fragilis (Issler 1926) Tx. 1955

35

Relevee no.	1	2	3	4	5
Cover %	100	100	100	100	100
Surface of releve (m ²)	500	500	500	500	500
<i>D.s. of the Salicion albae</i>					
Salix alba (D.s. of the ass.)	3	2	3	3	3
Salix fragilis (D.s. of the ass.)	2	+	1	1	+
Populus deltoides	+				
Fraxinus excelsior	+				
<i>D.s. of the Salicion cinerea</i>					
Salix pentandra	2				
<i>D.s. of the Salicetea purpureae</i>					
Amorpha fruticosa	2	1	2	2	2
<i>D.s. of the Phragmiti-Magnocaricetea</i>					
Lycopus europaeus	+	+	+	+	+
Carex acutiformis		1	+	1	1
Iris pseudacorus	+		+	+	
Phragmites australis				+	+
Carex riparia	1	+			
Galium palustre	+	+			
Scutellaria galericulata	+	+			
Carex acuta	+				
Carex hirta	1				
<i>D.s. of the Artemisietea vulgaris</i>					
Solanum dulcamara	+	+		+	
Tanacetum vulgare	1				
Arctium lappa	+				
<i>D.s. of the Galio-Urticetea</i>					
Galega officinalis	2	+	+	+	+
Althaea officinalis	1	+	+	+	
Eupatorium cannabinum	1	1	1	1	
<i>D.s. of the Robinietea</i>					
Urtica dioica	+	+	+	+	+
<i>D.s. of the Plantaginetea majoris</i>					
Plantago major	2		+	+	
<i>D.s. of the Chenopodietea</i>					
Sonchus arvensis	1				
<i>D.s. of the Alnetea glutinosae</i>					
Myosoton aquaticum	+				+
<i>D.s. of the Agropyretea repentis</i>					
Calamagrostis epigeios	1	+	+	+	+
Elytrigia repens	1				
Elytrigia repens	1				
<i>D.s. of the Bidentetea tripartiti</i>					
Bidens tripartita	1				
<i>D.s. of the Thero-Suaedetea maritimae</i>					
Atriplex prostrata	1				
<i>Other species</i>					
Calystegia sepium	+	+	+	+	+
Polygonum hydropiper	1	1	1	+	+
Symphytum officinale	+	+	+	+	1
Rorippa sylvestris	+	+	+	+	+
Agrostis stolonifera		1	1	+	+
Ranunculus sceleratus	+	+		+	+
Rorippa prostrata			+	+	+
Mentha aquatica	+	1	1		
Solanum dulcamara		+	+		
Rorippa brachycarpa	+	+			
Glechoma hederacea	+	+			
Alopecurus geniculatus	+	+			
Alopecurus pratensis	+	+			
Leersia oryzoides			+	+	
Ranunculus repens	+	+			
Agrostis gigantea	+				
Ranunculus polyanthemus	1				
Carduus acanthoides	+				
Trifolium fragiferum	+				

Melilotus albus	+				
Inula salicina	1				
Humulus lupulus	+				

Ass. Hippophae-Salicetum elaeagni (Br. -Bl. 1933) Br. -Bl. et Volk 1940

38

Relevee no.	1	2	3	4	5
Cover %	60	100	100	100	100
Surface of releve (m ²)	250	250	250	250	250
<i>D.s. of the ass. Hippophae-Salicetum elaeagni</i>					
Hippophae rhamnoides		3	5	5	2
<i>D.s. of the Salicion albae</i>					
Salix alba (D.s. of the ass.)	1	+	1	+	1
<i>D.s. of the Salicion elaeagni</i>					
Elaeagnus angustifolia (D.s. of the ass.)	5	5	3	3	3
<i>D.s. of the Tamaricetalia</i>					
Tamarix ramosissima		+	+	+	
<i>D.s. of the Salicetea purpureae</i>					
Amorpha fruticosa	+	+	4	2	4
<i>D.s. of the Phragmiti-Magnocaricetea</i>					
Phragmites australis				+	
<i>D.s. of the Artemisietea vulgaris</i>					
Lappula squarrosa	+	+	+	+	+
Artemisia vulgaris			+		
<i>D.s. of the Galio-Urticetea</i>					
Solanum dulcamara		1			
Calystegia sepium	+	+	+	+	+
Solanum dulcamara		1			
Cuscuta europaea			+	+	
<i>D.s. of the Ammophiletea</i>					
Leymus sabulosus			2	1	
<i>D.s. of the Festucetea vaginatae</i>					
Carex colchica	+	+	+	+	+
<i>D.s. of the Robinietea</i>					
Urtica dioica					+
<i>D.s. of the Chenopodietea</i>					
Chenopodium album		4	+	+	
Polygonum convolvulus		1			2
<i>D.s. of the Secalietea</i>					
Erigeron canadensis	+			+	
<i>D.s. of the Asteretea tripolium</i>					
Juncus gerardii	+				
Tripolium vulgare	+				
Puccinella distans	+				
<i>D.s. of the Agropyretea repentis</i>					
Calamagrostis epigeios	3	+	+	+	+
Elytrigia repens	+	4			
<i>D.s. of the Thero-Suaedetea maritimae</i>					
Atriplex prostrata	+				
<i>D.s. of the Cakiletea maritimae</i>					
Cakile euxina					+
<i>D.s. of the Crithmo-Staticetea</i>					
Lactuca tatarica	+	+	+	+	+
<i>Other species</i>					
Cynodon dactylon	+	+	+	+	+
Pulicaria dysenterica	1	+	+	+	+
Petasites spurius	+	+		+	
Polygonum persicaria			+		
Agrostis stolonifera					+
Stellaria media				+	
Inula sabuletorum	+				
Rumex maritimus			+		
Solidago canadensis	+				
Trifolium fragiferum	+				
Polypogon monspeliensis	1				

Cls. Salicetea purpureae Moor 1958
 Ord. Tamaricetalia Borza et Boşcaiu 1963 em. Popescu et Sanda 1992
 All. Artemisio scopariae-Tamaricion Simon et Dihoru (1962)1963
Ass. Tamaricetum ramosissimae (Şerbănescu 1965) Ciocârlan 1968
 (syn. Calamagrostio-Tamaricetum ramosissimae Simon et Dihoru 1963)

39

Relevee no.	1	2	3	4	5
Tree cover %	60	70	75	65	70
Herbaceous cover %	45	40	30	50	40
Surface of relevee (m ²)	100	100	200	100	100
<i>D.s. of the ass. Tamaricetum ramosissimae</i>					
Tamarix ramosissima	3	4	4	3	4
Calamagrostis epigeios	2	1	2	3	2
<i>D.s. of the Artemisio scopariae-Tamaricion</i>					
Cornus sanguinea	1	+	+	1	-
Artemisia scoparia	-	+	-	+	+
Thalictrum flavum	-	+	-	-	+
Rhamnus catharticus	-	-	+	+	-
<i>D.s. of the Tamaricetalia Borza</i>					
Artemisia absinthium	+	-	+	+	-
Achillea setacea	+	-	-	+	+
Potentilla reptans	-	-	+	-	1
Rosa dumetorum	-	-	-	+	-
<i>D.s. of the Salicetea purpureae</i>					
Salix fragilis	+	-	1	1	+
Salix purpurea	+	-	-	-	-
Salix alba	+	+	-	+	+
Populus nigra	+	+	-	-	-
Rubus caesius	1	2	1	+	+
Urtica dioica	1	-	+	+	-
Eupatorium cannabinum	-	+	-	+	+
Mentha longifolia	-	-	-	+	-
Other species					
Crataegus monogyna	+	-	+	-	-
Hippophae rhamnoides	+	-	-	-	1
Agrostis stolonifera	+	1	1	-	1
Poa angustifolia	+	+	+	1	+
Cynodon dactylon	+	-	1	1	+
Cichorium intybus	+	-	+	+	-
Sonchus arvensis	+	-	+	-	+
Euphorbia seguieriana	+	+	-	-	+
Galium humifusum	-	+	+	-	+
Lolium perenne	-	+	+	+	+
Cirsium arvense	-	-	+	-	-
Carex distans	-	-	+	-	+
Rumex crispus	-	-	+	+	-
Polygonum aviculare	-	-	+	-	+
Taraxacum officinale	-	-	+	+	-
Atriplex tatarica	-	-	-	+	+
Atriplex hastata	-	-	-	+	+
Cardaria draba	-	-	-	+	-
Capsella bursa-pastoris	-	-	-	+	-
Chenopodium glaucum	-	-	-	-	+
Juncus gerardi	-	-	-	-	+
Teucrium scordium	-	-	-	-	+

Cls. Potametea Klika in Klika et Novak 1941

Ord. Potametalia W.Koch 1926

All. Nymphaeion albae Oberd. 1957

Ass. *Trapo-Nymphoidetum peltatae* (Br. -Bl. 1933) Br. -Bl. et Volk 1940

41

Releve no.	1	2	3	4	5
Cover %	100	100	100	100	80
Surface of releve (m ²)	100	100	100	100	100
<i>D.s. of the ass. Trapo-Nymphoidetum peltatae</i>					
<i>Trapa natans</i>	5	5	5	5	3
<i>Nymphoides peltata</i>	3	2	3	4	3
<i>D.s. of the Potametea</i>					
<i>Ceratophyllum demersum</i>	+	+	+	+	+
<i>Nymphaea alba</i>		2	2	+	+
<i>Elodea canadensis</i>			+	+	+
<i>Myriophyllum spicatum</i>	1	+			
<i>Nuphar lutea</i>				+	1
<i>Potamogeton pectinatus</i>		+			
<i>D.s. of the Lemnetea</i>					
<i>Lemna minor</i>	+	+	+	+	+
<i>Utricularia vulgaris</i>	1	+			
<i>Lemna trisulca</i>					+
<i>D.s. of the Phragmiti-Magnocaricetea</i>					
<i>Sparganium erectum</i>		1			4
<i>Butomus umbellatus</i>		1			
<i>Other species</i>					
<i>Batrachium foeniculaceum</i>	+	+			
<i>Potamogeton berchtoldii</i>	+	+			
<i>Schoenoplectus litoralis</i>					3
<i>Mentha aquatica</i>					+
<i>Typha latifolia</i>					+
<i>Potamogeton crispus</i>		+			
<i>Potamogeton lucens</i>		1			
<i>Myriophyllum verticillatum</i>	+				

Ass. *Trapetum natantis* Th. Muller et Gors 1960

Releve no.	1	2	3	4	5
Cover %	100	100	100	100	100
Surface of releve (m ²)	100	100	100	100	100
<i>D.s. of the ass. Trapetum natantis</i>					
<i>Trapa natans</i>	5	5	5	5	5
<i>D.s. of the Potametea</i>					
<i>Ceratophyllum demersum</i>		3	+	+	+
<i>Nymphoides peltata</i>			+	3	
<i>Elodea canadensis</i>	+	+			
<i>Potamogeton natans</i>	+	3			
<i>Nuphar lutea</i>			2		
<i>Nymphaea alba</i>			3		
<i>Potamogeton lucens</i>				+	
<i>Potamogeton pectinatus</i>		+			
<i>Najas marina</i>		3			
<i>Myriophyllum spicatum</i>				1	
<i>D.s. of the Lemnetea</i>					
<i>Salvinia natans</i>	+	1	1	+	+
<i>Lemna minor</i>	+	2	+	+	+
<i>Spirodela polyrrhiza</i>	+	+	+	+	1
<i>Sagittaria sagittifolia</i>			1		1
<i>Azolla caroliniana</i>		+			
<i>Utricularia vulgaris</i>				1	
<i>D.s. of the Phragmiti-Magnocaricetea</i>					
<i>Sparganium erectum</i>			2		2
<i>Butomus umbellatus</i>			3		+
<i>Typha angustifolia</i>		1			
<i>Other species</i>					
<i>Ceratophyllum platyacanthum</i>				+	
<i>Caulinia minor</i>				+	
<i>Potamogeton perfoliatus</i>				+	

Ass. Nymphaetum albo-luteae Novinski 1928

Relevee no.	1	2	3	4	5
Cover %	100	100	100	100	100
Surface of releve (m ²)	100	100	100	100	100
<i>D.s. of the ass. Nymphaetum albo-luteae</i>					
Nuphar lutea	2	2	4	3	2
Nymphaea alba	5	5	2	3	5
<i>D.s. of the Potametea</i>					
Ceratophyllum demersum	3	2	+	1	+
Trapa natans		+	2	+	
Myriophyllum spicatum	+	+		+	
Nymphoides peltata		1	3		
<i>D.s. of the Lemnetea</i>					
Salvinia natans	+	+	+	+	+
Utricularia vulgaris				1	+
Lemna trisulca				1	+
<i>D.s. of the Phragmiti-Magnocaricetea</i>					
Sparganium erectum	1	1	1		
Typha angustifolia	+	+	+		
Butomus umbellatus	+	+	+		
<i>Other species</i>					
Sagittaria sagittifolia			1		
Utricularia intermedia					+

Ass. Nymphoidetum peltatae (All. 1922) Muller et Cors 1960

Relevee no.	1	2	3	4	5
Cover %	100	100	100	100	80
Surface of releve (m ²)	100	100	100	100	100
<i>D.s. of the ass. Nymphoidetum peltatae</i>					
Nymphoides peltata	5	5	5	4	3
<i>D.s. of the Potametea</i>					
Elodea canadensis	+	+	+	+	+
Trapa natans	1			2	3
Ceratophyllum demersum	2	3		+	
Nuphar lutea				2	+
Nymphaea alba				2	
Potamogeton nodosus	1				
Potamogeton perfoliatus		+			
Najas marina		+			
<i>D.s. of the Lemnetea</i>					
Salvinia natans	+	+	2	+	+
Spirodela polyrrhiza	+	+	2	+	+
Lemna trisulca				+	+
Hydrocharis morsus-ranae			3		
<i>D.s. of the Phragmiti-Magnocaricetea</i>					
Sparganium erectum				2	4
Butomus umbellatus				1	1
<i>D.s. of the Bolboschoenetea maritimi</i>					
Bolboschoenus maritimus			3	+	+
<i>Other species</i>					
Schoenoplectus littoralis			+	+	1
Mentha aquatica					+
Sagittaria sagittifolia				1	

Cls. Lemnetaea R.Tx. 1955

Ord. Lemnetalia R.Tx. 1955

All. Lemnion minoris R.Tx. 1955

Ass. Lemno-Azolletum carolinianae (All. 1922) Muller et Cors 1960

Relevee no.	1	2	3	4	5
Cover %	100	100	100	100	100
Surface of releve (m ²)	25	25	25	25	25
<i>D.s. of the ass. Lemno-Azolletum carolinianae</i>					
Azolla caroliniana	5	5	2	5	4
Lemna minor	3	5	2	3	5
<i>D.s. of the Lemnetaea</i>					
Salvinia natans	+	+	+	+	1
Spirodela polyrrhiza	+	+	+	1	1
Azolla filiculoides				+	
<i>D.s. of the Potametea</i>					
Trapa natans	+	2			
Potamogeton natans	+	+			
Potamogeton pectinatus	+		+		
Potamogeton perfoliatus		+			
Najas marina		+			
Ceratophyllum demersum		+			
<i>D.s. of the Phragmiti-Magnocaricetea</i>					
Sparganium erectum	+		3		
Eleocharis palustris			+		
<i>D.s. of the Bolboschoenetea maritimi</i>					
Bolboschoenus maritimus			+		
<i>Other species</i>					
Mentha aquatica			+		

Ord. Hydrocharietalia Rubel 1933

All. Hydrocharition Rubel 1933

Ass. Salvinio-Hydrocharetum (Oberd. 1957) Boscaiu 1966

Relevee no.	1	2	3	4	5
Cover %	100	100	100	100	100
Surface of releve (m ²)	25	25	25	25	25
<i>D.s. of the ass. Salvinio-Hydrocharetum</i>					
Hydrocharis morsus-ranae	5	3	4	1	2
Salvinia natans	+	2	5	1	4
<i>D.s. of the Lemnetaea</i>					
Lemna minor	+	+	+	1	+
Spirodela polyrrhiza	+	2	+	+	1
Lemna trisulca	+	+	3	+	+
Azolla caroliniana					3
<i>D.s. of the Potametea</i>					
Elodea canadensis		+	3	+	
Ceratophyllum demersum					2
Trapa natans				2	
Nymphaea alba			+		
Nymphoides peltata		2			
Potamogeton natans					2
<i>D.s. of the Phragmiti-Magnocaricetea</i>					
Typha angustifolia	+		1		1
Sparganium erectum	1		+		
Alisma plantago-aquatica	+				
<i>D.s. of the Bolboschoenetea maritimi</i>					
Bolboschoenum maritima	+		+		
<i>Other species</i>					
Sium latifolium	+	+			
Stratiotes aloides			+		
Polygonum amphibium					+

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Annex 4

Table with Red List species of vascular plants within the Biosphere Reserve "Danube Delta".

Conservation categories of threatened species

A description of the Red List species can be found in chapter 10 of this report.

The Red List species living in the Romanian part of the delta are provided according to *Flora Deltei Dunarii* (Ciocârlan, 1994) and *Flora Republicii populare Romine* (V.1-13, 1952-1976), of Ukrainian part - according to *"Vascular plants of Ukraine": a nomenclatural checklist* (Mosyakin, Fedoronchuk, 1999). Latin names of common plants living in the area of both countries, and names of which coincide, are provided with more accurate definitions according to *"Flora Europaea"* (V.1-5, 1964-1980) and *"Vascular Plants of Ukraine"* (Cherepanov, (Czerepanov), S.K. (1973), (tomi I-XXX).; Cherepanov, (Czerepanov), S.K. (1995) *Vascular plants of Russia and adjacent states* (the former USSR).

If the names of the same taxa do not coincide (mostly this is caused by different interpretation of a species capacity by different botanical schools), the Latin names as equivalent ones are provided according to the last Ukrainian and Romanian floristic data.

References

- Cherepanov (Czerepanov), S.K., 1973,
Additamenta et coorigenda ad "Floram URSS" (tomi I-XXX). Nauka Press, Leningrad.
668p. [Mostly Latin names and citations; comments in Russian.]
- Cherepanov (Czerepanov), S.K., 1995,
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Press, Cambridge & ee York. 990 p. [English language edition.]
- Ciocârlan, V., 1994,
Flora Deltei Dunarii.Cormophyta. Editura Ceres. Bucuresti. 115 [In Romanian.]
- Mosyakin, S.L., Fedoronchuk, M., 1999,
Vascular Plants of Ukraine. A Nomenclatural Checklist. National Academy of Sciences of
Ukraine. M.G. Kholodny Institute of Botany. Kiev. 345p. [In English.]

The following legenda is referring to the table of this Annex 4.

- **Ex.** (extinct):
species not definitely located in the wild, after many consecutive surveys. The surveys have been made in the areas they have former been recorded or in the areas assumed as former habitat. The species of present conservation category in the area of biosphere reserve up to date are not registered;
- **Ex. ?**:
50 years have passed from the last recording of the species, the possibility of the species to be recorded in the future still exists;
- **E** (endangered):
species in danger of extinction and whose survival is unlikely if the causal factors continue operating. Including populations whose numbers have been reduced to critical level;
- **V** (vulnerable):
species are decreasing, they are likely to move into the "endangered" category if the causal factors continue operating;
- **R** (rare):
species that are not at present "Endangered" or "Vulnerable", but are at risk, because they are usually localized within restricted geographical areas or habitats, or might be thinly scattered over a more extensive range;
- **I** (indeterminate):
species known as "Endangered", "Vulnerable" or "Rare", but where there is not enough information to say which of the mentioned category is appropriate. It has been used especially for those species, which have been seen in the past, but were not located during the last surveys. Certain (unofficial) recording still exists;
- **?**
species mentioned as previously recorded, not located at present, presence is uncertain, determination errors are suspected;
- **k** (insufficiently known):
species suspected, recorded during the last surveys, but not definitely known to establish the threatened category;
- **nt** (not threatened):
species threatened only at European level (Including the international conventions lists, for protection and conservation), not endangered on the territory of the Danube Delta Biosphere Reserve, being frequent and abundant;
- **Ssp.** (subverificate species):
species occurred in Romanian and Ukrainian delta area are subject to verification but in the one of them only they belong to determinate conservation category.

Besides determination of categories in the "Red List", information is provided concerning the world and national conservation status of species and populations.

- **RDBU**
Red Data Book of Ukraine (1996) (conservation categories used: O – extinct; I – endangered; II – vulnerable; III – rare; IV – indeterminate; V – insufficiently known; VI – restored);
- **RRL**
species listed in the "Red List of Romania";
- **ERL**
European Red List;
- **IUCN RL**
IUCN Red List of Threatened Plants (1997) (conservation categories used for UCN RL and ERL: Ex – endangered; Ex/E – extinct and species endangered with extinction; E – endangered species; V – vulnerable species; R – rare species; I – indeterminate species).
- **Br.I**
species included in the Annex I of the Bern Convention (European strictly protected plants) (Bern, 1979);
- **H**
species included in the European Council Directive no. 92/43/1992, referring natural habitats and wild flora and fauna conservation (species considered to need special conservation areas);
- **W**
species included in the Convention of trading endangered wild flora and fauna species (Washington, 1973), which enforces special practices for commerce.
- **e₁**
endemic species living in the Danube Delta territory only;
- **e₂**
endemic and subendemic species living in the territory of Romania and Ukraine or one of them;
- **e₃**
endemic and subendemic species areas of which are beyond the state limits.

Red List of Vascular Plants of the Romanian and Ukrainian Biosphere Reserve "Danube Delta"

Species name	Conservation category			
	Romania		Ukraine	
<i>Achillea coarctata</i> Poir.	V		-	
<i>Achillea collina</i> J. Becker ex Rchb.	R		R	
<i>Achillea inundata</i> Kondr.	K	e3	R	e3
<i>Achillea millefolium</i> L.	I		Ssp.	
<i>Acorus calamus</i> L.	V		Ssp.	
<i>Aegilops cylindrica</i> Host	R		Ssp.	
<i>Aeluropus littoralis</i> (Gouan) Parl. subsp. <i>intermedium</i> (Regel) Tzvelev.	I		-	
<i>Agrostemma githago</i> L.	Ex.?		-	
<i>Agrostis capillaris</i> L. (<i>A. tenuis</i> Sibth.)	I		-	
<i>Agrostis maeotica</i> Klokov	-		K	e2
<i>Ajuga chia</i> Schreb.	-		I	
<i>Ajuga reptans</i> L.	I/?		-	
<i>Aldrovanda vesiculosa</i> L.	V	Br.I/H	V	Br.I/H/RDBU
<i>Alisma gramineum</i> Lej.	Ssp.		I	
<i>Alisma lanceolatum</i> With.	R		R	
<i>Allium guttatum</i> Steven	R		-	
<i>Allium rotundum</i> L.	R		-	
<i>Allium ursinum</i> L.	I		-	
<i>Alyssum borzaeanum</i> Nyar.	E	e3	-	e3
<i>Alyssum calycinum</i> L.	-		I	
<i>Alyssum minutum</i> Schlecht. ex DC.	I		I	
<i>Alyssum savranicum</i> Andrz.	-		I	ERL (I)/e2
<i>Alyssum tortuosum</i> Waldst. et Kit. subsp. <i>euximium</i> (Nyar.) Nyar.	V	e3	-	e3
<i>Anacamptis pyramidalis</i> (L.) Rich.	E	W	-	
<i>Anchusa azurea</i> Mill.	R		-	
<i>Anchusa officinalis</i> L.	R		Ssp.	
<i>Anthriscus sylvestris</i> (L.) Hoffm.	I		Ssp.	
<i>Apera interrupta</i> (L.) P.Beauv.	I		-	
<i>Apium nodiflorum</i> (L.) Lag.	Ex.?		-	
<i>Arenaria rigida</i> M.Bieb	Ex.?	e3	-	e3/IUCN
<i>Arenaria serpyllifolia</i> L.	Ssp.		I	
<i>Arenaria zozii</i> Kleop.	-		V	ERL (R)/e2
<i>Artemisia santonicum</i> L. subsp. <i>patens</i> (Neilr.) K. Pearson	R		-	
<i>Artemisia scoparia</i> Waldst. et. Kit.	I		-	
<i>Artemisia tschernieviana</i> Besser. (<i>A. arenaria</i> DC.)	E	e3	Ssp.	e3
<i>Arum maculatum</i> L.	I		-	
<i>Asparagus levinae</i> Klokov.	-		V	e2
<i>Asparagus pseudoscaberrimus</i> Grecescu.	Ssp.		I	
<i>Asparagus tenuifolius</i> Lam.	I		-	
<i>Asperula cynanchica</i> L.	R		R	
<i>Asperula graveolens</i> M.Bieb ex Schult. et Schult. f.	-		I	
<i>Asperula setulosa</i> Boiss.	R	e3	R	e3
<i>Asperula taurina</i> L.	I		-	
<i>Asperula tenella</i> Heuff. ex Degen aggr.	V	e3	-	e3
<i>Aster canus</i> Waldst. et Kit	I/?		-	
<i>Astragalus asper</i> Jacq.	R	e3	-	e3
<i>Astragalus borysthenicus</i> Klokov.	-		I	ERL (R)/e2
<i>Astragalus cornutus</i> Pall.	I	e3	-	e3
<i>Astragalus dolichophyllus</i> Pallas	E	e3	-	e3
<i>Astragalus varius</i> S.G. Gmel.	R		R	
<i>Astragalus vesicarius pseudoglaucus</i> L.	E	e3	-	e3
<i>Astrodaucus littoralis</i> (M.Bieb) Drude	E	e3	V	RDBU/e3
<i>Atriplex littoralis</i> L.	I		Ssp.	
<i>Bassia sedoides</i> (Pall.) Asch.	R		Ssp.	
<i>Batrachium aquatile</i> (L.) Dumort. (= <i>Ranunculus aquatilis</i> L.)	Ssp.		R	
<i>Beckmannia eruciformis</i> (L.) Host	I		V	
<i>Blackstonia acuminata</i> (Koch et Ziz)				
<i>Domin</i> (= <i>B. perfoliata</i> (L.) Huds. subsp. <i>serotina</i> (Koch ex Rchb.) Vollm)	Ex.?		-	

Species name	Conservation category		Ukraine	
	Romania			
<i>Blysmus compressus</i> (L.) Panz.	I		-	
<i>Buffonia tenuifolia</i> L.	V		-	
<i>Bupleurum rotundifolium</i> L.	R		-	
<i>Cakile maritima</i> Scop. subsp. <i>euxina</i> (Pobed.) Nyar.	V	e3	-	e3
<i>Calamagrostis arundinacea</i> (L.) Roth	I		-	
<i>Calamagrostis canescens</i> (Web.) Roth	Ssp		I	
<i>Calamagrostis pseudophragmites</i> (Hall. f.) Koeler	I		I	
<i>Caldesia parnassifolia</i> (Bassi) Parl.	I		-	
<i>Calla palustris</i> L.	Ex.?		-	
<i>Callitriche hermaphroditica</i> L.	-		I	
<i>Callitriche palustris</i> L.	I/?		-	
<i>Callitriche verna</i> L.	-		R	
<i>Caltha palustris</i> L.	Ex.?		V	
<i>Camelina alyssum</i> (Mill.) Thell.	I		-	
<i>Camelina rumelica</i> Velen.	R		Ssp.	
<i>Camelina sativa</i> (L.) Crantz	I/?		-	
<i>Campanula bononiensis</i> L.	Ssp.		I	
<i>Camphorosma annua</i> Pall.	I	e3	I	e3
<i>Capsella procumbens</i> (L.) Nutt. (=Hymenolobus procubens (L.) Fries)	V		-	
<i>Cardamine impatiens</i> L.	Ex.?		-	
<i>Cardamine pratensis</i> L.	I		R	
<i>Carex acuta</i> L. I Ssp.				
<i>Carex buekii</i> Wimm.	I/?		-	e3
<i>Carex diluta</i> M.Bieb	I/?	e3	I	e3
<i>Carex dioica</i> L.	I/?		-	
<i>Carex disticha</i> Huds.	I/?		-	
<i>Carex flacca</i> Schreb.	I/?		-	
<i>Carex flava</i> L.	I		-	
<i>Carex melanostachya</i> M.Biebex Willd.	R		I	
<i>Carex otrubae</i> Podp.	Ssp.		I	
<i>Carex rostrata</i> Stokes	I/?		-	
<i>Carex secalina</i> Wahlenb.	Ssp.		I	Br.I
<i>Carex stenophylla</i> Wahlenb.	I/?		I	
<i>Carex supina</i> Willd. ex Wahlenb.	I/?		-	
<i>Carex tomentosa</i> L.	I/?		-	
<i>Carex vesicaria</i> L.	I/?		I	
<i>Carpinus betulus</i> L.	Ex.?		-	
<i>Catabrosa aquatica</i> (L.) Beauv.	Ex.?		-	IUCN
<i>Caulinia minor</i> (All.) Coss. et Germ.	-		I	
<i>Centaurea jankae</i> Brandza	E	e2	-	e2/IUCN
<i>Centaurea cuneifolia</i> Sibth. et Sm.	I	e3	-	e3
<i>Centaurea micranthos</i> S.G. Gmel.	R		-	
<i>Centaurea phrygia</i> L.	I/?		-	
<i>Centaurea pontica</i> Prod. et Nyar.	E	e1	-	e1/IUCN
<i>Centaurea rutifolia</i> Sibth. et Sm.	I	e3	-	e3
<i>Centaurea scabiosa</i> L.	I		-	
<i>Centaurea spinulosa</i> Roch.	I		-	
<i>Centaurea stenolepis</i> A. Kern.	I/?		-	
<i>Centaurea stereophylla</i> Bess.	I		-	
<i>Centaurium erythraea</i> Rafn	R	e3	I	e3
<i>Centaurium pulchellum</i> (Sw.) Druce	Ssp.		I	
<i>Centaurium spicatum</i> (L.) Fritsch	E		I	
<i>Cephalanthera longifolia</i> (L.) Fritsch	E	W	-	W
<i>Cephalanthera damasonium</i> (Mill.) Druce	Ex.?	W	-	W
<i>Cephalaria transsylvanica</i> (L.) Roem. et Schult.	I/?	W	I	W
<i>Cerastium glomeratum</i> Thuill.	I		-	
<i>Cerastium gracile</i> Dufour	R	e3	-	e3
<i>Cerastium odessanum</i> Klokov	-		I	e2
<i>Cerastium rotundatum</i> Schur	-		I	
<i>Cerastium sylvaticum</i> Waldst. et Kit.	-		V	
<i>Cerastium ucrainicum</i> Pacz. ex Klokov	-		R	e2
<i>Ceratocarpus arenarius</i> L.	I		I	
<i>Ceratocephala testiculata</i> (Crantz) Besser	-		I	
<i>Ceratophyllum submersum</i> L.	I		V	
<i>Chamaerion angustifolium</i> (L.) Holub	-		I	

Species name	Conservation category		Ukraine	
	Romania			
Chorispora tenella (Pall.) DC.	R		-	
Chrysopogon gryllus (L.) Trin.	Ssp.		E	RDBU
Cicuta virosa L.	Ssp.		I	
Cirsium alatum (S.L.Gmel.)Bobrov	R	e3	Ssp.	e3
Cladium mariscus (L.) Pohl	Ssp.		V	RDBU
Clematis integrifolia L.	-		R	
Comarum palustre L.	Ex.?		Ex.?	
Convallaria majalis L.	-		V	
Convolvulus cantabrica L.	V		-	
Convolvulus lineatus L.	V		-	
Convolvulus persicus L.	E		-	
Corispermum canescens Kit.	I/?	e3	-	e3
Corispermum marschalli Stev.	V		-	
Corispermum nitidulum Klokov	-		K	e2
Corispermum ucrainicum Iljin	-		R	e2
Corynephorus canescens (L.) P.Beauv.	Ex.?		-	
Cotoneaster integerrimus Medic.	I		-	
Crambe maritima L.	V		-	
Crataegus laevigata (Poir.) DC.	I		-	
Crepis pannonica (Jacq.) K.Koch	-		R	
Crepis setosa Hall.	R		-	
Cruciata pedemontana (Bellardi) Ehrend.	R		-	
Cuscuta epithimum (L.) L.	I		-	
Cuscuta europaea L.	I		Ssp.	
Cyperus badius Desf.	-		V	
Cyperus difformis L.	Ssp.		R	
Dactylis polygama Horvat.	I		-	
Dactylorhiza incarnata (L.) Soo	E	W/RDBU	E	W/RDBU
Dactylorhiza majalis (Rchb.) P.F.Hunt et Summerhayes	-	W/RDBU	E	W/RDBU
Dasypirum villosum (L.) P. Candargy	I		-	
Daucus guttatus Sibth.et Sm.	V	e3	-	e3
Dianthus andrzejowskianus (Zapal.) Kulcz.	-		R	
Dianthus bessarabicus Klokov (= D. polymorphus M.Bieb subsp. bessarabicus (Kleopow) Ciocarlan)	R	e3	R	ERL (R)/RDBU/e3
Dianthus capitatus Balb.	R		-	
Dianthus deltoides L.	-		I	
Dianthus giganteus D'Urv.	I/?	e3	-	e3
Dianthus platyodon Klokov	-		R	e2
Dianthus pontederiae Kern.	R		-	
Dipsacus fullonum L.	I		-	
Dipsacus laciniatus L.	Ssp.		I	
Ecballium elaterium (L.) A. Rich.	V		-	
Echinocystis lobata (Michx.) Torr. et A. Gray	R		Ssp.	
Elatine hungarica Moesz	Ssp.		R	
Eleocharis mitracarpa Steud.	-		V	
Eleocharis parvula (Roem.et Schult.)Bluff, Nees et Schauer	Ssp.		R	
Elymus pycnattum (Godron)				
Melderis deltaicus	R	e1	-	
Elytrigia bessarabica (Savul. et Rayss) Prokud. (= Agropyron junceum (L.) Beauv subsp. bessarabicum (Savul. et Rayss) Chiocarlan)	Ssp.		V	e3
Elytrigia maeotica (Prokudin)Prokudin	-		R	e2
Elytrigia stipifolia (Czern. ex Nevski) Nevski	-		V	ERL (R)/RDBU/e3
Ephedra distachya L.	V		V	
Epilobium palustre L.	R		Ssp.	
Epilobium parviflorum Schreb.	Ssp.		V	
Epilobium roseum Schreb.	I/?		-	
Epilobium tetragonum L.	Ssp.		V	
Epipactis atrorubens (Hoffm.) Bess.	-	W	-	W
Epipactis helleborine (L.) Crantz	Ex.?	W/RDBU	E	W/RDBU
Epipactis palustris (L.) Crantz	R	W	V	W/RDBU
Equisetum fluviatile L.	R		Ssp.	
Equisetum hyemale L.	Ex.?		R	
Equisetum palustre L.	R		Ssp.	
Equisetum telmateia Ehrh.	Ssp.		E	

Species name	Conservation category		Ukraine	
	Romania			
<i>Eragrostis aegyptiaca</i> (Willd.) Delile	-		V	
<i>Eremogone rigida</i> (M.Bieb) Fenzl	-		V	
<i>Erigeron podolicus</i> Bess.	-		V	
<i>Erodium cicutarium</i> (L.) L'Her.	E		Ssp.	
<i>Erodium hoefftianum</i> C.A.Mey.	R		-	
<i>Erophila praecox</i> (Steven) DC. (=Erophila verna (L.) Chevall. subsp. praecox (Stev.) Walters = E. glabrescens Jord.)	Ssp.		V	
<i>Eryngium maritimum</i> L.	R		Ssp.	
<i>Erysimum odoratum</i> Ehrh.	I	e3	-	e3
<i>Erysimum repandum</i> L.	R		Ssp.	
<i>Euphorbia agraria</i> M. Bieb	I		Ssp.	
<i>Euphorbia amygdaloides</i> L.	I		-	
<i>Euphorbia falcata</i> L.	R		-	
<i>Euphorbia klokovii</i> Dubovik	-		K	e3
<i>Euphorbia leptocaula</i> Boiss.	K	e3	Ssp.	e3
<i>Euphorbia lucida</i> Waldst.et Kit.	nt		nt	
<i>Euphorbia maculata</i> L.	R		K	
<i>Euphorbia palustris</i> L.	nt		Ssp.	
<i>Euphorbia paralias</i> L.	V		Ssp.	
<i>Euphorbia pepelis</i> L.	V		Ssp.	
<i>Euphorbia salicifolia</i> Host	I	e3	-	
<i>Euphorbia sequierana</i> Neck.	nt		nt	
<i>Euphorbia stepposa</i> Zoz	-		V	e2
<i>Euphorbia stricta</i> L.	I	e3	-	e3
<i>Euphorbia villosa</i> Waldst. et Kit.	I		-	
<i>Euphorbia virgata</i> Waldst. et Kit.				
(= <i>Euphorbia waldsteinii</i> (Sojak.)Szerep.)	R		Ssp.	
<i>Euphrasia nemorosa</i> (Pers.) Wallr.	I/?		-	
<i>Festuca beckeri</i> (Hack.)Trautv.	R	e3	R	e3
<i>Festuca callieri</i> (Hack.) Markgr.	R		-	
<i>Festuca pseudovina</i> Hack. ex Wiesb.	I		-	
<i>Fimbristylis annua</i> (All.) Roem. et Schult.	I		-	
<i>Frankenia hirsuta</i> L. (=Frankenia hispida DC.)	V		R	
<i>Frankenia pulverulenta</i> L.	V		V	IUCN RL (R)
<i>Fraxinus pennsylvanica</i> Marsh.	-		R	
<i>Fumana procumbens</i> (Dun.) Gren. et Godr.	V		V	
<i>Fumaria schleicheri</i> Soy.-Willem.	I		I	
<i>Galium sylvaticum</i> L.	I/?		-	
<i>Galium verum</i> L.	I/?		R	
<i>Gentiana cruciata</i> L.	Ex.?		-	
<i>Geranium asphodeloides</i> Burm. fil.	R	e3	-	e3
<i>Geranium dissectum</i> L.	Ex.?		-	
<i>Geranium divaricatum</i> Ehrh.	I/?		-	
<i>Geranium palustre</i> L.	I/?		-	
<i>Geranium phaeum</i> L.	Ex.?		-	
<i>Glechoma hirsuta</i> Waldst. et Kit.	I/?		I	
<i>Glinus lotoides</i> L.	V		V	
<i>Glyceria arundinacea</i> Kunth	-		R	
<i>Glyceria fluitans</i> (L.) R. Br.	I		V	
<i>Glyceria notata</i> Chevall (=Glyceria plicata (Fries) Fries)	-		R	
<i>Glyceria densa</i>	I		-	
<i>Gnaphalium luteo-album</i> L.	Ssp.		V	
<i>Gnaphalium uliginosum</i> L.	Ssp.		I	
<i>Groenlandia densa</i> (L.) Fourn.	I		-	
<i>Gypsophila glomerata</i> Pall.	E	e3	-	e3/IUCN
<i>Gypsophila pallasii</i> Ikonn.	-		V	e3
<i>Gypsophila paniculata</i> L.	V		Ssp.	
<i>Halimione verrucifera</i> (M.Bieb) Aellen.	R		Ssp.	
<i>Halocnemum strobilaceum</i> (Pall.) M. M.Bieb	R		R	
<i>Helianthemum nummularium</i> (L.) Mill.	R		R	
<i>Heliotropium dolosum</i> De Not.	I		R	
<i>Heliotropium suaveolens</i> M.Bieb	I		-	
<i>Herniaria euxina</i> Klokov	-		K	e2
<i>Herniaria hirsuta</i> L.	R		-	
<i>Herniaria polygama</i> J.Gay	-		V	
<i>Hesperis tristis</i> L.	Ex.?	e3	-	e3
<i>Hieracium piloselloides</i> Vill.	I	?	-	

Species name	Conservation category		Ukraine	
	Romania			
<i>Holcus lanatus</i> L.	I		-	
<i>Holosteum umbellatum</i> L.	I		-	
<i>Hordeum bulbosum</i> L.	I		-	
<i>Hordeum geniculatum</i> All.	-		R	
<i>Hordeum marinum</i> Huds.	R		-	
<i>Hottonia palustris</i> L.	Ssp.		E	
<i>Iris pumila</i> L.	-		E	
<i>Iris variegata</i> L.	R		-	
<i>Juncus acutiflorus</i> L.	-		R	
<i>Juncus conglomeratus</i> L.	I		R	
<i>Juncus hybridus</i> Brot.	I		-	
<i>Juncus subnodulosus</i> Schrank	I		-	
<i>Juncus tyraicus</i> (Pacz.) V.Krecz. et Gontsch.	-		R	e2
<i>Kochia prostrata</i> (L.) Schrad.	R		Ssp.	
<i>Koeleria cristata</i> (L.) Pers.	I		Ssp.	
<i>Koeleria lobata</i> (M.Bieb) Roem. et Schult.	V	e3	-	e3
<i>Koeleria pyramidata</i> (Lam.) Beauv.	Ex.?		-	
<i>Lappula marginata</i> (M.Bieb) Gurke.	R		-	
<i>Lathyrus hirsutus</i> L.	I		-	
<i>Lathyrus pannonicus</i> (Jacq.) Garcke	I		-	
<i>Lathyrus sylvestris</i> L.	R		-	
<i>Lathyrus venetus</i> (Mill.) Wohlf.	I		-	
<i>Lemna gibba</i> L.	Ssp.		V	
<i>Leontodon autumnalis</i> L.	I		I	
<i>Leontodon crispus</i> Vill.	I/?		-	
<i>Leontodon danubialis</i> Jacq.	-		R	
<i>Lepidium cartilagineum</i> (J. Mayer) Thell.	R		-	
<i>Leucanthemella serotina</i> (L.) Tzvelev	-		I	
<i>Leucojum aestivum</i> L.	Ssp.		V	RDBU
<i>Leuzea altaica</i> (Fischer ex Spreng.) Link (=L. salina Spreng.)		e3	-	e3
<i>Limodorum abortivum</i> (L.) Sw.	R	W	-	W
<i>Limonium alutaceum</i> (Stev.) O.Kuntze - V				
<i>Limonium danubiale</i> Klokov (= L. bellidifolium (Gouan) Dum. subsp.danubiale (Klokov) Roman)	V	e3	R	e1
<i>Limonium gmelinii</i> (Willd) O.Kuntze	I		-	
<i>Limonium hypanicum</i> Klokov	-		V	e2
<i>Limonium meyeri</i> (Boiss.) O.Kuntze	R	e3	Ssp.	e3
<i>Limonium platyphyllum</i> Lincz.	R		Ssp.	
<i>Limosella aquatica</i> L.	R		R	
<i>Linaria arvensis</i> (L.) Desf.	I/?		-	
<i>Linum perenne</i> L.	I		Ssp.	
<i>Liparis loeselii</i> (L.) L.C.M. Rich.	Ex.?	W	-	W
<i>Littorella uniflora</i> (L.) Aschers.	I/?		-	
<i>Lolium loliaceum</i> (Bory et Chaub.) Hand. -Mazz. (=L. rigidum Gaud. subsp. lepturoides (Boiss.) Sennen et Mauricio)	V		-	
<i>Lolium rigidum</i> Gaud.	I		-	
<i>Lythrum melanospermum</i> Savul. et Zahar.	Ssp.		R	e3
<i>Lythrum thymifolia</i> L.	K		-	
<i>Lythrum tribRACTEATUM</i> Salzm. ex Spreng.	I		R	
<i>Marrubium peregrinum</i> L.	R		Ssp.	
<i>Marsilea quadrifolia</i> L.	V		-	H
<i>Medicago minima</i> (L.) Bartal.	E		Ssp.	
<i>Medicago rigidula</i> (L.) All.	R		-	
<i>Medicago tenderiensis</i> Opperm.ex Klokov	-		K	e2
<i>Melampyrum sylvaticum</i> L.	I/?		-	
<i>Melilotus altissima</i> Thuill.	I		-	
<i>Melilotus arenaria</i> Grec.	R	e3	-	e3
<i>Menyanthes trifoliata</i> L.	Ex.?		-	
<i>Merendera sobolifera</i> C.A. Mey.	V		-	
<i>Minuartia bilykiana</i> Klokov	-		V	IUCN RL (I); ERL (V)/e3
<i>Minuartia setacea</i> (Thuill.) Hay	V	e3	-	e3
<i>Minuartia viscosa</i> (Schreb.) Schinz et Thell.	R		-	
<i>Molinia euxina</i> Pobed.	Ssp.		I	
<i>Muscari neglectum</i> Guss. ex Ten.	I		E	
<i>Myosurus minimus</i> L.	Ssp.		R	
<i>Myrrhoides nodosa</i> (L.) Cannon	I		-	

Species name	Conservation category		Ukraine	
	Romania			
Naumburgia thyrsoflora (L.) Rchb.	-		R	
Neottia nidus-avis (L.) L.C.M. Rich.	R	W	-	W
Nonea pulla (L.) DC.	Ex.?		-	
Nymphoides peltata (S.G.Gmel.)O.Kuntze	Ssp.		I	RDBU
Ononis pumila L.	V	e3	-	e3
Onosma arenaria Waldst. et. Kit	V		-	
Onosma borysthena Klokov	-		R	e2
Onosma setosum Ledeb.	I	e3	-	e3
Onosma visianii G.C. Clementi	R		-	
Ophioglossum vulgatum L.	Ex.?		-	
Orchis coriophora L. subsp. fragrans (Poll.) Sudre	E	W	-	W
Orchis laxiflora elegans (Heuffel) Soo	V	W/e3	-	W/e3
Orchis morio L.	V	W	-	W
Orchis palustris Jacq.	-	W/RDBU	V	W/RDBU
Orlaya grandiflora (L.) Hoffm.	I		-	
Ornithogallum amphibolum Zahar.	V	e3	-	ERL (I)/IUCN
Ornithogallum boucheanum (Kunth) Asch.	-		V	
Ornithogallum fimbriatum Willd.	-		V	
Ornithogallum kochii Parl. (=O. orthophyllum Ten. subsp. kochii (Parl.) Zahar.)	Ssp.		V	
Ornithogallum oreoides Zahar.	V	e3	V	e3/IUCN
Ornithogallum orthophyllum Ten.	I		-	
Orobanche lutea Baumg.	I		-	
Orobanche ramosa L.	R		-	
Orobanche reticulata Wallr.	I		-	
Padus avium Mill.	-		R	
Palimbia rediviva (Pall.) Thell.	I		-	
Paliurus spina-christi Mill.	R		-	
Papaver hybridum L.	V		Ssp.	
Parapholis incurva (L.) C.E. Hubbard	E		-	
Periploca graeca L.	V		I	
Persicaria lapathifolia (L.) Delarbre subsp. andrzejowskiana (Klokov) Sojak (=Polygonum andrzejowskianum Klokov)	-		R	
Persicaria maculosa S.F. Gray (=Polygonum persicaria L.)	I		Ssp.	
Petrosimonia brachiata (Pall.) Bunge	-		V	
Petrosimonia oppositifolia (Pall.) Litv.	-		V	
Petunia parviflora Juss.	E		-	
Peucedanum arenarium Waldst. et Kit.	V		Ssp.	
Peucedanum palustre (L.) Moench	I		Ssp.	
Pholiurus pannonicus (Host.) Trin.	I		V	
Phlomis pungens	I		-	
Plantago altissima L.	R		R	
Plantago cornuti Gouan	R		Ssp.	
Plantago coronopus L.	R		-	
Plantago schwarzenbergiana Schur	I	e3	-	ERL (I)/e3
Platanthera bifolia (L.) L.C.M. Rich.	E	W	-	W
Poa nemoralis L.	I		-	
Polycnemum arvense L.	I		-	
Polygala podolica DC.	-		I	
Polygonatum multiflorum (L.) All.	I		-	
Polygonatum odoratum (Mill.) Druce	Ex.?		-	
Polygonum graminifolium Wierzb.	I	e3	-	e3
Polygonum mesembrycicum Chrtek	V	e3	-	e3
Polygonum minus Huds.	I		R	
Polygonum novoascanicum Klokov	-		I	e2
Polygonum patulum M. Bieb	K		R	
Polygonum rurivagum Jord.	K		-	
Polygonum monspeliensis (L.) Desf.	R		R	
Potamogeton acutifolius Link.	I		I	
Potamogeton compressus L.	R		R	
Potamogeton gramineus L.	Ssp.		E	
Potamogeton obtusifolius Mert.et Koch	Ssp.		E	
Potamogeton pusillus L.	R		R	
Potamogeton trichoides Schlecht. et Cham.	R		V	
Potentilla astracantha Jacq.	-		V	

Species name	Conservation category		Ukraine	
	Romania			
Potentilla erecta (L.) Rausch.	K		-	
Potentilla intermedia L.	-		Ssp.	
Potentilla pedata Willd.	R		-	
Potentilla recta L.	R		-	
Prunus tenella Batsch	V		-	
Pteridium aquilinum (L.) Kuhn	Ex.?		-	
Puccinellia gigantea (Grossh.) Grossh.	R	e3	-	e3
Puccinellia poecilantha (C. Koch) Grossh. (=P. brachylepis Klokov)	I		-	
Radiola linoides Roth	R		-	
Ranunculus acris L.	I		-	
Ranunculus aquatilis L.	I		-	
Ranunculus ficaria L.	I		-	
Ranunculus peltatus Schrank	I		-	
Rochelia disperma (L. fil.) C. Koch.	I/?		-	
Rorippa nasturtium-aquaticum (L.) Hayek (=Nasturtium officinale R.Br.)	Ssp.		R	
Rorippa prolifera (Heuff.) Neir.	I	e3	-	e3
Rosa corymbifera Borkh.	I/?		-	
Rosa scabriuscula Sm.	K		-	
Rumex halacsyi Rech. (Rumex dentatus ssp. halacsyi)	Ssp.		R	e2
Rumex maritimus L.	R		Ssp.	
Rumex ucrainicus Fisch. ex Spreng.	-		I	ERL (R)/e2
Ruppia cirrhosa (Petagna) Grande	V		R	
Ruppia maritima L.	V		R	
Saccharum ravenae (L.) Murr.	E		-	
Saccharum strictum (Host) Spreng.	E	e3	-	e3
Sagina maritima G. Don	R		-	
Sagittaria latifolia Willd.	-		K	
Sagittaria trifolia L.	V	e3	V	e3
Salicornia procumbens Smith	K		-	
Salicornia ramosissima J. Woods	K		-	
Salix aurita L. Ph	Ex.?		-	
Salix pentandra L.	Ex.?		Ssp.	
Salix viminalis L.	Ex.?		R	
Salsola collina Pall.	K		-	
Salsola soda L.	R		Ssp.	
Salvia aethiopsis L.	R		-	
Salvia austriaca Jacq.	R		-	
Salvia glutinosa L.	Ex.?		-	
Salvia nemorosa L.	R		-	
Salvinia natans (L.) All.	nt	Br.I	nt	Br.I/ RDBU
Sanicula europaea L.	Ex.?		-	
Saxifraga adscendens L.	Ssp.		I	
Scabiosa ochroleuca L.	I		Ssp.	
Scirpus mucronatus L. (=Schoenoplectus mucronatus (L.) Palla)	-		R	
Scirpus triqueter L. (=Schoenoplectus triqueter (L.) Palla)	R		V	
Scleranthus polycarpus (L.) Thell. (=Scleranthus annuus subsp.				
Polycarpus (L.) Thell.)	Ex.?		-	
Scolymus hispanicus L.	R		-	
Scrophularia umbrosa Dumort.	I		Ssp.	
Scutellaria altissima L. Ex.? - Senecio borysthenticus (DC.) Andr. - I ERL (R)/e2 Senecio doria L.	I/?		-	
Senecio erucifolius L.	I		-	
Sideritis montana L.	Ssp.		R	
Silene thymifolia Sibth. et Sm.	I/?		-	
Sisymbrium officinale (L.) Scop.	I		Ssp.	
Solanum retroflexum Dum.	R		-	
Sparganium emersum Rehman	Ssp.		R	
Spergula arvensis L.	-		R	
Spergularia rubra (L.) J.Presl et C. Presl	R		Ssp.	
Stachys atherocalyx K. Koch (=Stachys acanthodonta Klokov)	V	e3	R	e3
Stachys maritima Gouan	E		-	

Species name	Conservation category	
	Romania	Ukraine
<i>Stipa borysthenica</i> Klokov ex Prokudin	Ssp.	E RDBU/e2
<i>Stipa capillata</i> L.	Ssp.	V RDBU
<i>Stipa joannis</i> Celak	I	-
<i>Stipa pulcherrima</i> C. Koch	I	-
<i>Suaeda altissima</i> (L.) Pall.	-	R
<i>Syrenia cana</i> (Piller et Mitterp.) Neilr.	I	Ssp. e3
<i>Syrenia montana</i> (Pall.) Klokov	R	R e3
<i>Syrenia siliculosa</i> (M.Bieb) Andr.	-	R
<i>Tanacetum millefolium</i> (L.) Tzvelev	-	V
<i>Tanacetum odessanum</i> (Klokov) Tzvelev	-	V e2
<i>Taraxacum erythrospermum</i> Andr.	-	V
<i>Tetragonolobus maritimus</i> (L.) Roth.	R	V
<i>Teucrium chamaedrys</i> L.	Ssp.	V
<i>Thalictrum lucidum</i> L.	I	R
<i>Thelypteris palustris</i> Schott	-	R
<i>Thymus dimorphus</i> Klokov et Des.-Shost.	-	R e3
<i>Tilia cordata</i> Mill.	Ex.?	-
<i>Trachomitum sarmatiense</i> Woodson (= <i>Trachomitum venetum</i> (L.) Woodson)	E	K
<i>Tragopogon borystenicus</i> Artemcz.	-	I ERL/e2
<i>Tragopogon podolicus</i> (DC.) Artemcz.	-	R e2
<i>Tragopogon pratensis</i> L.	I	-
<i>Tragopogon tesquicola</i> Klokov	-	R e3
<i>Trapa natans</i> L.	nt	Br.I nt Br.I/ RDBU
<i>Trifolium angulatum</i> Waldst. et Kit	I/?	-
<i>Trifolium filiforme</i> L.	Ex.?	-
<i>Trifolium ornithopodioides</i> (L.) Sm.	I/?	-
<i>Trifolium pallidum</i> Waldst. et Kit	I/?	-
<i>Trifolium resupinatum</i> L.	I/?	R
<i>Trifolium retusum</i> L.	I	R
<i>Trifolium scabrum</i> L.	-	R
<i>Trifolium striatum</i> L.	I/?	-
<i>Trifolium suffocatum</i> L.	Ex.?	-
<i>Trifolium vesiculosum</i> Savi	-	R
<i>Triglochin maritima</i> L.	I	-
<i>Triglochin palustris</i> L.	Ssp.	I
<i>Trigonella gladiata</i> Stev.	I	-
<i>Trigonella monspeliaca</i> L.	R	-
<i>Trigonella procumbens</i> (Besser) Rchb.	Ssp.	V
<i>Tussilago farfara</i> L.	Ssp.	I
<i>Typha grossheimii</i> Pobed.	-	R
<i>Typha minima</i> Funk	-	I Br.I
<i>Ulmus laevis</i> Pall.	Ex.?	Ssp.
<i>Urtica galeopsisifolia</i> Wierzb. ex Opiz	-	R
<i>Urtica kioviensis</i> Rogov.	I	e3 Ssp. e3
<i>Utricularia australis</i> R. Br.	R	-
<i>Utricularia bremii</i> Heer	I	-
<i>Utricularia intermedia</i> Hayne	-	R
<i>Utricularia minor</i> L.	I	Ssp.
<i>Vaccaria hispanica</i> (Mill.) Rauschert	I	-
<i>Valeriana officinalis</i> L.	Ssp.	I
<i>Valeriana stolonifera</i> Czern. (= <i>Valeriana collina</i> Wallr.)	-	V
<i>Valerianella carinata</i> Loisel.	I	-
<i>Valerianella coronata</i> (L.) DC.	I	-
<i>Valerianella lasiocarpa</i> (Stev.) Betcke	I	-
<i>Ventenata dubia</i> (Leers) Coss.	-	I
<i>Verbascum chaixii</i> Vill.	I	e3 - e3
<i>Verbascum lanatum</i> Schrad.	I	-
<i>Verbascum ovalifolium</i> Donn.	R	-
<i>Veronica austriaca</i> L.	-	R
<i>Veronica prostrata</i> L.	R	-
<i>Veronica scardica</i> Griseb.	I	-
<i>Veronica scutellata</i> L.	I	I
<i>Veronica spicata</i> L.	I	R
<i>Veronica triphyllos</i> L.	R	I
<i>Viburnum opulus</i> L.	Ssp.	V
<i>Vicia narbonensis</i> L.	R	-
<i>Vicia pannonica</i> Crantz	I	-

Species name	Conservation category		Ukraine	
	Romania			
Vicia tetrasperma (L.) Schreb.	I/?		-	
Vincetoxicum hirundinaria Medik. (= Vincetoxicum laxum (Bartl.) Gren. et Godr.)	-		R	
Vincetoxicum nigrum (L.) Moench	I		-	
Vincetoxicum rossicum (Kleopov) Barbar.	-		R	e3
Viola hirta L.	I		-	
Viola odorata L.	I		-	
Viola palustris L.	I		-	
Viola suavis M.Bieb	I		-	
Vitis sylvestris C.C.Gmel.	R		I	
Wolffia arrhiza (L.) Horkel ex Wimmer.	I		Ssp.	
Zannichellia palustris L.	R		Ssp.	
Zannichellia pedunculata Rchb.	-		I	
Ziziphus jujuba Mill.	V		-	
Zostera marina L.	I		Ssp.	
Zostera noltii Hornem. (=Zostera nana Roth, nom. illeg.)	I		Ssp.	
Zygophyllum fabago L.	R	e3	-	e3

Colophon

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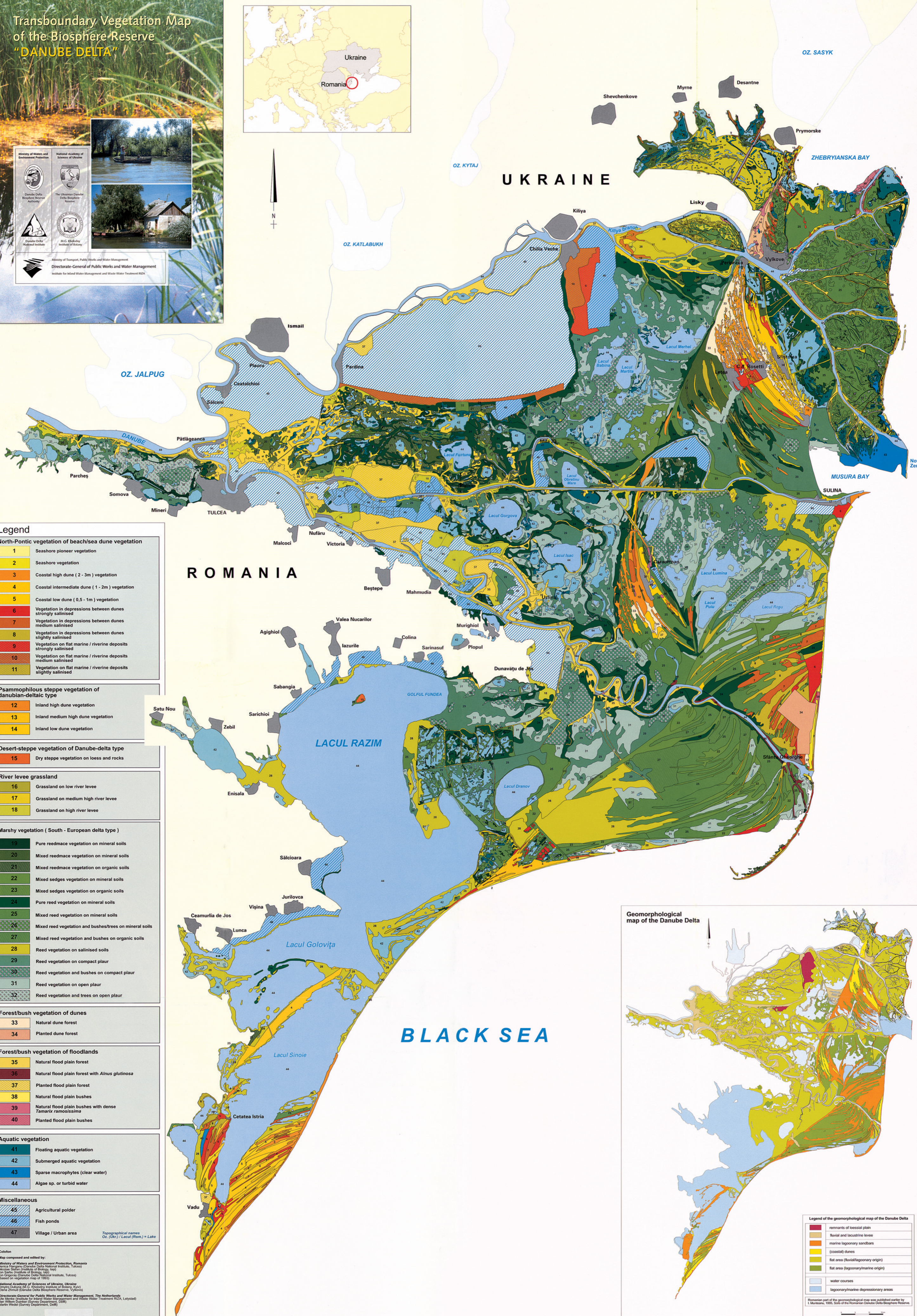
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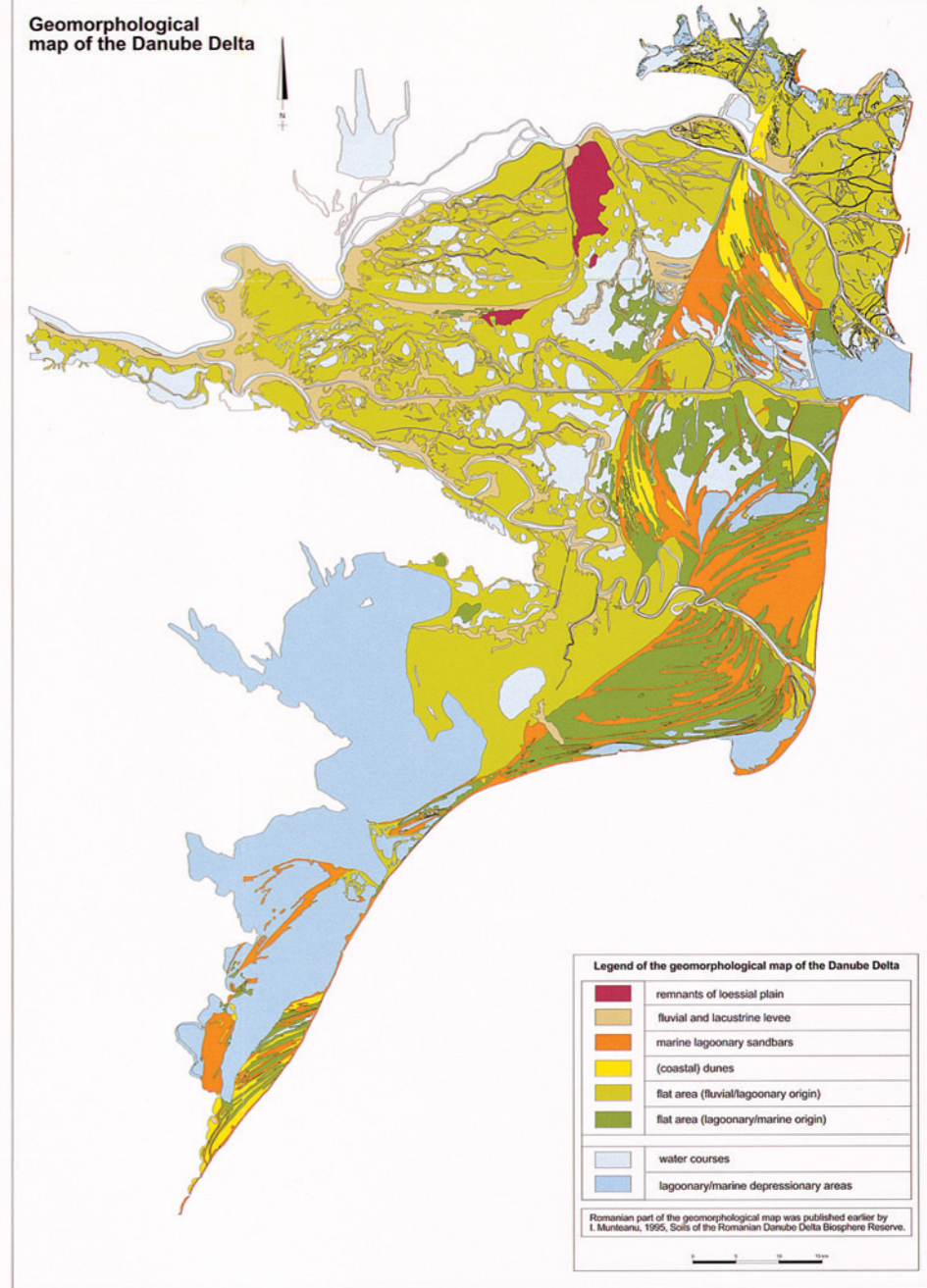


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 Institute for Inland Water Management and Waste Water Treatment RIZA



Legend

North-Pontic vegetation of beach/sea dune vegetation	
1	Seashore pioneer vegetation
2	Seashore vegetation
3	Coastal high dune (2 - 3 m) vegetation
4	Coastal intermediate dune (1 - 2 m) vegetation
5	Coastal low dune (0,5 - 1 m) vegetation
6	Vegetation in depressions between dunes strongly salinised
7	Vegetation in depressions between dunes medium salinised
8	Vegetation in depressions between dunes slightly salinised
9	Vegetation on flat marine / riverine deposits strongly salinised
10	Vegetation on flat marine / riverine deposits medium salinised
11	Vegetation on flat marine / riverine deposits slightly salinised
Psammophilous steppe vegetation of danubian-deltaic type	
12	Inland high dune vegetation
13	Inland medium high dune vegetation
14	Inland low dune vegetation
Desert-steppe vegetation of Danube-delta type	
15	Dry steppe vegetation on loess and rocks
River levee grassland	
16	Grassland on low river levee
17	Grassland on medium high river levee
18	Grassland on high river levee
Marshy vegetation (South - European delta type)	
19	Pure reed vegetation on mineral soils
20	Mixed reed vegetation on mineral soils
21	Mixed reed vegetation on organic soils
22	Mixed sedges vegetation on mineral soils
23	Mixed sedges vegetation on organic soils
24	Pure reed vegetation on mineral soils
25	Mixed reed vegetation on mineral soils
26	Mixed reed vegetation and bushes/trees on mineral soils
27	Mixed reed vegetation and bushes on organic soils
28	Reed vegetation on salinised soils
29	Reed vegetation on compact plaur
30	Reed vegetation and bushes on compact plaur
31	Reed vegetation on open plaur
32	Reed vegetation and trees on open plaur
Forest/bush vegetation of dunes	
33	Natural dune forest
34	Planted dune forest
Forest/bush vegetation of floodlands	
35	Natural flood plain forest
36	Natural flood plain forest with <i>Alnus glutinosa</i>
37	Planted flood plain forest
38	Natural flood plain bushes
39	Natural flood plain bushes with dense <i>Tamarix ramosissima</i>
40	Planted flood plain bushes
Aquatic vegetation	
41	Floating aquatic vegetation
42	Submerged aquatic vegetation
43	Sparse macrophytes (clear water)
44	Algae sp. or turbid water
Miscellaneous	
45	Agricultural polder
46	Fish ponds
47	Village / Urban area



0 5 10 15 km