

## MEADOW VEGETATION FROM BOTNA RIVER

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**Abstract:** The aim of the investigations is to highlight the state of vegetation on Botna alluvial river. The research objectives focused on highlighting the spectrum of the floristic composition, the development of natural vegetation of Botna floodplain, as well as the establishment of measures for improvement and preservation of plant diversity on the slopes of meadow and marsh ecosystems. The research was carried out according to Borza and Boşcaiu methods. There were reported a number of 94 vascular plants belonging to 84 genus and 34 families. The species of families' Poaceae, Asteraceae and Fabaceae are dominant. The plants from Botna river were grouped into five categories according to their economic value (medicinal, fodder, food, toxic and decorative). It was established that the forest vegetation is better represented on the upper and the outpouring of the river. The herbaceous vegetation (especially the hydrophytic vegetation) has a low distribution on the middle of the Botna river, which is caused by the high degree of water mineralization and increased soil salinity. We have developed measures for conservation of vegetation biodiversity in the meadow and marsh ecosystems.

**Keywords:** Botna River, meadow ecosystems, soil, vegetation, wetland

### Introduction:

Sustainable development requires knowledge of economy and rational use of resources and natural vegetation of the wetlands. Over the past decades the rivers has changed essentially Botna river, representing a basic component of the landscapes in the country. The marsh ecosystem is distributed unevenly, characterized by a vast variety of aspects, such as ecological, physical and geographical, hydrochemical and hydrobiological (Postolache 1995).

Deforestation, the draining of the marshes and floodplains, the regularization and hydrotechnical works, as well as the intensive grazing have a negative effect on

wetland ecosystems of the Botna river. As a result, the erosion and the modification of the areas occupied by indigenous natural vegetation specific to aquatic ecosystems occurred.

Data on the flora and vegetation of the river Botna is reduced. Our research aimed at highlighting the floristic state of vegetation composition in the Botna river valley of biodiversity conservation and outlining measures to improve them.

### Materials and methods:

The research on the flora and vegetation were undergone in the river valley that opens to the river Dniester, which is included in one of the three Ramsar "Lower Dniester" wetlands.

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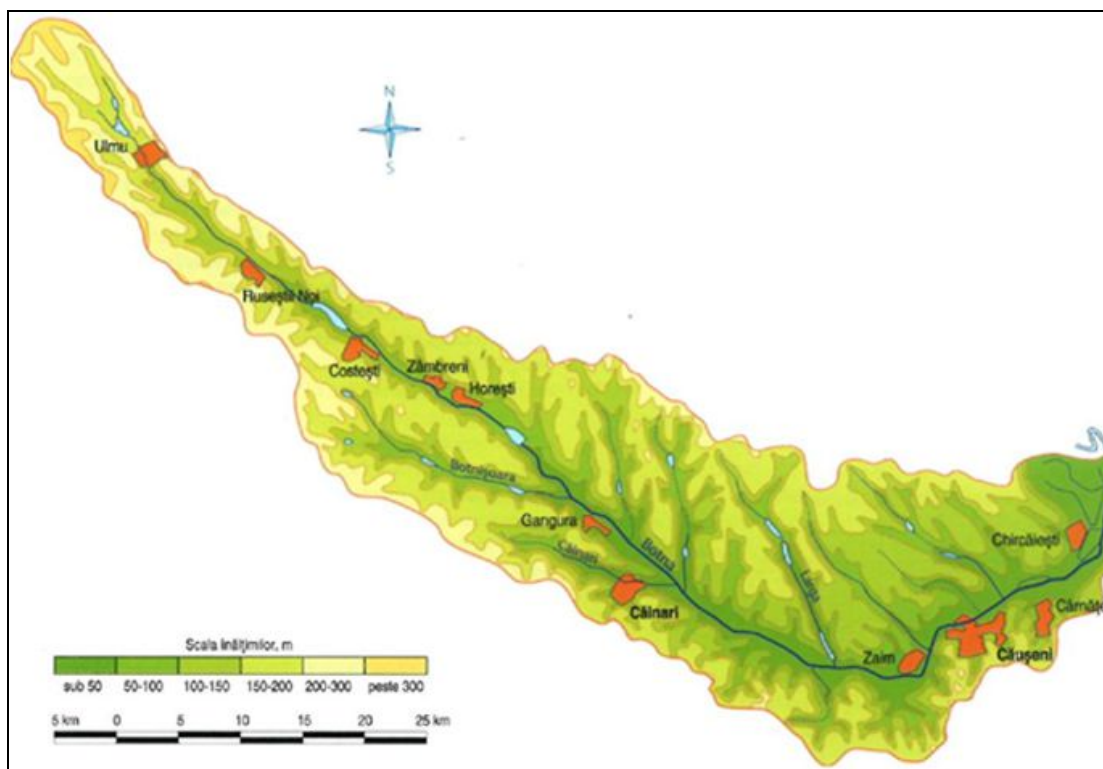
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The investigations of natural vegetation on slopes, in meadows and wetlands were carried out. The research was performed according to the methods of Borza and Boşcaiu (1965). The program initiated investigations in 2010 and included observations on parking lots, land routes. Expeditions within natural vegetation (grassland) enabled plant collections and laboratory analyses by conventional methods. In order to make plant descriptions and measurements, various determinants have been used (Gheideman 1986; Postolache 1995; Chirtoacă and Begu 2004;

Ciubotaru et al. 2007; Negru et al. 2005; Negru et al. 2006; Negru 2007).

The Botna river springs 1.7 km south from the village Stejăreni at an altitude of 225 m and flows into the Dniester river, on the right bank, approximately 5 km upstream of the Tiraspol city, at an altitude of 5 m. The river length is 152 km, the basin area is 1540 km<sup>2</sup>, the fall height is 220 m and the average slope is 1.45% (maximum 8.2% in the first 9 km segment). The basin is located in the south-east of the Codrilor Plateau and at south from the Bâcului Lower Plain (Fig. 1).

**Figure no. 1** Botna river basin



The topography of the basin area is hilly and heavily fragmented. At the top of the basin the height is ranging between 250 and 270 m while in the lower segments between 130 and 150 m. The meadow is bilateral; its width varies from 50 m (upstream) to 1.6 km (downstream, the locality Cărnăești) with a

prevailing width of 0.5 - 1.2 km. The meadow consists of sandy clays and along the riverbed there are many swamps. During the flood the meadow is covered with a layer of water of 0.3-1.0 m. Near the village of Chircăiești the Botna river forms a lake (Lake Botna), flowing through the middle of

the village, with a length of 4.5 km and a width of 1.7 km. In the summer the lake dries up completely. In this area the width of the river is 2-8 m and the depth is 0.1-0.8 m (Cazac et al. 2007).

According to Cazac et al. (2007) the river water supply is mixed: on the one hand, by the contribution on its tributaries and on the other hand by rainfalls and snowmelting. Spring high waters usually begin in late February - early March, whereas the maximum amount rises to 1.5 - 2.0 m tall. The average duration of high water spring is 39 days (maximum 70 days; minimum 20 days). The rainfall floods during the summer-autumn are short, averaging 10

days. In winter the water level in the river varies greatly (Fig. 2). The average flow of water is 0.77 m<sup>3</sup>/s (minimum 0.073 m<sup>3</sup>/s, maximum 2.5 m<sup>3</sup>/s). The river is regulated through three largest lakes (Ulmu, Costești și Rezeni), with a total area of 663 ha. The most of these lakes are clogged. The average flow of silt in suspension is of 0.37 kg/s and 1332 kg/h, causing silting of the river (Fig. 3). The river water is used for irrigation, as technical water and fishing.

There are hummus lands in the central and lower part of the valley. The river floodplain soils are alluvial, sometimes saline.

**Figure no. 2** River Botna - Winter partially frozen segment, Căușeni - Zaim



### Results and discussion:

As a result of the research conducted in the valley of Botna river there have been reported a number of 94 species of vascular plants (Tab. 1, Annexes). In terms of taxonomy the plant species belong to 84 genera and 34 families. The share genera and species in each family is shown in Figure 4 (Annexes). Most genera and species are included in the families Poaceae, Asteraceae and Fabaceae.

In terms of economic value the plant species were grouped into five categories:

- medicinal: *Acorus calamus* L., *Bidens tripartita* L., *Euphorbia helioscopia* L., *Achillea millefolium* L., *Xanthium spinosum* L., *Helichrysum arenarium* (L.) Moench, *Lepidium cartilagineum* subsp. *crassifolium* (Waldst. & Kit.) Thell., *Mentha longifolia* (L.) Huds., *Cichorium intybus* L., *Ranunculus acris* L., *Thymus serpyllum* L., *Trifolium repens* L., *Cynodon*

- dactylon* (L.) Pers., *Lolium perenne* L., *Equisetum arvense* L., *Erigeron canadensis* L., *Polygonum patulum* subsp. *patulum* Klokov, *Polygonum aviculare* L., *Thalictrum minus* L., *Agrimonia eupatoria* L., *Typha latifolia* L., *Typha angustifolia* L., *Tribulus terrestris* L.;
- fodder: *Spergularia maritima*, *Beckmannia eruciformis* (L.) Host., *Bothriochloa ischaemum* (L.) Keng., *Bromus japonicus* subsp. *japonicus* Thunb., *Picris hieracioides* L., *Tripolium vulgare* Nees., *Bupleurum tenuissimum* L., *Medicago falcata* L., *Medicago minima* (L.) L., *Melilotus albus* Medik, *Onobrychis gracilis* Besser, *Trifolium fragiferum* L., *Vicia cracca* L., *Vicia tetrasperma* (L.) Schreb., *Vicia villosa* Roth., *Poa trivialis* L., *Puccinellia distans* (Jacq.) Parl., *Cynodon dactylon* (L.) Pers., *Elymus repens* (L.) Gould., *Agrostis stolonifera* L., *Atriplex littoralis* L., *Typha latifolia* L., *Typha angustifolia* L., *Alopecurus pratensis* L., *Poa trivialis* L., *Arrhenatherum elatius* (L.) P.Beauv ex J.Presl. & C.Presl., *Stipa capillata* L.;
  - toxic: *Agrimonia eupatoria* L., *Buttomus umbellatus* L., *Salicornia europaea* L., *Spergula arvensis* L., *Cicuta virosa* L.;
  - decorative: *Bolboschoenus maritimus* (L.) Palla., *Xeranthemum annuum* L., *Helichrysum arenarium* (L.) Moench., *Buttomus umbellatus* L., *Phlomis herba-venti* subsp. *pungens* (Willd) Maire ex DeFilipps, *Salvia aethiopis* L., *Trifolium repens* L., *Stipa capillata* L., *Consolida regalis* Gray, *Thalictrum minus* L., *Sanguisorba officinalis* L., *Juncus gerardii* Loisel, *Typha latifolia* L., *Typha angustifolia* L.;
  - food: *Acorus calamus* L., *Spergula arvensis* L., *Chenopodium rubrum* L.

**Figure no. 3** Botna river' meadow has deep natural vegetation, degraded



Due to environmental conditions in the valley of Botna river the forest vegetation has certain features. In large areas there grow different species of shrubs of which the most common are Dog-rose (*Rosa canina* L.),

Common Sea-buckthorn (*Hippophae rhamnoides* L.), European Dewberry (*Rubus caesius* L.). At the confluence with the Dniester, the Botna river flows through a natural indigenous forest of Silver Poplar

(*Populus alba* L.) mixed with European Ash (*Fraxinus excelsior* L.), Field Elm (*Ulmus minor* Mill.), White Willow (*Salix alba* L.), Box Elder (*Acer negundo* L.) and, to a lesser extent, with Common Dogwood (*Cornus sanguinea* L.), European Spindle (*Euonymus europaeus* L.) etc. The grass layer is well developed being dominated by Common Nettle (*Urtica dioica* L.) and, to a lesser extent, by Greater Celandine (*Chelidonium majus* L.), Herb Bennet (*Geum urbanum* L.), Downy Burdock (*Arctium tomentosum* Mill.), Absinthe Wormwood (*Artemisia absinthium* L.), Common Wormwood (*Artemisia vulgaris* L.) and Creeping-Jenny (*Lysimachia nummularia* L.). The degree of coverage of the area with vegetation is 70-90%. The presence in the forest of tree species, both mature and young, indicates the fact that forest vegetation is in the full development phase.

Hydrophilic vegetation presents a poorer development in the area, mainly caused by the high water mineralization (1.81-2.05 g/l), but also due to a high soil salinity (Cl: 13.21-18.73ml/100g/sol). Over the course of the river and in the shore of the adjacent aquatic ecosystems there grows a tall vegetation represented by small groups of Common Bulrush (*Typha latifolia* L.), Common Reed (*Phragmites australis* (Cav.) Steud), Lesser Pond Sedge (*Carex acutiformis* Ehrh.).

The marshes are inhabited by several species of aquatic plants, present both in the shore area and up across the water, of which the most common are Lesser Duckweed (*Lemna minor* L.), Common Reed (*Phragmites australis* (Cav.) Steud), Field Horsetail (*Equisetum arvense* L.), Three-lobed Beggarticks (*Bidens tripartita* L.), Water-pepper (*Persicaria hydropiper* (L.) Spach.), Broad-leaved Pondweed (*Potamogeton natans* L.), Hard Rushes (*Juncus inflexus* L.), Common Knotweed (*Polygonum aviculare* L.), Nutsedges (*Cyperus flavescens* L.), Common Spike rush (*Eleocharis palustris* (L.) Roem. & Schult.).

## Conclusions:

Based on these results we can say that the natural vegetation of the valley of Botna river is underdeveloped and with a low floristic composition. Another important element is the uneven distribution of vegetation with wide variations from one area to another. The most affected areas are in the middle and lower regions of the Botna river, while in the upper regions and at the flow into the river Dniester zone we find an abundant and diversified vegetation.

It is obvious that in order to minimise the negative effects, as a result of human activity, there are needed certain measures to preserve the biodiversity in the areas where it is still present. In addition, the heavily damaged areas and the areas with underdeveloped natural vegetation require ecological reconstruction, amelioration and limitation of the human activity measures.

We consider that the most urgent measures to be applied in the short run are the following:

- the regulation of the grassing based on the capacity of the meadow;
- limiting the execution of the agricultural work to late Autumn and the beginning of Spring only;
- natural fertilisation of the soil;
- alternative exploitation of the meadow on an annual basis, cycling between grassland and pasture;
- reduction of the soil salinity through ameliorative techniques and inserting halophilous plants;
- fighting back the soil erosion by forestation with indigenous trees and the rehabilitation of the degraded herbaceous layer on the banks and steep slopes of the riverbed;
- the creation of natural protection vegetal stripes (trees, shrubs, grasses) in the bank area of all the aquatic ecosystems (marshes, storage reservoirs);
- the reduction and elimination of the water pollution of the Botna river with household and industrial waste.

All these measures must agree both with the regulations promoted by the National Ecological Network of the Republic of Moldova (Andreev et al. 2012) and with the Nationwide (SNPACB 2002) and International Biodiversity Conservation Strategy: the Convention on Wetlands of International Importance (Ramsar 1971); the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, 1973); the Convention on the conservation of European wildlife and natural habitats (Bern 1979); the Convention on the Conservation of Migratory Species of Wild Animals (Bonn 1979); the Convention on Biological Diversity (Rio de Janeiro, 1992); the Council Directive on the conservation of natural habitats and of wild fauna and flora (92/43/EEC 1992); the European Landscape Convention (Florence 2000).

#### Rezumat:

#### VEGETAȚIA DIN LUNCA RÂULUI BOTNA

Scopul investigațiilor a fost de a evidenția starea vegetației din lunca râului Botna. Obiectivele cercetărilor s-au axat pe determinarea spectrului compoziției floristice, dezvoltarea vegetației naturale din valea râului Botna, precum și stabilirea unor măsuri de ameliorare și conservare a diversității vegetale de pe versanții cu diferite expoziții din ecosistemele de luncă și de baltă. Cercetările au fost efectuate conform metodelor Borza și Boșcaiu (1965). Au fost identificate 94 de specii de plante vasculare, aparținând la 84 de genuri și 34 de familii. Dominante sunt speciile din familiile Poaceae, Asteraceae și Fabaceae. Plantele din lunca râului Botna au fost grupate în cinci categorii potrivit cu valoarea lor economică (medicinale, furajere, alimentare, toxice și decorative). S-a constatat că vegetația forestieră este mai bine reprezentată pe cursul superior și în zona de revărsare a râului. Covorul vegetal ierbos (în

special vegetația hidrofilă) are o distribuție scăzută pe cursul mijlociu al râului Botna, cauzată de gradul înalt de mineralizare a apei și de salinitatea sporită a solului. S-au elaborat măsuri de ameliorare și de conservare a diversității vegetale de pe versanții cu diferite expoziții atât din ecosistemul de luncă, cât și cel acvatic.

#### Acknowledgements:

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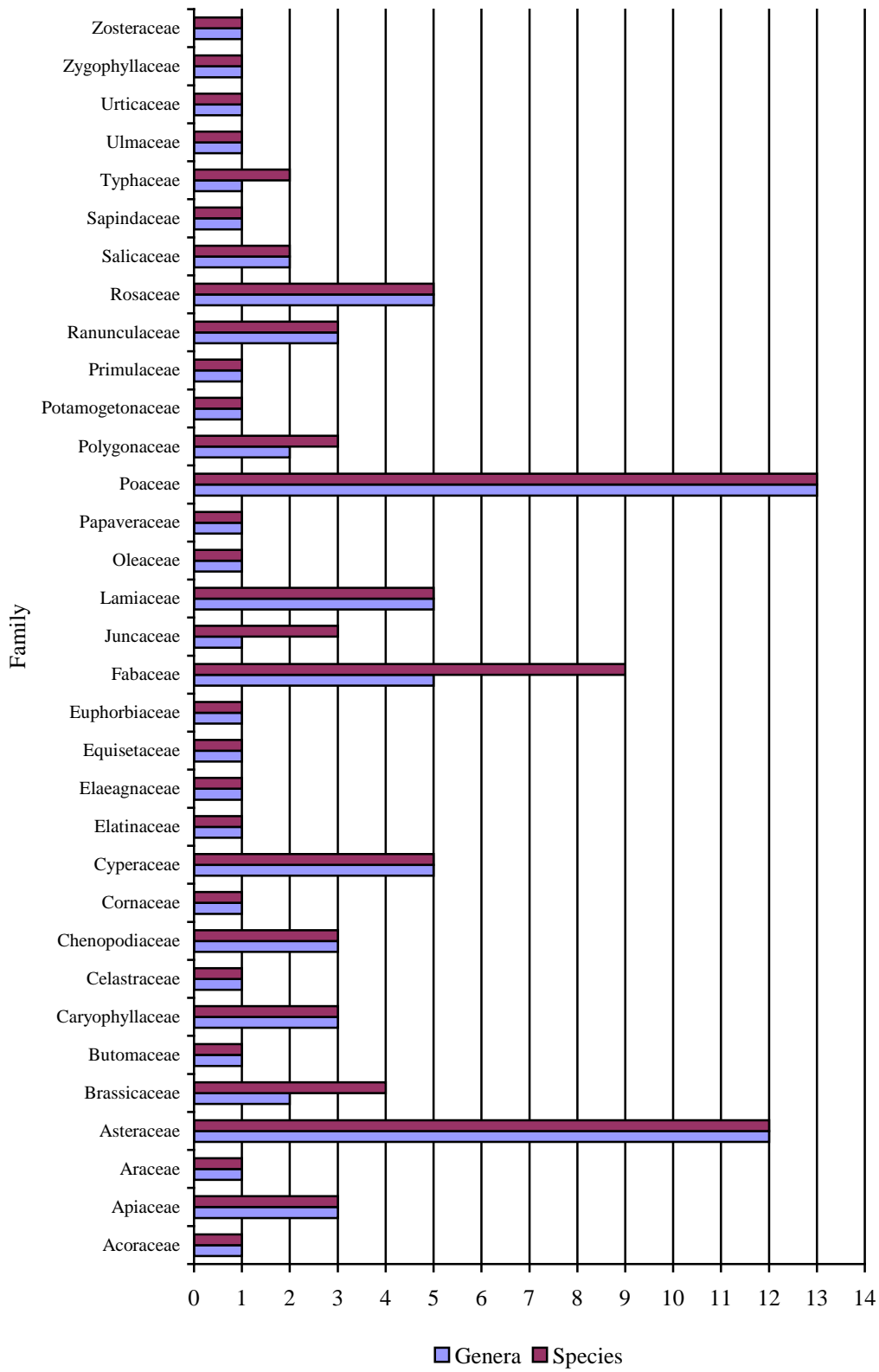
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**Annexes:**

**Figure no. 4** The shares of genera and species on families





**Table no. 1** The taxonomic list of the plant species of the river Botna

Family	Genus	Species	Common Name	
Acoraceae	<i>Acorus</i>	<i>calamus</i> L.	Sweet Flag	
Apiaceae	<i>Bupleurum</i>	<i>tenuissimum</i> L.	Slender Hare's-ear	
	<i>Aethusa</i>	<i>cynapium</i> L.	Fool's Parsley	
	<i>Cicuta</i>	<i>virosa</i> L.	Cowbane	
Araceae	<i>Lemna</i>	<i>trisolca</i> L.	Star Duckweed	
Asteraceae	<i>Achillea</i>	<i>millefolium</i> L.	Common Yarrow	
	<i>Helichrysum</i>	<i>arenarium</i> (L.) Moench	Dwarf Everlast	
	<i>Picris</i>	<i>hieracioides</i> L.	Hawkweed Oxtongue	
	<i>Xanthium</i>	<i>spinsum</i> L.	Spiny Cocklebur	
	<i>Xeranthemum</i>	<i>annuum</i> L.	Common Immortelle	
	<i>Tripolium</i>	<i>vulgare</i> Nees	Strandaster	
	<i>Cichorium</i>	<i>intybus</i> L.	Common Chicory	
	<i>Erigeron</i>	<i>canadensis</i> (L.) Cronquist	Horseweed	
	<i>Bidens</i>	<i>tripartita</i> L.	Three-lobe Beggarticks	
		<i>Arctium</i>	<i>tomentosum</i> Mill.	Downy Burdock
		<i>Artemisia</i>	<i>absinthium</i> L.	Absinthe Wormwood
		<i>Artemisia</i>	<i>vulgaris</i> L.	Common Wormwood
	Brassicaceae	<i>Lepidium</i>	<i>cartilagineum</i> subsp. <i>crassifolium</i> (Waldst. & Kit.) Thell.	
<i>Rorippa</i>		<i>amphibia</i> (L.) Besser <i>palustris</i> (L.) Besser <i>austriaca</i> (Crantz) Besser	Great Yellow-cress Common Yellowcress Austrian Field Cress	
		<i>umbellatus</i> L.	Flowering Rush	
Butomaceae	<i>Buttomus</i>	<i>umbellatus</i> L.	Flowering Rush	
Caryophyllaceae	<i>Myosoton</i>	<i>aquaticum</i> (L.) Moench	Giant Chickweed	
	<i>Spergula</i>	<i>arvensis</i> L.	Corn Spurrey	
	<i>Spergularia</i>	<i>maritima</i>	Media Sandspurry	
Celastraceae	<i>Euonymus</i>	<i>europaeus</i> L.	European Spindle	
Chenopodiaceae	<i>Chenopodium</i>	<i>rubrum</i> L.	Red Goosefoot	
	<i>Salicornia</i>	<i>europaea</i> L.	Glasswort	
	<i>Atriplex</i>	<i>littoralis</i> L.	Grassleaf Orache	
Cornaceae	<i>Cornus</i>	<i>sanguinea</i> L.	Common Dogwood	
Cyperaceae	<i>Bolboschoenus</i>	<i>maritimus</i> (L.) Palla.	Cosmopolitan Bulrush	
	<i>Schoenoplectus</i>	<i>lacustris</i> (L.) Palla.	Common Club-rush	
	<i>Carex</i>	<i>acutiformis</i> Ehrh.	Lesser Pond Sedge	
		<i>Eleocharis</i>	<i>palustris</i> (L.) Roem. & Schult.	Common Spike-rushes
		<i>Pycnus</i>	<i>flavescens</i> (L.) P.Beauv. ex. Rchb.	Yellow Flatsedge
Elatinaceae	<i>Elatine</i>	<i>alsinastrum</i> L.	Elatine Faux Alsine	
Elaeagnaceae	<i>Hippophae</i>	<i>rhamnoides</i> L.	Common Sea-buckthorn	
Equisetaceae	<i>Equisetum</i>	<i>arvense</i> L.	Field Horsetail	
Euphorbiaceae	<i>Euphorbia</i>	<i>helioscopia</i> L.	Sun Spurge	
Fabaceae	<i>Medicago</i>	<i>falcata</i> L. <i>minima</i> (L.) L.	Blue Alfalfa Bur Medick	
		<i>Melilotus</i>	<i>albus</i> Medik.	White Melilot
		<i>Onobrychis</i>	<i>gracilis</i> Besser	
		<i>Trifolium</i>	<i>repens</i> L. <i>fragiferum</i> L.	Dutch Clover Strawberry Clover
		<i>Vicia</i>	<i>cracca</i> L. <i>tetrasperma</i> (L.) Schreb. <i>villosa</i> Roth.	Tufted Vetch Smooth Tare Hairy Vetch

Juncaceae	<i>Juncus</i>	<i>gerardii</i> Loisel. <i>bufonius</i> L. <i>inflexus</i> L.	Saltmarsh Rush Toad Rush Hard Rush
Lamiaceae	<i>Phlomis</i>	<i>herba-venti</i> subsp. <i>pungens</i> (Willd) Maire ex DeFilipps	Eastern Jerusalem Sage
	<i>Salvia</i>	<i>aethiopis</i> L.	Mediterranean Sage
	<i>Thymus</i>	<i>serpyllum</i> L.	Breckland Thyme
	<i>Lycopus</i>	<i>europaeus</i> L.	Gypsywort
	<i>Mentha</i>	<i>longifolia</i> (L.) Huds	Horse Mint
Lemnaceae	<i>Lemna</i>	<i>minor</i> L.	Common Duckweed
Oleaceae	<i>Fraxinus</i>	<i>excelsior</i> L.	European Ash
Papaveraceae	<i>Chelidonium</i>	<i>majus</i> L.	Greater Celandine
Poaceae	<i>Alopecurus</i>	<i>pratensis</i> L.	Meadow Foxtail
	<i>Poa</i>	<i>trivialis</i> L.	Rough Bluegrass
	<i>Arrhenatherum</i>	<i>elatius</i> (L.) P.Beauv ex J.Presl. & C.Presl.	False Oat-grass
	<i>Stipa</i>	<i>capillata</i> L.	Feather Grass
	<i>Puccinellia</i>	<i>distans</i> (Jacq.) Parl.	Weeping Alkali Grass
	<i>Cynodon</i>	<i>dactylon</i> (L.) Pers.	Couch Grass
	<i>Lolium</i>	<i>perenne</i> L.	Perennial Rye-grass
	<i>Elymus</i>	<i>repens</i> (L.) Gould	Couch Grass
	<i>Agrostis</i>	<i>stolonifera</i> L.	Creeping Bentgrass
	<i>Beckmannia</i>	<i>eruciformis</i> (L.) Host	European Slough Grass
	<i>Bothriochloa</i>	<i>ischaemum</i> (L.) Keng	King Ranch Bluestem
	<i>Bromus</i>	<i>japonicus</i> subsp. <i>japonicus</i> Thunb.	Japanese Brome
	<i>Phragmites</i>	<i>australis</i> (Cav.) Steud.	Common Reed
Polygonaceae	<i>Polygonum</i>	<i>patulum</i> subsp. <i>patulum</i> Klokov <i>aviculare</i> L.	Bellard's Smartweed Common Knotgrass
	<i>Persicaria</i>	<i>hydropiper</i> (L.) Spach.	Water-pepper
Potamogetonaceae	<i>Potamogeton</i>	<i>natans</i> L.	Broad-leaved Pondweed
Primulaceae	<i>Lysimachia</i>	<i>nummularia</i> L.	Creeping-Jenny
Ranunculaceae	<i>Consolida</i>	<i>regalis</i> Gray	Forking Larkspur
	<i>Thalictrum</i>	<i>minus</i> L.	Lesser Meadow-rue
	<i>Ranunculus</i>	<i>acris</i> L.	Meadow Buttercup
Rosaceae	<i>Agrimonia</i>	<i>eupatoria</i> L.	Common Agrimony
	<i>Sanguisorba</i>	<i>officinalis</i> L.	Great Burnet
	<i>Rosa</i>	<i>canina</i> L.	Dog-rose
	<i>Rubus</i>	<i>caesius</i> L.	European Dewberry
	<i>Geum</i>	<i>urbanum</i> L.	Herb Bennet
Salicaceae	<i>Populus</i>	<i>alba</i> L.	Silver Poplar
	<i>Salix</i>	<i>alba</i> L.	White Willow
Sapindaceae	<i>Acer</i>	<i>negundo</i> L.	Box Elder
Typhaceae	<i>Typha</i>	<i>latifolia</i> L. <i>angustifolia</i> L.	Common Bulrush Lesser Bulrush
Ulmaceae	<i>Ulmus</i>	<i>minor</i> Mill.	Field Elm
Urticaceae	<i>Urtica</i>	<i>dioica</i> L.	Common Nettle
Zygophyllaceae	<i>Tribulus</i>	<i>terrestris</i> L.	Bullhead
Zosteraceae	<i>Zostera</i>	<i>marina</i> L.	Common Eelgrass