

# Beach and sand dune species plant of deltaic shore between Cape Buival-Câșla Vădanei (Sărăturile marine field)

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**Cuvinte-cheie:** deltaic shore, beach, sand dunes, wash-over funs, rare species, ecological types of plants, richness flora, biogeomorphological role.

**Beach and sand dune species plant of deltaic shore between Cape Buival-Câșla Vădanei (Sărăturile marine field).** Țărmlul deltaic Sărăturile dintre Cap Buival și Câșla Vădanei reprezintă sectorul cu cea mai completă și complexă morfologie emersă: plaje largi, adesea cu două trepte (berma de vară și berma de iarnă) dune, organizate într-un cordon dunar, conuri de rever, benciuri de eroziune nisipoase. Fiecare dintre aceste subunități ale sistemului de țărm constituie habitate pentru anumite specii de plante, în funcție de condițiile microecologice pe care le oferă. Există, de asemenea în cadrul țărmului, specii ubicviste. Unele sunt specii pioniere și astfel joacă un rol important în succesiunea ecologică primară. Câteva dintre speciile de plante identificate pe țărmul Sărăturile sunt specii cu statut de specii rare pentru flora europeană și flora României (*Convolvulus persicus*, *Eryngium maritimum*, *Plantago coronopus*, *Ephedra distachia*, *Corispemum nitidum*, *Argusia sibirica*). Diversitatea specifică este mai mare la Cap Buival decât în restul țărmului.

O parte dintre speciile de plante prezente în domeniul țărmului, prin habitus și dezvoltarea supraterană și subterană a cormului (sistem radicular, tulpină) contribuie la formarea și stabilizarea dunelor (au rol biogeomorfologic), funcționând ca niște capcane de nisip.

În cadrul Rezervației Biosferei Delta Dunării, Câmpul marin Sărăturile nu face parte din categoria ariilor strict protejate. În acest context sunt permise anumite activități economice. Presiunea exercitată asupra sistemului de țărm este indusă de pășunatul comutelor mari a căror efectiv a crescut foarte mult în ultimii. Animalele, pe lângă faptul că se hrănesc cu o parte din speciile prezente, prin călcare și bătătorire contribuie la destabilizarea dunelor incipiente, embrionare, precum și a celor mai vechi. În plus, excrementele reprezintă intrări de nutrienți nespecifici în sol precum și vectori de diseminare a altor specii de plante, ruderales, care nu sunt proprii biocenozelor de țărm.

## Introductions

The total length of analyzed deltaic shore is almost 13 km. This shore is the half-south part of Sărăturile beach ridge plain from Danube Delta (Fig. 1), which is the most important wetland area from Europe, even of world, and it is a Biosphere Reserve.

This shore has geomorphologic complete and complex features. On the first half (about 6 km), Vespremeanu (1987) has identified the next sub-units: a large beach, with summer and winter berm, sand dunes and wash-over funs (Fig. 2) The second half of the shore is very simple (Vespremeanu, 1987): an erosion sandy bench, which is cut in marine field (beach ridge plain) (Vespremeanu-Stroe, 2004), and the wash-over funs (Fig 3). There are no sand dunes in this part of shore.

On this deltaic shore could be identify specific habitats populated with many species of plants, most of these are rare species. In addition, these kinds of habitats, especially dunes system that develop over many years, there are in the Annex 1 of the European Community Habitats Directive although Sărăturile marine field are not strictly protected area but we consider that could be a possibility in the future for it.

The focus of this paper is on the plant species that grows on shore system and the relation which exists between every subunit of shore and the ecological types of plants. Natural vegetation covers the beach, dunes and wash-over funs. It is composed of psamphyllous, halophyllous and xerophyllous species. Mostly are pioneer plants. The

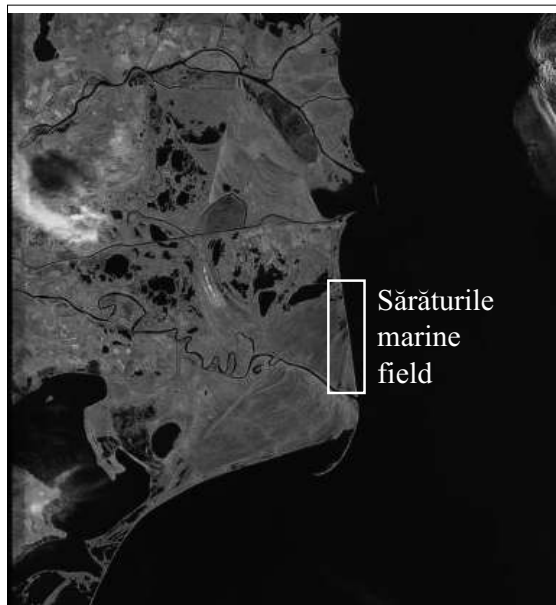


Fig. 1. The Danube Delta and the Sărăturile Deltaic Shore.

majority is grassy plants and only four are shrubs (*Eleagnus angustifolia*, *Hiphophaë rhamnoides*, *Tamarix ramosissima* and very rare individuals of *Amorpha fruticosa*, an invasive species and unassuming like all this plants).

Near the St. George arm mouth, to Cape Buival, the richness flora is much larger than on the rest of the shore and in this place there are other species than can be found on the north shore because of fresh water influences and nutrient enrichment caused mainly by mineralizing organic matter. The meeting of fresh water and salt water creates several habitats and many species exploit the mosaic nature of shore ecosystems.

Some plants are rare and endemic species for Romanian flora or European scale such as *Ephedra distachia*, *Eryngium maritimum*, *Euphorbia seguierana*, *Argusia sibirica*, *Centaurea arenaria subsp. borysthenica*, *Corispemum nitidum*, and *Convolvulus persicus*. For example, *Eryngium maritimum* and *Argusia sibirica*, which were have completely disappeared on the coastal sands in the region of port Varna (Bulgaria) during the construction of the port (A. Petrova and I. Apostolova, 1995), they could found on the Sărăturile shore.

## Works methods

The flora of every part of this sandy shore has not investigated in detail up to now. Last two years (2003–2004), we made an inventory of plants. We performed same relevé and transects along of entire analyzed shore. Transects began at the high-water mark (the end summer berm when is seaward line vegetations) and extended inland trough barrier dunes to the first occurrence of extensive woody shrub cover. In this way, it was overtaken plants and their community for every form of shore. It is about by across-shore compositional variability of specific biodiversity.

We was consulted a few papers about Romanian flora and other papers about European flora (Oleg Polunin, 1991, David Burnie, 2004). Plant identifications and nomenclature follows Ciocârlan (1994), Sârbu *et al.* (2001), Prodan and Buia (1966). We had identified 36 plant species but the checklist is still not complete. It has been described the characteristic and differential species for each sub-unit of shore.

## Results and discussions

Every analyzed component of shore is populates with characteristic species. Beaches are dynamic geomorphic environments where morphologic change can be rapid and pronounced. They overwashed periodically by storms waves especially in the winter season but same events, very powerful, could be summer too. Topography and vegetations are strongly influenced by over wash events. The burial-tolerant plant species recolonize over wash sediments and prevents excessive loss of sediments of sand by deflation. If the sediments are by the horizontally extensive rhizome networks of burial-tolerant plants they are unavailable to form protective fore dunes.

At the same time, the shore system is a very particular biogeomorphologic environment. A network of feedbacks among vegetation, landforms, and sediment mobility (Stallins and Parket, 2003) characterizes it. On deltaic shore, these interactions constitute a sensi-



Fig. 2. The central sector of the Sărăturile Shore with a large beach, the foredune and dune barrier which is very well consolidated.



Fig. 3. The Sărăturile Shore al Câșla Vădanei witha erosion sandy beach.



Fig. 4. *Argusia sibirica*, a rare species on the shore Sărăturile.



Fig. 5. *Eryngium maritimum*, a Mediterranean species that grows on sandy beaches. Around of this plant and *Salsola kali* forms embryonic dunes.



Fig. 6. *Salsola kali*, on the beach. This is a pioneer plant, a psammophytical and halophytical plant.

tive biogeomorphyc system, rather than a collection of independents components. The presence or absence of some species is controlled local gradients of energy, moisture and nutrients.

On the shore dune, there are transverse environmental gradients of salt spray exposure, incremental sediment mobility, and soil moisture as primary factors that distinguish dune vegetation. In response to physical gradients, dune vegetations often develop its characteristic compositional zonation parallel to the shoreline.

Over relatively short temporally scales, dune plant species promote sediment deposition, which ultimately shapes dune landforms. Dune landforms, in turn, influence sediment mobility, the spatial pattern and frequency of disturbance events, and the structure of physical gradients

On the beach there is halophytic and psammophytic species (Fig. 4, 5, 6): *Salsola kali*, *Eryngium maritimum*, *Convolvulus persicus*, *Argusia sibirica*, *Xantium strumarium*.

The community *Eryngio-Xanthietum strumarii* forms the initial stage of the psamosere on the fore dune, usually near the shoreline where it influenced by the waves. The fore dunes and the ridges dunes covered by annual species (*Xantium strumarium*, *Eryngium maritimum*) and by rizomatous geophytes (*Elymus sabulosus*, *Convolvulus persicus* and *Cynodon dactylon*). The species of genus *Elymus* are major element on Pontic dunes (K. V. Sýkora *et al.* 2003). These species grow on embryonic dunes along the fringes beaches. They have deep roots, which it can exploit deep water resources. Although *Convolvulus persicus* grows on all sub-units of shore, this species prefer high mobile sand dunes. On the high dunes, grow rare shrubs: *Tamarix ramossissima*, *Hippophaë rhamnoides* and *Elaeagnus angustifolia*.

The back dune and the wash-over fun are peopled with many species such as *Salsola kali*, *Eryngium maritimum*, *Centaurea arenaria*, *Euphorbia seguierana*, *Petasites spurius*, *Linum austriacum*, *Linaria sp.*, *Atriplex sp.*,



Fig. 7. The populations of *Petasites spurius* and *Convolvulus persicus* on wash-over dunes. In back ground, inland of marine field, it can see wooden vegetations (Shrubs with *Eleagnus angustifolia* and *Hippophaë rhamnoides*).

*Polygonum arenaria*, *Centrospermun*, *Daucus sp.* and *Convolvulus persicus*.

In the second part of the shore, on the marine field, immediately above the scarp, the characteristic species are *Xanthium strumarium*, *Convolvulus persicus*, *Cynodon dactylon*, *Daucus sp.* *Eryngium maritimum* and *Ephedra distachia*. This has found only one place, by only 80–100 m<sup>2</sup>. This plant is very rare species for Romanian flora as well as the *Convolvulus persicus*. Although this species it has considered rare species long time, even a natural monument. In this moment, this problem is doubtful because there is an abundant population on the Sărăturile shore where there is communities of *Convolvulus persicus* (**Convolvuletum persici**, Borza 1931, Sanda et al. 1998).

*Convolvulus persicus* is better to be on the list of rare species because there is not any prediction about the evolutions of populations of this species and. The geographical area of this species is very restricted: only south Sea

Caspian littoral and west Black Sea littoral. This plant is protecting in all countries where it grows: Iran, Kazakhstan, Azerbaijan, Romania, Bulgaria and Turkey.

Generally, on the analyzed shore, there is a balance between the human activities and the natural processes. It is still intact; still show a natural face, which is quite remarkable. In the winter, the erosion affected the beach and the dunes, especially the foredune. Summer, the rhizomatous plants (*Convolvulus persicus*, *Elymus sabulosus* and *Cynodon dactylon*) and other, ephemeral plants make a cover, which protects the dunes against the deflations.

Trough exist only few plant well for eat, the horned cattle graze on the shore and near it. This activity tramples and destroys the vegetations, especially the rare species, and the shore dunes. This fact is a kind of biogeomorphological process, too. In this case, the biological influence of cows is not only mechanical by treading underfoot the dunes and the

plants, and by grazing, but through nutrients incoming. It is about the cow's excrements that determine local enrichment of sand. In this case, on this shore can grow other plants, nonspecific for the natural conditions. It is about establishment of ruderal species especially on the dunes, there when they not affected by the storm-over wash. The micro fauna from the soil changes it, too.

Each sub-unit of shore is a habitat for certain plants species.

**The Cape Buival shore.** In this place, the shore has a beach very large and embryo and dynamic dunes. Habitats and observed plants in the Cape Buival are:

**1. The high beach habitat.** This beach is very large and very flat. On this habitat mostly is annual vegetation: *Eryngium maritimum*, *Spergularia salina*, *Salsola kali*, *Suaeda* sp., *Lactuca seriola*, *Polygonatum arenaria*, *Statice gmelini*, *Xanthium strumarium*, *X. spinosum*, *Euphorbia chamaesyce*, *Plantago arenaria*, *Plantago coronopus* and very rare and young shrubs of *Tamarix ramosissima*. *Argusia sibirica* and *Elymus sabulosus* is perennial rhizomatous geophytes.

**2. The embryo and dynamic dunes habitats.** In around of *Salsola* and *Eryngium* form embryo dunes. The others species are: *Convolvulus persicus*, *Xanthium strumarium*, *Linum austriacum*, *Hippophae rhamnoides*, *Elaeagnus angustifolia*, *Tamarix ramosissima*, *Amorpha fruticosa*, *Polygonatum arenaria*, *Fagopyron* sp. and *Elymus* sp. *Cuscuta* sp., a parasitical plant, which lives on the *Xanthium spinosum* and *Convolvulus persicus* but it prefer, especially, *Eryngium maritimum*.

**The shore between Cape Buival and R 49.** This shore has a large beach, sand dunes and wash-over fan. The list of species for each habitat has based on five levees. The habitats and their species are:

### 1. The high beach habitat

In this habitat, three are dominant: *Salsola kali*, *Xanthium strumarium* and *Eryngium maritimum*. The other species are *Convolvulus persicus*, *Argusia sibirica* and *Petasites spurius*.

### 2. The dunes habitat

On this habitat, there are same species as well as on beach but grows individuals by *Centaurea arenaria*, *Elymus sabulosus*, *Petasites spurius*, *Corispermum nitidum* and *Cynodon dactylon*, *Euphorbia seguierana* and shrubs (*Elaeagnus angustifolia*, *Hippophae rhamnoides*), too. *Tamarix ramosissima* is very rare.

### 3. The back dunes and the wash-over fan habitats

The species of these habitats are *Petasites spurius*, *Elymus sabulosus*, *Euphorbia seguierana*, *Cynodon dactylon*, *Corispermum nitidum*, *Equisetum* sp., *Centaurea arenaria*, *Polygonum arenarium*, *Helicrysum arenarium*, *Linum austriacum*, *Convolvulus persicus* and *Linaria vulgaris* (Fig. 7).

**The shore between R49 and Câșla Vădanei.** On this shore, the beach and the sand dunes are missing. The species, which were have found on the marine field immediately above the scarp, are *Convolvulus persicus*, *Xanthium strumarium*, *Eryngium maritimum*, *Argusia sibirica*, *Cynodon dactylon*, *Ephedra distachia*, *Fagopyrum esculentum*, *Linum austriacum*, *Pulicaria dysenterica*, *Aristolachia clematis*, *Linaria vulgaris*, *Atriplex tatarica*, *Ephedra distachia*, *Rubus caesius*.

**The checklist of plant species that has identified on the Sărăturile shore between Cape Buival - Câșla Vădanei (2003-2004)**

1. *Aeluropus littoralis* (Gouan) Parl. — Gramineae
2. *Argusia sibirica*\* (L.) Dandy — Boraginaceae
3. *Aristolachia clematis* L. — Aristolochiaceae
4. *Atriplex tatarica* L. — Chenopodiaceae
5. *Amorpha fruticosa* L. — Leguminosae
6. *Corispermum nitidum*\* (Kit.) — Chenopodiaceae
7. *Centaurea arenaria* Bieb. subsp. *borysthonica*\* (Gruner) Dost. — Compositae
8. *Cynodon dactylon* (L.) Pers. — Gramineae
9. *Convolvulus persicus*\* L. — Convolvulaceae



Fig. 8. The shrub of *Hippophaë rhamnoides* with fruits.

10. *Cuscuta campestris* Yunck. — Cuscutaceae
11. *Ephedra distachia*\* (L.) — Ephedraceae
12. *Eryngium maritimum*\* (L.) — Umbelliferae
13. *Elymus sabulosus* Bieb. — Gramineae
14. *Euphorbia seguierana* L. — Euphorbiaceae
15. *Euphorbia chamaesyce* L. — Euphorbiaceae
16. *Eleagnus angustifolia* L. — Elaeagnaceae
17. *Equisetum* sp. — Equisetaceae
18. *Fagopyrum esculentum* (L.) Gaertner — Polygonaceae
19. *Helicrysum arenarium*\* (L.) — Compositae
20. *Hippophaë rhamnoides* L. — Elaeagnaceae (Fig. 8).
21. *Lactuca tatarica* (L.) C. Mey. — Compositae
22. *Linum austriacum* L. — Linaceae
23. *Linaria vulgaris* Miller. — Scrophulariaceae
24. *Petasites spurius* (Retz.) Rchb. — Compositae
25. *Plantago arenaria* W. et K. (*Plantago indica* L.) — Plantaginaceae
26. *Plantago coronopus*\* L. — Plantaginaceae
27. *Polygonum arenarium* W. et K. — Polygonaceae
28. *Pulicaria dysenterica* (L.) Bernh. — Compositae
29. *Rubus caesius* L. — Rosaceae
30. *Rumex maritimus* L. — Polygonaceae
31. *Scabiosa ucranica* L. (*S. argentea*) — Dipsacaceae
32. *Salsola kali* (L.) subsp. *tragus* (L.) Nym. — Chenopodiaceae
33. *Spergularia maritima* (All.) Chiov. — Caryophyllaceae
34. *Suaeda maritima* (L.) Dumont — Chenopodiaceae
35. *Statice gmelinii* (Willd) Ktze — Plumbaginaceae
36. *Tamarix ramosissima* Ladeb. — Tamaricaceae
37. *Xanthium strumarium* L. — Compositae
38. *Xanthium spinosum* L. — Compositae





Fig. 9. The horned cattle on the Sărăturile beach at Sf. Gheorghe.

### Conclusions

Morphologically, the deltaic shore between Cape Buival - Câșla Vădanei is the most complex and complete shore from Romanian sandy littoral. Each sub-unit of shore is a habitat for certain plants species. The checklist of plant species that has identified on the Sărăturile shore between Cape Buival - Câșla

Vădanei (2003–2004) has 36 species. Some species are rare for European and Romanian flora and the others are important for them geomorphological role. They helped to the constructions and stabilizations of shore dunes. Some species, rare species, and the relief of shore are in danger to be destroyed because of horned cattle graze (Fig. 9).

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