# EMBRYONIC SHIFTING DUNES ON THE ROMANIAN BLACK SEA COAST

**Marius Făgăraș**

Ovidius University of Constanta, Faculty of Natural and Agricultural Sciences, Aleea Universitatii, Nr. 1, corp B, Constanţa, marius_fagaras@yahoo.com

***Keywords:embryonic shifting dunes, habitat 2110, plant communities, conservation, Romanian Black Sea coast***

## ABSTRACT

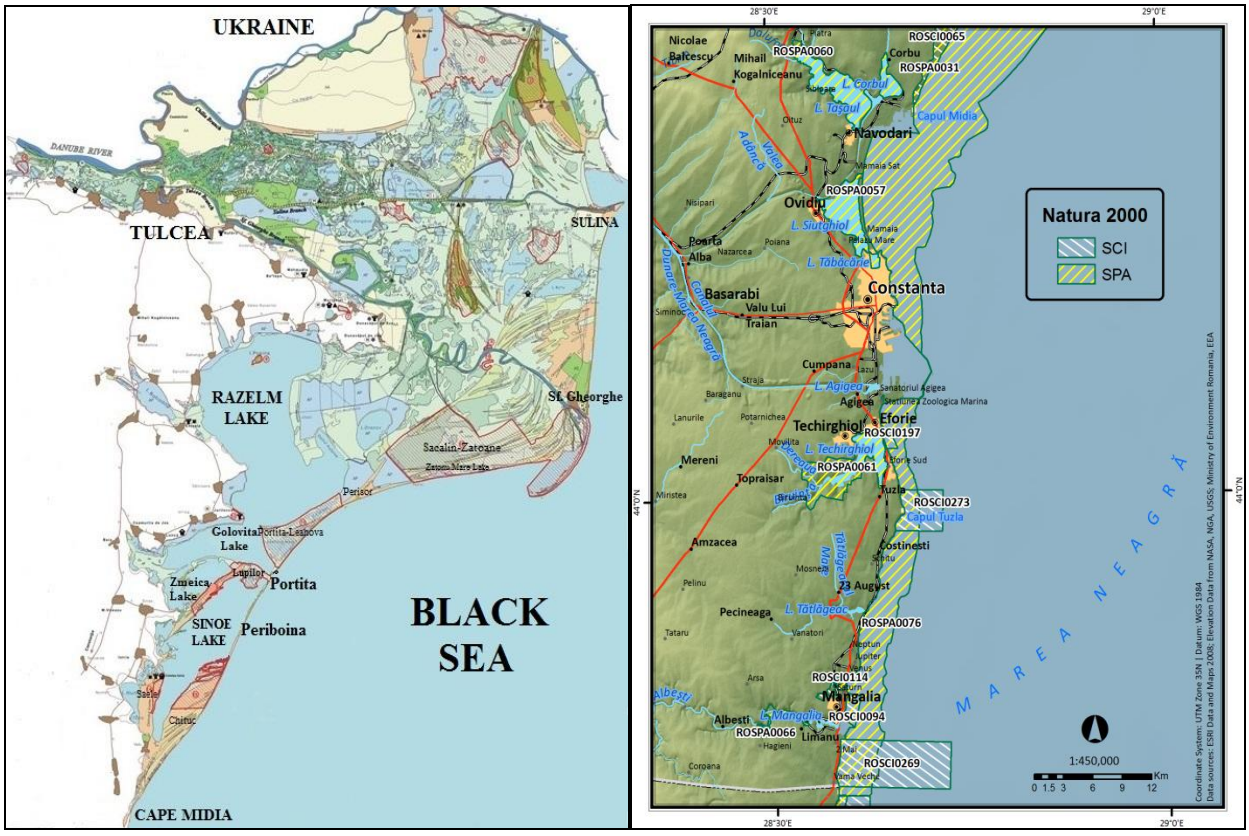
Embryonic shifting dunes are a type of habitat of Community interest specified in the Habitat Directive with the Corine code 16.211 and with the Nature 2000 code 2110. This habitat consists of mobile sand dunes, partially fixed by psammophilous vegetation. The habitat 2110 is present mainly on the northern Black Sea coast, on the sandy beaches of the Danube Delta Biosphere Reserve.On the southern coast of Romania, this habitat type has been mostly destroyed through the building and extension of some touristic resorts and it remained only in small scattered fragments between resorts. The sand dunesare well preserved on the southern coast of the Black Sea only in the natural reserve Marine Sand Dunes of Agigea.Conservation status of the habitat 2110 is generally favorable on the northern coast of Romania, excepting the beaches of Sulina, Chituc sandbank andPortița where it is threatened by grazing, arrangement works of the beaches, extension of some touristic facilities or by invasive plants. On the southern coast of Romania, the embryonic shifting dunes have an unfavorable conservation status, this segment of Romanian littoral being serious affected by tourism and economic activities, in area of the harbours, inresorts and coastal localities. A summary description of the plant communities specific to the habitat 2110 and also other information about the conservation status, vulnerabilities and evolution trend of the habitat 2110 are given in the paper.

## INTRODUCTION

Romanian Black Sea coast between Chilia branch of Danube in the north and the village of VamaVeche in the south has a length of 245 km and it is divided into two areas different through their origin and evolution. The northern zone (Fig. 1), between the Chilia Branch and Cape Midia (approximately 160 km) is a low accumulation shore made up of long sandbars (northeast-southwest) that form a system of marine sandbanks. The sandbanks of the southern Danube Delta (Lupilor, Chituc, Saele) are long strips of sand, bordered on the east by the Black Sea and on the west by a complex of lakes and former lagoons, of which the Razelm-Sinoe lagoon complex is the biggest (Făgăraș et al., 2008 a). Chituc is the most important sandbank in the southern Danube Delta with a surface of approximately 7700 ha. The entire northern area of the Romanian littoral is protected within the Danube Delta Biosphere Reservation, a huge wetland with a surface of 4152 km2.

The southern zone (Fig. 2), between Cape Midia and VamaVeche (approximately 85 km) is a high shore with cliff, fragmented by former fluvial-marine lagoons, presently littoral lakes. At the base of the seawall there are narrow sandy beaches.The beaches are wide in the coastal area of Danube Delta and near of some littoral lakes (Razelm, Sinoe, Taşaul, Corbu, Siutghiol, Techirghiol, Costineşti, Tatlageac, Mangalia) south of Danube Delta.

Unlike the northern coastal area, the southern littoral is a touristic zone because the Romanian littoral resorts are concentrated in this area. Because of this, the biodiversity is reduced compared to that of the northern seacoast.



Figs.1-2. Northern (left side) and southern (right side) coastal area of Romania

The largest part of the wide sandy beaches is covered by mobile, semi-fixed or stabilized sand dunes withpsammophilous vegetation. Among the dunes and behind the dune strips, there are low areas with higher moisture and salinity, swampy in the rainyperiods of year (especially in spring).

Embryonic shiftingdunes (white dunes)are a type of habitat of Community interest, specified in the Habitat Directive with the Corine code 16.211 and with the Nature 2000 code 2110 (Doniță et al., 2005). Embryonic shifting dunes represent the first stages of the sand dunes construction. This habitat consists of mobile sand dunes, partially fixed by psammophilousvegetation. The microclimate is characterized by considerable thermal contrasts between night and day, intense solar radiation during the day and low moisture.

The habitat 2110 is present mainly on the northern Black Sea coast, on the sandy beaches of the Danube Delta (in Sulina, Sfântu Gheorghe, on Sărăturile sandbank, in Sacalin area, on Buhazului sandbank, on Crucea-Zătoane sandbank, on Perișor sandbank) and along the sandbanks from the Razelm-Sinoe lagoon complex (Periteașca-Portița-Periboina, Edighiol-Periboina and Chituc sandbank). On the southern coast of Romania (Cape Midia-VamaVeche), the shifting dunes have been mostly destroyed, beginning with the years 1950s-1960s through the building and extension of the touristic resorts. This kind of habitat has remained only in small scattered fragments between the coastal resorts. The situation of these “natural vegetation oases” has been worsened drastically since 1995 because of the building of some residential complexes or touristic points even in area of the dune habitats, as it happend between Mamaia and Navodari andbetween North Eforie and South Eforie and also in the coastal villages 2 Mai and VamaVeche (Făgăraș et al., 2008 b). The habitat 2110 is well preserved on the southern

coast of the Black Sea only in the natural reserve Marine Sand Dunes of Agigea, but here this habitat 2110 small surfaces (approx. 1 ha).

Despite protected status of the Danube Delta as Biosphere Reserve and Natura 2000 site (ROSCI 0065 Danube Delta), northern coast of Romania is vulnerable at some anthropogenic pressures such as: grazing, invasive species, arrangement works of the beaches, extension of some touristic facilities. Tourism threaten the habitat 2110 mainly along Chituc sandbank and on the beaches at Sulina, Sf. Gheorghe and Portița. Grazing and compaction of sand dunes under the hooves of the animals (horses, cattle) is another serious threat for the psammophilous vegetation of the shifting dunes.

## MATERIAL AND METHOD

Nomenclature of the plant associations and coenotaxonomic affiliation of the plant communitiesare according to the book “Phytocoenoses of Romania” (Sanda et al., 2008). The habitat type „embryonic shifting dunes”(the habitat 2110) has been recognized on the base of typical plant associations (Gafta, Mountford et al., 2008).The name of the plant associations is concordant with the International Code of Phytosociological Nomenclature (Weber et al., 2000). Nomenclature of the plantspecies is according to Sârbu et al., 2013; Ciocârlan, 2009; Tutin et al., 1964-1980 and Tutin et al., 1993. All floristic rarities weretaken into consideration concordant with Red Book of the Vascular Plants from Romania (Dihoru & Negrean, 2009).

Conservation status of the habitat 2110 was assessed on the base of the following scale: favourable, inadequate, unfavorable and unknown. According to the Directive 92/43/EEC (http://eur-lex.europa.eu), the conservation status will be considered as „favorable” when the natural range and areas it covers are stable or increasing and the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future. Evolution trend of the habitat 2110 is considered as: stable (if the current status of habitat does not change significantly), increasing (if the current status of habitat is improving) or decreasing (if the current status of habitat is damaged).

## RESULTS AND DISCUSSION

Current area of the habitat 2110 on the Romanian Black Sea coast is approximately 8 km2. Current trend regarding the habitat quantityis stable on the northern coast of Romania and it is decreasing atsouth of Cape Midia. Significant changes of the habitat occurred in the touristic areas of southern Romanian coast. Future trend of the habitat is stable in the Danube Delta Biosphere Reserve and it is decreasing on the southern coast where anthropogenic influences are significant.

Current trend in the habitat quality is stable on the northern coast of Romania and it is decreasing south of Cape Midia. We expect a continuing decline of habitat quality on the southern coast of Romania because anthropogenic influences are still significant. Main factors contributing to degradation of the habitat are: expanding of recreational areas of the beaches, real estate developments in the sand dunes area, trampling of the psammophilousvegetation and its grazing by the cattle and horses, some invasive plant species such as *Xanthium italicum*or *Amorpha fruticosa*. Grazing has significant impact upon the habitat 2110 only in the coastal area of Danube Delta.

Concerning long historical trend, estimation of the habitat changes is very difficult because old bibliographical dates about the surface of the habitat almost lacking.

Conservation status of the habitat 2110 is generally favorable on the northern coast of Romania but inadequate on the beach of Sulina and along Chituc sandbank because of touristic activities and near Portițaresort due to the grazing. On the southern coast of

Romania, the shifting dunes have an unfavorable conservation status due to significant anthropogenic influences, mainly touristic activities.

Western-Pontic communities with *Leymussabulosus* and *Artemisia tschernieviana* (R1602) and Western-Pontic communities with *Secalesylvestre, Aperamaritima* and *Bromustectorum* (R1605) are the equivalent habitats for white dunes (the habitat 2110) in the Romanian classification system of the habitats (Doniță et al., 2005).

Most important plant communities of the habitat 2110 are the following (Făgăraș, 2012): *Elymetumgiganteis*Morariu 1957, *Artemisietumarenariae*Popescu et Sanda 1977, *Leymo sabulosi-Elymetum farcti*Gehu et al., 1986, *Secalisylvestris-Brometumtectorum*Hargitai 1940, *Secalisylvestri-Alyssetumborzaeani* (Borza 1931) Morariu 1959, *Aperetummaritimae*Popescu et al. 1980,*Convolvuletum persici* (B o r z a, 1931) B u r d u j a, 1968.

*Elymetumgigantei*(Fig. 3) and *Artemisietumarenariae*(Fig. 4)are the most common plant associations on the high mobile dunes. Vegetation coverage is generally between 60 and 80% on the mobile sand dunes. Species belonging to the orders*Elymetaliaarenariae*Br.-Bl. etR.Tüxen 1943,*Cakiletaliamaritimae*R.Tüxen et Preising 1950 and *Festucetaliavaginatae*Soó 1957 have a high presence in the floristic composition of the association. *Leymusracemosus* subsp. *sabulosus*(*Leymussabulosus*) and *Artemisia tschernieviana*(syn. *Artemisia arenaria*) are the characteristic and dominant species of the plant associations. Other species well represented in the composition of these associations are: *Eryngiummaritimum, Crambemaritima, Lactucatatarica, Centaureaarenaria*subsp.*borysthenica, Euphorbia segueriana, Medicagofalcata, Xanthium italicum, Cakilemaritima*subsp.*euxina, Alyssum hirsutum, Sileneconica, Secalesylvestre, Corispermumnitidum, Glauciumflavum, Salsola kali* subsp.*ruthenica, Gypsophila perfoliata.*

Fig. 3 – The plant community *Elymetumgigantei* at Portița

Some phytocoenoses with *Leymussabulosus*observed on the beach at Sulina (Făgăraș, 2013) and between Periboina and Periteașca (Făgăraș, 2014) belong to two subassociations: *Elymetumgiganteis*ubass. *crambetosummaritimaesubass. nova* and *Elymetumgiganteis*ubass. *eryngietosummaritimae*.

Fig. 4 – The plant community *Artemisietumarenariae*on Chituc sandbank

Both plant associations are common in the coastal area of Danube Delta Biosphere Reserve. Phytocoenoses with *Leymus sabulosus* are prevalent on the shifting sand dunes of the coastal area Portița-Periboina and along Chituc sandbank. Plant association *Elymetumgigantei*has been noticed also on small surfaces in Sulina, Sf. Gheorghe, Perișor, Cape Midia (in Midia harbour), between Năvodari and North Mamaia, between North Eforie and South Eforie, at South Eforie).Phytocoenoses with *Artemisia tschernieviana* are prevalent on the shifting sand dunes along Chituc sandbank and on smaller surfaces on Corbu beach, at Cape Midia (inside of Midia harbour area) and between Năvodari and North Mamaia.

The plant community *Leymo sabulosi-Elymetum farcti* G e h u et al., 1986is rare on the Romanian Black Sea coast and cover small surfaces of the habitat 2110. *Elymus farctus subsp. bessarabicus* share with *Leymus sabulosus*the first strip of embryonic dunes in some coastal zones. This speciesbecame Critically Endangered in Romania (Dihoru et Negrean, 2009) due to strong anthropogenic influences upon the beaches, especially on the southern coast of the Black Sea. Phytocoenoses with *Elymus farctus* subsp. *bessarabicus* were observed only along Chituc sandbank and between North Eforie and South Eforie (Făgăraș et al., 2006). Phytocoenoses from Eforie are seriously threatened by the arrangement works of the beaches and building of new touristic facilities in the dunes area.

The plant communities *Secali sylvestris-Brometum tectorum*and *Aperetum maritimae* occupy low shifting sand dunes, behind those occupied by *Leymus sabulosus* and *Artemisia tschernieviana*. These plant associations make the transition towards the stabilized sand dunes. Characteristic and dominant species of these associations are *Secalesylvestre, Bromustectorum*and*Aperaspicaventi*subsp.*maritima*. Other steppic and psammophilous species belonging to the order *Festucetaliavaginatae*Soó 1957 and class *Festuco-Brometea* Br.-Bl. et R. Tüxen in Br.-Bl. 1949 are well represented in the floristic composition of the plant communities: *Centaurea arenaria subsp. borysthenica, Gypsophila perfoliata, Polygonum arenarium, Euphorbia segueriana, Crepis foetida* subsp.*rhoeadifolia, Alyssum hirsutum, Linum austriacum, Plantago arenaria, Scabiosa argentea, Medicago falcata, Scirpus holoschoenus*, *Astragalus varius.*

The plant association *Secali sylvestri-Alyssetum borzaeani* (Borza 1931) Morariu 1959(Fig. 5) is very rare on the Romanian Black Sea coast, on the shifting sand dunes. It was noticed only on Lupilor sandbank (Sârbu et al. 2000) and in the protected site Marine Sand Dunes of Agigea (Morariu, 1959).*Alyssum borzaeanum,* characteristic species of the

association, has a very limited distribution in Romania (Lupilor and Saele sandbanks, Agigea) and it is considered as Critically endangeredaccording to the Red Book of Vascular Plants in Romania (Dihoru et Negrean, 2009).Species with high occurrence in the phytocoenoses with *Alyssum borzaeanum* and *Secale sylvestre* are the following: *Centaurea arenaria subsp. borysthenica, Alyssum hirsutum, Carex colchica, Euphorbia segueriana,Silene conica, Erysimum diffusum, Medicago falcata, Stachys atherocalyx, Linaria genistifolia, Bromus tectorum, Cynanchum acutum, etc.*

Fig. 5 – The plant community*Secali sylvestri-Alyssetum borzaeani* at Agigea

Fig. 6 – The plant community *Convolvuletumpersici* at Sulina

The plant community *Convolvuletum persici* (Borza 1931) Sanda et al. 1998 (Fig. 6) has a fragmented distribution along the Black Sea shore and on the maritime sandbanks within Danube Delta Biosphere Reserve. Typical phytocoenoses with *Convolvulus persicus* have been noticed in Danube Delta (Sulina, Sfântu Gheorghe, Cardon) and in the natural reserve Marine Sand Dunes of Agigea.*Convolvulus persicus* is dominant and diagnostic species of the plant association *Convolvuletum persici*. Most of accompanying species are psammophilous and steppe plants belonging to the alliances *Scabiosion ucrainicae* Boșcaiu 1975, *Festucion vaginatae* Soó 1929 and *Elymion gigantei*

Morariu1957: *Secale sylvestre, Centaurea arenaria subsp. borysthenica, Alyssum hirsutum, Euphorbia segueriana, Eryngium maritimum, Leymus racemosus* subsp. *sabulosus, Cakile maritima* subsp. *euxina, Salsola kali* subsp. *ruthenica, Bromus tectorum*, *Silene conica,Cynanchum acutum*.

Many rare plant species occur on the shifting sand dunes: *Stachys maritima* (CR), *Convolvulus persicus* (CR), *Petasites spurius* (CR), *Alyssum borzaeanum* (CR), *Elymus farctus* subsp. *bessarabicus* (CR), *Argusia sibirica* (CR), *Argusia sibirica* (CR),*Astrodaucus littoralis* (EN), *Dianthus bessarabicus* (EN), *Syrenia montana* (EN), *Crambe maritima* (EN), *Silene exaltata* (EN), *Artemisia tschernieviana* (EN), *Cakile maritima* subsp. *euxina* (EN), *Silene thymifolia* (VU), *Polygonum oxyspermum* subsp. *raii* (VU), *Polygonum maritimum* (VU), *Eryngium maritimum* (VU), *Gypsophila perfoliata* (VU), *Astragalus varius* (VU), *Scolymus hispanicus* (VU).*Astrodaucus littoralis* has the biggest local population in Romania on the sand dunes between Portița and Periboina (Făgăraș, 2014).

## CONCLUSIONS

Embryonic shifting dunes are well represented on Romanian Black Sea coast, especially north of Cape Midia, in the coastal area of Danube Delta Biosphere Reserve.

South of Cape Midia, the habitat 2110 has remained only in small and scattered fragmentsbetween coastal resorts.

Typical plant communities of this type of habitat in Romania belong to the classes *Ammophiletea* Br.-Bl. et Tuxen 1943 and*Festucetea vaginatae*Soó 1968.

Conservation status of the habitat 2110 is generally favorable on the northern coast of Romania but inadequate in Sulina, along Chituc sandbank and near Portița.

On the southern coast of Romania, the embryonic shifting dunes have an unfavorable conservation status due to economic activities; in this segment of Romanian littoral there are importantharbours and a lot of coastal resorts.

Current and future trend regarding habitat quantity and quality is stable on the northern coast of Romania and it is decreasing atsouth of Cape Midia where anthropogenic influences are still significant.

Main factors contributing to degradation of the habitat 2110 are: expanding of recreational areas of the beaches, real estate developments in the dunes area, trampling of the psammophilousvegetation and its grazing by the cattle and horses, some invasive plant species.

Proper preservation of the habitat 2110 on the northern coast of Romania require a better control of the grazing and of touristic activities on the sandy beaches of the Danube Delta by the field agents of the Biosphere Reserve Administration.

## AKNOWLEDGEMENTS

This work was supported by the grant PN-II-PT-PCCA-2011-3.2-1427of the Romanian Ministry of National Education, contract nr. 69/2012 (project acronym: ECOMAGIS).

## BIBLIOGRAPHY

1. **Ciocârlan, V**., 2009 -Flora ilustrată a României. Pteridophyta et Spermatophyta, Edit. Ceres, Bucureşti.
2. **Dihoru, Gh., Negrean, G**., 2009 - Cartea Roşie a plantelor vasculare din România, Edit. Academiei Române, Bucureşti.

3. **Doniță, N., Popescu, A., Paucă-Comănescu M., Mihăilescu S., Biriș, A.I**., 2005 – Habitatele din România, Edit.Tehnică Silvică, București.
4.**Făgăraş, M., Bercu, R., Loreley, J.**, 2006 - The reasons in favour of setting up a new natural reserve in the Black Sea shore area between North and South Eforie (Constanta County), in **Nature Conservation–Concepts and Practice** [D. Gafta, J. Akeroyd (Eds.), SPRINGER Berlin Heidelberg New York, pg. 90-97.
5.**Făgăraş, M., Skolka, M., Anastasiu, P., Cogălniceanu, D., Negrean, G., Bănică, G., Tudor, M., Samoilă, C.**, 2008 a - Biodiversitateazoneicostiere a DobrogeidintreCapulMidiaşiCapulKaliakra, Edit. Ex Ponto, Constanţa, 451 pp.
6.**Făgăraş, M. (coord.)**, 2008 b - Studii comparative privind biodiversitatea habitatelor costiere, a impactului antropicşi a posibilităţilor de conservare şi restaurare a habitatelor de interes comunitar dintre Capul Midia (România) şiCapul Kaliakra (Bulgaria)"- Volum cu lucrările Conferinței de la Constanţa, Edit. Ex Ponto, Constanţa, 161 pp.
7. **Făgăraș, M**., 2012 - Habitats of conservative interest and plant communities in the sandy Black Sea coast area of Romania and Bulgaria, J. Environ. Prot. Ecol., 13 (3A), 1688-1694.
8. **Făgăraș, M**., 2013 – Habitats with conservation significance and psammophilous plant associations from Sulina beach (Danube Delta Biosphere Reserve). Analele Ştiinţifice ale Universităţii „Al. I. Cuza” Iaşi, s. II a. Biologie vegetală, 59, 2: 85-98.
9.**Făgăraş, M**., 2014 -Psammophilous plant associations from the coastal area of the Black Sea between Periboina and Peritească (Danube Delta Biosphere Reserve), Analele Universității din Craiova, Seria Agricultura-Montanologie-Cadastru, vol. XLIV, 89-100.
10.**Gafta, D., Mountford, O.** (eds), Alexiu, V., Anastasiu, P., Bărbos, M., Burescu, P., Coldea, Gh., Drăgulescu, C., Făgăraș, M., Goia, I., Groza, Gh., Micu, D., Mihăilescu, S., Moldovan, O., Nicolin, A., Niculescu, M., Oprea, A., Oroian, S., Paucă-Comănescu, M., Sârbu, I., Șuteu, A., 2008 - Manual de interpretare a habitatelor Natura 2000 din România, Edit. Risoprint, Cluj-Napoca.
11. **Morariu, I**., 1959 - Contribuţii la studiul vegetaţiei litoralului Mării Negre*, Studii şi Cercet. de Biol.* Bucureşti, Seria Biol. vegetală, 11, 4: 361-378.
12. **Sanda, V., Őllerer, K., Burescu, P**., 2008 - Fitocenozele din România. Sintaxonomie, structură, dinamică și evoluție, Edit. Ars Docendi, Universitatea din București.
13. **Sârbu, I., Ştefan, N., Oprea, A., Zamfirescu, O**., 2000 –Flora şi vegetaţia Rezervaţiei Naturale Grindul Lupilor (Rezervaţia Biosferei Delta Dunării), Bul. Grăd. Bot. Iaşi, **9**: 91-124.
14. **Sârbu, I., Ştefan, N., Oprea, A**., 2013 - Plante vasculare din Romania. Determinator ilustrat de teren, Edit. Victor B Victor, Bucureşti.
15. **Trif, C. R., Făgăraș, M. M., Hîrjeu, N. C., Niculescu, M**.- 2015. Ghid sintetic de monitorizare pentru habitate de interes comunitar (sărături, dune continentale, pajiști, apa dulce) din Romania, Ed. Bolda, Constanța
16. **Tutin, T.G. Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A.** (eds), 1964-1980 - Flora Europaea, Vols. 1-5, Cambridge, Cambridge University Press.
17. **Tutin, T.G. Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A.** (eds., assist. by Akeroyd, J.R & Newton, M.E.; appendices ed. by Mill, R.R.), 1993 (reprinted 1996) - Flora Europaea, 2nd ed., Vol. 1, Cambridge, Cambridge University Press.
18. **Weber, H.E., Moravec, J., Theurillat, J.P**., 2000 - International Code of Phytosociological Nomenclature, 3 Ed. –J. Veg. Sci., 11 (5), pp 739-768.
19. *** **Habitats Directive 92/43/EEC** - Council Directive 92/43/EEC on the conservation of natural habitats and of wild Fauna and flora (http://eur-lex.europa.eu).