CONTRIBUTIONS TO THE KNOWLEDGE OF VEGETATION FROM BRĂILA SALT LAKE AREA (ROMÂNIA)

Georgiana Papurică

Received: 20.09.2022 / Accepted: 03.11.2022

Abstract: Our study briefly presents the first observations regarding the vegetation in the Brăila Salt Lake area within the research theme of halophilic plants in Brăila County. Some of the species and ecosystems specific to the Salt Lake area have been re-identified. A number of 55 plant species have been reported, belonging to 24 plant families. The anthropogenic factor and climate change are the main factors that determine the qualitative and quantitative changes in ecosystems.

Keywords: County Brăila, halophilic vegetation, Salt Lake

Introduction:

The Romanian Plain is dotted with a multitude of salty, shallow lakes, located between Ialomița and Siret Rivers. Due to the special properties of water and mud, researchers were interested, among other things, in the study of the Salt Lake in Brăila county (Fig. 1).

Salt Lake, called "the Pearl of Bărăgan", has a beneficial effect on human health. The area designated for the study is located in the administrative perimeter of Chiscani village (a subdivision within Brăila county) and consists of two compartments: a northern one with salt water for bathing, and a southern one with brackish water. Between the two, there is a ring road. Salt Lake is part of the Steppe Bioregion, one of the five bioregions of Romania and also it is a part of a series of Natura 2000 protected areas called ROSCI0307 (2011).

According to Natura 2000 in Romania, the specific ecosystems of the Salt Lake area are:

- mixed forests with tree species: *Populus tremula* (European aspen), *Populus alba* (White poplar), *Quercus pedunculiflora* (Brumary oak), *Fraxinus excelsior* (European ash), *Acer pseudoplatanus* (Scottish maple);
- ornamental vegetation including both forests such as: *Thuja* sp. (Arborvitae), *Tilia* sp. (Basswood), *Fraxinus excelsior* (European ash), *Catalpa bignonioides* (Indian-bean), *Malus sylvestris* (European crab apple), *Robinia pseudacacia* (Acacia), *Sophora japonica* (Japanese acacia), as well as herbaceous species such as: *Forsythia europaea* (Forsythia), *Salvia* sp. (Sage), *Berberis* sp. (Oregon-grape), *Petunia* sp. (Petunia);

Georgiana Papurică:
Museum of Braila ”Carol I”
Department of Natural Sciences
Aleea Parcului no. 15
810229 Braila, Romania

e-mail: georgianapapurica82@yahoo.com

- salt marsh vegetation with characteristic halophilic species such as *Salicornia herbacea* (Common glasswort) and *Suaeda maritima* (Herbaceous seepweed);
- salty meadows with the characteristic species *Puccinellia limosa* (Alkali grass), *Festuca pseudovina*, *Cynodon dactylon* (Bermuda grass), *Trifolium fragiferum* (Strawberry Clover);
- vegetation specific to salty and brackish wetlands with the characteristic species *Typha angustifolia* (Narrowleaf cattail);
- shrubs, found between the salt meadows and agricultural land, the specific species are: *Elaeagnus angustifolia* (Russian olive), *Hyppophaë rhamnoides* (Sallowthorn) and more rarely, *Tamarix ramosissima* (Saltcedar).

Regarding the history and genesis of the lake, several hypotheses have been formulated. Gâștescu (1971) supports the hypothesis of the formation of the Salt Lake through the process of subsidence in the loess, forming the roofs, where the precipitation and groundwater gathered. Vâlsan (in Gâștescu 1971) assume the formation of the lake by the clogging of an older arm of the Danube, this is known as the oldest hypothesis. Salt Lake is hypersaline, with a sulfate-sodium to chloro-sodium and sulfate-magnesium salinisation. Sludge was formed by biological and geological processes from the mixture of organic and inorganic particles with water (D. Albu 1993). The number of taxa in the southern compartment is higher than in the northern one, and some species are common to both compartments. The observations made by E. Nestorescu et al. (1984), confirmed that in the Salt Lake there is a significant process of accumulation of plant mass which form the basis of peloidogenic transformations.

In the specialised literature, information on the halophilic flora of the Salt Lake has been mentioned since the beginning of the 20th century (Bujor 1900). This provides a description of the flora and fauna of the salt lakes in Romania and of the flora bordering these lakes. Regarding the issue of halophyte classification, Grigore (2008) makes some clarifications regarding a single classification of halophytes, as different authors sometimes use different terms when referring to a certain halophilic species. Grigore (2008) based his classification on the works of Prodan (1939) (in Grigore 2008), Țopa (1954) (in Grigore 2008) and Bucur (1957) (in Grigore 2008). Prodan (in Grigore 2008) does not precisely nominate the categories of halophytes, nor does he yet proposes a terminology in this sense. Țopa (in Grigore 2008) defines strict halophytes as plants belonging to salt marshes: the special ones prefer salt marshes where they find the optimal living conditions, the supporting ones can withstand the salts, without competing with the native vegetation, and the accidental ones end up on the salt, where they cannot maintain themselves.

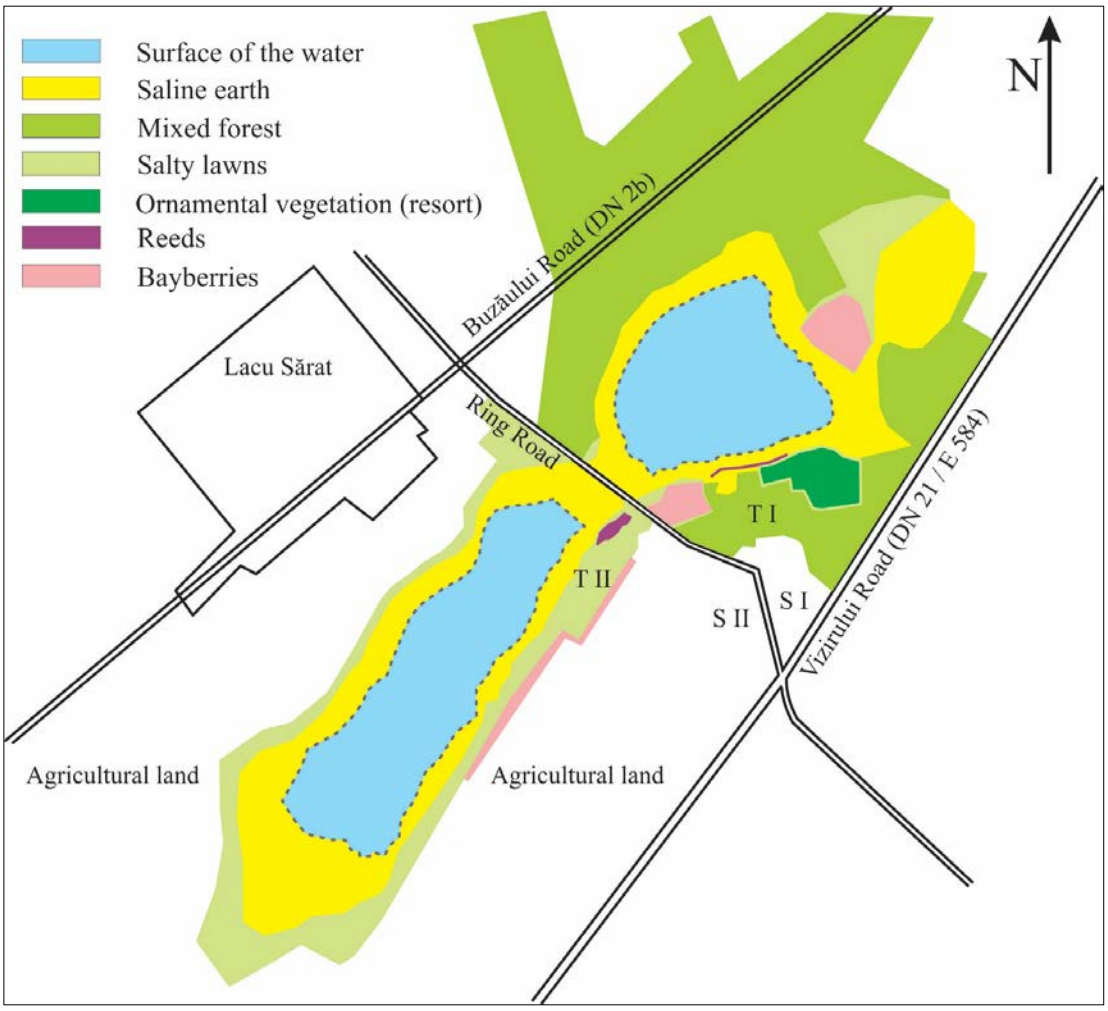
Classification of Bucur (in Grigore 2008) is particularly interesting and is the result of concrete research on the salinity tolerance range of some plants. It refers to the strict halophytes, those species that only live on salt and prefers only salinised soils, facultative halophytes or salinity-adapted halophytes, plants very sensitive to salinity, and plants very little adapted to salinity. As stated by Bucur (in Grigore 2008), there are neither halophilic plants nor well-distinct halophobic plants, but rather there are gradual transitions from one category to another. We must not lose the sight of the evidence that along with salinity as the main factor in the development and distribution of plant species on salt marshes, there are other factors with a secondary role, such as humidity. This plays a major role, especially in hygrophytes.

In Grigore and Toma (2010), a new classification of halophytes was also proposed, based on observations of integrative anatomy. Following the analysis of anatomical adaptations and taking into account some ecological factors such as salinity, two categories of halophytes are suggested: extremohalophytes (irreversible and reversible) and mesohalophytes.

This study is part of a research theme aiming to observe and re-identify ecosystems, halophilic vegetation and plant associations present in the Salt Lake area.

Istros – Museum of Braila "Carol I"

Figure no. 1 Map of Salt Lake Brăila (processed after Onea 2012)



Materials and methods:

The observations on the flora in the Salt Lake area started in February 2022, and will be completed during of four years of study.

The research method used was direct observation of plants in nature, their distribution, characteristics and habitat. Two to three hours a day were allocated to the observations. The biological material was collected and herborised for effective conservation in order to study and enrich the museum heritage. Traditional field research tools were used such as binoculars and a camera. In the laboratory, the pressing technique and the ruler were used to determine the dimensions of the plants with the aim of entering them into the database of the Brăila Museum.

Results and discussion:

Field visits have conducted to observation of 53 superior plants species, from which, herbaceous 43 and woody 10 species, but also 2 inferior plant species.

Previous studies have shown that the vegetation characteristic of saline areas can be seen from great distances, especially in

summer. The soil of the salt fields is specific, rich in salts such as sodium chloride and calcium sulfate, which precipitate and settle on the surface in the form of a white pellicule. Salt marsh vegetation is neither varied nor attractive to the eye of the beholder or to the pollinating insects (Todor 1968).

The Salt Lake area is a habitat composed of annual plants, many succulents, located on soils concentrated in salts. From a geochemical point of view, the halophilic species that live in this extreme environment have a special adaptation. Due to the osmotic pressure, water passes from the soil to the roots of the plant. Few species of plants are strictly adapted to this type of habitat. They have a series of special organic substances in the cell juice, so that by creating a very high artificial osmotic pressure, they enable the plant to extract water from the salty soil (Brânzan et al. 2013). The most widespread plant communities of halomorphic soils are meadows with plant associations of *Salicornia* and *Suaeda*. Other plant associations observed in the Salt Lake area are *Cynodonetum dactyloni*, *Artemisietum maritimae*, *Puccinellietum distantis*, *Juncetum gerardii* and *Camphorosmatum annuae* in addition to those previously mentioned, such as *Suaedum maritimae* and *Salicornietum herbaceae* (Doniță et al. 1992).

In Table 1 (Annexes), there are shown the plants observed in the area of Salt Lake Brăila.

Compared to the Brăila Salt Lake Standard Sheet - ROSCI0307 (2011) in which 22 species are presented, on the basis of which the Salt Lake II area was included in the Natura 2000 list, we observed only 10 species. These species have an uneven and sometimes punctate distribution in the immediate vicinity of the salt lake, where they find the specific salt habitat conditions.

Our observations led to the highlighting of a rich vegetation, which is either found at the border of the salt zone, or sometimes intermingles with the plants specific to the zone.

In February, due to the arid climate, it was possible to observe the dry vegetation bordering the lake, consisting of plants specific to salt areas such as: *Salicornia europaea* (Common glasswort), *Suaeda maritima* (Herbaceous seepweed), *Artemisia salina* (Wormwood), *Limonium sinuatum* (Wavyleaf sea lavender) and *Puccinellia limosa* (Alkali grass) (Fig. 2, Annexes).

In March, the same dry vegetation such as *Salicornia* and *Suaeda* are consistently seen (Fig. 3, Annexes). A few species have adapted to the diurnal and nocturnal temperature differences, namely: *Veronica hederifolia* (Ivy-leaved Speedwell) (Fig. 4, Annexes), *Gagea arvensis* (Fig. 5, Annexes) and *Syntrichia ruralis* (Great Hairy Screw-moss) (Fig. 6, Annexes). *Xanthoria parietina* (Maritime sunburst lichen) (Fig. 7, Annexes) is quite widespread on the surrounding tree vegetation. The vegetative and flowering buds of the trees in the area can also be observed.

In May, the vegetation is in different stages of development depending on the species. On the shore of the lake, in addition to the species of specific salt plants, *Salicornia* and *Suaeda* (Fig. 8, Annexes), also can be seen *Bassia hirsuta*, specific to brackish areas. Ruderal plants have adapted to the habitat requirements: Wormwood (*Artemisia salina*), species of grasses such as *Cynodon*, *Juncus* (Fig. 9, Annexes), *Bromus*, *Festuca*, *Agropyron*, *Puccinelia*, but also Wild chamomile (*Matricaria perforata*), a species of mouse tail (*Achillea setacea*), *Sisymbrium officinale* and *Lactuca tatarica*. Among the shrubs, we can record the Dog rose (*Rosa canina*), the Sallowthorn (*Hippophaë rhamnoides*) and the Russian olive (*Elaeagnus angustifolia*) (Fig. 10, Annexes).

In July, the halophilic vegetation is in full development. Wide expanses of halophilic plant associations of *Salicornia* and *Suaeda* can be observed (Fig. 11, Annexes). *Cychorium intybus* (Belgium endive) is a common plant with purple flowers that delights everyone's eyes (Fig. 12, Annexes).

Since a comparison cannot be made with previous recent studies, the following aspects can be observed: the presence and

discontinuous distribution of swamp vegetation on the shore of Salt Lake I, represented by *Phragmites australis* (Common reed) and the presence of a patch of swamp vegetation, also represented by *Phragmites*, near the canal adjacent to Salt Lake II.

In October, the plants mentioned in the study reach maturity and the herbs are already dry. *Salicornia* and *Suaeda* become reddish, sign of their anatomical and physiological decline (Fig. 13, Annexes).

The mild temperatures of October and as could be seen in October 2022, also favored the flowering and the maintenance of the flowers in other salt-tolerant species. It was possible to find *Spergularia marginata* (Fig. 14, Annexes) with a flowering period between July and September and *Aster tripolium* (Fig. 15, Annexes) with a flowering period of June and October.

Conclusion:

Following field research in the area of the Salt Lake, 55 plant species, belonging to 24 families, were reported. As for the number of species, the families Asteraceae, Poaceae and Chenopodiaceae predominate.

A reduction in the number of specimens and implicitly in their area was observed, especially in strongly halophilic species such as *Salicornia* and *Suaeda*. The main reason a species can become threatened is overexploitation that causes habitat loss, for example: drying up of lakes, domestic activities such as sheep herding, but also their promotion and use as edible species. It is essential to maintain the protection of the area to ensure the survival and proliferation of the species and their remaining specimens.

Anthropogenic disturbances contribute to the decrease in the number of specimens in the area. If these disturbances continue, then there is a possibility that species diversity will also decrease. Active measures are needed to remove the unfavorable circumstances on the habitat and prevent the possible extinction of the species.

Rezumat:

CONTRIBUȚII ADUSE LA CUNOAȘTEREA VEGETAȚIEI DIN ZONA LACULUI SĂRAT BRĂILA (ROMÂNIA)

Studiul nostru prezintă succint primele observații privind vegetația din zona Lacului Sărat Brăila în cadrul temei de cercetare a plantelor halofile din județul Brăila. Au fost reidentificate o parte din ecosistemele specifice zonei Lacului Sărat. Au fost semnalate un număr de 55 de specii, aparținând la 24 de familii. Factorul antropic și schimbările climatice sunt principalii factori care determină schimbările calitative și cantitative ale ecosistemelor.

References:

ALBU DUMITRICA (1993), *Rezervații naturale, zone protejate și monumente ale naturii din ținuturile Brăilei*, Ed. Alma, Galați.

BRÂNZAN T., BĂDĂRĂU A.S., MURARIU D., STAICU CRISTINA, PATRICHE N., CIUBUC C., HULEA D. (2013), *Catalogul habitatelor, speciilor și siturilor Natura 2000 în România*, Ed. Ministerul Mediului și Schimbărilor Climatice, București.

BUJOR P. (1900), Contribution à l'étude de la faune des lacs salés de Roumanie. I. Thékirghiol (départ. de Constantza-Dobrogea). II. Lacu-Sărat (Le lac salé départ. de Braila, *Annales scientifiques de l'Université de Jassy*, Vol. I, Fasc. 2, pp. 3-40.

DONIȚĂ N., IVAN D., COLDEA GH., SANDA V., POPESCU A., CHIFU TH., PAUCĂ-COMĂNESCU MIHAELA, MITITELU D., BOȘCAIU N. (1992), *Vegetația României*, Ed. Tehnică Agricolă, București.

GÂȘTESCU P. (1971), *Lacurile din România*, Ed. Academiei R.S.R., București.

GRIGORE M.-N. (2008), *Halofitotaxonomia: lista plantelor de sărătură din România*, Ed. PIM, Iași.

GRIGORE M.-N., TOMA C. (2010), A proposal for a new Halophytes classification, based on integrative anatomy observations, *Oltenia. Studii și comunicări. Ştiinţele Naturii*. Tom. 26, No. 1/2010.

NESTORESCU EMILIA, IONESCU VENERA, NĂSTĂSESCU MARIA, IGNAT GHE. (1984), Studiul microbiologic, floristic și faunistic al apei și nămolului din Lacul Sărat-Brăila. Implicații în explicarea procesului de peloidogeneză, *Acta Botanica Horti Bucurestiensis*, *Lucrările Grădinii Botanice din București*, *volum omagial dedicat Centenarului Herbarului Grădinii Botanice 1883-1983*, p. 139-144.

ONEA N. (2012), Contributions to knowledge avifauna of the Brăila Lacu Sărat area (Brăila County, România), *J. Wetlands Biodiversity*, 1: 65-96.

ROSCI0307 (2011), Formularul Standard Natura 2000 ROSCI0307, Ministerul Mediului, București.

SĂVULESCU T. (Coord.) (1952-1976), *Flora Republicii Populare Române/Flora Republicii Socialiste România*, Vol. I – XIII, Ed. Acad. RPR/RSR, București.

TODOR I. (1968), *Mic atlas de plante din flora Republicii Socialiste România*, Ed. Didactică și Pedagogică, București.

Annexes:

Table no. 1 The plants observed of Salt Lake Brăila

Family	Species	Common name
Teloschistaceae / Fungi	*Xanthoria parietina*	Common Orange Lichen
Timmiellaceae / Bryophita	*Syntrichia ruralis*	Great Hairy Screw-moss
Salicaceae	*Salix alba*	White Willow
	Populus alba	White Poplar
Betulaceae	*Betula pendula*	European white birch
Fagaceae	*Quercus robur*	English oak
Chenopodiaceae	***Salicornia herbacea***	Common glasswort
	Suaeda maritima	Herbaceous seepweed
	Bassia hirsuta	Hairy smotherweed
	Camphorosma annua	-
Caryophyllaceae	*Spergularia marginata*	Salt sandspurry
	Gypsophila muralis	Annual gypsophila
Ranunculaceae	*Delphinium consolida*	Royal larkspur
	Ranunculus sardous	Hairy buttercup
Brassicaceae	*Sisymbrium officinale*	Hedge Mustard
	Lepidium perfoliatum	Clasping pepperweed
Rosaceae	*Rosa canina*	Dog rose
Fabaceae	*Medicago lupulina*	Black Medic
Zygophyllaceae	*Nitraria schoberi*	Nitere bush
Eleagnaceae	*Hippophaë rhamnoides*	Sallowthorn
	Elaeagnus angustifolia	Russian olive
Tamaricaceae	*Tamarix ramosissima*	Saltcedar
Apiaceae	*Eryngium campestre*	Field Eryngo
Plumbaginaceae	*Limonium gmelinii*	Sea-lavender
Oleaceae	*Fraxinus excelsior*	European ash
Boraginaceae	*Lappula echinata*	Bluebur
Labiatae	*Lamium purpureum*	Purple deadnettle
	Ballota nigra	Black Horehound
	Mentha arvensis	European corn mint
Scrophulariaceae	*Verbascum blattaria*	Moth Mullein
	Veronica hederifolia	Ivy-leaved Speedwell
Asteraceae	***Aster tripolium***	Sea aster
	Achillea setacea	Bristly yarrow
	Matricaria perforata	Wild chamomile
	Artemisia salina	Wormwood
	Artemisia maritima	Sea wormwood
	Senecio vulgaris	Old-man-in-the-spring
	Carlina vulgaris	Carline thistle
	Arctium lappa	Burdock
	Carduus nutans	Nodding plumeless thistle
	Cirsium arvense	California thistle
	Cichorium inthybus	Belgium endive
	Taraxacum officinale	Blowball
	Lactuca tatarica	Russian blue lettuce
	Anthemis arvensis	Corn Chamomile
	Anthemis austriaca	Austrian chamomile
Liliaceae	*Gagea arvensis*	-
Juncaceae	***Juncus gerardii***	Black-grass
Poaceae	*Setaria viridis*	Green Bristle-grass
	Phragmites australis	Common reed
	Puccinelia limosa	Alkali grass
	Festuca pseudovina	-

Bromus tectorum	Cheatgrass
Cynodon dactylon	Bermuda grass
Agropyron repens	Couch grass

Note: Taxonomy from Romanian Flora Vol. I – XIII, 1952 – 1976; bold species are found in the Natura 2000 Standard Sheet for ROSCI 0307.

Figure no. 2 Vegetation of the Salt Lake Brăila in February

Figure no. 3 Vegetation of Salt Lake Brăila in March

Figure no. 4 *Veronica hederifolia* in March

Figure no. 5 *Gagea arvensis* in March

Figure no. 6 *Syntrichia ruralis* in March

Figure no. 7 *Xanthoria parietina* in March

Figure no. 8 *Salicornia herbacea* și *Suaeda maritima* in May

Figure no. 9 *Juncus gerardii* in May

Figure no. 10 *Elaeagnus angustifolia* in May

Figure no. 11 Plant associations betweeen *Salicornietum herbaceae* and *Suaedum maritimae* in July

Figure no. 12 *Cichorium intybus* in July

Figure no. 13 Plant associations between *Salicornietum* and *Suaedum* in October

Figure no. 14 *Spergularia marginata* in October

Figure no. 15 *Aster tripolium* in October