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COLCHICUM SOBOLIFERUM, MARSILEA QUADRIFOLIA AND *TRAPA NATANS* VAR. *NATANS* IN THE DANUBE DELTA BIOSPHERE RESERVE

CHIRILĂ Simona Dumitrița[1*], DOROFTEI Mihai[1], COVALIOV Silviu[1]

Abstract: Rare plant species are more sensitive to anthropogenic disturbances, their effects causing a decrease in populations and the fragmentation of their habitats. Their unclear population structure often impedes conservation planning. The purpose of the study is to update the distribution and population size, identify habitat preferences, investigate limiting factors, and assess the current conservation status of three threatened taxa – *Colchicum soboliferum, Marsilea quadrifolia,* and *Trapa natans* var. *natans* from the Danube Delta Biosphere Reserve (DDBR). The study took place between 2019-2023. The study results showed that the taxa are rare in DDBR, and they have affinities to specific plant communities. *C. soboliferum* occurs frequently in *Artemisio santonici-Juncetum maritimi* and *Agrostio maeoticae-Scirpoidetum holoschoeni* subass. *aperetosum maritimae, M. quadrifolia* is mainly found in *Typhetum angustifoliae* and *Artemisio santonici-Juncetum maritimi*, while *Trapa natans* var. *natans*, is found in *Trapo-Nymphoidetum* association. The threats to the three species are overgrazing and soil compaction for *C. soboliferum*; water pollution, invasion of *Elodea nuttallii* and habitat change due to trampling for *M. quadrifolia*; wetland drainage, boating and silting for *Trapa natans* var. *natans*. Therefore, for all three species, changing the conservation status to endangered, protecting and restoring the actual habitats, and transplanting individuals to safer areas with similar habitats are part of the conservation plan within the DDBR area.

Keywords: rare taxa, habitat preferences, population status, phytocoenotic affinity

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Introduction

Biodiversity conservation represents an important challenge in an era of unprecedented global change, with rare plant species often at the forefront of conservation efforts (Farooqi et al. 2022). Rare taxa are those with low abundance and small ranges (Gaston 1994a). The significance of biodiversity conservation cannot be overstated given the critical roles plants play in ecosystems, including carbon sequestration, nutrient cycling, etc. (Chapin et al. 2000). Rare taxa, defined by their limited geographic distribution (Leitão et al. 2016) small population sizes (Rodrigues et al. 2019), or both, are particularly vulnerable to anthropogenic pressures such as habitat fragmentation, climate change, invasive species (Rabinowitz 1981, Gaston 1994b). Therefore, a significant challenge for ecologists is determining how species respond to climate change (Vincent et al. 2020). The study of rare taxa contributes to

[1] "Danube Delta" National Institute for Research and Development, 165 Babadag str., 820112 – Tulcea, Romania
*Correspondence: simonachirilasc@yahoo.com

understanding biodiversity and ecosystem function and provides essential insights for conservation strategies to prevent biodiversity loss (Frankham et al. 2010).

Endemic and relict plants and marginal species (alpha diversity – species level) residing at the edge of their habitats are acknowledged as rare plants (Namzalov et al. 2019). This rarity extends to vegetation communities (beta diversity – amount of differentiation between species communities; Andermann et al. 2022) and landscape complexes, including phytocoenoses from the region (gamma diversity – ecosystem level; Namzalov et al. 2019). Alpha diversity must be conserved as it underpins ecosystem services and human well-being (Sandifer et al. 2015, Ong et al. 2022). Nonetheless, associated beta and gamma diversities are rapidly declining globally (Ong et al. 2022). Although a few dominant species can adequately maintain ecosystem functions, rare species are indispensable for supporting various ecosystem services (Leitão et al. 2016, Ives et al. 2016). In this scenario, rare species, which are on the brink of extinction, may be particularly susceptible to climatic shifts (Schwartz et al. 2006). Therefore, it is imperative to devise conservation strategies for rare species by assessing their responses to climate change (Vincent et al. 2020). In addition to these considerations, it is important to note the role of genetic diversity within species (intraspecific diversity) in the resilience and adaptability of populations to environmental changes (Hughes et al. 2008). Conservation efforts must also include preserving the genetic variability that underlies adaptive potential, especially for rare and endemic species that may have limited genetic diversity due to small population sizes (Frankham et al. 2010). Furthermore, landscape connectivity should be enhanced to facilitate gene flow and species migration, thereby counteracting the fragmentation that can exacerbate the vulnerability of rare species (Crooks et al. 2011).

The study aims to expand the current knowledge regarding some rare taxa in the DDBR by presenting new locations where they are found and by analyzing their habitat preferences and limiting factors. This study aims to contribute to the study area by providing data for protecting and sustaining threatened plant species in the face of ecological and anthropogenic changes. The objectives are: (i) identification of new locations, (ii) identification of preferred habitat types, and (iii) investigation of limiting factors of the analyzed plant species.

This study presents a detailed description of each species, information on distribution, plant associations, limiting factors, threat categories, and conservation status.

Material and methods

The study was divided into three steps: preliminary work, fieldwork, and assembly work. The field research was conducted in the Danube Delta Biosphere Reserve (DDBR; Fig. 1) between March 2019 and July 2023. The methodology used for phytosociological surveys was based on Braun-Blanquet (1964). In each relevé, the following data were recorded: species composition, total coverage (%), plant species abundance-dominance (AD), and the number of taxa. The area covered by the taxon ranges from + (sparse and covering a small area) to 5 (covering more than 75% of the area). Abundance and range size was taken into account to measure rarity at the site level, the degree of presence of the individuals is scaled as follows: 5 – abundant (80-100%); 4 – frequent (60 – 80%); 3 – constantly present (40 – 60%); 2 – rare (20 – 40%); 1 – sparsely (1 – 20%) of the areas. The range size is considered the area within which species occurs. Plant species were identified using a field identification key for the

Romanian flora (Ciocârlan 2009), while the nomenclature followed Plants of the World Online (2024). The identification of plant associations followed Coldea et al. (2012, 2017), and the classification of habitats according to the EUNIS system was adopted after Chytrý et al. (2020). To estimate the species rarity at the plant associations level in which they are found, we recorded individuals' total abundance and range distribution as 1 m^2 plots at each site where a species was present. To identify new areas for possible individual transplanting, we have analyzed the species' potential range based on plant association distribution at the site level in which the species occur. The compilation of the protected plants list was based on various sources, including the Red List of extinct, endangered, vulnerable, and rare vascular plants of Romania's flora (Boşcaiu et al. 1994), the Red List of rare, vulnerable, and endemic plants of Romania's flora (Dihoru & Dihoru 1994), the Red List of vascular plants of Romania's flora (Oltean et al. 1994), the Critical list of vascular plants in Romania (Oprea 2005), and the Red Book of vascular plants in Romania (Dihoru & Negrean 2009). Despite being present in high numbers in a specific quadrat, the studied species were still labeled as rare if their abundance was inconsistent across multiple relevés within areas. The maps were made using the QGIS program version 3.34.3 (QGIS Development Team 2024).

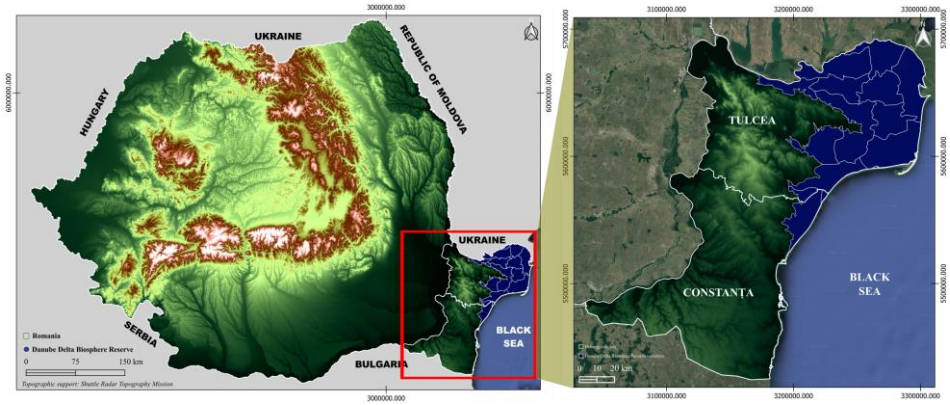

Fig. 1. Maps of the study area: a) at the national level; b) at the regional level

Results and discussion

***Colchicum soboliferum* (C. A. Mey.) Stef.** – Colchicaceae DC. [Syn. *Bulbocodium soboliferum* (C. A. Mey.) Heynh., *B. hastulatum* Friv., *Merendera sobolifera* C. A. Mey., *M. hastulata* (Friv.) Baker]

Description. *C. soboliferum* is a perennial plant (Ciocârlan 2009) with a height between 8 and 20 cm (Grințescu et al. 1966, Ciocârlan 2009). This plant has bulbotuber and underground stolons (soboli; Dihoru & Negrean 2009). The bulbotuber resulting from the previous vegetative cycle is small, obtuse, and trigonal, with a diameter between 10-15 mm, located at the base of the flower structure. It is covered in a brown tunic, present during the flowering period, with three stoloniform extensions. Two extensions are lateral and shorter (3-8 mm long), and one is medial and longer (15-30 mm long). The flowering plant is fixed subapically on the median extension, and on the lateral extensions, the sterile stems are born (Grințescu et al. 1966). In the fruiting

phase, the bulbotuber develops, generating a new generation of stoloniferous extensions. In this case, the lateral extensions bear the reserve buds, and the median extension bears subapically the renewal buds (Grințescu et al. 1966). The plant has three glabrous leaves, which appear simultaneously with the flower. These leaves are erect, have a linear-lanceolate shape, and are pointed at the tip. Their length varies between 6 and 15 cm, and the width is between 3 and 5(7) mm (Grințescu et al. 1966, Apostolova & Petrova 1997). The flowers, which can be solitary or grouped in groups of 2-3, have a shade of lilac pink. Perigonal leaflets are free, oblong-lanceolate, measuring 17 to 25 mm long. At the base, they are arrowed, having two linear auricles of 2 mm in length, placed on some thin pedicles with lengths between 3.5 and 5 cm (Grințescu et al. 1966). The stamens are 10-15 mm long, twice as short as the petals. Anthers, oblong-elliptical in shape, vary in length between 2 and 4 mm. The ovary is 2-3 mm long and has three free filamentous stylodes. The stigmas are extremely short, decurrent, almost capitate. The fruit capsule is elongated-cylindrical, having a length of 15-20 mm and a diameter of 8-10 mm. The seeds are subglobose (Grințescu et al. 1966). The species reproduce by myrmecochory (Apostolova & Petrova 1997). Myrmecochory, a form of ant-mediated seed dispersal, constitutes an essential ecological interaction for the distribution of the species. This fact and the specificity of the underground system for vegetative spread ultimately lead to the observed uneven population structure (Apostolova & Petrova 1997). Soboli, representing underground stolons of the plant, contributes to vegetative propagation and spatial dissemination over short distances, forming a network of above-ground vegetative and generative shoots. This vegetative reproduction strategy allows new individuals (clones) to form rapidly, facilitating an efficient spread in its habitat. The long-distance dispersal of seeds could be explained by epizoochory (Apostolova & Petrova 1997), the seeds carried by waterfowl. Individuals are frequently found at elevations from 800 to 2400 m in Armenia (Oganezova 2014). In Romania, the elevation is specified from 1 to 10 m.

Distribution, conservation status, ecology, and coenology. The distribution area of this species extends from the Balkan Peninsula, in South-West Asia, the Caucasus to Central Asia (Dihoru & Negrean 2009, Oganezova 2014), with the western limits located in Greece and North Macedonia. In Romania, the species was recorded in the Dobrogea region (Grințescu et al. 1966). In this region, the distribution of the species has been documented in various localities in Tulcea and Constanța counties. In Tulcea County, the species was recorded in Perișor (Ciocârlan & Sârbu 1998, Ciocârlan 2009), between the locality of Cardon and Letea Forest (Roman 1992). In Constanța County, the species was identified in Vadu (Făgăraș & Gomoiu 2002), in the area of the Cetatea Histria (Dihoru & Negrean 2009), on the grindul Lupilor (Roman 1992, Ciocârlan & Sârbu 1998, Sârbu et al. 2000), grindul Saele (Ciocârlan & Sârbu 1998, Făgăraș et al. 2000), grindul Chituc (Roman 1992, Ștefan et al. 2001), as well as in the localities of Năvodari, Corbu (Făgăraș & Gomoiu 2002) and Mamaia (Răvăruț et al. 1961). Also, the species was recorded between Tuzla Lake and Sinoe Lake (Dolțu et al. 1983), reflecting an extensive and varied distribution within the ecosystems of Dobrogea. In the DDBR, *C. soboliferum* was identified in Vadu (Constanța County), Letea, and Caraorman (Tulcea County).

The species is not evaluated at global and European levels (EEA 2024a). In Romania, the species was classified into the following categories: "Vulnerable" (Oltean et al. 1994, Boșcaiu et al. 1994) or "Endangered" (Dihoru & Dihoru 1994, Dihoru &

Negrean 2009). For the DDBR territory, the species was evaluated as "Vulnerable" (Oțel 2000). It is a toxic plant with decorative value (Dihoru & Negrean 2009). The species was recorded in the *Artemisietum santonici* (Sârbu et al. 2000), *Aperetum maritimae*, and *Limonio bellidifolii-Puccinellietum convolutae parapholietosum incurvae* associations (Ștefan et al. 2001). The main limiting factors for populations of this species are overgrazing and soil compaction. These anthropogenic actions represent significant stress sources, contributing to this species's observed global decline (Apostolova & Petrova 1997).

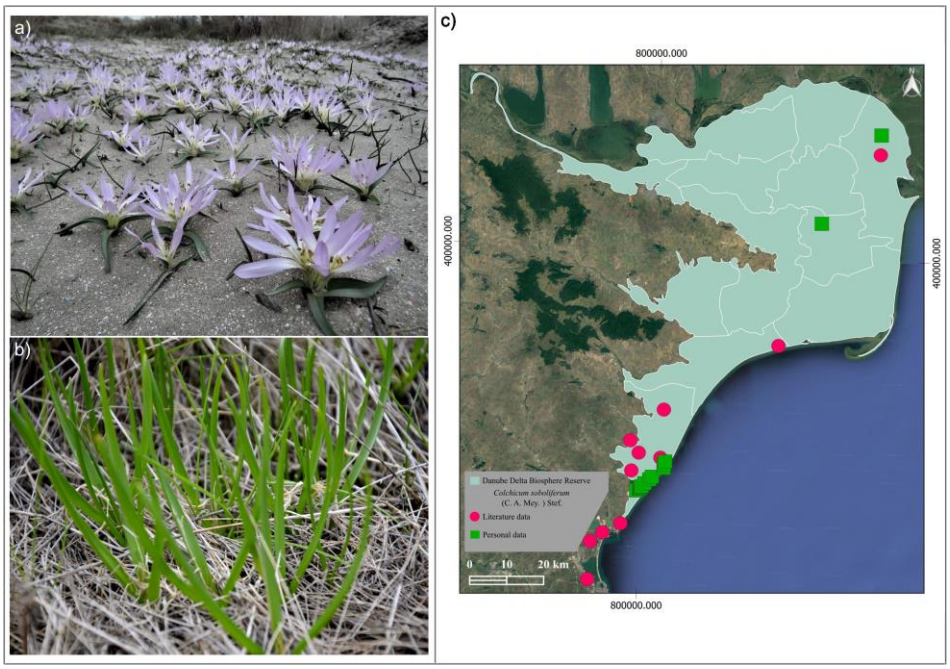

Fig. 2. *Colchicum soboliferum*: a) in the flowering stage (©Mihai Doroftei); b) in the vegetative stage (©Simona Chirilă); c) the distribution of the species in the DDBR (©Simona Chirilă).

In Vadu, the species was identified in the following associations: *Secali sylvestris-Alyssetum borzeani* (Borza 1931 n.n.) Morariu 1959, *Artemisio santonici-Juncetum maritimi* Šeljag-Sosonko et al. 2000, *Puccinellietum limosae* Magyar ex Soó 1933 subass. *elymetosum elongati* (Șerbănescu 1965) Coldea et al. 2012, *Limonio bellidifolii-Halocnemetum strobilacei* (Țopa 1939) Coldea et al. 2012, *Ephedro-Caricetum colchicae* Morariu 1959, *Agrostio maeoticae-Scirpoidetum holoschoeni* Coldea et al. 2012 subass. *aperetosum maritimae* Coldea et al. 2012. The habitat is represented by temporary wet meadows, where the soil is sandy, sometimes slightly saline. Moderate grazing or trampling the land at a reduced frequency stimulates vegetative reproduction; under these conditions, it can compete with other species. The high density of individuals in small areas can indicate stimulated vegetative reproduction. Compared with a previous monitoring period (2008-2011), on the same

sites, we observed that the population declined; overgrazing may be the leading cause since the species composition is modified. Dispersal of the species is thought to have occurred predominantly along the coasts and secondarily to inland wetlands by epizoochory – the transport of seeds via mud adhering to birds' feet.

At the site level, *C. soboliferum* was encountered in six plant communities, being framed in four Natura 2000 habitats as follows:

- 2110 Embryonic shifting dunes within the phytocoenoses of the plant ass. *Secali sylvestris-Alyssetum borzeani* (Borza 1931 n.n.) Morariu 1959 – 7 out of 33 relevés (21% of the relevés at the DDBR level and henceforward), the species is considered rare;
- 1410 Mediterranean salt meadows (*Juncetalia maritimi*) within the phytocoenoses of the plant ass. *Artemisio santonici-Juncetum maritimi* Šeljag-Sosonko et al. 2000 – 18 out of 29 relevés (62%), the species is considered frequent;
- 1530* Pannonic salt-steppes and salt-marshes within the phytocoenoses of the plant ass. *Puccinellietum limosae* Magyar ex Soó 1933 subass. *elymetosum elongati* (Șerbănescu 1965) Coldea et al. 2012 – 11 out of 35 relevés (31%), the species is considered rare, and within the phytocoenoses of the plant ass. *Limonio bellidifolii-Halocnemetum strobilacei* (Țopa 1939) Coldea et al. 2012 – 4 out of 27 relevés (14%), the species is considered sparsely;
- 2130* Fixed coastal dunes with herbaceous vegetation (grey dunes) with *Ephedro-Caricetum colchicae* Morariu 1959 – 8 out of 34 relevés (23%), the species is considered rare and *Agrostio maeoticae-Scirpoidetum holoschoeni* Coldea et al. 2012 subass. *aperetosum maritimae* Coldea et al. 2012 – 21 out of 37 relevés (56%), the species is considered frequent.

***Marsilea quadrifolia* L.** – Marsileaceae Mirb. [Syn: *Lemma quadrifolia* (L.) Desr., *Marsilea coromandelica* Burm.f., *M. europaea* Desv., *Zaluzianskia quadrifolia* (L.) Kuntze]

Description. The species *M. quadrifolia* is an aquatic, perennial plant with a height from 5 to 20 cm. The rhizome has a length between 0.5 m and 1 m, with a fixing root. The leaves are long petiolate with four leaflets. Sporocarps, formed on secondary pedicels, are elliptical, laterally flattened, and initially hairy, later becoming glabrous, horizontally oriented, and provided with two small teeth (Țopa et al. 1952, Ciocârlan 2009). This aquatic plant has two types of leaves (Țopa et al. 1952, Janiak et al. 2014): aquatic plants, with floating leaves, with a petiole; and terrestrial plants, with erect (aerial) leaves. Reproduction occurs either sexually, i.e., through sporocarps and the release of micro and megaspores (Schneider & Pryer 2002), or vegetative reproduction, i.e., through rhizomes (Schmidt 1978, Corli et al. 2021a).

Distribution, conservation status, ecology, and coenology. *M. quadrifolia* is native to Eurasia, distributed in south-central Europe, and extends from Eurasia to tropical and temperate areas of eastern Asia and North America (Benson et al. 2004, Corli et al. 2021a). In Romania, the species was mentioned in different localities (Țopa et al. 1952) from Crișana, Oltenia, Banat, Muntenia, Transylvania, and Dobrogea (Schneider-Binder 2014). In Dobrogea, the species was recorded in Tulcea County, at Sulina (Panțu et al. 1935), Rusca channel (Sârbu 2003), and Obretin. In DBRR, the species was identified at Mila 28 in the Rusca channel, Sf. Gheorghe, Vulturu, Mila 26, and Sulina (Tulcea County).

Globally, the species is included in the "Least Concern" category (Gupta 2011). At the European level, it is included in the "Vulnerable" category (Christenhusz et al. 2017), and at the European Union level, the species is included in the "Near Threatened" category (EEA 2024b). In Romania, the species is considered "Vulnerable" (Oltean et al. 1994, Dihoru & Dihoru 1994, Witkowski et al. 2003, Oprea 2005) or "Endangered" (Boșcaiu et al. 1994). For the DDBR territory, the species was considered "Vulnerable" (Oțel 2000). *M. qudrifolia* grows in various natural and artificial habitats (Hulina 1993). These habitats include the edges of ponds, lakes or rivers (Johnson 1986), standing water (Strat 2012), temporary ponds (Corli et al. 2021b) with fish (Schneider-Binder 2014), freshwater (Bolqvadze et al. 2016), artificial lakes (Conti et al. 1992), rivers (Corli et al. 2021b), marshes (Ciocârlan 2009), etc. The critical low-temperature threshold for its growth is -30 °C (Janiak et al. 2014). The soils in which the species grows are muddy, clay-sandy, or sandy (Oberdorfer 2001), but they also grow in marshy soils, rich in organic matter (Dehondt et al. 2005), etc. The decline of the species *M. qudrifolia* was caused by human activities (Corli et al. 2021a). These activities determine the loss and degradation of habitats (Schneider-Binder 2014). The systematic use of herbicides has led to a dramatic decline of *M. quadrifolia* in European Mediterranean countries (Corli et al. 2021b). Eutrophication and water pollution are other causes of the decline of the species' populations (Schneider-Binder 2014, Corli et al. 2021a). In the Rusca area, specifically at Mila 28, the population ceased to exist due to the weedicide used on site. However, we managed to transplant individuals to various sites near the current ones (Litcov channel, Sulina, Maliuc, Letea); in the same plant communities, a much lower number of specimens were found, and the number of individuals was stable. The sites are under five-year observation. At Vai de Ei, Mila 26, the species covered a large part of the area where the species was found. Also, various temporary constructions were set up at Sulina, where the species is present, thus destroying 40% of the surface. *M. quadrifolia* was identified in Vulturu, Sf. Gheorghe, and Sulina (Tulcea County). It was observed that the taxon is rare in terms of phytocoenotic affinity and was identified in the following associations: *Artemisio santonici-Juncetum maritimi* Šeljag-Sosonko et al. 2000, *Typhetum angustifoliae* Pign. 1953, *Pulicario vulgaris-Menthetum pulegii* Slavnić 1951, *Scirpo-Phragmitetum* W. Koch 1926, *Limosello-Eleocharitetum acicularis* Wendelberg-Zelinka 1952. At local level, the invasive species *Elodea nuttallii* (Planch.) H. St. John and *Paspalum distichum* L. replace *M. quadrifolia*. Limiting factors for the species' survival include the application of agricultural chemicals. These chemicals can adversely affect the growth and development of the species. Also, the unclogging operations contribute to modifying the *M. quadrifolia* habitat. The soil material resulting from these processes is often deposited on the banks, including where this species is found, which can disturb the natural balance of the area and the availability of living space for plants. Another important limiting factor is the desiccation of the habitat by lowering the water table, a condition that directly affects *M. quadrifolia*, a species adapted to humid environments. Falling water levels can significantly reduce the area available for this fern to grow, thus limiting its ability to reproduce and survive.

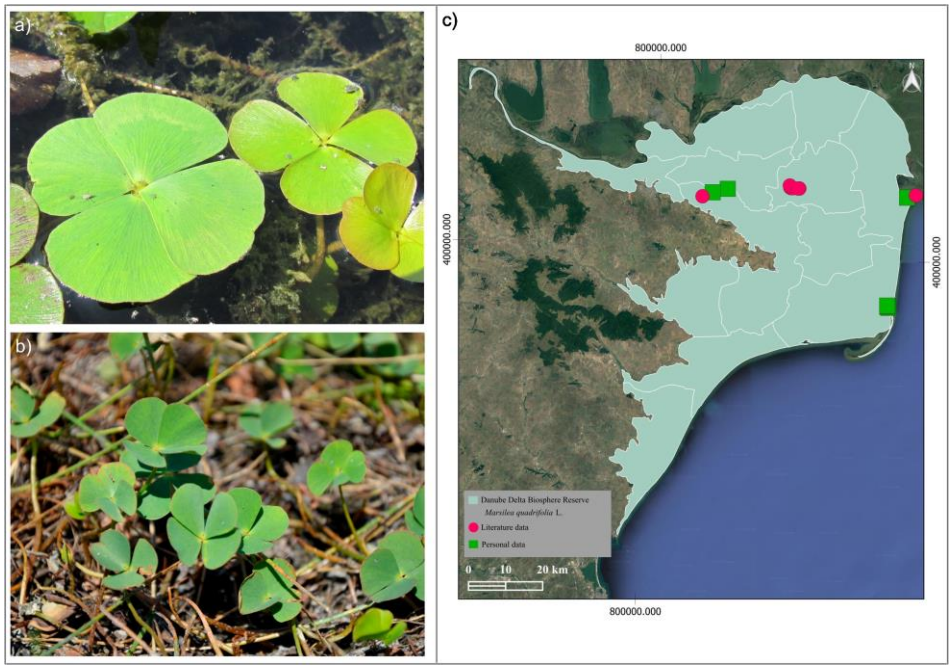

Fig. 3. *Marsilea quadrifolia*: a) leaves – detail (©Mihai Doroftei); b) leaves – habitus (©Simona Chirilă); c) the distribution of the species in the DDBR (©Simona Chirilă).

At the site level, *M. quadrifolia* was encountered in two plant communities, being framed in two Natura 2000 habitats as follows:

- 1410 Mediterranean salt meadows (*Juncetalia maritimi*) with *Artemisio santonici-Juncetum maritimi* Šeljag-Sosonko et al. 2000 – 22 out of 30 relevés (73%), the species is considered frequent;
- 3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or *Isoëto-Nanojuncetea* with *Limosello-Eleocharitetum acicularis* Wendelberg-Zelinka 1952 – 8 out of 21 relevés (38%) the species is considered rare.

Other plant communities that do not correspond to a Natura 2000 habitat are *Typhetum angustifoliae* Pign. 1953 – 10 out of 38 relevés (26%), *Pulicario vulgaris-Menthetum pulegii* Slavnić 1951 – 4 out of 16 relevés (25%) and *Scirpo-Phragmitetum* W. Koch 1926 – 9 out of 41 relevés (21%), the species is considered rare.

***Trapa natans* var. *natans* L.** – Lythraceae J. St.-Hil. [Syn: *Trapa muzzanensis* Jäggi]

Description. *T. natans* var. *natans* is an annual aquatic species with a length from 0.5 to 1 m. The flowers are white, and the sepals thicken after flowering and turn into thorns. Two types of leaves can be distinguished on the submerged stem: petiolate floating leaves with rhombic lamina and swollen petiole, arranged in a rosette, and submerged, sessile, opposite, pectinate-sectate leaves. In the axils of emerging leaves, bisexual, solitary flowers with white petals develop (Ţopa et al. 1957, Ciocârlan 2009). The fruit shows between the 4 horns and 4 prominent tubercules (Ciocârlan 2009,

Sinjushin 2018). The crown of the fruit is well developed, deep, and has an obvious neck (Sârbu et al. 2013).

Distribution, conservation status, ecology, and coenology. Globally, the species is distributed in Eastern Europe (Ciocârlan 2011) and South Asia (Frey et al. 2017). In Romania, the species was recorded in Dobrogea, Tulcea County (Sârbu et al. 2013). For the DDBR territory, the species was recorded at Mila 36 (Ciocârlan 2001) and Mila 23 (Fig. 4). Among the factors restricting its distribution, the dredging activities stand out prominently. The material generated from dredging is frequently deposited along the banks where this species exists. Such actions can adversely impact the plant's natural habitat, leading to disturbances in the ecological equilibrium of the area. It was observed that the taxon is rare in terms of phytocoenotic affinity and was identified in the following associations: *Nymphaeetum albo-candidae* (Hejny 1950) Passarge 1957 subass. *nymphaeetosum candidae* Ștefan et al. 1997, *Trapo-Nymphoidetum* Oberd. 1957 and *Trapetum natantis* V. Kárpáti 1963.

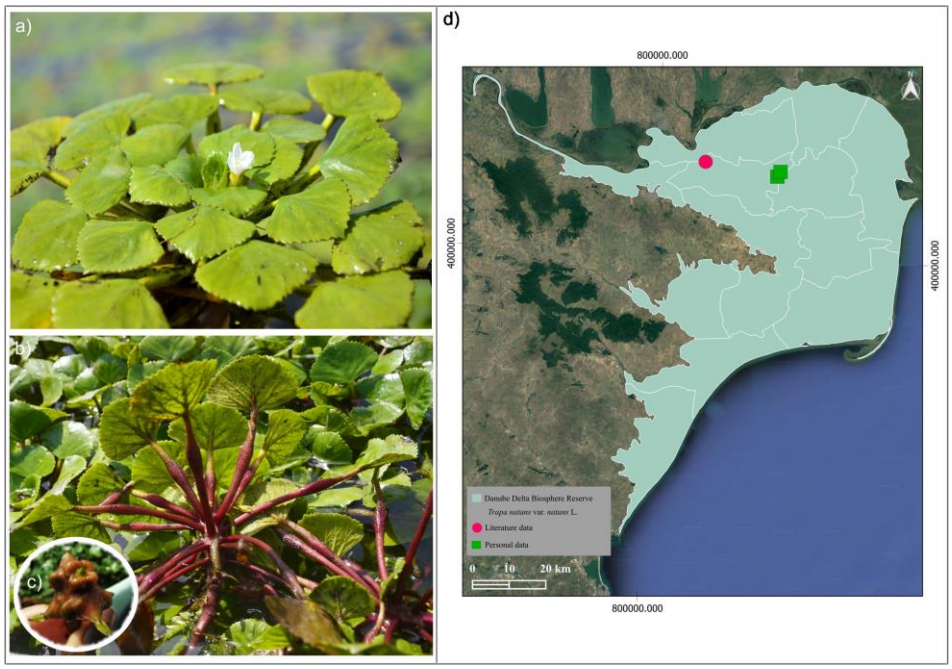

Fig. 4. *Trapa natans* var. *natans*: a) in the flowering stage; b) leaves and petiole; c) fruit – spiny horns and prominent tubercules in them; d) the distribution of the species in the DDBR (©Simona Chirilă).

At the site level, *T. natans* var. *natans* occurs in three plant communities belonging to Natura 2000 habitat 3160 Natural dystrophic lakes and ponds: *Nymphaeetum albo-candidae* (Hejny 1950) Passarge 1957 subass. *nymphaeetosum candidae* Ștefan et al. 1997 plant community – 12 out of 29 relevés (41%), the species is constantly present; *Trapo-Nymphoidetum* Oberd. 1957 – 19 out of 36 relevés (52%), the

species is considered frequent; *Trapetum natantis* V. Kárpáti 1963 – 6 out of 28 relevés (21%), the species is considered rare.

Conclusions

The analyzed taxa are rare for the Danube Delta Biosphere Reserve territory. These species demonstrate remarkable adaptability to their specific environments. Dispersal mechanisms such as myrmecochory and epizoochory are essential in their geographic distribution. Human activities, including tourism development, intensive agriculture, grazing, soil compaction, and non-native species, pose significant threats to the survival of the species. Conservation of the species requires concrete actions, such as protecting and restoring habitats, controlling invasive species, limiting the impact of human activities, and, in specific cases, transplanting individuals to safer habitats.

C. soboliferum is considered rare in the associations *Secali sylvestris-Alyssetum borzeani*, *Limonio bellidifolii-Halocnemetum strobilacei*, and *Ephedro-Caricetum colchicae*, and *Puccinellietum limosae* subass. *elymetosum elongati*, and frequent in the associations *Artemisio santonici-Juncetum maritimi* and *Agrostio maeoticae-Scirpoidetum holoschoeni* subass. *aperetosum maritimae*.

M. quadrifolia is considered rare in the associations *Typhetum angustifoliae*, *Pulicario vulgaris-Menthetum pulegii*, and *Scirpo-Phragmitetum*, and frequent in the association *Artemisio santonici-Juncetum maritimi*.

T. natans var. *natans* is considered rare in the associations *Trapetum natantis* and *Nymphaeetum albo-candidae* subass. *nymphaetosum candidae*, and frequent in the *Trapo-Nymphoidetum* association.

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Table 1. Summary of the taxa phytocoenotic affinities and population status in DDBR

Natura 2000 habitats cover (%) in DDBR	Plant community	Phytocoenotic affinitiy	GPS coordinates	Average no. of individuals per m²	Limiting factors	Populati on status	Sites	Habitat cover in DDBR (%)
Colchicum soboliferum								
1410 Mediterranean salt meadows (*Juncetalia maritimi*)	*Artemisio santonici-Juncetum maritimi*	62%	44.264177 28.450189	89	Overgrazing, vegetation trampling	Stable	Vadu	0.808
1530* Pannonic salt steppes and salt-marshes	*Puccinellietum limosae* subass. *elymetosum elongati*	31%	44.265462 28.451797	61		Decreasing		0.029
	Limonio bellidifolii-Halocnemetum strobilacei	14%	44.271039 28.451642	20				
2110 Embryonic shifting dunes	*Secali sylvestris-Alyssetum borzeani*	21%	45.015572 29.234992	42	Other plant species' competitors		Caraorman	0.182
			45.195354 29.301672	38		Stable	Letea	
			44.454444 28.771663	140	Overgrazing, vegetation trampling		Vadu	
			44.321274 28.454826	18			Histria	
2130* Fixed coastal dunes with herbaceous	*Ephedro-Caricetum colchicae*	23%	45.025498 29.231231	36	Other plant species' competitors		Caraorman	0.626

Natura 2000 habitats cover (%) in DDBR	Plant community	Phytocoenotic affinitiy	GPS coordinates	Average no. of individuals per m^2	Limiting factors	Population status	Sites	Habitat cover in DDBR (%)
vegetation (grey dunes)			45.231802 29.314916	28		Stable	Letea	
			44.275303 28.475321	121		Decreasing	Vadu	
	Agrostio maeoticae-Scirpoidetum holoschoeni - aperetosum maritimae	56%	44.294370 28.483090	136	Overgrazing, vegetation trampling	Stable	Vadu	
Marsilea quadrifolia								
1410 Mediterranean salt meadows (*Juncetalia maritimi*)	*Artemisio santonici-Juncetum maritimi*	73%	44.892400 29.605372	281	Drying of the area by lowering the water level where the *Marsilea quadrifolia* species grows	Stable	Sf. Gheorghe	0.808
3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and *Isoëto-Nanojuncetea*	*Limosello-Eleocharitetum acicularis*	38%	45.168542 29.012608	92	Unclogging, the material from unclogging is deposited on the river bank where the species exists.	Decreasing	Vulturu	0.008

Natura 2000 habitats cover (%) in DDBR	**Plant community**	**Phytocoenotic affinitiy**	**GPS coordinates**	**Average no. of individuals per m²**	**Limiting factors**	**Populati on status**	**Sites**	**Habitat cover in DDBR (%)**
-	*Scirpo-Phragmitetum*	21%	45.100521 29.005852	88	Spraying with chemicals from agriculture		Mila 28	
-	*Typhetum angustifoliae*	26%	45.103674 29.034909	31	Replaced by the invasive species *Elodea canadensis* and *Paspalulm paspalodes*		Mila 26	
-	*Pulicario vulgaris-Menthetum pulegii*	25%	45.155667 29.668681	139	Unclogging, the material from unclogging is deposited on the river bank where the species exists.		Sulina	
Trapa natans var. *natans*								
3160 Natural dystrophic lakes and ponds	*Nymphaeetum albo-candidae* subass. *nymphaeetosum candidae*	41%	45.130704 29.135216	6	Unclogging, the material from the unclogging is deposited on the shore where the species exists	Decreasing	Mila 23	0.944
	Trapo-Nymphoidetum	52%	45.125141 29.135642	11				
	Trapetum natantis	21%	45.218047 29.229717	9				

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