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## Contribution to a new vascular flora of Sardinia (Italy): I (1-30)

### Abstract

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In the context of creating a new, updated, and revised vascular flora of Sardinia, this work contributes new data on the distribution of various taxa in the island. These include both native and alien taxa, which are characterized by their rarity, limited recognition, phytogeographical significance, potential issues, or novelty to Sardinia. These updates mostly result from floristic research primarily conducted in north Sardinia, with several discoveries in other sectors of the island. The first report of *Convolvulus sabatius* subsp. *mauritanicus*, *Cyperus brevifolioides* (naturalized) and *Brachychiton populneus* (casual alien) in Sardinia is documented here. Moreover, this study includes new distributional data for 27 taxa, some of which required confirmation. Notably, *Trifolium clusii*, previously considered doubtful in recent years, along with *Fuirena pubescens* and *Silene inaperta*, which were indicated for the southern part of Sardinia over thirty years ago and have not been reported elsewhere since. For others, an expansion or a better definition of their distribution range within the island is documented, as in the case of *Chloris gayana*, *Digitaria ciliaris*, *Eragrostis curvula*, *Paraserianthes lophantha*, *Sporobolus indicus* (naturalized alien species), *Asparagus asparagoides*, *Cenchrus setaceus*, *Eclipta prostrata*, *Halophila stipulacea* (invasive alien species), *Allium sardoum*, *A. savii*, *Anthyllis barba-jovis*, *Asplenium marinum*, *Bellevalia romana*, *Butomus umbellatus*, *Cladium mariscus*, *Dianthus sardous*, *Dysphania botrys*, *Jacobaea maritima* subsp. *maritima*, *Leersia oryzoides*, *Nepeta foliosa*, *Nuphar lutea*, *Spirodela polyrrhiza*, *Utricularia australis* (rare native).

*Key words:* Alien Species, Mediterranean vascular flora, Rare Plants, Sardinia, Tyrrhenian islands.

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### Introduction

Sardinia (Italy), with an area of 24,090 km, is the second-largest island in the Mediterranean Basin. It is located in the center of the western Mediterranean area and is part of the Cyrno-Sardinian biogeographic province, with Corsica and the Tuscan Archipelago (Bacchetta & al. 2012, 2013). The island falls within the Italo-Tyrrhenian

Superprovince (Ladero-Álvarez 1987; Bacchetta & al. 2013) and has been divided into six biogeographic sectors and 22 subsectors (Fenu & al. 2014).

Geologically, Sardinia is rather diverse (Carmignani & al. 2016), and its climate is typically Mediterranean (Bacchetta & al. 2009), though two macro-bioclimates, seven thermometric belts, and 43 isobioclimates were recognised by Canu & al. (2015). Despite not having towering mountains, with Punta La Marmora (Gennargentu Massif) rising to 1,834 m, the island is characterized by a coastline more than 1,900 km long (Ginesu & al. 2016) and has a high variety of environments that allow the presence of many vegetational typologies (Bacchetta & al. 2009).

According to the most recent checklists, the Sardinian vascular flora is represented by 2,330 native taxa (including cryptogenic ones), with an additional 108 archaeophytes and 412 neophytes, resulting in a total of 2,963 taxa, including casual alien ones (Bartolucci & al. 2021).

As part of research efforts aimed at expanding the floristic knowledge of Sardinia, several taxa new to the Sardinian flora and/or rare, little known and of particular phytogeographic interest have been discovered, along with various alien taxa deserving to be monitored. These investigations comprehensively covered the entire island territory, although this contribution specifically focuses on the Turritano, Logudorese, Gallurese and Baronico biogeographic subsectors, encompassing the northernmost portion of the region. (Fenu & al. 2014).

Floristic research in Sardinia began in the early 19<sup>th</sup> century when botanists, notably Moris, undertook botanical expeditions in the then Kingdom of Sardinia, compiling the first lists of plant species on the island (Moris 1827, 1837-1859). Subsequently, new botanical explorations, descriptions, and findings were conducted by numerous other botanists during their travels to various locations in the regional territory. These contributions were later consolidated into floras or floristic lists by authors such as Parlatore (1848-1875), Barbey (1884), and Fiori (1923-1929).

Further floristic updates occurred between the late 19<sup>th</sup> century and the early 20<sup>th</sup> century, thanks to the contributions of various authors, including Nicotra (1896), Terracciano (e.g., 1909), Negodi (1931), and Schmid (1933). From the mid-20<sup>th</sup> century, numerous more comprehensive floras were compiled for specific areas, especially coastal or mountainous zones (e.g., Desole 1960; De Marco & Mossa 1974; Veri & Bruno 1974; Camarda 1984; Bocchieri 1996; Mossa & al. 1996).

In the early 21<sup>st</sup> century, a project for a complete flora of the island was complemented by Arrigoni (2006-2015). Concurrently and more recently, other floristic contributions have been made, encompassing specific categories of taxa and introducing new reports to the flora of Sardinia (e.g. Bacchetta & al. 2007; Desfayes 2008; Podda & al. 2012; Puddu & al. 2016; Bartolucci & al. 2019, 2020; Galasso & al. 2018b, 2019, 2022, 2023a, 2023b; Fois & al. 2022).

However, floristic knowledge concerning the island of Sardinia is far from complete, and new findings and updates continue to be made from north to south, necessitating ongoing revisions of their occurrences, distributions, and the communities they form. In this first contribution, we present the findings of newly discovered taxa for the island, offering a more precise definition of the distributional data for various native taxa of particular phytogeographic interest. Additionally, we highlight alien taxa that merit future monitoring. Furthermore, our report includes information on the rarity and threats faced by the native

taxa documented here, along with a revision of the invasiveness status for the mentioned alien taxa on the island.

## Materials and method

This work is based on extensive plant collections made by the authors in Sardinia between 2001 and 2023, together with a bibliographic and herbarium revision. The field research, which has engaged the authors for several years and still does, was followed by the study of numerous herbarium samples and extensive bibliographic material. Plants were identified using Italian and European floras (Tutin & al. 1964-80, 1993; Pignatti 1982; Castroviejo & al. 1986-2015; Arrigoni 2006-2015; Jeanmonod & Gamisans 2013; Tison & De Foucault 2014; Pignatti & al. 2017-2019) and monographs, as for the genus *Utricularia* (Taylor 1989).

The status of each alien species was determined and ordered on the basis of the criteria proposed by Richardson & al. (2000), elaborated by Pyšek & al. (2004) and reviewed according to Richardson & al. (2011). Archaeophyte and neophyte taxa were differentiated depending on their introduction before or after 1492/1500, respectively.

The list of taxa follows the systematic classification of Pignatti & al. (2017-2019), while the nomenclature is derived from Bartolucci & al. (2018) and Galasso & al. (2018a). Herbarium specimens are preserved in personal herbaria of some authors (Herbarium Ruggero, Herb. Calvia, Herb. Mascia, Herb. Manca) and in the CAG and SS herbaria. Acronyms follow Thiers (2024).

## Native taxa

### *Allium sardoum* Moris (*Amaryllidaceae*)

Distribution update

Findings: Oschiri (Sassari) lago Coghinas, in loc. Mandras (40.760403°N - 9.068523°E). Luoghi aridi, rocce. 165-180 m. 23-06-2008, *G. Calvia* (Herb. Calvia); Berchidda (Sassari) SP138 a Canale Longu (40.833548°N - 9.242113°E). Luoghi aridi sabbiosi. 400-450 m. 17-07-2010, *G. Calvia* (Herb. Calvia); Oschiri (Sassari) Sigalesa, lago Coghinas (40.738829°N - 9.060062°E), pascolo. 28-07-2019, *A. Ruggero* (Herb. Ruggero).

Observations: *Allium sardoum* is a narrow Mediterranean species found in the Iberian Peninsula, Provence, Italy, the Balkan countries, Greece, Turkey, Morocco, Algeria, Tunisia, and Libya (POWO 2024). In Italy, it is known in Latium, Apulia, Basilicata, Sicily, and Sardinia, while it is not confirmed in Campania, erroneously reported in Veneto and Molise, and uncertain in Calabria (Bartolucci & al. 2018; Conti & al. 2023). Moris (1827) described the species based on material from Mandas (province of Sud Sardegna), along the route from San Nicolò d'Arcidano (Oristano) to Aritzo (Nuoro). Later, the species was reported in the territory of Oliena (Nuoro) (Martinoli 1955; Garbari 1976). Additional data came from Santadi (Sud Sardegna) (Bacchetta 2006), Sassari and Oschiri (Sassari) (Arrigoni 2015), Anela (Sassari) (Farris & al. 2018), and

Monte Limbara (Calvia & Ruggero 2020). This last report, was referred to findings in Calangianus (Sassari) and Berchidda (SS) sides, and near the northern shores of Lake Coghinas (Oschiri). To this information, we add findings from the plain of Riu Mannu of Berchidda, along with other sites close to Lake Coghinas (Oschiri, Tula - Sassari). Additionally, we confirm its presence near Oschiri (updated distribution in Fig. 1).

Rarity and threats: the species is likely more frequent than currently recognized. Some populations appear to be conspicuous, but threats like wildfires and human activities (e.g. roadworks, building sites and agricultural works) pose concern about the local durability of the species. To address these concerns, *ex situ* actions are needed.

***Allium savii* Parl. (Amaryllidaceae)**

Distribution update

Findings: Berchidda (Sassari) Riu Mannu in loc. Sas Rujas (40.757918°N - 9.142945°E).

Pozze a ristagno temporaneo nei cespugli di *Polygonum scoparium*. 03-08-2008, *G. Calvia* (Herb. Calvia); Berchidda (Sassari) Riu Mannu in loc. San Marco (40.762457°N - 9.137794°E). Prati umidi. 29-08-2021, *G. Calvia* (Herb. Calvia); Chiaramonti/Ploaghe (Sassari) loc. S'Ena 'e Gorzi-Santa Giusta (40.706678°N - 8.796708°E). Pendii umidi su substrati ad alta rocciosità. 26-08-2023, *F. Mascia* (Herb. Mascia); Nulvi (Sassari) loc. Piana Ederas (40.815097°N - 8.767339°E). depressioni stagionalmente allagate ai margini della sughereta, con *Eryngium barrelieri*. 26-08-2023, *F. Mascia* (Herb. Mascia).

Observations: this species is an endemic of the western Mediterranean biogeographic region, confined to Minorca (Fraga 2002), Provence (Tison & al. 2014), Corsica (Delage & Hugot 2020), peninsular Italy (Emilia-Romagna, Tuscany, Latium), and Sardinia (Bartolucci & al. 2018). Based on bibliographic data, the species appears to be highly rare across much of its range, with a larger number of populations known only in Corsica (Delage & Hugot 2020). Knowledge about its distribution in Sardinia was limited to a few high hilly or sub-mountainous areas of the central and central-southern sectors (Aritzo and Campeda, Nuoro; Laconi, Oristano; Mandas, Sud Sardegna - Brullo & al. 1994; Arrigoni 2015a).

The populations here reported are situated in north Sardinia, in the municipalities of Berchidda, Chiaramonti, Nulvi and Ploaghe (Sassari), where the species grows in wet meadows, humid slopes, temporary stagnant wetlands and puddles, from 165 to 450 m a.s.l. (Fig. 1).

Rarity and threats: in Sardinia, this species is currently known from less than 15 sites, with an occupancy area often limited to a few square meters. Heatwaves and extreme droughts can represent a serious threat for the species. *In situ* and *ex situ* conservation actions are needed and the species should be evaluated for a regional assessment according to IUCN criteria.

***Anthyllis barba-jovis* L. (Fabaceae)**

Distribution update

Findings: Arzachena (Sassari) Pevero (41.112025°N - 9.547843°E). Bordo superiore della spiaggia. 05-04-1999, *A. Ruggero* (Herb. Ruggero); Trinità d'Agultu (Sassari) presso Li Cossi (41.049646°N - 8.937925°E). Tra le rocce. 09-04-2017, leg. *A. Ruggero*, *A. Di Giacomo*, *G. Calvia*, det. *A. Ruggero* (Herb. Ruggero).

Observations: this species is native in the central-western Mediterranean, encompassing southern France, Corsica, Italy, Sardinia, Sicily, Balkan Countries, Algeria and Tunisia (Barina & al. 2013; Terzi & al. 2020; Delage & Hugot 2020; POWO 2024). It is acknowledged as naturalized in Spain, Libya, and Australia (Castroviejo 2000; POWO 2024). The populations in Greece are presently classified under *A. splendens* Willd. (Dimopoulos & al. 2013). The species distribution in Italy is confined to the Tyrrhenian regions (Tuscany, Latium, Campania, Calabria, Sardinia and Sicily), and to a few spots in Apulia (Bartolucci & al. 2018; Pignatti & al. 2017-2019).

In Sardinia, the species is documented in scattered sites in the northern part of the island, such as the calcareous promontories of Capo Figari (Golfo Aranci, Sassari), where it was first collected by Lisa in 1840, and Capo Caccia (Alghero, Sassari) (Camarda & Valsecchi 2008). On granitic substrates at La Maddalena Archipelago (Sassari) on the Islands of Budelli, Italiani central islet and Santa Maria (Bocchieri 1992; Biondi & Brugiapaglia 1995; Bocchieri 1996; Arrigoni 2010b). Finally, other populations were recorded on the dune system of Pevero Beach (Arzachena, Sassari - Trainito 2009) and on the islet Le Rocche (Arzachena - Bocchieri 1996; Trainito 2009). This study confirms the species' presence in all previously known sites, with special emphasis on Capo Figari, which received confirmation after 184 years without official verification. We also identified the species on the neighboring islet of Figarolo. Furthermore, we document a new growing station on the northern coast of Sardinia, in granitic rocky areas along the path leading from Costa Paradiso to Li Cossi Beach (Trinità d'Agultu, Sassari) (Fig. 2).

Rarity and threats: the species is often scattered and represented by only a few individuals. The population at Capo Figari was nearly entirely destroyed by a wildfire in June 2013. Other populations face threats from tourism activities (e.g. enlargement or creation of new paths, trampling) and local issues related to browsing. *In situ* and *ex situ* actions are needed and the species should be evaluated for a regional assessment according to IUCN criteria.

### *Asplenium marinum* L. (*Aspleniaceae*)

#### Distribution update

Findings: Santa Teresa G. (Sassari) Capo Testa (41.242935°N - 9.143344°E). Sotto sporgenza in arenaria, tra i graniti, presso il mare, 16-02-2002, leg. *A. Ruggero*, *A. Di Giacomo*, det. *A. Ruggero* (Herb. Ruggero); Santa Teresa G. (Sassari) Capo Testa (41.243625°N - 9.142512°E), *G. Bacchetta* (CAG); Isola di Razzoli (Sassari) (41.300633°N - 9.340859°E). Anfratti rocciosi direttamente esposti all'aerosol marino, esposizione S-SE, 3 m s.l.m. 09-05-2023, *F. Mascia* (Herb. Mascia).

Observations: this species exhibits a scattered distribution in several European countries, Morocco and Algeria (Pichi Sermolli 1979). In Italy, it is known from a few localities in Tuscany (Capraia and Elba), Latium (Circeo promontory), Apulia (Gagliano del Capo near Grotta Grande del Ciolo, Gallipoli and Taranto), Sicily (Pantelleria Island) and Sardinia (Beccarisi & al. 2001; Marchetti 2004; Bartolucci & al. 2018; Bartoli & al. 2021; Rizzo 2021).

In Sardinia, the species is known from a few sites: Capo Testa (Santa Teresa Gallura, Sassari), La Maddalena Archipelago (La Maddalena, Caprera, Spargi and Spargiotto) in

the northern part, Cagliari(?) and Isola dei Cavoli (Villasimius, Sud Sardegna) in the southern part (Barbey 1884; Mossa & Tamponi 1978; Marchetti 1999; Arrigoni 2006). The first report of the species in Sardinia is due to Moris (1827), who discovered it on the eastern coast. Subsequent researchers did not confirm the species in that part of the island.

In this study, we confirm the survival of the Capo Testa population, also noting its presence in a second small site near Santa Teresa, beneath the Aragon tower, on crevices of granitic coastal cliffs. Additionally, we discovered a small growing station on trachyte coastal cliffs east of Cala Ostina beach, near Castelsardo (Sassari). Moreover, we add a new island of La Maddalena Archipelago, namely Razzoli, to those where the species grows (Fig. 1).

Rarity and threats: the species is very rare in Sardinia, mostly consisting of only a few individuals per site. Some of these sites face threats from tourism activities, particularly climbing on the crevices of Capo Testa. Hence, *in situ* actions are needed and the species should be evaluated for a regional assessment according to IUCN criteria.

***Bellevalia romana*** (L.) Sweet (*Asparagaceae*)

Distribution update

Findings: Berchidda (Sassari) Sa Tanca ‘e Su Re (40.778751°N - 9.174679°E). Incolti, cigli stradali. 200-230 m. 15-03-2010, *G. Calvia* (Herb. Calvia); San Giovanni Suergiu (Sud Sardegna) Matzaccara (39.110418°N - 8.483537°E). Luoghi umidi lungo la strada. 16-03-2014, *G. Calvia* (Herb. Calvia); Oschiri (Sassari) lago Coghinas in loc. Su Campu (40.700126°N - 9.042805°E). Prati umidi. 165 m s.l.m. 14-04-2014, *G. Calvia* (Herb. Calvia); Villanovaforru (Sud Sardegna) loc. Acqua Frida (39.626083°N - 873707°E). Margini di seminativi a cereali, 12-03-2021, *F. Mascia* (Herb. Mascia); Elmas (Cagliari) loc. Santa Caterina (39.260540°N - 9.051359°E). Pascoli sub-nitrofilii. 28-02-2023, *F. Mascia* (Herb. Mascia)

Observations: the species has a central-eastern Mediterranean distribution, limited to Provence, Corsica, Italy, the Balkan countries, Greece, and Egypt (Boulos 2000; Delage & Hugot 2020; POWO 2024). In Italy, it is present in almost all regions, excepted Val d’Aosta and Piedmont (where it was mistakenly reported, Bartolucci & al. 2018).

Its presence in Sardinia has been relatively recently reported, mostly in relation to coastal areas: San Teodoro (Sassari) (Chiesura Lorenzoni & Lorenzoni 1984), La Maddalena (Cesaraccio 1990), Santa Gilla and Molentargius (Cagliari) (Ballero 1995), around Olbia, and in Oristanese (Arrigoni 2015a). New findings came from Berchidda (Calvia & Ruggero 2020). We added here our new findings from Lake Coghinas (Oschiri), Villanovaforru (Sud Sardegna), Elmas (Cagliari) and Matzaccara (San Giovanni Suergiu, Sud Sardegna) (Fig. 1).

Rarity and threats: the species is often poor in individuals. The plants commonly grow on meadows and grasslands that are occasionally subject to trampling, mowing, grazing and human activities like roadworks and hydraulic works. *Ex situ* actions are needed, and the species should be evaluated for a regional assessment according to IUCN criteria.

***Butomus umbellatus*** L. (*Butomaceae*)

Distribution update

Findings: Oschiri (SS) lago Coghinas, Frassu (40.725127°N - 9.022648°E). Prati umidi presso le sponde lacustri. 164 m s.l.m. 22-05-2011, leg. *G. Calvia*, *A. Manca*, det. *G. Calvia* (Herb. Calvia); Mores (SS) Riu Mannu a monte della stazione (40.546325°N - 8.880101°E): Flora ripariale. 200 m s.l.m. 10-08-2011, *G. Calvia* (Herb. Calvia); Norbello (OR) Rio a valle delle cascate di Liune (40.156851°N - 8.820299°E). *G. Bacchetta* (CAG).

Observations: this Euro-Siberian species, found in various regions of Europe and invasive in North America (Gaskin & al. 2021), in its native area is often considered rather rare and locally CR (critically endangered) due to habitat reduction, as seen in Trentino (Prosser & al. 2020).

Its presence in Sardinia was first reported by Moris (1827) near Decimomannu and Bosa, in slowly flowing waters (presumably Riu Mannu and Temo River). Later, the species was recorded at Santa Gilla Pond and near Assemini (Cagliari), at the mouth of Rio Gutturu Mannu, along Rio Cixerri, near Uta (Cagliari), and on the canals of Oristanese (De Martis & al. 1984; Bacchetta 2006; Arrigoni 2006). The occurrence of the species along Riu Mannu and Rio Cixerri is here confirmed.

In north Sardinia, specifically in the Coghinas catchment basin, the species is sporadically spread along Riu Mannu of Ittireddu, Mores and Ozieri (Sassari), as part of the riparian helophytic and bankside flora. On the shores of Lake Coghinas, a station was found along a small stream. Another population was recently found in a small stream of central Sardinia, in the municipality of Norbello (Oristano) (Fig. 1).

Rarity and threats: the species is quite rare and faces competition from other taxa, such as *Phragmites australis* (Cav.) Trin. ex Steud. In addition, alien species, such as the red swamp crayfish (*Procambarus clarkii*) and the coypu (*Myocastor coypus*), represent a threat for some populations. The collection of its flowers has also been observed, along with grazing and habitat reduction due to roadworks and bonification. *In situ* and *ex situ* actions are needed and the species should be evaluated for a regional assessment according to IUCN criteria.

### ***Cladium mariscus* (L.) Pohl (Cyperaceae)**

Distribution update

Findings: Berchidda (Sassari) Rio Badu Pedrosu (40.750995°N - 210942°E). Flora ripariale, 200-205 m s.l.m. 31-08-2020, *G. Calvia* (Herb. Calvia); Oschiri (Sassari) versanti occidentali dell'altopiano di Balascia, in loc. Sarra Niedda (40:803761°N - 9.042337°E). Zone umide (tre nuclei lungo il sentiero), 450 m s.l.m. 02-07-2022, *G. Calvia* (Herb. Calvia).

Observations: this sub-cosmopolitan species grows spontaneously across all continents and is considered native throughout Europe (POWO 2024). In Italy, despite being known in all regions, it is considered rather rare (Pignatti & al. 2017-2019) and is occasionally included in regional IUCN red lists, even classified as EN (endangered), as in Trentino (Prosser & al. 2020).

Knowledge about its presence in Sardinia was limited to a few coastal river mouths or ponds, such as Platamona (Porto Torres, Sassari, Sorso - Chiappini 1963), Rio Li Cossi (Trinità d'Agultu, Sassari), Santa Maria Navarrese beach (Baunei, Nuoro - Desfayes 2008); upstream from Arbatax beach (Nuoro) and near Tancau beach, in Lotzorai

(Nuoro - Scudu 2022). The latter author also mentioned the traditional use of this species for building hut roofs in San Giovanni di Sinis (Oristano). More recently, a small population has been described for the inner part of Porto Conte Cove (Alghero, Sassari) by Morabito & al. (2023).

We confirm the previous reports, and we add a population close to Fiume Santo (Porto Torres, Sassari). Furthermore, we found several populations inland, in north Sardinia, between 50 and 450 m a.s.l. These populations are all concentrated in the Coghinas catchment basin: Coghinas River (Oschiri, Tula, Erula, Tempio Pausania, Bortigiadas, Perfugas); Rio Badu Pedrosu (Berchidda, Oschiri); Rio Mannu-Rio Rizzolu (Buddusò, Oschiri); Rio Cantares de Uda-Rio Sa Conca and its left tributary (Alà dei Sardi, Berchidda). Finally, we identified a small population near a rivulet tributary of the Coghinas River, at the western boundaries of the Limbara massif (Calvia & Ruggero 2023). We also found other inland populations on calcareous outcrops in Ogliastra (central eastern Sardinia), along some streams of the municipalities of Osini, Ulassai and Ussassai (Nuoro), at an elevation between 760 and 805 m a.s.l. (Fig. 1)

Rarity and threats: despite being quite rare, the species locally covers relatively wide areas, (e.g. Platamona Pond). However, since it inhabits wet places and riverbeds, it is susceptible to periodic extreme events, including floods and/or droughts, along with human interventions designed to reclaim wet sites. *In situ* and *ex situ* actions are needed.

***Dianthus sardous*** Bacch., Brullo, Casti & Giusso (*Caryophyllaceae*)

Distribution update

Finding: Arzachena (Sassari) Capo Ferro (41.155353°N - 9.516846°E). Rocce metamorfiche sul mare. 22-05-2016, *A. Ruggero* (Herb. Ruggero)

Observations: this is an endemic species of Sardinia, with a rather extensive distribution on the island, being reported in most of the island's sectors (Bacchetta & al. 2010).

With this report, we highlight the first and only known population of this species in the Gallurese subsector, where it was found in a coastal area, on schistose rocks and scree, in the territory of Arzachena (Fig. 2). This is the northernmost known station of a *Dianthus* species in Sardinia and the only one in Gallura, based on the bibliographic data available.

Rarity and threats: this taxon is widespread on the island, occurring in various environments and geologic substrates, and ranging from sea level to 1,300 m a.s.l., being not particularly susceptible to threats. Nonetheless, the sole population known in Gallura should be monitored and protected, being small and close to tourist sites constantly under threat of new construction projects.

***Dysphania botrys*** (L.) Mosyakin & Clemants (*Amaranthaceae*)

Distribution update

Findings: Pattada (Sassari) lago Lerno (40.584385°N - 9.163384°E). Sponde sabbiose. 07-07-2012, *G. Calvia* (Herb. Calvia); Berchidda (Sassari) lago Coghinas loc. Funtana 'e Cannas (40.759968°N - 9.096712°E). Sabbie. 160-165 m. 18-08-2022, *G. Calvia* (Herb. Calvia)

Observations: this Eurasian taxon, now alien in many countries, particularly in the United States of America (POWO 2024), was considered native in all Italian regions except Abruzzi (mistakenly reported), Friuli-Venezia Giulia and Sardinia, where it was reported as alien (Bartolucci & al. 2018).



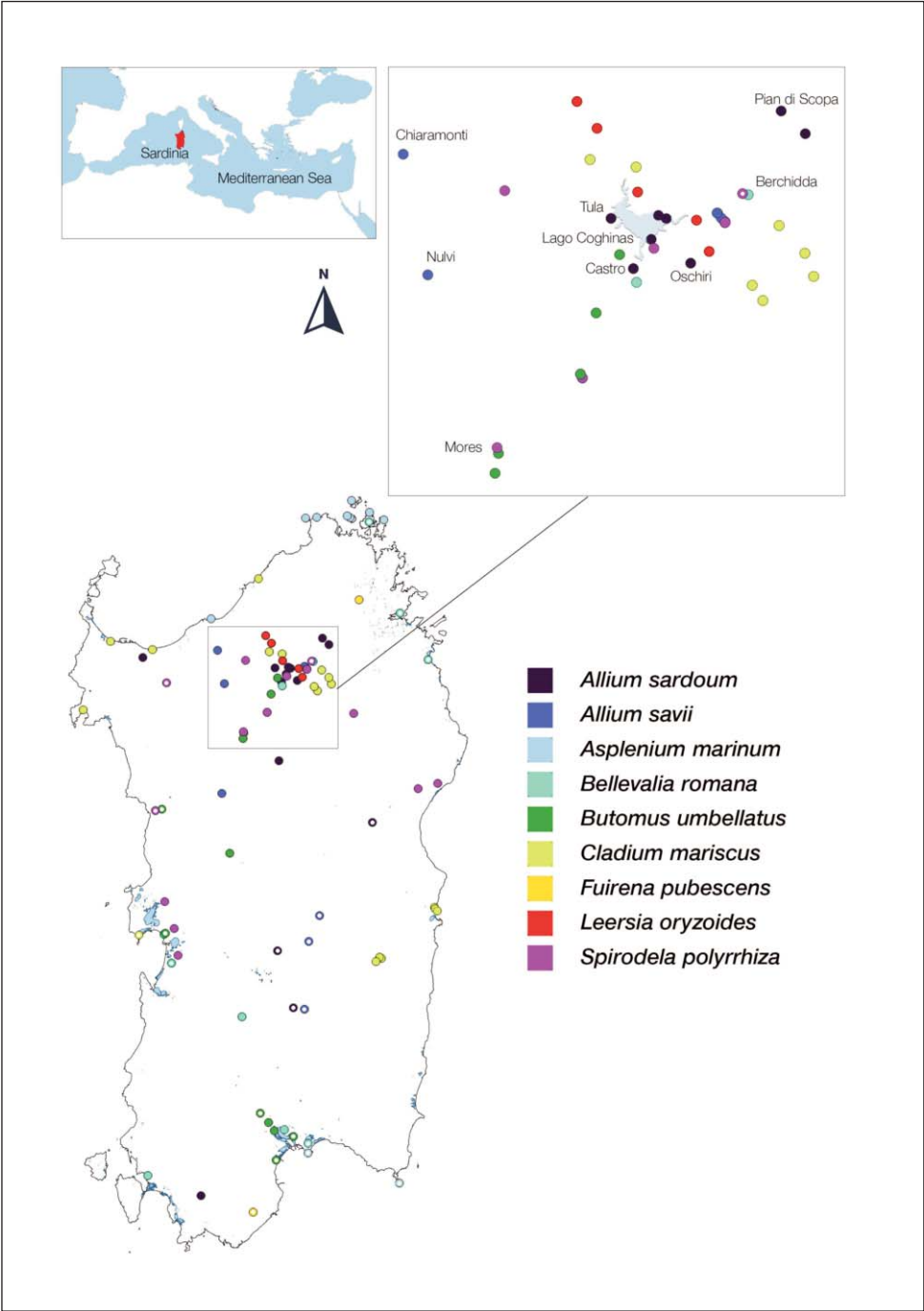


Fig. 1. Distribution map of some native species cited in this article. Pointed circles refer to not confirmed data.

In Sardinia, the species was considered rare and limited to a few locations in the southern half of the island. The first report came from the surroundings of Cagliari (Gennari & Pirota 1885). Subsequently, Tutin & al. (1964, 1993) confirmed its presence. Camarda (1982) collected the species near Nuraghe Arrubiu (Orroli, Nuoro). Finally, Arrigoni (2006) cited only previous reports.

In recent years, we have discovered the species in northern and central Sardinia, often near waterbodies and artificial lakes. Specifically, it is relatively common along the shores of lake Lerno (Pattada, Sassari) and rarer on Coghinas (Berchidda, Oschiri). We also found it along Riu Mannu di Ittireddu, near a small lake in the locality Genna Orruali (Gairo, Nuoro), along Rio Govosoleo (Fonni-Lodine, Nuoro) and middle Flumendosa river (Seulo, Sud Sardegna) (Fig. 2).

Rarity and threats: the species can be still considered rare in Sardinia, but its actual distribution is far from certain. The species grows in sandy soils that are temporarily submerged during the winter, suggesting its seeds might be transported by waterbirds (Viana & al. 2016). As for other species that are naturally expanding their range in the island due to waterbirds, also this species cannot be considered alien with certainty, thus we consider it as cryptogenic.

***Fuirena pubescens* Kunth (Cyperaceae)**

Distribution update

Finding: Sant'Antonio di Gallura (Sassari) Sarra di Littu Petrosu, luoghi umidi tra le pinete naturali e la cava abbandonata (40.978319°N - 9.370332°E). 400-420 m. 21-05-2018, *G. Calvia* (Herb. Calvia).

Observations: this paleo-temperate species is known in many African and south-western Asian countries (POWO 2024). The Mediterranean Basin represents its northern limit, especially with Ligurian populations (Pignatti 1982). The population at the mouth of the Lao River in Calabria is now considered extinct (Bartolucci & al. 2018). *Fuirena pubescens* is also documented in various locations in Corsica (Briquet 1910; Jeanmonod & Gamisans 2013; Delage & Hugot 2020).

In Sardinia, the species was reported only along the Rio Pixinamanna (Pula, Cagliari), where it appears to be rather rare (Arrigoni 1964; Pignatti 1982; Bacchetta 2006). Desfayes (2008) included *F. pubescens* among the taxa deserving confirmation, due to the lack of recent records.

We located this species in a site in north Sardinia (Sant'Antonio di Gallura, Sassari), under the canopy of natural pine woodlands and in stagnant water and small rivulets of a nearby granite quarry now abandoned. This finding expands the species' distribution towards the northern part of the island and confirms its presence after 60 years of absence in new records (Fig. 2).

Rarity and threats: the population is substantial in numbers but remains isolated and its occupancy area is less than 0.5 ha, thus deserving attention. *Ex situ* actions are needed and the species should be evaluated for a regional assessment according to IUCN criteria.

***Jacobaea maritima* (L.) Pelsers & Meijden subsp. *maritima* (Asteraceae)**

Distribution update

Findings: Santa Teresa (Sassari) Santa Reparata (41.228266°N - 9.167063°E). Gariga

marina (sub *Senecio cineraria* DC.). 20-05-2001, *A. Ruggero* (Herb. Ruggero); Olbia (Sassari) di fronte al faro di Lido del Sole (40.919515°N - 9.560802°E). Sabbie, garighe costiere, 1-2 m, 17-06-2015, *G. Calvia* (Herb. Calvia); Sant'Antonio di Gallura (Sassari) Sarra di M. Santu (40.982953°N - 9.385931°E). Pinete naturali, 550-600 m. 21-05-2018, *G. Calvia* (Herb. Calvia).

Observations: this taxon has a natural distribution limited to Spain, southern France, Corsica, Morocco, Algeria, Tunisia, and Italy (POWO 2024). In Italy, it is native in Liguria, Tuscany, and Sardinia, and is alien in Umbria, Abruzzi, Molise and Apulia (Bartolucci & al. 2018).

Previous studies only recorded this taxon along the northern coasts of Sardinia (e.g., Camarda & Valsecchi 1990). More specifically, it has been reported in Capo Caccia (Alghero) and Capo Figari (Golfo Aranci) on carbonate substrata, and in smaller islands and islets in the northern sectors: Asinara, La Maddalena Archipelago, Figarolo, Tavolara, and Molaria (Barbey 1884; Desole & Pignatti 1961; Bocchieri 1988, 1996; Biondi & Bagella 2005; Bocchieri & Iiriti 2005; Arrigoni 2015a). The taxon is confirmed in those places and is also present in the Stintino promontory (Sassari), near Costa Paradiso (Trinità d'Agultu), Santa Teresa Gallura, Baja Sardinia (Arzachena), Soffi and Mortorio Islands and Le Camere islets, and near Olbia. Recent surveys at the island of Razzoli have also confirmed its presence at the northernmost micro-insular territories of Sardinia. Moreover, we found this species inland, in scrublands, rocky places, and pine woodlands on the Monte Pino and Monti Santu high hills (Olbia, Sant'Antonio di Gallura, Telti), at altitudes up to 670 m a.s.l.

The species also occurs along the north-western coastline from Alghero to Bosa (Oristano) as far as Porto Alabe (Tresnuraghes, Oristano). Moreover, the southernmost growing site of the island, located in the Isola Rossa (Teulada, Sud Sardegna) is here reported (Fig. 2).

Rarity and threats: since the species is currently known in Sardinia on coastal environments, it is potentially susceptible to threats related to tourist sites' expansion and locally to coastal erosion (Gulf of Olbia). Nonetheless, in most of the sites, the species is currently not subject to threats.

### ***Leersia oryzoides* (L.) Sw. (Poaceae)**

#### Distribution update

Findings: Bortigiadas (Sassari) fiume Coghinas, presso Scala Ruja (40.862743°N - 8.972515°E). Riva fluviale, 19-09-2011, *A. Ruggero* (Herb. Ruggero); Perfugas/Bortigiadas (Sassari) fiume Coghinas presso la traversa di Donigazza (40.838635°N - 8.996166°E). Flora ripariale di sponda. 60 m s.l.m. 16-09-2023, *G. Calvia* (Herb. Calvia).

Observations: this sub-cosmopolitan species has a distribution encompassing much of North America, Europe, and Asia (POWO 2024). In Italy, it is present in most of the regions, excepted Val d'Aosta, Abruzzi, Molise, Apulia, Basilicata, and Sicily, and was mistakenly reported in Calabria (Bartolucci & al. 2018).

The first report of *Leersia oryzoides* in Sardinia is due to Calvia & Urbani (2007), on a stream in the southern Limbara and in the Riu Mannu of Berchidda. Lately, Arrigoni (2015b) cited it as a probable occasional adventive, a status subsequently adopted by

Bartolucci & al. (2018). Later, Calvia & Ruggero (in Bartolucci & al. 2019b), based on new findings along the Riu Mannu of Oschiri and confirmation of previous records, confirmed it as a native species in Sardinia.

More recently, new findings and the rediscovery of a neglected herbarium specimen allowed us to enlarge our knowledge to the lake Coghinas shores and the Coghinas River, in the riparian vegetation downstream of the homonymous dam (Perfugas, Bortigiadas, Sassari) (Fig. 1).

Rarity and threats: the new findings better define the species distribution to a broader area within the Coghinas River basin. However, the species is rare in the island, with a low occupancy area. The species faces threat of an increased frequency of extreme floods, alien species expansion (both plants and animals) and human activities such as road-works and bridges' building.

### ***Nepeta foliosa*** Moris (*Lamiaceae*)

Distribution update

Finding: Olbia (Sassari) Isola di Tavolara, versante SE, quota 440-445 m a.s.l., incl. 35-40° (40.894618°N - 9.697592°E). Calcari mesozoici, 09-06-2021, *G. Bacchetta* (CAG).

Observations: this species is a rare Sardinian endemic with a restricted distribution area. After the description on the calcareous outcrops of Monti d'Oliena (Nuoro) (Moris 1827-1839), it was later found on the eastern side of Tavolara Island (Olbia) (Béguinot & Vaccari 1929; Béguinot & Landi 1931). This finding was not confirmed by Desole (1960) in the vascular flora of Tavolara, thus not considered by further authors (Valsecchi & Diana-Corrias 1973; Diana-Corrias 1979; Arrigoni 2013). In the late spring of 2021, on a fieldtrip for collection of germplasm, we found seven specimens of this species on a calcareous slope on the south-eastern side of the island of Tavolara. This finding serves to validate earlier reports and significantly expands the known distribution area of the species to the north-eastern area of Sardinia (Fig. 2).

Rarity and threats: the species is quite rare and has been classified as VU (Vulnerable) by Orsenigo & al. (2018). To a restricted occupancy area, threats like grazing of wild and feral animals, together with tourism activities and natural cliffs' evolution were considered (Congiu & al. 2014). Specifically, the extremely limited number of plants occurring on the Tavolara site prompt us to propose *in situ* interventions to support reinforcement of this population.

### ***Nuphar lutea*** (L.) Sm. (*Nymphaeaceae*)

Distribution update

Findings: Berchidda (Sassari) Rio di Berchidda in loc. Tamuri (40.772435°N - 9.196622°E). Piscine naturali. 185-190 m, 17-09-2007, *G. Calvia* (Herb. Calvia); Perfugas/Bortigiadas (Sassari) fiume Coghinas presso la traversa di Donigazza (40.838635°N - 8.996166°E). Nelle piscine naturali dallo sbarramento a salire per oltre 4 km. 60 m s.l.m. 16-09-2023, *G. Calvia* (Herb. Calvia).

Observations: *Nuphar lutea* is a floating aquatic plant native to Eurasia, widespread across Europe and in many temperate-cold regions of Asia, also known in Algeria (POWO 2024). In Italy, the species is found in almost all northern and central regions and in Sardinia, but it is considered alien in Liguria and Marche (Bartolucci & al. 2018). *N.*

*lutea* is absent in Val d'Aosta, Abruzzi, Molise, Apulia, Basilicata, and Calabria, and not confirmed in Sicily (Bartolucci & al. 2018).

In Sardinia, *N. lutea* was first reported “*in rivo lente fluente, circa Mores,*” meaning Rio Mannu of Mores (Moris 1837-1859). Subsequent reports came from “Badu Oschiri,” (Mola 1919), from the “stagni di Oschiri e Berchidda e Riu Mannu di Mores-Ozieri” (Arrigoni 2006), and from Poggio dei Pini (Capoterra, Cagliari) (Bacchetta 2006). Later, Desfayes (2008), not having directly found the species, included it in a list of taxa worthy of confirmation. This might have led to the status of casual alien species assigned by Bartolucci & al. (2018). The definitive confirmation of its presence as a native species in Sardinia came from Bacchetta & Calvia (in Bartolucci & al. 2019a).

The species is locally common in the Coghinas River basin, especially along the Riu Mannu of Ittireddu, Mores, and Ozieri, the Riu Mannu of Berchidda, and the Rio Badu Alzolas (Berchidda). Further downstream, it forms extensive colonies along the Coghinas River (Perfugas, Bortigiadas). The small population of the Riu Mannu of Oschiri is here confirmed.

In southern Sardinia, the only small population currently existing is found along some small canals in the locality San Genesio (Assemini, Cagliari) (Fig. 2).

Rarity and threats: the species is limited to a few watercourses' stretches, covering a relatively small area of occupancy. The threats for the species are the increased frequency of extreme floods and, conversely, droughts. Alien species, such as *Procambarus clarkii* and *Myocastor coypus*, represent local threats. *Ex situ* actions are needed, and the species should be evaluated for a regional assessment according to IUCN criteria.

### ***Silene inaperta* L. (Caryophyllaceae)**

#### Distribution update

Findings: Berchidda (Sassari) Rio Badu Pedrosu a monte del ponte di Osseddu. Pratelli sabbiosi prossimi al corso d'acqua (40.741909°N - 9.245905°E) 235-245 m s.l.m. 28-07-2021. *G. Calvia* (Herb. Calvia); Berchidda (Sassari) Rio Badu Pedrosu tra Rattacasu e Badu Chelvinu. Dune fluviali. (40.753095°N - 9.213505°E) 190-200 m s.l.m. 18-08-2019. *G. Calvia* (Herb. Calvia); Berchidda (Sassari) Riu Mannu tra San Marco e Silvani. Pratelli aridi sabbiosi e ciottolosi tra le dune fluviali (40.758390°N - 9.132132°E). 165-170 m s.l.m. 10-07-2022. *G. Calvia* (Herb. Calvia).

Observations: the species has a western Mediterranean distribution and is documented in Portugal, Spain, southern France, Morocco, Algeria (POWO 2024), Liguria (Pignatti 1982), Corsica (Briquet 1910; Jeanmonod & Gamisans 2013), and Sardinia. In the latter region, the first and only discovery so far dates back to Bianchini & Di Carlo (1988), who found it between Arco dell'Angelo and Arcu Neridu, along the old SS 125 road (Burcei, Cagliari).

The occurrence of the species in south-eastern Sardinia is here confirmed, in the first site, on the floodplain sandy soils along the Riu Ollastu (San Vito, Sud Sardegna) and at Rocca Arricelli (Burcei). In northern Sardinia, we have found the species between Rio Badu Pedrosu and Riu Mannu of Berchidda (Berchidda, Oschiri), on river dunes and in sandy meadows that are colonized by numerous psammophilous species, including prominent ones like *Linaria flava* subsp. *sardoa* (Sommier) A.Terracc., *Marcus-kochia ramosissima* (Desf.) Al-Shehbaz, and *Silene canescens* Ten. These findings confirm the presence of the

species in Sardinia and expand its range to the north of the island after 36 years of no new records (Fig. 2).

Rarity and threats: the area of occupancy of this species in Sardinia is restricted to a few hectares, and its environments are typically sandy places on flooded areas, which are frequently subjected to floodings that can disrupt partially the growing stations. *Ex situ* actions are needed, and the species should be evaluated for a regional assessment according to IUCN criteria.

***Spirodela polyrrhiza* (L.) Schleid. (Araceae)**

Distribution update

Findings: Galtelli (Nuoro) Località Logheri/Pappadosa (40,355654°N - 9.571574°E). Pozze del fiume Cedrino, 28-05-1999, *M. Manca* (Herb. Manca); Chiaramonti (Sassari) Bados de Lovè (40.782462°N - 8.887132°E). Pozze del torrente. 165-170 m s.l.m. 07-09-2022, *G. Calvia* (Herb. Calvia)

Observations: this cosmopolitan species is distributed across all continents and is present in nearly all European countries (POWO 2024). In Italy, it was considered rare but can be found in all regions (Pignatti, 1982; Bartolucci & al. 2018). Locally, it is even classified as CR (critically endangered) (Prosser & al. 2020).

The species was first reported in Sardinia by Moris (1827), under *Lemna polyrrhiza* L., in stagnant waters near Riola (Oristano). Nicotra reported it “al Rio scala di Cioca” near Sassari (Nicotra, 1895). This data was not confirmed by Bagella & Urbani (2006). Then, a sample was collected by Cavara & Cossu near Berchidda (specimen seen in SASSA). However, this data was not confirmed by Calvia & Ruggero (2020). More recently, Arrigoni (2015) documented its presence in Oschiri, Ozieri, Bosa, and Oristanese, emphasizing its abundance in the last area only.

In the last decades, we have found the species in a few additional locations, in standing and slow flowing waters, specifically along a stream in the countryside of Chiaramonti (Sassari), Lake Coghinas, Riu Mannu of Berchidda, near Oschiri, Riu Mannu of Mores and Ittireddu, Coluna basin (Alà dei Sardi), and Cedrino River (Galtelli, Orosei - Nuoro) (Fig. 1).

Rarity and threats: despite being rare at a regional level, the species is locally abundant and does not appear threatened, with the sole exception of rare watercourses that can experience the increased frequency of extreme floods, especially when they occur off-season.

***Trifolium clusii* Gren. & Godr. (Fabaceae)**

New data and confirmation

Findings: Masainas (Sud Sardegna) (39.019202°N - 8.577555°E). Dune di Is Solinas, 15-20 m 08-04-2022, *G. Calvia* (Herb. Calvia); San Teodoro (Sassari) (40.787735° N - 9.669821°E). Dune di La Cinta, 5 m a.s.l. 08-03-2023, *G. Calvia* (Herb. Calvia).

Observations: this Mediterranean species is predominantly found on the eastern side of the basin (Bulgaria, East Aegean Islands, Turkey, Lebanon-Syria, Palestine, Egypt, Iran), while its occurrence on the western side is rarer, including Morocco, France, Sardinia, and Sicily (Pignatti & al. 2017-2019; POWO 2024).

The presence of this species in Sardinia has been a topic of debate for a long time.

Arrigoni (2010b) considered it as a vicariant of *Trifolium resupinatum* L. in arid meadows, sporadic in the island. He mentioned Moris (1827) as the “*primus inventor*”, but the species is absent in either Moris (1827) or Moris (1837-1859). Conversely, Pignatti (1982) did not include it in his flora. More recently, Bartolucci & al. (2018) regarded its presence in Sicily and Sardinia as doubtful, while Pignatti & al. (2017-2019) confirmed its presence on the island following Arrigoni (2010b).

Confirmation of this species in Sardinia was made based on two accidental findings, one in the south-western and one in the north-eastern part of the island. Both growing stations are situated in sandy dunes within coastal, extremely dry environments (Fig. 2).

Rarity and threats: the distribution of the species in Sardinia is undefined because of the lack of information. Consequently, nothing can be said about the threats that the species faces in the island. Given its rarity, *ex situ* actions such as collection of germplasm should be applied.

### ***Utricularia australis* R.Br. (Utriculariaceae)**

#### Distribution update

Finding: Torpè (Nuoro), Rio Posada (40.632513°N - 9.647790°E). Pozza, 7 m s.l.m., 15-09-2008, *M. Manca* (Herb. Manca); Torpè (Nuoro), (40.640000°N - 9.646667°E). Cave di sabbia sul Rio Posada, 10 m s.l.m., 08-09-2012, *M. Manca* (Herb. Manca, specimens preserved according to Taylor 1989); Torpè (Nuoro), Rio Posada, fra la vegetazione fluviale in tratti a debole corrente (40.628374°N - 9.661389°E e 40.634137°N - 9.675657°E) 6 e 4 m s.l.m., 4-10-2013, *M. Manca* (Herb. Manca); Bitti (Nuoro) Rio Posada loc. Piras, pozza temporanea (40.648645°N 9.479703°E). 123 m s.l.m. 21-05-2023, *M. Manca* (Herb. Manca); Torpè (Nuoro), Foresta Demaniale Usinavà, laghetto artificiale collinare di P.ta Colloredda (40.700560°N - 9.583357°E) 707 m s.l.m. 23-09-2016, *M. Manca* (Herb. Manca); Bitti (Nuoro) Rio Posada, pozza con ninfee ai piedi della SP 95 (40.650653°N - 9.492125°E). 114 m s.l.m. 22-07-2023, *G. Calvia* (Herb. Calvia).

Observations: *Utricularia australis* has a distribution spanning various European countries, Levantine regions (Turkey, Syria, Lebanon, Palestine, Israel), Morocco, Algeria, and Tunisia (Uotila, 2013). In Italy, *U. australis* has been reported in nearly all regions, with the exception of Marche, Molise, Basilicata, and Calabria (Bartolucci & al. 2018). The presence of *U. australis* in Sardinia was initially documented in the lower course of the Coghinas River by Camarda (1995), later cited by Arrigoni (2013) and confirmed by recent personal observations. Desfayes (2008) discovered the species between 1999 and 2000 on the Rio S’Eleme (Monti, Alà dei Sardi), a finding here confirmed. In 2008, the species was further identified along Posada River, then cited into the Italian Flora Red List-II database (Rossi & al. 2020). Ongoing field research within the Tepilora Regional Nature Park has updated the species’ distribution in the area. Orrù & al. (2020) provided additional confirmation of its presence in the Posada River, at 53 m a.s.l. (Lodè, Nuoro). Moreover, in the summer 2023, a new station was identified at 114 m a.s.l. (Bitti, Nuoro), along with five growing sites in semi-permanent pools on clay-arenaceous substrates (Alà dei Sardi, Buddusò). A unique finding in southern Sardinia was made in Quirra (Villaputzu, sud Sardegna) in a pool formed by furrows created by the passage of agricultural vehicles, on silty-arenaceous soils (Fig. 2).

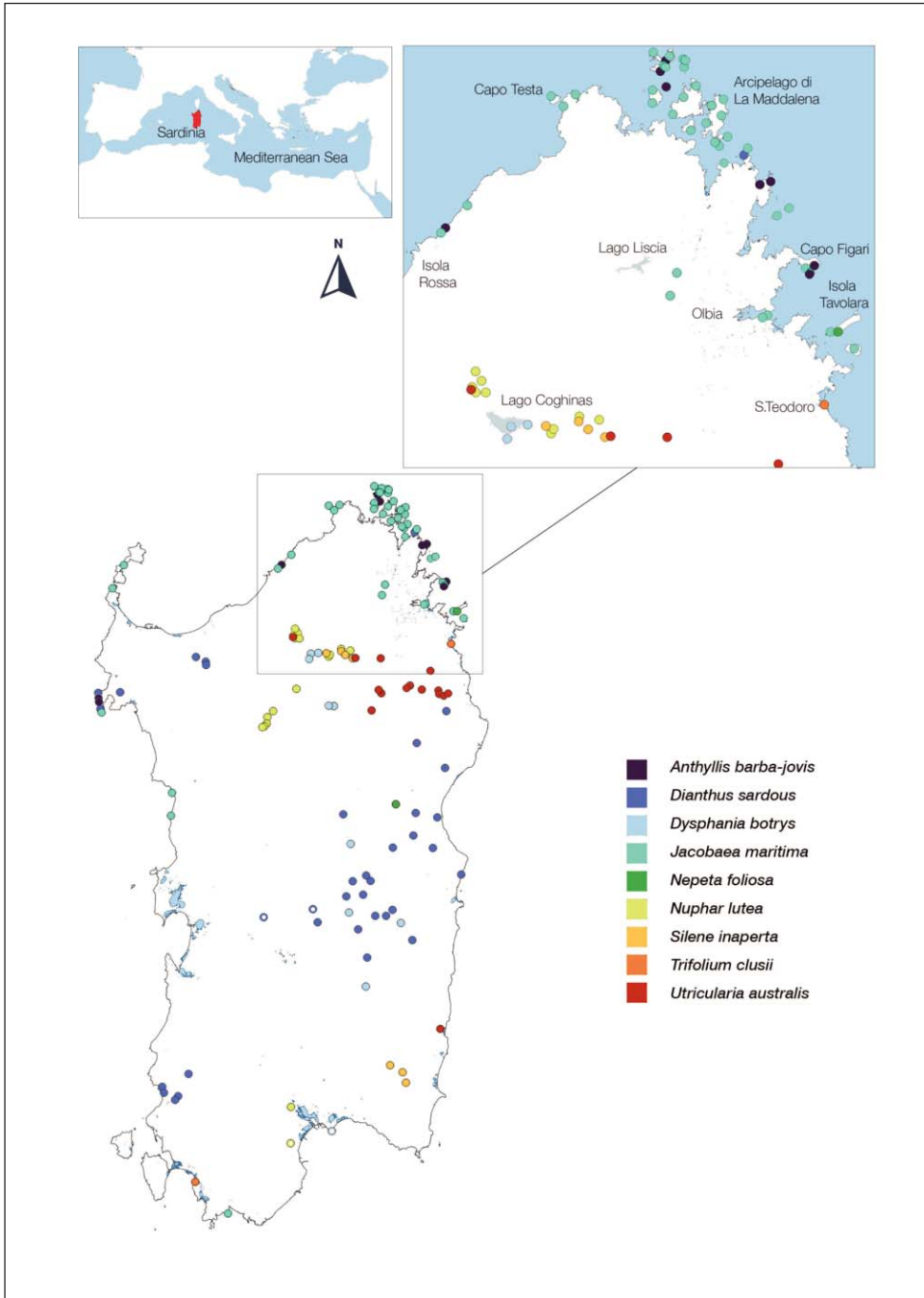


Fig. 2. Distribution map of some native species cited in this article. Pointed circles refer to not confirmed data.



Rarity and threats: despite being categorized in the Red List of Italian flora as Least Concern (LC) (Rossi & al. 2020), *U. australis* is very rare in Sardinia and warrants protective measures. Threats to specific locations encompass habitat alteration, fragmentation, and loss due to changes in hydrological regimes from dam construction, cementification of riverbeds and embankments, and pollution altering water chemical and physical characteristics. Furthermore, natural events such as extreme floods and droughts can impact certain populations. It is imperative to conduct further research and implement conservation strategies to provide a comprehensive distributional overview and ensure the safeguard of the species on the island.

### Alien taxa

#### *Asparagus asparagoides* (L.) Druce (*Asparagaceae*)

New station of an invasive species.

Finding: Badesi (Sassari) Li Fughilaggi (40.964392°N - 8.871859°E). Siepe a margine di un coltivo, 30-04-2023, *A. Ruggero* (Herb. Ruggero).

Observations: the species is native to South Africa, considered a naturalized neophyte in Italy, and reported in Calabria, Campania, Liguria, Sardinia, and Sicily (Galasso & al. 2018a; Mariotti & Zappa 2022; Spampinato & al. 2022). Its presence in Sardinia was first noted by Podda & al. (2010), sub *Elide asparagoides* (L.) Kerguélen, in the central-southern part of the island (Cagliari, and Pauli de Sali, Cabras, Oristano), then confirmed by Lazzeri & al. (2013) in the Molentargius-Saline Regional Natural Park (Cagliari).

This report extends the taxon' distribution range to the northern part of the island, where it grows on hedgerows close to cultivated fields. It is challenging to determine in this specific location whether the species has spread naturally or was cultivated and subsequently naturalized (Fig. 3).

Invasiveness: over the past decade, the species has widely naturalized and displays a strong tendency to colonize, notably in the Molentargius Park, where it can be now considered invasive.

#### *Brachychiton populneus* (Schott & Endl.) R.Br. (*Malvaceae*)

New casual taxon for the flora of Sardinia

Finding: Cagliari, "Fossa di S. Guglielmo" (39.220724°N - 9.115218°E). 70 m s.l.m. 05-05-2018, *L. Podda*, *G. Calvia*, *G. Bacchetta* (CAG)

Observations: this tree has an eastern Australia origin (Buist & al. 2001) and has rarely become naturalized in some countries such as California, Ecuador, Greek islands, Pakistan, Spain, and Trinidad and Tobago (POWO 2024). In Italy, the species is reported as naturalized in Sicily (Galasso & al. 2018a).

During a study on the old walls and ramparts of Cagliari, we first recorded the presence of the species in Sardinia through the finding of a few small trees naturally growing in fallow lands, close to the historical center of Cagliari. We also observed a few seedlings growing close to a planted tree, in fallow lands in the suburbs of Carbonia (Sud Sardegna) (Fig. 3).

***Cenchrus setaceus*** (Forssk.) Morrone (*Poaceae*)

New stations of an invasive species.

Findings: Sarroch (Cagliari) strada privata nei pressi incrocio strada statale 195 e deviazione per Cagliari (39.054412°N - 08.992222°E). Margini stradali. Substrato alluvioni quaternarie. Bioclima termomedit. sup./secco sup., 57 m s.l.m., 14-10-2018, *G. Bacchetta*, *I. Orrù*, *L. Podda* (CAG); Berchidda (Sassari) (40.782001°N - 9.169127°E): Ingresso del paese, sul marciapiede 223 m s.l.m. 31-08-2023, *G. Calvia* (Herb. Calvia); Olbia (Sassari) Capo Ceraso (40.909028°N - 9.606412°E). Cigli stradali e vialetti verso la spiaggia di Li Cuncheddi, 10-20 m s.l.m. 14-09-2023, *G. Bertotto* (SS).

Observations: this species, native to northern and eastern Africa, the Arabian Peninsula, and Afghanistan (POWO 2024), has been introduced worldwide for ornamental purposes and soil stabilization, rapidly spreading in dry climates such as Mediterranean regions (Spampinato & al. 2019). In Italy, it is considered invasive in Calabria, Sicily, and Sardinia, naturalized in Apulia and Campania, and casual alien in Tuscany and Latium (Galasso & al. 2018a, 2018b). In Sardinia, *Cenchrus setaceus* was first reported in Pula (Cagliari) by Bocchieri (1981, specimen seen in CAG) and is now widespread in several municipalities of the metropolitan city of Cagliari.

The species is listed in the European Union's regulation on invasive alien species (EU Regulation 1263/17) since 2017 (Brundu & al. 2020) this controls and prohibits the introduction, or disposes the eradication of alien taxa if they threaten ecosystems, habitats, or species (referring to Article 4 of EU Regulation 1143/2014). Nonetheless, in north Sardinia, various florists and garden designers seem to continue commercializing and using it, especially as an ornamental plant in coastal villas and along roadside flowerbeds, as observed in the Municipality of Olbia.

Between 2017 and 2023, *C. setaceus* has been observed in various areas of Sardinia. The species colonizes ruderal, fallow lands, sidewalks, road margins, and paths, in the municipalities of Arzachena (La Celvia), Berchidda, Olbia (Rudalza, Cugnana, industrial zone, Li Cuncheddi), San Teodoro (Vaccileddi, Punta Aldia-Lu Impostu), Oristano (industrial docks), Assemmini (SS 130), Elmas (outskirts, industrial zone, airport), Monserrato (outskirts), Selargius (industrial zone, SS 554), Sestu (industrial zone, SP 8), Capoterra (Frutti d'Oro, Torre degli Ulivi), Sarroch, Pula (Is Molas, Santa Margherita, SS 195), Domus de Maria (Chia), Carbonia (along SP 2 near Genna Corriga, city center, bike path to San Giovanni Suergiu) (Fig. 3).

Invasiveness: the species exhibits aggressive spreading capabilities and can colonize new areas in very short periods (Pasta & al. 2010; Spampinato & al. 2019). Therefore, a joint effort from the scientific community, gardeners and private nurseries, public authorities, and regulatory bodies is essential to eradicate the species before it becomes an irreversible problem and further compromises the already fragile coastal ecosystems, strained by rampant tourism, negligence, and underestimation of the impact of invasive species on natural environments.

***Chloris gayana*** Kunth (*Poaceae*)

New station of a naturalized species

Finding: Alghero (Sassari) lungomare Valencia (40.549490°N - 8.320826°E). Scarpata, bordo strada. 10 m s.l.m. 16-08-2023, leg. *D. Locci*, det. *L. Podda* (CAG).

Observations: this robust, stoloniferous herbaceous plant, native to Africa (POWO 2024), has been previously reported as casual only in southern Sardinia, in Villa S. Pietro (Podda & al. 2010), in Sicily (Di Gregorio & al. 2017), and Calabria (Galasso & al. 2022a), but it is considered invasive in many parts of the world (Rojas-Sandoval 2022). The new site is located on the waterfront of Alghero, where it was likely used as an ornamental species or for slope stabilization, from which it escaped, spreading in the surrounding areas. It is also confirmed the presence of the species in the southernmost site, where the species can be currently considered as naturalized (Fig. 3).

Invasiveness: given its potential invasive nature (Mahklouf 2019) it would be advisable to monitor its presence in the future.

***Convolvulus sabatius* subsp. *mauritanicus* (Boiss.) Murb. (*Convolvulaceae*)**

New naturalized taxon for the flora of Sardinia

Finding: Luras (Sassari) Li Espi (41.009359°N - 9.264838°E). A margine della strada, naturalizzata, 20-11-2016, *A. Ruggero*, *G. Calvia* (Herb. Ruggero).

Observations: *Convolvulus sabatius* Viv. has a western Mediterranean distribution. In Italy, the typical subspecies is known as native only from a few sites in Liguria (Bartolucci & al. 2018). On the other hand, the subspecies *mauritanicus* is native to the mountains of Morocco and Algeria (Carine & Robba 2010; Wood & al. 2015). Both subspecies have been utilized in gardens and have escaped cultivation over time (Carine & Robba 2010; Wood & al. 2015). In Italy, the subspecies *mauritanicus* is a naturalized neophyte found in Liguria, Tuscany, Latium, and Apulia (Carine & Robba 2010; Lazzeri & al. 2017; Galasso & al. 2019; Longo & al. 2022).

This is the first record for Sardinia and involves a small population likely escaped to cultivation near a resort close to Lake Liscia (Luras, Sassari). Here, the species is slowly colonizing fallow land, some country road margins, dry meadows, and the base of granitic rocks (Fig. 3).

***Cyperus brevifolioides* Thieret & Delahouss. (*Cyperaceae*)**

New naturalized alien species for the flora of Sardinia

Finding: Arzachena (Sassari) Cala di Volpe (41.095445°N - 9.537895°E). Presso una villa privata, su prato ornamentale di *Cynodon* spp., substrato irrigato. 16-09-2023, *A. Lallai* (CAG); San Teodoro (Sassari) Capo Coda Cavallo (40,841079°N - 9.698305°E). Pratelli e avvallamenti umidi, 14-09-2023, *G. Bertotto* (SS).

Observations: this perennial herbaceous plant, originally from East Asia, has been reported as an alien species in the eastern United States, the Caucasus region (POWO 2024), the Iberian Peninsula (Luceño & al. 2008, sub *Kyllingia brevifolia* Rottb.), and Italy (Galasso & al. 2018a). In Italy, it is noted as naturalized in Lombardy, where it was first discovered in 1950 as a species infesting rice fields (Galasso & al. 2006).

This is the first record of the species in Sardinia, and it has to be considered a naturalized alien. During the summer 2023 the species has been identified in irrigated ornamental meadows in Costa Smeralda (Arzachena), likely arriving as impurities in grass seeds. It was also found in the localities Cugnana (Olbia), and Capo Coda Cavallo (San Teodoro) and close to Bari Sardo (Nuoro), along a small canal near a country road (Fig. 3). In the Capo Coda Cavallo site, the species displays a strong tendency to colonize nearer wet environments.

***Digitaria ciliaris* (Retz.) Koeler (*Poaceae*)**

New stations (certain) of a naturalized species

Finding: Arzachena (Sassari), presso Hotel Romazzino (41.099609°N - 9.562951°E). In aiuola, 01-10-2023, *A. Ruggero* (Herb. Ruggero).

Observations: this species, originally widespread in tropical and subtropical regions of Asia and Africa, has become globally distributed (POWO 2024). In Italy, it is considered a naturalized alien species found in all regions except Val d'Aosta, Apulia, and Marche (Galasso & al. 2018a, 2020). While the presence of this taxon in Sardinia was reported multiple times (Celesti-Grapow & al. 2010; Podda & al. 2012; Puddu & al. 2016; Galasso & al. 2018a), these reports have been general and lacking specific references to its actual distribution, except for the detailed report by Pau G.B. on the Acta Plantarum forum (Topic\_id: 115784) concerning Siniscola (Nuoro).

The station here reported is located in Costa Smeralda (Arzachena) in a flowerbed planted with *Lantana* sp. and irrigated (Fig. 3).

Invasiveness: this growing station borders for several hundred meters the sidewalk leading to the Hotel Romazzino. The population is extensive, potentially invasive, but with slender plants. Therefore, monitoring its future development is necessary. Identifying species within the genus *Digitaria* is complex and requires careful examination of spikelet morphology, thus the distribution of several species is often not well understood (Wilhelm 2009). The observed population is characterized by slender plants with few culms and an inflorescence with only two sub-digitate racemes, a habit more fitting for *D. ischaemum* (Schreb.) Muhl. and *D. radicata* (J. Presl) Miq. However, the former has ternate spikelets, at least in part of the spike, rather than paired, and the latter has narrower spikelets and a smaller upper glume (Verloove 2008; Wilhelm 2009).

***Eclipta prostrata* (L.) L. (*Asteraceae*)**

New station of an invasive species

Finding: Luras (Sassari), Li Espi (41.009393°N - 9.271096°E). Lago Liscia, prati temporanei sulle rive del lago, 15-06-2016, *A. Ruggero* (Herb. Ruggero).

Observation: this species, native to the tropical Americas, is considered an invasive neophyte in Italy, where it is found in all regions except Val d'Aosta, Friuli-Venezia Giulia, and Molise (Galasso & al. 2018a). In Sardinia, this taxon was initially reported by Marchioni Ortu & al. (1988) in rice fields in the areas of Oristano and Muravera (Sud Sardegna). Subsequently, it was confirmed in the same environment (Brundu & al. 1998; Cossu & al. 2014; Arrigoni 2015a). More recently, Lazzeri & al. (2015) indicated the taxon for the mouth of Rio di Pula (Cagliari) a more natural habitat, confirming that the species is gradually expanding.

In south Sardinia, we observed the species widespread at the rice fields of San Gavino Monreale, at the mouth of Rio Foxi and Villasimius along with some sparse plants near Assemini and in the meadows of the Terramaini Park (Cagliari).

The species, at the northernmost station, is invading temporary meadows that form on the shores of the artificial lake on the Liscia River when the water level drops in the summer months, in a semi-natural context (Fig. 3).

Invasiveness: this species, whose invasiveness is well known (Shengjing & al. 2021), was already cited as invasive in Sardinian rice fields by Cossu & al. (2014). Later, this infor-

mation was not recorded by Galasso & al. (2018a). Here we confirm that the species is to be considered invasive in the island, not only in rice crops, but also in natural and semi-natural environments.

***Eragrostis curvula*** (Schrad.) Nees (*Poaceae*)

New growing stations of a naturalized species

Finding: Monti (Sassari) SS 729, 111 m s.l.m. (40.837654°N - 9.380276°E). 02-05-2023, leg. G. Bertotto, det. G. Calvia (SS); Oschiri (Sassari) SS 729 tra Su Campu e Rio Paulu 'e Carru (40.682795°N - 9.026600°E). Scarpate, cigli stradali. 185 m s.l.m. 20-9-2023, G. Calvia (Herb. Calvia).

Observations: this species, originating from sub-Saharan Africa, is now spread in the Americas, Australia, New Zealand, China, India, Japan, and Europe (Roberts & al. 2021). It has been reported in several Italian regions: Piedmont, Veneto, Tuscany, and Calabria as naturalized; Trentino-Alto Adige, Latium, and Sardinia as casual (Galasso & al. 2018a).

In Sardinia, it was first reported in 2013 (Lazzeri & al. 2013) along the SS 131 DCN road, between the municipalities of Oniferi and Orotelli (Nuoro). After that, the species was not reported for several years. However, in the last two years, its presence has become increasingly widespread along the SS 729 Sassari-Olbia Road, where it appears extensively along the embankments and road edges, especially between Olbia and Monti, Berchidda, and between Oschiri and Tula (Fig. 3).

Invasiveness: given its known invasive potential (Muranaka & Washitani 2004; Han & al. 2012), the creation of the mentioned new road junction is likely facilitating its spread in various parts of northern Sardinia. Its presence should be closely monitored in the future.

***Halophila stipulacea*** (Forssk.) Asch. (*Hydrocharitaceae*)

Distribution update of an invasive species.

Finding: Olbia (Sassari) spiaggia delle Vecchie Saline (40.907447°N - 9.573255°E). Fondali bassi sabbiosi. 31-07-2022, leg. G. Calvia - det. E. Trainito, G. Calvia (Herb. Calvia).

Observations: this tropical species is native to the Red Sea and Indian Ocean (Winters & al. 2020). Due to the opening of the Suez Channel, the species easily colonized the Mediterranean Sea, eventually reaching the Italian and Tunisian coasts (Georgiou & al. 2016). In Italy, it is currently recognized as naturalized in Apulia, Calabria, Campania, Sicily (Galasso & al. 2018a) and Sardinia (Galasso & al. 2022b).

The initial record in Sardinia dates back to 2018, in shallows near Razza di Juncu beach (Arzachena, Olbia). Subsequently, in 2020 the species was identified near the harbor of Golfo Aranci, in sandy sea floors (Pica & al. 2021). Further surveys along the north-eastern Sardinian coasts highlighted the invasiveness of the species, which has greatly extended its distribution in the area of Golfo Aranci, in the external portion of the Gulf of Olbia and up to the Tavolara-Punta Coda Cavallo Marine Protected Area, as far as the Porto San Paolo cove and Tavolara Island (Fig. 3).

Invasiveness: the species prefers sandy seabed areas at depths ranging from 1.5 to 10 meters, often occupying substantial areas, which can span tens of square meters. In the

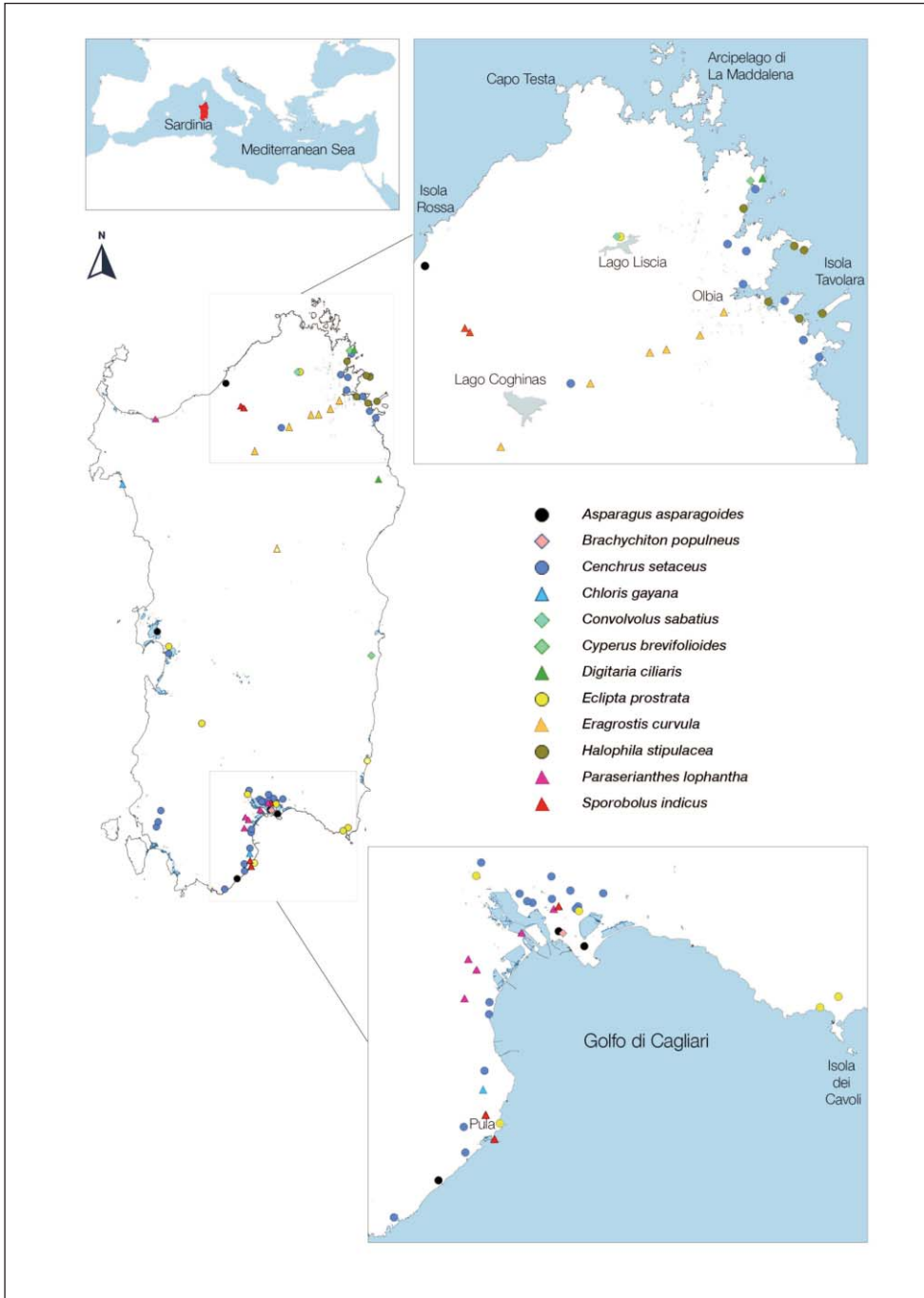


Fig. 3. Distribution map of the alien taxa cited in this article. Rhombuses refer to new taxa from Sardinia, triangles to naturalized taxa, and circles to invasive taxa. Pointed symbols refer to not confirmed data.

Spalmatore di Terra bay at Tavolara, where the *Posidonia oceanica* (L.) Delile meadow has been deeply impacted by small and large vessels anchoring, the muddy seabed is crossed by deep furrows and dug up with scattered large blocks of dead matte and deep holes; at lower depths, it is colonized by the native *Caulerpa prolifera* (Forsskål) J. V. Lamouroux and by the alien algae *C. cylindracea* Sonder and *C. taxifolia* (M. Vahl) C. Agardh, while at the unusual depth of 25-27 m there is a dense and extended prairie of *Halophila stipulacea*.

***Paraserianthes lophantha*** (Willd.) I.C.Nielsen (*Fabaceae*)

New station of a naturalized species

Finding: Sorso (Sassari) stagno di Platamona, riva settentrionale (40.816498°N - 9.487831°E). Naturalizzata in pineta artificiale a *Pinus pinea*, 15-12-2019 A. Ruggero, A. Di Giacomo (Herb. Ruggero).

Observations: originally native to West Australia, Java, Sumatra, and the Sunda Islands, this taxon has subsequently spread to various regions globally (Thompson & al. 2013; POWO 2024). In Italy, it is regarded as a naturalized neophyte, found in Liguria, Tuscany, Campania, Apulia, Sicily, and Sardinia (Galasso & al. 2018a). In Sardinia, it was broadly reported as a naturalized neophyte without precise locations (Celesti-Grappow & al. 2010; Podda & al. 2012; Puddu & al. 2016; Galasso & al. 2018a), then specifically along Rio Santa Lucia in Capoterra (Galasso & al. 2021). Arrigoni (2010) reported it as cultivated and tending to naturalize. To our knowledge, additional locations where the species is naturalized in southern Sardinia include new sites along Rio Santa Lucia (Assemini and Capoterra), Porto Canale (Cagliari) and Poggio dei Pini (Capoterra).

This current report expands its distribution further North on the island. The population is situated in the northern part of the Platamona pond (Sorso), within the narrow strip separating the waterbody from SP 81 road, in an artificial pine grove predominantly composed of *Pinus pinea* L. and invasive *Acacia saligna* (Labill.) H. L. Wendl. (Fig. 3).

Invasiveness: this population consists of several dozen specimens of various ages, potentially posing an invasive threat in the near future, as also observed along the lower part of Rio Santa Lucia. Monitoring its expansion is crucial to prevent potential ecological impacts since the species is known to have a great invasiveness potential (Thompson & al. 2013).

***Sporobolus indicus*** (L.) R.Br. (*Poaceae*)

New station of a naturalized species

Findings: Bortigiadas (Sassari) fiume Coghinas presso Scala Ruja (40.866615°N - 8.953762°E). Sponte fluviali, su sabbie umide, 12-08-2004, A. Ruggero (Herb. Ruggero), sub *Sporobolus poiretii* (Roem. & Schult.) Hitchc.; Bortigiadas (Sassari) fiume Coghinas, Middinu (40.860331°N - 8.963111°E). Incolti aridi a margine di una pista, 01-05-2012, A. Ruggero (Herb. Ruggero), sub *Sporobolus poiretii* (Roem. & Schult.) Hitchc.

Observations: this North American species is considered a naturalized neophyte in Italy and is present in all regions except Apulia and Val d'Aosta (Galasso & al. 2018a, 2019, 2020). Its presence in Sardinia was initially reported at Brotzu Hospital in Cagliari (Campus & De Pascali 2017). Subsequently, other populations were discovered in arti-

ficial meadows near Nora and Pula (Cagliari), from which it is spreading to surrounding areas (Galasso & al. 2022).

Our discovery, predating the first report on the island but still confirmed, expands the taxon's range in Sardinia and places it in a more natural context, similar to the population found in Marche (Galasso & al. 2019). The species was found near the Coghinas River, on its riverbanks, in a humid environment, and occasionally nearby, on dryer pastures and fallow fields (Fig. 3).

Invasiveness: as far as we know in northern Sardinia, after 20 years from the first finding, the species is naturalized, but does not show any tendency to invade the habitats it occupies. About the diffusion of the taxon in this area, it can be hypothesized an origin of this population linked to the transportation of seeds by migratory birds (Viana & al. 2016).

## Conclusions

In the course of extensive research aimed at deepening our knowledge of the vascular flora of Sardinia, with specific focus on its northern side, three new taxa have been recorded for the flora of the island, two naturalized (*Convolvulus sabatius* subsp. *mauritanicus* and *Cyperus brevifolioides*) and one casual alien taxa (*Brachychiton populneus*). Several other taxa of phytogeographic interest or endemic, along with naturalized or invasive alien species, have been identified. When deemed noteworthy, their distribution has been updated for Sardinia. We report 27 taxa for which knowledge in northern Sardinia was previously incomplete or sometimes not existent. We have clarified or updated the distributional aspects regarding several taxa not previously reported in north Sardinia (*Allium savii*, *Asparagus asparagoides*, *Butomus umbellatus*, *Chloris gayana*, *Disphania botrys*, *Paraserianthes lophantha*, *Sporobolus indicus*), rare taxa for which the range has been extended or clarified (*Allium sardoum*, *Anthyllis barba-jovis*, *Asplenium marinum*, *Bellevalia romana*, *Cladium mariscus*, *Dianthus sardous*, *Jacobaea maritima* subsp. *maritima*, *Leersia oryzoides*, *Nepeta foliosa*, *Nuphar lutea*, *Spirodela polyrrhiza*, *Utricularia australis*), rare taxa for which scarce data left doubts about their current persistence on the island (*Fuirena pubescens*, *Silene inaperta*, *Trifolium clusii*), and a taxon generically reported as a naturalized alien without any distributional reference in previous publications (*Digitaria ciliaris*). Furthermore, for some naturalized or invasive alien taxa (*Cenchrus setaceus*, *Eclipta prostrata*, *Eragrostis curvula*, *Halophila stipulacea*), the distribution has been expanded, emphasizing the need for future monitoring, control, and even eradication efforts in areas where such invasions are occurring. Finally, highlighting the importance of field research, we emphasize the need for further studies to make the knowledge of the Sardinian floristic heritage more comprehensive.

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